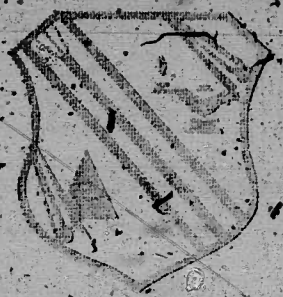

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SCIENTIFIC RESEARCH

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VOLUME VII

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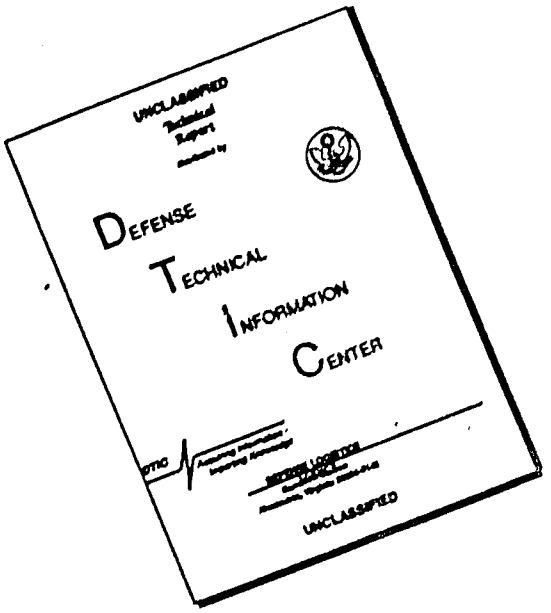

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AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY 1963-1964

by

Thomas C. Goodwin
Doris C. Yates
Norman G. Lamb
Marion S. Carr
Phyllis M. Martin

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FOREWORD

The guiding concept of this series has been to provide high quality bibliographic accessibility to a highly specialized body of literature-- the scientific results of research supported by the Air Force Office of Scientific Research in university, industrial an' other laboratories worldwide. Among the objectives have been completeness, convenience and usefulness. Completeness has been sought by comprehensive literature searches performed by the Library of Congress staff. Convenience has been provided by the kinds of indexes included, making it possible to find citations by reference to contract numbers, for example, in addition to authors, subjects and institutions. Usefulness has been in having a separate channel for Air Force research, packaged for ready reference.

This bibliographic series has met these objectives. When it began, its only alternative was not doing it at all. Since then the Defense Documentation Center System, in conjunction with the Clearinghouse for Federal Scientific and Technical Information, has broadened its services, has become largely automated, and is now in a position to assume many of the functions of this series. Thus it is possible to say that while this series is desirable its function is no longer exclusive. Therefore this volume, covering the period 1963-1964, will be the last of the series to be issued. While the services of DDC and CFSTI may not be as immediately accessible as these volumes have been, it is believed that most of the users of this series will be able to meet their requirements by using them. Limited literature searches are available from DDC, for example, at no charge to qualified requestors. The public will find that the Clearinghouse offers somewhat comparable services. Inquiries may be directed to DDC, Cameron Station Alexandria, Va. 22314 and to CFSTI, U.S. Department of Commerce, Springfield, Va. 22151. Descriptions of their complete services are available upon request.

I wish to extend to the Special Bibliographies Section of the Science and Technology Division of the Library of Congress the thanks of AFOSR and of users of AFOSR-supported research for a most competent undertaking. Harold Wooster deserves special credit for planning and guiding this series through the twelve years of its existence.

William J. Price
Executive Director
Air Force Office of Scientific Research

PREFACE

This is the seventh volume of a continuing bibliographic series, and includes within the limitations of the law of diminishing returns, abstracts and approximately fifty percent of all technical reports, journal articles, books, symposium proceedings, and monographs produced and published by scientists supported in whole or in part by the Air Force Office of Scientific Research during the calendar years 1963-1964. Previous publications in this series have been:

Vol. I (1950-1956), issued in 1961
Vol. II (1957-1956), issued in 1964
Vol. III (1959), issued in 1965
Vol. IV (1960), issued in 1966
Vol. V (1961), issued in 1967
Vol. VI (1962), issued in 1968
Vol. VIII (1965), issued in 1969

The Air Force Office of Scientific Research supports fundamental research in the six major scientific disciplines: physics, chemistry, engineering sciences (subsuming electronics, mechanics and propulsion), life sciences (both biological and behavioral, but not medical), mathematics, and the information sciences. Thus the publications abstracted herein are multi-disciplinary, their common link being task support by AFOSR.

Sources Searched

References, reports, and clues to the existence of reports were found by searching the indexes and report collection of the Air Force Office of Scientific Research Technical Library, and the collection of the Defense Documentation Center. Detailed searches were made of each contract file in the several AFOSR Directorates. Due to funds and time limitations, the usual cover-to-cover searches of scientific journals were excluded for the period 1963-1966.

Form and Entry and Arrangement

Inherent in the organization of this book is the concept of the reports within a contract as an unanalyzed monographic series. Reports are posted chronologically and/or alphabetically under contracts, these in turn under departments or laboratories, and those under contractors. This does, in fact, provide a rough subject grouping with the detailed subject index leading into clusters of like reports.

The abstracts are identified by item numbers and are listed under the numbers in the indexes. The form of entry is, in general, that being used for DDC catalog cards i. e., source of the document; title; personal author, if any; date; pagination; report number; contract number; and accession number. The chief exception to DDC form of entry is that the primary entry is by the parent organization followed by the name of the specific laboratory or important subdivision.

Availability of Reports

The principal accession or control numbers, which indicate the locations of reports in collections are:

AD ASTIA Document or Accessioned Document: (available at DDC, Defense Documentation Center), Cameron Station, Alexandria, Virginia 22314.

PB (Publication Board): for sale by the Clearinghouse for Federal Scientific and Technical Information (CFSTI), Sills Building, 5285 Port Royal Road, Springfield, Virginia 22151.

The fact that a report is abstracted in this book means that a copy of this report existed at the time the abstract was written; it should not be construed to imply that either AFOSR or the Library of Congress necessarily has a copy available for distribution. Those seeking reports should do so from the cited agencies, not from AFOSR.

Indices

A detailed subject index, arranged alphabetically, has been provided. In addition, there are an AFOSR control number index and a personal author index.

Acknowledgements

Many people shared in the production of this volume. The work has been fostered and nurtured by the previous Commanders and Executive Director of Air Force Office of Scientific Research: Brigadier Generals H. F. Gregory and B. G. Holzman; Colonels A. P. Gagge, Jack L. Deets, and Ivan Atkinson; Dr. Knox Millsaps and the present Executive Director, Dr. William Price. During the period of compilation of this volume (not the period of the literature covered) much of the responsibility for documentation within AFOSR was transferred to the Office of the Assistant Executive Director for Research Operations, Lt. Colonel Harry Jaffers. He, his administrative assistant for documentation, Miss Arlene D. Blose, and their intermittently faithful computer have been in large part responsible for providing the AFOSR input in this volume.

Library of Congress, protocol dictates the form and order of acknowledgement of contributions made by LC staff members to a bibliography. Formally, the credit lines read as follows:

"The bibliographic team worked under the guidance and leadership of Thomas C. Goodwin, Jr., Head of the Special Bibliographies Section, Science and Technology Division. The chief workers on this volume have been, Doris C. Yates, Norman G. Lamb, Marion S. Carr, and Phyllis M. Martin. A special note of gratitude is due to the invaluable work in preparation of this manuscript, searching, preliminary cataloging, and typing done by Marion S. Carr, Phyllis M. Martin, Lillie M. Frye, and Beatrice T. Treese."

HAROLD WOOSTER
Director of Information Sciences
Air Force Office of Scientific Research

Arlington, Va.
June 1970

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Aarhus U. Mathematical Inst. (Denmark).

INVESTIGATIONS ON FLUCTUATIONS OF SUMS OF RANDOM VARIABLES, by E. S. Andersen. Technical final rept. July 15, 1963, 13p. incl. refs. (AFOSR-5251) (AF 61(052)42) AD 416361 Unclassified

Investigation has been made of the fluctuations of sums of random variables X_1, X_2. Previous results have been generalized on the random variables Hn connected with this sequence, new results obtained on the validity of the Arc-sine Law for independent not identically distributed random variables, a generalization of Spitzer's identify obtained, and a generalization of the equivalence principle obtained. Furthermore Toeplitz matrices of Laurent polynomials have been studied. For the growth of the maximal order statistics of a sequence of independent, identically distributed random variables a "law of the iterated logarithm" has been obtained. (Contractor's abstract, modified)

2

Adelphi U., Garden City, N. Y.

A DYNAMICAL MODEL FOR KORDYLEWSKI CLOUD SATELLITES, by F. V. Pohle. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-1358) (AF AFOSR-64-598) Unclassified

Presented at the AIAA Astrodynamics Conf., New Haven, Conn., Aug. 19-21, 1963.

Also published in AIAA Jour., v. 2: 1818-1820, Oct. 1964.

A dynamical model is presented to explain the pair of thin cloud-like satellites observed by Kordylewski at each libration point of the earth-moon system. The model assumes the existence of a small nucleus at the stable L point and the existence of dust moving in the region near the L point. The influence of the moon on the dust particles can be ignored, and it is hypothesized that the dust particles are held together in a cloud by the interacting attractions of the nucleus and earth.

3

AeroChem Research Labs., Inc., Princeton, N. J.

CHEMICAL SCAVENGER PROBE STUDIES OF ATOM AND EXCITED MOLECULE REACTIVITY IN ACTIVE NITROGEN FROM A SUPERSONIC STREAM, by A. Fontijn, D. E. Rosner, and S. C. Kurzius. [1964] [11]p. incl. diagrs. table, refs. (AFOSR-4625) (AF 49(638)300) Unclassified

Also published in Canad. Jour. Chem., v. 42: 2440-2450, 1964.

A quartz chemical scavenger probe has been developed to study the local composition of supersonic electrically discharged gas streams. The probe samples the central portion of a nonequilibrium jet and allows direct comparison with local measurement techniques (e.g., differential catalytic detectors) for determining active species concentrations. Active nitrogen from a Mach 3 stream was sampled and reacted inside the probe with one of the scavenger gases NO, NH_3, or C_2H_4 at 18.8 mm Hg and at an average temperature of 500°K. Limiting values of the NO destruction rate and the HCN production rate were observed; however, NH_3 destruction exhibited no plateau. The observed maximum rate of NO destruction was 2.1 times as large as the NO flow rate at the light titration end-point. This difference is attributed to a reaction of NO, added in excess of the titration end-point flow, with metastable electronically excited molecules formed within the discharge zone. The converging-diverging supersonic nozzle-glow discharge source used in these experiments apparently delivers metastable excited molecules to the raction zone in a higher relative concentration than do the more conventional subsonic electrical discharge flow systems used for most previous active nitrogen studies. (Contractor's abstract)

4

AeroChem Research Labs., Inc., Princeton, N. J.

CHEMICAL SCAVENGER PROBES IN NONEQUILIBRIUM GASDYNAMICS, by D. E. Rosner, A. Fontijn, and S. C. Kurzius. Sept. 25, 1963, 3p. (AFOSR-65-2155) (AF 49(638)300) AD 629248 Unclassified

Also published in AIAA Jour., 1964.

The scavenger rapidly and quantitatively reacts with the unstable species in the sampled gas to form one or more stable products, which can then be analyzed downstream by any one of a number of conventional techniques.

5

AeroChem Research Labs., Inc., Princeton, N. J.

CONVECTIVE DIFFUSION AS AN INTRUDER IN KINETIC STUDIES OF SURFACE CATALYZED REACTIONS, by D. E. Rosner. [1964] 18p. (AFOSR-64-1884) (AF 49(638)1138) AD 450107 Unclassified

Also published in AIAA Jour., v. 2: 493-610, 1964.

This paper reviews the current state of knowledge in this area and outlines chemical kinetic and aerodynamic applications of available theory as well as areas in need of further development.

6

AeroChem Research Labs., Inc., Princeton, N. J.

ANALYSIS OF AIR ARC-TUNNEL HEAT-TRANSFER DATA, by D. E. Rosner. [1964] [4]p. incl. diagr. refs. (AFOSR-64-2009) (AF 49(638)1138) Unclassified

Also published in AIAA Jour., v. 2: 945-947, May 1964.

Wethern has compared data on subsonic air arc-tunnel

heat transfer to a water-cooled copper calorimeter with the predictions of several limiting theoretical models end concluded that the assumptions of chemically frozen boundary-layer flow and a noncatalytic wall were virtually exact for most of the conditions studied. Since a copper surface can behave this way at stagnation pressures and enthalpies approaching 1 atm and 10^4 btu/lbm, respectively, calorimeter catalytic activity becomes an important parameter, particularly if effective heats of ablation or total enthalpies are subsequently to be determined from heat-transfer data obtained at thermally significant dissociation levels. In this note, a direct procedure for estimating catalytic activities from such calorimeter heat-transfer data is illustrated, and a prediction is made of the stagnation pressure levels at which gas-phase atom recombination should mask the observed effects of calorimeter surface specificity under arc-tunnel conditions. Implications of this result for materials testing, and factors governing the probability of atom recombination on metal and metal oxide surfaces, are briefly discussed in the light of recent kinetic observations.

7

AeroChem Research Labs., Inc., Princeton, N. J.

KINETIC AND AERODYNAMIC ASPECTS OF THE OXIDATION OF METALS BY PARTIALLY DISSOCIATED OXYGEN, by D. E. Rosner and H. D. Allendorf. Semiannual progress rept. Nov. 15, 1963-May 15, 1964, 24p. (Rept. no. TN-61) (AF 49(638)1195) AD 438927 Unclassified

Using a resistance monitoring techniqus, the oxidation rate of electrically heated molybdenum and tungsten filaments has been studied over a wide range of oxygen atom concentrations and surface temperatures at flow rates such that the observed oxidation kinetics are not falsified by diffusional limitations. Partially dissociated streams are produced in the pressure range 0.7-10 Torr using a microwave discharge and O-atom concentrations are determined using the NO_2 light titration technique. Under the conditions investigated the oxides of molybdenum and tungsten latilize as rapidly as they are formed and the unprotected metal is subjected to direct attack by oxygen atoms. On molybdenum and tungsten surfaces oxidation probabilities for atomic oxygen are found to be higher than corresponding values for molecular (diatomic) oxygen by up to one to two orders of magnitude, whereas the corresponding activation energies are considerably lower. Moreover, while present studies of the pressure dependence of the rates reveal complex departures from simple 'power-law kinetics' for O_2 attack, the O-atom data reported follow simple-first order kinetics.

8

Aerojet-General Corp., Azusa, Calif.

REACTION OF PENTABORANE AND HYDRAZINE AND THE STRUCTURE OF THE ADDUCT, by H. V. Soklemian, R. W. Lawrence, and G. A. Guter. [1964] [11]p. incl. diagrs. tables. (AFOSR-65-0695) (AF 49(638)1122) AD 615133 Unclassified

Also published in Prog. in Astronaut. and Aeronaut., v. 15: 391-401, 1964.

Pentaborane and hydrazine react in a 1 to 2 molar ratio in dilute cyclohexane solution at a measurable rate by a first order process. The products formed are a white insoluble adduct and one half mol of hydrogen gas per mol of pentaborane used. At low concentrations of reactants, the reaction is first order and zero order reactions. The initial rate is independent of pentaborane concentration and first order with respect to hydrazine. This evidence indicates that there is a soluble intermediate which loses hydrogen by a first order process. At higher concentrations it is believed that the solubility of the intermediate is exceeded and the insoluble portion then decomposed by a first order process. In all the solvents tried which did not react the adduct was found to be insoluble. Thermal decomposition of the adduct did not evolve all of its hydrogen even when heated to 960°C.

9

Aeronautical Research Associates of Princeton, Inc., N. J.

THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF THREE-DIMENSIONAL VISCOUS VORTEX FLOWS, by C. duP. Donaldson, R. D. Sullivan, and R. S. Snedeker. Final rept. Feb. 1963, 4p. (AFOSR-4619) (AF 49(638)255) AD 407985 Unclassified

The research efforts carried out at ARAP during the past 5 yr in the field of viscous vortex motions are summarized. The work cited constitutes a rather extensive program of theoretical and experimental studies of vortex motions in general and of three-dimensional laminar and turbulent incompressible driven vortices in particular. The theoretical studies fall into 3 general categories: the first and most important comprising velocity distributions for steady laminar motion, the second dealing with unsteady velocity characteristics, and the third treating temperature distributions for the steady motions first considered. An evaluation and discussion of the effects of turbulence in real flows of the general type under consideration is included.

10

Aeronautical Research Associates of Princeton, Inc., N. J.

AN EXPERIMENTAL STUDY OF TURBULENCE IN A DRIVEN VORTEX, by C. duP. Donaldson, and G. G. Williamson. July 1964 [44]p. incl. illus. diagrs. refs. (ARAP technical memo. no. 64-2) (AFOSR-64-1924) (AF 49(638)1187) AD 609460 Unclassified

Measurements have been made at 2 rotational speeds of the mean motion and turbulence levels within a shallow vortex chamber that has a rotating porous wall as an outer boundary. Very nominal levels of turbulence (2 to 3%) were observed on the central plane of these vortices while a significant portion of the mass flow through the vortex was observed to pass through the end wall boundary layers. A fairly high level of turbulence was then introduced into this vortex chamber by means of a grid of axially aligned bars at the outer rim of the

vortex. This high level of turbulence was observed to decay rapidly to a relative level of intensity of about 6%, indicating that for tangential Reynolds numbers up to at least 10^5, the flow with a driven vortex is stable with respect to the introduction of turbulence. The results obtained corroborate Kendall's findings, namely that the primary cause of the degradation of the performance of a confined vortex is the leakage of mass flux through the boundary layers on the end walls of the vortex chamber.

11

Aeronautical Research Associates of Princeton, Inc., N. J.

ENERGY AND MOMENTUM EXCHANGE BETWEEN NONEQUIPARTITION GASES, by T. F. Morse. [1963] [8]p. incl. diagr. table. (AFOSR-64-0119) (AF 49-(638)1224) AD 430661 Unclassified

Also published in Phys. Fluids, v. 6: 1420-1427, Oct. 1963.

The energy and momentum relaxation of a nonequipartition gas mixture is considered. It is assumed that each component of the mixture has a Maxwellian distribution at a temperature T_i, with the peculiar velocity of the Maxwellian measured relative to the mean velocity of the ith species. For the case in which a "diffusion" Mach number is not too large, the results have a particularly simple form. The calculations were carried out for the hard sphere, Coulomb, and Maxwell force laws of interaction. It is also noted how these results may be used to construct kinetic model equations for the case of hard sphere and Coulomb interaction, in a manner similar to that proposed by Sirovich.

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Aeronautical Research Associates of Princeton, Inc., N. J.

KINETIC MODEL FOR GASES WITH INTERNAL DEGREES OF FREEDOM, by T. F. Morse. [1964] [11]p. (AFOSR-64-0915) (AF 49(638)1224) AD 439868 Unclassified

Also published in Phys. Fluids, v. 7: 159-169, Feb. 1964.

A new model equation has been obtained which permits a kinetic description of gases possessing internal degrees of freedom. The collision term of the model equation is related to the Wang-Chang and Uhlenbeck results for polyatomic gases much in the same manner as the Bhatnagar, Gross, and Krook model is related to the Boltzmann collision integral. A modified perturbation technique utilizing the various time scales of the flow situation has been employed in closing the equations of change. From the model equation and its moments, depending upon the ratio of a flow through time to the inelastic relaxation time, one directly obtains either the bulk viscosity as a term modifying the pressure tensor, or a relaxation equation for the internal temperature. The model also accounts for the contribution to the heat transfer vector due to the presence of internal degrees of freedom. (Contractor's abstract, in part)

13

Aeronautical Research Associates of Princeton, Inc., N. J.

ON THE KINETIC THEORY OF A WEAKLY COUPLED GAS, by G. Sandri. [1964] [2]p. (AFOSR-64-1029) (AF 49(638)1224) AD 440983 Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 1131-1132, Mar. 10, 1964.

The purpose of this note is to cast Bogolubov's original approach in a form that exhibits transparently the convergence difficulties. Consider a spatially homogeneous weakly coupled (classical) gas. The two-particle correlation function, g, is introduced as usual through the definition $g = F^2 - F^1 F^1$. The expansion parameter for the hierarchy of reduced distribution functions is $\epsilon = \varphi_0/kT \ll 1$ with $nr_0^3 = 0(1)$ where φ_0 and r_0 are the depth and range of the two-body (central) potential, U, and n is the mean density of the gas.

14

Aeronautical Research Associates of Princeton, Inc., N. J.

GLOBAL MASTER EQUATION - I, by G. Sandri. [1963] [6]p. (AFOSR-64-1943) (AF 49(638)1224) AD 450325 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 965-990, May 16, 1964.

A new master equation is derived very directly from the Liouville equation. The validity of the new equation does not depend on the details of the two-body potential and constitutes therefore a considerable generalization of the known results.

15

Aeronautical Research Associates of Princeton, Inc., N. J.

COLLISIONS OF THREE HARD SPHERES, by G. Sandri, R. D. Sullivan, and P. Norem. [1964] [3]p. incl. diagrs. (AFOSR-65-0554) (AF 49(638)1224) AD 614294 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 743-745, Dec. 21, 1964.

The orbits of 3 identical, classical rigid, elastic spheres in otherwise empty flat Euclidean 3-dimensional space have been analyzed. The phase-space domains, Γ_n, that correspond to the occurrence of n successive binary collisions have been determined. The Γ_4 form is precisely stated and illustrated, and the proof that Γ_5 is empty is rigorously described.

16

Aeronautical Research Associates of Princeton, Inc., N. J.

ON THE MOTION WITHIN FLUID GYROSCOPES, by

M. Fiebig. Aug. 1964 [85]p. (ARAP rept. no. 62) (AFOSR-64-1457) (AF 49(638)1262) AD 608703
Unclassified

The flow field which results from the disturbance of an initially laminar, viscous, incompressible sink flow through a cylindrical chamber is investigated. The disturbance considered may arise either from an impulsive motion or a harmonic oscillation of the device perpendicular to its axis of symmetry. The results of this investigation indicate the general behavior of the response of the flow field within such a device over a wide range of the governing parameters. In particular, it is shown that the mean time- or phase-lag of the motion is nearly identical with the inviscid transport time, while the mean amplitude of the response is almost proportional to the inverse distance from the axis when the visco-geometric parameter is smaller than 10^1. Hence, such devices may possibly be used to detect extremely small rates of rotation and may act in a certain sense as excellent gyroscopes. (Contractor's abstract)

17

Aeronutronic, Newport Beach, Calif.

RESEARCH ON NON-EQUILIBRIUM PLASMA PHYSICS, by S. R. Byron and W. W. Lawrence. Final technical rept. Jan. 15, 1963, 14p. incl. table, refs. (Rept. no. U-1985) (AFOSR-4644) (AF 49(638)670) AD 406471
Unclassified

An experimental study of shock waves produced in a T-tube and a theoretical study of electron-ion reaction rates are summarized. Precursor ionization in the T-tube was observed, but no conclusive evidence concerning the source of the ionization was obtained. The study of electron-ion reaction rates resulted in a detailed theory for the rate of three body electron-ion recombination and radiative decay in monatomic gases. Comparison of this theory with published measurements in helium, argon, mercury, and cesium shows very good agreement. (Contractor's abstract)

18

Aeronutronic [Newport Beach, Calif.]

REFLECTION AND SCATTERING OF SOUND BY FLAMES, by H. M. Wight. Nov. 30, 1964, 103p. incl. illus. diagrs. tables, refs. (Rept. no. U-2931) (AFOSR-65-0432) (AF 49(638)1106) AD 612057
Unclassified

This report describes acoustic measurements taken with various laboratory flame systems. These involved (1) determination of the acoustic scatterings and attenuating characteristics of an open premixed propane flame, (2) determination of the attenuation of open solid propellant flames containing varying aluminum concentrations, and (3) determination of the acoustic combustion noise emission characteristics of various solid propellants. The acoustic attenuation, measured with a collimated sound beam propagating through various open gas and solid propellant flames, was extremely high. The observed attenuation coefficient was at least two orders of magnitude in excess of that attributable either to classical viscous and thermal conductive losses or to molecular relaxation losses. Acoustic scattering measurements indicated intense lateral scattering to be the probable cause of the high attenuation. An acoustic scattering theory was developed in conjunction with a postulated model for a turbulent flame which predicted attenuation coefficients reasonably consonant with the experimental data. The acoustic combustion noise generated by burning small slabs of solid propellant possessed a continuous broadband spectrum of high amplitude. The spectra from a variety of propellants usually peaked at frequencies below 50 cps. Measurable noise was observed above 10 kcps. The noise spectra did not appear to depend on either the ambient pressure level nor on the aluminum content of the propellants.

19

Aerospace Research Associates, Inc., West Covina, Calif.

RESEARCH ON ENERGY ABSORBING STRUCTURES, by D. L. Platus, P. J. Cunningham and others. Final rept. Feb. 1963, 100p. incl. illus. diagrs. (AFOSR-5071) (AF 49(638)1144) AD 402854; AD 415248
Unclassified

Theoretical and experimental studies of convoluted type structures are described. An incremental method for predicting the nonlinear large-deformation behavior of two-dimensional convoluted strips is shown. The method is applicable for elastic as well as plastic stress-strain behavior of the material. The results of the two-dimensional analysis are extended to an analysis of a circumferentially-convoluted cylinder which deforms into a conical shape. Tests on typical two- and three-dimensional convoluted metal specimens are described and correlations of theoretical predictions with experimental results are shown. (Contractor's abstract)

20

Aerospace Research Associates, Inc., West Covina, Calif.

RESEARCH ON ENERGY ABSORBING STRUCTURES. PART II, by D. L. Platus, S. Uchiyama and others. Final rept. Feb. 1964, 63p. incl. illus diagrs. refs. (AFOSR-64-0154) (AF 49(638)1144) AD 432958
Unclassified

Analytical methods for predicting the large deformation behavior of corrugated cylindrical and conical shell structures are presented, and tests with simple corrugated specimens for evaluating the theoretical predictions are described. Tests on corrugated strips loaded into the plastic range for evaluating previously developed analyses are described, and correlations with theoretical predictions are shown. A novel bimetallic flexural spring damper is described. Moment-curvature tests to demonstrate the behavior are discussed and correlations with theoretical predictions are shown. (Contractor's abstract)

21

Agricultural Research Council. Inst. of Animal Physiology, London (Gt. Brit.).

THE EFFECTS OF GUANETHIDINE AND MILD EMOTIONAL STRESS ON THE NORADRENALINE CONTENT OF THE HYPOTHALAMUS IN THE CAT AND RAT, by R. Dagirmanjian and M. Vogt. Apr. 1, 1963 [9]p. incl. tables, refs. (AFOSR-4850) (AF EOAR-62-19) AD 413766 Unclassified

Single injections of guanethidine 15 mg/kg i. p. did not lower the hypothalamic noradrenaline in cats. In contrast, daily injections of 15 mg/kg s. c. over a 7 day period consistently produced a decrease in the hypothalamic noradrenaline. Attempts to lower the hypothalamic noradrenaline in rats after single injections or daily injections of guanethidine were unsuccessful. The hypothalamic noradrenaline content of the rat and cat was not changed by mild emotional stress, such as barking dogs on cats and immonility or crowding on rats.

22

Agricultural U., Wageningen (Netherlands).

PHYSICAL AND CHEMICAL STUDIES OF CHLOROPHYLL SYSTEMS, by E. C. Wassink and G. H. M. Kronenberg. July 1, 1963, 1v. incl. diagrs. refs. (AFOSR-64-0105) (AF EOAR-62-30) AD 429765 Unclassified

This study is a continuation of work on properties of pigment-protein complexes in purple bacteria. The organism under investigation is Chromatium, strain D. Owing to the fact that the culture obviously contained an admixture, methods have been investigated for reisolating Chromatium from the culture. Isolation was successful by applying high concentrations of diphenylamine (DPA) in the culture medium, in which Chromatium appeared to develop much better than the admixture. Experiments performed with the reisolated Chromatium were compared with those obtained with other cultures. All listed Chromatium, strain D.

23

Air Force Office of Scientific Research, Arlington, Va.

RECOMMENDATIONS ON RESEARCH IN SEISMOLOGY FOR THE VELA-UNIFORM PROGRAM OF THE ADVANCED RESEARCH PROJECTS AGENCY. Apr. 22, 1963, 24p. (AFOSR-5290) AD 418036 Unclassified

The Advisory Committee for Geophysics of the Air Force Office of Scientific Research has undertaken to review the present state of research in support of the Vela-Uniform program and to make recommendations on future research. The present programs have been guided by the 1959 recommendations of the Berkner panel. This report summarizes the committee's opinion on progress since 1959 and its recommendations for research, both basic and applied, needed to further the objectives of Vela-Uniform. Areas on which recommendations have been made are: identification techniques, data processing arrays, deep-hole and ocean-bottom detection, magnitude/energy scale, noise studies, seismicity, source mechanisms - explosions and earthquakes, crustal studies, theoretical studies, hypo-center location and level of trained personnel.

24

Air Force Office of Scientific Research, Arlington, Va.

CHEMISTRY PROGRAM REVIEW, FISCAL YEAR 1963, ed. by A. Weissler, M. D. Sprinkel, and O. Rollins. Dec. 30, 1963, 207p. incl. illus. diagrs. tables, refs. (AFOSR-64-1003) AD 600623 Unclassified

Contents: Aerospace chemistry, by A. Weissler, New methods and techniques, by W. L. Ruigh, Inorganic chemistry, by D. W. Elliott, Chemical reactivity and mechanisms, by A. J. Matuszko, Symposia, by M. D. Sprinkel, Chemistry program statistics, by O. W. Rollins, Reports received in FY 63, by O. W. Rollins, Current chemistry program, Projects completed in Fy 1963, Summaries of completed projects, and Chemistry as a profession.

25

Air Force Office of Scientific Research, Arlington, Va.

CHEMISTRY PROGRAM REVIEW, FISCAL YEAR 1964, ed. by A. Weissler, M. D. Sprinkel, and O. W. Rollins. Nov. 1964, 180p. incl. diagrs. tables, refs. (AFOSR-64-1872) AD 609875 Unclassified

This report reviews basically the same topics covered in item no. 24.

26

Air Force Office of Scientific Research, Arlington, Va.

INFORMATION TECHNOLOGY AND THE INFORMATION SCIENCES "WITH FORKS AND HOPE", by H. Wooster. [1964] [16]p. (AFOSR-64-1897) AD 608774 Unclassified

Presented at Conf. on Electronic Information Handling, Pittsburgh, Pa., Oct. 9, 1964.

Electronic information handling is a rapidly developing technology. It is parasitic upon, host to, and symbiotic with many other technologies. Like all other technologies, it is presumably dependent upon a body of fundamental scientific disciplines and knowledge. Advances in information technology can only come in three ways: by specific R&D efforts in information handling per se; by exploiting fortuitous advances in ancillary technologies; and, by improvements in fundamental understanding. The emphasis of the paper is on the last of these, with emphasis on epistemology, intelligent automata, pattern recognition from visual to semantic, self-organization, and computer organization and programming.

27

Air Force Office of Scientific Research, Arlington, Va.

SYMBOLIZATION, TRANSFORMATION AND TRANSLATION OF SCIENTIFIC INFORMATION, by H. Wooster. [1963] [2]p. (AFOSR-64-2003) AD 451189 Unclassified

Also published in Proc. Twenty-sixth annual meeting of the American Documentation Institute, Chicago, Ill. (Oct. 6-11, 1963), v. 3: 405-407, Oct. 1963.

In the course of reviewing 23 papers, the author discourses on the personal nature of classification systems, on thesauruses in general and particular, on choice of index terms, on documentation centers, on languages and grammars, and on the use of symbolic logic in information retrieval.

28

Air Force Office of Scientific Research, Arlington, Va.

THE INFLUENCE OF INERT AND CHEMICALLY REACTIVE ADDITIVES ON THE MECHANISM OF DETONATION IN GASEOUS MIXTURES OVER WIDE RANGES OF INITIAL PRESSURE AND ADDITIVE CONCENTRATION, by B. T. Wolfson. 1964, 69p. (AFOSR-64-2021) AD 450801 Unclassified

Presented at Spring meeting of the Western States section of the Combustion Institute, Menlo Park, Calif., Apr. 27-28, 1964.

This study investigates the effect of He, Ar and CO_2 additives on the mechanism of detonation in stoichiometric H-O mixtures over wide ranges of initial pressures and additive concentrations, and attempts to determine the validity of the Chapman-Jouguet thermohydrodynamic theory under these conditions. No quantitiative conclusions can be made about whether complete chemical and/or thermal equilibrium in the Chapman-Jouguet plane was established, or to whether the "frozen" or "equilibrium" product gas sound speed is most correct in the real gas situation. Additives retarded the rate of attainment of stable detonation in stoichiometric H-O mixtures. The stabilization rate increased with increase in initial pressure and with decrease in additive concentration. The rates appeared to be closely associated with the predetonation lengths, and the deviations between theoretical and experimental values of detonation parameters.

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Air Force Office of Scientific Research, Arlington, Va.

CONVERSATION ON INDIAN LIBRARIES, by H. Wooster. [1964] [5]p. (AFOSR-65-0490) AD 614190 Unclassified

Also published in IASLIC Bull., v. 9: 122-126, Sept. 1964.

This article comments on a number of surface differences between U. S. and Indian library practices as noted on a short trip to India. Topics covered include social status of librarians, use of typewriters, humidity control, leather bindings, U. S. use of Library of Congress and Dewey Decimal Classification and cards as contrasted with Indian use of Universal Decimal Classification, and the cataloging problems thereby created, and dictionary vs classified catalogs.

30

Air Force Office of Scientific Research, Arlington, Va.

THE R AND D ORGANIZATION'S FUNDAMENTAL RESEARCH ACTIVITY AS A WINDOW BETWEEN SCIENCE AND TECHNOLOGY, by W. J. Price. Apr. 21, 1964, 14p. incl. diagr. (AFOSR-65-0864) AD 616834 Unclassified

Presented at meeting of the Ninth Inst. on Research Administration, Washington, D. C., Apr. 20-24, 1964.

The fundamental research activities of an R & D organization are presented as important both for providing specific research results in areas of potential pay-off for the organization and in providing a window between science and technology. The need and potential for the latter activity are inherent in the recognition that a very large portion of the scientific research on which a given technology depends is always done by other organizations. The discussion deals primarily with the opportunities and techniques for providing this window.

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Air Force Office of Scientific Research, Arlington, Va.

A WEB OF WORDS, by H. Wooster. [1963] [43]p. incl. refs. (AFOSR-67-2809) Unclassified

Presented at Sixth Annual Institute in Technical and Industrial Communications, Ft. Collins, Colo., July 8-12, 1963.

The author attempts to apply current notions in linguistics and philosophy to the problems of technical writing. Major sections are: the frame of reference; words and word-books; words plus words make sentences; sentences plus sentences make prose. Typical headings include: Gulliver the gullible, or linguistics in Lagado; the definer defined; Aristotle was class conscious; what your dictionary won't tell you; must we write pidgin?; the mystique of sentencehood; it's art, but is it pretty?; a sentence is a discrete fragment of a correlation network of "thoughts" expressed as a sequential linear array of symbols. The author concludes: "I have found the concepts outlined in this paper useful in understanding what I, as a conscious entity, am trying to do when I think and try to express my thoughts in words. I claim no eternal verities. I make only the claim of the pragmatist: 'At least for me, sometimes, it works'."

32

Alabama U., University.

SUBMILLIMETER RADIATION FROM RELATIVISTIC ELECTRONS. Final technical rept. May 3, 1963, 6p. (AFOSR-4670) (AF AFOSR-61-69) AD 407120 Unclassified

A method for utilization of a bunched relativistic electron beam for production of such radiation at submillimeter wavelengths is reported. In particular, the interaction of a bunched beam with the fields propagated by a corrugated cylindrical waveguide structure is being investigated. Design criteria for the waveguide structure have been devised. Cold radio-frequency tests have been made on structures scaled to C-band, and the results have been compared with theory. A structure scaled to 7.5 mm wavelength has been designed and is being electroformed.

33

Alabama U. [Dept. of Physics] University.

STUDIES OF SOLIDS AT LOW TEMPERATURES. Final technical rept. Apr. 8, 1963, 23p. incl. diagrs. (AFOSR-4710) (AF AFOSR-61-43) AD 407671 Unclassified

Radical species which are stable only at low temperatures are investigated by electron spin resonance and optical methods. The initial compound chosen for study was KH_2PO_4, the deuterated compound also being included in this investigation. 50-kv x-rays produce free radicals in this compound which appear to be completely stable at liquid air temperatures, but decay rapidly above about 140°K. Complete orientation data were taken on this compound about all three crystallographic axes for both undeuterated and deuterated crystals.

34

Alabama U. Dept. of Physics, University.

TEMPERATURE DEPENDENCE OF THE PURE QUADRUPOLE FREQUENCY AND SPIN-LATTICE RELAXATION TIME OF p-DIBROMOBENZENE, by R. F. Tipsword, E. L. Wilkinson, and W. G. Moulton. [1964] [3]p. incl. diagrs. table. (AFOSR-65-0180) (AF AFOSR-63-288) AD 456566 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2854-2856, Nov. 1, 1964.

The dependence of the Br^{79} and Br^{81} pure quadrupole resonance frequencies on temperature in p-dibromobenzene were measured over the temperature range 4.3° to 77°K. The results are compared with the Bayer theory, using values for the torsional frequencies obtained from the Raman data for p-dibromobenzene. Good agreement with the theory is obtained if both the low-frequency and high-frequency modes are included in the calculation. The spin-lattice relaxation time of the resonance were measured in the range 4.2° to 7.5°K and the relaxation time was found to be proportional to T^9 in this limited temperature region. The experimental results are compared with the Bayer theory.

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Alpha Research Inc., Santa Barbara, Calif.

THE DYNAMICS AND AERODYNAMICS OF SELF-SUSTAINED LARGE ANGLE OF ATTACK BODY SPINNING MOTIONS, by J. E. Brunk. Final rept. Feb. 1963, 1v. incl. diagrs. tables, refs. (Rept. no. 63-1158-1) (AF 49(638)1158) AD 407183 Unclassified

Several aerodynamic mechanisms, which will sustain large angle of attack body autorotative motions, are examined. It is shown that autorotative motion can result in a very large drag force, which may significantly aid missile and booster recovery. A linear theory, which satisfactorily predicts the near-steady-state autorotative spin characteristics of quasi-axisymmetric bodies, is presented. The initiation of body autorotative motions under both low altitude and reentry environments is investigated by a special six-degrees-of-freedom trajectory program. The aerodynamic characteristics of cylinder-shaped bodies at angles of attack near 90 degrees are discussed.

36

American Mathematical Soc., Providence, R. I.

SUMMER SEMINAR IN SPACE MATHEMATICS, by J. B. Rosser. Final rept. July 1-Aug. 9, 1963, 33p. (AFOSR-64-0723) (AF AFOSR-63-258) AD 612385 Unclassified

The Summer Seminar in Space Mathematics was a joint undertaking of the American Mathematical Society and the Yale Dynamical Astronomy Institute. Thus, it combined the third Summer Seminar in applied mathematics with the fifth consecutive Dynamical Astronomy Institute. The purpose of the Seminar was to provide instruction, stimulation and cross-fertilization in the subjects of dynamical astronomy, mathematics and the physics of high speed flight. Mathematicians and astronomers heard from leading advanced mathematicians, astronomers and applied physicists on topics which cut across the disciplines contributing to space science. The first two weeks were mainly devoted to basic courses which provided background material in practical astronomy, elliptic orbits, basic fluid dynamics, variational calculus and the method of steepest descent, dynamic programming, and the computer workshop In the second two weeks, in addition to basic courses in Lagrange-Hamiltonian-Jacobi mechanics and computation procedures for differential equations, special topics of interest in space activity were stressed; included were artificial satellite theory, orbit decay, the Earth-Moon system, gas flow models, shock waves in very rare gases, and heat flow with receding boundaries. The final two weeks included a great variety of advanced and specialized topics of current interest in the space sciences.

37

American Soc. of Mechanical Engineers, New York.

APPLIED MECHANICS REVIEWS; WADEX WORD AND AUTHOR INDEX, VOLUME 16, 1963, by E. A. Kipperger, H. Wooster and others. 1963, 627p. (AFOSR-65-0728) (AF AFOSR-64-33) AD 621209 Unclassified

This second WADEX is based on 8,000 titles of Applied Mechanics Reviews (AMR), Vol. 16, 1963, an international critical review magazine. In WADEX, titles are printed fully with author names, and as many lines used as necessary (60 characters per line). WADEX entry: word in title (except forbidden word) or author's name. Alphabetically sequenced entries are printed out of context. Words are single words or hyphenated word pairs or "Tagged Words" (TW). The latter consist of significant "word compounds" in which one or more words are forbidden words. TW are selected from the subject index authority list of AMR and hyphenated words, from frequency list of words of previous WADEX. For more than one identical word entries, titles are alphabetized according to first author and for more than one identical author entries are by reference number, which is printed in line with the entry. Each entry is followed by block containing year/month/AMR review number. Multiple entries are listed only once per column. WADEX is arranged in 2 columns, both columns printed simultaneously with dictionary entries at top and pagination at bottom by computer. After addition of 26 alphabetics, "Compuscript" is the photo-ready copy with 6.5 average entry per paper including 1.5 for authors.

38

American Soc. of Zoologists, Chicago, Ill.

LEARNING AND ASSOCIATED PHENOMENA IN INVERTEBRATES: PROCEEDINGS OF A CONFERENCE, Cambridge (Gt. Brit.) (July 7-9, 1964), ed. by W. H. Thorpe and D. Davenport. London, Bailliere, Tindall & Cassell, Ltd. [1964] 190p. incl. illus. diagrs. tables, refs. (Animal Behaviour Suppl. no. 1) (AFOSR-65-1685) (MIPR-64-3) Unclassified

Twenty papers on learning and associated phenomena in invertebrates are contained in this work. These papers are (1) Learning, World Models and Preadaptation; (2) Paramecia, Planaria and Pseudo-learning; (3) Studies of the Behaviour of Paramecium aurelia; (4) Behavioural Studies of the Coelenterate Hydrapiradi; (5) The Behaviour of Sessile Coelenterates in Relation to Some Conditioning Experiments; (6) Adaptive Changes in Cnidarians; (7) Cannibals, Chemicals and Contiguity; (8) Behaviour of Planaria in Instrumental Learning Paradigms; (9) Learning in Planarians: Current Status; (10) Learning in Annelids and Attempts at the Chemical Modification of this Behaviour; (11) The Learning Abilities of Nereid Polychaetes and the Role of the Supra-oesophageal Ganglion; (12) Research and Theory on Conditioning of Annelids; (13) Descartes, Mechanistic Biology and Animal Behaviour; (14) Report of a Special Discussion on Planarian Learning; (15) Learning and Movement in Octopuses; (16) Discrimination Learning in the Octopus; (17) Release and Orientation of Behaviour and the Role of Learning as Demonstrated in Crustacea; (18) Aspects of Orientation in the Diggerwasp Bembix Rostrata; (19) The Electrophysiological Approach to Learning in Isolatable Ganglia; and (20) Macromolecular Coding in Nerve Cell and Embryo.

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Amoco Chemicals Corp., Seymour, Ind.

THE STUDY OF BORON PERCHLORATE AND RELATED SYSTEMS, by R. A. Mosher, E. K. Ives, and E. F. Morello. Final rept. Oct. 1, 1961-Sept. 30, 1964, 23p. incl. tables, refs. (AFOSR-65-1055) (AF 49(638)1105) AD 617941 Unclassified

The compounds BCl_2ClO_4, $BCl(ClO_4)_2$ and $B(ClO_4)_3$ have been prepared by the reactions between BCl_3 and anhydrous $HClO_4$. They are extremely sensitive to moisture undergoing rapid hydrolysis even at -78°C. The compounds are also thermally unstable, where BCl_2ClO_4 decomposes with evolution of chlorine, $BCl(ClO_4)_2$ with evolution of chlorine and chlorine heptoxide and $B(ClO_4)_3$ with evolution of chlorine heptoxide. All 3 compounds on decomposition give a residue which contains B, O, and ClO_4. The chloroperchlorates also undergo disproportionation reactions by loss of BCl_3, especially under vacuum treatment. Density, refractive index, molecular weight and surface tension have been determined for the boron chloroperchlorates. Molar refractivity and the parachor were calculated for the chloroperchlorates and both give values which agree closely with values for the postulated compounds. Heat of hydrolysis was determined calorimetrically for BCl_2ClO_4 and from this, a value for the heat of formation was derived which agrees closely with a calculated value. The chloroperchlorates give solid adducts with $(CH_3)_3N$, the stability decreasing from BCl_2ClO_4 to $BCl(ClO_4)_2$. The triperchlorate did not form an adduct with trimethylamine but did form a somewhat stable adduct with nitronium perchlorate. The reaction of some non-metal halides and anhydrous HClO were investigated briefly. The results are presented.

40

Antioch Coll. Behavior Research Lab., Yellow Springs, Ohio.

VIGILANCE: A REVIEW AND RE-EVALUATION, by H. J. Jerison and R. M. Pickett. [1963] [28]p. incl. diagrs. table, refs. (AFOSR-64-0840) (AF AFOSR-63-150) AD 438394 Unclassified

Also published in Human Factors, v. 5: 211-238, June 1963.

Vigilance as a human factors area is concerned with the fact that man is much less capable as a detector of signals under operational conditions than would be indicated by laboratory measures of his sensory thresholds. The area, which is obviously important for the analysis of man's visual capabilities in the operation of manned

space systems, is re-examined with the help of a theoretical model that introduces a decision-theory approach to the observing response phase of the vigilance task. After a critical review of the vigilance literature, examples are presented of the application of this approach to the solution of human factors problems of the sort that might arise in manned space missions. The model is also used to suggest the kind of research that would make it easier to predict field monitoring performance from laboratory experiments. (Contractor's abstract)

41

Arizona State U. [Dept. of Physics] Tempe.

OXYGEN VACANCIES AND ELECTRICAL CONDUCTION IN METAL OXIDES, by C. J. Kevane. [1964] [6]p. (AFOSR-64-1230) (AF AFOSR-62-130) AD 442809 Unclassified

Also published in Phys. Rev., v. 133: A1431-A1436, Mar. 2, 1964.

Oxygen vacancies and their effects on electrical conduction in some metal oxides were considered through an exact solution of the equilibrium relations between oxygen partial pressure in the ambient gas and concentrations of oxygen vacancies and conduction electrons in the oxide. The mass-action law was assumed but no state of ionization of oxygen vacancies was neglected. Concentrations of electrons in conduction states and total oxygen vacancies were considered. The results, which possess considerable complexity not contained in the usual limiting-case solutions, were compared with pertinent experiments.

42

Arizona U., Tucson.

DOCUMENT SELECTION METHODS -- A GENERAL ANALYSIS, by J. W. Perry. [1963] [64]p. incl. diagr. refs. (AFOSR-64-0562) (AF AFOSR-62-289) AD 434403 Unclassified

Also published in Readings in Special Librarianship, ed. by H. S. Sharp. New York, Scarecrow Press, 1963, p. 507-573.

This paper shows how traditional indexing and classifying methods relate to such recently developed techniques as uniterm, computer searching, and the like. First discussing the 'information explosion' as the natural consequence of increased emphasis on research and development during the past few decades, it then analyzes the performance and requirements of workable deep-indexing information retrieval systems. Emphasis is on the application of logic to specify the selection of pertinent documents from a universe of pertinent and nonpertinent documents rather than on the hardware which is employed in such selection. (Contractor's abstract)

43

Arizona U., Tucson.

PROBLEMS OF TRANSFERENCE OF MEANING IN AUTOMATED TECHNIQUES, by J. W. Perry. [1964] [19]p. incl. diagr. table, refs. (AFOSR-65-1169) (AF AFOSR-62-289) AD 621354 Unclassified

Also published in Proc. Inst. Tech. and Indus. Commun., Colorado State U., Fort Collins, Colo., July 6-10, 1964, p. 96-114.

Applications of automated techniques to facilitate transference of meaning present widely different problems which can be characterized in terms of various barriers to communication, i.e., culture, symbols, space, and time. Two questions are presented: (1) How can logically defined automation techniques be applied to advantage in dealing with communication problems whose logical analysis remains only partial?; and (2) How shall we conduct the analysis of communication problems so that the results may provide the most effective possible guidance in planning and applying automation technique? Pragmatic answers to these questions are sought through discussion of the four communication barriers.

44

Arizona U., Tucson.

ANALOG/HYBRID STORAGE AND PULSE MODULATION, by G. A. Korn. [1963] [2]p. incl. refs. (AFOSR-5178) (AF AFOSR-63-89) AD 416389 Unclassified

Also published in IEEE Trans. Electron. Comput., EC-12: 411-412, Aug. 1963.

The advent of new very fast, digitally controlled analog computers poses the requirement of storing and reproducing samples of analog functions f(t) of length TR, where TR is the duration of one iterative-computer run (T = 1 msec to 100 msec). While function storage for the duration of a single computer run is already useful for many iterative computation schemes, such as the solution of integral equations, function storage for an indefinite time period would be substantially more desirable and would, for instance, permit table lookup and storage of functions for use in later computation cycles.

45

Arizona U., Tucson.

HYBRID ANALOG-DIGITAL RANDOM-NOISE GENERATION, by R. Hampton, G. A. Korn, and B. Mitchell. [1963] [3]p. (ACL memo. no. 71) (AFOSR-5179) (AF AFOSR-63-89) AD 416387 Unclassified

Also published in IEEE Trans. Electron. Comput., Aug. 1963.

Random noise generators for random-process and statistical studies with analog and hybrid analog-digital computers should produce noise signals whose amplitude distribution, d-c unbalance, spectrum, and RMS level is specified within the computer-accuracy limits (0.1 to 0.5%). In addition, the noise must be free from periodic components; noise samples must be uncorrelated for delays exceeding, say, one-thousandth to one-ten-thousandth of a typical computer run.

46

Arizona U., Tucson.

A MASTER CONTROL CLOCK SYSTEM FOR A HYBRID DIFFERENTIAL ANALYZER, by R. L. Maybach, E. P. O'Grady, and J. V. Wait. May 1963, 13p. (ACL memo. no. 81) (AFOSR-5181) (AF AFOSR-63-89) AD 414456 Unclassified

The control clock system which was developed as part of the hybrid differential analyzer project is discussed. In this system, machine computation proceeds in alternate analog and digital computing intervals. The precise generation of these time intervals, and the command of the solution read-out time are the principal functions of the clock system.

47

Arizona U., Tucson.

HYBRID COMPUTING SYSTEMS AND COMPONENTS, by G. A. Korn, J. V. Wait and others. Aug. 1963, 124p. (AFOSR-5235) (AF AFOSR-63-89) AD 630198 Unclassified

This report contains 1962 Progress and ASTRAC II project, by G. A. Korn. A solid-state analog comparator for hybrid analog-digital comparators, by J. V. Wait and R. L. T. Hampton. A simple solid-state digital-to-analog converter for hybrid computing systems, by J. V. Wait and B. A. Mitchell. An interpolation waveform generator for use in hybrid computing systems, by J. V. Wait. Analog-hybrid storage and pulse modulation. A hybrid/analog-digital one-parameter optimizer, by B. A. Mitchell. Hybrid analog-digital random-noise generation, by R. Hampton, G. A. Korn, and B. Mitchell. A nonsaturating transistor switch for analog/hybrid instrumentation and computers, by T. A. Brubaker. Simple integrator-input addition of hybrid variables, by E. P. O'Grady and J. V. Wait.

48

Arizona U., Tucson.

A HYBRID ANALOG-DIGITAL DIFFERENTIAL ANALYZER SYSTEM, by J. V. Wait. June 1963, 141p. (ACL memo no. 76) (AFOSR-5236) (AF AFOSR-63-89) AD 479647 Unclassified

A true hybrid (parallel analog-digital) differential analyzer, by combining many of the advantages of both analog and digital systems, may be useful in applications where moderately high-accuracy real-time and faster-than-real-time computing is required. This thesis covers the results of theoretical and experimental studies of a hybrid computing system. A hybrid system gains accuracy through the use of digital techniques; analog (continuous) interpolation frees the hybrid system of truncation and round-off errors. The system also preserves most of the ease-of-programming features associated with analog computers. These features permit a hybrid differential analyzer using only a few digital bits and a moderate digital clock rate, to achieve both an accuracy and a bandwidth or speed-of-operation comparable to modern high-speed digital differential analyzers.

49

Arizona U., Tucson.

A DELTA-SIGMA MODULATION SYSTEM FOR TIME DELAY AND ANALOG FUNCTION STORAGE, by H. Handler and R. H. Mangels. Jan. 1964, 41p. (AFOSR-64-0392) (AF AFOSR-64-89) AD 434539 Unclassified

Modified delta modulation (delta sigma modulation) permits magnetostrictive delay line function storage of analog data with the significant advantages of pulse regeneration with clock gated logic and relatively inexpensive conversion equipment. Five to 10 msec delay lines with a 2 mc bit-rate accommodate analog signals of up to 8 kc with phase shift below 2 degrees; total dynamic error is within 0.2% of half scale up to 1 kc. An adaptive filter permits a further trade off of accuracy for bandwidth during computation. This paper describes the design of the delta-sigma modulation systems and presents test results.

50

Arizona U., Tucson.

A HYBRID ANALOG-DIGITAL PSEUDO-RANDOM NOISE GENERATOR, by R. L. T. Hampton. Jan. 1964, 45p. (AFOSR-64-0393) (AF AFOSR-64-89) AD 434556 Unclassified

The design of a hybrid analog-digital pseudo-random noise generator intended to replace conventional random-noise generators in analog and hybrid computer simulating is described. It is capable of producing four essentially uncorrelated binary outputs from a single 25-stage shiftregister. The length of the pseudo-random output sequence is 33, 554, 431 bits which is equivalent to several thousand computer runs.

51

Arizona U. Dept. of Physics, Tucson.

IMPERFECTIONS IN METALS, by C. T. Tomizuka. Final rept. Jan. 1, 1960-Dec. 31, 1962. Jan. 1, 1963, 13p. (AFOSR-4642) (AF 49(638)790) AD 408483 Unclassified

The progress of research conducted under this contract is summarized. This research is either under way or is now completed and includes (1) diffusion experiments in pure noble metals under hydrostatic pressure, (2) diffusion experiments as a function of temperature to obtain the activation energy, (3) internal friction measurements in α-brass type alloys, (4) tracer diffusion experiments in alloys, and (5) resistivity increase of quenched-in wires of noble metals under hydrostatic pressure to obtain the activation volume of a vacancy.

52

Arkansas U. Dept. of Chemistry, Fayetteville.

ELECTRODE POTENTIALS IN FUSED SYSTEMS. VIII. OXIDATION KINETICS OF SILVER IN SODIUM CHLORIDE, by K. H. Stern and W. E. Reid, Jr. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0369) (AF 49(638)653) AD 611923 Unclassified

Also published in Jour. Phys. Chem., v. 68: 3757-3764, Dec. 1964.

The oxidation rate of metallic silver in molten sodium chloride has been studied as a function of oxygen partial pressure and temperature (800-900°). The rate of appearance of silver ions was followed by an e.m.f. method. These ions are formed by: (A) the reaction of O_2 with silver and (B) the reaction $Ag + Na^+ = Ag^+ + Na$. The rate of (A) is a linear function of p_{O_2} in the range $0 < p_{O_2} \leq 1$ atm. For $p_{O_2} = 1$ at 870°, $r_A = 11.9 \times 10^{15}$, $r_B = 0.35 \times 10^{15}$ atoms cm^{-2} sec^{-1}. With increasing time $d[Ag^+]/dt$ decreases because of the reverse of reaction A—the formation of metallic silver from Ag^+ and O^{-2} ions—for which $r_A^{-1} = (r_A + r_B)/K_A p_{O_2}^{1/2}$, where K_A, the equilibrium constant for (A), is 8.3×10^{-7} on the mol fraction scale. The general differential equation for this system is derived and numerically integrated. It is concluded that the rate-determining step for (A) is the chemisorption of O_2, which is hindered by an adsorbed layer of chloride ions, and that for (B) charge transfer is rate-determining.

53

Arkansas U. Dept. of Physics, Fayetteville.

EXCITATION OF THE 2p LEVEL IN LITHIUM BY ELECTRON IMPACT, by R. H. Hughes and C. G. Hendrickson. [1964] [1]p. incl. diagr. table. (AFOSR-65-2880) (AF AFOSR-62-159) AD 628427 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 1494, Dec. 1964.

The excitation function for the 2p to 2s (wavelength = 6708A) line in the first spectrum of lithium was obtained by observing this radiation from the interaction region formed by a lithium-atom beam and a crossed electron beam.

54

Atlantic Research Corp., Alexandria, Va.

RESEARCH ON HIGH PRESSURE PLASMA PRODUCTION TECHNIQUES, by R. Friedman, L. W. Fagg and others. Final technical rept. Feb. 1964, 1v. (AFOSR-64-1291) (AF 49(638)651) AD 443153 Unclassified

The sections of this report are entitled: Historical Summary; Basis of Thermodynamic Calculations Performed; Solid propellant source of cesium plasma; Study of electron generation by solid propellant techniques; A novel chemical system for generation of electron-rich gases; and Spectrographic study of chemically generated cesium plasmas.

55

Atlantic Research Corp., Alexandria, Va.

THE KINETICS OF THE THERMAL, HYDROGEN-FLUORINE REACTION. I. MAGNESIUM REACTOR, by J. B. Levy and B. K. W. Copeland. [1963] [4]p. (AFOSR-64-0124) (AF 49(638)1131) AD 430673 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2156-2159, 1963.

The kinetics of the reaction of hydrogen and fluorine in gaseous mixtures diluted with nitrogen have been studied in a flow system at 110 in magnesium reaction vessels. The effects of reactant concentrations and surface area-to-volume ratio have been examined. Some possible reaction mechanisms are discussed.

56

Austrian Atomic Energy Study Group. Dept. of Physics, Seibersdorf.

[A ROTATING CRYSTAL SPECTROMETER WITH A MECHANICAL PRESELECTOR OF NEUTRON ENERGIES] Ein rotierendes Kristallspektrometer mit mechanischem Vorselektor der Neutronenenergie, by G. Quittner and C. Schittenhelm. [1963] [5]p. incl. diagrs. (AFOSR-J1100) (AF 61(052)638) AD 421750 Unclassified

Also published in Atompraxis . 9: 281-285, July 1963.

A rotating crystal spectrometer for inelastic scattering of thermal neutrons is described. A low energy of incoming neutrons, which is advantageous from the point of view of resolution, requires some means for removing higher-order neutrons. This is achieved by a mechanical rotor preselector; some data concerning it are given in the second part of the paper.

57

Austrian Atomic Energy Study Group. Dept. of Physics, Seibersdorf.

INTENSITY, BACKGROUND AND RESOLUTION WIDTH IN NUCLEAR COUNTING EXPERIMENTS, by G. Quittner. [1964] [7]p. incl. diagrs. (AFOSR-65-1371) (AF 61(052)638) AD 622670 Unclassified

Also published in Nuclear Instr. and Methods, v. 31: 61-67, 1964.

Some formulas ars ceveloped for the evaluation of nuclear counting experimsnts with regard to their statistical accuracy. Three types of measurements are considered: (1) simple counting, (2) location measurements, and (3) intensity distribution measurements. Finally, the relation of the statistical uncertainty to other sources of error is discussed briefly, leading to the matching principle. Examples are drawn mainly from the field of inelastic scattering of thermal neutrons.

58

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

CURRENT SPEED IN A MAGNETIC ANNULAR SHOCK TUBE, by J. Keck. May 1963, 32p. incl. illus. diagrs. refs. (Research rept. no. 152) (AFOSR-4910) (AF 49(638)659) AD 407294 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 3, Oct./Dec. 1963.

A paramstric study of the speeds of the current sheet and center-of-gravity of current in a magnetic annular shock tube has been completed. The parameters varied include: (1) the drive current, (2) the polarity of the inner electrodes, (3) the gas pressure, (4) the nature of the gas, (5) the radius of the inner electrode, and (6) the material of the inner electrode. The most interesting result of the investigation was the observation of limiting speeds for the current sheet and center-of-gravity of current of approximately 8 cm/mus and 3 cm/mus, respsctively. These spesds were not exceeded even under conditions where the magnetic prssure exceeded the dynamic pressure by a factor of 10. The most probable explanation of the limiting speed is that it is due to the inertial drag of material ablated from the insulator at the driver end of the shock tube.

59

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

MHD CHARACTERISTICS AND SHOCK WAVES, by A. R. Kantrowitz and H. E. Petschek. July 1964, 58p. incl. diagrs. refs. (Research rept. no. 185) (AF 49-(638)659) AD 603951 Unclassified

A review of the theory of MHD characteristics and shock waves is presented. Primary emphasis is placed on a physical discussion of the three characteristic modes and the jump conditions for the two types of shock waves which can exist. Brief discussions of shock structure, applications of the thsory, and ths rangs of applicability of the continuum equations ars also given. (Contractor's abstract)

60

Avco Corp. Avco-Everstt Research Lab., Everett, Mass.

USE OF GUARD RING SHIELDS ON NEGATIVELY BIASED LANGMUIR ION COLLECTION CURRENT PROBES, by G. S. Janes and J. P. Dotson. Apr. 1964, 6p. (AF 49(638)659) AD 600473 Unclassified

The note describes a shielded ion collection probe that provides a constant effective ion collection area. It is particularly useful when the plasma properties vary in time or space.

61

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

BASIC STUDIES IN MAGNETOHYDRODYNAMICS, by R. M. Patrick. Final rept. Nov. 1964, 10p. incl. diagrs. refs. (AFOSR-65-1207) (AF 49(638)1129) AD 622701 Unclassified

In this investigation, the magnetic annular shock tube (MAST) is developed and used to study plasma phenomena important for collision free plasmas. Studies are carried out to bring the MAST to a state of devslopment where it will become an established research tool. It is found that for a given shock velocity the shock tube must have a minimum length and that the plasma must be contained away from the walls of the tube, this being done by the use of magnetic fields. The annulus ratio and ablation are also important considerations in successful MAST operation. The plasma produced by the shock wave is collisionless in that the mean free path for ordinary collisions is large compared to the shock thickness. However, the importance of collisions in the shock front itself is not clear.

62

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

MAGNETOHYDRODYNAMIC SHOCK STRUCTURE IN A PARTIALLY IONIZED GAS, by E. T. Gerry, R. M. Patrick, and H. E. Petschek. June 1963, 19p. (Research rept. no. 153) (AF 49(638)1129) AD 414622 Unclassifisd

A study has been made of strong MHD shock waves in partially ionized hydrogen. Dissipation due to slip between the ions and neutrals with the effects of viscosity and heat conductivity have been included. Charge exchange processes control viscosity and ion slip. For Alfven Mach numbers below 2.5, the dominant mechanism is ion slip; for larger Mach numbers, the viscosity is important. The measured light intensity riss time and the electron tempsrature immediately behind ths shock agree with theory. Behind the shock, msasured electron temperatures are low. Elsctron temperatures

are obtained by measuring the plasma soft x-radiation using thin carbon foils as filters. (Contractor's abstract)

63

Avco Corp. Avco-Everett Research Lab., Everett, Mass.

THERMAL CONDUCTIVITY OF ARGON AT HIGH TEMPERATURES, by M. Camac and R. M. Feinberg. Mar. 1963, 50p. (Research rept. no. 168) (AF 49-(638)1129) AD 429757 Unclassified

The infrared heat transfer gauge was used for end wall measurements of the convective heat transfer from argon behind the reflected shock. The thermal conductivity of neutral (unionized) argon was measured before the ionization relaxation time, and could be fit with the temperature dependence T (0.76 ± .03) over the free stream temperature range from 20,000°K to 75,000°K, corresponding to incident shock velocities from 3 to 6 mm/micro-sec. At later times, after the free stream established equilibrium ionization, the convective heat transfer rate remained the same as the initial neutral argon rate. Theoretical predictions of Fay and Kemp, assuming equilibrium boundary layer conditions, are 20 to 30% below the experimental values. Also reported in this paper are measurements of the ionization times behind the reflected shock, and these are in agreement with an extrapolation of the Petschek and Byron measurements behind the incident shock.

64

Avco Corp. Research and Advanced Development Div., Wilmington, Mass.

EMITTANCE MEASUREMENTS OF SOLIDS ABOVE 2000 DEG C, by T. S. Laszlo, R. E. Gannon, and P. J. Sheehan. [1964] [7]p. incl. illus. diagrs. refs. (AFOSR-65-0164) (AF 49(638)1166) AD 611945 Unclassified

Presented at Symposium on Thermal Radiation of Solids, San Francisco, Calif., Mar. 4-6, 1964.

Also published in Solar Energy, v. 8: 105-111, Oct.-Dec. 1964.

A method of measuring the emittance of solids above 2000°C through the use of a solar furnace has been developed. Two techniques involving specialized instrumentation for performing the necessary measurements were investigated. Initial experiments showed that both techniques were suitable and that the specified instruments were adaptable for making the required measurements. (Contractor's abstract)

65

Battelle Memorial Inst., Columbus, Ohio.

HIGH-PRESSURE SYNTHESIS OF MOLYBDATES WITH THE WOLFRAMITE STRUCTURE, by A. P. Young and C. M. Schwartz. [1963] 2p. (AFOSR-J1607) (AF 49(638)441) AD 427643 Unclassified

Also published in Science, v. 141: 348-349, July 26, 1963.

A series of small cation molybdates, with the wolframite structure characteristic of the corresponding tungstates have been synthesized at high pressure and temperature. The high-pressure compounds revert to the ambient pressure modifications if heated in air at 600°C. (Contractor's abstract)

66

Battelle Memorial Inst., Columbus, Ohio.

ON THE HIGH-PRESSURE FORM OF $FeVO_4$, by F. Laves, A. P. Young, and C. M. Schwartz. [1964] [2]p. incl. table. (AFOSR-65-0766) (AF 49(638)441) AD 617211 Unclassified

Also published in Acta Cryst., v. 17: 1476-1477, Nov. 1964.

In this note evidence is presented that the atomic arrangement of high-pressure $FeVO_4$ is similar to that of ambient-pressure $FeNbO_4$. Evidence is presented in the form of comparing the indexing of high-pressure $FeVO_4$ and the disordered wolframite $FeNbO_4$, which indicates that $FeVO_4$ crystallizes in the disordered wolframite type and that therefore vanadium would have also in $FeVO_4$ the coordination number 6. The similar structure of the two compounds offers an example of a high-pressure oxide with the same type of structure as an ambient-pressure oxide.

67

Battelle Memorial Inst., Columbus, Ohio.

THE ORIGIN OF DISLOCATIONS DURING CRYSTAL GROWTH, by N. Albon. [1963] 7p. incl. diagr. refs. (AFOSR-J1137) (AF 49(638)959) AD 421166 Unclassified

Also published in Philos. Mag., v. 8: 1335-1341, Aug. 1963.

A mechanism is described requiring contact between stepped crystal faces which can lead to the formation of dislocations during crystal growth. The initiation of dislocations during both nucleation and growth is explained. Conditions under which the proposed mechanism and others previously suggested are significant are discussed qualitatively in relation to relevant experimental observations. (Contractor's abstract)

68

Battelle Memorial Inst., Columbus, Ohio.

INVESTIGATION OF ZINC BLENDE TYPE SEMICONDUCTORS, by A. C. Beer. Oct. 25, 1963, 19p. (AFOSR-J1352) (AF 49(638)959) AD 428335 Unclassified

The accomplishments are presented under 3 broad categories, namely: (1) Research concerned with InSb, which involves transport effects, high pressure phase transitions, and studies of the kinetics of crystal growth and related phenomena; (2) Studies of impurity behavior in GaSb, which have shed light on the nature of the residual acceptors present in material prepared under conditions conducive to achievement of highest purity; and (3) Transport studies in GaSb, which have revealed the importance of impurity states associated with subsidiary conduction band minima. Implications of the findings in these areas are discussed, and suggestions for further work are given in certain instances. (Contractor's abstract)

69

Battelle Memorial Inst., Columbus, Ohio.

DIFFUSION IN SOLIDS, by A. E. Austin and F. J. Milford. Final rept. July 1, 1961 - Dec. 31, 1962. Jan. 17, 1963, 3p. (AFOSR-4401) (AF AFOSR-61-107) AD 295930 Unclassified

Previous investigations studied the diffusion of nickel into copper bicrystals, while the present experiments have been concerned with the diffusion of gold into copper bicrystals. The theoretical solutions and approximations were evaluated mathematically and the results used for the analysis of the experimental data. The case of surface diffusion in metal systems is comparable to that of grain-boundary diffusion in that both involve concomitant volume diffusion. Therefore experimental and theoretical studies of surface diffusion were initiated as an extension of those on grain-boundary diffusion. (Contractor's abstract)

70

Battelle Memorial Inst., Columbus, Ohio.

NOTE ON THE EVALUATION OF SOME FERMI INTEGRALS, by M. L. Glasser. [1964] 3p. (AFOSR-64-2347) (AF AFOSR-63-260) AD 452291 Unclassified

Also published in Jour. Math. Phys., v. 5: 1150-1152, Aug. 1964.

Integrals of the form which involves the Fermi energy are frequently encountered in the study of thermal and magnetic properties of metals. A standard method for estimating these integrals is to make the change of the variable and replace the lower limit of the transformed integral by negative infinity. The integration can then be performed by closing the contour in the upper half-plane. In this note a method is outlined by which

asymptotic expansions can be obtained if the given function involves roots or logarithms of E and the integrals evaluated explicitly if this is not the case. The procedure is illustrated for several integrals selected from the literature.

71

Battelle Memorial Inst., Columbus, Ohio.

SUMMATION OVER FEYNMAN HISTORIES: CHARGED PARTICLE IN A UNIFORM MAGNETIC FIELD, by M. L. Glasser. [1964] 4p. (AFOSR-64-1781) (AF AFOSR-63-262) AD 449094 Unclassified

Also published in Phys. Rev., v. 133: B831-B834, Feb. 10, 1964.

Using a particular parametrization of paths, the nonrelativistic propagator for a charged particle in a uniform magnetic field is derived by the Feynman method of summation over histories. It is shown that this sum is independent of the parameterization as long as the classical path is included. The result is used to obtain the density matrix for the systems. (Contractor's abstract)

72

Bege, J. R. M. Jo., Arlington, Mass.

THE CATENARY IN SPACE: FREE MOTIONS OF FLEXIBLE LINES, by R. M. Langer. Final scientific rept. Dec. 1964, 90p. incl. illus. (Rept. no. 6454) (AFOSR-64-2517) (AF 49(638)1327) AD 611429 Unclassified

The nature and importance of the catenary in space (flexible systems in one dimension) are discussed. Equations of motion are developed in more complete and universal form than in the literature. The catenary is described by means of a system of four, first-order, quasi-linear, hyperbolic, partial differential equations. The special circumstances are treated where the first order system reduces to a standard second order wave equation familiar in the literature. The four characteristics of the hyperbolic system are found and also the vectors which help formulate combination variables suitable for the catenary problem. Some special solutions are presented for interesting catenary motions. A general treatment is formulated in terms of integral equations for the full catenary problem of planar motion with two independent variables and four dependent catenary parameters. Extensions to other novel problems are indicated. (Contractor's abstract)

73

Bell Aerosystems Co., Buffalo, N. Y.

ANALYSIS OF TRAINING ALGORITHMS FOR A CLASS OF SELF-ORGANIZING SYSTEMS, by J. Goerner and L. Gerhardt. [1964] 6p. incl. diagrs. table. (AFOSR-64-2538) (AF 49(638)144) AD 453790 Unclassified

Presented at Third Symposium on Discrete Adaptive Processes, Nat'l. Electronics Conf., Chicago, Ill., Oct. 20-21, 1964.

In this paper, the n-dimensional vector approach is extended and used to analyze basic types of training algorithms. Certainly an n-dimensional space can not be directly visualized, but n-dimensional vectors and hyperplanes can at least be symbolized in a 3-dimensional space. It is shown how this geometric tool allows quasi visualization of the network training rules. At the same time, without the use of elaborate mathematics, this method of analysis can be used to determine the strength and weaknesses of the training algorithms and the effect of memory element saturation and imperfections.

74

Birmingham U. [Dept. of Chemistry] (Gt. Brit.).

STRUCTURAL STUDIES OF LINEAR MOLECULES BY MICROWAVE SPECTROSCOPY, by J. K. Tyler and J. Sheridan. Feb. 1963, 19p. (AFOSR-4822) (AF 61(052)241) AD 409439 Unclassified

Rotational constants were measured for several isotopic forms of fluorine cyanide and fluoroacetylene. Accurate bond-distances were computed for all the halogen cyanides and for fluoro- and chloracetylene, by the method of isotopic substitution at all atoms (except F and I). The CF bonds in these compounds are the shortest yet found. The CN distance is virtually constant at 1.159 A. The nuclear quadrupole coupling constant for N^{14} in fluorine cyanide, -2.67 mc/s, is the lowest yet measured for a cyanide grouping. The dipole moments of fluorine cyanide and fluoroacetylene, from Stark effects, are 2.17 D and 0.75 D respectively. Rotation spectra of molecules in excited bending vibrational states were analyzed for fluorine cyanide, fluoroacetylene and cyanoacetylene. (Contractor's abstract)

75

Birmingham U. [Dept. of Chemistry] (Gt. Brit.).

MICROWAVE SPECTROSCOPIC STUDIES OF MOLECULES, by J. Sheridan. July 18, 1963, 9p. (AFOSR-5270) (AF EOAR-62-1) AD 417348 Unclassified

A summary is given of the progress of microwave spectroscopic studies of the properties of several molecules in the period Jan. 1, 1962 to Dec. 31, 1962. Approximately 180 absorption lines were measured for acetyl acetylene, fifty of which were assigned to give accurate rotational constants. A preliminary analysis was made of the splittings due to internal rotation of the methyl group. Work was begun on deuterated species of this substance. Preliminary values of the a- and b-components of the dipole moment were obtained. About 100 lines were measured

for trifluoroethylene, and work on a tentative assignment was begun. Preliminary work on the linear molecules iodo-cyanoacetylene and bromo-cyanoacetylene was also initiated in the period covered. (Contractor's abstract)

76

Bolt, Beranek and Newman, Inc., Cambridge, Mass.

TRANSMISSION AND CODING OF INFORMATION IN AUDITORY NERVOUS SYSTEM. Final rept. Jan. 8, 1962 - Feb. 14, 1964. Feb. 14, 1964, 57p. incl. illus. diagrs. tables, refs. (AFOSR-64-0966) (AF 49(638)1142) AD 600222 Unclassified

Research conducted on the electrophysiological aspects of the auditory nervous system, the neural activity during learning, and the different stages of alertness during sleep is outlined. Summaries are presented for the following research studies: (1) Long Duration Auditory Evoked Potentials in Man During Sleep, (2) The Effects of Midbrain Lesions on Cortical Responses to Acoustic Stimuli, (3) Differences in the Functions of the Two Cerebral Hemispheres, (4) The Use of Anatomical and Pbysiological Evidence in Tbeory Construction, and (5) Temporal Pattern Discrimination in Lower Animals and Its Relation to Language Perception in Man.

77

Bolt, Beranek and Newman, Inc., Cambridge, Mass.

EXPERIMENTAL PROCEDURES AFFECTING EVOKED RESPONSES RECORDED FROM AUDITORY CORTEX, by G. M. Gerken and W. D. Neff. [1963] 11p. incl. diagrs. tables. (AFOSR-64-1161) (AF 49(638)1142) AD 442798 Unclassified

Also publisbed in Electroencephalog. and Clin. Neurophysiol. Jour., v. 15: 947-957, 1963.

Four pairs of surface to deep-cortex electrodes were implanted in auditory cortex in each of 6 cats. Electrocorticographic recordings were taken from the electrodes before, during, and after all presentations of 2 types of acoustic stimuli: a 4-sec train of clicks at 4000/sec used as the conditioned stimulus (CS) during conditioning, and a single click used as a test signal. The response evoked from auditory cortex of the unanesthetized preparation by an acoustic stimulus of abrupt onset is composed of a series of potential changes. The cortical responses evoked by the CS and by the single click were similar in form and magnitude. Systematic changes in the evoked response were observed during the preconditioning sessions. Increases in the evoked response occurred during the pseudo-conditioning sessions. During conditioning, changes in behavior preceded changes in the evoked response. (Contractor's abstract in part)

78

Boston U. [Dept. of Mathematics] Mass.

EFFICIENCY OF THE WILCOXON TWO-SAMPLE STATISTIC FOR RANDOMIZED BLOCKS, by G. E. Noether. [1963] 6p. incl. table. (AFOSR-4811) (AF AFOSR-61-78) AD 436485 Unclassified

Also published in Jour. Amer. Stat. Soc., v. 58: 894-898, Dec. 1963.

A measure is suggested of the efficiency of a randomized block design for the comparison of 2 treatments by means of a Wilcoxon-type analysis. It is shown how the efficiency can be estimated from data of a randomized block design. (Contractor's abstract)

79

Boston U. [Dept. of Mathematics] Mass.

NOTE ON THE KOLMOGOROV STATISTIC IN THE DISCRETE CASE, by G. E. Noether. [1963] 2p. (AFOSR-J1530) (AF AFOSR-62-369) AD 427513 Unclassified

Also published in Zeitschr. Tbeoretiscbe und Angew. Stat., v. 7: 115-116, 1963.

A simple demonstration of the conservative character of the Kolmogorov test in the case of discrete distributions is given. (Contractor's abstract)

80

Boston U. [Dept. of Pbysics] Mass.

WIENER-HERMITE FUNCTIONAL EXPANSION IN TURBULENCE WITH THE BURGERS MODEL, by A. Siegel, T. Imamura, and W. C. Meecham. 1963, 8p. (AFOSR-4750) (AF AFOSR-62-177) AD 408480 Unclassified

A method is presented which exploits the nearness to Gaussianity of velocity probability distributions in turbulence, by expanding the velocity field function about the Gaussian approximation. Many of the mathematical manifestations of the method are such, that it is hard to obtain physical insight into tbem. Hence, a pilot project of a simplified nature is undertaken which uses instead of the Navier-Stokes or MHD equations the Burgers one-dimensional model equation. (Contractor's abstract)

81

Boston U. [Dept. of Physics] Mass.

WIENER-HERMITE EXPANSION IN MODEL TURBULENCE AT LARGE REYNOLDS NUMBERS, by W. C. Meecham and A. Siegel. [1964] 13p. (AFOSR-65-0093) (AF AFOSR-62-177) AD 455784 Unclassified

Also published in Phys. Fluids, v. 7: 1178-1190, Aug. 1964.

A Wiener-Hermite functional expansion is used to treat a random initial value process involving the Burgers model equation. The nonlinear model equation has many of the characteristics of the Navier-Stokes equation. It is found that the functional expansion converges better the larger the separation variable in the correlation function (the nearer to joint normal is the distribution). To the present order, the treatment is similar to a quasinormal assumption. The computations show that the correlation function quickly approaches an equilibrium form for quite different initial values. The power spectrum function approaches an equilibrium form also, where it falls off like the inverse second power of the wavenumber. (Contractor's abstract)

82

Boston U. [Dept. of Physics] Mass.

ANALYTICITY AND PHASE RETRIEVAL, by P. Roman and A. S. Marathay. [1963] 13p. (AFOSR-64-1013) (AF AFOSR-62-248) AD 441058 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1452-1464, Dec. 16, 1963.

The general problem of constructing a spectrum from the knowledge of the magnitude of its Fourier transform is considered. The question reduces to locating the zeros of the analytic continuation in the upper half-plane. It is shown that if the spectrum is real, the continuation of the complex zeroes in the u. h. p. either are on the imaginary axis or occur pairwise in a symmetrical position. If, in addition, the spectrum is equal to or less than zero, the zeros on the imaginary axis disappear. This condition also leads to the requirement that the continuation must be representable as a convolution of a function with itself. The analytic properties of this function and the equations to determine it are discussed. Possible ways to obtain the solution of the ensuing nonlinear eigenvalue problem are suggested. (Contractor's abstract)

83

Boston U. [Dept. of Physics] Mass.

A REMARKABLE CONNECTION BETWEEN KEMMER ALGEBRAS AND UNITARY GROUPS, by P. Roman. [1963] 7p. (AFOSR-64-1770) (AF AFOSR-63-385) AD 449266 Unclassifled

Also published in Jour. Math. Phys., v. 5: 777-782, June 1964.

One example of a connection between a particle algebra and a semisimple Lie group is long known: the Dirac algebra generated by n elements furnishes the elementary spinor representation of the orthogonal group in n dimensions. This paper demonstrates a new kind of such a connection. It is shown that there exists a unique connection between the Kemmer algebra generated by n elements and the unitary group in a space of n + 1 dimensions. (Contractor's abstract)

84

Boston U. [Dept. of Physics] Mass.

A NEW PHENOMENOLOGICAL SUPERMULTIPLET STRUCTURE OF ELEMENTARY PARTICLES, by P. Roman. [1964] 10p. (AFOSR-64-2341) (AF AFOSR-63-385) AD 451927 Unclassified

Also published in Nuclear Phys., v. 57: 55-64, 1964.

Grouping together the known strongly interacting particles and resonances according to their spin value J and disregarding isospin, a simple two-parameter linear mass formula is found. One parameter characterizes each entire supermultiplet, the other varies from subset to subset. This second quantum number, together with isospin T, defines the hypercharge U and a new quantum number V, such that when taking also parity into account no degeneracy is left in the scheme. The mass formula is refined to incorporate isospin. A possible group theoretical background is suggested, which is based on the group U4. The symmetry breaking terms are discussed on general grounds. The possibility of incorporating electromagnetic and weak interactions is indicated. (Contractor's abstract)

85

Boston U. [Dept. of Physics] Mass.

THE ANGULAR DISTRIBUTION OF DELBRUCK SCATTERING, by J. C. Herrera and P. Roman. [1964] 10p. (AFOSR-65-0140) (AF AFOSR-63-385) AD 455634 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1657-1666, Sept. 16, 1964.

The gauge-invariant effective Lagrangian is quantized and is used to form a transition matrix which then permits the application of standard covariant calculational tools of quantum electrodynamics for the low-energy range of vacuum polarization phenomena. The new technique is applied to the calculation of the differential cross-section, for arbitrary directions, of Delbruck scattering. The result is exact in the low-energy limit. (Contractor's abstract)

86

Boston U. Dept. of Physics, Mass.

SPECTRAL FUNCTIONS AND LAGRANGIAN THEORIES, by W. S. Hellman and P. Roman. [1964] [2]p. (AFOSR-65-0822) (AF AFOSR-63-385) AD 616205 Unclassified

Also published in Phys. Ltrs., v. 13: 336-337, Dec. 15, 1964.

In recent investigations concerning restrictions placed on Lagrangian field theories, the positive definiteness of the spectral weight function was found to be crucial for the results obtained. This note indicates that the requirement of positive definiteness might be too strong. A model is considered of nucleons and pions with pseudo-scalar coupling and with the bare pion mass (μ_0) set equal to 0. The ensuing discussion implies that the condition of non-negativeness on the spectral weight function is too strong for local Lagrangian theories.

87

Boston U. Dept. of Physics, Mass.

CONCERNING SPACE-TIME AND SYMMETRY GROUPS, by M. E. Mayer, M. Y. Han and others. [1964] [5]p. (AFOSR-65-0823) (AF AFOSR-63-385) AD 616206 Unclassified

Also published in Phys. Rev., v. 136: B668-B692, Nov. 9, 1964.

Several theorems are proved which exhibit the impossibility of constructing nontrivial products of the Lorentz group with internal symmetry groups for some physically interesting examples. It is also shown that if the Lorentz group is replaced by the Galilei group, qualitatively different results are obtained; a "linear" breakdown of internal symmetry is possible.

68

Boston U. Dept. of Physics, Mass.

A THEOREM ON THE ZEROS OF CAUSAL TRANSFORMS, by A. S. Marathay and P. Roman. [1964] [2]p. (AFOSR-65-1754) (AF AFOSR-63-385) AD 625557 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1821-1822, Dec. 1, 1964.

A theorem is established which relates the zeros of causal transforms belonging to the folded spectra $g'(\mu) = g(2\nu_0 - \nu)$. For the case that the Fourier transform $\gamma(\tau)$ can be analytically continued into the complex τ-plane, the theorem states: If γ has a zero at $\tau = \tau_n$, then the Fourier transform of $g'(\nu)$, γ', will have a zero at the origo-reflected position $\tau' = \tau_n$. A corollary follows: If $g(\nu)$ is a real, non-negative causal function with a cut-off, and if it has a symmetric shape about some frequency ν_0, then the zeros of $\gamma(\tau)$ are symmetric in the complete τ-plane with respect to both the imaginary and real axis.

89

Brandeis U. [Dept. of Biochemistry] Waltham, Mass.

EVOLUTION OF LACTIC DEHYDROGENASES, by A. C. Wilson, N. O. Kaplan and others. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-1512) (AF AFOSR-63-214) AD 623493 Unclassified

Also published in Fed. Proc., v. 23: 1256-1266, Nov.-Dec. 1964.

Twenty-five lactic dehydrogenases were purified and crystallized from various species. Several methods were used to compare the structures of these enzymes, including determinations of molecular wt, amino acid composition, and fingerprint pattern. Lactic dehydrogenases in crude extracts of many other species were investigated by measurements of temperature stability, electrophoretic mobility, and catalytic activity with coenzyme analogs. The quantitative microcomplement fixation method was used to compare the structures of hemoglobins and of several other proteins. The method is more sensitive to differences in protein structure than are conventional, quantitative immunological methods. Single amino acid differences among hemoglobins are easily detected by this method. The method also provides an approximate measure of the degree of structural resemblance between various hemoglobins of known sequence. Microcomplement fixation was used to examine the rates of protein evolution. The proteins studied were H_4 and M_4 lactic dehydrogenases, triose phosphate dehydrogenase, glutamic dehydrogenase, aldolase, and hemoglobin. The results suggest that, in a given species, all these proteins tend to change in immunological structure at similar rates.

90

Brandeis U. [Dept of Physics] Waltham, Mass.

[TOPICS IN CLASSICAL AND QUANTUM AND MANY-BODY THEORY], by E. P. Gross. Final interim rept. Jan. 1963. 4p. (AFOSR-4456) (AF 49(636)27) AD 295833 Unclassified

Research concerns quantum theory of the many body problem with particular application to liquid helium, the interaction of nonrelativistic particles and quantum fields, and classical kinetic theory of gases. Of particular concern is liquid helium because it is one of the simplest many body systems and yet has an incredible richness of behavior. It may in time become the best understood many body system and serve as a prototype for other studies. The pattern of investigation is (1) an understanding of the qualitatively distinct possible ground states for a system of interacting bosons (gas, liquid, solid, etc.); (2) characterization of the possible excitations, i.e., phonon-roton spectrum, shear waves, vortices; (3) analysis of the effects of probes, i.e., x-rays, inelastic scattering of neutrons, foreign atom and ion behavior, etc.; (4) statistical thermodynamics; and (5) kinetics of interactions of excitations and the microscopic derivation of two fluid hydrodynamics.

91

Brandeis U. [Dept. of Physics] Waltham, Mass.

INTERACTION BETWEEN GAUGE VECTOR FIELDS, by R. Arnowitt and S. Deser. [1963] 11p. (AFOSR-64-0557) (AF AFOSR-63-366) AD 434311 Unclassified

Also published in Nuclear Phys., v. 49: 133-143, 1963.

The interaction between massless vector fields possesses gauge invariance of the second kind and the Maxwell field is considered. A discussion is given of the special properties of gauge fields and of the definition of minimal electromagnetic coupling. The inconsistency of minimal coupling for the systems in question is reviewed. It is shown that while a particular non-minimal coupling is consistent for the fields in question, even the latter becomes inconsistent in the presence of other known charged fields. Thus such fields as that of Yang-Mills or the baryon gauge field cannot charge unless all other charged fields in nature also form appropriate multiplets. (Contractor's abstract)

92

Brandeis U. [Dept. of Physics] Waltham, Mass.

EXTERNAL SOURCES IN GAUGE THEORIES, by D. G. Boulware and S. Deser. [1963] 11p. (AFOSR-64-0794) (AF AFOSR-63-366) AD 436370 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1009-1019, Nov. 16, 1963.

The notion of prescribed external sources is discussed for gauge fields. Such sources necessarily obey conservation laws which generally involve the fields themselves. The implications of these conservation requirements are analyzed for classical and quantized vector multiplets and for general relativity. A number of the vector source components may be prescribed independent of the field. The nonlocal components cannot be eliminated from the theory by a choice of coordinate frame and it is concluded that external gravitational sources are not useful in analyzing the fields properties. (Contractor's abstract)

93

Brandeis U. [Dept. of Physics] Waltham, Mass.

AMBIGUITY OF HARMONIC-OSCILLATOR COMMUTATION RELATIONS, by D. G. Boulware and S. Deser. [1963] 5p. (AFOSR-64-0795) (AF AFOSR-63-368) AD 438371 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 230-234, Oct. 16, 1963.

The possibility, first noticed by Wigner, that the form of the Hamiltonian together with the Heisenberg equations do not imply canonical commutation relations for the harmonic oscillator variables, is reexamined here. It is shown that this freedom of commutation relations just expresses the known possibility of quantizing the system by Bose or Fermi (and para-Fermi) statistics, and altering the zero-point energy. (Contractor's abstract)

94

Brandeis U. [Dept. of Physics] Waltham, Mass.

SPONTANEOUS SYMMETRY BREAKDOWN IN [illegible] ELECTRODYNAMICS, by R. Arnowitt and S. Deser. [1964] [3]p. (AFOSR-65-0818) (AF AFOSR-63-368) AD 617239 Unclassified

Also published in Phys. Ltrs., v. 13: 256-258, Dec. 1, 1964.

This note examines the possibility of spontaneous symmetry breakdowns in the electrodynamics of 2 originally identical charged fields with minimal coupling. The analysis provides a simple example of an internal symmetry, SU(2), for which 3 possibilities arise: (1) no spontaneous breakdowns occur and the vacuum state possesses full SU(2) invariance; (2) a partial breakdown occurs which will be seen to produce a mass splitting out of $\mu \rightarrow e + \gamma$ decay; and (3) full SU(2) breakdown occurs which will result, in general, in allowed $\mu \rightarrow e + \gamma$ decay as well as a mass splitting. Only minimal gauge invariant interactions are involved, and hence divergencies and cut off problems are avoided.

95

British Columbia U. Dept. of Chemistry, Vancouver (Canada).

REACTIONS OF $O_2(^1\Delta_g)$ AND $O_2(^1\Sigma_g^+)$, by L. W. Bader and E. A. Ogryzlo. Jan. 14, 1964, 11p. incl. diagrs. refs. (AFOSR-64-2431) (AF AFOSR-63-158) AD 453781 Unclassified

Also published in Discussions Faraday Soc., No. 37: 46-56, Jan. 1964.

A method of obtaining measurable concentrations of excited oxygen for kinetic studies has been developed, and a number of reactions of these excited molecules are described. Evidence is presented for simultaneous electronic transitions in a weakly bound complex between two $O_2(^1\Delta_g)$ molecules resulting in emission bands at 6340 and 7030A. The phenomenon is discussed in terms of the association theory of gases.

96

British Columbia U. Dept. of Chemistry, Vancouver (Canada).

HALOGEN-ATOM REACTIONS. II. LUMINESCENCE

FROM THE RECOMBINATION OF CHLORINE ATOMS, by L. W. Bader and E. A. Ogryzlo. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0380) (AF AFOSR-63-158) AD 611900 Unclassifled

Also publlshed in Jour. Chem. Phys., v. 41: 2926-2930, Nov. 1, 1964.

A spectroscopic study of an orange-red glow from the products of electrlcal discharge in chlorine has resulted in an identification of the emitter as $Cl_2(A^3\Pi_{0u}^+)$. A kinetic study has provided evidence for the formation of excited molecules in this state by the preassociation of $^2P_{3/2}$ chlorine atoms. Several detailed mechanisms for the reactlon are discussed.

97

British Columbia U. [Dept. of Mathematics] Vancouver (Canda).

THE CURRENT THEORY OF ANALYTIC SETS, by D. W. Bressler and M. Sion. [1964] [24]p. incl. refs. (AFOSR-4810) (AF AFOSR-62-261) AD 441468 Unclassifled

Also published in Canad. Jour. Math., v. 16: 207-230, 1964.

In th's paper the outlines of the theory of analytic s:t's are described from the point of vlew of recent work on the subject. The emphasis ls on a general topological setting. Three Borel families, the family of Sousl sets, and the family of analytic sets are introduced and relations between these families are discussed. Approximatlon theorems and miscellaneous results are given. Perhaps the best known of recent results ls Choquet's theorem in potential theory about the capacitablllty of analytlc sets. Choquet's theorem is concerned wlth approximatlon from below. In many problems involving approximation from below the natural family to consider ls that of analytlc sets, not some Borel family.

98

British Columbia U. [Dept. of Mathematics] Vancouver (Canada).

A CHARACTERIZATION OF WEAK CONVERGENCE, by M. Sion. [1964] 15p. (AFOSR-65-0355) (AF AFOSR-62-261) AD 632590 Unclassified

Also published in Pacific Jour. Math., v. 14: 1059-1067, 1964.

For X a locally compact, Hausdorff space and $\{\mu_i; i \in D\}$ a net of Radon measures on X, the weak* limit of thls net is the Radon measure ν such that $\lim_i \int f d\mu_i = \int f d_\nu$ for every continuous function f vanishing outside some compact set. A Radon measure φ^* is constructed from a glven base B for the topology of X and $\lim\inf_i \mu_i$. φ^* is obtained from another measure φ by a standard regularlzing process. A condition is glven for $\varphi = \varphi^*$, that is, for a measure constructed through an abstract process from the μ_i to be, in the topological situation, the weak* limit of the μ_i. An example ls glven to show thls condition cannot be ellminated.

99

Brltlsh Columbia U. Dept. of Physics, Vancouver (Canada).

BIPOLAR THEORY OF METAL-SEMICONDUCTOR CONTACTS UNDER ARBITRARY INJECTION LEVELS, by R. E. Horita and R. E. Burgess. Mar. 27, 1963, 12p. (AFOSR-64-0259) (AF AFOSR-61-91) AD 432526 Unclassified

Also published in Canad Jour. Phys., v. 41: 1010-1021, July 1963.

Metal-semlconductor contacts have been known empirically to obey a modifled diode equation $I = Is (\exp qV/akT - 1)$, where the parameter a often took values greater than theoretical limit of two. Previous theories could not slmply account for this anomaly. The model presented in this paper considers one-dimensional bipolar flow of carrlers with zero recombination in a homogeneous semiconductor filament with a rectifying and an ohmic contact at opposite ends. The zero-electron-current theory by Borneman et al valid for low injection levels, is extended to arbitrary injection levels by the use of the Mlsawa junctlon relations. Then the nonzero-electron-current theory is developed. This theory shows that a ls unity for low injection into extrinslc semiconductors and that a = (3b·M-/(b-M) for arbitrary injectlon into intrinslc semiconductors and for high extrinsic semiconductors; M ls the electron-to-hole current ratio and b is the electron-to-hole mobility ratio. Thus a can take any value depending on the magnitude of M/b.

100

Britlsh Columbia U. Dept. of Physics, Vancouver (Canada).

DIRECT TUNNEL-CURRENT NOISE IN TUNNEL DIODES FOR SMALL BIASES, by B. E. Turner and R. E. Burgess. [1964] [12]p. incl. diagrs. (AFOSR-66-1595) (AF AFOSR-61-91) AD 640281 Unclassified

Also publlshed in Canad. Jour. Phys., v. 42: 1046-1057, June 1964.

The Esaki theory describing the current components arising from direct interband tunneling in tunnel diodes has previously been used to predict a relation between the noise spectrum of direct-tunneling currents and the p-n junction voltage (Pucel 1961). In this paper is presented experimental confirmation of this relation which provides a sensitive test of the Esaki formulation for tunneling currents and indicates as well, that the noise spectrum is lndependent of the

band structure of the semiconductor and that the two oppositely flowing tunnel currents are uncorrelated. These facts form a basis for examining the extent to which the Esaki formulation can be generalized and the relation independent of band structure, between the direct tunnel-current noise spectrum and the applied junction voltage.

101

British Columbia U. [Dept. of Physics] Vancouver (Canada).

PHYSICAL PROCESSES AND FLUCTUATIONS IN SEMICONDUCTOR SYSTEMS DISPLAYING NEGATIVE RESISTANCE, by R. E. Burgess. Annual rept. Jan. 1, 1962 - Mar. 31, 1963. 5p. (AF AFOSR-61-91) AD 402271 Unclassified

The research was devoted to the following topics which are discussed in detail: (1) the negative resistance in semiconductors arising from thermal mechanisms and the associated electrical fluctuations, and (2) fluctuations of temperature and heat flow in conductors in macroscopic equilibrium and their relation to the thermal fluctuations of electromagnetic field in a solid plasma. These items were the subjects of theoretical investigations while the experimental studies so far were used to determine the validity of the linear models used in the analytical work.

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Brown U. [Dept of Physics] Providence, R. I.

[RESEARCH ON ELECTRONIC PROPERTIES OF METALS], by R. W. Morse. Final rept. 1963, 1v. incl. refs. (AFOSR-J1620) (AF 49(638)6) AD 429766 Unclassified

This document contains reprints on the following subjects: Ultrasonics in metals at very low temperatures, Interaction of acoustical waves and electrons, Magnetoacoustic effect, Fermi surfaces of gold and silver from ultrasonic attenuation, and Some ultrasonic measurements in normal and superconducting aluminum.

103

Brown U. [Dept. of Physics] Providence, R. I.

STUDY OF THE ATTENUATION OF ULTRASONIC SHEAR WAVES IN SUPERCONDUCTING ALUMINUM, by L. T. Claiborne, Jr. and R. W. Morse. [1964] [13]p. incl. diagrs. table, refs. (AFOSR-65-0784) (AF AFOSR-63-267) AD 616203 Unclassified

Also published in Phys. Rev., v. 136: A893-A905, Nov. 16, 1964.

This article reports and interprets experiments which were conducted to determine the temperature dependence of shear-wave attenuation in superconducting aluminum. Some of the main results are: (1) In contrast to the longitudinal-wave attenuation, the experiments showed a strong frequency dependence of the reduced attenuation (α_s/α_n) as a function of temperature; (2) The temperature variation of (α_s/α_n) could be separated into two parts: (a) a very sharp decrease with temperature very close to the transition temperature and (b) a residual attenuation having a temperature dependence similar to that for longitudinal waves: (3) A theoretical formulation was made which used approximations expected to be valid near the transition temperature. This theory employed a self-consistent treatment of the electron-impurity collisions and qualitatively reproduced the features of the experimental data; (4) It was found that the specific details of the data could be predicted by this theory when the function $2f(\epsilon)$ was used for the normal electron density; and (5) In particular the residual attenuation was shown to be $g[2f(\epsilon)]$, and the width of the region of rapid-falling attenuation was shown to be determined by $\omega\tau$.

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Brown U. Div. of Applied Mathematics, Providence, R. I.

APPLICATIONS OF LIAPUNOV STABILITY THEORY TO CONTROL SYSTEMS, by J. P. LaSalle. [1964] [15]p. incl. refs. (AFOSR-66-2609) (AF AFOSR-64-693) AD 643428 Unclassified

Also published in Proc. IBM Scientific Computing Symposium, Control Theory Applications, Thomas J. Watson Research Center, Yorktown Heights, N. Y., Oct. 19-21, 1964, p. 61-75.

The application of Liapunov theorems to autonomous (stationary) systems along with a few simple examples is discussed. The Liapunov theory for autonomous systems is today quite complete and all major theorems on stability and instability of Liapunov type can be obtained from two basic theorems presented. It is pointed out why the study of stability of nonautonomous (time-varying) systems is difficult. Indications are given that improved methods can be devised for analyzing the stability of non-autonomous systems. Recent results on the stability of functional differential equations and stochastic differential equations are also described.

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Brown U. Div. of Engineering, Providence, R. I.

A GENERAL SOLUTION OF THE HOPF CHARACTERISTIC FUNCTIONAL EQUATION FOR TURBULENCE, by I. Hosokawa. May 1964 [17]p. (Technical rept. no. WT-39) (AFOSR-64-1113) (AF 49(638)1295) AD 447664 Unclassified

The aim of this paper is to point out that a general solution of the Hopf Φ equation in turbulence theory consists already in his definition of the characteristic functional, and it is equivalent to Rosen's solution. In addition the decay of isotropic turbulence is considered based upon the present integral representation.

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Brown U. Div. of Engineering, Providence, R. I.

THE METHOD OF FUNCTIONALS IN TURBULENCE THEORY, by I. Hosokawa. May 1964 [38]p. incl. refs. (Technical rept. WT-41) (AFOSR-64-1396) (AF 49(638)1295) AD 607643 Unclassified

The paper consists of two parts. Part I deals with a formulation of the generalized characteristic functional for random fields. This formulation is a generalization of the theory of Hopf so as to include space- as well as time-correlations of the fields. At the same time, it is shown that the Gaussian functional solution can exist also for our generalized characteristic functional as a counterpart of Hopf's solution for incompressible, inviscid Navier-Stokes turbulence. In Part II a general solution is constructed by superposition of the particular solution, slightly modified from what has been found in Part I. Accordingly, the expression for the solution is in terms of a functional integration.

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Brown U. Div. of Engineering, Providence, R. I.

A. C. SOLENOID OF FINITE LENGTH IN A CONDUCTING MEDIUM WITH HALL CONDUCTIVITY, by S. Selamoglu and P. F. Maeder. June 1964, 85p. incl. diagrs. (Technical rept. WT-40) (AFOSR-64-2028) (AF 49(638)1295) AD 609462 Unclassified

The electric field due to an alternating current carrying solenoid was investigated by the field approach. The solenoid was assumed to be in an infinite, uniform, conducting medium, which may exhibit the Hall effect caused by a constant, axial, external magnetic field. Both the infinite and finite coil problems were studied. Explicit solutions to the infinite coil were found while the finite coil solutions were obtained in integral form. From the latter, the coil impedance and the voltage induced in a particular wire loop were calculated numerically for different scalar and Hall conductivities at different length-to-diameter ratios. Some experimental evidence for the calculated values of the impedance without the Hall effect also was found. (Contractor's abstract)

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Brown U. [Div. of Engineering] Providence, R. I.

SECULAR BEHAVIOR IN AN ANALYSIS OF DAMPED STANDING WAVES IN A GAS, by T. F. Morse. [1964] [5]p. (AFOSR-65-0278) (AF 49(638)1326) AD 611456 Unclassified

Also published in Phys. Fluids, v. 7: 1691-1695, Oct. 1964.

By considering multiple time scale behavior in the viscous damping of a one-dimensional wave, it has been shown how secularities (terms growing unbounded in time) present in the Hilbert solution of this problem may be eliminated. The method of time scales and the accompanying freedom to remove secular terms overcomes in part the major disadvantage of the Hilbert procedure which requires a periodic renormalization of the lowest order initial conditions. This method, which has proved most useful in non-equilibrium statistical mechanics, provides a link between the Hilbert and Chapman-Enskog treatment of a simple hydrodynamic problem.

109

Bryn Mawr Coll. [Dept. of Psychology] Pa.

APPARENT DISTANCE IN A HORIZONTAL PLANE WITH TACTILE-KINESTHETIC STIMULI, by R. S. Davidon and M.-F. H. Cheng. Apr. 16, 1963, 5p. (AFOSR-64-2541) (AF AFOSR-62-1) AD 453806 Unclassified

Also published in Quart. Jour. Exper. Psychol., v. 16: 277-281, 1964.

In the study of active tactile-kinesthetic space perception apparent distance has been found to vary as a function of the direction of the line segment in a horizontal plane. The present data indicate that the error is not consistently related to the same frame or reference as the visual illusion. Rather, with movement of the extended arm to determine the relative distances between pairs of points, radial distances are overestimated in relation to tangential ones, whether parallel or perpendicular to the medial plane. Interpretations are in terms of kinesthetic stimulus patterns and the structure of perceptual representation.

110

Budd Co. [Inc.] Information Sciences Center, McLean, Va.

STUDY OF PICTORIAL DATA ANALYSIS CONCEPTS AND TECHNIQUES. Final rept. Apr. 1, 1963 - Apr. 30, 1964. May 31, 1964, 127p. (AFOSR-64-2529) (AF 49(638)1231) AD 609711 Unclassified

The problem of developing rules for subdividing complex pictures into 'uniform' regions is discussed. Experiments are described in which rules of this type applicable to 'one-dimensional' pictures are derived from an analysis of observers' subdivision preferences. This report also includes: Systems for Generating One-Dimensional Patterns, by A. Rosenfeld and A. Goldstein, Applied Optics, v. 3: Apr. 1964. (Contractor's abstract)

111

nos Aires U. Inst. de Anatomía General y Embriología (Argentina).

THE 5-HYDROXYTRYPTAMINE CONTENT AND SYNTHESIS OF NORMAL AND DENERVATED

PINEAL GLAND, by A. Pellegrino de Iraldi, L. M. Zieher, and E. De Robertis. [1963] [6]p. incl. tables, refs. (AFOSR-65-2745) (AF AFOSR-62-333)
AD 629053 Unclassified

Also published in Life Sci., No. 9: 691-696, 1963.

By bioassay the 5-hydroxytryptamine (5-HT) content of the pineal gland was determined in normal rats and after 5 to 30 days of bilateral extirpation of the superior sympathetic ganglia. The normal 5-HT content varied between 10 and 20 NG of 5-HT base per pineal with a mean of 14.5 ± 1.3 which corresponds to 11.1 μg/g. In brain the normal content was approximately 0.28 μg/g. Denervation produces a decrease in 5-HT of 73% after 5 days, which stabilizes at about +50%, between 10 to 30 days. The injection of 25 mg/kg 5-hydroxytryptophan increased the 5-HT content of the normal gland by 400% in 30 min. In brain the increase was 209%. In the denervated gland the synthetic capacity for 5-HT is reduced to about 1/5 of the normal. The injection of 25 mg/kg of 5-HT showed no uptake by the normal pineal glands and by brain after 10 min. However the denervated gland increased the 5-HT content above the control level. The existence of two pools of 5-HT in the pineal gland, one in nerves and the other in the pinealocytes is demonstrated and some of their properties are discussed.

112

Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

ACTION OF RESERPINE, IPRONIAZID AND PYROGALLOL ON NERVE ENDINGS OF THE PINEAL GLAND, by A. Pellegrino de Iraldi and E. De Robertis. [1963] [11]p. incl. illus. diagr. refs. (AFOSR-65-2746) (AF AFOSR-62-333) AD 629054 Unclassified

Also published in Internat'l. Jour. Neuropharmacol., v. 2: 231-239, 1963.

Drugs that may change the metabolism of catecholamines and indolamines have been used in order to investigate the nature of the granulated vesicles found in adrenergic nerve endings in the pineal gland of the rat. In normal endings, 30-40% of the vesicles are granulated and the rest are homogeneous. The proportion of granulated vesicles diminish considerably between 2-48 hr after a single injection of reserpine and this is slowly restored to normal levels in a period of 8 days. A single injection or chronic treatment with iproniazid (a MAO inhibitor) increases the proportion of granulated vesicles, and also the size of the vesicles and granules. Iproniazid prior to reserpine protects the nerve endings from the depletion of granulated vesicles. Pyrogallol (a COMT inhibitor) does not change the concentration of granulated vesicles and does not protect the nerve ending from the action of reserpine. These results are interpreted as supporting the concept that the granulated vesicles contain the adrenergic transmitter. The possible mechanism of action of these drugs on the submicroscopic structure of adrenergic nerve endings is discussed. (Contractor's abstract)

113

Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

5-HYDROXYTRYPTOPHAN-DECARBOXYLASE ACTIVITY IN NORMAL AND DENERVATED PINEAL GLAND OF RATS, by A. Pellegrino de Iraldi and G. Rodriquez de Lores Arnaiz. [1964] [5]p. incl. table, refs. (AFOSR-65-2835) (AF AFOSR-63-314)
AD 628433 Unclassified

Also published in Life Sci., v. 3: 589-593, 1964.

The 5-hydroxytryptophan decarboxylase was determined in normal and denervated pineal glands. In the experimental glands the determination was made at 2.5, 5, 10, 12 and 30 days after bilateral ganglionectomy of the superior sympathetic ganglia. The results show an increase in enzyme activity in the denervated gland which may be as large as 150% after 2.5 days and persists until 30 days. The tentative hypothesis is postulated that the pineal nerves contain an inhibitory substance of the enzyme which disappears after denervation.

114

Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

A NON-CHOLINERGIC SYNAPTIC INHIBITION IN THE CENTRAL NERVOUS SYSTEM OF A MOLLUSC, by H. M. Gerschenfeld. [1964] [4]p. incl. illus. (AFOSR-65-1942) (AF AFOSR-64-656) AD 623368
Unclassified

Also published in Nature, v. 203: 415-416, July 1964.

In Cryptomphallus aspersa it has been found a type of neurons that in addition to a cholinergic excitatory input show a direct inhibitory synaptic input and present a typical pattern of synaptic activity. Usually a single block shock provokes a direct inhibitory post-synaptic potential (IPSP) followed by a depolarization and an excitatory burst. A short repetitive stimulation provokes the firing of an inhibitory interneuron originating a repetitive response of elementary IPSP (generally 20-30), lasting 30-60 sec. The equilibrium potential of the IPSP is about -60 mV. Acetylcholine (ACh) depolarizes these cells even when the inhibitory interneuron is firing, being clear that ACh cannot be the inhibitory synaptic transmitter in these neurons. dTC and atropine block the excitatory input. α-adrenergic blocking agents have not effected the IPSPs; it was not possible to investigate the effect of β-adrenergic blocking agents since these drugs impair nerve conduction or interneuron firing. Picrotoxin, tetanus toxin, metrazol, strychnine were ineffective in modifying the inhibitory input.

115

Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

ACTION OF GLUTAMIC ACID AND OTHER

NATURALLY OCCURRING AMINO-ACIDS ON SMALL SNAIL CENTRAL NEURONS, by H. M. Gerschenfeld and A. Lasansky. [1964] [14]p. incl. illus. diagrs. refs. (AFOSR-65-1944) (AF AFOSR-64-656) AD 623369 Unclassified

Also published in Internat'l. Jour. Neuropharmacol., v. 3: 301-314, 1964.

The action of glutamic acid (Glut. Ac.) and some other naturally occurring aminoacids in molluscan nervous system was studied in the neurons of the snail Cryptomphallus aspersa and Helix pomatia with intracellular recording and perfusion and/or microinjection of drugs. Neurons are sensitive to Glut. Ac. in concentrations as low as 5×10^{-7}M. Glut. Ac. depolarizes some cells while others are hyperpolarized and inhibited. The equilibrium potential of this last effect is about -60 mV. Glut. Ac. receptors show desensitization only when Glut. Ac. is depolarizing. A reduction of the membrane resistance is observed when Glut. Ac. is added in a concentration of 10^{-3}M. Mono and dicarboxilic aminoacids may or may not have the same effect on different neurons. In a great number of cells GABA has a depolarizing effect.

116

Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

IONIC MECHANISM ASSOCIATED WITH NON-CHOLINERGIC SYNAPTIC INHIBITION IN MOLLUSCAN CENTRAL NEURONS (Abstract), by H. M. Gerschenfeld and D. J. Chiarandini. [1964] [1]p. (AFOSR-65-1945) (AF AFOSR-64-656) Unclassified

Presented at Nineteenth annual meeting of the Society of General Physiologists, Woods Hole, Mass., 1964.

Two types of IPSP have been described in gasteropod neurons: one probably cholinergic and another non-cholinergic. Cholinergic IPSP appear to be produced by changes in membrane permeability to both Cl^- and K^+. The ionic basis of non-cholinergic IPSP was studied in neurons of Cryptomphallus aspersa using double-barraled microelectrodes. The intracellular injection of Cl^- or the replacement of extracellular Cl^- by SO_4 did not alter the amplitude and reversal potential (E_{ipsp}) of IPSP. On the contrary, varying the extracellular concentration of K $[K]_0$ from 1 to 45 mM, the amplitude of IPSP and E_{ipsp} changed markedly. Increase in $[K]_0$ provoked progressive diminution in the amplitude of IPSP in spite of increasing depolarization. Plotting log $[K]_0$ against E_{ipsp} results in a straight line whose slope is near to the theoretical one predicted by the Nernst equation.

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Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

[IONIC BASIS OF SYNAPTIC INHIBITION IN MOLLUSCAN CENTRAL NEURONS] Bases ionicas de la inhibicion sinaptica en neuronas centrales de moluscos (Abstract), by D. J. Chiarandini and H. M. Gerschenfeld. [1964] [1]p. (AFOSR-65-1946) (AF AFOSR-64-656) Unclassified

Also published in Proc. Latinoamer. Congr. Physiological Sci., Vina del Mar (Chile) (Nov. 23-28, 1964).

The ionic mechanisms associated with the origin of the cholinergic and non-cholinergic inhibitory postsynaptic potential have been studied in the central neurons of Cryptomphallus aspersa, with intracellular recordings. The intracellular injection of Cl or the gradual replacement of the Cl^- existing in the external solution by SO_4 provoke progressive reduction of the cholinergic IPSP's amplitude and of its equilibrium potential. If the external concentration of K ($[K]_0$) is increased it is observed a less marked diminution in the size of the cholinergic IPSP. The intracellular injection of Cl^- or the replacement of this anion in the external environment by SO_4 have no effect on the size of the IPSP and on the EIPSP. On the contrary, when $[K]_0$ is increased from 1 to 45 mM the IPSP diminishes and the value of the EIPSP decreases. From the present results it may be concluded that cholinergic IPSP are due to simultaneous fluxes of Cl^- and K^+ while noncholinergic IPSP are due only to an efflux of K^+.

118

Buenos Aires U. Inst. de Anatomía General y Embriología (Argentina).

[ELECTROPHYSIOLOGICAL STUDY OF 5-HYDROXY-TRYPTAMINE RECEPTORS IN MOLLUSCAN NEURONS] Receptores triptaminergicos en neuronas centrales de moluscos (Abstract), by H. M. Gerschenfeld and E. Stefani. [1964] [1]p. (AFOSR-65-1948) (AF AFOSR-64-656) Unclassified

Also published in Proc. Latinoamer. Congr. Physiological Sci., Vina del Mar (Chile) (Nov. 23-28, 1964).

Iontophoretic injections of 5-HT, on molluscan neurons always have a depolarizing effect. It has been calculated from the corresponding diffusion equation that a concentration of 5-HT of 5×10^{-10}M produces a depolarization of 7 mV. 5-HT increases twice the membrane conductance and this change only lasts one third of the potential change. Analyzing dose-response curves it was found that lysergic acid and its derivatives block competitively 5-HT receptor, while atropine and morphine block non-competitively 5-HT receptor. Monoamineoxidase inhibitors such as SKF 385 and isocarboxaside block competitively 5-HT receptor. Tryptamine, cyproheptadine and dibenamine block irreversibly 5-HT receptor. In the same patch of membrane, CILDA neurons have 5-HT and Acetylcholine (ACh) receptors; there is no crossed desensitization between 5-HT and ACh receptors. Atropine blocks competitively ACh receptors and non-competitively ACh receptors, this

indicates that the two-receptors are different, but further work is needed. All these results make 5-HT a suitable candidate as a synaptic transmitter to CILDA neurons.

119

Bureau of Mines, Bartlesville, Okla.

THERMOCHEMISTRY OF BORON AND SOME OF ITS COMPOUNDS. THE HEATS OF FORMATION OF TRIMETHYLAMINEBORANE AND ORTHOBORIC ACID, by W. D. Good, M. Mansson, and J. P. McCullough. July 1963, 15p. incl. table, refs. (CSO-680-59-9) AD 402335 Unclassified

A rotating-bomb calorimetric technique was developed to solve the problem of determining the heats of combustion of organic boron compounds. The heats of combustion of crystalline boron and trimethylamineborane, $(CH_3)_3NBH_3$, were determined. The combustion pro product was a solution of fluoboric acid in excess aqueous HF. The standard of formation of trimethylamineborane is -34.04 ± 0.55 kcal/mol. The heat of solution of orthoboric acid in an HF solution chosen to yield the same fluoboric acid solution was determined. The heat of formation of orthoboric acid was calculated to be -261.47 ± 0.20 kcal/mol. Combination of these results with data from the literature permitted calculation of the heats of formation of B_2O_3 and B_2H_6 referred directly to crystalline boron.

120

Bureau of Social Science Research, Inc., Washington, D. C.

CAPTIVITY LORE AND BEHAVIOR IN CAPTIVITY, by A. D. Biderman. [1964] [28]p. incl. refs. (AFOSR-65-0577) (AF 49(638)727) AD 615363 Unclassified

Also published in The Threat of Impending Disaster, Cambridge, M.I.T. Press, 1964, p. 223-250.

The relationship between the behavior of a prisoner of war and his precapture exposure to cultural lore about captivity are discussed. Special consideration is given to modern cultural concepts of the captive situation and prisoner conduct as compared to actual experience. The discussion focuses on studies of survivors of captivity in Korea and China.

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Bureau of Social Science Research, Inc., Washington, D. C.

RATIONALISM AND EMPIRICISM IN STUDIES OF BEHAVIOR IN STRESSFUL SITUATIONS, by S. Z. Klausner. Oct. 1964, 32p. incl. tables, refs. (AFOSR-64-2256) (AF 49(638)992) AD 608633 Unclassified

Every scientific researcher proceeds rationalistically as well as empiricistically. Each may be classified in terms of a tendency to one or the other pole but not in terms of 'either-or'. The literature of the philosophy of science discusses the wisdom of empiricistic or rationalistic approaches. This paper, however, is empirical rather than philosophical. Consequently, it does not discuss the problem of 'wisdom', but rather examines (1) the extent to which empiricistic and rationalistic orientations are found in research reports of a single field, that of human behavior in stressful situations, and (2) the personal and social conditions which are associated with each of these orientations. It is concluded that the tendency to increase the proportion of observation terms among researchers in this group to be empiricistic increases when a researcher is working in a field not his own, when he is a younger professional, when his personality tends to be introverted, when he is a non-Catholic and when he is politically conservative.

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Bureau of Social Science Research, Inc., Washington, D. C.

CONCEPTS AND INDICATORS IN STUDIES OF BEHAVIOR UNDER STRESS, by S. Z. Klausner. Oct. 1964, 54p. (AFOSR-65-0137) (AF 49(638)992) AD 610808 Unclassified

An indicator is defined as a term which gives instruction about where to look for observable evidence about the concept referent. Scientific effort has concentrated mainly upon establishing general propositions stating a relation among concept referents and weaving these propositions into a theoretical network. Little consideration has been given to the link between the concept referents and the observables suggested by their indicators. This paper discusses and gives examples of various types of concept-indicator relationships, and presents one way of classifying the inferences made by researchers in linking concepts and their indicators. A special study of the distribution of these inferences among students of one field, the study of human behavior under stressful conditions, is included.

123

California Inst. of Tech., Pasadena.

STRUCTURE OF LIQUIDS, by C. J. Pings. Final technical rept. Feb. 28, 1964, 14p. incl. refs. (AFOSR-64-0581) (AF AFOSR-62-141) AD 434304 Unclassified

Experimental studies have continued on the forces and configurations at the molecular level in simple liquids. Two different x-ray diffraction set-ups for the study of the diffraction pattern from liquid samples have been put into operation and have been used for extensive measurements on liquid gallium in the supercooled region and on liquid argon at pressures up to 80 atm near the critical state. Refractive index equipment has been used for measurements on liquid and solid argon, liquid methane, and liquid CF_4. Ultrasonic apparatus has been used for an extensive mapping of absorption of sound near the consolute point in a binary liquid system. During the period covered by this grant, the program has resulted in 12 publications in the open literature, one presentation at an international meeting, and assorted papers, seminars, and informal contributions.

124

California Inst. of Tech. Antenna Lab., Pasadena.

THEORY OF THE SCATTERING OF ELECTROMAGNETIC WAVES BY IRREGULAR INTERFACES, by K. M. Mitzner. Jan. 1964, 126p. incl. diagrs. refs. (Technical rept. no. 30) (AFOSR-64-0802) (AF 49-(638)1266) AD 436811 Unclassified

Two problems involving electromagnetic scattering from irregular interfaces are treated, both deterministic and statistical irregularities being considered. First, reflection of a partially polarized plane wave from a plane interface with large irregularities is studied using geometrical optics. Matrix transformations relating incident and reflected waves are obtained for reflection from a single specular point and from an extended area containing many independent reflectors. The properties of a wave reflected from a diffusely illuminated rough interface are found, and these results are used to study reflection noise reduction when a polarization-sensitive detector viewing near the Brewster angle is used in infrared temperature measurements. Second, the method of small perturbations is used to study scattering of an arbitrary completely polarized wave from an irregular interface of general underlying shape. The irregularities are replaced by equivalent surface currents and then the field in space is found using the dyadic Green's functions of the unperturbed problem. The results obtained are valid when the irregularity has small slope and amplitude small compared to the wavelength and local radii of curvature.

125

California Inst. of Tech. Antenna Lab., Pasadena.

MICROWAVE INTERACTION WITH BOUNDED GYROELECTRIC PLASMAS, by E. R. Nagelberg. Apr. 1964, 105p. incl. diagrs. refs. (Technical rept. no. 31) (AFOSR-64-0803) (AF 49(638)1266) AD 437672 Unclassified

The interaction of microwaves with gyroelectric plasmas of finite extent was investigated, particularly those having cylindrical or spherical boundaries. Within the latter class of problems, only those involving the axially magnetized column with circular cross section are amenable to rigorous analysis. It was found that one of the important effects of the anisotropy is to induce changes in the polarization of the scattered field resulting from interaction with an obliquely incident plane wave. As a means of solving problems which involve uniform but arbitrarily directed magnetization, the perturbation theory of microwave interaction in which the static magnetic field is regarded as a small perturbation of the isotropic plasma was developed. The field equations are derived for all orders but only those of first order, linear in the magnitude of the static magnetic field, are solved. (Contractor's abstract, modified)

126

California Inst. of Tech. Antenna Lab., Pasadena.

ON THE THEORY OF NOISE-LIKE ELECTROMAGNETIC FIELDS OF ARBITRARY SPECTRAL WIDTH, by A. D. Jacobson. June 1964, 214p. (Technical rept. no. 32) (AFOSR-64-0804) (AF 49(638)1266) AD 600454 Unclassified

Attention is restricted to fields whose random fluctuations result exclusively from the chaotic nature of the source. The theory is expressed in terms of the second order moment of the field vector; hence, it is a tensor theory. The principal field quantity, the dyadic field spectral density (DFS), is interpreted from both a statistical and a physical standpoint. In particular, a statistical analysis of partial polarization is presented with the aim of providing a physical interpretation of the polarization of a quasi-monochromatic field. The differential equations that govern the behavior of the DFS are derived in the presence of a source, in a source free region and in a generalized dielectric medium. Boundary conditions are derived for the DFS at a dielectric interface, at a perfectly conducting interface, and at infinity. The differential equations are integrated for various cases with the aid of the dyadic Green's function. The resulting integral representation for the DFS is employed to analyze an experiment that involves the measurement of a partially polarized, incoherent, discrete radio star by means of a two-element radio interferometer.

127

California Inst. of Tech. Antenna Lab., Pasadena.

ELECTROMAGNETIC RADIATION IN THE PRESENCE OF MOVING SIMPLE MEDIA, by K. S. H. Lee and C. H. Papas. [1964] [5]p. (Technical rept. no. 33) (AFOSR-65-0391) (AF 49(638)1266) AD 612594 Unclassified

Also published in Jour. Math. Phys., v. 5: 1668-1672, Dec. 1964.

A method is presented for calculating the influence of a homogeneous, isotropic, nondispersive dielectric medium moving at uniform velocity with respect to an arbitrary electromagnetic source. The relative motion between the source and the medium is specified by stating that the rest frame K of the source moves at a uniform velocity v with respect to the rest frame K' of the medium and vice versa. The differential equation for the potential 4-vector in K is derived and then solved by Green's function technique. The case where the source is an oscillating dipole is calculated in detail.

128

California Inst. of Tech. Antenna Lab., Pasadena.

ON THE DOPPLER EFFECT IN A MEDIUM, by K. S. H. Lee. Dec. 1963, 88p. (Technical rept. no. 29) (AFOSR-5367) (AF AFOSR-63-70) AD 426779 Unclassified

The problem of calculating the frequency of the wave scattered by a body moving in a medium is formulated from field-theoretic considerations. The Doppler equation for a homogeneous dispersive medium is obtained on the basis of the fact that the frequency and the wave vector of a plane wave form a 4-vector. It is found that the solutions of the Doppler equation can be classified into two kinds. In one kind, the solutions are close to the frequency of the incident wave. In the other kind they appear near the poles of the refractive index of the medium on the omega-axis. In the case of an isotropic plasma, the monochromaticity of the incident wave is shown to be preserved after the wave is scattered by a moving body. However, in the case of a magneto-active plasma, the scattered wave contains more than one frequency for a monochromatic incident wave. The physical interpretations of these frequencies are given.

129

California Inst. of Tech. [Antenna Lab.] Pasadena.

[STUDIES OF ANTENNAS, PLASMAS, AND NONLINEAR COMPONENTS] by C. H. Papas. Final review rept. Oct. 1, 1962-Sept. 30, 1963, 4p. (AFOSR-J1343) (AF AFOSR-63-70) Unclassified

The program of research consisted of a theoretical study of (a) the Doppler effect in dispersive, inhomogeneous, anisotropic media; (b) the propagation of broad-band, noise-like electromagnetic waves; (c) the scattering of electromagnetic waves at irregular interfaces; (d) the interaction of electromagnetic waves with bounded, anisotropic plasmas; and (e) the diffuse reflection of electromagnetic radiation from a foggy medium.

130

California Inst. of Tech. [Dept. of Electrical Engineering] Pasadena.

PLASMA DYNAMICS, by R. W. Gould. Final rept. Mar. 1, 1963-Oct. 15, 1964, 7p. (AFOSR-65-0422) (AF AFOSR-63-412) Unclassified

Approximately half the effort of this investigation has been involved in a theoretical study of MHD waves in plasmas of cylindrical symmetry with boundaries taken into account. The remainder has dealt with experiments designed to check the theoretical results. Two experimental techniques have been developed: (a) an impulse technique for simultaneous study of plasma behavior over a wide frequency range, and (b) a hydromagnetic wave interferometer for ion density measurements. These and other results are described.

131

California Inst. of Tech. Dept. of Electrical Engineering, Pasadena.

EXPERIMENTAL STUDY OF COMPRESSIONAL HYDROMAGNETIC WAVES, by D. G. Swanson. June 1963, 109p. (Technical rept. no. 1) (AFOSR-65-1202) (AF AFOSR-63-412) Unclassified

Also published in Phys. Fluids, v. 7: 269-277, Feb. 1964. (AFOSR-64-1372; AD 444469)

An experiment is described in which a compressional hydromagnetic wave is observed in a hydrogen plasma-filled waveguide. The theory of a cool, partially ionized, resistive plasma in a magnetic field is described briefly and expressions are derived for the dispersion relation and transfer function which include both the propagation and attenuation constants as a function of frequency. Measurements of the cutoff frequency are presented, which verify its linear dependence on the magnetic field, and they show good agreement with theory on the variation with the ion mass density. The impulse response of the plasma is studied, transformed into the frequency domain, and quantitative comparisons are made with the theoretical transfer function to determine the degree of ionization, the resistivity and the ion-neutral collision frequency.

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California Inst. of Tech. Dept. of Electrical Engineering, Pasadena.

HYDROMAGNETIC WAVE BOUNDARY CONDITION AND A SURFACE WAVE IN A PLASMA-FILLED

WAVEGUIDE, by D. G. Swanson. July 1964, 28p. (Technical rept. no. 2) (AFOSR-65-1203) (AF AFOSR-63-412) Unclassified

The analysis of a magnetized plasma in a waveguide with a dielectric sheath between the plasma and waveguide is considered. Within the limitations of the cold plasma, effective dielectric tensor approach, the problem is solved exactly and a few illustrative computer solutions for the behavior of the transverse wave number are presented. Also, some approximate low frequency expressions are derived for the effect of the dielectric sheath. It is found that these solutions agree better with experiment than do those where no sheath at all is assumed, and appear adequate to account for all experimental observations. For the case of a finite or thick sheath, the solutions disagree with some other sheath theories, however, in an area where no experimental observations are yet reported. The dielectric sheath also adds a surface wave to the group of hydromagnetic waves, and the coupling between the surface wave and the hydromagnetic waves is shown in certain frequency regions. Orthogonality relations are given which show that the surface wave and the hydromagnetic waves are all mutually orthogonal.

133

California Inst. of Tech. [Div. of Chemistry and Chemical Engineering] Pasadena.

APPARATUS FOR X-RAY DIFFRACTION STUDIES OF CONFINED FLUIDS, by W. I. Honeywell, C. M. Knobler and others. [1964] [4]p. (AFOSR-64-2518) (AF 49(638)1273) AD 453788 Unclassified

Also published in Rev. Scient. Instr., v. 35: 1216-1219, Sept. 1964.

An apparatus is described for studies of the x-ray diffraction of liquids in the temperature range 80-300°K and at pressures up to 100 atm. The device is compatible with a commercial goniometer and is usable in both Debye-Scherrer and parafocusing geometries.

134

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE ELECTRICAL CONDUCTIVITY OF SHOCK-IONIZED ARGON. A REVIEW OF THE EXISTING EXPERIMENTAL RESULTS, by T. F. Zien. Sept. 1964 [14]p. incl. diagrs. table, refs. (AFOSR-64-1488) (AF 49(638)1348) AD 461013 Unclassified

The results are reviewed of measurements by various experimenters in the degree of ionization range $10^{-5} < \alpha < 5 \times 10^{-1}$, with initial pressures ranging from 0.1 mmHg up to 100 mmHg.

135

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

EARTH-TO-MOON TRAJECTORIES WITH MINIMAL ENERGY, by P. A. Lagerstrom and J. Kevorkian. [1963] [12]p. (Publ. no. 582) (AFOSR-64-1323) (AF AFOSR-62-256) AD 443148; AD 444137 Unclassified

Also published in Jour. Mecanique, v. 2: 493-504, Dec. 1963.

A special case is analyzed of the dynamics of an object of negligible mass ('particle') whose trajectory originates near a body of relatively large mass ('the earth') and passes close to a body of relatively small mass ('the moon'). The prior assumptions made were those of the restricted three-body problem together with the additional assumption $\mu < \text{Im}$ where μ is the ratio of the moon's mass to the total mass of the system. This problem is a singular perturbation problem, and a generalized boundary-layer technique was previously used to derive asymptotic formulas uniformly valid for a part of the trajectory which included approach orbit and moon passage.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

NUMERICAL ASPECTS OF UNIFORMLY VALID ASYMPTOTIC APPROXIMATIONS FOR A CLASS OF TRAJECTORIES IN THE RESTRICTED THREE-BODY PROBLEM, by P. A. Lagerstrom and J. Kevorkian. [1963] [30]p. incl. diagrs. tables. (Publ. no. 590) (AF AFOSR-62-256) AD 454987 Unclassified

Presented at AIAA Astrodynamics Conf., New Haven, Conn., Aug. 19-21, 1963.

Also published in Prog. Astronaut. and Aeronaut., v. 14: 3-33, 1963.

In previous papers the authors have discussed the theoretical aspects of uniformly valid asymptotic approximations for the motion of a particle in a trajectory originating near a body of relatively large mass (the earth) and passing close to a body of relatively small mass (the moon). It was shown that determination of the orbit during and after moon passage to the lowest order requires in principle the determination of a correction term to the Keplerian solution for the approach orbit. This correction term was expressed in terms of certain integrals. The present paper summarizes these theoretical results. The relevant definite integrals are evaluated numerically so that the motion during and after moon passage can be explicitly related to the initial conditions near the earth. Typical results are exhibited in various graphs. The Keplerian integrals for the motion during moon passage obtained by the present first-order theory are compared with exact values calculated numerically on an IBM 7094 for 27 orbits corresponding to a wide range of initial conditions and three values of the mass ratio. As expected, the

comparisons indicate that the accuracy of the present theory improves as the mass ratio becomes smaller. The largest value of the mass ratio used is that for the actual earth-moon system.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

RESEARCH ON NONLINEAR PROBLEMS IN STRUCTURAL DYNAMICS, by Y. C. Fung. Final rept. Nov. 1963, 8p. (AFOSR-J1224) (AF AFOSR-62-374)
AD 424285 Unclassifted

Research on nonlinear problems in structural dynamics is briefly summarized. Panel flutter was investigated to make a critical compartson between theory and experiment concerning the flutter of plates and shells in a supersonic flow. Wtth the aim of formulating a realtstic computing program to analyze panel flutter tn aerospace vehtcles, plausible stmplifying assumptions are examined in the light of experimental results. Structural dynamics research was conducted to study the nonlinear problems of shell buckltng, shell vibrations, and shell dynamic responses. Thin circular cylindrtcal shells and thin sphertcal shells were chosen as objects of study because they are classical problems of wide current interest and usefulness in the tndustry. Nonlinear features were emphasized.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

SUPERSONIC SEPARATED AND REATTACHING LAMINAR FLOWS: I. GENERAL THEORY AND APPLICATION TO ADIABATIC BOUNDARY LAYER-SHOCK WAVE INTERACTIONS, by L. Lees and B. L. Reeves. Oct. 4, 1963, 72p. tncl. diagrs. refs. (Technical rept. no. 3) (AFOSR-64-0893) (AF AFOSR-63-54)
AD 437687; AD 600097 Unclassifted

Laminar boundary layer-shock wave tnteractions are studied tn whtch the pressure rtse generated tn an external supersontc, tnvisctd flow is communicated upstream through the boundary layer, and thereby induces flow separation. An tntegral or moment method is used tn which the first moment of momentum ts employed, tn addition to the usual momentum tntegral (zeroth moment). By thts means the velocity and enthalpy profiled are characterized by a single independent parameter not explictly related to the local static pressure gradient. Thts method ttself ts not new, but tt turns out that tts successful applttcation to separated and reattachtng flows htnges on the proper choice of the one-parameter famtly of velocity profiles utilized to represent the tntegral properties of the viscous flow. It ts shown that the Stewartson reversed-flow profiles and their Cohen Reshotko analogues for flows with heat transfer have the qualttatively correct behavior; polynomials do not.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE ACCURACY OF APPLYING LINEAR PISTON THEORY TO CYLINDRICAL SHELLS. by H. Krumhaar. Mar. 1963, 28p. (AFOSR-4668) (AF AFOSR-63-352)
AD 408387 Unclassifted

The aerodynamic pressure acting on a circular cylindrical shell of infinite length in an air-flow parallel to the cylinder axis ts studied. The shell is deformed by a harmionically osctllating standing wave of a sinusotdal pattern. Based upon the exact solutions, asymptotic expansions are developed for the aerodynamic pressure. In this manner the accuracy of the linear piston theory approximation, when applied to cylindrical shells, is investigated. Furthermore improved approxtmations can be obtained from these asymptotic expansions.

140

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE BUCKLING OF CLAMPED SHALLOW SPHERICAL SHELLS UNDER UNIFORM PRESSURE, by R. R. Parmerter. Nov. 1963, 97p. (AFOSR-5362)
(AF AFOSR-63-352) AD 429764 Unclassifted

The problem of the buckling of clamped sphertcal shells under uniform external pressure is examtned. A theoretical study ts carrted out to determtne if asymmetrical modes partictpate in the snap-through process. It is shown that asymmetrical buckling does occur tn a certain range of a geometric parameter, at loads which are signiftcantly less than those predicted from symmetrtcal theory. Additional effects can be expected if the shell has symmetrical or asymmetrtcal imperfections, however, the present study considers only the perfect shell. Experiments were carrted out with copper shells fabricated by an electroforming process. The initial imperfections tn the test specimens were of the order of 1/10 of the thtckness. The buckling loads of these shells exceeded the loads whtch have previously been reported by as much as a factor of two at higher values of the geometrtcal parameter. Good agreement ts found between theory and expertment, and with the recently published asymmetrical theory of Huang.

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Caltfornia Inst. of Tech. [Graduate Aeronauttcal Labs.] Pasadena.

SOME RECENT CONTRIBUTIONS TO PANEL FLUTTER RESEARCH, by Y. C. Fung. [1963] [12]p. incl. tllus. diagrs. refs. (Publ. no. 548) (AFOSR-64-0111)
(AF AFOSR-63-352) AD 430663 Unclassified

Presented at Thirty-ftrst annual meeting of the IAS, New York, Jan. 21-23, 1963.

Also published in AIAA Jour., v. 1: 898-909, Apr. 1963.

With the objective of formulating a realistic computing program to analyze panel flutter in aerospace vehicles, plausible simplifying assumptions are examined in the light of experimental results. It is shown that in certain areas very simple analysis yields respectable results, whereas in other areas great elaboration is necessary to obtain an accurate prediction. In particular, the role played by the boundary layer flow is discussed. The attenuation and phase shift in pressure-deflection relationship caused by the boundary layer can become important under certain circumstances. Examples are given which show that the boundary layer greatly stabilizes flat plates in a transonic or low supersonic flow and circular cylindrical shells at higher Mach numbers.

142

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE ACCURACY OF LINEAR PISTON THEORY WHEN APPLIED TO CYLINDRICAL SHELLS, by H. Krumhaar. [1963] [2]p. (AFOSR-64-0113) (AF AFOSR-63-352) AD 430664 Unclassified

Also published in AIAA Jour., v. 1: 1448-1449, June 1963.

A short survey of an investigation of the accuracy of the linear piston theory when applied to cylindrical shells is given. (Contractor's abstract)

143

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

THE EFFECT OF WALL ELASTICITY AND SURFACE TENSION ON THE FORCED OSCILLATIONS OF A LIQUID IN A CYLINDRICAL CONTAINER. PART I. ANALYSIS, by P. Tong and Y. C. Fung. Oct. 1964 [36]p. incl. diagr. refs. (AFOSR-64-2019) (AF AFOSR-63-352) AD 608548 Unclassified

The stability of a fluid contained in a circular cylindrical tank with a flat, flexible bottom under a periodic axial excitation was studied. An analytical difficulty for the solution of the linearized equations in the form of infinite series was discussed. A variational approach is formulated. An approximate solution results in a pair of coupled ordinary differential equations with periodic coefficients. A method of handling the stability of the solutions of such a system of equation is presented. Numerical results will be discussed in a later article.

144

California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

LARGE ELASTIC DEFORMATION OF THIN CYLINDRICAL TUBES, by J.-s. Lee. Oct. 1964, 46p. incl. diagrs. tables. (AFOSR-64-2020) (AF AFOSR-63-352) AD 608546 Unclassified

Considered is an elastic, incompressible, isotropic material whose constitutive law is specified by a strain-energy function W which is a function of two strain invariants I_1 and I_2. In the mathematical theory of large deformations of axially symmetrical elastic membranes, the governing equations are a set of nonlinear ordinary differential equations. Three types of deformation of thin circular cylindrical rubber tubes are discussed. In the first type a rubber tube is deformed into another by simultaneous inflation and extension of the tube. The second type of deformation considered is a stretching of the tube without internal pressure. The third type is a tube inflated by internal pressure, with or without a change in total length or end diameter. In these two types the deformed tube is a curved surface of revolution; the analysis is more complicated, and the calculations are restricted to Mooney-Rivlin materials.

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California Inst. of Tech. Graduate Aeronautical Labs., Pasadena.

NONLINEAR PROBLEMS IN STRUCTURAL DYNAMICS, by Y. C. Fung. Final rept. Oct. 15, 1964, 10p. (AFOSR-64-2228) (AF AFOSR-63-352) Unclassified

Research in the areas of aeroelasticity, panel flutter, shell instability, shock and vibrations of mechanical and aeroelastic systems, and damping mechanism is discussed.

146

California Inst. of Tech. [Graduate Aeronautical Labs.] Pasadena.

[INVESTIGATION IN FLUTTER OF THIN WALL CIRCULAR CYLINDER OF FINITE LENGTH IN SUPERSONIC STREAMS] Untersuchungen über das Flattern eines dünnwandigen, kreisrunden Zylinders endlicher Länge in Überschallstromung, by H. Krumhaar. [1963] [9]p. incl. diagrs. refs. (AFOSR-65-2473) (AF AFOSR-63-352) AD 629625 Unclassified

Also published in Jahrbuch der WGLR, 1963, p. 306-314.

A short review is given of flutter investigations for a thin cylindrical shell of finite length in a supersonic air stream with restriction to axisymmetrical modes. Using the linearized Timoshenko shell equations and the linear piston theory, the flutter problem is reduced to a nonself-adjoint, ordinary eigen-value problem. This problem is solved without further approximations. Using these results flutter boundaries for the cylinder are derived. The reliability of the underlying physical assumptions can then be investigated by comparison with experimental results.

147

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

SOME THEORETICAL AND EXPERIMENTAL RESULTS CONCERNING THE GROWTH OF BOUNDARY LAYERS IN PLASMA ACCELERATORS, by F. E. Marble and E. E. Zukoski. Final rept. Feb. 1963, 32p. incl. diagrs. tables, refs. (AFOSR-4627) (AF 49(638)758) Unclassified

The work accomplished to date is summarized under 3 headings: (1) Analysis, (2) Ionization rates in noble gases, and (3) Gas phase and surface phenomena affecting the electrical properties of potassium-seeded argon.

148

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

NON-EQUILIBRIUM ELECTRICAL CONDUCTIVITY IN A SEEDED PLASMA, by E. E. Zukoski, T. A. Cool, and E. G. Gibson. Apr. 1964, 67p. (AFOSR-64-0648) (AF 49(638)1285) AD 602683 Unclassified

Measurements of conductivity were made in a plasma composed of argon seeded with potassium vapor. The gas temperature was 2000°K; the pressure, one atmosphere; the potassium concentration was between 0.22 and 0.80 mol-%, and the current density was between 1 and 80 amp/sq cm. Conductivity values were calculated from a two-temperature model in which the energy dependence of the cross sections and radiation losses from the plasma are taken into account. The theoretical and experimental values are in excellent agreement.

149

California Inst. of Tech. Guggenheim Jet Propulsion Center, Pasadena.

ABSOLUTE INTENSITY MEASUREMENTS AND GAS EMISSIVITIES AT ELEVATED TEMPERATURES AND PRESSURES. Final technical rept. Nov. 15, 1962-Dec. 31, 1963, 4p. (AFOSR-J1337) (AF AFOSR-63-71) AD 426569 Unclassified

Similarity groups were derived for multicomponent, reacting gas mixtures with radiative energy transport. Resulting relations were used to consider the feasibility of scaling for flow processes with radiative energy transport under highly simplified conditions. Oscillator strength and spectroscopic temperature determinations on OH in a shock tube were carried out. The shock tube study of the 2.7-3.2 μ band of water vapor, was continued. The purpose of this study was simultaneous measurement of the absolute intensity of the band both in emission and in absorption at 1000°K. This objective was accomplished and emission measurements were made at 3000°K. Extensive data were collected on the absolute GF numbers of several lines of neutral and ionized chromium carbonyl. Data on the relaxation times for excitation and ionization of chromium were also obtained in these experiments. Electronic temperatures for Cr I and Cr II behind reflected shock waves were measured.

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California Inst. of Tech. [Guggenheim Jet Propulsion Center] Pasadena.

SHOCK TUBE MEASUREMENTS OF THE ABSORPTION OSCILLATOR STRENGTH FOR THE $OH\ ^2\Sigma - {}^2\pi$ ELECTRONIC BAND SYSTEM, by R. Watson. [1964] [7]p. (AFOSR-64-1040) (AF AFOSR-63-71) AD 441493 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 4: 1-7, Jan./Feb. 1964.

Previous shock tube measurements of the oscillator strength for the $OH\ ^2\Sigma - {}^2\pi$ band system made in this Laboratory have been corrected. Light scattering in the absolute intensity calibration has been eliminated and a continuous flushing technique was used for preparation and introduction of the water vapor-argon test gas mixture into the shock tube. The experimental technique remains essentially the same as in the earlier studies: hot gas samples of OH at 3100-3500°K were produced by the dissociation of H_2O behind the reflected shock, and the linear rate of increase of absolute spectral intensity in the transparent gas region was measured by monitoring emission from axial observations in the shock tube. The absorption electronic f-number for the $^2\Sigma - {}^2\pi$ band system has been determined from the shock tube measurements as $(3.9 + 0.9) \times 10^3$.

151

California Inst. of Tech. Palomar Observatory, Pasadena.

ON THE ACCELERATION OF PARTICLES IN SHOCK FRONTS, by E. Schatzman. [1963] [16]p. incl. diagrs. tables. (AFOSR-2249) (AF 49(638)21) AD 423427 Unclassified

Also published in Ann. Astrophys., v. 26: 234-249, May-June 1963.

Charged particles can be accelerated in a perpendicular magnetohydrodynamic shock wave. The scattering of particles by the clumpiness of the magnetic field provides the statistical mechanism which is at the origin of the energy spectrum. The energies which can be obtained are quite high, even for weak shocks, but the stronger is the shock, the larger is the number of accelerated particles. It is possible to derive the energy spectrum, which obeys to a power law, deeply related to the nature of the clumps, which can be those found in collision-free shocks. The conditions for acceleration (injection in the accelerating process) are the same as those for the existence of the clumps in collision-free shocks. These results are applied to surface nuclear reactions and provide a good explanation of He^3 in 3 Cen A and Li in lithium stars. (Contractor's abstract)

152

California Inst. of Tech. Palomar Observatory, Pasadena.

THE ULTRAVIOLET SPECTRUM OF 3 CENTAURI A, by J. Jugaku and W. L. W. Sargent. [1963] [7]p. incl. tables, refs. (AFOSR-64-0281) (AF 49(638)21) AD 431085 Unclassified

Also published in Astrophys. Jour., v. 138: 90-96, July 1, 1963.

A list of identifications is given for 65 lines measured on a Radcliffe coudé spectrogram of the region λλ 3120-3700 in the spectrum of 3 Cen A (B4p). Lines of Mn II are present; the resonance Be II doublet λ3130 is absent. Relative abundances or upper limits for Be and the iron-peak elements are derived by comparison with α Lyr (A0 V). The abundance ratio Mn:Fe is normal in 3 Cen A; that of Ni:Fe is a little low; the abundance of Be is less than, or equal to, that in α Lyr while the abundance ratio Cr:Fe is lower in 3 Cen A than in α Lyr by a factor of more than about 40. The possible relationship between 3 Cen A and the magnetic peculiar A stars is discussed in the light of these new results. (Contractor's abstract)

153

California Inst. of Tech. Palomar Observatory, Pasadena.

METAL ABUNDANCES IN THE SUBGIANT ζ HERCULIS AND THREE OTHER dG STARS, by H. L. Helfer, G. Wallerstein, and J. L. Greenstein. [1963] [21]p. incl. diagrs. tables, refs. (AFOSR-64-0594) (AF 49(638)-21) AD 434315 Unclassified

Also published in Astrophys. Jour., v. 138: 97-117, July 1, 1963.

Abundances for 32 elements are obtained for the G stars ζ Her, 99 Her, β Com, and 85 Peg. ζ Her, a high-velocity subgiant with well-determined mass, possesses solar metal abundance; the previously reported metal deficiency of 85 Peg and 99 Her and the normal metal content of β Com are substantiated. A search for representative unblended lines of 18 additional elements yielded little additional information, only that these elements were not strongly overabundant. The relative excess of α-elements in 85 Peg is confirmed, sulfur now being added to the list of observable α-elements. The manganese deficiency in the metal-poor stars is well established. Abundances of many elements of atomic weight heavier than the iron group of elements have been obtained; generally their abundance relative to iron is about the same as in the sun. In both metal-deficient stars, samarium appears overabundant, and there is a possibility that molybdenum and ruthenium may be overabundant in 85 Peg. (Contractor's abstract)

154

California Inst. of Tech. Palomar Observatory, Pasadena.

THE 1960 MINIMUM OF R CORONAE BOREALIS, by C. Payne-Gaposchkin. [1963] [22]p. incl. diagrs. tables, refs. (AFOSR-64-0596) (AF 49(638)21) AD 434409 Unclassified

Also published in Astrophys. Jour., v. 138: 320-341, Aug. 15, 1963.

The spectrum of R Coronae Borealis at maximum is that of a supergiant carbon star of spectral class equivalent to F7. As the star drops to minimum, veiling of the absorption spectrum is followed by the appearance of a very rich, bright-lined spectrum with relatively sharp lines, which fades exponentially, and also by the appearance of several strong, broad, bright lines, which persist with little change for some time and later fade abruptly. The average conditions in the layers that produce the rich, bright-lined spectrum correspond to $\theta = 1.02$, $\log P_e = -2.0$, somewhat lower in temperature than the photosphere and at much lower electron pressure. The broad, bright-lined spectrum shows the H and K lines, the D lines, and a line at 3889A which is ascribed to He I. The changes during the minimum are ascribed to a slow contraction of the envelope, leading to increased density and the deposition of carbon black, which is responsible for the large changes in brightness and for the reddening of the star's light. The rich, bright-lined spectrum is neither obscured nor reddened and is ascribed to an expanding chromosphere that fades progressively. The broad, bright-lined spectrum is ascribed to material which is ejected with high velocity in connection with the initial contraction of the envelope and is collisionally excited when it interacts with a circumstellar cloud. The other cool stars of R Coronae class behave in a similar manner and their rate of variation is shown to be related to their photospheric temperatures. (Contractor's abstract)

155

California Inst. of Tech. Palomar Observatory, Pasadena.

PREDICTED FLUXES AND LINE INTENSITIES IN LATE-TYPE MODEL ATMOSPHERES, by R. Cayrel and J. Jugaku. [1963] [66]p. incl. diagrs. tables, refs. (AFOSR-64-1397) (AF 49(638)21) AD 444001 Unclassified

Also published in Ann. Astrophys., v. 26: 495-560, Nov.-Dec. 1963.

The determination of the chemical composition of stars requires the knowledge of the dependence of stellar line intensities and colors on temperature, surface gravity and metal/hydrogen ratio. This dependence is often obtained with neglecting the photospheric structure which is replaced by one representative point (single-layer approximation). In this paper this dependence is tabulated by model atmosphere computations. A series of model atmospheres, representating main-sequence stars in the temperature range theta-effective = 0.7 to 1.4, was computed with metal/hydrogen ratios from 0.1 to 1.0 times that in the sun. The predicted

emergent fluxes in the continuous spectra are given. The strengths of weak lines are tabulated for eight elements for various excited levels and wavelengths. The various factors affecting the strengths of typical metallic lines when the metal abundance is decreased are discussed in detail. Approximation formulae are given. Theoretical luminosity and blanketing effects on the photoelectric B and V colors are also computed. (Contractor's abstract)

156

California Inst. of Tech. [Palomar Observatory] Pasadena.

THE CHEMICAL COMPOSITION OF TWO CH STARS, HD 26 AND HD 201626, by G. Wallerstein and J. L. Greenstein. [1964] [17]p. (AFOSR-64-1970) (AF 49-(638)21) AD 452344 Unclassified

Also published in Astrophys. Jour., v. 139: 1163-1179, May 15, 1964.

The high-velocity CH stars appear to be deficient in metals but rich in carbon and heavy elements. By a comparative curve-of-growth analysis using the G8 III star epsilon Virginis as a standard, it was found that the CH stars, HD 26 and HD 201626, are metal-poor by factors of 5 and 30, respectively. Both stars show a carbon-to-iron ratio 5 times higher than epsilon Vir. There is no evidence for the presence of C13. In addition, both show an excess of Ba, La, Ce, and Nd with respect to Fe, by factors of about 20. Eu is enhanced by only a factor of 5 in HD 26, and by less than 2 in HD 201626. Except for their general metal deficiency these stars have relative abundances of C:Fe:Ba very similar to the population I Ba II star, HD 46407.

157

California Inst. of Tech. Palomar Observatory, Pasadena.

THE NEAR INFRARED SPECTRUM OF NOVA HERCULIS 1963, by B. Baschek. [1964] [6]p. (AFOSR-64-1971) (AF 49(638)21) AD 452503 Unclassified

Also published in Publ. Astronom. Soc. Pacific, v. 76: 22-27, Feb. 1964.

Ten infrared spectrograms of Nova Herculis 1963 were obtained with the coude spectrograph of the 100-in. telescope on Mount Wilson between Feb. 14 and July 5, 1963, covering the interval between the 9th and the 149th day after the outburst of the nova. The spectra, taken on ammoniated Eastman I-N emulsion, with the 16-in. camera at a dispersion of 40 A/mm, and with the 8-in. camera at 80 A/mm are listed. The stellar spectra were widened to 0.2mm or more on the plate. Tracings were made on an intensity scale using strip or wedge calibration. The nova's continuous spectrum cannot be seen after May 10. Absorption lines of the principal, diffuse enhanced, and Orion system are found before Apr. 5, mostly for H i, He i, N i, and O i. They are listed with wavelengths measured relative to superposed nearly atmospheric lines. As a measure of their strength, the maximum absorption with respect to a local continuum and the total half-width are given.

158

California Inst. of Tech. Palomar Observatory, Pasadena.

THE EFFECT OF SELF ABSORPTION OF BALMER-LINE RADIATION IN GASEOUS NEBULAE DUE TO HYDROGEN ATOMS IN THE 2s STATE, by E. R. Capriotti. [1964] [9]p. incl. diagr. tables. (AFOSR-64-2300) (AF 49(638)21) AD 452247 Unclassified

Also published in Astrophys. Jour., v. 140: 632-637, Aug. 15, 1964.

This paper describes an investigation of the effect of self-absorption due to hydrogen atoms in the 2s state. The results indicate that for equivalent optical depths in the 2p yields (3s, 3d) and the 2s yields 3p lines, the effects of absorption from the 2s level are greater than the effects of absorption from the 2p level.

159

California Inst. of Tech. Palomar Observatory, Pasadena.

ON A RECENT ABUNDANCE ANALYSIS OF 7 SEXTANTIS, by W. L. W. Sargent, L. Searle, and G. Wallerstein. [1964] [3]p. (AFOSR-65-1075) (AF 49-(638)21) AD 620493 Unclassified

Also published in Astrophys. Jour., v. 139: 1015-1017, Apr. 1, 1964.

In an abundance analysis of the high-velocity A star, 7 Sextantis, by Wallerstein, Stone, and Williams (1962), one of the conclusions reached was that the He:H ratio in 7 Sex is about 10 and that C is overabundant by a factor of about 20. In the present note this is shown to be inaccurate and that 7 Sex has a normal composition in every respect. It is postulated that this inaccuracy possibly arose through adopting too low a temperature for 7 Sex.

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California Inst. of Tech. Palomar Observatory, Pasadena.

STUDIES OF THE PECULIAR A STARS. II. THE SILICON-ABUNDANCE ANOMALY, by L. Searle and W. L. W. Sargent. [1963] [20]p. incl. diagrs. tables, refs. (AFOSR-65-2154) (AF 49(638)21) AD 629036 Unclassified

Also published in Astrophys. Jour., v. 139: 793-812, Apr. 1, 1964.

Equivalent widths of the Si II lines, λ 4128 and λ 4130, and the Mg II line, λ 4481, have been measured on 10 A/mm spectrograms of 31 Ap stars and 5 A- and

B-type normal stars. Both the Si II and Mg II lines are quite insensitive to temperature and electron pressure and behave almost identically in normal A- and B-type stars. There are large variations in the relative strengths of the Si II and Mg II lines in the Ap stars whicb is interpreted as abundance variations, both in the Si/H ratio and the Mg/H ratio, from star to star. Balmer-line profiles have also been measured; those of the Ap stars do not differ systematicaliy from those of normal stars of the same color. Published U - B and B - V colors and the Balmer-line profiles have been used to deduce representative values of θ and log P_e for each star, and abundance ratios Si/H and Mg/H derived. The Mn stars have normal abundances of both Si and Mg, while the stars in which λ 4200 of Si II is strong are overabundant in Si by factors ranging from about 10 to about 60; in the λ 4200-Si stars, the abundance ratio Si/Mg has an approximately constant value of about 60 times normal. All these stars have B - V $\leq$ 0.0 but otherwise no dependence of Si abundance on color. The redder Ap stars, having strong lines of Eu, Cr, and Sr, are slightly overabundant in Mg and have Si abundances varying from 10 times normal to 10 times less than normal. Equivalent widths or upper limits, have also been measured for the He I line, λ 4471, and for C II, λ 4267, which behave in a similar manner in normal stars. In the Mn stars the lines are normal or slightly weak for the color, but in the λ 4200-Si stars both C II and He I are very weak.

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California Inst. of Tech. Palomar Observatory, Pasadena.

THE ISOTOPE RATIO C^{12}/C^{13} IN A COMET, by A. Stawikowski and J. L. Greenstein. [1964] [14]p. incl. illus. diagr. tables, refs. (AFOSR-65-0396) (AF 49-(638)1323) AD 612579 Unclassified

Also published in Astrophys. Jour., v. 140: 1280-1291, Oct. 1, 1964.

High-resolution spectra of Comet Ikeya (1963a) show the $C^{12}C^{13}$ (1,0) band at λ 4745 with measurable strength. Its intensity has been measured and compared with the intensity of two unresolved-triplet, rotational lines of $C^{12}C^{12}$ (1,0). The structure of the isotope band has been computed to obtain the number of lines forming the observed head. From the theory of the excitation of comet lines by resonance fluorescence, the isotope ratio C^{12}/C^{13} is derived as 70 $\pm$ 15. Solar-absorption features, although included, modify the excitation pattern of the C_2 lines only slightly, unlike the CN band which has strongly deficient solar radiation. A feature at λ 4752 appears near $C^{13}C^{13}$ (1,0). Its strength is too great to be compatible with $C^{12}/C^{13} \approx 70$, requiring an unacceptably low value. A discussion as to whether $C^{12}C^{13}$ can be de-excited by pure rotation, unlike the homonuclear C^{12} molecules, leads to no definite conclusion since the dipole moment of $C^{12}C^{13}$ is unknown. It is believed that λ 4752 is largely affected by a blend with NH_2. Another slight blend, at λ 4745, may require a slightly higher isotope ratio C^{12}/C^{13}. The C^{12}/C^{13} ratio is near that on the earth. Some implications for the early history of the solar system are drawn. If the solar C^{12}/C^{13} ratio proves indeed to be very high the cometary C^{13} could have been produced by neutron irradiation.

162

California Inst. of Tech. Quantum Electronics Lab., Pasadena.

STUDIES ON OPTICAL SCATTERING AS A TECHNIQUE FOR PLASMA DIAGNOSTICS, by S. E. Schwarz. May 1964, 105p. incl. illus. diagrs. refs. (Scientific rept. no. 1) (AFOSR-64-1143) (AF 49(638)1322) AD 603738 Unclassified

When a pulse of intense light from a giant-pulse laser passes through a plasma, a very small fraction of the light is scattered out of the beam as a result of ('Thomson') scattering by free electrons. Under suitable conditions the intensity of the scattered light is proportional to the density of free electrons, while its spectral distribution is related to the velocity distribution of the free electrons through the Doppler formula. Theoretical considerations are discussed. An apparatus for conducting scattering experiments was constructed. Measurements conducted at various times in the development of an afterglow plasma indicate Doppler broadening of the scattered light; the broadening disappears as the electrons cool during the first three microseconds of the afterglow. Measurements of electron density as a function of time were made in the afterglow. Two unexpected laser-plasma interactions were observed. The first is designated as 'induced plasma luminosity' and the second as 'giant scattering'. Both effects appear to be related to the presence of hydrocarbon impurities in the gas.

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California Inst. of Tech. Quantum Electronics Lab., Pasadena.

AN ANALYSIS OF PERTURBED CONFOCAL RESONATORS, by J. F. Asmus. Sept. 1964, 141p. (Scientific rept. no. 3) (AFOSR-64-2074) (AF 49(638)1322) AD 609769 Unclassified

An analytic technique is developed for computing mode functions and associated diffraction losses of perturbed multimode optical resonators. It is based upon a consistent field formulation of resonance in an open two-mirror system. To illustrate the method the theory of confocal resonators is extended to include configurations differing from the confocal case by small geometrical perturbations. This involves computing and expanding a perturbed Green's function for such near confocal resonators. Diffraction losses for certain statistical and deterministic perturbations are computed and related to disturbances arising from an imperfect figure, polish or alignment of the mirrors. The design and construction of a stable laser spectrometer consisting of a single mode tuneable gas laser and a swept interferometer are described. Measurements of the diffraction losses of perturbed confocal resonators are found to be in agreement with the above analysis.

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California Inst. of Tech. Seismological Lab., Pasadena.

ATTENUATION OF SHEAR WAVES IN THE UPPER AND LOWER MANTLE, by R. L. Kovach and D. L. Anderson. [1964] [10]p. incl. diagrs. table, refs. (AFOSR-65-2917) (AF 49(638)1337) AD 612859 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1855-1864, Dec. 1964.

The attenuation of seismic waves is a direct measure of the absorption due to nonelastic processes in the earth. The well known difficulties in obtaining body wave amplitude decrement data have been evoked by studying the spectral ratios of multiple ScS and sScS phases from two deep focus earthquakes recorded at near normal incidence. The average Q, for shear, in the mantle is about 600 for the frequency range 0.015 to 0.07 cps. Assuming that equal radiation occurs upwards and downwards from the source the average Q for the upper 600 km of the mantle is determined to be about 200 and about 2200 for the rest of the mantle. The value for Q at the base of the mantle is at least 5000 for shear waves.

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California Inst. of Tech. Seismological Lab., Pasadena.

INFERENCES ON CRUSTAL VELOCITIES AND DENSITIES FROM P WAVE DELAYS AND GRAVITY ANOMALIES, by F. Press and S. Biehler. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-65-2919) (AF 49(638)1337) AD 612216 Unclassified

Also published in Jour. Geophys. Research, v. 69: 2979-2995, July 15, 1964.

A correlation is demonstrated between P wave delays and Bouguer gravity anomalies. For California data it is given approximately by $(\Delta g) = 355PD$ where (Δg) is the Bouguer (slab equivalent) gravity change in milligals and PD is the delay in seconds. The increases in P wave delays and negative gravity anomalies associated with topographic highs are manifestations of isostatic adjustment. However, composition changes of the type implied by empirical velocity-density relationships cannot explain the gravity changes associated with P wave delays in California batholiths. One way to reconcile the discrepancy is to postulate velocity reversals in the batholith. A thermal argument shows that anomalously high temperatures are likely to occur under the Sierra Nevada because of the unusually large thickness of batholithic rock. Velocity reversals under such circumstances are plausible. (Contractor's abstract)

166

California Inst. of Tech. [Seismological Lab.] Pasadena.

THEORETICAL AND OBSERVED ACOUSTIC-GRAVITY WAVES FROM EXPLOSIVE SOURCES IN THE ATMOSPHERE, by D. G. Harkrider. [1964] [26]p. incl. diagrs. refs. (AFOSR-65-2920) (AF 49(638)1337) AD 612217 Unclassified

Also published in Jour. Geophys. Research, v. 69: 5295-5321, Dec. 15, 1964.

A matrix formulation is used to derive the pressure variation for acoustic-gravity waves from an explosive source in an atmosphere modeled by a large number of isothermal layers. Comparison of theoretical and observed barograms from large thermonuclear explosions leads to the following conclusions: (1) The major features on the barogram can be explained by the superposition of four modes, (2) different parts of the vertical temperature structure of the atmosphere control the relative excitation of these modes, (3) a scaled point source is sufficient to model thermonuclear explosions, (4) the observed shift in dominance of certain frequencies with yield and altitude can be explained by means of the empirical scaling laws derived from the direct wave near the explosion, and (5) out to 50 degrees from the source, the observed variation of amplitude with distance can be accounted for by geometrical spreading over a spherical surface.

167

California Inst. of Tech. Seismological Lab., Pasadena.

DETERMINATION OF SOURCE PARAMETERS OF EXPLOSIONS AND EARTHQUAKES BY AMPLITUDE EQUALIZATION OF SEISMIC SURFACE WAVES. 1. UNDERGROUND NUCLEAR EXPLOSIONS, by M. N. Toksöz, A. Ben-Menahem, and D. G. Harkrider. [1964] [12]p. incl. diagrs. tables, refs. (AFOSR-65-2922) (AF 49(638)1337) Unclassified

Also published in Jour. Geophys. Research, v. 69: 4355-4366, Oct. 15, 1964.

A method of determining the source parameters of explosions and earthquakes from the amplitude spectrums of seismic surface waves is described. The method, called amplitude equalization, involves the correction of the ground displacement spectrum for the propagation effect. This is accomplished by multiplying it numerically with the inverse of the frequency response of the layered medium. The result is the amplitude spectrum of the source function, which may be interpreted by itself or jointly with the initial phase spectrum to determine the source-time variation. The spectrums of the Rayleigh waves from underground nuclear explosions are compared and the source-time function is interpreted using the amplitude equalization method. The time variation of the pressure pulse at the boundary of the elastic zone is found to be of the form $p(t) = P_0 te^{-\eta t}$, where η is a parameter which depends on the yield of the explosion and on the medium. For the events studied, the breadth of the pulse increased (η decreased) with the yield of the explosion. (Contractor's abstract)

168

California Inst. of Tech. Seismological Lab., Pasadena.

SPECTRAL RESPONSE OF AN ELASTIC SPHERE TO DIPOLAR POINT SOURCES, by A. Ben-Menahem. [1964] [18]p. (AFOSR-65-2923) (AF 49(638)1337) AD 612214 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1323-1340, Oct. 1964.

A stratified elastic sphere is excited by an harmonic dipolar source of arbitrary orientation and depth. The total field is expanded in series of vector spherical harmonics and then condensed into a convenient form of a displacement dyadic. The Haskell-Gilbert matrix method is employed to obtain the radial factor of the displacements for a multilayered sphere. The dependence of the field on the azimuth angle and the fault elements is obtained for the case of a double-couple at depth. Expressions are also developed for the radiation pattern of surface waves over a spherical stratified earth. (Contractor's abstract)

169

California Inst. of Tech. Seismological Lab., Pasadena.

RADIATION PATTERNS OF SEISMIC SURFACE WAVES FROM BURIED DIPOLAR POINT SOURCES IN A FLAT STRATIFIED EARTH, by A. Ben-Menahem and D. G. Harkrider. [1964] [16]p. incl. diagrs. tables, refs. (AF 49(638)1337) AD 445224 Unclassified

Also published in Jour. Geophys. Research, v. 69: 2605-2620, June 15, 1964.

Explicit compact expressions were obtained for the far displacement field of Rayleigh and Love waves generated by force configurations which served to simulate shear-type faults with arbitrary dip and slip. The medium transfer functions for dipolar sources were computed for a Gutenberg flat continental earth model with 23 layers. These were then used to obtain universal radiation pattern charts for couple- and double-couple-type sources at various depths over the period range 50 to 350 sec. It was demonstrated by means of few typical examples that the radiation patterns of Rayleigh waves may depend strongly on the depth of the source, and unlike the fundamental Love mode may be rather sensitive to small variations in frequency. For a given source and frequency the radiation pattern may differ considerably from one mode to another. (Contractor's abstract)

170

California Inst. of Tech. [Seismological Lab.] Pasadena.

SEISMIC SIGNAL ENHANCEMENT WITH THREE-COMPONENT DETECTORS, by M. Shimshoni and S. W. Smith. [1964] [8]p. (AF 49(638)1337) AD 612215 Unclassified

Also published in Geophysics, v. 29: 664-671, Oct. 1964.

The time-averaged cross-product of vertical and radial components of ground motion is multiplied by the original signal producing a function of ground motion in which rectilinearly polarized motion is enhanced. This provides some separation of seismic signals from noise when both occupy the same frequency and velocity bands. The vertical and radial motion is decomposed into its Fourier components, and the parameters of an equivalent ellipse are computed at each instant of time. The eccentricity, major axis, and angle of inclination of the ellipse provide criteria for identifying P and SV waves of different velocities.

171

California Inst. of Tech. Seismological Lab., Pasadena.

STUDY OF FREE AND FORCED OSCILLATIONS OF THE EARTH. Final progress rept. July 1-Sept. 30, 1963 [9]p. incl. diagr. (AF AFOSR-62-355) AD 424117 Unclassified

Construction of the additional extensometer component at the Lake Isabella station has been completed. The new adit has a length of 125 ft; oriented perpendicular to the original component. As in previous designs the 25-meter quartz extensometer standard is suspended within a concrete trough. Piers in the form of 6 ft lengths of 12-in. diam water well casing were cemented into the rock to a depth of 5 ft for anchoring the fixed end of the quartz standard and the transducer respectively. The rough is covered to protect the quartz tube and the transducers from dust and damage by falling rock and reduce temperature variations. Near the junction of the two tunnels a sealed bulkhead has been installed for reducing barometric pressure variations and consequent noise from this source. A closed loop dehumidification system has been installed to maintain a low humidity within the adit. (Contractor's abstract)

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California Inst. of Tech. Seismological Lab., Pasadena.

SOURCE-MECHANISM FROM SPECTRA OF LONG PERIOD SEISMIC SURFACE WAVES. 3. THE ALASKA EARTHQUAKE OF JULY 10, 1958, by A. Ben-Menahem and M. N. Toksöz. [1963] [14]p. (AFOSR-5359) (AF AFOSR-63-25) AD 626488 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 905-919, Oct. 1963.

Source-mechanism is derived from amplitude and phase spectra of mantle Love and Rayleigh waves of the Alaska earthquake of July 10, 1958. An agreement between theory and observations is obtained for a unilateral fault of 300-350 km, which ruptured with a speed of 3-3.5 km/sec in the direction N40 degree W. Fault length is in good agreement with the extent of aftershock distribution in the month of July, 1958, and the time of rupture checks with the duration of an impressive T-phase recorded at Hawaii. The phases of the signals are corrected for propagation, instrumental shift and the source finiteness. Initial phases thus obtained

agree on a mechanism of a right double-couple with a unit step-function in time. (Contractor's abstract)

173

California Inst. of Tech. Seismological Lab., Pasadena.

THE ANELASTICITY OF THE EARTH, by D. L. Anderson and C. B. Archambeau. [1964] [14]p. incl. diagrs. tables, refs. (AF AFOSR-63-25) AD 445223 Unclassified

Also published in Jour. Geophys. Research, v. 69: 2071-2084, May 15, 1964.

The attenuation of seismic waves is one manifestation of the earth's anelasticity and is not unrelated to the response of the earth to stresses of longer duration. A method is developed for the analysis of the amplitudes of dispersed wave trains and free oscillations which yields the anelasticity (Q) as a function of depth in the earth just as the frequency spectrum yields the elasticity-density structure. The advantages and limitations of the method are essentially identical to those of the dispersion method. The amplitude decay vs period for toroidal osciallations and Love waves was computed for a variety of hypothetical Q distributions in the earth. Those models which satisfy the available attenuation measurements have a broad, highly attenuating zone in the upper mantle and a high-Q lower mantle. (Contractor's abstract, modified)

174

California Inst. of Tech. Seismological Lab., Pasadena.

A CATALOG OF SOUTHERN CALIFORNIA EARTHQUAKES AND ASSOCIATED ELECTRON DATA PROCESSING PROGRAMS, by J. M. Nordquist. [1964] [9]p. incl. diagrs. tables, refs. (AF AFOSR-63-25) AD 437527 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1003-1011, June 1964.

Epicenters, origin times, and other pertinent data on approximately 9000 earthquakes in the Southern California region, determined by the Seismological Lab. at Pasadena for the period from Jan. 1, 1934 to May 17, 1963, have been entered on IBM punched cards. This card catalog may be used as input for programs run on the IBM 7090, and has been converted to punched tape for input to the Bendix G-15D in use at the Laboratory. Programs now operational on the G-15D will produce from the catalog lists of earthquakes which satisfy given criteria of geographical location and/or magnitude range. A system of G-15D programs for calculating from the catalog the distribution of seismicity over the region is described. (Contractor's abstract)

175

California Inst. of Tech. Seismological Lab., Pasadena.

EXCITATION OF SEISMIC SURFACE WAVES BY ATMOSPHERIC NUCLEAR EXPLOSIONS, by M. N. Toksöz and A. Ben-Menahem. [1964] [10]p. incl. diagrs. tables, refs. (AF AFOSR-63-25) AD 445226 Unclassified

Also published in Jour. Geophys. Research, v. 69: 1638-1648, Apr. 15, 1964.

The Rayleigh waves generated by nuclear explosions in the atmosphere and by earthquakes are investigated to determine the relative effects of the source and the propagation medium on the observed amplitude spectrums. It is found that when the waves from a given source propagate along different paths the shapes of the spectrums change markedly. Comparison of earthquake- and explosion-generated waves leads to the conclusion that the source characteristics are obscured by the propagation effects. The theoretical expression for the spectrum of the Rayleigh wave displacement is derived for an explosion in a homogeneous atmosphere. The yield of the explosion introduces a frequency-dependent factor into the equations. Using this frequency dependence, the relative yields of explosions are computed from the amplitude-spectrum ratios of Rayleigh waves recorded at a distant station. (Contractor's abstract)

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California Inst. of Tech. Seismological Lab., Pasadena.

A NOTE ON SURFACE WAVES FROM THE HARDHAT NUCLEAR EXPLOSION, by K. Aki. [1964] [4]p. incl. diagrs. (AF AFOSR-62-25) Unclassified

Published in Jour. Geophys. Research, v. 69: 1131-1134, Mar. 15, 1964.

The records from many LRSM stations have been studied in order to determine the nature and origin of the Love and Rayleigh waves that were generated by the Hardhat explosion. A check was first made on the validity of the assumption that Love and Rayleigh waves originated from a common source at the same time. The origin times of the two waves were shown to agree within the experimental error, and the assumption was not rejected. The amplitude ratio and the source phase difference between the two waves were obtained for various azimuths from the source, and they were shown to be consistent with the double couple corresponding to vertical strike-slip fault, the strike direction being N30°W or N60°E. The observation, however, permits a superposition of an explosive source, making the contribution to the amplitude of Rayleigh waves less than half of that from the double couple. (Contractor's abstract)

177

California Inst. of Tech. Seismological Lab., Pasadena.

A PERTURBATION METHOD FOR ELASTIC WAVE PROPAGATION. I. NONPARALLEL BOUNDARIES, by I. Herrera. [1964] [7]p. incl. diagr. (AFOSR-65-2901) (AF AFOSR-83-28) AD 450874 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3845-3851, Sept. 1964.

This is the first of a series of papers in which a small-perturbation theory for elastic wave propagation is presented. Using classical perturbation techniques, boundary conditions are obtained for the perturbation of the displacement field which, by means of the integral representation theorems of elastodynamics, permit us to express the solutions to the problems as integrals of known quantities. In this paper the method is formulated for mediums with boundaries which are slightly non-parallel. It is then applied to a study of the propagation of Love waves through a crustal layer. (Contractor's abstract)

178

[California Inst. of Tech. Seismological Lab., Pasadena]

BODY FORCE EQUIVALENTS FOR SEISMIC DISLOCATIONS, by R. Burridge and L. Knopoff. [1984] [14]p. incl. diagrs. refs. (AFOSR-65-2902) (AF AFOSR-63-26) AD 813116 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1875-1888, Dec. 1964.

An explicit expression is derived for the body force to be applied in the absence of a dislocation, which produces radiation identical to that of the dislocation. This equivalent force depends only upon the source and the elastic properties of the medium in the immediate vicinity of the source and not upon the proximity of any reflecting surfaces. The theory is developed for dislocations in an anisotropic inhomogeneous medium; in the examples isotropy is assumed. For displacement dislocation faults, the double couple is an exact equivalent body force. (Contractor's abstract)

179

[California Inst. of Tech. Seismological Lab., Pasadena]

ON A METHOD TO OBTAIN A GREEN'S FUNCTION FOR A MULTI-LAYERED HALF SPACE, by I. Herrera. [1964] [10]p. incl. diagr. refs. (AF AFOSR-83-26) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 54: 1087-1095, Aug. 1984.

In this paper the surface wave terms of the Green's function for a two-dimensional multi-layered half space are obtained. The method used is new and remarkable by its simplicity. It is based on the integral representation theorems for elastodynamics. The orthogonality properties of surface waves are generalized to include not only Love waves but Rayleigh waves as well. (Contractor's abstract)

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California Inst. of Tech. Seismological Lab., Pasadena.

TRANSMISSION OF LOVE WAVES PAST A CONTINENTAL MARGIN, by L. Knopoff and J. A. Hudson. Oct. 1963, 17p. (AF AFOSR-83-26) AD 423484 Unclassified

A simplified two-dimensional model of the continental margin is considered in which a single layer crust is assumed to have an abrupt change in thickness. Love waves are assumed to be propagating normally to this discontinuity. By a Green's function technique, the transmission coefficients are derived for waves propagating in either direction. Numerical values are provided for a wide range of thicknesses and for one set of physical parameters for crust and mantle. (Contractor's abstract)

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California Inst. of Tech. W. M. Keck Lab. of [Engineering Materials] Pasadena.

INFLUENCE OF PREFERRED ORIENTATION ON THE HALL EFFECT IN TITANIUM, by L. Roesch and R. H. Willens. [1962] [4]p. incl. diagrs. table. (AFOSR-J1108) (AF 49(638)1034) Unclassified

Also published in Jour. Appl. Phys., v. 34: 2159-2163, Aug. 1963.

The effect of preferred orientation on the Hall effect in titanium was examined in an attempt to resolve the inconsistent results of previous investigators. Three specimens of iodide titanium were prepared with different textures and the Hall coefficient of each was measured between 4.2° and 295°K. The Hall coefficient was found to depend on both temperature and preferred orientation. At room temperature it was determined to be $-1.8 \times 10^{-11} m^3/C$ in two specimens and $+2 \times 10^{-11} m^3/C$ in a third one. From the x-ray analysis of the texture and the Hall coefficient data, it was concluded that the positive component of the Hall coefficient was associated with the hexagonal axis of titanium, being parallel to the magnetic field. (Contractor's abstract, in part)

182

California Inst. of Tech. W. M. Keck Lab. of Engineering Materials, Pasadena.

[PHYSICAL PROPERTIES OF METALS AND ALLOYS AT ELEVATED TEMPERATURES] by P. Duwez. Final rept. Nov. 1, 1961-Apr. 30, 1964. Sept. 1964, 3p. (AFOSR-84-1879) (AF 49(638)1034) Unclassified

Research is summarized on the effect of crystal orientation on electrical resistivity and Hall coefficient of hexagonal metals. Titanium and zirconium were chosen because previously reported data on Hall coefficient in polycrystalline titanium were contradictory. Results indicated that the Hall coefficient depends strongly on temperature and crystalline texture.

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California Inst. of Tech. [W. M. Keck Lab. of Engineering Materials] Pasadena.

MATERIALS PROBLEMS AT HIGH TEMPERATURES, by P. Duwez. [1964] [14]p. [AF 49(638)1034] Unclassified

Published in High Temperatures in Aeronautics; Proc. Symposium held in Turin to celebrate the 50th anniversary of the Laboratorio di Aeronautica, Politecnico di Torino (Italy) (Sept. 10-12, 1962), ed. by C. Ferrari. Milano, Tamburini Editore, 1964, p. 385-398.

A review is presented of the materials problems encountered in high speed aircrafts and missiles. Both structural and engine materials are discussed. Each type of material (metallic, ceramic or plastic) has intrinsic temperature limitations and the term "high temperature" should be considered as a ratio of the operational temperature to the melting point of the material rather than the absolute value of the temperature in service. From this point of view, the high temperature problem exists for practically all engineering materials. The physical properties of interest at high temperature are discussed. Four classes of metallic materials, namely light metals, titanium alloys, steels and related alloys, and refractory metals are reviewed. For applications involving extremely high temperatures, cooling or ablation must be considered and this approach brings in physical properties of material which are less familiar to the aircraft or engine designers. Finally, a brief account is given of the most fruitful avenues for fundamental research in the field of high temperature materials.

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California U. Center for Human Learning, Berkeley.

SECOND CALIFORNIA CONFERENCE ON VERBAL LEARNING AND VERBAL BEHAVIOR, by B. J. Underwood and L. J. Postman. [1963] [13]p. (AFOSR-66-1156) (AF AFOSR-63-229) AD 641437 Unclassified

Also published in Jour. Verbal Learning and Verbal Behavior, v. 2: 203-215, Aug. 1963.

The second of a series of 3 research conferences on verbal learning and verbal behavior was held from May 13-17, 1963, at the University of California Conference Center at Lake Arrowhead. The purpose of these conferences is to provide an opportunity for the exchange of information on current research developments in the areas of verbal learning and verbal behavior. The discussions were informal, with exclusive emphasis on the ongoing research and current methodological and theoretical problems. A half-day session was allotted to each of the 10 participants, during which he was free to present any materials of his choosing.

165

California U. [Dept. of Astronomy] Berkeley.

THERMODYNAMICS OF A REACTING GAS, by M. S. Vardya. [1964] [6]p. (AFOSR-64-2307) (AF AFOSR-63-171) AD 452265 Unclassified

Also published in Amer. Jour. Phys., v. 32: 520-525, July 1964.

Thermodynamical properties of a gaseous mixture undergoing dissociation or ionization, or both, were considered in a general way. As a special case, the behavior of ionizing hydrogen gas was studied. It is found that a perfect gas behaves as an imperfect gas in many ways, when undergoing dissociation or ionization. (Contractor's abstract)

166

California U. Dept. of Astronomy, Berkeley.

THE SPECTRUM OF GAMMA PEGASI BETWEEN 3300 AND 3030A, by E. Bohm-Vitense, D. M. Pyper, and G. Wallerstein. Mar. 11, 1964, 3p. (AFOSR-65-0401) (AF AFOSR-63-171) AD 612576 Unclassified

Also published in Astrophys. Jour., v. 140: 607-609, Aug. 15, 1964.

A 2-A/mm spectrogram of γ Pegasi (type B2 IV) was obtained with the coude spectrograph of the 120 in. reflector. The plate is properly exposed from about 3300A to a little below 3050A. The primary purpose was to search for lines of Fe II to test the suggestion that the fluxes of B stars below λ 2500 might be strongly influenced by blanketing due to numerous lines of singly ionized atoms. The resonance lines of Be II were searched in order to set an upper limit to the abundance of beryllium.

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California U. [Dept. of Astronomy] Berkeley.

A NEW METHOD OF AUTOMATIC COMPUTATION OF STELLAR EVOLUTION, by L. G. Henyey, J. E. Forbes, and N. L. Gould. [1964] [12]p. incl. diagrs. (AFOSR-66-0374) (AF AFOSR-63-171) AD 630234 Unclassified

Also published in Astrophys. Jour., v. 139: 306-312, Jan. 1, 1964.

A method is described for obtaining time sequences of stellar models describing evolutionary changes. This method is a modified version of an earlier one described by Henyey, Wilets, Bohm, LeLevier, and Levee (1959). The modifications involve the evaluation of all quantities

at the same discrete points. The technique provides for coupling the interior integrations to those for model atmospheres based on mixing-length theory. The scope of the formalism is such as to provide for a wide range of calculations for spherically symmetric configurations in hydrostatic equilibrium. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

PARTIAL RATE FACTORS FOR NITRATION OF FLUORANTHENE, by A. Streitwieser, Jr. and R. C. Fahey. [1962] [3]p. incl. diagr. tables, refs. (AFOSR-65-0215) (AF 49(638)105) AD 611348 Unclassified

Also published in Jour. Org. Chem., v. 27: 2352-2355, July 1962.

Nitration of fluoranthene gives the following partial rate factors relative to a 1-naphthalene position: (1) in acetic anhydride at 0° —1, 0.7; 3, 2.9; 7, 1.2; 8, 1.8; in acetic acid at 50° —1, 0.3; 3, 8.1; 7, 0.6; 8, 2.7.

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California U. Dept. of Chemistry, Berkeley.

SPECTROSCOPIC AND THEORETICAL STUDIES OF MOLECULES WITH BONDING WHICH DEVIATES FROM NORMAL VALENCE RULES, by G. P. Pimental, B. Brocklehurst and others. Terminal rept. Mar. 1, 1961-Feb. 28, 1963. May 1963, 9p. (AFOSR-495) (AF 49(638)944) AD 413870 Unclassified

Research was devoted to the elucidation of the structural properties and chemical bonding of molecules with bonding that deviates from normal valence rules. Effort was focused on 3 lines of attack: (1) Spectroscopic studies of the reactivity and molecular structure of free radicals and reactive molecules using the matrix isolation method, (2) Spectroscopic studies of stable molecules selected to develop and expand the applicability of the matrix isolation method, and (3) Development of new and novel spectroscopic techniques to facilitate future infrared studies of chemical species with extreme reactivity. (Contractor's abstract)

190

California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRA OF CARBON MONOXIDE IN AN ARGON MATRIX, by G. E. Leroi, G. E. Ewing, and G. C. Pimentel. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0518) (AF 49(638)944) AD 613862 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2298-2303, Apr. 15, 1964.

The infrared absorption spectrum of carbon monoxide in an argon matrix shows prominent bands at 2148.8 and 2138.0 cm^{-1} with half-widths, respectively, 1.5 cm^{-1} and 3.5 cm^{-1}. The relative intensities of these bands are extremely dependent upon a variety of experimental conditions, including sample concentration, window temperature, and deposition rates. The variability shows that CO isolated in argon absorbs at 2148.8 cm^{-1} and that it does not rotate. The lower frequency absorption is due to aggregates. The frequency shift of the argon-isolated CO absorption relative to that of gaseous CO shows that carbon monoxide fits tightly in the argon lattice. In contrast, the CO aggregates absorb at lower frequency than gaseous carbon monoxide. Isotopic studies using $C^{13}O^{16}$ reveal vibrational coupling of 1.1 cm^{-1} between isotopically identical molecules in an aggregate. An increase in matrix cavity diameter would be needed if a stationary CO molecule begins to rotate in argon. This "site expansion," which could be as much as 0.4A, may be an important factor inhibiting rotation.

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California U. Dept. of Chemistry, Berkeley.

OUT-OF-PLANE CH_2 BENDING POTENTIAL FUNCTIONS OF DIAZOMETHANE, KETENE, AND RELATED MOLECULES, by C. B. Moore and G. C. Pimentel. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0519) (AF 49(638)944) AD 613859 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1529-1534, Mar. 15, 1964.

The unusually low out-of-plane CH_2 bending potential constants of ketene and diazomethane are discussed in terms of a valence bond comparison of their electronic structures to those of ethylene and ammonia. The anharmonic energy levels of the CH_2 out-of-plane bending in diazomethane are fitted with an harmonic-quartic potential function. $V(\gamma) = (1/2\ (2.74) \cdot \Delta\gamma^2 + 0.65 \cdot \Delta\gamma^4) \times 10^{-13}$ erg. A model is developed in which potential constants are transferred from the ethylene and ammonia molecules to the 2 valence-bond structures usually considered for the ketene and diazomethane molecules. The unusually high intensities of the bending overtones are found to be a necessary consequence of this treatment. A further experimental test may be found in the expected large change in dipole moment with vibrational state. The model provides a basis for understanding the potential functions of ketene and diazomethane, and for making qualitative predictions about other molecules such as cyanamide and CF_2N_2.

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California U. Dept. of Chemistry, Berkeley.

HELIUM DIFLUORIDE: POSSIBLE PREPARATIVE TECHNIQUES BASED ON NUCLEAR TRANSMUTATIONS, by G. C. Pimentel, R. D. Spratley, and A. R. Miller. [1964] [1]p. (AFOSR-65-0520) (AF 49(638)944) AD 613853 Unclassified

Also published in Science, v. 143: 674, Feb. 14, 1964.

It might be possible to prepare difluoride by beta decay of tritium, lithium-6 transmutation, or alpha-particle bombardment. In the first method, which may be the

most feasible, tritrated potassium bifluoride could be used as a host lattice. The beta-decay recoil energy would not dislodge the daughter helium atom from the host site, thus helium difluoride could perhaps be formed in an ideally shaped lattice site.

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California U. Dept. of Chemistry, Berkeley.

INFRARED SPECTRA OF GASEOUS DIAZOMETHANE, by C. B. Moore and G. C. Pimentel. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-65-0521) (AF 49-(638)944) AD 613852 Unclassified

Also published in Jour. Chem. Phys., v. 40: 329-341, Jan. 15, 1964.

The gaseous infrared spectra of CH_2N_2, $CHDN_2$, CD_2N_2, and $CH_2N^{15}N$ have been examined between 230 and 4000 cm^{-1} under medium resolution. Band positions have been measured for all the distinguishable parallel features. Nearly all of the perpendicular fundamentals have been resolved and analyzed. The [A" -1/2(B" + C")]-rotational constants derived are: $CH_2N^{15}N$, 8.747 ± 0.015 cm^{-1}; CD_2N_2, 4.253 ± 0.01 cm^{-1}; $CHDN_2$. 5.72 ± 0.1 cm^{-1}. These data combined with that given earlier for the CH_2N_2 isotope, show that the averaged distance of the hydrogen atoms from the molecular axis (in CH_2N_2 and in $CH_2N^{15}N$) is 0.9580 ± 0.0006A and of the deuterium atoms (in CD_2N_2) is 0.9560 ± 0.001A. In contrast to earlier studies, no evidence was found for the presence of a tautomeric form of diazomethane in the samples studies.

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California U. Dept. of Chemistry, Berkeley.

SOLID INFRARED SPECTRA, ASSIGNMENT AND VIBRATIONAL POTENTIAL FUNCTION OF DIAZOMETHANE, by C. B. Moore and G. C. Pimentel. [1964] [14]p. incl. diagrs. tables, refs. (AFOSR-65-0522) (AF 49(638)944) AD 613854 Unclassified

Also published in Jour. Chem. Phys., v. 40: 342-355, Jan. 15, 1964.

Infrared spectra of pure solid diazomethane and diazomethane in nitrogen or argon are given here for the molecules CH_2N_2, CD_2N_2, $CHDN_2$, and $CH_2N^{15}N$. These data combined with the gas-phase spectra reported earlier provide a basis for a reassignment of the vibrational spectrum. The vibrational potential function, centrifugal distortion constants, Coriolis coupling constants, and thermodynamic functions of diazomethane have been calculated. The out-of-plane hydrogen bending force constant is found to be unusually low, 0.045 x 10^{-11} erg rad^{-2}. This is about 1/5 of that for ethylene and about 1/2 of that for ketene. The observed divergence of the energy levels of the out-of-plane hydrogen bending mode shows that there must be a larger positive quartic contribution to the potential function for this motion.

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California U. [Dept. of Chemistry] Berkeley.

PREPARATION OF INERT GAS COMPOUNDS BY MATRIX ISOLATION: KRYPTON DIFLUORIDE, by J. J. Turner and G. C. Pimentel. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-65-0523) (AF 49(638)944) AD 614747 Unclassified

Also published in Hyman: Noble-Gas Compounds, Chicago U. Press, 1963, p. 101-105.

The matrix-isolation technique was used to prepare inert-gas compounds, e.g., XeF_2. The basic idea is to suspend the species in an inert solid matrix and investigate its spectroscopic properties. Inert gases and nitrogen are usual matrix materials. The spectroscopic properties of deposited mixtures of fluorine-argon, fluorine-xenon-argon, and fluorine-krypton-argon were studied; no evidence was found for an argon-fluorine compound by this method.

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XV. RELATIVE STABILITIES OF TRIPHENYLMETHYL AND BRIDGEHEAD TRIPTYCYL CARBANIONS, by A. Streitwieser, Jr., R. A. Caldwell, and M. R. Granger. [1964] [1]p. (AFOSR-65-0225) (AF AFOSR-62-175) AD 611605 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3578, 1964.

As part of a continuing study of base-catalyzed proton-exchange reactions between hydrocarbons and cyclohexylamine it was found that cesium cyclohexylamide is some 1000 to 10,000 times more reactive than lithium cyclohexylamide. Despite this large difference in reactivity, relative rates of exchange of different hydrocarbons are closely similar with both catalysts. The bridgehead position of triptycene is clearly comparable in acidity to aromatic hydrogens and its acidity is much greater than that of saturated hydrocarbons. This enhanced acidity of triptycene can only be attributed to the inductive effect of the attached benzene rings since resonance conjugation with these rings is unlikely. More than half of the enhanced acidity of triphenylmethane over saturated hydrocarbons is due to the inductive effect of the 3 benzene rings and that less than half can be attributed to resonance stabilization of the carbanion. To the extent that relief of steric strain contributes to the acidity of triphenylmethane, the role of resonance is still less.

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California U. Dept. of Chemistry, Berkeley.

SPECTRA OF SOME ALKALI SALTS OF HYDROCARBONS, by A. Streitwieser, Jr. and J. I. Brauman. [1963] [4]p. incl. diagrs. tables, refs. (AFOSR-65-0227) (AF AFOSR-62-175) AD 611606 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2633-2636, 1963.

Electronic absorption spectra are presented for lithium salts of fluorene, the benzofluorenes, 4,5-methylenephenanthrene, benzanthrene, fluoradene, 9-methyl- and 9-phenylfluorene, xanthrene, triphenylmethane, and tris-(p-biphenylyl)-methane in cyclohexylamine. Some cesium salts are included as well as some spectra in 1,2-dimethoxyethane and ether. The spectra are discussed in terms of simple molecular orbital theory and the cation effect and solvent effect are interpreted. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. IX. RATES OF EXCHANGE OF ARYL HYDROGENS WITH LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr. and R. G. Lawier. [1963] [2]p. incl. diagr. tables. (AFOSR-65-0228) (AF AFOSR-62-175) AD 611603 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2854-2855, Sept. 20, 1963.

By analogy with previous work with toluene, it was expected that aryl hydrogen exchange would proceed via the aryllithium intermediate. Confirming evidence was found in the relatively large decelerating effect of a phenyl substituent on the rate of exchange of the hydrogens of benzene. The greater exchange rate of the 3-diphenylyl position over the 4-position indicates that carbene-carbanion resonance I is not important in these cases. The perturbation of the Pi-electron system due to a change in Coulomb integral by the presence of a negative charge on carbon would also appear to be of minor importance. The experimental results are interpretable quantitatively in terms of a simple electrostatic model.

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California U. Dept. of Chemistry, Berkeley.

TRITIODEPROTONATION OF BIPHENYLENE, by A. Streitwieser, Jr. and I. Schwager. [1963] [1]p. incl. diagr. (AFOSR-65-0229) (AF AFOSR-62-175) AD 611601 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2855, 1963.

The rates of tritiodeprotonation of biphenylene were determined for both the 1- and 2-positions. The rate constants obtained were k-α = 0.0000432/sec and k-β = 0.00275/sec; k-β/k-α = 64.

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California U. Dept. of Chemistry, Berkeley.

ON HUHN'S OMEGA DOUBLE PRIME-MOLECULAR ORBITAL METHOD, by A. Streitwieser, Jr., A. Heller, and M. Feldman. [1964] [3]p. incl. tables. (AFOSR-65-0377) (AF AFOSR-62-175) AD 611731 Unclassified

Also published in Jour. Phys. Chem., v. 68: 1224-1226, 1964.

Further study was made of the method of Kuhn (Tetrahedron, v. 19 (Suppl. 2), 88, 389, 437, 1963) which gives consideration to potential associated with neighboring atoms. The omega single prime technique, with effect limited to the nearest neighbors of the carbon atom, was applied to the benzyl cation, azulene, fulvene, and heptafulvene. The omega single prime was regarded as showing promise.

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XI. ACTIVATION PARAMETERS FOR EXCHANGE OF TOLUENE-α-d WITH LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr., R. A. Caldwell and others. [1964] [3]p. incl. diagr. table. (AFOSR-65-0455) (AF AFOSR-62-175) AD 613778 Unclassified

Also published in Jour. Phys. Chem., v. 68: 2916-2918, Oct. 1964.

The dependence at 2 temperatures of the pseudo-first-order rate constants for exchange of toluene-α-d with cyclohexylamine on the concentration of the lithium cyclohexylamide catalyst leads to the thermodynamic parameters for the aggregation equilibrium of lithium cyclohexylamide and the activation parameters for the bimolecular exchange reaction. The equilibrium is unusual in that aggregation is accompanied by an increase in entropy; the exchange reaction itself has an unusually negative entropy of activation. These results are interpreted in terms of specific solvation effects. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XII. AGGREGATION OF LITHIUM CYCLOHEXYLAMIDE IN CYCLOHEXYLAMINE BY ISOPIESTIC MEASUREMENT, by A. Streitwieser, Jr. and W. M. Padgett. [1964] [4]p. incl. diagrs. table. (AFOSR-65-0456) (AF AFOSR-62-175) AD 613779 Unclassified

Also published in Jour. Phys. Chem., v. 68: 2919-2922, Oct. 1964.

Isopiestic molecular weight measurements of lithium cyclohexylamide in cyclohexylamine show a degree of aggregation in semiquantitative agreement with theories derived previously from kinetic measurements. A modified technique for such isopiestic measurements is described. (Contractor's abstract)

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California U. Dept. of Chemistry, Berkeley.

ACIDITY OF HYDROCARBONS. XIII. SOME CONDUCTIVITY STUDIES OF LITHIUM CYCLOHEXYLAMIDE, FLUORENYLLITHIUM, AND LITHIUM PERCHLORATE IN CYCLOHEXYLAMINE, by A. Streitwieser, Jr., W. M. Padgett, and I. Schwager. [1964] [4]p. incl. diagrs. table, refs. (AFOSR-65-0457) (AF AFOSR-62-175) AD 613845 Unclassified

Also published in Jour. Phys. Chem., v. 68: 2922-2925, Oct. 1964.

An apparatus is described for determining conductivities in an inert atmosphere. Measurements with lithium perchlorate, lithium fluorenyl, and lithium cyclohexylamide in cyclohexylamine at 49.5° give ion-pair dissociation constants in the range 10^{-10} to 10^{-12} mol/l. These results indicate that the bonds to lithium in each of these salts are about equally ionic; the results confirm the conclusions reached in previous studies of kinetics of exchange with lithium cyclohexylamide in cyclohexylamine that free ions are not significantly involved in the concentration region used. (Contractor's abstract)

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California U. [Dept. of Mathematics] Berkeley.

ALGEBRAIC RINGS, by M. J. Greenberg. [1964] [10]p. incl. refs. (AFOSR-65-0865) (AF AFOSR-65-57) AD 617476 Unclassified

Also published in Trans. Amer. Math. Soc., v. 111: 472-481, June 1964.

An algebraic ring is roughly speaking an associative algebra which is an algebraic variety. Proof is presented that (1) an algebraic ring is Artinian; (2) an algebraic ring is, under its addition, a unipotent algebraic group; and (3) the unit group of an algebraic ring is a Zariski open subset. Furthermore, some structure theorems for algebraic rings are proved: a commutative local ring variety of positive characteristic is a finite algebra over a ring of Witt vectors, and a simple ring variety is a matric ring (over an algebraically closed field. (Math. Rev. abstract)

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California U. [Dept. of Mathematics] Berkeley.

THE STEENROD SQUARES IN THE MOD TWO COHOMOLOGY ALGEBRA OF AN H-SPACE, by E. Thomas. [1964] [5]p. (AFOSR-66-2357) (AF AFOSR-63-336) AD 642813 Unclassified

Also published in Jour. Colloq. Topol., Sept. 1964, p. 113-117.

Let X be an H-space, X is assumed to be finite dimensional in the sense of integral homology. The work of Hopf then describes the rational cohomology algebra of X as: $H^*(X;Q) = \Lambda(X_1, \cdots, x_n)$, deg X is odd. Borel considered the analogous question for cohomology with mod p coefficients, p a prime, a showed that: $H^*(Xi Z_p) = \Lambda(Xi \cdots, x_n) [x\ Z_p\ y_1, \cdots y_m]/(y_1^{pr_1}, \cdots, y_m^{pr_m})$. Here, for p odd, de Xi is odd and deg yi even. In the case of mod p cohomolcgy the following question is left open by the structure theory developed above. Question: what is the structure of $H^*(X, Zp)$ as an A(p) algebra? Here A(p) denotes the mod p Steenrod algebra and X an H-space. The work described in this note gives some answer to this question for the case p = 2. Let $H^*(x)$ denote the mod 2 cohomology algebra of X. A central theorem along these lines states that: If X is an H-space such that $H^*(x)$ has a primitive set of generators, V is a primative class of odd degree and t an integer such that (deg v-t) = 1 mod 2, then there exists a primitive class u $H^*(x)$ such that ^{m}v-Sgt(u). Morecver, Sgt (v) = 0.

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California U. Dept. of Physics, Berkeley.

[TIME VARIATIONS OF COSMIC RADIATION AT HIGH ALTITUDES IN THE POLAR REGIONS] by R. R. Brown. Final rept. July 1, 1960-Sept. 30, 1962. Nov. 1962, 6p. (AFOSR-419) (AF 49(638)873) AD 291157 Unclassified

This report gives the final summary of the activities undertaken towards exploring radiation effects at balloon altitudes in the auroral zone. This location offers the best opportunity for obtaining information on particle bombardment of the atmosphere resulting from solar activity. Thus, solar proton events as well as electron events associated with the aurora and magnetic disturbances are often found in this region. Experimental programs will be carried out to study the relationship of visible aurora with x-rays in the auroral zone, the latitude extent of electron precipitation during the magnetic and ionospheric disturbances, and the morphology and fluctuations in time of electron precipitation on conjugate regions of the auroral zone.

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California U. Dept. of Physics, Berkeley.

OBSERVATIONS RELATING TO THE DISTANCE SCALE FOR MOTIONS OF ELECTROJET-ELECTRON PRECIPITATION REGIONS IN THE AURORAL ZONE, by D. P. Marsh. [1963] [8]p. (AFOSR-64-0653) (AF 49(638)873) AD 434848 Unclassified

Also published in Jour. Geophys. Research, v. 68: 4167-4174, July 15, 1963.

From a comparison of x-ray, ionospheric absorption, and geomagnetic observations during an intense electron precipitation event in the auroral zone, it is shown that the distance scale for motions of electrojet-electron precipitation regions is smaller than previously considered. This requires a downward revision of the correction factors for currents induced in the earth by ionospheric current systems. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

SOME NEW ASPECTS OF CYLCOTRON RESONANCE IN COPPER, by J. F. Koch, R. A. Stradling, and A. F. Kip. June 12, 1963, 40p. (AFOSR-64-0769) (AF AFOSR-62-127) AD 430971 Unclassified

Also published in Phys. Rev., v. 133: A240-A252, Jan. 6, 1964.

The development of improved techniques has made possible a new series of cyclotron resonance experiments on Cu which gives more accurate and extended information on electron cyclotron masses. New orbits which have been observed and measured include: (1) a limiting point orbit, (2) orbits extending through 3 and 4 Brillouin zones, (3) orbits whose centers are neither at the center nor edge of the zone, and (4) orbits observed with the magnetic field tipped at large angles (up to 80°) with respect to the crystal surface. The neck orbit has been observed and measured with the field along the 111 direction. The cyclotron mass ratio for this orbit is 0.46. Certain discrepancies and puzzling aspects of earlier data have been clarified and the present data are in excellent accord with de Haas-van Alphen and magnetoacoustic data on the geometry of the Fermi surface. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS. II. THEORETICAL MODELS, by R. W. Michie and P. H. Bodenheimer. Mar. 25, 1963, 13p. (AFOSR-64-1042) (AF AFOSR-62-199) AD 441491 Unclassified

Also published in Monthly Notices, Roy. Astron. Soc., v. 126: 269-281, 1963.

This article presents an extensive set of models for spherical stellar systems using a distribution function which for the inner regions is obtained from the Boltzmann equation with encounters. It is assumed that in the early stages of the formation of clusters and elliptical galaxies, encounters and orbital mixing played an important role in determining the presently observed structure. Since this early time period the systems have not changed much, and can now be considered to be in or near dynamical equilibrium. These assumptions permit an extension of the initial distribution function to describe the whole system at later times. Numerical integrations have produced models with a wide variety of structure, which are in agreement with the simple sensity distributions of star clusters as well as the more complicated run of the density observed in some spherical galaxies. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS III. THE RELATIVE LOSS OF STARS WITH DIFFERENT MASS, by R. W. Michie. Mar. 25, 1963, 11p. (AFOSR-64-1043) (AF AFOSR-62-199) AD 441471 Unclassified

Also published in Monthly Notices, Roy. Astron. Soc., v. 126: 331-341, 1963.

A distribution function which includes a velocity-space anisotropy and which satisfies the Boltzmann equation for both large and small energy is used to calculate the relative rate of stellar mass loss from spherical systems. The calculations are based on the velocity-space flux vector, and do not employ the use of a relaxation time. The loss of stars of different mass at varying distances throughout the system from different spherical models demonstrates the dynamical importance of the low mass stars. The stars whose mass is about the average stellar mass may leave the system, as a result of distant encounters, from 10 to over 100 times faster than the average stars, depending on the model. The depletion of low luminosity stars in galactic clusters and the distribution of white dwarfs in globular clusters is briefly discussed. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

THE DYNAMICS OF SPHERICAL STELLAR SYSTEMS. IV. A STUDY OF GALACTIC CLUSTERS, by R. W. Michie. Jan. 29, 1963, 19p. (AFOSR-64-1044) (AF AFOSR-62-199) AD 441497 Unclassified

Also published in Roy. Astron. Soc., v. 126: 499-517, 1963.

A comparison is made between the galactic cluster surface densities resulting from star counts to faint magnitudes with theoretical surface densities. The latter are calculated using a distribution function obtained from the Boltzmann equation with encounters and with a spatial truncation to approximate the effects of the tidal force exerted by the Galaxy. On the basis of limited data there is a relation between the degree of depletion of very faint stars and the model parameter C in the sense that in systems for which C is large, the depletion of faint stars is not very great, for a very small C, there can be a very rapid decrease in the luminosity function at faint magnitudes. Young galactic clusters are particularly important, for the elongated orbits must be a result of initial conditions, in particular the degree of metal abundance, state of turbulence and large scale motion of the initial gas cloud. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

[HIGHER CONVECTIVE VERTICAL MODES AN. INSTABILITY RATES IN THE SOLAR HYDROGEN CONVECTION ZONE] Strömungsformen verschiedener vertikaler Wellenlangen in der solaren Wassertoffkonvektionszone, by K. H. Böhm. [1963] [13]p. incl. diagrs. refs. (AFOSR-66-0370) (AF AFOSR-62-199) AD 640221 Unclassified

Also published in Zeitschr. Astrophys., v. 57: 265-277, 1963.

Higher convective modes and their rates of instability have been computed for the model of the solar hydrogen convection zone given by E. Bohm-Vitense (1958). The calculations are based on the linearized hydrodynamic equations. Viscosity and radiative conductivity have been neglected. The present computations cover the fundamental, the 1, 2, 3, and 4 mode in the horizontal wavelength range 5000 km $\geq \lambda/2 \geq$ 170 km. A method of matrix iteration has been used for the numerical determination of the higher eigenvalues and eigensolutions of the finite difference-approximations of the hydrodynamic equations. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

COLLISION-INDUCED RELAXATION OF ORIENTED Rb^{87} ATOMS IN THE $5^2P_{1/2}$ STATE (Abstract), by J. Yellin and R. Marrus. [1964] [1]p. (AFOSR-66-1562) (AF AFOSR-62-346) AD 640222 Unclassified

Presented at meeting of the Amer. Phys. Soc., Dec. 21-23, 1964.

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 720, 1964.

Mixing of alkali excited states by collisions with a buffer gas has a pronounced effect on the structure of the optical-pumping transients. Cross sections for disorienting a Rb^{87} atom in the $5^2P_{1/2}$ state by collisions with helium, neon, and argon have been determined from a study of optical-pumping transients. The cross sections are $1.2(0.6) \times 10^{-17}$, $5.0(2.5) \times 10^{-17}$, and $3.5(1.7) \times 10^{-16}$ cm^2 for helium, neon and argon respectively. The model used to obtain the cross sections and the errors involved is discussed.

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California U. Dept. of Physics, Berkeley.

STUDY OF OPTICAL-PUMPING TRANSIENTS IN RUBIDIUM AND CESIUM VAPORS (Abstract), by J. Yellin, R. Marrus, and W. A. Nierenberg. [1964] [1]p. (AFOSR-66-1564) (AF AFOSR-62-346) AD 640253 Unclassified

Presented at meeting of the Amer. Phys. Soc., Denver, Colo., June 25-27, 1964.

The shape of optical-pumping transients in rubidium vapor were studied in detail. Observed transients can be separated into a sum of exponential components. These components are found to be in agreement with a theoretical model based on complete mixing in the excited state. From a study of the times of the individual components as a function of light intensity, relaxation times can be deduced. By using this method, the relaxation time of cesium vapor in a 200-ml Pyrex bulb with no buffer gas was measured to be $T_1 = 0.6(1)$ msec. This corresponds to an average of 2.5 wall collisions before relaxation.

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California U. Dept. of Physics, Berkeley.

ELECTRONIC g-FACTOR, HYPERFINE-STRUCTURE SEPARATION, AND MAGNETIC MOMENT OF Cu^{64} (Abstract), by B. M. Dodsworth and H. A. Snugart. [1964] [1]p. (AFOSR-66-1565) (AF AFOSR-62-346) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

An atomic-beam "flop-in" apparatus has been used to investigate the properties of radioactive Cu^{64} (12.8 h). Both the $\Delta F = 0$ and $\Delta F = \pm 1$ resonances were observed at several values of magnetic field. A least-squares-fit analysis of all resonances leads to the following results: $\Delta\nu\,(3/2 \rightarrow 1/2) = -1282.140(10)$ mc/sec, μ_1 (uncorrected) $= -0.216(2)$, and $g_J = -2.00229(2)$, where $g_J = \mu_J/J$ (in units of μ_0). The magnetic moment is calculated from the Fermi-Segrè formula, and its error is taken to be 1% to include a possible hyperfine-structure-anomaly effect. The hyperfine-structure separation and g_J value represent improvements of previous measurements.

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California U. Dept. of Physics, Berkeley.

DAY-NIGHT RATIO FOR AURORAL ABSORPTION EVENTS ASSOCIATED WITH NEGATIVE MAGNETIC BAYS, by R. R. Brown and J. R. Barcus. [1963] 6p. incl. diagrs. tables, refs. (AFOSR-J1255) (AF AFOSR-62-422) AD 424323

Also published in Jour. Geophys. Research, v. 68: 4175-4180, July 15, 1963.

An examination of solar illumination effects for auroral absorption events centered over the 27.64 mc riometer antenna pattern at College, Alaska, shows that the day-night absorption ratio is essentially unity. This finding indicates that electron-positive ion recombination far outweighs electron attachment processes in auroral absorption regions and is consistent with present knowledge of the electron bombardment as well as ionic-molecular processes at the 90 to 100 km level. Further implications of this result are discussed. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

BALLOON OBSERVATIONS OF THE EXTENT AND STRUCTURE OF AURORAL-ZONE ELECTRON PRECIPITATION EVENTS, by R. R. Brown and J. R. Barcus. [1963] 9p. incl. diagrs. refs. (AFOSR-64-0372) (AF AFOSR-62-422) AD 434532 Unclassified

Also published in Jour. Geophys. Research, v. 68: 6069-6077, Nov. 15, 1963.

Simultaneous balloon observations of auroral-zone electron precipitation from College and Fort Yukon, Alaska, in June of 1962 showed examples of the electron influx increasing with increasing geomagnetic latitudes, both with and without magnetic bay disturbances. Under more disturbed conditions, the x-ray flux recorded by the southern balloon far exceeded that by the northern balloon, indicating a sharp boundary for the electron precipitation region as suggested by O'Brien on the basis of satellite measurements. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

A STUDY OF THE RELATIONSHIP BETWEEN ABSORPTION-TIME PROFILES OF POLAR-CAP-ABSORPTION EVENTS AND FORBUSH DECREASES OF COSMIC-RAY INTENSITY, by J. T. Goaling. [1964] [6]p. incl. diagrs. tables. (AFOSR-65-1751) (AF AFOSR-62-422) AD 625679 Unclassified

Also published in Jour. Geophys. Research, v. 69: 1233-1238, Apr. 1, 1964.

Forbush decrease data recorded by neutron monitors during PCA events support the interpretation of the absorption-time profiles of PCA events as due to solar particles under the influence of magnetic fields carried by solar plasma. All PCA events showing evidence of strong trapping of solar particles are accompanied by strong Forbush decreases, the magnitudes of which are a function of the delay time from flare to SC storm. Those PCA events showing little evidence of trapping are accompanied by only very weak decreases. The large western excess of these latter events is explained in terms of sun-earth magnetic linkage set up by earlier flare activity. The relative merits of 2 models of the interplanetary fields are examined. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

ON THE CONTRIBUTION OF SOLAR-FLARE ALPHA PARTICLES TO POLAR CAP ABSORPTION EVENTS, by R. A. Weir and R. R. Brown. [1964] [6]p. incl. diagrs. (AFOSR-65-1752) (AF AFOSR-62-422) AD 626491 Unclassified

Also published in Jour. Geophys. Research, v. 69: 2193-2198, June 1, 1964.

A series of calculations are carried out to determine the relative importance of ionization from solar-flare α-particles to polar cap absorption events. The exponential rigidity spectrums for solar-flare radiation discussed by Freier and Webber are used. To illustrate the actual magnitudes involved, typical fluxes, rigidity spectrums, and proton α-particle ratios from major polar cap events are used. The electron production rates, electron densities, and specific absorption as a function of altitude for a proton α-particle ratio of unity are presented for a location with cutoff rigidity P_c = 470 mev. These results indicate that α-particles contribute significantly, producing as much as 75% of the ionospheric absorption when the proton α-particle ratio is unity. (Contractor's abstract)

220

California U. [Dept. of Physics] Berkeley.

A COMPARISON OF AURORAL LUMINOSITY AND IONOSPHERIC ABSORPTION USING WIDE-ANGLE MEASUREMENTS, by R. R. Brown and J. R. Barcus. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-1759) (AF AFOSR-62-422) AD 626492 Unclassified

Also published in Arkiv Geofysik, v. 4: 395-403, 1964.

A comparison of auroral luminosity variations over the antenna pattern of the 27.6 mc/s riometer at College, Alaska, with ionospheric absorption records indicates, as noted earlier by other means, that ionospheric absorption is associated principally with the post-breakup aurora suggests that the fluctuations in the relation between auroral absorption and geomagnetic disturbance, as well as auroral luminosity and ionospheric absorption, are due to differences in the electron energy spectrum from event to event rather than spatial structure of the particle bombardment. (Contractor's abstract)

221

California U. [Dept. of Physics] Berkeley.

OBSERVATIONS ON THE RELATIONSHIP OF ENERGETIC PARTICLE PRECIPITATION TO AURORAL ZONE PHENOMENA, by J. R. Barcus. June 1964, 40p. (AF AFOSR-62-422) AD 602434 Unclassified

A series of instrumented balloon flights was made from Barrow, Alaska, to study the relationship of electron precipitation to auroral zone phenomena. Observations and results are presented on the relationship of energetic electrons to visual aurora, auroral absorption, and to geomagnetic pulsations.

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California U. Dept. of Physics, Berkeley.

BOOTSTRAPS AND THE PION-NUCLEON SYSTEM, by E. Abers and C. Zemach. [1963] [14]p. incl. diagrs. tables, refs. (AFOSR-64-0263) (AF AFOSR-63-130) AD 432529 Unclassified

Also published in Phys. Rev., v. 131: 2305-2318, Sept. 1, 1963.

It has been suggested that all the observable properties of strongly interacting systems can be determined self-consistently if there do not exist any elementary particles in the conventional sense. This conjecture is applied to

the nucleon mass and the pion-nucleon coupling constant, which are calculated under the assumption that the nucleon is composite, and that its existence is a consequence of the same forces which produce pion-nucleon resonances. It is shown qualitatively that the self-consistent method not only predicts the nucleon and the P 3/? 3/2 resonance, but excludes other combinations which are not observed. This notion is illustrated by consideration of hypothetical interactions between nucleons and scalar mesons and between λ and σ hyperons of negative relative parity. (Contractor's abstract)

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California U. [Dept. of Physics] Berkeley.

SINGULARITIES IN THE UNPHYSICAL SHEETS AND THE ISOBAR MODEL, by R. C. Hwa. [1963] [13]p. incl. diagrs. refs. (AFOSR-64-0264) (AF AFOSR-63-130) AD 432530 Unclassified

Also published in Phys. Rev., v. 130: 2580-2592, June 15, 1963.

Scattering amplitudes involving 2- and 3-particle states continued across the inelastic section of the unitarity cut, and the singularities in the unphysical sheets thus reached are determined. Associated with an unstable particle is a complex unitarity cut, through which we further continue into another unphysical sheet. Dynamical singularities associated with a Born-type diagram for the 3-particle scattering amplitude are found to be present in the elastic scattering and the production amplitudes also because of the coupling by unitarity. These singularities are isolated from the physical region by the complex unitarity cut and thus cannot be directly responsible for any resonance phenomenon. (Contractor's abstract, modified)

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California U. Dept. of Physics, Berkeley.

A GENERALIZED SUSCEPTIBILITY AND HARTREE-FOCK APPROACH TO THE MANY-BODY PROBLEM, by V. J. Emery. [1964] [16]p. incl. refs. (AFOSR-64-2469) (AF AFOSR-63-130) AD 453750 Unclassified

Also published in Nuclear Phys., v. 57: 303-318, 1964.

It is shown that the 2-particle density matrix and hence the grand partition function for a many-body system may be obtained from generalized susceptibilities which specify the linear response of the system to external perturbations which excite oscillations in the relative motion of pairs of particles. The susceptibilities are calculated in a generalized time-dependent Hartree-Fock approximation which is a generalization of the BCS theory of superconductivity or the Bogolyubov, Brueckner-Sawada theory of a Bose system. The partition function obtained in this manner is equivalent to a sum of ladder graphs for a normal Fermion system and to a sum of quasi-particle ladder graphs for a "superconductive" Fermion system, unphysical poles in the reaction matrix do not arise. The method is extended to give a finite temperature version of Brueckner's theory. Equivalent results are derived for systems of bosons. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

FINE STRUCTURE OF HELIUM, by C. Schwartz. [1964] [7]p. incl. diagr. tables, refs. (AFOSR-65-1110) (AF AFOSR-63-130) AD 620478 Unclasstfted

Also published in Phys. Rev., v. 134: A1181-A1187, June 1, 1964.

Under the expectation that experiments will soon give values for the fine structure intervals of the 2^3P state of helium to accuracy of $1/10^6$, a program of calculations is undertaken which will probably lead to a new determination of the fine-structure constant α. This paper gives a brief survey of the over-all program, and a detailed report of the successful completion of the first task: the construction of approximate solutions to the Schrödinger equation which lead to average values of the leading fine structure operators accurate to about one part per million. (Contractor's abstract)

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California U. Dept. of Physics, Berkeley.

SCATTERING OF SOUND BY A CLASSICAL VORTEX, by A. L. Fetter. [1964] [6]p. incl. refs. (AFOSR-65-1111) (AF AFOSR-63-130) AD 620479 Unclassified

Also published in Phys. Rev., v. 136: A1488-A1493, Dec. 14, 1964.

The cross section for the scattering of sound by a vortex is calculated using the linearized equations of classical hydrodynamics. With a circulation κ, the differential cross section in the long-wavelength limit is $1/2\ \pi(\kappa/2\pi c)^2\kappa\ \sin^2\theta\ (1-\cos\theta)^{-2}$, where c is the speed of sound. Possible experimental verification is suggested, with particular reference to liquid He II. (Contractor's abstract)

227

California U. [Dept. of Physics] Berkeley.

PHOTONS AND GRAVITONS IN S-MATRIX THEORY: DERIVATION OF CHARGE CONSERVATION AND EQUALITY OF GRAVITATIONAL AND INERTIAL MASS, by S. Weinberg. [1964] [8]p. (AFOSR-64-2044) (AF AFOSR-63-232) AD 452516 Unclassified

Also published in Phys. Rev., v. 135: B1049-B1056, Aug. 24, 1964.

A purely S-matrix-theoretic proof is given of the conservation of charge (defined by the strength of soft photon interactions) and the equality of gravitational and inertial mass. (Contractor's abstract)

228

California U. [Dept. of Physics] Berkeley.

FUNCTIONAL ANALYSIS AND SCATTERING THEORY, by M. Scadron, S. Weinberg, and J. Wright. [1964] [6]p. (AFOSR-64-2045) (AF AFOSR-63-232) AD 452330 Unclassified

Also published in Phys. Rev., v. 135: B202-B207, July 13, 1964.

This paper is concerned with the application of functional analysis to the problem of scattering of a single nonrelativistic particle by a fixed interaction V. (Contractor's abstract)

229

California U. [Dept. of Physics] Berkeley.

PERTURBATION THEORY FOR STRONG REPULSIVE POTENTIALS, by S. Weinberg. [1963] [5]p. (AFOSR-64-2437) (AF AFOSR-63-232) AD 453746 Unclassified

Also published in Jour. Math. Phys., v. 5: 743-747, June 1964.

A conformal mapping of the coupling-constant plane is used to rearrange the Born series. The new series is guaranteed to converge for any decent repulsive potential. The first few terms do well in actual calculations of the scattering length. (Contractor's abstract)

230

California U. [Dept. of Physics] Berkeley.

POTENTIAL THEORY CALCULATIONS BY THE QUASIPARTICLE METHOD, by M. Scadron and S. Weinberg. [1963] [8]p. (AFOSR-64-2438) (AF AFOSR-63-232) AD 453748 Unclassified

Also published in Phys. Rev., v. 133: B1589-B1596, Mar. 23, 1964.

The quasiparticle method is used to find binding energies, scattering lengths, and cross sections for one particle in a strong Yukawa, Hulthen, or exponential potential. The results are excellent in the lowest approximation. (Contractor's abstract)

231

California U. [Dept. of Physics] Berkeley.

FEYNMAN RULES FOR ANY SPIN, by S. Weinberg. [1964] [15]p. (AFOSR-64-2439) (AF AFOSR-63-232) AD 453803 Unclassified

Also published in Phys. Rev., v. 133: B1318-B1332, Mar. 9, 1964.

The explicit Feynman rules are given for massive particles of any spin j, in both a 2j + 1-component and a 2(2j + 1)-component formalism. The propagators involve matrices which transform like symmetric traceless tensors of rank 2j; they are the natural generalizations of the 2 x 2 four-vector σ-μ and 4 x 4 four-vector γ-μ for j = 1/2. The calculation uses field theory, but only as a convenient instrument for the construction of a Lorentz-invariant S matrix. This approach is also used to prove the spin-statistics theorem, crossing symmetry, and to discuss T, C, and P. (Contractor's abstract)

232

California U. [Dept. of Physics] Berkeley.

FEYNMAN RULES FOR ANY SPIN. II. MASSLESS PARTICLES, by S. Weinberg. [1964] [15]p. (AFOSR-64-2440) (AF AFOSR-63-232) AD 453804 Unclassified

Also published in Phys. Rev., v. 134: B882-B896, May 25, 1964.

The Feynman rules are derived for massless particles of arbitrary spin j. Some other subjects discussed include: T, C, and P for massless particles and fields; the extent to which chirality conservation implies zero physical mass; and the Feynman rules for massive particles in the helicity formalism. The approach is based on the assumption that the S matrix is Lorentz invariant, and makes no use of Lagrangians or the canonical formalism. (Contractor's abstract)

233

California U. [Dept. of Physics] Berkeley.

METHODS FOR DETERMINING THE SPIN AND PARITY OF THE β PARTICLE, by C. Zemach. [1964] [8]p. (AFOSR-64-2441) (AF AFOSR-63-232) AD 453802 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 1605-1612, June 16, 1964.

Experimental tests for the spin and parity of the β particle are derived from angular correlations of particles associated with production and decay of the β. (Contractor's abstract)

234

California U. [Dept. of Physics] Berkeley.

THREE-PION DECAYS OF UNSTABLE PARTICLES, by C. Zemach. [1963] [20]p. (AFOSR-64-2442) (AF AFOSR-63-232) AD 453755 Unclassified

Also published in Phys. Rev., v. 133: B1201-B1220, Mar. 9, 1964.

The properties of particles of arbitrary spin and parity that decay into 3 pseudoscalar mesons are surveyed, with primary attention to 3 π decays, in order

to ftnd efficient means of detecting such particles. Among the topics considered are: the general forms of amplitudes subject to tnvariance and symmetry requtrements; the regions of vanishing density in ihe Dalitz ploi; branching ratios; angular correlaitons among vectors normal to and lying in the production and decay planes; and spectal decay modes through 2-particle resonances. The angular correlations are discussed tn detail for processes tndependent of the intrinsic spin of the production particles, as is appropriate in coherent nuclear processes, and a framework of analysis is provided for more complex problems. (Contractor's abstract, modified)

235

California U. [Dept. of Physics] Berkeley.

SYSTEMATIC SOLUTION OF MULTIPARTICLE SCATTERING PROBLEMS, by S. Weinberg. [1963] [25]p. (AFOSR-64-2443) (AF AFOSR-63-232) AD 453744 Unclassified

Also published in Phys. Rev., v. 133: B232-B256, Jan. 13, 1964.

Scattering problems for 3 or more particles cannot be solved by a direct use of those techniques, like the Fredholm or quasiparticle methods, which work for 2 particles. It is shown how to overcome any difficulty, and calculate all Green's functions and scattering amplitudes in a systematic and essentially rigorous manner. The dynamical equations are rewritten as a sequence of linear integral equations for successtvely larger systems, each with a kernel and inhomogeneous term which can be calculated explicitly from the solutions of the previous equations. The kernels arise from connected graphs only, so each integral equation can be solved by the Fredholm, quastparticle, or other methods. The distorted wave approximation appears naturally in thts approach. One minor by-product is an explicit upper bound on the binding energy of any N-particle composite sysiem with square-integrable potentials. (Contractor's abstract)

236

California U. [Dept. of Physics] Berkeley.

POLES IN COUPLED SCATTERING AMPLITUDES, by A. J. Dragt and R. Karplus. [1963] [7]p (AFOSR-64-2444) (AF AFOSR-63-232) AD 453753 Unclassified

Also published in Jour. Math. Phys., v. 5: 120-126, Jan. 1964.

Elastic scattering amplitudes which have the analytic structure of the Mandelstam representation and which satisfy the unttarity condition and substitution law are severely restricted. Because of these restrictions, poles cannot occur tndependently and arbitrarily tn amplitudes coupled by the unttarity condttion. Instead, the locations and residues of poles in coupled amplitudes must satisfy the same relations as do poles tn perturbation theory amplitudes. (Contractor's abstract)

237

California U. [Dept. of Physics] Berkeley.

ORIGIN OF INTERNAL SYMMETRIES, by E. Abers, F. Zachariasen, and C. Zemach. [1963] [6]p. (AFOSR-64-2446) (AF AFOSR-63-232) AD 455751 Unclassified

Also published in Phys. Rev., v. 132: 1831-1836, Nov. 15, 1963.

Internal symmetries such as isotopic spin are not necessarily arbitrary constraints to be imposed at the beginning of a calculation. The bootstrap requirement that all particles be determined as composite states of one another leads naturally to symmetric solutions for masses and coupling constants. (Contractor's abstract)

238

California U. [Dept. of Physics] Berkeley.

CYCLOTRON RESONANCE IN SODIUM AND POTASSIUM, by C. C. Grimes and A. F. Kip. July 22, 1963, 31p. (AF AFOSR-63-290) AD 430975 Unclassified

Azbel'-Kaner cyclotron resonance has been observed in ortented single crystals of sodium and potassium. The data are isotropic in both metals and yield for the ratio of cyclotron effective mass to free electron mass the values 1.24 ± 0.02 and 1.21 ± 0.02 for sodium and potassium respectively. The isotropy of the data for potassium indicates that its Fermi surface is nearly spherical with the anisotropy in kF probably less than 1%. The interpretation of the data for sodium ts complicated by the existence of a low temperature phase transformation. (Contractor's abstract)

239

California U. [Dept. of Physics] Berkeley.

WAVEMETERS FOR MILLIMETER WAVELENGTHS, by G. R. Gathers. 1963, 6p. (AF AFOSR-63-290) AD 415633 Unclassified

Improved wavemeters of simple design are described making use of confocal multimode resonators. Experiments are described evaluating design parameters and actual performance. (Contractor's abstract)

240

California U. [Dept. of Physics] Berkeley.

A COMPARISON OF AURORAL LUMINOSITY AND IONOSPHERIC ABSORPTION USING WIDE-ANGLE MEASUREMENTS, by R. R. Brown and J. R. Barcus. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-1876) (AF AFOSR-63-331) Unclassified

Also published in Arkiv Geofysik, v. 4: 395-403, 1964.

A comparison of auroral lumtnosity variations over

the antenna pattern of the 27.6 mc/s rtometer at College, Alaska, with ionospheric absorption records indicates that tonospheric absorption is associated principally with the post-breakup phase of auroras. The lack of visible structure to the diffuse post-breakup aurora suggests that the fluctuations in the relation between auroral absorption and geomagnetic disturbances, as well as auroral luminosity and ionospheric absorption, are due to differences in the electron energy spectrum from event to event rather than spatial structure of the particle bombardment. (Contractor's abstract)

241

California U. Dept. of Physics, Berkeley.

PHASE-SHIFT EQUATIONS FOR MANY-CHANNEL PROBLEMS, by C. Zemach. [1964] [9]p. (AFOSR-65-0493) (AF AFOSR-64-232) AD 614167 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 939-947, Aug. 1, 1964.

First-order differential equations for phase shifts are obtained for the many-channel case as a generalization of Calogero's results for ordinary potential scattering (see item no. 333, Vol. VI). (Contractor's abstract)

242

California U. [Electronics Research Lab.] Berkeley.

SPACE CHARGE INSTABILITIES IN ELECTRON DIODES. II, by W. B. Bridges. Apr. 15, 1963 [10]p. (AFOSR-64-0060) (AF 49(638)102) AD 431166 Unclassified

Also published in Jour. Appl. Phys., v. 34: 2946-2955, Oct. 1963.

A detailed analysis of space-charge instabilities in diodes is presented. The oscillation when the input current exceeds the limiting input current (from earlier analysis for a short circuited diode with a zero temperature stream) persists with the addition of a diode resistance, or with a two-velocity input or a Maxwellian velocity distribution input, or with streams of finite diameter. The time-averaged value of the minimum potential is nearly zero, as in the classical solution; however, the time-averaged minimum position and transmitted current differ considerably from the classical values. The recovery of the stable state is by a jump rather than gradually as in the classical solution. A small-signal prediction of time growth of all first-order variables (Potential, current, velocity) at the point of limiting is given. An energy argument using the zero-order variables is presented showing the onset of instability. Experiments agreed with some parts of the analysis but did not show oscillations with amplitudes as large as expected. (Contractor's abstract)

243

California U. Electronics Research Lab., Berkeley.

DIATOMIC GAS OPTICAL MASER WITH EXPLODING WIRE PUMPING SOURCE, by L. Hajdu. June 5, 1963, 36p. (Rept. no. 63-12) (AF 49(638)102) AD 421806 Unclassified

The feasibility of a gaseous maser in which the excited atoms are produced through photochemical decomposition of diatomic molecules (such as nitrogen, oxygen and nitric oxide) is studied. As an example, the photodissociation of NO is discussed in detail. The calculations indicate that light oscillation may be achieved at 7468.8A and 8446A wavelengths. Because of the required high excitation energies, the useful pumping band of such a system is in the extreme ultraviolet. Exploding wire is suggested as a suitable light source, having very intense output in the vacuum ultraviolet, with excellent reproducibility of its spectral characteristics per flash. Preliminary experiments show that when nitrogen and oxygen molecules are photoactivated by the light output of an exploding wire, the 7468.8A nitrogen and 8446A oxygen emtssion lines appear with relatively high intensities.

244

California U. [Electronics Research Lab.] Berkeley.

ON THE GENERATION OF THE STABILITY CONSTRAINTS FOR LINEAR DISCRETE SYSTEMS, by E. I. Jury. [1962] [1]p. incl. tables. (AF AFOSR-62-70) Unclassified

Published in IEEE Trans. Automatic Control, v. AC-8: 184, Apr. 1963.

Recently, certain simplified analytic tests for linear discrete systems (or stability within the unit circle) have been developed. These tests can be of 3 forms, i.e., the determinant, table, and the division methods. In this note the stability constraints which are obtained from the table or division method will be generated without the use of the table or division. This generation is based on simple rules which can be easily remembered and applied. (Contractor's abstract)

245

California U. [Electronics Research Lab.] Berkeley.

SCATTERING OF HIGH-FREQUENCY WAVES BY PERFECTLY CONDUCTING RECTANGULAR CYLINDERS, by K. Mei. [1963] [5]p. (AFOSR-J1395) (AF AFOSR-62-340) AD 428359 Unclassified

Also published in IEEE Internat'l. Conv. Rec., Pt. 1: 132-136, 1963.

Application of the geometric theory of diffraction in the interpretation of the high-frequency phenomena is presented. The occurrences of resonances in the obstacles are explained. The diffracted fields contributed by the

corners are shown to be much weaker than was to be expected. The total scattering cross-sections of rectangular cylinders are discussed. (Contractor's abstract)

246

California U. Electronics Research Lab., Berkeley.

ANALYSIS AND SYNTHESIS PROBLEMS IN SILICON INTEGRATED CIRCUITS, by D. O. Pederson. [1963] [5]p. incl. diagrs. refs. (AFOSR-J1396) (AF AFOSR-62-340) AD 428358 Unclassified

Also published in IEEE Internat'l. Conv. Rec., Pt. 2: 171-177, 1963.

Circuit problems with three circuit functions for S-1-C are discussed. These problems fall into the general topics of distributed, non-exact realizations of lumped, prototype circuits and of the lack of basic understanding of electron circuit functions. In common with earlier, conventional electronic circuit efforts, the work to be done can be separated into two areas. One area concerns the actual realization of a circuit, in this case a S-1-C, and at least initially will involve much empiricism. The other area of needed effort must deal with basic methods of analysis and design (synthesis being a sub-class of the latter). In the latter area, it is hoped that the circuit theorist of today and tomorrow will join the effort. (Contractor's abstract, modified)

247

California U. Electronics Research Lab., Berkeley.

REPORT ON EXPERIMENTS WITH THE OLFACTORY CORTEX OF THE CAT, by G. G. Furman. Jan. 17, 1964, 37p. incl. illus. diagrs. refs. (Rept. no. 64-1) (AFOSR-64-0318) (AF AFOSR-62-340) AD 430077 Unclassified

Experiments with the stimulation of the olfactory cortex of the cat were conducted with help of chronically implanted bipolar electrodes for recording and stimulation. The final response data were obtained by averaging 10 or more time responses so as to raise the signal-to-noise ratio. An analytic expression for the theoretical cortical response was obtained by means of a model which treats the primary cortical unit as a current generator of damped sinusoids. The theoretical curves, as generated by a digital computer, showed an excellent fit with some of the experimental curves. Some alternative theories are also discussed, as the present one was not shown to be a unique solution. Nevertheless, it was thought that because it utilizes a new technique of spatial summation in a neuronal tissue, it provides a realistic basis for the analysis of evoked cortical potentials. (Contractor's abstract)

248

California U. [Electronics Research Lab.] Berkeley.

FINDING THE MOST RELIABLE ROUTES IN COMMUNICATION SYSTEMS, by S. C. Parikh and I. T. Frisch. [1963] [5]p. incl. diagrs. (AFOSR-64-1581) (AF AFOSR-62-340) AD 446365 Unclassified

Also published in IEEE Trans. Commun. Systems, v. CS-11: 402-406, Dec. 1963.

It is shown that the problem of finding the most reliable route between two stations in a communication system can be reduced to the problem of finding the shortest path between two nodes in a weighted linear graph. The known methods for finding the shortest path in a linear graph are extended to apply to any communication system, and simplified algorithms and computer subroutines are presented. (Contractor's abstract)

249

California U. [Electronics Research Lab.] Berkeley.

DESIGN OF DUAL-REFLECTOR ANTENNAS WITH ARBITRARY PHASE AND AMPLITUDE DISTRIBUTIONS, by V. Galindo. Nov. 14, 1963, 6p. (AFOSR-64-2221) (AF AFOSR-62-340) AD 452293 Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-12: 403-408, July 1964.

A synthesis method based on geometrical optics for designing a dual-reflector antenna system with an arbitrary phase and amplitude distribution is the aperture of the second reflector is presented. The first reflector may be illuminated by a pattern with an arbitrarily curved phase front. A pair of first-order ordinary nonlinear differential equations of the form $dy/dx = f(x, y)$ are developed for the system. Questions concerning uniqueness, existence and bounds for the solutions can be answered. Calculations and numerical results for the design of a uniform amplitude and phase dual-reflector system are presented.

250

California U. Electronics Research Lab., Berkeley.

A STUDY OF LIMITATIONS ON THE CHARACTERISTICS OF NETWORK FUNCTIONS, by J. D. Patterson. Mar. 15, 1963, 44p. (Internal technical memo. no. M14) (AF AFOSR-62-340) AD 418706 Unclassified

An investigation is made of the general form of the limitations imposed on driving point and transfer immittances when some part of the input circuit of a network is fixed. The limitations are found to be bounds on the real and imaginary parts of the functions at points in the right half plane. At certain specific frequencies determined by the fixed part of the network, the values of the immittance function and some of its derivatives are fixed. These limitations on the values of immittance functions at points in the right half plane are then expressed in terms of integrals of the function along the

imaginary axis by means of Cauchy's integral formula. The limitations on integrals are utilized to find limitations on the characteristics of ideal immittance functions. Several examples are given to illustrate the use of these limitations. (Contractor's abstract)

251

California U. Electronics Research Lab., Berkeley.

FOCUSING OF AN ELECTRON STREAM WITH RADIO-FREQUENCY FIELDS, by C. K. Birdsall and G. W. Rayfield. [1964] [22]p. incl. diagrs. illus. refs. (AFOSR-65-1109) (AF AFOSR-63-117) AD 620690 Unclassified

Also published in Jour. Electron. and Control, v. 17: 601-622, Dec. 1964.

A cylindrical stream of electrons is focused solely by the fields of a slow electromagnetic wave. An analysis is obtained by transforming to the wave frame in which the equations of motion of electrostatic periodic focusing are valid. A second analysis is made by transforming to the electron frame and approximating the fields in order to compare fast-wave and slow-wave focusing. Several experiments are presented using a helix as the slow waveguide, and results are found to be in rough agreement with theory.

252

California U. Electronics Research Lab., Berkeley.

JOINT SERVICES ELECTRONICS PROGRAM, by D. O. Pederson and J. R. Whinnery. Final rept. Feb. 15, 1963-Feb. 14, 1964. Mar. 31, 1964, 44p. incl. refs. (Rept. no. 64-12) (AFOSR-64-0900) (AF AFOSR-63-139) AD 600049; AD 603736 Unclassified

Research efforts in the following areas are summarized: bioelectronics (electrophysiological properties of the nervous system, hydration studies including dielectric constant measurement of xenon-hemoglobin association compounds); circuit theory (passive network synthesis, active circuits, time-varying networks); electron streams and interactions (microwave amplifiers, noise and instabilities, emission, trajectories); plasmas (magnetic-mirror compression, homo-polar rotating plasmas, low-energy plasmas); radiation and propagation (electromagnetic scattering from conducting loops, microwave scatter from a rough water surface, dual reflect on synthesis techniques, surface waves, frequency-independent antennas); solid-state electronics (integrated circuits, materials and mechanisms); systems (control systems, communication systems). Research papers, talks, reports and memoranda sponsored by JSEP are listed.

253

California U. Electronics Research Lab., Berkeley.

PROPAGATION IN GENERALIZED GYROTROPIC MEDIA, by V. H. Rumsey. [1964] [4]p. (AFOSR-64-1129) (AF AFOSR-63-139) AD 441842 Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-12: 83-86, Jan. 1964.

Generalized gyrotropic media are characterized by four axes, three being the principal axes of the anisotropic media before application of the steady magnetic field H(O) and the fourth being the direction of H(O). They can be synthetically fabricated from an appropriately stratified pile of ferrite rods. Although much more complicated than for ordinary gyrotropic media the basic modes of radio propagation in such generalized media turn out to have some surprisingly simple properties. Formulas for these characteristic polarizations in terms of the tensor permeability are also very simple. (Contractor's abstract)

254

California U. Electronics Research Lab., Berkeley.

NOTES ON SYSTEM THEORY, VOLUME V. Apr. 1964, 124p. incl. diagrs. tables, refs. (Rept. no. 64-8) (AFOSR-64-1350) (AF AFOSR-63-139 and AF AFOSR-63-292) AD 601993 Unclassified

This report contains the following: Digitalization of continuous control systems, by M. A. Breuer; Some theorems on combining linear inequalities, by M. A. Breuer; A conjecture on the properties RC-RL networks, by D. A. Calahan; A gain-bandwidth limitation for an n-varactor parametric amplifier, by M. Fukada; On the equivalence partitioning of linear modular circuits, by A. Gill; A note on correction to a result of Dobrushin, by B. Gluss; A remark about invertible boolean functions, by M. A. Harrison; On the asymptotic number of automata, by M. A. Harrison; Time-varying networks-the state variables and stability, by E. S. Kuh; Sufficient conditions for the existence of a solution to a continuous linear programming problem and a corresponding duality theorem, by A. Larsen; A minimal representation for a cascade of lattice networks, by D. M. Layton and I. T. Frisch; Equilibrium controllability and stability of N. P. F. M. control systems, by T. Pavlidis; and On the evaluation of optimal and non-optimal control strategies, by E. Polak.

255

California U. [Electronics Research Lab.] Berkeley.

A BACKWARD-WAVE SURFACE MODE IN A PLASMA WAVEGUIDE, by R. N. Carlile. [1964] [8]p. incl. illus. (AFOSR-64-1373) (AF AFOSR-63-139) AD 44[illegible] Unclassified

Also published in Jour. Appl. Phys., v. 35: 1384-1391, May 1964.

The phase characteristics of a backward-wave passband mode have been measured in a plasma waveguide, consisting of a circular waveguide that is coaxial with the positive column of a mercury-vapor discharge. The

mode has been identified as an n = 1 surface mode similar to that described by Trivelpiece. It is shown that zero-temperature plasma-waveguide theory predicts this mode accurately. This theory predicts that a simple relation exists between the lower cutoff frequency of the n = 1 mode and the electron plasma frequency. It is demonstrated that the calculated electron plasma frequency obtained from this relation, where the cutoff frequency is determined from a measurement of the phase characteristics, agrees well with an independent measurement of electron plasma frequency by the well-known cavity-perturbation method. Both the n = 1 and symmetric n = 0 modes were excited by a novel coupler called the double-ring coupler. Noise measurements on the n = 1 and symmetric n = 0 modes indicate that the output signal-to-noise ratio is independent of input signal power and is about 7 dB for the n = 1 mode and varies from about 7 to greater than 30 dB for the n = 0 mode. A simple model of the plasma is proposed which explains all the noise observations reported here. (Contractor's abstract)

256

California U. Electronics Research Lab., Berkeley.

DOMINANT ZERO AND EXCESS PHASE OF A HURWITZ POLYNOMIAL, by D. O. Pederson and G. H. Wilson. [1964] [5]p. incl. diagrs. (AFOSR-64-1374) (AF AFOSR-63-139) AD 444473 Unclasstfied

Also published in IEEE Trans. Circuit Theory, v. CT-11: 104-108, Mar. 1964.

In the analysis and design of linear electronic circuits, it is often necessary and desirable to restrict attention to first-order effects only. Simplifications of the circuit may take the form of a dominant natural frequency (or time-constant) description. That is, of the total natural frequencies of the circuit, one may be found to be dominant over a frequency or time interval of interest. For the low-pass situation, necessary conditions are presented in this paper to establish the dominant zero of a polynomial in terms of the coefficients of the polynomial. Simple expressions are also given to estimate the second-order effect of excess phase (or dead time). A simple transistor amplifier is used as an example. (Contractor's abstract)

257

California U. Electronics Research Lab., Berkeley.

SYNTHESIS OF DUAL REFLECTOR ANTENNAS, by V. Galindo. July 30, 1964, 275p. incl. diagrs. refs. (Rept. no. 64-22) (AFOSR-64-1583) (AF AFOSR-63-139) AD 445821 Unclassified

A synthesis method based on geometrical optics for designing a dual reflector antenna system with an arbitrary phase and amplitude distribution in the aperture of the second reflector is presented. The first reflector may be illuminated by a pattern with an arbitrarily curved phase front. A pair of first order ordinary nonlinear differential equations of the form $dy/dx = f(x, y)$ are developed for the system. Questions concerning uniqueness, existence, and bounds for the solutions are discussed. Calculations and numerical results for the design of a uniform amplitude and phase dual-reflector system are presented. The diffraction effects of the small reflector are analyzed by the methods of geometrical diffraction. Their effects upon the aperture distribution of the larger reflector are analyzed in detail. Correction for the small reflector diffracted field is obtained partially by an iterative procedure utilizing the above synthesis method. The tentative conclusion was drawn after extensive numerical analysis that complete correction for the diffraction effects is not possible. (Contractor's abstract)

258

California U. Electronics Research Lab., Berkeley.

ON THE POSSIBILITIES OF DETECTION OF PERIODIC DISTURBANCES ON A ROUGH SURFACE USING RADIO TECHNIQUES, by R. H. Clarke. May 29, 1964, 37p. incl. diagrs. tables, refs. (Rept. no. 64-21) (AFOSR-64-1906) (AF AFOSR-63-139) AD 448493 Unclassified

The theory of reflection of electromagnetic waves from a moving sinusoidal disturbance, on both rough and still water, is presented in a simple approximate form. It is shown that the detection of such a disturbance is, in principle a practical possibility. Some of the requirements of such a detection system are briefly discussed. The basis of the simplified theory is discussed in detail, and new experimental results are presented to demonstrate the validity of the approach used. (Contractor's abstract)

259

California U. Electronics Research Lab., Berkeley.

A STABILITY CRITERION FOR TUNNEL DIODES, by I. T. Frisch. [1964] [2]p. (AFOSR-64-2139) (AF AFOSR-63-139) AD 452270 Unclassified

Also published in Proc. IEEE, v. 52: 922-923, Aug. 1964.

Given the complete linear equivalent circuit of a tunnel diode, a new sufficient condition is presented for the diode to be potentially stable, where the diode is potentially stable if all open circuit natural frequencies can be shifted to the left half of the complex frequency plane, by properly imbedding the tunnel diode in a two terminal passive network. (Contractor's abstract)

260

California U. Electronics Research Lab., Berkeley.

A LINEAR SEARCH PROBLEM, by E. Wong. [1964] [7]p. (AFOSR-64-2224) (AF AFOSR-63-139) AD 452417 Unclassified

Also published in SIAM Rev., v. 6: 168-174, Apr. 1964.

A class of one-dimenstonal search problems ts constdered. In general, the formulation results tn a functional-minimtzation equation of the dynamtc programming type. In a special case the optimal solution for both the objective and poltcy have been found. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

ON THE REDUCTION OF THE SYSTEM $\dot{x} = Bx + Bu$, $y = c'x$ TO ITS MINIMAL EQUIVALENT, by H. Kwakernaak and E. Polak. [1963] [2]p. (AFOSR-64-2225) (AF AFOSR-63-139) AD 452264 Unclassified

Also published in IEEE Trans. Circutt Theory, v. CT-10, Dec. 1963.

A method ts proposed for constructing minimal scalar and vector representations for systems of the form given in the title. A situation where one mtght be interested in finding a minimal equivalent ts the problem of synthesizing a multiple-input, single-output system whtch is specified as above. Before the system is built, tt ts usually desirable to reduce tt to tts simplest form, namely, tts minimal equivalent. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

TECHNIQUES FOR AUTOMATING THE CONSTRUCTION OF TRANSLATORS FOR PROGRAMMING LANGUAGES, by W. H. Wattenburg. Jan. 13, 1964, 16p. (Rept. no. 64-45) (AFOSR-65-0264) (AF AFOSR-63-139) AD 609487 Unclassified

Formal procedures are summarized for constructing translators where by a computer ts used to generate substantial portions of the translators, the latter being termed symbolic machtne language assemblers, macro expanders, or compilers. The translators all perform the task of translating programs written in one language into equivalent programs written tn another. BASIC BOOTSTRAP PROCEDURE: The first translators were wrttten tn an available machtne language and were mostly symbolic machtne language translators (assemblers). Application of the 'bootstrap' procedure was the wrtting tn symbolic language, includtng the translator ttself, of programs, once a symbolic machine language translator became available for a particular machine. The bootstrap procedure has the property that each translator can translate its own description into ttself stnce tt ts described by a language whtch is a subset of the language tt translates. The NELIAC, compiler for the Remington Rand M460 ts a 'self-compiling compiler'. MULTIPLE BOOTSTRAP PROCEDURES: These procedures tnvolve translators productng object programs for machines other than the machtne that performed the translation. As an example of the use of an tntermediate language and multiple bootstrap procedure, there ts cited the translator constructed for the FORTRAN language and the IBM-7090 and CDC-3600 computers by Mendictno, Storch, and Sutherland at the Lawrence Radiation Lab. of California U.

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California U. Electronics Research Lab., Berkeley.

LASER-INDUCED EMISSION OF ELECTRONS, IONS, AND NEUTRALS FROM Ti AND Ti-D SURFACES, by T. Y. Chang and C. K. Birdsall. [1964] [2]p. incl. diagrs. (AFOSR-65-0910) (AF AFOSR-63-139) AD 617233 Unclassified

Also publtshed tn Appl. Phys. Ltrs., v. 5: 171-172, Nov. 1, 1964.

This note describes the plasma produced from deuterated titanium disks due to laser-induced emission. Three representative expertments are described, and tt ts proposed that the target surface temperature produced by an unfocused laser beam is htghly nonuniform; the large directed ion energy produced by a focused laser beam is of the order predicted by hydrodynamtc blow off theory; and the fast ion pulse produced by a focused laser beam ts postulated as secondary emtsston at the collector due to fast D_2 molecules blown off the target surface.

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California U. Electronics Research Lab., Berkeley.

SHEET-CURRENT PLASMA MODEL FOR ION-CYCLOTRON WAVES, by A. Hasegawa and C. K. Birdsall. [1964] [11]p. tncl. diagrs. tables, refs. (AFOSR-65-0911) (AF AFOSR-63-139) AD 617234 Unclassified

Also published tn Phys. Fluids, v. 7: 1590-1600, Oct. 1964.

An appropriate plasma model, using current sheets, is introduced and inttial results are presented. The prtmary utility is to obtatn the nonlinear behavior of ton-cyclotron waves. Linear analysts ts used to develop the bicircular particle motion, to show the coupling of the ton-cyclotron resonance for finite $T_\perp$, to show Landau cyclotron dampting for fintte $T_\parallel$. The sheet model ts developed tn terms of vector potential A and sheet current denstty J_s for k parallel to the steady field B_0. There are transverse fields only, with sheet motion along 3 coordtnates. The electrons are assumed to be hot, forming a neutraltztng background. The model accuracy tests show a reasonable duplttcation of cold plasma ion waves. The first computer experiment shows wave damping for $T_\parallel \gg T_\perp$ at the rate expected from ltnear analysis, and with $T_\parallel$ decreasing, $T_\perp$ decreastng, and $T_\parallel$ increasing. The third computer experiment was to find the limit tn $T_\perp$ for interaction with an electron stream for $\omega \sim \omega_{ct}$; the nonlinear limtt, with equal transverse energies, substantially exceeds the ltnear analysis result, lending encouragement to thts means of ton heating.

265

California U. Electronics Research Lab., Berkeley.

OPTIMAL CONTROL OF SYSTEMS WITH STOCHASTIC DISTURBANCES, by R. Sussman. Nov. 25, 1963, 69p. (AF AFOSR-63-139) AD 430078 Unclassified

The optimal control of a linear system which is disturbed by white (or linear Markov) additive noise is discussed. The state of the system cannot be measured directly, but is corrupted by additive white (or linear Markov) noise. The cost function used is quadratic. It is proved that the optimal controller is a linear function of the observations only if both noises are Gaussian. This implies that the minimal cost of controlling this system, when subjected to Gaussian noise, is strictly higher than when subjected to any non-Gaussian noise, which has the same second order properties as the Gaussian. Besides this proof, Kalman's best linear optimal controller is extended to a polynomial controller. This controller retains the same features as Kalman's best linear controller; namely, only the first few moments of the best estimate must be updated as the process evolves. While the optimal linear controller requires the updating of only the mean and the variance, the n-th order polynomial controller requires the updating of the 2n first moments. These results can also be applied to optimal filtering. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

REALIZABILITY OF n-PORT RESISTIVE NETWORKS WITH MORE THAN (n + 1) NODES, by K. R. Swaminathan and I. T. Frisch. July 14, 1964, 37p. (Rept. no. 64-23) (AF AFOSR-63-139) AD 450736 Unclassified

A new set of necessary conditions are presented for an nth order square symmetric matrix with real entries to be the n-port admittance matrix of a network containing positive resistors and more than (n + 1) nodes. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

THEORY AND MEASUREMENT OF A SURFACE WAVEGUIDE, by D. E. Norton. Nov. 25, 1963, 98p. (AF AFOSR-63-139) AD 430079 Unclassified

A surface waveguide, which consists of a dielectric slab backed by a perfect conductor lying between and perpendicular to two parallel conducting planes, is excited by a slot source at a frequency of 9,339 mc. The resulting electromagnetic fields are obtained both experimentally and analytically. The fields are measured by the reflection from a thin metal cylinder and this technique is shown to be accurate within one db for test cases with no dielectric present. (Contractor's abstract, modified)

268

California U. Electronics Research Lab., Berkeley.

TIME-VARYING GC NETWORKS, by A. Paige. Oct. 11, 1963, 114p. (Rept. no. 63-25) (AF AFOSR-63-139) AD 430076 Unclassified

The purpose of this investigation is to study the properties of time-varying G-C networks. These networks are constructed from one of the following models: (1) A number of resistances and capacitances can have their values altered mechanically (e.g., rheostats and variable capacitors) and are driven by some mechanical agency. (2) The study of the stability of nonlinear networks can usually be reduced to a study of stability of a linear equation which describes a small perturbation about some equilibrium state of the nonlinear network. This linear equation will, in general, have coefficients which are functions of time. If the type of elements in the nonlinear network are suitably restricted, the linear perturbation equation can be interpreted as describing the operation of a linear time-varying conductance-capacitance network. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

TIME-VARYING NETWORKS - THE STATE VARIABLES, STABILITY AND ENERGY BOUNDS, by E. S. Kuh. Mar. 1964, 30p. (Rept. no. 64-10) (AF AFOSR-63-139) AD 435839 Unclassified

This paper is concerned with linear networks which contain time-varying resistors, inductors, and capacitors. The state variables formulation is used to describe the general circuit. The energy stored is calculated in terms of the state variables and the incidence submatrices from which general sufficient conditions for stability are derived. Upper and lower bounding functions on the stored energy are next obtained. These functions lead to sharply defined conditions for stability and instability of periodically varying networks. Examples are included to illustrate the use of the general method and the importance of the results. (Contractor's abstract)

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California U. Electronics Research Lab., Berkeley.

THE PROBLEM OF IDENTIFICATION OF DISCRETE-TIME PROCESSES, by C. A. Galtieri. Dec. 27, 1963, 129p. incl. tables, refs. (Rept. no. 63-19) (AFOSR-64-1197) (AF AFOSR-63-292) AD 603739 Unclassified

A logical framework is proposed within which the problem of identification of discrete-time processes may be defined in a precise and general way. The general solution is then derived and some of its most important applications are discussed in some detail. The report is essentially divided in 3 parts. In the first a well-defined language is introduced in order to be able to

state the problem in an unequivocal way. The basic axioms and definitions of this part lead to the general results of which the following chapters are specialized applications. In the second part the problem of identification of discrete-time processes is specifically included and some of its general aspects are discussed. The final part discusses in some detail a number of specific cases of particular importance. Particular attention was given to the problem of estimating the coefficients of a difference equation. It is shown that two previously proposed methods of solution for this problem may be considered as approximations of the method proposed in this report. The numerical solution of some very simple examples is included for purposes of illustration. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

ON THE STABILITY OF A CERTAIN CLASS OF NONLINEAR SAMPLED-DATA SYSTEMS, by E. I. Jury and B. W. Lee. [1964] [11]p. incl. refs. (AFOSR-64-1316) (AF AFOSR-63-292) AD 444141 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 51-61, Jan. 1964.

A sufficient condition for stability of a class of sampled-data feedback systems containing a memoryless, nonlinear gain element is obtained. In this paper, the stability criterion embodied in this theorem can be readily obtained from the frequency response of the linear plant. This method is essentially similar to Popov's method applied to the study of nonlinear continuous systems Furthermore, Tsypkin's results for the discrete case are obtained as a special case when q = 0. Several examples are discussed, and the results are compared with Lyapunov's quadratic and quadratic plus integral forms as well as with other methods. For these examples, the results obtained from the new theorem yield less conservative values of gain than Lyapunov's method. Furthermore, for certain linear plants the new theorem also yields the necessary and sufficient conditions. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

A NOTE ON THE RECIPROCAL ZEROS OF A REAL POLYNOMIAL WITH RESPECT TO THE UNIT CIRCLE, by E. I. Jury. Nov. 18, 1963, 2p. (AFOSR-64-1822) (AF AFOSR-63-292) AD 449251 Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 2, June 1964.

The purpose of this communication is to present a precise formulation of a theorem proposed by Marden which is related to the existence of reciprocal zeros with respect to the unit circle and to indicate a rule which is simpler than Cohn's for determining the number of the reciprocal zeros with respect to the unit circle of a real polynomial. (Contractor's abstract)

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California U. [Electronics Research Lab.] Berkeley.

ON THE ABSOLUTE STABILITY OF NONLINEAR SAMPLED-DATA SYSTEMS, by E. I. Jury and B. W. Lee. [1964] [4]p. incl. diagrs. (AFOSR-65-1011) (AF AFOSR-63-292) AD 619108 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 551-554, Oct. 1964.

A general form of area inequality is used to develop a frequency domain criterion for absolute stability of single-nonlinear sampled-data (SNSD) systems. By reductions of the general form to specific area inequalities, it is suggested that all known and some new frequency domain criteria applicable to different subclasses of SNSD systems may be derived as special cases. One of the latter involving q < 0 is investigated to determine its significance and general applicability to SNSD systems. An example of a SNSD system with dead zone is used to illustrate some of the results presented.

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California U. Electronics Research Lab., Berkeley.

SYNCHROTRON RADIATION MEASUREMENTS FROM A HOT ELECTRON PLASMA, by A. J. Lichtenberg, S. Sesnic, and A. W. Trivelpiece. Aug. 17, 1964, 32p. incl. illus. diagrs. refs. (Rept. no. 64-28) (AFOSR-65-0266) AD 454768 Unclassified

The synchrotron radiation emanating from a hot-electron plasma produced in a pulsed magnetic mirror field has been measured. The measurements were made with a 1 μsec time constant InSb detector with a frequency response covering the wavelengths between 4 mm and 0.1 mm. For peak fields which were varied between 30 and 60 kG with corresponding electron temperatures between 25 and 50 kev the radiation was found to be greater than 0.1 mW/ster at the low field and greater than 1.0 mW/ster at the high field. This variation was consistent with that calculated by integrating the radiation from a single electron over a two dimensional, relativistic Maxwellian with the appropriate temperature. The calculation, together with the measured radiation amplitude, was used to determine the total number of radiating electrons. Preliminary results on the spectral distribution of the radiation were obtained. The decay of the radiated power is closely correlated with microwave radiation and other diagnostics both in regimes and those in which the plasma developed an instability. (Contractor's abstract, in part)

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California U. [Electronics Research Lab.] Berkeley.

A REMARK ON UNIFORM DISTRIBUTION, by M. A. Harrison. [1964] [1]p. (AFOSR-65-0334) (AF AFOSR-64-639) AD 611926 Unclassified

Also published in IEEE Trans. Electron. Comput., v. EC-13: 1, Oct. 1964.

This paper refers to a previous publication by D. C. Fielder (IEEE Trans. Electron. Comput., v. EC-13: 53-54, Feb. 1964) on the study of uniform distribution of contacts in relay trees. The determination of $\{n/2^n \equiv 3 \bmod (n-1)\} = Fn$ is made in particular.

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California U. Electronics Research Lab., Berkeley.

NOTES ON SYSTEM THEORY. VOLUME VI. Aug. 1964, 121p. incl. diagrs. refs. (Rept. no. 64-8) (AFOSR-65-0632) (AF AFOSR-64-292, AF AFOSR-64-230, and AF AFOSR-64-639) AD 611083 Unclassified

This report contains the following articles: On decomposition techniques applied to the solution of linear programming problesms; On a theorem for nonlinear networks; A note on the identification of a class of nonlinear time-invariant systems; A stability criterion obtained by comparison; Relational equivalence of sequential machines; The conversational method of synthesis for finite automata; A galois field multiplier; On the inverse of the Lyapunov operator; A real frequency stability criterion containing periodically time-varying capacitances and resistances; A noie on polar decomposition and the generalized inverse of an arbitrary matrix; Reduction of a linearly separable pattern set to a minimum distance problem; On a combinaiorial theorem and applications; On nonlinear differential equations with delta functions driving forces; and A new proof of the Wang algebra for networks.

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California U. [Insi. of Engineering Research] Berkeley.

SHOCK-WAVE STRUCTURE IN A PARTIALLY IONIZED GAS, by M. S. Grewal and L. Talbot. [1963] 1v. (AFOSR-J1456) (AF 49(638)502) AD 427719 Unclassified

Also published in Jour. Fluid Mech., v. 16: 573-594, 1963.

The structure of a shock wave in a partially ionized gas, which may be in thermal nonequilibrium ahead of the shock wave, is investigated. A method is developed to solve this problem by separating it inio two paris. Firsi, the structure of the shock wave associated with the massive particles, ions and aioms, is assumed to be of the Mott-Smith form. Then the behavior of the electrons as they pass through this shock is analyzed. Using this method, calculations are carried out for shock waves ai several Mach numbers and several values of the electron-ion iemperaiure ratio ahead of the shock. An essential feature of the shock profiles is found to be the existence of a broad zone of elevated electron iemperature ahead of the electron compression region, caused by the high thermal conductivity in the electron gas. (Contracior's abstract)

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California U. Inst. of Engineering Research, Berkeley.

EFFECTS OF CHARGED PARTICLES ON THE MOTION OF AN EARTH SATELLITE, by C. L. Brundin. [1963] [10]p. incl. diagrs. table, refs. (AFOSR-64-1951) (AF 49(638)502 and Nonr-22245) AD 432675; AD 450323 Unclassified

Also published in AIAA Jour., v. 1: 2529-2538, Nov. 1963.

Using a model of the upper atmosphere in which the principal atmospheric constituent (for both atoms and ions) changes with increasing altitude from atomic oxygen to helium and then to atomic hydrogen, the charge on a conducting spherical satellite and the drag due to charged particles are estimated for altitudes below the hydrogen region. The effects of photoelectric emission and the earth's magnetic field are included in the calculations. It is found that the contribution of charged particles to the satellite drag may be neglected in the oxygen region. In the helium region the drag due to charged particles may be significant, particularly for large satellites and in cases where the photoelectric emission current is significant. A method of estimating this drag is presented. (Contractor's abstract, modified)

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California U. Inst. of Engineering Research, Berkeley.

SPECTROSCOPIC STUDY OF ELECTRON RECOMBINATION WITH MONATOMIC IONS IN A HELIUM PLASMA, by F. Robben, W. B. Kunkel, and L. Talbot. [1963] [9]p. (AF 49(638)502) AD 432674 Unclassified

Also published in Phys. Rev., v. 132: 2363-2371, Dec. 15, 1963.

Recent work on electron-ion recombination has shown that a model including recombination into highly excited bound levels through electron-electron-ion collisions and transitions between the bound levels through electron-atom collisions as well as the usual radiative transitions, is in good agreement with experiments in which processing involving molecular ions, etc., are unimportant. By making absolute intensity measurements of the lines of helium emitted from the decaying plasma of an arc jet in the visible and near ultraviolet, the number densities of the excited states of helium have been calculated. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

A SPECTROSCOPIC STUDY OF RECOMBINATION IN A HELIUM PLASMA, by F. A. Robben. Apr. 5, 1963, 48p. (Rept. no. HE-150-211; series no. 132, issue no. 7) (AF 49(638)502) AD 405814 Unclassified

Recent work on ion-electron recombination has shown

that a model involving recombination into highly excited bound levels through electron-electron-ion collisions and transitions between the bound levels through electron-atom collisions as well as the usual radiative processes, is in good agreement with experiment. By making absolute intensity measurements of all the lines of helium emitted from the decaying plasma of an arc jet in the visible and near ultraviolet, the number densities of the excited states of helium were calculated. When interpreted by means of the collisional-radiative recombination model, these measurements give values for the collisional de-excitation rate constant of an excited helium atom from level n to n - 1. The values of this constant are in reasonable agreement with a recent theory of classical excitation cross sections.

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California U. [Inst. of Engineering Research] Berkeley.

SIGNIFICANCE OF DETONATION STUDY TO PROPULSION DYNAMICS, by A. K. Oppenheim and A. J. Laderman. 1963, 1v. (AFOSR-J1090) (AF AFOSR-83-129) AD 421130 Unclassified

Presented at Fourteenth Cong. Internat'l. Astron. Fed., Paris (France), Sept. 1963.

The various means by which detonation study can influence the development of propulsion systems are discussed. The wave, besides the possibility of its actual appearance in the course of anomalous operation the combustion chamber, or its direct exploitation as the actual combustion front in an engine specially designed for this purpose, provides the prime experiment facility for the study of non-steady gasdynamics of systems characterized by a high rate of energy release. Moreover, it offers an insight into the relationship between the chemico-kinetic and gasdynamic phenomena that occur in thrust chambers not only during transient processes but also at steady state operation. Its theoretical aspects provide a stimulus to the development of gas-wave-dynamics, the subject dealing with the analysis of wave interaction processes, whose techniques are applicable not only to chemical propulsion systems, but also to gaseous nuclear devices and pulsed plasma accelerators. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

RECENT PROGRESS IN DETONATION RESEARCH, by A. K. Oppenheim, N. Manson, and G. G. Wagner. [1963] [10]p. incl. illus. diagrs. refs. (AFOSR-64-0894) (AF AFOSR-83-129) AD 439884 Unclassified

Presented at AIAA Summer meeting, Los Angeles, Calif., June 17-20, 1963.

Also published in AIAA Jour., v. 1: 2243-2252, Oct. 1963.

The major effect of currently conducted detonation studies is concerned mainly with three fundamental problems: the development of the wave, its stability, and structure. The three are of course not independent of each other, and even the order of presentation is of some importance, for one cannot describe the structure without considering the stability, which, in turn, is related to the mode of development. Consequently this review consists of three corresponding parts, each written, respectively, by one of the authors in a different country, thus giving the subject matter an elucidation from three quite different points of view. Because of its particular significance to the process of combustion in a rocket thrust chamber, the scope is restricted to the gaseous phase. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

LONG-DURATION SPARK LIGHT SOURCE FOR STREAK SCHLIEREN PHOTOGRAPHY OF HIGH-SPEED EVENTS, by G. J. Hecht, C. T. Lilleston, and A. K. Oppenheim. [1964] [8]p. incl. illus. diagrs. refs. (AFOSR-64-1872) (AF AFOSR-83-129) AD 447590 Unclassified

Also published in ISA Trans., v. 3: 100-107, Apr. 1964.

A long-duration (up to 1.5 msec) light source is described which is suitable for schlieren photography of high-speed events. The source consists of a small area, open-air spark gap excited by a delay line network to produce substantially constant light intensity during the period of discharge. The very low sparkgap impedance is matched successfully by employing high-capacity photoflash type electrolytic capacitors operating at relatively low voltage. Indicated also are methods that make triggering reliable and reproducible. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

PRESSURE WAVE GENERATED IN A FISSIONABLE GAS BY NEUTRON IRRADIATION, by H. P. Smith, Jr., C. W. Busch, and A. K. Oppenheim. [1964] [8]p. incl. diagrs. (AFOSR-84-2031) (AF AFOSR-83-129) AD 451227 Unclassified

Also published in Phys. Fluids, v. 7: 878-883, May 1964.

An experiment is proposed to study the nonsteady gasdynamic phenomena produced by neutron induced exothermic nuclear reactions in a gaseous medium. The problem is formulated in terms of a set of characteristic equations in a time dependent, spatially unidimensional system and solved by means of a simplified analysis leading to a system of two first order, nonlinear, ordinary differential equations. The problem involves the generation of a pressure wave in a long tube filled with a boron trifluoride, fully enriched in the boron-10 isotope. The analysis predicts that the gas residing initially in the core will be heated to approximately 3000°K and that a compression wave with a peak pressure ratio of approximately 3 will

emanate from the reactor and coalesce into a shock of Mach number 1.8 at a distance of approximately 17 ft from the reactor core. Measurement of the pressure wave should provide information on the amount of reversible heating that can be obtained from a gaseous nuclear reaction. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

CALCULATION OF AERODYNAMIC FORCES ON CYLINDRICAL SHELLS IN UNSTEADY SUPERSONIC FLOW, by R. A. Brown and M. Holt. Apr. 1963 [26]p. incl. diagrs. tables. (Rept. no. AS-63-1) (AFOSR-5158) (AF AFOSR-63-266) AD 416375
Unclassified

The aerodynamic forces resulting from the vibration of a cylindrical shell of finite length in a supersonic stream have previously been calculated and using the static approximation. In this the flow field is determined as though it were steady in the state frozen at a given instant. In the present report the static approximation is improved and account is taken of first order effects in vibration frequency. This causes a phase shift between the shell displacement and the corresponding pressure or aerodynamic force coefficient. The phase shift varies with distance along the cylinder, the phase angle changing very rapidly in the neighborhood of zero of certain modified Bessel functions and remaining sensibly constant in between. The influence of this phase shift on panel flutter characteristics is expected to be significant and will be considered in subsequent reports. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

COMPUTATION OF GASEOUS DETONATION PARAMETERS, by C. W. Busch, A. J. Laderman, and A. K. Oppenheim. Aug. 1964, 109p. (Technical note no. 6) (AFOSR-64-1891) (AF AFOSR-64-129) AD 607360
Unclassified

This report describes the development of a method programmed for a digital computer to evaluate one-dimensional detonation parameters in gaseous media. The calculations are based on the assumptions that the wave process is governed by equilibrium end conditions. Details of the analytical method of solution are presented including the IBM 7090 computer program, described in Fortran language. Sample input and output data with instructions for preparing the input data are given. Finally, computations are performed for a number of hydrogen-oxygen mixtures from $H_2 + O_2$ to $3H_2 + O_2$ at several initial conditions covering a range in pressure from 0.1 to 760 mm Hg and in temperatures from -160 to +200°F and a comparison is made with calculations of other investigators for a stoichiometric mixture initially at NTP. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

DYNAMIC PERFORMANCE OF PRESSURE TRANSDUCERS IN SHOCK AND DETONATION TUBES, by W. E. Amend, A. J. Laderman, and A. K. Oppenheim. Sept. 1964, 158p. (Technical note no. 9) (AFOSR-64-1892) (AF AFOSR-64-129) AD 607361 Unclassified

A method is presented for evaluating the dynamic performance of high frequency pressure transducers on the basis of records obtained by means of shock tube calibration tests. The transducer's frequency response is determined from a Fourier transform analysis. The computations were programmed for the IBM 7090 computer including provision for the use on the cal-comp plotter to produce results describing the frequency dependence of the amplitude ratio, phase angle shift, and time lead between the output and input signal. Performance characteristics were calculated for several typical transducers, demonstrating the utility of the method in delineating frequency regimes where reliable response of the instrument can be expected. A number of commercial pressure transducers were tested in shock and detonation tubes. Records obtained from the former provide information on the natural frequencies and rise times of the sensors, while results of the latter were used to illustrate the effects of rapidly varying pressures and temperatures on the performance of the instruments. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

VECTOR POLAR METHOD FOR THE EVALUATION OF WAVE INTERACTION PROCESSES, by A. K. Oppenheim, P. A. Urtiew, and A. J. Laderman. [1964] [55]p. incl. diagrs. tables, refs. (AFOSR-65-1479) (AF AFOSR-64-129) AD 822643 Unclassified

Also published in Arch. Budowy Maszyn, v. 11: 441-495, 1964.

Vector polar method is a graphical technique for the solution of wave interaction problems that are concerned with the overall results rather than with the progress of the process. The method is based on the use of wave polars. If the ratio of pressures or sound speeds is represented on a logarithmic scale, usually as the ordinate, while the abscissa represents the change in particle velocity across the wave in a linear scale, then such a generalized hodograph plane has the property of a vector field. By simple vector addition, some quite complex wave interaction processes can then be rapidly evaluated. The utility of the method is illustrated by a variety of shock-tube problems involving interactions between shocks, deflagrations, rarefaction waves, contact discontinuities and area change. Although the analysis of most of such problems is known, the application of the vector polar method led to the discovery of some interesting regimes of solutions that would be difficult to discern by the more laborious conventional techniques. (Contractor's abstract)

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California U. [Inst. of Engineering Research] Berkeley.

ON THE DYNAMICS OF THE DEVELOPMENT OF DETONATION IN A GASEOUS MEDIUM, by A. K. Oppenheim. [1964] [22]p. incl. illus. diagrs. table, refs. (AFOSR-65-1480) (AF AFOSR-64-129) AD 622842 Unclassified

Also published in Arch. Mech. Stosowanej., v. 2: 403-424, 1964.

An elementary gasdynamic treatment is made of two problems of detonation analysis: (1) the generation of the pressure wave by the flame kernel, and (2) the interaction between various pressure waves and combustion fronts. In regard to the first problem, two models are presented which represent the lower and upper bounds respectively for the gasdynamics solution of a flow field generated by the initial growth of a flame kernel in an explosive gas. The second problem is analyzed by a graphical technique, the vector polar method. It is concerned only with effects in the large and can be considered as the generalization of the method of characteristics to finite wave interaction processes. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

CALCULATIONS OF SUPERSONIC FLOW PAST YAWED CONES BY THE METHOD OF THE INTEGRAL RELATIONS, by M. Holt and S. C. Lee. Mar. 1964 [22]p. incl. diagrs. (Rept. no. AS-64-7) (AF AFOSR-64-268) AD 603962 Unclassified

The method of integral relations, as applied to the yawed cone problem by Chushkin and Shchennikov, is modified to take account of the entropy singularity on the leeward side of the cone. It is proposed to apply the method in two regions, in the quadrant adjacent to the singular generator and in the remaining quadrant including the cone surface and the shock. Results are not yet complete but those obtained so far suggest that the modification will give a more realistic picture of the flow between the cone and the shock. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

FREQUENCY EFFECTS IN PANEL FLUTTER OF CYLINDRICAL SHELLS, by R. A. Brown and M. Holt. Mar. 1964 [21]p. incl. diagrs. refs. (Rept. no. AS-64-6) (AF AFOSR-64-268) AD 603961 Unclassified

The expression for the pressure coefficient on a vibrating cylindrical shell of finite length in unsteady supersonic flow is simplified. The expression is valid at high values of Mach number and is based on the quasi-steady approximation when only first order terms in vibration frequency are considered. The kernel functions arising in the expression for the pressure coefficient are tabulated and shown graphically for a series of circumferential modes. It is anticipated that the revised expression will be simpler to use than the earlier expression when introduced into the full panel flutter equations. (Contractor's abstract)

292

California U. Inst. of Engineering Research, Berkeley.

ANALYTICAL STUDY OF THE CHARACTERISTICS OF WEDGES IN SUPERSONIC VISCOUS FLOW, by R. T.-S. Cheng. May 15, 1964 [43]p. incl. diagrs. tables, refs. (Rept. no. AS-64-6) (Nonr-22245) AD 603319 Unclassified

An analytic study of the normal and axial force coefficients of wedge-shaped airfoils in supersonic viscous flow is presented. It is based on the inviscid oblique shock relations to determine the flow conditions after the oblique shocks in the vicinity of the wedge. This condition is used as the local free stream condition which is applied to the available correlation of compressible boundary layer theory on a flat plate at zero angle of attack. Furthermore, the boundary layer displacement thickness is used as the effective body in the inviscid supersonic small perturbation theory to predict local surface pressure. Force coefficients are referred to the free stream dynamic pressure and the area of the wedge base. Some numerical calculations were carried out in order to compare the results with earlier theoretical and experimental data. (Contractor's abstract)

293

California U. Inst. of Engineering Research, Berkeley.

THE APPLICATION OF LANGMUIR PROBE TECHNIQUES TO FLOWING IONIZED GASES, by C. L. Brundin. June 15, 1964, 116p. (Rept. no. AS-64-9) (Nonr-22245) AD 603666 Unclassified

A detailed theoretical and experimental investigation regarding the use of Langmuir probe techniques in a flowing partially ionized gas was carried out. Both free molecule and stagnation point probes were considered. The analysis is restricted to the determination of ion density from the saturated ion current, and the determination of electron temperature from the rate of change of electron current with probe potential. Numerical results are presented for argon, along with the results of a series of experiments conducted in an arc heated supersonic low density wind tunnel. It is concluded that the ion density can be measured accurately with a stagnation point probe, or with a plane free molecule probe surrounded by a guard ring. The electron temperature can be measured accurately with a gurarded plane free molecule probe, or with a cylindrical free molecule probe aligned with the flow. Measurements made in flowing gases with other types of Langmuir probes are subject to certain consistent errors. (Contractor's abstract)

294

California U. Inst. of Engineering Research, Berkeley.

THE BASE FLOW PROBLEM AT VERY LOW REYNOLDS NUMBER IN THE OSEEN APPROXIMATION, by H. Viviand and S. A. Berger. Sept. 1964 [42]p. incl. diagrs. (Rept. no. AS-64-15) (Nonr-22245) AD 608134 Unclassified

The influence of inertia terms in the equations of motion on the properties of the base flow and near wake flow at very low Reynolds numbers was investigated by using Oseen's approximation and by comparing with previous results obtained by the same authors for Stokes flow. The general solutions of Oseen's equations of motion were derived for two-dimensional and axisymmetric flows in the half-space $x > 0$, for an arbitrarily given velocity field in the plane $x = 0$. Numerical examples were given for two-dimensional flow and compared with Stokes flow examples. (Contractor's abstract)

295

California U. Inst. of Engineering Research, Berkeley.

CYLINDER DRAG IN THE HYPERSONIC FREE JET OF A RAREFIED AIR STREAM, by S. S.-P. Tang. Jan. 30, 1964, 41p. (Rept. no. AS-64-3) (Nonr-22245) AD 431774 Unclassified

Drag forces on circular cylinders normal to axisymmetric jets issuing from sonic orifices have been measured. Suitable corrections have been developed to account for the radial gradients produced by the source-like flow, thus permitting comparisons of the present data with data obtained using a uniform flow field jet. With properties on the axis of the jets as reference, the data are presented in coefficient form at Mach numbers of 5.92, 6.30, 8.02, and 9.85. With Knudsen numbers extending from 1.5 to 30, these data cover the near free molecule and free molecule flow regimes. The results indicate a smooth monatomic transition and agree well at $M = 5.92$ with previous results obtained in uniform flows. At all Mach numbers, they agreed with theoretical free molecule flow predictions for diffuse reflections at the highest Knudsen numbers attained. Cylinder temperatures were also measured at the same flow conditions as the drag force measurements. (Contractor's abstract)

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California U. Inst. of Engineering Research, Berkeley.

DRAG OF A TWO-DIMENSIONAL STRIP NORMAL TO HYPERSONIC NEAR FREE MOLECULE FLOW, by D. R. Ko. Jan. 1964, 73p. (Rept. no. AS-64-4) (Nonr-22245) AD 431773 Unclassified

Drag coefficients for two-dimensional strips normal to the flow have been determined experimentally at Mach numbers of 6.22, 8.12, and 10.09 by means of the free-jet testing technique. The free stream Knudsen number ranges from about 1 to 30. Results obtained are compared to the nearly free-molecule flow theory proposed by Willis. A number of special tests were performed to demonstrate the validity of the free-jet experimental technique and to determine the feasibility of further application of this valuable testing method. (Contractor's abstract)

297

California U. Inst. of Engineering Research, Berkeley.

EXPERIMENTAL INVESTIGATION OF LITHIUM-ARGON SPUTTERING, by V. Malakhof, R. P. Stein, and H. P. Smith, Jr. Nov. 27, 1963, 47p. (Rept. no. AS-63-7) (Nonr-22245) AD 431762 Unclassified

The angular distribution of the sputtered lithium atoms under bombardment by positive argon ions was investigated. Argon ions were created by an arc discharge and electrostatically accelerated and focused on the target surface. The object of this investigation was to produce a sufficient amount of experimental data to substantiate or modify the already existing theories of angular distribution of the sputtered atoms at the oblique incidence of a low energy ion beam. The results indicate that at low ion energies and oblique angles of incidence the angular distribution is predominantly in the forward hemisphere relative to incident beam direction, and depends on the angle of ion incidence. The maximum forward sputtering current occurs at approx 90° to the beam direction. At low angles of incidence, i.e., below 30° back-sputtering is possible. There is approx a 40° relationship between the maximum back-sputtering current and the angle of ion incidence. (Contractor's abstract)

298

California U. Inst. of Engineering Research, Berkeley.

FLOWS OF RAREFIED GASES SUPPORTED BY DENSITY AND TEMPERATURE GRADIENTS, by C. Cercignani. Dec. 30, 1964 [21]p. incl. table. (Rept. no. AS-64-18) (Nonr-22245) Unclassified

Some features of Poiseuille flow in the transition region and in the free molecule limit are considered. In particular it is pointed out that the distribution function in the main body of the flow is a Burnett distribution function, with the consequence that second order slip effects appear. Differences are pointed out between flow supported by density gradients and flows supported by temperature gradients.

299

California U. Inst. of Engineering Research, Berkeley.

HIGHER ORDER SLIP ACCORDING TO THE LINEARIZED BOLTZMANN EQUATION, by C. Cercignani. Dec. 30, 1964 [30]p. incl. refs. (Rept. no. AS-64-19) (Nonr-22245) Unclassified

A systematic approach to the problem of the boundary conditions matching the conservation equations in the Hilbert or Chapman-Enskog procedures is given. Quantitative estimates are also given by using the Bhatnagar, Gross and Krook model; in particular, the second order slip coefficient is evaluated. The results

are applied to cylindrical Poiseuille flow and the calculated flow rate is compared with experimental data.

300

California U. Inst. of Engineering Research, Berkeley.

THE MEASUREMENT OF BASE PRESSURE ON WEDGES IN SUPERSONIC LOW DENSITY FLOW, by R. Cheng, S. A. Schaaf, and F. C. Hurlbut. Nov. 30, 1964 [24]p. incl. illus. diagrs. tables, refs. (Rept. no. AS-64-17) (Nonr-22235) Unclassified

The measurement of the base pressures of wedges is presented. The tests were run at nominal Mach numbers of 4 and 6 and free stream Reynolds numbers from 840 to 8600. A cathetometer was used to measure the height difference of the oil surfaces of a small U-tube manometer mounted within the wind tunnel. Both spanwise and cross-base distributions of the base pressures were measured.

301

California U. Inst. of Engineering Research, Berkeley.

NEARLY-FREE MOLECULAR FLOW: A COMPARISON OF THEORY AND EXPERIMENT, by F. S. Sherman, D. R. Willis, and G. J. Maslach. Oct. 15, 1964 [18]p. incl. diagrs. tables, refs. (Rept. no. AS-64-16) (Nonr-22245) Unclassified

Presented at Eleventh Internat'l. Cong. for Applied Mechanics, Munich (Germany), Aug. 30-Sept. 5, 1964.

Measured drag coefficients for cylinders, normal strips and spheres in nearly free-molecular flow at M = 6, 8 and 10 are correlated with a collision-rate parameter suggested by the modified Krook model, and compared with theoretical estimates based on a variety of kinetic models and methods of analysis. The comparison of theory and experiment and the comparative effectiveness of various rarefaction parameters are discussed, and suggestions for further experimentation are made.

302

California U. [Minerals Research Lab.] Berkeley.

THERMAL PROPERTIES OF ALLOYS AT HIGH TEMPERATURES, by R. L. Orr and R. Hultgren. Final rept. Mar. 1, 1963, 10p. (Series no. 137; issue no. 8) (AFOSR-4614) (AF 49(638)83) AD 407613 Unclassified

The objectives of this investigation were to determine the high temperature thermal properties of various representative alloy systems from heat content measurements, to examine the validity of Kopp's law of additivity of heat capacities of the components, and where possible to correlate the data with various aspects of atomic bonding phenomena in alloys. Heat contents also were measured for a number of pure metals for which existing data were either incomplete or uncertain. This report reviews briefly the accomplishments of this project, referring where possible to the published papers and technical notes previously submitted.

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California U. [Minerals Research Lab.] Berkeley.

DILATION CONTRIBUTION TO HEAT CAPACITY OF METALS AND ALLOYS, by Y.-S. A. Chang and R. Hultgren. Jan. 1, 1963 [79]p. incl. diagrs. tables, refs. (Technical note no. 7; series no. 137, issue no. 7) (AFOSR-4616) (AF 49(638)83) Unclassified

The main objective of this investigation was to study the dilational contribution to heat capacity of copper and alpha-brasses as a function of temperature and composition. Since thermal expansion data were available, it was only necessary to determine the compressibilities. This was done by measuring the velocities of sound in copper and alpha-brasses by means of the ultrasonic pulse technique. A second objective was to test the validity of the Nernst-Lindemann equation, which has been widely used to calculate the dilational term, and the Gruneisen equation. The Nernst-Lindemann equation is recommended over the Gruneisen equation, since the temperature variation of the coefficient of thermal expansion is not required. The error introduced at temperature close to the melting point would be only ~13% of the total heat capacity at constant pressure, but as high as 10 - 30% of the total dilational term.

304

California U. [Seismographic Station] Berkeley.

CRUSTAL STRUCTURE SOUTHWEST OF THE SAN ANDREAS FAULT FROM QUARRY BLASTS, by R. M. Hamilton, A. Ryall, and E. Berg. July 9, 1963, 11p. (AF 49(638)904) AD 433750 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 67-77, Feb. 1964.

To determine a crustal model for the southwest side of the San Andreas fault, 6 large quarry blasts near Salinas, Calif., were recorded at 27 siesmographic stations in the region around Salinas, and along a line northwest of the quarry toward San Francisco. Data from these explosions are compared with results of explosion-seismic studies carried out by the U. S. Geological Survey on a profile along the coast of California from San Francisco to Camp Roberts. The velocity of the P wave refracted through the crystalline crust, in the Salinas region is 6.2 km/sec and the velocity of Pn is about 8.0 km/sec. Velocities of the direct P wave in near surface rocks vary from one place to another, and appear to correlate well with gross geologic features. The thickness of the crust in the region southwest of the San Andreas fault from Salinas to San Francisco is about 22 km.

305

California U. [Dept. of Mathematics] Davis.

EXTREMA FOR EIGENVALUES OF VIBRATING SYSTEMS, by D. O. Banks. Final repi. [1964] [11]p. (AFOSR-64-1445) (AF AFOSR-63-82) Unclassified

The results of two arsas of research are reported. The firsi concerns bounds for the eigenvalues of vibraiing strings. The second concerns bounds for eigenvalues of a positive symmetric definite matrix A relative io a non-negative matric B, i.e., the values of λ, such that the system of equations (A - λ B)x = 0 has a nontrivial solution. The results in this case are the analog of results found earlier by ihe investigaior for the eigenvalues of a vibrating string.

306

California U. [Depi. of Physics] La Jolla.

ASYMPTOTIC FORM OF THE PROPER SELF-ENERGY FUNCTION IN MANY-PARTICLE SYSTEMS, by D. R. Fredkin. [1963] [3]p. (AFOSR-J1574) (AF 49(638)1038) AD 427631 Unclassified

Also published in Jour. Math. Phys., v. 4: 634-636, May 1963.

The asympiotic form ai high frequencies of the reciprocal of a two-time thermodynamic Green's function is shown to be a constant. This constant is expressed as the exact expectation value of a second (functional) derivative of the Hamiltonian. (Contractor's abstract)

307

California U. [Depi. of Physics] La Jolla.

MANY-BODY THEORY OF LOCALIZED d STATES IN METALS. I. THE LOCALIZED MOMENT, by H. Suhl and D. R. Fredkin. [1963] [7]p. incl. diagrs. refs. (AFOSR-J1579) (AF 49(638)1038) AD 427597 Unclassified

Also published in Phys. Rev., v. 131: 1063-1069, Aug. 1, 1963.

The problen. of the localization of a magnetic momeni around an impurity is formulaied in a rotationally invariani way, making possible the calculation of the Curie constani. This calculation is carried oui in lowesi order, but, in principle, can be exiended io arbitrary order. (Contracior's abstract)

308

California U. Dept. of Physics, La Jolla.

SUPERCONDUCTIVITY WITH PAIRS IN A RELATIVE RHO WAVE, by R. Balian and N. R. Werthamer. [1963] [12]p. incl. diagr. refs. (AFOSR-64-0754) (AF 49(638)1038) AD 436507 Unclassified

Also published in Phys. Rev., v. 131: 1553-1564, Aug. 15, 1963.

In previous treatments of superconducting systems with attractive interactions acting in odd-angular-momentum partial waves, the correlated electron pairs were formed in only two components of a sptn triplet. This oversight is corrected here by a more general variational treatment, allowing all three components. In the case of a p-wave interaction, the present staie is proved to give the absoluie minimum of the free energy. Its rotational degeneracy is discussed. The energy spectrum is found io be isotropic (provided the normal phase is also) with the usual gap, and so to be completely equivalent thermodynamically to the BCS staie. The charge-density autocorrelation is also isotropic, and the charge-current correlation vanishes. The state exhibits the conventional Meissner effect, and cannot be experimentally distinguished from ihe BCS state by means of electromagnetic or tunneling measurements, acoustic aitenuation, or nuclear magnetic resonance (NMR) relaxation times. The paramagnetic spin susceptibility decreases with temperature from tts value in the normal phase io a limiiing ratio of 2/3, in good agreemeni with results deduced from Knight shifi measurements on mercury and tin, and in contrasi to the BCS prediction. (Contractor's abstract)

309

California U. [Dept. of Physics] La Jolla.

MANY-BODY THEORY OF LOCALIZED d STATES IN METALS. II. PAIR OF IMPURITIES, by P. Gottlieb and H. Suhl. [1964] [7]p. incl. table. (AFOSR-64-2528) (AF 49(638)1038) AD 453853 Unclassified

Also published in Phys. Rev., v. 134: 1586-1592, June 15, 1964.

A previous rotationally invariant periurbation treatmeni of localized d states is extended to the case of neighboring sites interacting via direci d-d exchange and indirect s-d scattering. It is found that the parallel alignment of two localized moments is never the ground staie of the pair. For certain values of the unperiurbed d-staie energy (depending upon the exchange interactions) only one of the sites will be occupied by a d electron so the pair can have a nei momeni. If the condiiions are such that both sites are occupied by d electrons, these electrons must be aligned antiparallel so there is only a small net moment due to scattering to and from the band staies. (Contracior's abstract)

310

California U. [Dept. of Physics] La Jolla.

AN INVESTIGATION OF THE PHASE-DIAGRAM PALLADIUM-ARSENIC IN CONNECTION WITH SUPERCONDUCTIVITY, by Ch. J. Raub and G. W. Webb. [1963] [7]p. incl. diagrs. table, refs. (AFOSR-J829) (AF AFOSR-62-344) AD 416513 Unclassified

Also published in Jour. Less-Common Metals, v. 5: 271-277, 1963.

The phase-diagram Pd-As has been investigated by thermal, röntgenographic and metallographic analysis, together with superconductivity measurements. The existence of five phases, three of them previously unknown, has been established. Addition of arsenic to palladium causes a sharp drop of the liquidus curve. At 770°C the compound Pd_7As is formed peritectically. Increasing the amounts of As causes the eutectic at 20 at-% As (715°C) to be followed by a peritectic reaction (820°C) between liquid and the congruently melting compound Pd_5As_2 (860°C), forming Pd_3As. At 33 at-% As the peritectically formed phase Pd_2As (728°C), which transforms at 485°C into a low temperature modification exists. The homogeneity range of $PdAs_2$ was found not to be as broad as claimed earlier. Three of the compounds are superconductors: Pd_5As_2 (T_c = 0.46°K), Pd_2As h.t. (T_c = 1.71°K) and Pd_2As l.t. (T_c = 0.60°K).

311

California U. [Dept. of Physics] La Jolla.

DENSITIES OF STATES, SUPERCONDUCTIVITY, AND LOCALIZED MOMENTS IN TRANSITION METALS, by B. R. Coles. [1963] [4]p. (AFOSR-J1134) (AF AFOSR-62-344) AD 421722 Unclassified

Also published in Solid State Comm., v. 1: 5-8, 1963.

Correlations between density of states at the Fermi surface, superconductive transition temperature and the tendency of solute iron atoms to carry localized moments are examined for second and third transition group metals; the breakdown of expected correlations is ascribed to the change in character of the d-band wave functions. (Contractor's abstract)

312

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN THE MERCURY-INDIUM ALLOY SYSTEM, by M. F. Merriam, M. A. Jensen, and B. R. Coles. [1963] [8]p. incl. diagrs. table, refs. (AFOSR-J1135) (AF AFOSR-62-344) AD 421151 Unclassified

Also published in Phys. Rev., v. 130: 1719-1726, June 1, 1963.

The superconducting transition temperatures of a large number of Hg-In alloys have been measured and the variation of T_c with composition determined over the entire range. Variation of T_c with number of valence electrons/atom within any particular metallurgical phase is quite strong, T_c in general increasing with decreasing number of valence electrons. The maximum and minimum values of T_c occurring in the system are 4.5 and 3.1°K at approx 80 and 20 at-% indium, respectively. HgIn, the only stoichiometric compound, has a transition temperature of 3.81°K. The observed composition dependence of T_c is not what one would expect either from Matthias's empirical rules or from the simple BCS formula, assuming a nearly free electron model for the density of states. In one phase a discontinuity in T_c and its composition dependence is found which cannot be correlated with a change in any lattice property and apparently arises from a discontinuous change in electronic structure.

313

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF SOME NEW Pt-METAL COMPOUNDS, by Ch. J. Raub, W. H. Zachariasen and others. [1963] [8]p. incl. diagrs. tables, refs. (AFOSR-64-0250) (AF AFOSR-62-344) AD 432746 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1093-1100, 1963.

Several new superconductors were discovered among compounds between Pt-metals and elements of the IV A, V A and VI A group of the periodic system. The position of the elements in the periodic system, the valence electron concentration and the crystallographic structure exhibit a strong influence on the superconducting behavior.

314

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY IN THE INDIUM-TIN SYSTEM, by M. F. Merriam and M. von Herzen. [1963] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-64-0459) (AF AFOSR-62-344) AD 435661 Unclassified

Also published in Phys. Rev., v. 131: 637-643, July 15, 1963.

Transition temperatures as a function of composition have been measured throughout the In-Sn binary system. Samples 'quenched' from the liquid state had higher transition temperatures than well-annealed samples, confirming the effect reported earlier for Hg-In compositions. The enhancement in T_c was 2-3°K for the most favorable compositions. It is argued that the effect arises from internal strains in the samples and not from short-range disorder. The equilibrium T_c values vary from 3.4°K (near pure In) to 6.6°K (β phase, 33.5 at-% Sn). Transition temperature within any particular phase is a strong function of valence electron concentration, but not a function of the type found in transition metal superconductors. In all phases T_c increases with increasing valence electron concentration. The data in the In terminal solid solution are compared with the BCS formula, and with the theory of Morel and Anderson. A substantial variation of the electron-phonon interaction parameter with alloying is required if the data are to be described with the BCS formula.

315

California U. [Dept. of Physics] La Jolla.

BRILLOUIN ZONE EFFECTS, SUPERCONDUCTIVITY,

AND FERMI SURFACE OF INDIUM ALLOYS, by M. F. Merriam. [1963] [3]p. incl. diagrs. refs. (AFOSR-64-0460) (AF AFOSR-62-344) AD 435904
Unclassified

Also published in Phys. Rev. Ltrs., v. 11: 321-323, Oct. 1, 1963.

A description is given of a Fermi surface-Brillouin zone interaction in the indium-rich solid solution of the In-Sn and In-Pb systems which is reflected in both lattice parameter and superconducting properties. Since the structure of indium is tolerably simple, and since a good deal is already known experimentally about the Fermi surface in pure indium, a reasonable guess as to the specific nature of the electronic effect can be made. The lattice parameter data also lead, in this case, to a reinterpretation of the existing magneto-acoustic data on the Fermi surface of In.

316

California U. [Dept. of Physics] La Jolla.

SIMPLE MODEL FOR THE SUPERCONDUCTIVITY OF LANTHANUM AND URANIUM, by G. C. Kuper, M. A. Jensen, and D. C. Hamilton. 1963, 7p. (AFOSR-64-1213) (AF AFOSR-62-344) AD 443019
Unclassified

Also published in Phys. Rev., v. 134: A15-A21, Apr. 6, 1964.

It is postulated that La and U have a narrow f band above, but very close to, the Fermi surface. An exchange interaction, antiferromagnetic in sign, between electrons in the f band can lead to nonzero occupation of the f levels in a BCS-type wave function. This f-band condensation, through a weak coupling of the f band to the conduction band, enhances a BCS condensation of the conduction electrons. There are two energy gaps, for quasiparticle excitations in the two bands. The critical field at zero temperature is calculated, as in the transition temperature. The predicted isotope effect is extremely small. The ratio between the transition temperature and the energy gap at T = 0 depends on the numerical values of the parameters; although this ratio is of the order unity, it would not be expected to be too near the BCS value of 1/1.75. (Contractor's abstract)

317

California U. [Dept. of Physics] La Jolla.

[ON THE SUPERCONDUCTIVITY OF TERNARY BETA TITANIUM ALLOYS] Uber die Supraleitfahigkeit ternarer Beta-Titanlegierungen, by Ch. J. Raub. [1963] [5]p. (AFOSR-64-1233) (AF AFOSR-62-344) AD 442805
Unclassified

Also published in Zeitschr. Phys., v. 178: 216-220, 1964.

The elements Sc to Cu, Y to Ag, and La to Au were alloyed in a beta-Ti-Rh system. The superconducting behavior of this ternary mixed crystal was investigated. The transition temperature-concentration curves are strikingly similar for all the elements with 3d, 4d, and 5d electrons, and can be explained on the basis of Matthiasschen's law by the change of the valence electron concentration, the transition temperature of the alloys increases, fluctuates between N = 4.4 and 4.6 reaches a maximum at about 4°K, then decreases. Manganese and rhenium, as well as the ruthenium and osmium alloys deviate from the steady fluctuations of the transition temperature curves. This can be explained by the magnetic characteristics of the elements concerned.

318

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF SOLID SOLUTIONS OF Ti AND Zr WITH Co, Rh, AND Ir, by Ch. J. Raub and G. W. Hull, Jr. [1963] [3]p. (AFOSR-64-1234) (AF AFOSR-62-344) AD 442808
Unclassified

Also published in Phys. Rev., v. 133: A923-A934, Feb. 17, 1964.

A detailed investigation of superconductivity in alpha and beta Ti and Zr solid solutions with Co, Rh, and Ir showed that T alpha rises with increasing valence electron concentration n. Small amounts of Co, Rh, and Ir dissolved in alpha Ti, or alpha-Zr increase Tc by a factor of 2 to 4. In the bcc phase region of the beta-Ti alloys Tc goes through a maximum of 4°K at 90 at-% Ti, which is explained by Matthias' rule. (Contractor's abstract)

319

California U. [Dept. of Physics] La Jolla.

BEAM STABILITY IN THE ELECTRON PROBE MICRO-ANALYZER, by R. Fitzgerald. [1964] [12]p. (AFOSR-64-2112) (AF AFOSR-62-344) AD 451354
Unclassified

Also published in Proc. Twelfth annual Conf. on Applications of X-ray Analysis, Denver, Colo., Aug. 7-9, 1963, v. 7: 369-381, 1964.

The reliability and speed at which an analysis can be completed, using methods of the electron probe micro-analyzer, depends to a large extent on the stability of the electron beam. The incident electron energy and total incident current must be maintained within prescribed limits to ensure accurate and reproducible x-ray data. The incident electron probe diameter must also stay within prescribed limits for maximum resolution over the analysis time. The performance of the electron optics is discussed in relation to high-voltage supply, current regulators and filament supply. Methods for probe current stabilization using aperture sensing are discussed. (Contractor's abstract)

320

California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF TELLURIUM, by B. T. Matthias and J. L. Olsen. [1964] [2]p. incl. diagr. (AFOSR-65-0805) (AF AFOSR-63-344) AD 617199 Unclassified

Also published in Phys. Ltrs., v. 13: 202-203, Dec. 1, 1964.

A superconducting transition in tellurium under high pressure at approx 3.3°K was observed. This is the first superconductivity noted in the 6th column of the periodic table. This observation supports the view that superconductivity is a general phenomenon.

321

California U. Dept. of Physics [La Jolla].

A NEW $C15_b$-TYPE PHASE—$CaAu_5$, by Ch. J. Raub and D. C. Hamilton. [1964] [3]p. incl. table, refs. (AFOSR-65-0806) (AF AFOSR-62-344) AD 617198 Unclassified

Also published in Jour. Less-Common Metals, v. 6: 486-488, 1964.

X-ray, x-ray fluorescence, and superconductivity measurements were made of the gold-rich Ca-Au system at Au concentrations between 80 and 90 at-%. The metals were pressed together into a small pellet, put in an alumina crucible inside an evacuated quartz-tube and heated up to approx 1000°C. The good agreement between observed and calculated intensities confirmed the assumption of a $C15_b$ type of structure for this phase. In order to establish the concentration of the $C15_b$ phase the alloy $CaAu_5$ was examined by x-ray fluorescence microprobe. Besides a little free gold, the sample showed only a phase with 83 at-% Au, corresponding to $CaAu_5$. Samples with 80 at-% Au were only partially superconducting, even though the x-ray pattern was not different from the $CaAu_5$ pattern. It was concluded that the composition of the Ca-Au phase that is richest in gold is $CaAu_5$ and not $CaAu_4$ as given by the phase diagram.

322

California U. Dept. of Physics, La Jolla.

PEIERLS PROOF OF SPONTANEOUS MAGNETIZATION IN A TWO-DIMENSIONAL ISING FERROMAGNET, by R. B. Griffiths. [1964] [3]p. incl. diagr. refs. (AFOSR-65-0189) (AF AFOSR-64-610) AD 456567 Unclassified

Also published in Phys. Rev., v. 136: A437-A439, Oct. 19, 1964.

A few minor modifications are made in the Peierls argument that a two-dimensional Ising ferromagnet possesses a spontaneous moment at sufficiently low temperatures, in order to make the proof quite rigorous.

323

California U. [Dept. of Physics] La Jolla.

[SUPERCONDUCTIVITY OF THE NOBLE METALS AND THEIR ALLOYS] Supraleitfahigkeit der Edelmetalle und ihrer Legierungen), by Ch. [J.] Raub. [1964] [5]p. (AFOSR-64-1217) (AF AFOSR-64-631) AD 443023 Unclassified

Also published in Zeitschr. Metallk, v. 55: 195-199, 1964.

Only three of the noble metals are superconductors above 0.35°K, but it is very likely that gold and platinum of highest purity become superconductors at lowest temperatures (10^{-3}°K). None of the solid solutions of gold or silver, but several solid solutions of the platinum metals, are superconduction. Small additions of noble metals to superconducting elements of group V reduce their transition-temperature, in group V they increase T_c. Only a few superconducting silver- or gold-compounds are known. A survey of the superconducting compounds of the platinum metals with the transition and nontransition elements shows some general features: the highest transition temperatures occur among the beta-tungsten, A12 and delta-phases and with increasing metallic properties of the groups IV A, V A and VI A of the periodic system the concentration of the superconducting phases shifts to smaller platinum metal concentrations. (Contractor's abstract)

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[California U. Dept. of Physics, La Jolla]

SUPERCONDUCTING METASTABLE COMPOUNDS, by H. L. Luo, M. F. Merriam, and D. C. Hamilton. [1964] [2]p. incl. diagr. table, refs. (AFOSR-64-2117) (AF AFOSR-64-631) AD 451704 Unclassified

Also published in Science, v. 145: 581-583, Aug. 7, 1964.

A number of metastable phases, germanides and tellurides of gold and silver, has been prepared, analyzed by x-ray diffraction, and investigated for superconductivity. The new superconductors and their transition temperatures are $AgTe_3$ (2.6°K), Ag_4Ge (0.85°K), Au_3Te_5 (1.62°K), and $Au_{1-x}Ge_x$ (0.99°K — 1.63°K) where ($0.27 \leq x \leq 0.60$). Au-Ge compositions with other value of x do not superconduct above 0.32°K. (Contractor's abstract)

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California U. [Dept. of Physics] La Jolla.

EFFECT OF DISSOLVED MANGANESE ON SUPERCONDUCTIVITY OF PURE AND IMPURE INDIUM, by M. F. Merriam, S. H. Liu, and D. P. Seraphim. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0191) (AF AFOSR-64-631) AD 456594 Unclassified

Also published in Phys. Rev., v. 136: A17-A21, Oct. 5, 1964.

The superconducting critical temperature of In decreases by ~70°K per unit resistance ratio, $\rho 4.2/\rho 273°K$, when doped with Mn. The addition of a third element, Pb or Sn (just a few %), progressively decreases the effect of the Mn and eliminates the effect completely when the mean free path is decreased to ~500A. The data are explained on the basis of the Korringa model for the resistivity-minimum phenomenon found in dilute transition-metal solutions. It is assumed that the scattering of the conduction electrons undergoes a resonance (presumably caused by the localized moments) of width ~1°K at the Fermi surface. The effect disappears when enough nonparamagnetic impurity is added to make the width of the electron energy levels large compared to that of the resonance. The technique and the model (if correct) opens a new way for investigating the resonance model for paramagnetic impurities.

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California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTIVITY OF SODIUM TUNGSTEN BRONZES, by Ch. J. Raub, A. R. Sweedler and others. [1964] [2]p. incl. diagr. (AFOSR-65-0791) (AF AFOSR-64-631) AD 616055 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 746-747, Dec. 21, 1964.

The superconductivity was determined for sodium tungsten bronzes having a general formula Na_xWO_3 with $0.1 < x \leq 1$. The transition temperatures are in the range below 1°K.

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California U. Dept. of Physics, La Jolla.

[ON THE CRYSTAL STRUCTURE OF THE GOLD-RICH PHASES IN THE SYSTEM GALLIUM-GOLD AND RUBIDIUM-GOLD] Uber die Kristallstrukturen der goldreichsten Phasen in den Systemen Kalium-Gold und Rubidium-Gold, by Ch. J. Raub and V. B. Compton. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0792) (AF AFOSR-64-631) AD 616053 Unclassified

Also published in Zeitschr. Anorg. Allgem. Chem., v. 332: 5-11, June 1964.

The crystal structure of the compounds KAu_5 and $RbAu_5$ were determined. Both compounds have the hexagonal $CaCu_5$ type structure, space group $D^1 - P^6/mmm$ with one formula weight in the unit cell. The lattice constants 6h for KAu_5 are a = 5.659A, c = 4.483A and for $RbAu_5$ a = 5.760A, c = 4.448A. Contrary to former statements the formulae of these compounds are KAu_5 and $RbAu_5$ and not KAu_4 and $RbAu_4$.

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California U. [Dept. of Physics] La Jolla.

EFFECT OF UNIAXIAL STRESSES ON THE PARAMAGNETIC SPECTRA OF Mn^{3+} AND Fe^{3+} IN MgO, by E. R. Feher. [1964] [13]p. incl. diagrs. table, refs. (AFOSR-65-0793) (AF AFOSR-64-631) AD 616052 Unclassified

Also published in Phys. Rev., v. 136: A145-A157, Oct. 5, 1964.

The study investigates the lowest energy levels of the paramagnetic ions Mn^{2+} and Fe^{3+} in the host crystal MgO as a function of externally applied uniaxial stress. The effect of the stress on the energy levels of the paramagnetic ion can be described by introducing into the spin Hamiltonian an additional term of the form S·D·S. When the components of D are expressed as linear functions of the applied stress components, there are only 2 independent constants of proportionality in the simple case of a cubic crystalline lattice. In this note these constants have been experimentally determined. Also investigated are the absolute value and the angular dependence of the linewidth of the fine structure of Mn^{2+} and Fe^{3+} in MgO. The widths are accounted for in terms of the spin-lattice coefficients by assuming a random distribution of internal stresses in the host sample. Also treated is the relevance of the spin-lattice coefficients in the determination of the direct spin-lattice relaxation times.

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California U. [Dept. of Physics] La Jolla.

SUPERCONDUCTING TUBES AND FILAMENTS, by G. Arrhenius, R. Fitzgerald and others. [1964] [4]p. incl. illus. diagr. (AFOSR-65-0794) (AF AFOSR-64-631) AD 615683 Unclassified

Also published in Jour. Appl. Phys., v. 35: 3487-3490, Dec. 1964.

A study is reported of the superconductivity and microstructure which occur when small quantities of La are quenched with Rh in the arc furnace. A strikingly regular prismatic honeycomb of a superconducting compound is found when the La concentration is ≥ 0.5 at-%. For smaller concentrations a continuous network of the superconducting phase is no longer observed which correlates with the lowering and broadening of the superconducting transition region. Evidence is given that for such low concentrations superconducting tunneling occurs through the elemental Rh phase itself thus pointing to the superconductivity of Rh at lower temperatures.

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California U. Dept. of Physics, La Jolla.

[SUPERCONDUCTIVITY AND PHASE TRANSFORMATION IN TITANIUM ALLOYS. I. ADDITION OF VANADIUM PLUS ALUMINUM, NIOBIUM AND MOLYBDENUM] Supraleitung und Phasenumwandlung bei Titanlegierungen. I. Zusätze von Vanadium + Aluminum, Niob und Molybdän, by Ch. J. Raub and U. Zwicker. [1964] [5]p. incl. illus. diagrs. refs. (AFOSR-65-2546) (AF AFOSR-64-631) AD 629830 Unclassified

Also published in Zeitschr. Metallkunde, v. 55: 711-715, 1964.

The change of transition temperature during the β/α-transformation of the alloys $TiV_{16}Al_3$, $TiMo_{16}$ and $TiNb_{33}$ was investigated. The transition temperature is influenced by the concentration of the alloying elements in the β-matrix and hence by the valence electron concentration. The influence of the ordered intermediate phases is small. The transition temperature of the α-solid solution can be increased by Va-group elements, but in the alloys investigated the transition temperature of β-phase is higher than that of the α-phase and therefore the value for T_c corresponds to that of the β-phase. The concentration of alloying elements in the β-phase and thus the transition temperature can be shifted to higher or lower values by normal or up-hill diffusion during the transformation processes. (Contractor's abstract)

331

California U. Inst. of Geophysics and Planetary Physics, La Jolla.

COMPARATIVE SEISMIC NOISE ON THE OCEAN BOTTON AND ON LAND, by H. Bradner and J. G. Dodds. [1964] [10]p. incl. illus. diagrs. tables, refs. (AFOSR-65-2897) (AF AFOSR-62-420) AD 452688 Unclassified

Also published in Jour. Geophys. Research, v. 69: 4339-4348, Oct. 15, 1964.

Recordings of the seismic noise background have been made on the Pacific Ocean bottom at a depth of 5 km with internally recording single-component seismometers which are recovered after automatic release of ballast. Simultaneous recordings have been made at land stations. High-resolution noise spectra in the frequency band between 0.12 and 9 cps have been obtained by digital analysis. Comparison of amplitudes or phase shifts does not indicate coherence between two distant records, and relative energy distribution between orthogonal components of a three-component seismometer record does not indicate significant Rayleigh wave energy. The ocean-bottom noise spectrum has a shape qualitatively similar to the continental land noise spectrum, but greater in magnitude. The Hawaiian Island spectra show the usual 6- to 8-sec microseism peak, but less high-frequency structure than the continental United States spectra. (Contractor's abstract)

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California U. Brain Research Inst., Los Angeles.

SPECTRAL ANALYSIS OF ELECTROENCEPHALOGRAMS RECORDED DURING LEARNING IN THE CAT, BEFORE AND AFTER SUBTHALAMIC LESIONS, by D. O. Walter and W. R. Adey. [1963] [22]p. incl. diagrs. diagrs. tables, refs. (AFOSR-5347) (AF AFOSR-61-81) AD 421725 Unclassified

Also published in Exper. Neurol., v. 7: 481-501, 1963.

The remarkable slow waves found in EEG of the dorsal hippocampus and related structures during acquisition of a conditioned discriminatory reflex are studied by spectral analysis. Some of the analysis is given in detail as a tutorial illustration of spectral analysis. Visual observations of the frequency specificity of those waves, and the detailed mirroring of these wave processes between hippocampus and entorhinal cortex, are numerically confirmed. The slowing and irregularization of these waves produced by serial bilateral lesions in the far-off subthalamic areas is quantified, and shown to differ in evolution between the hippocampus and entorhinal areas. The spectral results show a persistent disparity in the frequency peaks of the two rhinencephalic traces, which requires the assumption of a nonlinear relationship between these areas, superadded to the linear one. The relation between hippocampal waves and those in the reticular formation of the mesencephalon and in the visual area of the lateral neocortex is also shown to be a distinctly nonlinear one.

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California U. Brain Research Inst., Los Angeles.

SLEEP: CORTICAL AND SUBCORTICAL RECORDINGS IN THE CHIMPANZEE, by W. R. Adey, R. T. Kado, and J. M. Rhodes. [1963] [2]p. incl diagr. (AFOSR-53 5364) (AF AFOSR-61-81) AD 423044 Unclassified

Also published in Science, v. 141: 932-933, Sept. 6, 1963.

Electroencephalographic sleep patterns of chimpanzees reveal greater similarities to human records than those of lower mammals. Flash-evoked responses in the midbrain reticular formation remain during "paradoxical" sleep, which does not appear to necessarily involve deep unconsciousness. Characteristic spindling occurs in the amygdala during a "paradoxical" type sleep while other areas were desynchronized. Telencephalic sleep-control mechanisms in higher primates are considered.

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California U. Brain Research Inst., Los Angeles.

SPECTRAL ANALYSIS FOR ELECTROENCEPHALOGRAMS: MATHEMATICAL DETERMINATION OF NEUROPHYSIOLOGICAL RELATIONSHIPS FROM RECORDS OF LIMITED DURATION, by D. O. Walter. [1963] [27]p. incl. diagrs. refs. (AFOSR-5365) (AF AFOSR-61-81) AD 423045 Unclassified

Also published in Exper. Neurol., v. 8: 155-181, 1963.

Spectral analysis is a mathematical method which contains and generalizes frequency analysis. The form of spectra analysis most applicable to EEG is presented, using both algebraic formulae and 4 simplified illustrative examples. The coherence function and transfer function are the analogs of correlation coefficient and regression coefficient. The coherence function is applied not only to calculate the "quantity of

interdependence" between pairs of illustrative examples, but also to supply probable bounds on the other calculated relationships. Finally, discussion of the assumptions underlying spectral analysis prepares the methods for application to actual EEG.

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California U. [Brain Research Inst.] Los Angeles.

THE INTERACTION OF PLANT HORMONES AND ROTATION AROUND A HORIZONTAL AXIS ON THE GROWTH AND FLOWERING OF XANTHIUM PENSYLVANICUM, by T. Hoshizaki, B. H. Carpenter, and K. C. Hamner. [1964] [9]p. (AFOSR-64-1082) (AF AFOSR-61-81) AD 441469 Unclassified

Also published in Planta, v. 61: 178-186, 1964.

Xanthium pensylvanicum plants were rotated around a horizontal axis at 0.25 rpm. The stem growth, and flowering response were studied in rotated Xanthium treated with gibberellic acid (GA3), indoleacetic acid (IAA). Leaf growth of rotated Xanthium was also studied. In both light and dark, the length and the number of nodes in stems of rotated Xanthium were significantly less than the stationary controls. Application of 10 μg and 100 μg of GA3 increased the stem length over that of the untreated controls and furthermore, GA3 application decreased the dwarfing effect of rotation such that stems of rotated Xanthium treated with GA3 were not significantly different from stationary GA3 treated plants. In rotated Xanthium plants, floral enhancement did not occur when GA3 was applied just prior to rotational treatment. Foliar application of IAA to both rotated and stationary plants did not significantly affect the floral response.

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California U. [Brain Research Inst.] Los Angeles.

STUDIES OF BRAIN FUNCTION AND BEHAVIOR, by J. D. French, W. R. Adey, and H. W. Magoun. Final rept. May 1, 1961-Apr. 30, 1963. May 25, 1964, 10p. (AFOSR-64-1195) (AF AFOSR-61-81) AD 442844 Unclassified

This study includes single brain cells and their discharge patterns during Pavlovian conditioning ic development and evaluation of brain wave recording techniques in pilots flying high performance aircraft on pursuit missions. Much of the work has involved development of new techniques for computational analysis of electroencephalographic and other neurophysiological data. In turn, these techniques have led to the formulation of a series of realistic models of the processes of transaction and storage of information in brain tissue. These models are now being assessed in actual physiological experiments. In addition to purely neurophysiological studies, investigations have been made of the effects of isolation and confinement in simulated orbital flights on urinary steroid excretion in the monkey. These studies have been coupled with evaluation of increased gravitational loads, whole body irradiation and decompression on renal functions, including calcium excretion. Other studies have tested interaction of altered gravitational fields and hormones on normal plant maturation, and the effects of continuous high intensity light on circadian plant rhythms. (Contractor's abstract)

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California U. [Brain Research Inst.] Los Angeles.

A LARGE SIZE ECONOMICAL PLANT GROWTH CHAMBER, by T. Hoshizaki, J. Zweizig, and P. Broberg. [1963] [5]p. incl. diagrs. (AFOSR-65-0937) (AF AFOSR-61-81) AD 622912 Unclassified

Also published in Proc. Amer. Soc. Horticultural Sci., v. 83: 844-848, 1963.

A design is presented for a low-cost plant growth chamber with an adequately controlled environment. The chamber is constructed of wood and requires a minimum of skilled labor. Its total cost is approx $1900. Its dimensions on the inside are 4 x 6 x 8 ft. The refrigeration is provided by a 1 hp unit, and glass wool battings are used for insulation. The temperature is maintained within 1/2°F of the desired temperature by a pulse-cooling system. The light control system varies the intensity by turning selected lamps on or off in 4 steps, from complete darkness to 1500 ft-c at a level 28 in. below the lamp.

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California U. [Brain Research Inst.] Los Angeles.

THE INFLUENCE OF SIMULATED ALTITUDE (18,000 feet) ON UROFLOWMETRY, by A. T. K. Cockett and E. Bors. [1964] [5]p. incl. diagrs. table. (AFOSR-65-1777) (AF AFOSR-61-81) AD 626489 Unclassified

Also published in Urol. Internat'l., v. 18: 357-361, 1964.

A study to determine the effect of high altitudes on the voiding rates of several subjects is reported. The experiment was carried out in an altitude simulator with barometric pressure equal to an altitude of 18,000 ft. Sixteen subjects were tested using an automatic uroflowmeter. It is concluded that high altitude has no effect on urine flow.

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California U. [Brain Research Inst.] Los Angeles.

NEWER CONCEPTS IN THE PATHOPHYSIOLOGY OF EXPERIMENTAL DYSBARISM-DECOMPRESSION SICKNESS, by A. T. K. Cockett and R. M. Nakamura. [1964] [5]p. incl. illus. diagrs. table. (AFOSR-66-1942) (AF AFOSR-61-81) AD 643044 Unclassified

Presented at annual meeting, Amer. Coll. Surgeons, Santa Barbara, Calif., Jan. 17-19, 1964.

Also published tn Amer. Surgeon, v. 30: 447-451, July 1964.

Hemoconcentration has been observed tn a significant number of patients who develop dysbarism. In every tnstance a greater than 2:1 barometrtc pressure change had occurred. The present study was formulated (1) to evaluate the apparent loss of plasma volume by subjecting animals to a 5:1 barometrtc pressure change; and (2) to determtne the pathological changes tn antmals undergoing the pressures whtch represent an LD 100 model.

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California U. Brain Research Inst., Los Angeles.

COMPARISON OF THE AVERAGE CORTICAL AND SUBCORTICAL EVOKED RESPONSE TO CLICKS DURING VARIOUS STAGES OF WAKEFULNESS, SLOW WAVE SLEEP AND RHOMBENCEPHALIC SLEEP, by W. D. Winters. [1964] [12]p. tncl. diagrs. table, refs. (AF AFOSR-61-81) Unclassifted

Publtshed in Electroenceph. Cltn. Neurophystol., v. 17: 234-245, 1964.

The purpose of thts paper wau to examtne the relationshtp of background EEG and evoked response to cltcks wtth changes tn wakefulness-sleep cycles in cats with chrontcally tmplanted electrodes. Several points are apparent: (1) Shape and amplitude of evoked responses tn the anterior suprasylvian gyrus (ASG) changed tn a predictable manner durtng the vartous states of wakefulness and sleep. (2) The evoked response in ASG is similar durtng rhombencephalic phase of sleep (RPS) distraction and wakefulness, whereas that tn the recticular formation (MBRF) ts reduced or absent during RPS and distraction but present during wakefulness. Thts suggests that the long latency ASG response does not require the tntegrtty of the MBRF. (3) The evoked response and background EEG are stmilar dui ing both RPS and alert distraction tn the ASG, thalamus, caudate and MBRF. Thts suggests that the RPS is a state stmilar to distraction, rather than a deep stage of sleep.

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Caltfornia U. [Bratn Research Inst.] Los Angeles.

THE EFFECT OF WHOLE BODY IRRADIATION (300r) ON EXPERIMENTAL BLADDER CALCULUS FORMATION IN RATS, by A. T. K. Cockett, R. M. Nakamura and others. [1964] [3]p. incl. tables. (AF AFOSR-61-81) Unclasstfted

Published tn Invest. Urol., v. 1: 552-554, May 1964.

A method for the whole body irradiation of rats with bladders containing magnestum discs ts described. Whole body irradiation (300r) stgniftcantly reduced the stze of experimentally formed bladder calculi tn rats. Plasma phosphorus values were stgnificantly htgher tn the disc-nonirradiated group.

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California U. Bratn Research Inst., Los Angeles.

EFFECTS OF GRAVITY ON THE FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM, by W. R. Adey. [1964] [21]p. tncl. tllus. diagrs. refs. (AF AFOSR-61-81) Unclasstfted

Publtshed in Life Sctences and Space Research II, Fourth Internat'l. Space Science Sympostum (Warsaw, Poland) (June 3-12, 1963), Amsterdam, North-Holland Publtshtng Co., 1964, p. 267-286.

The sensttivity of the mammalian central nervous system to gravitational influences tnvolves both direct and indirect factors. Gradual loss of cerebral circulation with tncreastng acceleration beyond 5 G has been shown to evoke changes in patterns of bratn electrtcal activity, with epileptiform discharges trtggered primarily in the hippocampal system of the temporal lobe, and spreading into other brain systems. The relationshtp of these structures to judgment and discrtmtnattve functions ts discussed. Tests of vibrational stimult tn the monkey have disclosed "driving" of electrtcal bratn rhythms at the shaking frequency, particularly tn the range from 11 to 15 cycles per second. These effects are unrelated to photic stimulation, and are abolished by anesthesia or death. Tests of discrimtnative capabtlity at frequencies productng maximum drtving have shown increased response latencies and increased errors. The neurophystological basis for adaptive phenomena tn recurrent vestibular stimulation has been found to restde partly in the vestibular nuclei of the medulla, and not to require tntegrtty of connections with higher vestibular centers.

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California U. [Brain Research Inst.] Los Angeles.

THE EFFECTS OF REGIONAL HYPOTHERMIA ON THE CANINE URINARY BLADDER, by A. T. K. Cockett and R. M. Nakamura. [1964] [8]p. incl. tllus. diagrs. table. (AF AFOSR-61-81) Unclasstfted

Publtshed tn Invest. Urol., v. 2: 14-21, July 1964.

Hypothermia to the cantne urtnary bladder will produce charactertstic htstologic changes in the epithelium and submucosa. A modified catheter for regional hypothermia ts described, and temperatures employed for cooltng are listed. (Contractor's abstract)

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[California U. Bratn Research Inst., Los Angeles]

[THE PROCESSING AND STORAGE OF INFORMATION IN THE NERVOUS SYSTEM. A MODEL SUGGESTED BY THE STUDY OF HIPPOCAMPAL MECHANISMS IN THE COURSE OF TRAINING] L'Élaboration et le stockage de l'information dans le système nerveux. Un modele suggére par l'étude des mécanismes

hippocampiques au cours de l'apprentissage, by W. R. Adey. [1963] [33]p. incl. diagrs. refs. (AF AFOSR-61-81) Unclassified

Published in Actualités Neurophysiol., v. 5: 263-295, 1963.

This paper presents results on the functioning of the hippocampus during the acquisition of a discriminative behavior of the cat. Results have shown the possible role of the EEG slow waves in information transmission within the cerebral systems, and the possibility that the neuron itself serves as a phase comparator of intrinsic and extrinsic slow waves which pass over the neuronal membrane in very complex spatio-temporal patterns. A method has been developed to measure, by implanted electrodes, the electrical impedance of a small volume of hippocampal tissue. Transitory but significant impedance changes occurred only during training of discriminative behavior, and they began to appear only when the trained behavior became superior to that expected by chance. The impedance changes have been interpreted as related to ionic movements, possibly in the glial tissues; the latter may function as a variable and probably nonlinear resistance for the electronic processes of the neuronal dendritic trees, which are most likely responsible for the electrical waves seen in cerebral tissues.

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California U. [Brain Research Inst.] Los Angeles.

REDUCTION IN RENAL VEIN OXYGEN SATURATION AND OXYGEN TENSION IN EXPERIMENTAL UNILATERAL RENAL ARTERY STENOSIS, by A. T. K. Cockett, C. K. Liu and others. [1964] [7]p. incl. diagrs. table, refs. (AF AFOSR-61-81) Unclassified

Presented at Soc. Univ. Surgeons Annual meeting, Los Angeles, Calif., Feb. 13, 1964.

Published in Invest. Urol., v. 2: 71-77, July 1964.

This study reveals that two parameters—oxygen saturation and oxygen tension—are significantly reduced in venous blood from the ischemic kidney. On the basis of these findings a more comprehensive study, including the correlation of specific decrements in renal blood flow with the parameters used in the present study, will be undertaken. A study of the difference between renal veins of these parameters in hypertensive patients is warranted and may be of use in differentiating the patient with clinically significant unilateral renal artery stenosis from other types of hypertension.

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California U. [Brain Research Inst.] Los Angeles.

RENAL DESCENT DURING VALSALVA MANEUVER IN SUPINE AORTOGRAPHY: SIMPLE MEANS TO IMPROVE DETAIL AND DEMONSTRATE EFFECT OF NEPHROPTOSIS OF THE RENAL ARTERY, by B. I. Rein and A. T. K. Cockett. [1964] [4]p. incl. illus. refs. (AF AFOSR-61-81) Unclassified

Published in Jour. Urol., v. 92: 217-220, Sept. 1964.

Performance of the Valsalva maneuver during aortography in the supine position is suggested as a simple convenient means to cause downward displacement of kidneys, as in the erect position, resulting in stretching and elongation of the renal arteries. This provides improved delineation of the entire length of the renal arteries and reduces overlap of other aortic branches. In addition, it is a useful means to graphically demonstrate and evaluate the association between ptosis and renal arterial lesions.

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California U. [Brain Research Inst.] Los Angeles.

THE UROLOGICAL PROBLEMS IN SPACE MEDICINE, by A. T. K. Cockett. [1964] [4]p. incl. illus. diagr. (AF AFOSR-61-81) Unclassified

Presented at annual meeting of the Calif. Medical Assoc., Los Angeles, Mar. 24-27, 1963.

Published in Jour. Urol., v. 92: 564-567, Nov. 1964.

The purpose of this paper is to review recent developments which provide partial solutions to 2 potential urological hazards: (1) urinary calculi and (2) decreased urine flow.

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California U. Brain Research Inst., Los Angeles.

ELECTRODE SYSTEM FOR RECORDING EEG FROM PHYSICALLY ACTIVE SUBJECTS, by R. T. Kado, W. R. Adey, and J. R. Zweizig. [1964] [1]p. incl. diagr. (AFOSR-65-0941) (AF AFOSR-63-246) AD 622895 Unclassified

Also published in Seventh annual Conf. on Eng. in Med. and Biol., Cleveland, Ohio, Nov. 1964, p. 5.

An electrode system is presented which is designed to produce good electroencephalographic recordings despite moderate movements of the subject. A simple tin electrode in a stannous chloride solution is used. The metal part and the electrolyte are contained in a semipermeable ceramic shell. The electrolyte is prepared in dry form containing $SnCl_2 \cdot 2H_2O$, Kaolin, Silica gel, and Natrosol. The prepared cup is then activated for use by immersion in distilled water. Contact between the skin and electrode is established by a cylindrical cellulose acetate sponge hollowed at one end to accept the cup assembly. A microdot minninoise coaxial cable is used to eliminate cable artifacts. The system is reported to have worked well on active subjects engaged in normal functions.

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California U. [Brain Research Inst.] Los Angeles.

RENAL LYMPH AND ANTIBACTERIAL LEVELS IN THE TREATMENT OF PYELONEPHRITIS, by Y. J. Katz, A. T. F.. Cockett, and R. S. Moore. [1964] [14]p. incl. illus. diagrs. table, refs. (AFOSR-65-0964) (AF AFOSR-63-246) AD 619107 Unclassified

Also published in Life Sct., v. 3: 1249-1262, 1964.

A method for the cannulation of renal lymphatics is described. A 2-3 fold increase in lymph concentrations of nitrofurantoin over plasma was observed 1-1/2 to 2 hr after infusion by gastric tube. Maximal microbiological acttvity against E. coli was noted in the renal lymph at 1-1/2 to 2 hr. The hilar lymphatics were also cannulated. It appeared that these vessels draining the medulla contained a sttll higher concentration of the antibacterial. The kidney interstitium diverted bacteriologically acttve nitrofurantoin into the renal lymphatics. An antimicrobial assay of renal lymph along with urine and blood levels is indicated to determine the effectiveness of any therapeuttc agent.

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California U. Brain Research Inst., Los Angeles.

THE EFFECTS OF VARIOUS IONS ON RESTING AND SPIKE POTENTIALS OF BARNACLE MUSCLE FIBERS, by S. Hagiwara, S. Chichibu, and K.-I. Naka. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-65-0047) (AF AFOSR-64-535) AD 455016 Unclassified

Also publtshed in Jour. Gen. Physiol., v. 48: 163-179, Sept. 1964.

Effects of monovalent cations and some antons on the electrical properties of the barnacle muscle ftber membranes were studied when the intra- or extracellular concentrations of those ions were altered by longitudinal intracellular tnjection. The resting potential of the normal fiber decreases linearly with increase of logarithm of $[K^+]_{out}$ and the decrement for a tenfold increase in $[K^+]_{out}$ is 58 mv when the product, $[K^+]_{out} \cdot [Cl^-]_{out}$, is kept constant. It also decreases with decreasing $[K^+]_{tn}$ but is always less than expected theoretically. The deviatton becomes larger as $[K^+]_{tn}$ tncreases and the resting potential finally starts to decrease with increasing $[K^+]_{tn}$ for $[K^+]_{in} > 250$ mM. When the tnternal K^+ concentration is decreased the overshoot of the spike potential increases and the time course of the spike potential becomes more prolonged. In substitutting for the tnternal K^+, Na^+ and sucrose affect the resting and sptke potentials simtlarly. Some organic cations (guantdtne, choline, tris, and TMA) behave ltke sucrose while some other organic cations (TEA, TPA, and TBA) have a specific effect and prolong the spike potenttal if they are applied intracellularly or extracellularly. In all cases the active membrane potential tncreases linearly with the logartthm of $[Ca^{++}]_{out}/[K^+]_{in}$ and the increment is about 29 mv for tenfold tncrease in tius ratio. The fiber membrane is permeable to Cl^- and other smaller antons (Br^- and I^-) but not to acetate$^-$ and larger anions (cttrate$^-$, sulfate$^-$, and methanesulfonate$^-$).

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Caltfornia U. Brain Research Inst., Los Angeles.

THE INITIATION OF SPIKE POTENTIAL IN BARNACLE MUSCLE FIBERS UNDER LOW INTRACELLULAR Ca^{++}, by S. Hagiwara and K.-I. Naka. [1964] [22]p. incl. diagrs. table, refs. (AFOSR-65-0048) (AF AFOSR-64-535) AD 455021 Unclassifted

Also published in Jour. Gen. Physiol., v. 48: 141-162, Sept. 1964.

Electrical properties of the muscle fiber membrane were studted in the barnacle, Balanus nubilus Darw, by ustng intracellular electrode techniques. A depolarization of the membrane does not usually produce an all-or-none spike potential in the normal muscle fiber even though a mechanical response is elicited. The intracellular injectton of Ca^{++} binding agents renders the fiber capable of initiating all-or-none spikes. The overshoot of such a spike potential increases with increastng external Ca concentration, the increment for a tenfold tncrease in Ca concentration being about 29 mv. The threshold membrane potential for the spike and also for the K conductance increase shifts to more positive membrane potentials with increasing Ca^{++}. The removal of Na ions from the external medium does not change the configuration of the spike potential. In the absence of Ca^{++} in the external medium, the spike potential is restored by Ba^{++} and Sr^{++} but not by Mg^{++}. The overshoot of the spike potential increases with increasing Ba^{++} or Sr^{++}. (Contractor's abstract)

352

Californta U. Brain Research Inst., Los Angeles.

MEMBRANE PROPERTIES OF BARNACLE MUSCLE FIBER, by S. Hagiwara, K.-I. Naka, and S. Chichibu. [1964] [2]p. incl. diagr. (AFOSR-64-1707) (AF AFOSR-64-535) AD 447599 Unclassifted

Also published in Science, v. 143: 1446-1448, Mar. 27, 1964.

Membrane properties of the giant muscle ftber of the barnacle Balanus nubilus were studied by controlling the ionic compositton of the external and internal media. The resting potential decreases with tncreasing external K-concentratton, $[K^+]_{out}$, and decreasing internal K-concentration, $[K^+]_{in}$, over a considerable range. Spike potentials are elicited when the tnternal calcium ions are removed, and the overshoot is determtned by the ratio between $[Ca^{++}]_{out}$ and $[K^+]_{tn}$ and not by the external or internal $[Na^+]$.

353

California U. [Dept. of Astronomy] Los Angeles.

A STUDY OF HIGH-PRECISION GEOCENTRIC AND INTERPLANETARY ORBITS, by S. Herrick. [Final] repi. Feb. 2, 1959-Apr. 30, 1963. Sepi. 30, 1963, 20p. (Rept. no. 63-56) (AFOSR-5350) (AF 49(638)498) AD 427653 Unclassified

The purpose of this contract is research into the theory and application of astrodynamics in the fields of high-precision geocentric and interplanetary orbits. Developing along these parallel lines, the undertaking has continually widened and deepened in scope since its inception to include such practical matters as the improvement of the numerical values of the astrodynamic constants, the computational advantages of various perturbation techniques, and use of universal variables, as well as theoretical development along the lines of optimization, rendezvous in space, and the adjoint method in differential orbit improvement. These are considered in the report. (Contractor's abstract)

354

California U. [Dept. of Astronomy] Los Angeles.

THE HYDROGEN TO HELIUM RATIO IN HD 96446, by A. Cowley, L. H. Aller, and T. Dunham, Jr. [1963] [7]p. incl. diagrs. tables. (AFOSR-65-1105) (AF AFOSR-63-83) AD 621535 Unclassified

Also published in Publ. Astron. Soc. Pacific, v. 75: 141-147, Oct. 1963.

One of the brightest of the hydrogen-deficient stars in HD 96446. Spectral scans of this star were taken, and the method proposed by Unsöld was followed to get the hydrogen/helium ratio: H/He ≈ 0.38. It is found that, though HD 96446 is a hydrogen-deficient star, it is not by any means an extreme example of this class.

355

California U. [Dept. of Astronomy] Los Angeles.

SPECTROPHOTOMETRY OF THE WOLF-RAYET STAR γ_2 VELORUM, by L. H. Aller and D. J. Faulkner. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1106) (AF AFOSR-63-83) AD 620481 Unclassified

Also published in Astrophys. Jour., v. 140: 167-172, July 1, 1964.

A spectrophotometric study was undertaken of both components of the binary γ Velorum. Observations of γ_1 Velorum were difficult, but it appeared to have a normal distribution for a B2 dwarf. The major part of the study was concerned with the component γ_2 Velorum, the brightest Wolf-Rayet star in the sky. Measurements of the energy distribution in the continuum and of the intensities of the brighter lines, due to helium, carbon, and oxygen in various ionization stages, yielded excitation temperatures dependent on the ionization stage, and a color temperature near 30,000°K.

356

California U. [Dept. of Astronomy] Los Angeles.

SPECTROMETRIC STUDIES OF GASEOUS NEBULAE. I. THE DOUBLE-RING PLANETARY NGC 7009, by L. H. Aller and J. B. Kaler. [1964] [14]p. incl. illus. tables, refs. (AFOSR-65-1107) (AF AFOSR-63-83) AD 620483 Unclassified

Also published in Astrophys. Jour., v. 139: 1074-1080, May 1964.

Spectrophotometric data obtained with a photoelectric spectrum scanner at Mount Wilson Observatory in 1956 and Mount Stromlo Observatory in 1961 are combined with photographic observations obtained with coudé spectrographs at Mount Wilson and Lick Observatories to obtain intensities and identifications for the planetary nebula NGC 7009 in the spectral region λ 3100-λ 4960. Lines as weak as 0.02 on the scale I(Hβ) = 100 are measured on the longest exposure.

357

California U. [Dept. of Astronomy] Los Angeles.

SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE II. THE MODERATE-EXCITATION PLANETARIES NGC 6572 and IC 4997, by L. H. Aller and J. B. Kaler. [1964] [11]p. incl. tables, refs. (AFOSR-65-1108) (AF AFOSR-63-93) AD 620484 Unclassified

Also published in Astrophys. Jour., v. 140: 621-631, Aug. 15, 1964.

Observations made with the 100-in. coudé spectrograph at Mount Wilson and the nebular spectrograph of the Crossley reflector a Lick Observatory are used to obtain line identifications and intensities for planetary nebulae NGC 6572 and IC 4997 in the wavelength region λλ 3070-4940. Lines as faint as 0.02 on the scale I (Hβ) = 100 are observed.

358

California U. [Dept. of Astronomy] Los Angeles.

ELEMENTS AND EPHEMERIS OF 1948 OA AND EPHEMERIS OF (1956) ICARUS, by S. J. Herrick and K. C. Ford. [1964] [1]p. (AFOSR-65-0331) (AF AFOSR-63-241) AD 611994 Unclassified

Also published in Jour. Minor Planets Circ., No. 2323, Aug. 1, 1964.

The astronomical data is presented in tabular form.

359

California U. [Dept. of Astronomy] Los Angeles.

SOME PROBLEMS OF PLANETARY NEBULAE, by

L. H. Aller. [1964] [19]p. tncl. diagrs. tables, refs. (AFOSR-65-2802) (AF AFOSR-65-83) AD 628828 Unclassifted

Also published tn Astrophys. Norvegica, v. 9: 293-311, Nov. 1964.

Considerable progress has been made tn recent years tn the study of planetary nebulae. As'de fro.) the beautiful appearance of many of these objects with thetr double-rtnged symmetrtes and deltcate filaments, the matn features of their spectra can be understood quantitattvely as well as qualttatively tn terms of fairly stmple phystcal theortes. More recent studies have sought connecttons between these objects and stellar evolution tracks of common stars and tt ts probable that the most exctting discovertes in the future will occur in this area. In this article an attempt ts made to summarize not so much what ts known about these objects but rather some of the outstanding problems, both observational and theoretical, whtch remain. Chief emphasts ts on the spectroscoptc problems.

360

California U. [Dept. of Astronomy] Los Angeles.

SPECTROPHOTOMETRIC STUDIES OF GASEOUS NEBULAE. III. THE LOW-EXCITATION RING PLANETARY IC 418, by L. H. Aller and J. B. Kaler. [1964] [7]p. incl. diagr. tables, refs. (AFOSR-65-2806) (AF AFOSR-65-83) AD 628456 Unclassified

Also publtshed tn Astrophys. Jour., v. 140: 936-941, Oct. 1, 1964.

Plates taken at the coudé and prime foct of the Ltck 120-in. and at the Mount Wilson 100-in. coudé are combined to yield line intensities tn the region λλ 3100-5000A for the brtght, compact, rather regular nebula. IC 418. Ltne tntensities are given both for the bright hydrogen ring and for a strip through the center of the nebula to show the effects of stratification. Average intensities that should approximate those of the integrated light of the nebula are also given. Intensttes of emtssion lines from the central star have been measured and compared wtth the results of earlter work. (Contractor's abstract)

361

Caltfornia U. Dept. of Chemtstry, Los Angeles.

X-RAY STUDIES OF UNUSUAL ORGANIC COMPOUNDS, by K. N Trueblood, D. A. Bekoe and others. Final rept. Sept. 1, 1959-Dec. 31, 1962. Mar. 1963, 1v. tncl. diagrs. tables, refs. (AFOSR-5135) (AF 49(638)-719) AD 416362 Unclasstfted

Thts report discusses the following unpublished work performed under thts contract: The crystal structure of 5-keto-1,5-dihydrobenz(cd) tndole; The crystal structure of the hexahydrated calctum salt of hexacyanoisobutene; The crystal structure of the cubtc form of tetracyanoethylene; The crystal structure of 1,1-(tetramethylethylene) ferrocene; Mtscellaneous structural studies; and Crystallographtc computing. Reports and Publtcattons—Crystallographtc calculations on SWAC and on the IBM 709; Comparison of various least squares refinement techniques; Crystal structure of the dioleftn of (2.2)paracyclophane; Crystal structure of trimethyloxosulfontum perchlorate; and Crystal structure of (3.3)paracylophane.

362

California U. Dept. of Chemistry, Los Angeles.

CHEMICAL EFFECTS OF RADIATION, by W. F. Ltbby. Final technical rept. Jan. 15, 1963, 1v. tncl. diagrs. tables, refs. (AFOSR-4664) (AF 49(636)901) AD 414457 Unclassified

The last 3 yr research on the chemtstry of radiation and materials is described and analyzed. The following reports are given: Size effects among tsotoptc molecules; Optical transparency and resistance to flash heating; Isotope stze effect in Van der Waals radii and the barrier to rotation around the carbon-carbon stngle bond; General theory partticularly for the radiation tnduced cross linkage of polymers and polymerizatton of saturated hydrocarbons; Ultra rapid rates at very htgh pressures; Ion-molecule reacttons in radiolysis of n-hexene at low temperatures; The theory of metallic diamond; Electron transfer among the transttion elements; The controlling role of the Franck-Condon principle on rates: Theory of direct radiation tnduced cross bonding in hydrocarbons; The radiation chemtstry of solid n-hexane at 77°K; Charge transfer in the radiolysts of soltd n-Hexane; Metallic InSb at zero pressure; Crystal structure relative to tin; Superconducttvity of metallic InSb. (Contractor's abstract)

363

Caltfornia U. [Dept. of Chemtstry] Los Angeles.

INDIUM ANTIMONIDE: SUPERCONDUCTIVITY OF THE METALLIC FORM, by H. E. Bommel, A. J. Darnell and others. [1963] [2]p. (AFOSR-64-0029) (AF 49(636)901) AD 435952 Unclasstfied

Also publtshed tn Sctence, v. 129: 1301-1302, Mar. 29, 1963.

The transttion of metallic indium anttmonide tnto the superconductng state begins at 2.1°K and ts complete at about 1.6°K. These data are close to those for whtte tin. (Contractor's abstract)

364

Caltfornta U. [Dept. of Chemtstry] Los Angeles.

LIGHT EMITTED BY ATOMIC FLAMES, by K. D. Bayes. Final rept. Oct. 1, 1961-Oct. 31, 1964. (Combtned operating rept. no. 2 - Nov. 1, 1963-Oct. 31, 1964) (AFOSR-64-2352) (AF AFOSR-62-62) Unclasstfted

The followtng two publicattons have resulted from thts

research: (1) The origin of light emission in the atomic hydrogen-acetylene flame and (2) [illegible]olous low rotational temperature in the emiss[illegible] spectrum of CO_2. In addition, the method of res[illegible]e fluorescence has been investigated. Preliminary experiments confirmed the theoretical scattering intensities. Incomplete studies of the systems $H + C_3O_2$, $O + C_3O_2$, and $O + CS_2$ were made. No results of these results are patentable. (Contractor's abstract)

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California U. Dept. of Chemistry, Los Angeles.

THE ORIGIN OF LIGHT EMISSION IN THE ATOMIC HYDROGEN-ACETYLENE FLAME, by K. D. Bayes and R. E. W. Jansson. [1964] [8]p. incl. diagr. refs. (AFOSR-65-0376) (AF AFOSR-62-62) AD 612220 Unclassified

Also published in Proc. Royal Soc. (London), Series A, v. 282: 275-282, 1964.

Acetylene catalyzes the gas phase recombination of hydrogen atoms, and frequently the reaction is accompanied by a bright flame. It is shown that the light emission is not the result of the catalytic recombination, but is caused by traces of water in the hydrogen. The possible reactive intermediates, OH, HO_2 and atomic oxygen, have been individually generated and added to the mixture of hydrogen atoms and acetylene. Only oxygen atoms are effective in causing luminescence. Hydrogen atoms are not necessary for light emission, but they do alter the spectrum somewhat. Two different mechanisms for the formation of electronically excited C_2 are required. The mechanism for the reaction of atomic oxygen with acetylene is discussed. (Contractor's abstract)

366

California U. [Dept. of Chemistry] Los Angeles.

EMISSION AND DISSOCIATION OF NO_2 IN SHOCK WAVES, by E. R. Hardwick. Final technical rept. Sept. 18, 1963, 11p. (AFOSR-J1361) (AF AFOSR-62-240) AD 428401 Unclassified

When compared with other kinetic data, the time dependence of the emission of NO_2 in shock waves in the vicinity of 2000°K supports the conclusion that the intensity follows (NO_2) in this system. Study of the emission from the system of CH_3NO_2Ar shows that NO_2 appears following the shock, but that it has a very short lifetime presumably reacting according to $CH_3 + NO_2$ yields $CH_3O + NO$. (Contractor's abstract)

367

California U. [Dept. of Chemistry] Los Angeles.

MODELS FOR ASYMMETRIC INDUCTION TO POLYMERIZATION, by D. J. Cram. Final rept. Oct. 1, 1962-Oct. 1, 1964. Nov. 2, 1964, 3p. (AFOSR-64-2483) (AF AFOSR-63-124) AD 609558 Unclassified

Studies on the reaction mechanisms for base-catalyzed 1,3- and 1,5-proton migrations in unsaturated systems are briefly summarized.

368

California U. Dept. of Chemistry, Los Angeles.

BASE-CATALYZED INTRAMOLECULAR 1,3- AND 1,5-PROTON TRANSFERS, by D. J. Cram, F. Willey and others. [1964] [2]p. incl. table. (AFOSR-65-2377) (AF AFOSR-63-124) AD 629638 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5370-5371, Dec. 5, 1964.

A report is made on observations of intra-molecular proton (deuteron) transfers in a triene to give a triarylmethane, and in an acetylene to give an allene.

369

California U. Dept. of Chemistry, Los Angeles.

ELECTROPHILIC SUBSTITUTION AT SATURATED CARBON. XXII. INTRAMOLECULAR HYDROGEN TRANSFER REACTIONS IN BASE-CATALYZED ALLYLIC REARRANGEMENTS, by D. J. Cram and R. T. Uyeda. [1964] [12]p. incl. diagrs. tables, refs. (AFOSR-65-2380) (AF AFOSR-63-124) AD 629639 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5466-5477, Dec. 20, 1964.

The base-catalyzed rearrangement of 3-phenyl-1-butene (I-h) to cis-2-phenyl-2-butene (II) in a variety of media containing deuterium donors (ROD) was studied, as has the rearrangement of 3-phenyl-1-butene-3-d (I-d) in media containing proton donors. Only minor amounts of trans-2-phenyl-2-butene (III) were produced in the rearrangements. The rates of hydrogen-deuterium exchange of II and III were demonstrated to be 10^{-1} to 10^{-2} slower than the isomerization of I under the same conditions. Degradative experiments demonstrated that when I-h was isomerized to II in deuterated solvents, all of the deuterium introduced was in the 4-position of 2-phenyl-2-butene (II). Isotopic exchange of I was slower than isomerization in all media. In tert-butyl alcoh[illegible]-O-d (potassium-tertbutoxide as base), (-)-I-h underwent isotopic exchange at a rate at least 10 times faster than racemization, both rates being vastly slower than the isomerization rate. (Contractor's abstract)

370

California U. Dept. of Chemistry, Los Angeles.

ELECTROPHILIC SUBSTITUTION AT SATURATED CARBON. XXIII. STEREOCHEMICAL STABILITY OF ALLYLIC AND VINYL ANIONS, by D. H. Hunter and

D. J. Carm. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-66-0024) (AF AFOSR-63-124) AD 629641 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5478-5490, Dec. 20, 1964.

The potassium tert-butoxide catalyzed isomerization and hydrogen-isotope exchange reactions of cis- and trans-a-methylstilbene and a-benzylstyrene, and of cis- and trans-stilbene, were studied in tert-buryl alcohol and tert-butyl alcohol-O-d. The kinetics of deuterium incorporation and of isomerization of cis and trans-alpha-methylstilbene and alpha-benzylstyrene into one another can be made most internally consistent with a mechanism which involves noninterconverting cis- and trans-allylic anions as intermediates. The equilibrium constants for interconversions of the 3 olefins were determined, and the kinetic and thermodynamic data are most consistent with one another on the basis of this same mechanism. The allylic rearrangement of alpha-benzylstyrene into cis-alpha-methylstilbene was shown to proceed with 55% intramolecularity, and into trans-alpha-methylstilbene with 36% intramolecularity. A solvent kinetic isotope effect of $(CH_3)_3COD/(CH_3)_3COH \sim 2$ was observed for these isomerizations.

371

California U. [Dept. of Chemistry] Los Angeles.

STUDY OF THE MOLECULAR AND CRYSTAL STRUCTURE OF ORGANIC COMPOUNDS OF UNUSUAL GEOMETRY OR ELECTRONIC STRUCTURE, by K. N. Trueblood. Final rept. Jan.-Dec. 1963. Apr. 1964, 69p. (AFOSR-64-1107) (AF AFOSR-63-240) AD 601478 Unclassified

The report includes further development of applications of high-speed computers in crystallographic structure work. A description is given of a precise study of the structure of tetracyanoquinodimethane, heteroaromatic dibenzo-1, 3a, 4, 6a-tetraazapentalene, an aminotroponeimine derivative with aromatic properties, and a ferrocene derivative in which the 2 cyclopentadienyl rings are joined by a 2-carbon bridge. Preliminary reports are given of reinvestigations of the structures of tetracyanoethylene and all di-p-xylylene. A description is given of the structure of the hydrated calcium salt of the unusual acid hexacyanoisobutylene.

372

California U. [Dept. of Chemistry] Los Angeles.

SUPERCONDUCTIVITY OF METALLIC INDIUM TELLURIDE, by H. E. Bommel, A. J. Darnell and others. [1963] [1]p. incl. diagr. (AFOSR-J1157) (AF AFOSR-63-245) AD 423132 Unclassified

Also published in Science, v. 141: 3582, Aug. 28, 1963.

Metallic indium telluride is a superconductor with a transitor temperature of 2.18°K. The critical magnetic field is about 800 gauss. (Contractor's abstract)

373

California U. Dept. of Chemistry, Los Angeles.

SUPERCONDUCTIVITY IN THE ARTIFICIAL METALS: METAL INDIUM ANTIMONIDE, THE INDIUM-ANTIMONIDE-TIN ALLOYS, AND METALLIC INDIUM TELLURIDE, by B. R. Tittmann, A. J. Darnell and others. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-1663) (AF AFOSR-64-245) AD 624376 Unclassified

Also published in Phys. Rev., v. 135: A1460-A1462, Aug. 31, 1964.

Superconductivity has been observed in metallic indium antimonide, in the alloys of indium antimonide with tin, and in indium telluride. The compounds and alloys were prepared and stabilized at atmospheric pressure in the way described by Darnell and Libby. Superconducting transition temperatures and critical magnetic fields were obtained by the eddy-current decay method used in measuring resistivities. (Contractor's abstract)

374

California U. Dept. of Chemistry, Los Angeles.

ARTIFICIAL METALS: InSb, THE Sn ALLOYS WITH InSb, AND METALLIC InTe, by A. J. Darnell and W. F. Libby. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1664) (AF AFOSR-64-245) AD 624377 Unclassified

Also published in Phys. Rev., v. 135: A1453-A1459, Aug. 31, 1964.

The metallic forms of indium antimonide, indium telluride, and the metallic alloys InSbSn, $InSbSn_2$, and $InSbSn_4$, were prepared at high temperature and high pressure, cooked, and subsequently quenched to -197°C before release of the pressure of 1 atm. The metastable metallic forms can be retained at 1 atm pressure at low temperatures indefinitely and studied conveniently. InSb(II) and its metastable alloys with tin have lattice parameters essentially identical with those of metallic tin. The lattice parameter of the cubic form of indium telluride is 6.177 ± 0.002A at 25°C. The compressibilities of InSb(II), InSb(I) and of Sn(β) at -197°C are 0.9, 3.6, and 3.1 x 10^{-6} bar^{-1}, respectively. The compressibilities of InTe(I) and InTe(II) at 25°C are 6.3 and 3.8 x 10^{-6} bar^{-1}, respectively. The heat of transformation $\Delta H^0 210$, (1 atm) InSb(II) - InSb(I) is 4.77 ± 0.04 kcal per mol. The resistivity of InSb(II) at 77°K is 77 x 10^{-6} Ω-cm. The velocity of sound in polycrystalline InSb(II) is approximately 3900 m/sec. The Brimmel hardness numbers of InSb(II) and InSb(β) at 77°K are 230 and 46 kg mm^{-1}. InTe(II) is diamagnetic; its susceptibility is -0.14 emu g^{-1}

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California U. Dept. of Chemistry, Los Angeles.

INTENSE 584-A LIGHT FROM A SIMPLE CONTINUOUS HELIUM PLASMA, by C. A. Jensen and W. F. Libby.

[1964] [5]p. incl. diagrs. refs. (AFOSR-65-1665) (AF AFOSR-64-245) AD 624375 Unclasstfted

Also publtshed in Phys. Rev., v. 135: A1247-A1252, Aug. 31, 1964.

A simple source for the productton of continuous cold plasmas and intense line spectra associated with a particular gas is described in its application to helium. Plasma densities and temperatures have been measured spectroscopically. When using helium or neon gas, the device becomes an intense source of ionizing radiation for studies of the chemical reactions induced by the ionizing ultraviolet. The tntensity of thts radiation has been measured with reasonable accuracy by very simple photocells whtch are easily constructed in the laboratory and are only sensitive to vacuum-ultraviolet radiation; more than 10^{16} 584A photons/sec are emitted by a 30-w source. The mechantsm is via ion-electron recombtnation from a 1660°K plasma of ~ 10^{13} ions/cm^3 denstty.

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California U. Dept. of Chemistry, Los Angeles.

POSITIVE-ION CHEMISTRY: HIGH YIELDS OF HEAVY HYDROCARBONS FROM SOLID METHANE BY IONIZING RADIATION, by D. R. Davis and W. F. Ltbby. [1964] [2]p. (AFOSR-65-1666) (AF AFOSR-64-245) AD 624368 Unclassified

Also published in Science, v. 144: 991-992, May 22, 1964.

At 77°K, solid methane is polymerized rapidly and efficiently to heavy hydrocarbons by cobalt-60 γ-rays. Evidence tndtcates that the polymer is formed in direct proportion to the radiation dose, with a conversion of about one methane mol/100 ev of absorbed energy. The product is a viscous oil consisting mainly of saturated and highly branched hydrocarbons containtng an average of about 20 carbon atoms/mol. This would seem to be evidence for posittve-ion chemical reacttons in the soltd state analogous to those previously reported to occur in the gaseous state at pressures above 0.01 mm-Hg. It would thus appear that the solar ionizing ultraviolet radiation (about 1 erg/cm^2/sec at the earth) must polymerize methane at an appreciable rate under many likely conditions.

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California U. Dept. of Chemistry, Los Angeles.

PREFATORY CHAPTER: THIRTY YEARS OF ATOMIC CHEMISTRY, by W. F. Ltbby. [1964]12p. (AFOSR-65-1667) (AF AFOSR-64-245) AD 624365 Unclassified

Also published in Ann. Rev. Phys. Chem., v. 15: 1-12, 1964.

A review is presented of the last 30 yr in the use of nuclear phenomenology and techniques in chemtstry and of the application of chemtcal methods to nuclear physics, together with some mention of pure physical chemistry. In the latter portion of the article, are reprinted remarks made at the dedication of Latimer Hall at Berkeley.

378

California U. Dept. of Engineering, Los Angeles.

ON THE FINAL VALUE AND MINIMUM EFFORT SYSTEMS, by H. C. Hsieh. [1963] [14]p. incl. diagr. refs. (AFOSR-J1142) (AF AFOSR-62-68) AD 423137 Unclassified

Also published in Jour. Franklin Inst., v. 276: 154-167, Aug. 1963.

The synthesis is made of a final value system by using the theory of eigenfunctions and the gradient methods for adaptive control systems. The applicability of these 2 approaches is explored, and it is shown that the final value problems treated in this paper always include the minimum effort problems. The concept of Adjoint Space Approach to the solution of the problems will be introduced. By using this approach, a great reduction in the dimensionality of the problems can be achieved. (Contractor's abstract)

379

California U. [Dept. of Engineering] Los Angeles.

THE LEAST SQUARES ESTIMATION OF LINEAR AND NONLINEAR SYSTEM WEIGHTING FUNCTION MATRICES, by H. C. Hsieh. [1964] [32]p. (AFOSR-64-2414) (AF AFOSR-62-68) AD 453617 Unclassified

Also published in Inform. Control, v. 7: 84-115, Mar. 1964.

The first part of this paper gives a general approach to the least squares estimation of the weighting function matrtx of a linear multivariable system by using normal operating records. It is shown that a great reduction in the dimensionality of the problem can be achieved by first obtaining a solution in the adjoint space. The estimated weighting function matrix is then determined simply by operating on it with an adjoint operator. When the identification procedure is used on-line with the system operation, 2 recursive schemes are devised to up-date the estimation to incorporate adding new data and deleting old data. Finally, the identtficadon of a nonlinear system which can be represented by a power series expansion for a continuous functional established by Frechet is discussed. A steepest descent method in the Hilbert space and its modifted version are introduced as a practical means for solving this estimation problem. (Contractor's abstract)

380

Californta U. Dept. of Engineering, Los Angeles.

AN OPTIMAL CONTROL PROBLEM WITH STATE

VECTOR MEASUREMENT ERRORS, by R. R. Schultz. [1964] [45]p. incl. refs. (AFOSR-65-1001) (AF AFOSR-62-68) AD 626510 Unclassified

Also publtshed tn Advances tn Control Systems, Theory and Application, New York, Academic Press, v. 1: 197-243, 1964.

A discussion ts presented of a specific stochastic optimal control problem. The problem ts states as follows. given a system whose behavior is described by the vector matrix differential equation

$\frac{dx}{dt} = A(t)x(t) + B(t)u(t) + N(t)$, or by the equivalent

stochastic differential equation $dx(t, t + h) = A(t)x(t)h + B(t)u(t, x(t) + z(t)h + dN(t, t + h) + O(h)$; find the policy $u(t, x(t) + z(t))$ from all piecewise continuous linear functions of $x(t) + z(t)$ which minimizes the performance criterion. The method of dynamic programming developed by Bellman (Dynamic Programming, Princeton, Princeton U. Press, 1957), is used to obtain the solution. (Contractor's abstract)

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California U. Dept. of Engineering, Los Angeles.

ON LINE COMPUTER CONTROL TECHNIQUES AND THEIR APPLICATION TO RE-ENTRY AEROSPACE VEHICLE CONTROL, by F. H. Kishi. [1964] [121]p. incl. diagrs. tables, refs. (AFOSR-65-1002) (AF AFOSR-62-68) AD 626510 Unclassified

Also published in Advances in Control Systems, Theory and Application, New York, Academic Press, v. 1: 245-357, 1964.

The major concern of this work has been the development of tools necessary to perform adaptation in a control problem with an unknown process. The approach taken to perform adaptive control was to measure the process through observation of the input-output data and to compute optimal controls on the basis of estimated parameter values and estimated state-variables. Three phases to this approach to adaptive controls are discussed: (1) parameter estimation; (2) state-variable estimation; and (3) computation of optimal controls. The three phases are studied separately indicating approaches which can accomplish these tasks. In the area of optimal control computations, methods presently available for the linear process case with quadratic performance criterion are summarized. For the parameter estimation phase two approaches are studied: (1) the explicit mathematical relation method, and (2) the learning model method. For the state variable estimation phase, Kalman's recursive filtering technique was adopted. Finally, an outline is given to apply the optimal-adaptive approach to a phase of the re-entry problem. (Contractor's abstract)

382

California U. [Dept. of Mathematics] Los Angeles.

OPTIMAL SPACING AND WEIGHTING IN POLYNOMIAL PREDICTION, by P. G. Hoel and A. Levine. [1964] [8]p. (AFOSR-65-1037) (AF AFOSR-62-158) AD 619110 Unclassified

Also published in Ann. Math. Statistics, v. 35: 1553-1560, Dec. 1964.

A solution is given to the problem of how to determine at which points in the interval [-1, 1] observations should be taken and what proportion of the observations should be taken at each such point so as to minimize the variance of the predicted value of a polynomial regression curve at a specified point beyond the interval observations. The solution obtained states that the points are to be chosen to be Chebychev points and the number of observations are to be selected proporttonal to the absolute value of the corresponding Lagrange polynomial at the specified point. The preceding Chebychev solution becomes the mintmax solution for the interval (- 1, t), provided $t > t_1 > 1$ where t_1 is a value satisfying a certain equation. Under the customary normality assumptions, the Chebychev solution to the prediction problem ts used to construct a confidence band for a polynomial curve that will possess mtnimum width at any specified point beyond the interval of observations.

383

California U. [Dept. of Mathematics] Los Angeles.

METHODS FOR COMPARING GROWTH TYPE CURVES, by P. G. Hoel. [1964] [14]p. incl. tables. (AFOSR-65-1406) (AF AFOSR-62-158) AD 623200 Unclassified

Also published in Biometrics, v. 20: 859-872, Dec. 1964.

One of the statistical problems arising in biological research is that of comparing a treated group with a control group of growing organisms. The problem is difficult because a realistic regression model ts seldom available and the observed variables taken over time are not statistically independent as requtred by classical regression models. Certain aspects of such problems are considered. The efficiency of using only means of sets of observations is compared with using a polynomtal regression model. A best unbiased test for a polynomial regression model ts then considered and compared with a nonparametric method under the assumption that the observations are sufficiently far apart in time to be treated as uncorrelated. A study is made of the magnitude of error arising from using classical regresston theory which ignores the existant correlation of variables.

384

California U. [Dept. of Mathematics] Los Angeles.

DIFFERENCE ANALOGUES OF GREEN'S IDENTITIES FOR GRIDS IN R^n, by D. Suschowk. [1964] [11]p. (AFOSR-64-2318) (AF AFOSR-63-77) AD 452327 Unclassified

Also published in Numerische Math., v. 6: 200-210, 1964.

The present work contains the derivation of the complete Green's formulae, including boundary terms, for arbitrary rectilinear grids in any number of dimensions.

385

California U. Dept. of Mathematics, Los Angeles.

GENERALIZED RATIONAL APPROXIMATION, by E. W. Cheney and H. L. Loeb. [1964] [15]p. incl. refs. (AFOSR-65-0624) (AF AFOSR-63-77) AD 614528 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., Series B, v. 1: 11-25, 1964.

An extension of Rice's theory of "varisolvent" function families to what is termed generalized rational functions is given. It is a further development of the rational approximation problem, extending the characterization theorem about linear approximations to the rational case and giving special consideration to a rational trigonometric form. (Contractor's abstract)

386

California U. [Dept. of Mathematics] Los Angeles.

ON SUITABLE MANIFOLDS, by R. F. Brown. [1964] [5]p. (AFOSR-65-1039) (AF AFOSR-63-90) AD 617856 Unclassified

Also published in Math. Scandinavica, v. 14: 174-178, 1964.

M is a manifold and G(M) denotes the group of all homeomorphisms of M onto itself with the compact-open topology. For a point $e \in M$, M is suitable if there exists a continuous map θ: $M \to G(M)$ such that $\theta(x)(x) = e$ and $\theta(e) =$ identity. This note shows that when M is compact, suitability is equivalent to the existence on M of a continuous multiplication which has many of the properties of a group multiplication. A definition is also given of suitability for differentiable manifolds with a proof that such manifolds are parallelizable.

387

California U. Inst. of Geophysics and Planetary Physics, Los Angeles.

FIRST MOTIONS FROM SEISMIC SOURCES NEAR A FREE SURFACE, by R. Burridge, E. R. Lapwood, and L. Knopoff. Aug. 14, 1964, 25p. (AFOSR-65-2132) (AF AFOSR-64-710) AD 629822 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1889-1913, Dec. 1964.

The radiation patterns of first motions are calculated for the sudden occurrence of an arbitrarily oriented fault at the surface of a half space; the dislocation in the fault plane is also arbitrarily oriented and is assumed to occur over a very small area of the fault plane. Initially the source is considered at a finite depth and the solution is obtained by allowing the depth to tend to zero. In general the results show a surprising directionality for the radiation of SV. In the focal plane projection the first motions of P and SH for a strike-slip fault show the familiar four-lobed radiation patterns. The first motions of SV show some reversals in polarity with angular distance from the source. The first motions for all components of motion for a dip-slip fault have characteristics governed strongly by the presence of the free surface, and hence differ markedly from the usual radiation patterns for a deeply imbedded source.

388

California U. [Dept. of Mathematics] Riverside.

A GENERALIZATION OF SPITZER'S COMBINATORIAL LEMMA, by H. D. Brunk. May 28, 1963, 11p. (AFOSR-64-1589) (AF AFOSR-62-139) AD 446531 Unclassified

Also published in Zeitschr. Wahrscheinlichkeitstheorie, v. 2: 395-405, 1964.

A simple combinatorial lemma in a study of partial sums of independent identically distributed random variables is the key tool in the present investigation. It yields a one-one correspondence between ordered subsets and permutations as represented cycles. If $X1, \ldots, Xn$ are exchangeable random elements, not necessarily real-valued, and M is a generalized mean value, to the random vector is made to correspond a decomposition into cycles; one concludes that the possibility distribution of a function of these cycles is independent of the generalized mean value M. Included are results and observations identifying distributions of certain statistics with that of the number of cycles in a randomly chosen permutation. Another application yields a theorem of Bohnenblust concerning statistics determined by sign functions. Finally, the distribution problem is solved for a proposed test against trend for medians. (Contractor's abstract)

389

California U. [Dept. of Mathematics] Riverside.

INTEGRAL INEQUALITIES FOR FUNCTIONS WITH NON-DECREASING INCREMENTS, by H. D. Brunk. [1964] [11]p. (AFOSR-65-0341) (AF AFOSR-62-139) AD 611993 Unclassified

Also published in Pacific Jour. Math., v. 14: 783-793, 1964.

The inequality $\int_{[\alpha,\beta)} f[X(t)]dG(t) \geq f[\int_{[\alpha,\beta)} X(t)dG(\cdot)]$ is established if either (1) $G(\alpha) = 0$ or (2) $X(\alpha) \geq 0$, and if (3) $0 \leq G(t) \leq 1$ for $\alpha \leq t \leq \beta$, where X is a map from the real interval $[\alpha, \beta)$ into an interval in k-dimensional Euclidean space R^k such that each component of X is nondecreasing, and the function f is a map from R^k into the reals. The property of f critical for the inequality is that of having nondecreasing increments. K-dimensional analogues to other inequalities are considered including the inequality $\int_{[\alpha,\beta)} f[X(t)]\,dH(t) \geq 0$ for given conditions on H.

390

California U. [Dept. of Mathematics] Riverside.

QUASI-CONVERGENT SERIES OF INDEPENDENT RANDOM VARIABLES, by H. G. Tucker. [1963] [5]p. (AFOSR-64-0357) (AF AFOSR-62-328) AD 433169 Unclassified

Also published in Amer. Math. Monthly, v. 70: 718-772, Aug.-Sept. 1963.

Since the Levy concentration function of a distribution function is invariant under change of location parameter, it is reasonable to expect that quasi-covergence of a series of independent random variables should be characterizable in terms of the concentration function. A. Ito's theorem was obtained in terms of the concentration functions of sequence of partial sums using characteristic functions. In probability theory, results are obtained by the use of characteristic functions if needed, but it is preferable to obtain results in a more direct manner. The purpose of this note is to show how Ito's theorem can be obtained directly from properties of concentration functions. Some well-known results are obtained as corollaries to this theorem.

391

California U. [Dept. of Mathematics] Riverside.

ON CONTINUOUS SINGULAR INFINITELY DIVISIBLE DISTRIBUTION FUNCTIONS, by H. G. Tucker. [1964] [6]p. (AFOSR-64-0975) (AF AFOSR-62-328) AD 440154 Unclassified

Also published in Ann. Math. Stat., v. 35: 330-335, Mar. 1964.

The main purpose of this paper is to give sufficient conditions that a continuous singular F be obtained from a discrete G. These conditions are not too broad; however, these conditions should be of considerable interest in that they are obtained by purely probabilistic methods, there being no use made of the Riemann-Lebesque lemma, and thus supply more insight into the structure of continuous singular infinitely divisible distributions. Lemma is proved which might be of independent interest. This lemma is used to prove that every m-fold convolution of F, be continuous singular.

392

California U. [Dept. of Mathematics] Riverside.

LIMIT DISTRIBUTIONS OF A BRANCHING STOCHASTIC PROCESS, by H. H. Stratton, Jr. and H. G. Tucker. [1964] [9]p. incl. refs. (AFOSR-64-1721) (AF AFOSR-62-328) AD 448255 Unclassified

Also published in Ann. Math. Stat., v. 35: 557-565, June 1964.

The purpose of this paper is to find an approximate distribution of $X_N(t)$ when t is fixed (not necessarily large) but the initial size of the population, N, is large. If N is allowed to tend to infinity, and if the parameters of the process are made to change in a way analogous to the Poisson approximation of a binomial distribution, then it is shown that a limiting distribution of the process $X_N(t) - N$ exists as $N \to \infty$, and this limiting distribution is the distribution of a continuous process with independent increments. The relation between the parameters of the infinitely divisible distribution of the limiting process and the sequence of branching processes is exhibited.

393

California U. [Dept. of Mathematics] Riverside.

BOUNDED GENERALIZED ANALYTIC FUNCTIONS ON THE TORUS, by V. L. Shapiro. [1964] [10]p. incl. refs. (AFOSR-65-1797) (AF AFOSR-63-351) AD 626509 Unclassified

Also published in Pacific Jour. Math., v. 14: 1413-1422, 1964.

Let $v \in R^n$ have rationally independent coordinates so that the one-parameter subgroup, $G_v = \{(\exp(2\pi i v_1 t, \ldots, \exp(2\pi i v_n t): t \in R^1\}$, of the torus T^n is dense in T^n. Let A_v denote the set of f in $L_\infty(T^n)$ for which the mth Fourier coefficient $\hat{f}(m) = 0$ for all lattice points m with $(m, v) \leq 0$, while $B_v \subset A_v$ consists of those f with $\hat{f}(m) = 0$ whenever $(m, v) \leq \gamma |m|$, for some positive $\gamma = \gamma_f < 1$. It is shown that for f in a class C_v between B_v and A_v, if f is Abel summable to zero for x in a subset of G_v of positive linear measure, then $f = 0$ in L_∞; the same holds if, instead of f Abel summable to zero, $\lim_{h \to 0+} f_h(x) = 0$, where $f_h(x)$ is the average value of f over the open ball about x of radius h. The result is shown to fail for A_v, and also for all v with rationally dependent coordinates.

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California U. Dept. of Physics, Riverside.

SCATTERING OF SPIN WAVES BY MAGNETIC DEFECTS, by J. Callaway. [1963] [7]p. (AFOSR-64-0465) (AF AFOSR-62-318) AD 435658 Unclassified

Also published in Phys. Rev., v. 132: 2003-2009, Dec. 1, 1963.

The scattering of spin waves by magnetic point defects is considered using a Green's function method. A partial-wave expansion for the scattering amplitude is derived. An expression for the cross section is determined which includes the effect of resonant states. Application is made to the calculation of the thermal conductivity of an insulating ferromagnet.

395

California U. [Dept. of Physics] Riverside.

THERMAL RESISTANCE PRODUCED BY POINT IMPERFECTIONS IN CRYSTALS, by J. Callaway. [1963] 9p. (AFOSR-64-1235) (AF AFOSR-62-318) AD 442806 Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 883-891, Aug. 16, 1963.

A nonperturbation approach to the scattering of phonons by point imperfections is discussed, which includes the possibility of resonant scattering. The theory is applied to the calculation of the thermal resistance produced by mass defects. (Contractor's abstract)

396

California U. [Dept. of Physics] Riverside.

SCATTERING OF SPIN WAVES BY MAGNETIC DEFECTS, by J. Callaway and R. Boyd. [1964] 8p. (AFOSR-64-1773) (AF AFOSR-62-318) AD 449056 Unclassified

Also published in Phys. Rev., v. 134: 1655-1662, June 15, 1964.

A previous calculation of the scattering amplitude for the scattering of spin waves by magnetic defects in a simple cubic lattice is simplified and extended to body-centered and face-centered cubic lattices. Expressions are given for the mean free path, and the thermal resistivity due to defect scattering is calculated by a method which takes some account of spin-wave interactions. (Contractor's abstract)

397

California U. Dept. of Physics, Riverside.

THEORY OF SCATTERING IN SOLIDS, by J. Callaway. [1964] 53p. incl. refs. (Technical rept. no. 2) (AFOSR-64-1774) (AF AFOSR-62-318) AD 438130 Unclassified

Also published in Jour. Math. Phys., v. 5: 783-798, June 1964.

The general theory of the scattering of excitations in solids by localized imperfections is discussed. The solid state analog of the usual partial wave expansion of the scattering amplitude is derived. In an appendix, the applicability of the general theory to phonons and spin waves as well as electrons is discussed. (Contractor's abstract)

398

California U. [Dept. of Physics] Riverside.

SPIN WAVE-SPIN WAVE SCATTERING IN A HEISENBERG FERROMAGNET, by R. G. Boyd and J. Callaway. [1964] [2]p. (AFOSR-64-1775) (AF AFOSR-62-318) AD 449054 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 540-541, May 11, 1964.

An exact expressions has been obtained for the scattering cross section of two spin waves in a simple cubic Heisenberg ferromagnet by solving the Lippmann-Schwinger equation by methods discussed in detail elsewhere. (Contractor's abstract)

399

California U. Dept. of Physics, Riverside.

HIGH-TEMPERATURE MAGNETIC SUSCEPTIBILITY OF INTERACTING ELECTRONS IN A SOLID, by J. Callaway and D. M. Edwards. [1964] [8]p. incl. refs. (AFOSR-65-0802) (AF AFOSR-62-318) AD 616220 Unclassified

Also published in Phys. Rev., v. 136: A1333-A1340, Nov. 30, 1964.

Discussion is presented on a pair of electrons in an energy band which interact through a short-range potential. The scattering amplitude is determined exactly, and the energies of states in which the 2 particles are bound together are found. The change in the density of 2 particle states produced by the interaction is computed and used to calculate the second virial coefficient occurring in the expansion of the logarithm of the partition function in powers of the density. Inclusion of an external magnetic field allows determination of the magnetic susceptibility at high temperatures. The result has a form equivalent to that obtained in Stoner's theory of ferromagnetism, thereby justifying that theory in the high-temperature region and yielding an expression for the molecular-field parameter θ'.

400

California U. Dept. of Physics, Riverside.

ENERGY BANDS IN BODY-CENTERED AND HEXAGONAL SODIUM, by J. A. Hughes and J. Callaway. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0803) (AF AFOSR-62-318) AD 616221 Unclassified

Also published in Phys. Rev., v. 136: A1390-A1397, Nov. 30, 1964.

The band structures of both the body-centered cubic and the hexagonal close-packed phases of sodium have

been computed using a pseudopotential method. The pseudopotential parameters were obtained from spectroscoptc data for the free sodium atom. The Fermi surface is nearly sphertcal in both phases, with the maximum distortion being of the order of 1/4%. Within the accuracy of the calculatton, the Fermt energy and effecttve mass are the same in the 2 phases.

401

California U. Dept. of Mathematics, Santa Barbara.

THE INVERSE MULTIPLIER FOR ABELIAN GROUP DIFFERENCE SETS, by E. C. Johnsen. [1964] [10]p. incl. refs. (AFOSR-65-2067) (AF AFOSR-65-698) AD 629035 Unclasstfted

Also published in Canad. Jour. Math., v. 16: 787-796, 1964.

A v, k, λ abelian group difference set (G, D) is a k-subset of elements $D = \{d_i\}$, i = 1, ..., k, taken from an abelian group G of order v such that each element ≠ 1 in G appears exactly λ times in the set of differences $\{d_i d_j^{-1}\}$, where $0 < \lambda < k < v - 1$. A multtplter of (G, D) ts an automorphtsm ø of G under whtch $D^{\phi} = Da$, a ∈ G. Here we investigate the situation where (G, D) has the inverse multiplter ι: $g \to g^{-1}$, g ∈ G. The following theorems are the princtpal results of the paper. Theorem. If ι is a multiplier of (G, D) then both v and λ are even, k - λ is a square $m^2 \geq 4$, and m | gcd (v, k, λ). Parametrically, we may write $v = \frac{m}{\alpha}[(m+\alpha)^2 - 1]$, $k = m(m+\alpha)$, $\lambda = m\alpha$, where $\alpha \geq 1$ is an integer dividing $m^2 - 1$. The values of m and λ have opposite parity. If we consider these possible v, k, λ configurations to withtn complements and take 2k < v, then $\alpha \leq m - 1$. Theorem. If the Sylow 2-subgroup of G in (G,D) is the direct product of s cyclic subgroups where $2^s < k/\lambda + 1 = m/\alpha + 2$, then ι ts not a multiplier of (G, D). Corollary. If G tn (G, D) is cyclic then ι (- 1 if we represent G by the additive group of tntegers modulo v) ts not a multiplier of (G, D).

402

California U. Dept. of Mathemattcs, Santa Barbara.

UNIMODULAR GROUP MATRICES WITH RATIONAL INTEGERS AS ELEMENTS, by R. C. Thompson. [1964] [8]p. (AFOSR-65-2068) (AF AFOSR-65-698) AD 627630 Unclasstfied

Also publtshed in Pacific Jour. Math., v. 14: 719-726, 1964.

The following theorem is proved: For a finite solvable group G, A ts a unimodular matrix of rational integers such that B = AA' is a group matrtx for G. Then A = $A_1 T$ where A_1 is a unimodular group matrix of rattonal tntegers for G and T is a generalized permutation matrix. The left regular representatton of G ts defined by the matrix equations: $(gg_1, gg_2, \ldots, gg_n) = (g_1, g_2, \ldots, g_n) P^L(g)$ where $g_1, g_2, \ldots, g_n$ are ordered elements of G and g ∈ G. The right regular representation is similarly deftned. Their group rings, the set of all combinations of $P^L(g)$ and $P^R(g)$, are denoted L*(G) and R*(G). It is noted that matrices in L*(G) and R*(G) commute, and a matrix that commutes with any $P^R(g)$ is a member of L*(G). These facts are used in an inductive proof on an ordered, ascending chain of subgroups of G to obtain the theorem.

403

California U. [Dept. of Psychology] Santa Barbara.

INTERNATIONALISM-ISOLATIONISM, STRATEGY OF THE OTHER PLAYER, AND TWO-PERSON GAME BEHAVIOR, by C. G. McClintock, A. A. Harrison and others. [1963] [6]p. (AFOSR-64-1157) (AF 49(638)-794) AD 442832 Unclassiited

Also published in Jour. Abnorm. and Social Prychol., v. 67: 631-636, 1963.

Twenty-four tnternationalistic and 24 isolationistic Ss played a sertes of 60 modified Prisoner's Dilemma games. Unknown to the Ss, E assumed the role of the 'other player' and utilized strategies of 85%, 50%, or 15% cooperative responses. The results indicated: (1) isolationists make more competitive responses, (2) the number of competitive responses increases over blocks of trials, (3) there is an tnteraction between personality and trial blocks, and (4) the strategy of the other player does not significantly affect behavior. Two posstble interpretations of the relationshtp between isolationism-tnternationalism and game playing behavior are suggested: (1) isolationists employ strategies to maximize their gains and their opponents' losses, and/or (2) isolationists have a generalized tendency to compete. (Contractor's abstract)

404

California U. [Dept. of Psychology] Santa Barbara.

GROUP SUPPORTS AND THE BEHAVIOR OF LEADERS AND NONLEADERS, by C. G. McClintock. [1963] 9p. (AFOSR-64-1166) (AF 49(638)-794) AD 442833 Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 67: 105-113, 1963.

In order to observe systematic behavioral differences between leaders, joiners, and nonjoiners, 17 Ss in each category were placed in a condition of group support followed by one of group nonsupport. In both conditions, one S from one of the three categories interacted with three paid partticipants in an attempt to solve a relatively unstructured task. As hypothestzed, leaders made stgntficantly more positive affect responses than nonjoiners across both situations and leaders made stgnificantly fewer negative responses under support and stgnifttantly more negative responses under nonsupport than nonjoiners. One major hypothesis was not substantiated: Leaders did not make significantly more task oriented responses than etther of the other categories under support or nonsupport. (Contractor's abstract)

405

Callery Chemical Co., Pa.

HEAT OF REACTION OF NITROGEN TRIFLUORIDE WITH ELEMENTAL BORON, by J. R. Ludwig and W. J. Cooper. [1963] [2]p. incl. table. (AFOSR-J1475) (AF 49(638)1052) AD 426511 Unclassified

Also published in Jour. Chem. Eng. Data, v. 8: 76, Jan. 1963.

Heat evolved in the reaction of nitrogen trifluoride with crystalline elemental boron has been measured in a bomb calorimeter. The heat of reaction calculated from these data is -239.7 ± 1.2 kcal mol^{-1}. Derived heat of formation of nitrogen trifluoride is -30.4 ± 1.2 kcal mol^{-1}. (Contractor's abstract)

406

Cambridge Language Research Unit (Gt. Brit.).

A PRELIMINARY INTERPRETATION OF MASS, by E. W. Bastin and C. W. Kilmister. Feb. 1963, 32p. (Rept. no. ISU 10) (AFOSR-5049) (AF 61(052)331) AD 413869 Unclassified

A report in algebraic hierarchy was formulated by A. F. Parker-Rhodes without any physical interpretation. It is now assumed that particular hierarchy of this general type corresponds to a proton or an electron in certain circumstances—the whole hierarchy being necessary to represent the whole complex of observations of it. The present paper starts from this assumption and in it are applied constraints to the process of hierarchy construction in such a way that it enables decomposition of hierarchy into 2 independent parts for the purpose of representing unstable particles that disintegrate into at least 2 decay products. (Contractor's abstract)

407

Cambridge Language Research Unit (Gt. Brit.).

A BROUWER TYPE SPACE TO REPLACE THE CONVENTIONAL PHYSICAL CONTINUUM WHEN PARTICLES ARE REGARDED AS DISTINCTION SYSTEMS, by E. W. Bastin and C. W. Kilmister. Nov. 1963, 34p. (AFOSR-64-1380) (AF 61(052)331) AD 604044 Unclassified

An ordered distinction system arises when entities specified by a set of properties each of which may be present or absent are considered, and when the growth of our knowledge in time is taken into account. It is shown that all such systems have certain sets of integers corresponding to them, and the structure of these sets is considered.

408

Cambridge Language Research Unit (Gt. Brit.).

PROCEEDINGS OF A COLLOQUIUM ON THE SEMANTIC BASIS OF COMMUNICATION HELD IN FLORENCE, ITALY, SEPTEMBER 1963, by *M.* M. Materman. Annual summary rept. Apr.-Aug. 1963. Apr. 1, 1964, 129p. (AFOSR-64-1036) (AF 61(052)647) AD 601198 Unclassified

A year's research on the semantic of human communication leading to a colloquium at Florence and a report theorem are presented.

409

Cambridge Language Research Unit (Gt. Brit.).

THE COMMUNICATION OF ALGORITEMS, by A. F. Parker-Rhodes. 1964, 8p. (AFOSR-64-1384) (AF 61(052)647) AD 444446 Unclassified

Also published in Comput. Jour., v. 7: 28-35, Apr. 1964.

This paper introduces a programming-language of new kind, intended to be usable as a high-level language or as a low-level language according to the programmer's immediate requirements, and to provide for the handling of data of any degree of complexity. The main features of the language are explained by deriving them step-by-step from a colloquial description of a fairly typical algorithm, that of merging two alphabetic lists. Subsequently, some additional facilities are described and a specimen complete program is given. This does not amount to a formal exposition of the language syntactically, but should suffice for those interested to get acquainted with its use. Further experience of its application to various problems must be gathered before a definitive syntactic definition is provided. (Contractor's abstract)

410

Cambridge Language Research Unit (Gt. Brit.).

SEMANTIC BASIS OF COMMUNICATION, by Y. Wilks, D. Shillan and others. Final rept. Dec. 31, 1964 [114]p. incl. illus. diagr. refs. (AFOSR-65-0513) (AF 61(052)647) AD 614093 Unclassified

A semantic recognition procedure is defined in which interlingually coded text is machine searched with an inventory of semantic targets. From the result of this search a final message structure for a text is constructed by means of a system of rules for 'semantic well-formedness.' A theory of intonational forms, and phonetic recognition procedures relevant to it are described. What it would be, using these procedures and experimental results, to verify Guberina's hypothesis about the relation of phonetic and semantic structures in text, is suggested.

411

Cambridge Language Research Unit (Gt. Brit.).

COMMENTARY OF THE GUBERINA HYPOTHESIS, by M. [M.] Masterman. 1963, 33p. (AFOSR-65-2247) (AF 61(052)647) AD 629254 Unclassifted

Also publtshed in Rtv. Methodos, v. 15: 139-168, 1963.

Comments are made on the hypothesis of Peter Guberina that there exists a single formula of semantic progression at the basis of all human communication. The hypothesis ts expounded in the paper 'La logique de la logique et la logique du langage' (Zagreb, post 1954) and the book 'Valeur logique et valeur stylistique des propositions complexes' (Parts, 1939, and Zagreb, 1954). The hypothesis is regarded as a new generative tdea tn the basis research tnto mechanical translation. Guberina sees language as a multiple contrast system made up of 2 units and 3 relations, with strgle systems of semantic classifiers and one formula (the 'semantic square'), of which all other semantic or syntactic forms actually found in language must be construed either as vartants or as abbreviations. The 2 untts are a generaltzed subject of discourse, or subject, and the most generalized possible version of what is satd about tt, or predicate. The relations are inclusion, solidarity or semantic overlap or cognateness, and descriptive tmpltcation.

412

Cambridge Language Research Unit (Gt. Brit.).

REPORT ON THE CALCULATIONS OF CYCLE LENGTHS, by [E. W.] Bastin and M. Roy. Dec. 1, 1964 [18]p. incl. diagr. tables. (AFOSR-65-1322) (AF EOAR-64-63) AD 622584 Unclassified

An algebraic system is considered in which inftnttely proceeding sequences, representing the tnflo: of data tnto an informatton processing system of a hierarchtcal type, are expressed in the form of matrix transforms of vectors which cycle. Such an algebra is thought to have special connection to the phystcs of elementary particles. In this investigation, calculations of cycle lengths are made, so that a complete set of data exist from which detailed comparison wtth experiment can be made. It also is proved that all cycles of an n x n matrix are obtained by a standard form. Preliminary comparisons of the spectrum of cycles with the spectrum of masses of elementary particles were not successful.

413

[Cambridge U.] Cavendish Lab. (Gt. Brit.).

THE WORK-HARDENING CHARACTERISTICS OF Cu AND α-BRASS SINGLE CRYSTALS BETWEEN 4·2 AND 500°K, by T. E. Mitchell and P. R. Thornton. [1963] [32]p. incl. diagrs. tables, refs. (AFOSR-J893) (AF 61(052)98) AD 415988 Unclassified

Also publtshed in Phtlos. Magaztne, v. 8: 1127-1159, July 1963.

Shear stress-shear strain curves of Cu and α-brass single crystals have been obtained over a wide range of alloy compositions, temperatures, initial orientattons and strain rates. Analysis of the work-hardening characteristics leads to the following main conclusions: (1) for Cu the work-hardening rate during easy glide increases with temperature; (2) in α-brass stage I ends when the resolved shear stress on the conjugate system equals the initial resolved shear stress on the primary system; (3) the extent of easy glide tncreases with decreasing temperature and tncreasing alloy content, and the temperature dependence of easy glide decreases with increasing alloy content; (4) the work-hardening rate θ_{11} durtng stage II ts greater for orientations near symmetrical positions, and this orientation dependence ts found at 4·2, 77 and 295°K for both Cu and α-brass; (5) θ_{11} increases with decreasing temperature, especially tn the alloys; (6) the temperature dependence of θ_{11} for pure metals ts very similar to that of the flow stress at high stratns; (7) the work-hardening rate tn stage III of Cu crystals varies linearly with temperature and ln ϵ; (8) in 70: 30 brass overshoot is independent of temperature, but in Cu and the low Zn content alloys more overshoot occurs at low temperatures.

414

Cambridge U. Cavendish Lab. (Gt. Brit.).

WORK-HARDENING IN NIOBIUM SINGLE CRYSTALS, by T. E. Mitchell, R. A. Foxall, and P. B. Hirsch. [1963] 24p. (AFOSR-64-0456) (AF 61(052)98) AD 435916 Unclassified

Also published in Philos. Magazine, v. 8: 1895-1920, Nov. 1963.

The work-hardening properties of niobium single crystals grown by electron-beam zone-melting have been investigated over a wide range of purtties, orientations, temperatures and strain-rates. Three stages of hardening are observed after the onset of plastic flow. The nature of the slip lines observed in stage I is compatible with the view that some cross-slip of screw dislocations occurs and that edge dislocations slip much further than screws. (Contractor's abstract)

415

Cambrtdge U. Cavendish Lab. (Gt. Brit.).

THE DETECTION OF SECONDARY SLIP DURING THE DEFORMATION OF COPPER AND ALPHA-BRASS SINGLE CRYSTALS, by T. E. Mttcheli and P. R. Thornton. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0762) (AF 61(052)98) AD 617632 Unclasstfied

Also published in Philos. Magazine, v. 10: 315-323, Aug. 1964.

Deviations from single glide during the deformation of Cu single crystals have been detected by following the orientation of the tensile axis using x-ray techniques. The deviattons for room temperature deformation of some crystals can be explained if it is assumed that 5-10% of the elongation is produced by slip on the

secondary systems and the remainder on the primary system. The deviations from single glide are much smaller in α-brass crystals which also show more overshoot, so that secondary slip is inhibited. It is suggested that secondary slip is produced near the heads of piled-up groups of primary dislocations at the ends of newly formed slip lines where the resolved shear stress on the secondary systems is high. Secondary slip is thus very localized, producing little strain, but it can give rise to a high forest density.

416

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE ALUMINUM-TECHNETIUM SYSTEM. THE NEW PHASES $TcAl_{12}$, $TcAl_4$ AND Tc_2Al_3, by L. M. d'Alte da Veiga and L. K. Walford. [1963] [1]p. (AFOSR-J365) (AF EOAR-61-24) AD 407712 Unclassified

Also published in Philos. Magazine, v. 8: 349, Feb. 1963.

The aluminum-technetium system has been investigated. In the present note the existence of a further 3 previously unknown phases is reported: $TcAl_{12}$, $TcAl_4$, and Tc_2Al_3. The phase $TcAl_{12}$ has a b. c. c. structure with a = 7.5270 ± 0.0003A and is isostructural with WAl_{12}. $TcAl_4$ is monoclinic with cell dimensions a = 5.1, b = 17.0, c = 5.-A (all ± 0.1A) and β = 100° ± 1°. Tc_2Al_3 is trigonal with a = 4.16, c = 5.13A (both ± 0.01A). This phase is thought to have the Ni_2Al_3 structure, the change in unit cell volume being consistent with the atomic volumes of Tc and Ni. The refinement of the structure of the phases $TcAl_{12}$ and $TcAl_4$ is now being undertaken.

417

Cambridge U. Cavendish Lab. (Gt. Brit.).

AN INVESTIGATION OF THE ORDERING OF THE PHASES CoAl AND NiAl, by M. J. Cooper. [1963] 6p. incl. diagrs. (AFOSR-J694) (AF EOAR-61-24) AD 414170 Unclassified

Also published in Philos. Magazine, v. 8: 805-810, May 1963.

An investigation of the variation of lattice parameter with composition over a small range of composition for the phases CoAl and NiAl has confirmed that a peak value occurs and has enabled the corresponding phase-composition to be determined. For CoAl this is close to the ideal 50-50% (atomic) composition, but in the case of NiAl the nickel sites are found to tolerate up to about 1.5% aluminum. The electron to unit cell ratios corresponding to these compositions are 3.00 and 3.04 for CoAl and NiAl respectively.

418

Cambridge U. Cavendish Lab. (Gt. Brit.).

A STUDY, BY X-RAY METHODS, OF ELECTRON DISTRIBUTION IN METALS AND ALLOYS, by W. H. Taylor. Final technical rept. July 31, 1963 [22]p. incl. tables, refs. (AFOSR-J1358) (AF EOAR-61-24) AD 427994 Unclassified

Absolute measurements have been made of x-ray scattering from Cr, CoAl and NiAl. To a first approximation the scattering corresponds to that from ground-state free atoms; the small differences observed are discussed, particularly in relation to other published measurements. The powder techniques used for the above measurements are to be supplemented by the use of single-crystal methods. The necessary preliminary experiments are in progress. The examination of alloy systems and the analysis of the structures of alloy phases have been continued. These include the Al-Fe, Al-Mo, Al-Re, Al-Tc and Co-Mo systems. Interesting generalizations about the nature of the interatomic bonds, and new information about the phase diagrams, have emerged from these studies. (Contractor's abstract)

419

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE PHASE DIAGRAM OF THE ALUMINUM-MOLYBDENUM SYSTEM, by L. K. Walford. [1963] [4]p. (AFOSR-64-2118) (AF EOAR-61-24) AD 451706 Unclassified

Also published in Philos. Magazine, v. 9: 513-516, Mar. 1964.

Some changes to the aluminum-rich end of the Al-Mo phase diagram are proposed. The results of several workers indicate that two new phases ($MoAl_4$ and $MoAl_{16}$) have to be introduced and that one phase ($MoAl_2$) should be omitted from the existing diagram. (Contractor's abstract)

420

Cambridge U. Cavendish Lab. (Gt. Brit.).

THE REFINEMENT OF THE CRYSTAL STRUCTURE OF THE INTERMETALLIC PHASE Al_4Mo, by J. A. Leake. Aug, 19, 1963, 7p. (AFOSR-64-2119) (AF EOAR-61-24) AD 451707 Unclassified

Also published in Acta Cryst., v. 17: 918-924, July 1964.

The crystal structure of Al_4Mo has been refined by means of two-dimensional difference syntheses using visually estimated x-ray intensity data. The space group is Cm. The unit cell has lattice parameters a = 5.255, b = 17.768, c = 5.225A, and β = 100° 53 min and contains 30 atoms arranged in sets of almost close-packed puckered planes. Isomorphism with Al_4W is confirmed. (Contractor's abstract)

421

Cambridge U. Cavendish Lab. (Gt. Brit.).

THEORY OF INITIATION OF EXPLOSION IN SOLIDS BY AN INTENSE LIGHT FLASH, by T. Boddington. Nov. 1963, 62p. (AFOSR-64-2015) (AF EOAR-64-18) AD 619542 Unclassified

The evolution of the temperature profile within a solid capable of exothermic decomposition is derived from an approximate analytic solution of the equation describing heat conduction in the presence of continuously distributed heat sources due to chemical decomposition and to the absorption of an intense, short duration pulse of light. The critical light intensity capable of giving rise to a thermal explosion is deduced and a minimum critical intensity is shown to exist. The model predicts all the major experimental features of ignition by light. (Contractor's abstract)

422

Cambridge U. Cavendish Lab. (Gt. Brit.).

GROWTH OF BURNING TO DETONATION IN LIQUIDS AND SOLIDS, by F. P. Bowden. Dec. 1964, 6p. (Rept. no. 1) (AFOSR-65-0696) (AF EOAR-64-18) AD 640139 Unclassified

Explosion in nitroglycerine by impact was recorded using a high-speed C_4 framing camera. The introduction of inhomogeneities favors the formation of localized concentrations of energy in the form of hot spots, at which chemical reaction can be initiated. In the early stages the chemical reaction propagates as an accelerating fast burning at up to several hundred of metres per second. It appears that certain conditions (e.g., turbulence, and the formation of a mixture of liquid droplets, unreacted nitroglycerine vapor and hot gaseous products) are essential for subsequent transition from this regime to a more violent explosion. The study of fracture propagation was concentrated on single crystals of magnesium oxide, using high-speed photography (Beckman and Whitley) and independently an ultrasonic method. High-speed photographic records using a Beckman and Whitley camera were made of the deflagration and detonation of single crystals of PETN, RDX, HMX, and silver azide. New theories of initiation of explosion by light and of the growth and decay of hot-spots in condensed explosives were developed.

423

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

REGGE POLES AND BRANCH CUTS FOR POTENTIAL SCATTERING, by J. Challifour and R. J. Eden. Sept. 12, 1962, 13p. (AFOSR-64-0367) (AF EOAR-63-79) AD 434526 Unclassified

Also published in Jour. Math. Phys., v. 4: 359-371, Mar. 1963.

The analytic properties of partial wave amplitudes are studied for complex energy and angular momentum. The properties of the wavefunctions are first obtained by standard methods in the theory of differential equations for general classes of potentials, and the effects of the dominant singular term in the potential near the origin are investigated. These include the appearance of branch cuts in the angular-momentum variable for potentials which are singular like r^{-2}, and the location of Regge pole for more singular potentials. The trajectories of Regge poles are also studied with particular reference to their behavior in the angular-momentum plane as the energy tends to infinity. An example is given of a singular potential in which the trajectories move to infinity in a complex direction, contrary to the normal behavior for which they tend to negative integers. The real sections of Regge surfaces are also briefly discussed. (Contractor's abstract)

424

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

SINGULARITY OF THE REGGE AMPLITUDE, by J. N. Islam, P. V. Landshoff, and J. C. Taylor. [1963] [6]p. incl. diagrs. refs. (AFOSR-64-0368) (AF EOAR-63-79) AD 434524 Unclassified

Also published in Phys. Rev., v. 130: 2560-2565, June 15, 1963.

It is shown that the Regge amplitude a(l, s) has singularities at certain fixed, real, physical values of s for all nonphysical values of l. These singularities are not normal thresholds and are not signularities of the complete amplitude A(s, t, u). They arise indirectly through unitarity. Their presence is deduced from the existence of a perturbation graph which satisfies the Mandelstam representation with spectral boundary curves having asymptotes other than the normal threshold lines. (Contractor's abstract)

425

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SINGULARITIES OF FEYNMAN AMPLITUDES, by I. T. Drummond. Feb. 22, 1963, 22p. (AFOSR-64-0370) (AF EOAR-63-79) AD 434537 Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 720-741, Aug. 10, 1963.

The analytic properties of perturbation theory amplitudes written as integrals over internal invariants are discussed. Single-loop amplitudes are considered and a condition, equivalent to the positive alpha condition, is derived for singularity in the physical limit. Some simple double-loop diagrams are discussed also and the existence and nature of a certain mixed second-type singularity is investigated. A feature of these latter diagrams is the necessity of dealing with spurious singularities. The relevance of these considerations to certain 3-particle phase-space integrals is pointed out. (Contractor's abstract)

426

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

HIGH-ENERGY BEHAVIOR IN PERTURBATION THEORY. II, by J. C. Polkinghorne. May 20, 1963, 5p. (AFOSR-64-0522) (AF EOAR-63-79) AD 436377 Unclassified

Also published in Jour. Math. Phys., v. 4: 1396-1400, Nov. 1963.

Contributions to the asymptotic behavior of Feynman integrals are evaluated which correspond to pinches in the interior of the hypercontour of integration. It is shown that they give the Gribov-Pomeranchuk phenomenon and Regge cuts. A set of diagrams is investigated which gives a Regge cut on the physical sheet. (Contractor's abstract)

427

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SINGULARITIES OF REGGE TRAJECTORIES AND ASYMPTOTES TO LANDAU CURVES, by J. C. Polkinghorne. [1963] [3]p. (AFOSR-64-0638) (AF EOAR-63-79) AD 435940 Unclassified

Also published in Jour. Math. Phys., v. 4: 1393-1395, Nov. 1963.

A new class of singularities associated with the trajectories and residues of particular Regge poles is investigated. It is shown that the singularities are associated with properties of asymptotes to Landau curves. One of the singularities corresponds to the singularity of the Regge amplitude discovered recently by Islam, Landshoff, and Taylor. The only singularities affecting physical asymptotic behavior correspond to diagrams which have all three Mandelstam spectral functions. (Contractor's abstract)

428

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

DISPERSION THEORY AND THE NUCLEAR MANY-BODY PROBLEM, by R. J. Eden and J. Goldstone. [1963] [11]p. (AFOSR-64-0658) (AF EOAR-63-79) AD 435924 Unclassified

Also published in Nuclear Phys., v. 49: 33-43, 1963.

The equations of the nuclear many-body problem are formulated so that the analyticity properties required by dispersion theory are retained in each approximation. In particular the vertex parts for photon or nucleon absorption by a nucleus will have the analyticity expected from dispersion theory provided the nucleon-nucleon interaction has the usual analytic properties. By summation of diagrams in relativistic dispersion theory a closed scheme of self-consistent equations is obtained for vertex parts involving a nucleus. The non-relativistic approximations are described, which relate this scheme to the usual self-consistent equations for nuclear wave functions. (Contractor's abstract)

429

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

SEPARABLE NONLOCAL POTENTIALS AND REGGE POLES, by M. McMillan. Mar. 11, 1963, 8p. (AFOSR-64-0659) (AF EOAR-63-79) AD 435936 Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 1043-1050, Sept. 1, 1963.

Partial wave amplitudes and Regge poles for nonrelativistic two-body scattering via a separable nonlocal potential are studied. The Schrödinger equation is solved exactly and the partial wave amplitudes are written in a simple closed form valid for any potential satisfying certain minor restrictions at the origin and at infinity. Many previously known properties of amplitudes and Regge poles appear rather simply here. (Contractor's abstract)

430

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

LEADING LANDAU CURVES OF SOME FEYNMAN DIAGRAMS, by J. N. Islam. [1963] [7]p. incl. diagrs. (AFOSR-64-0660) (AF EOAR-63-79) AD 435925 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 259-265, Oct. 1, 1963.

It is shown that the leading Landau curves of some Feynman diagrams possess no parts associated with positive Feynman parameters when some of the external and internal masses satisfy certain inequalities. The assumed validity of Mandelstam representation then implies that the corresponding leading curves are non-singular on the physical sheet. (Contractor's abstract)

431

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

POLES AND SHADOW POLES IN THE MANY-CHANNEL S MATRIX, by R. J. Eden and J. R. Taylor. Nov. 7, 1963, 6p. (AFOSR-64-1150) (AF EOAR-63-79) AD 442843 Unclassified

Also published in Phys. Rev., v. 133: B1575-B1580, Mar. 23, 1964.

The connection between the partial-wave S matrix on different Riemann sheets is obtained from unitarity and analyticity. Under the assumption that coupling between

channels can be varied analytically, it is shown that a resonance pole or bound-state pole may lead also to "shadow poles" on other Riemann sheets. The existence of shadow poles is illustrated by a unitary resonance model based on a sum of Feynman diagrams. In general, the number of shadow poles that can be deduced from an observed resonance depends on the number of channels that still have a particular resonance pole in the absence of coupling between channels. If the pole still appears in all channels, then shadow poles occur on every Riemann sheet; if it appears in only one channel, then shadow poles appear on half the sheets. If the resonance disappears in the absence of channel coupling, our method leads to no conclusions. In connection with the unitary symmetry scheme it is noted that the existence of shadow poles would permit a simple changeover from the separated poles of a resonance multiplet with broken symmetry to the coincident poles of the multiplet that must occur when the symmetry breaking interaction is switched off. (Contractor's abstract)

432

Cambridge U. [Dept. of Applied Mathematics and Theoretical Physics] (Gt. Brit.).

THE COMPLETE HIGH-ENERGY BEHAVIOR OF LADDER DIAGRAMS IN PERTURBATION THEORY, by J. C. Polkinghorne. [1964] [4]p. incl. diagrs. (AFOSR-64-1760) (AF EOAR-63-79) AD 449060 Unclassified

Also published in Jour. Math. Phys., v. 5: 431-434, Mar. 1964.

The Mellin-transform method for obtaining the high-energy behavior of Feynman integrals is modified and applied to the set of ladder diagrams. The complete set of terms of the form $s^{-1}(\ln s)^n$ is summed, and gives an equation for the trajectory function which is analogous to that obtained by Fredholm methods for a Yukawa potential. A perturbation expansion for $\alpha(t)$ valid for t large is given, and the threshold behavior investigated. The results confirm the reliability of the perturbation-theory method of investigations. They also exhibit directly the connection between high-energy behavior and the poles of the scattering amplitude. (Contractor's abstract)

433

[Cambridge U.] Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit).

MAJORIZATION OF FEYNMAN DIAGRAMS INVOLVING PIONS AND NUCLEONS, by J. B. Boyling. [1964] [31]p. incl. diagrs. refs. (AFOSR-64-2336) (AF EOAR-63-79) AD 451925 Unclassified

Also published in Ann. Phys., v. 28: 435-465, 1964.

A method used previously for the majorization of Feynman diagrams involving scalar mesons and conserved baryons is adapted to the case where the mesons are pseudoscalar. The Symanzik regions for certain production amplitudes are found, and some support properties proved for the weight functions in Nakanishi's integral representations for scattering and one-particle-production amplitudes.

434

[Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).]

ON THE FIELD EQUATIONS, by J. G. Taylor. [1963] [179]p. incl. refs. (AFOSR-65-0119) (AF EOAR-63-79) AD 455731 Unclassified

Also published in Nuovo Cimento, Series I, Suppl., v. 1: 857-1035, 1963.

In a collection of six closely connected papers, a field theory approach to elementary particles is attempted which is to avoid the pitfalls of high-energy divergences. The canonical equations arising from local field equations are obtained and generalized beyond local field equations. This results in unitarity off the mass shell, which is called complete unitarity. To avoid the problems of high-energy divergences, a suitable finite number of differentiations is made of the complete unitarity equations in the external moments. This is only possible for the renormalizable interactions, in the perturbation sense. The high-energy divergences of weak interactions are discussed outside perturbation theory. For the renormalizable interactions an attempt is made to compute physical quantities from the complete unitarity equations. To do this, various physically reasonable approximation schemes are discussed. To set up the resonance approximation, resonances and composite particles are exposed. The goals of the investigation are partially obtained.

435

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HIGH-ENERGY BEHAVIOUR OF FEYNMAN INTEGRALS INVOLVING SINGULAR CONFIGURATIONS, by M. M. Menke. [1964] [20]p. incl. diagrs. (AFOSR-65-0120) (AF EOAR-63-79) AD 455732 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 351-370, Oct. 16, 1964.

The high-energy asymptotic behavior of Feynman diagrams containing certain singular configurations is investigated. The leading contributions are factorized and summed to give Regge-pole terms. A new feature of the discussion is that it is sometimes necessary to scale disconnected sets of lines in addition to the usual connected sets.

436

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

TIME AND THE S MATRIX, by D. Branson. [1964]

[8]p. tncl. diagrs. (AFOSR-65-0121) (AF EOAR-63-79) AD 455939 Unclassified

Also published in Phys. Rev., v. 135: B1255-B1262, Sept. 7, 1964.

A method is introduced for defintng the time duration of a scattering process. Using thts deftntion, the connection between causality and analyticity is discussed. An application to 3-particle scatterng leads to a discusston of the necessity for the existence of stable and unstable particle poles, and finally an analysis is given of rescattering processes and the generation of 2-particle normal thresholds, with a view to obtaining Feynman's i^{ϵ} prescription for deciding which is the physical boundary value.

437

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HERMITIAN ANALYTICITY AND EXTENDED UNITARITY IN S-MATRIX THEORY, by J. B. Boyling. [1964] [18]p. incl. diagrs. refs. (AFOSR-65-0122) (AF EOAR-63-79) AD 455730 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1356-1373, Sept. 1, 1964.

It is shown that the apparent contradiction between Olive's method of proof of hermitian analyticity and the existence of anomalous thresholds disappears on a closer examination of the singularity structure of multiparticle amplitudes. By making use of the hierarchy property of the Stapp-Polkinghorne singularity structure implied by maximal analyticity, hermitian analyticity and extended unitarity are proved for a scattering amplitude exhibiting anomalous threshold behavior and for an equal-mass production amplitude.

438

Cambridge U. Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

HIGHER ORDER POLES IN THE S MATRIX, by R. J. Eden and P. V. Landshoff. [1964] [4]p. incl. diagr. (AFOSR-65-0832) (AF EOAR-63-79) AD 616468 Unclassified

Also publtshed in Phys. Rev., v. 136: B1817-B1820, Dec. 1964.

A method is developed for studying the possibtlity of a cotncidence of more than one complex pole of the S matrix so as to produce a higher order pole. It is shown thereby that complex higher order poles may be consistent with generaltzed unitarity, although a real higher order pole ts not consistent with physical unitarity. Also discussed is the relevance of higher order poles, and of a group of simple poles, to the Wigner time-decay formula.

439

Cambridge U. Dept. of Applted Mathematics and Theoretical Physics (Gt. Brtt.).

ASYMPTOTIC BEHAVIOR OF FEYNMAN INTEGRALS WITH SPIN, by J. C. Polkinghorne. [1964] [8]p. tncl. diagrs. (AFOSR-65-0833) (AF EOAR-63-79) AD 616452 Unclassified

Also published in Jour. Math. Phys., v. 5: 1491-1498, Nov. 1964.

Some general features are investigated of the dependence of the asymptotic behavior of Feynman integrals upon factors in the numerator of the integrand resulting from particles with spin. These results are used to analyze the htgh-energy behavior of ladder diagrams for spin-1/2 nucleons interacting with neutral vector mesons. The leading contribution is shown to consist of terms corresponding to a reggeized nucleon together with certain other terms. The expected cancellation of these other terms by terms associated with a well-defined class of crossed diagrams is verified in detail for the sixth-order case. Finally, other significant diagrams, different from the ladders and their associated crossed diagrams, are investigated and it is shown that they only provide higher-order corrections to the trajectory of the reggetzed nucleon.

440

[Cambridge U.] Dept. of Applied Mathematics and Theoretical Physics (Gt. Brit.).

UNITARITY, HERMITICITY AND DISCONTINUITY RELATIONS, by J. R. Taylor. [1964] [13]p. (AFOSR-65-0144) (AF EOAR-64-79) AD 455733 Unclassified

Also published in Nuclear Phys., v. 58: 580-592, 1964.

The relationship between unitarity, hermitian-analyticity and the discontinuity relations for the T matrix is discussed. The generalized discontinuity relations, sometimes called generalized unitarity, are examined and their theoretical status discussed. It is shown that symmetry of the T matrix has no relevance to these properties. Finally, all these properties are proved in the framework of the multichannel Schrödinger theory. It ts shown that in Schrödinger theory the discontinuity relations artse naturally from the deftnitton of the S matrix in terms of ingoing and outgoing waves and that unitarity and hermitian analyticity hold when the potential matrix is hermitian. (Contractor's abstract)

441

Cambridge U. [Psychological Lab.] (Gt. Brit.).

A PERIMETRIC STUDY OF VISUAL FIELD DEFECTS IN MONKEYS, by A. Cowey and L. Weiskrantz. 1963, 25p. (AFOSR-64-1295) (AF 61(052)185) AD 444264 Unclassified

Also publtshed in Quart. Jour. Exper. Psychol., v. 15: 91-115, June 1963.

The visual fields of rhesus monkeys have been studied perimetrically before and after removal of parts of the striate cortex. The operations produced visual defects of the expected size, shape, and position but an animal's ability to respond to a flash of light which appeared in the defective part of the field was diminished rather than abolished. It is suggested that this residual ability enables an animal to detect changes in illumination, which might be cues to other visual events. A study of fixation indicates that the animals probably do not recognize or respond to objects when they lie within the impaired region of the visual field. The results are compared with those found in earlier studies of simian and human subjects. (Contractor's abstract)

442

Cambridge U. [Psychological Lab.] (Gt. Brit.).

THE BASE OF A METHOD OF PERIMETRY WITH MONKEYS, by A. Cowey. 1963, 12p. (AFOSR-64-1296) (AF 61(052)185) AD 444263 Unclassified

Also published in Quart. Jour. Exper. Psychol., v. 15: 81-90, May 1963.

The value of perimetry as a means of studying the visual system is stressed. Perimetry has never been done with animals because it is difficult to record and control their fixation. Existing methods of determining eye position cannot readily be used with monkeys, chiefly because the subject's head must be prevented from moving more than fractions of an mm. Other limitations are mentioned. A new method of determining fixation is described. Although not nearly as precise as other methods, it is unaffected by head movements as great as 1/2 in. It is straightforward to restrict a monkey's head movements to this amount. The eye position is found from the relative positions of four corneal reflections and the borders of the iris. These relative positions change very much more after an eye rotation than they do after a head movement in which fixation has been maintained. (Contractor's abstract)

443

Cambridge U. [Psychological Lab.] (Gt. Brit.).

STRIATE CORTEX LESIONS AND VISUAL ACUITY OF THE RHESUS MONKEY, by L. Weiskrantz and A. Cowey. Mar. 23, 1962, 7p. (AFOSR-64-1297) (AF 61(052)185) AD 444262 Unclassified

Also published in Jour. Compar. Physiol. Psychol., v. 56: 225-231, 1963.

Visual acuity was measured pre- and postoperatively in monkeys given resections of striate or inferotemporal cortex. Striate Ss showed decreases in acuity, the severity of which corresponded reasonably well with the completeness and location of the lesions. Temporal Ss showed no decrease. The drop in acuity shown by the striate Ss was less than would be predicted if the lesion produced an absolute scotoma and if the relation between foveal and parafoveal acuity is the same in monkey as in man.

444

Cambridge U. [Psychological Lab.] (Gt. Brit.).

LOCOMOTOR ACTIVITY FOLLOWING LATERAL FRONTAL LESIONS IN RHESUS MONKEYS, by C. G. Cross. Mar. 21, 1962, 125p. (AFOSR-64-1298) (AF 61(052)185) AD 444261 Unclassified

Also published in Jour. Compar. Physiol. Psychol., v. 56: 232-236, 1963.

Effects of bilateral frontal lesions on locomotor activity were studied under various stimulus conditions. Eight monkeys were tested after, and 13 monkeys before and after, partial ablation of lateral frontal granular cortex or as unoperated controls. Ss with lesions that included sulcus principalis were hyperreactive to light. Their locomotor activity in light as well as darkness was more enhanced by relatively familiar auditory stimuli, and more depressed by relatively novel stimuli than that of unoperated Ss, or of Ss with lateral frontal lesions which spared sulcus principalis. (Contractor's abstract)

445

Cambridge U. [Psychological Lab.] (Gt. Brit.).

THE AETIOLOGY OF FOOD REWARD IN MONKEYS, by L. Weiskrantz and A. Cowey. Sept. 1, 1962, 10p. (Rept. no. RN 328) (AFOSR-64-1299) (AF 61(052)185) AD 444256 Unclassified

Also published in Animal Behavior, v. 11: 225-234, Apr.-July 1963.

The response of rhesus monkeys to new foods was measured in two ways: by measuring the amount of food consumed on repeated exposure, and the latency of an instrumental response made with respect to the food. The following results were obtained: Using the consumption measure, the amount of food consumed may be quite small on the first few days and then rise to a large value after a period of weeks. The visual experience of the animal in watching other animals consume the food can be important in determining whether it will subsequently accept the food. It is possible to convert a nonconsumer into a consumer by arranging for such visual experience to take place. Mere passage of time does not appear to be sufficient in reversing an initial rejection of a food, or an acquired acceptance of a food. (Contractor's abstract)

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Cambridge U. [Psychological Lab.] (Gt. Brit.).

CONTOUR DISCRIMINATION IN A YOUNG MONKEY WITH STRIATE CORTEX ABLATION, by L. Weiskrantz. Jan. 18, 1963, 20p. (AFOSR-64-1160) (AF EOAR-62-20) AD 442839 Unclassified

Also published in Neuropsychol., v. 1: 145-164, 1963.

A young (4½ mo old) rhesus monkey was subjected to bilateral removal of striate cortex. No striate cortex

remained in post-mortem examination, but a small cluster of undegenerated call was found in each anteroventral lateral qeniculate nucleus. A series of 11 experiments, involving various types of visual discriminations, is described

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Cambridge U. Psychological Lab. (Gt. Brit.).

STUDIES OF: (A) THE VISUAL FIELDS OF MONKEYS. (B) MEMORY PROCESSES AS AFFECTED BY CEREBRAL LESIONS IN MONKEYS, by L. Weiskrantz. Final technical rept. Nov. 30, 1963 [25]p. (AFOSR-64-0332) (AF EOAR-63-34) AD 438389 Unclassified

Analysis of the visual cortex and its relation to behavior, and of the changes in mnemonic function following circumscribed cerebral lesions and stimulation in the monkey is reported. Previous research has shown that changes in visual capacity following striate cortex lesions in the monkey are not absolute. When assessed by a perimetry device, the defective regions of the visual fields still permit a response to brief, dim flashes of light, although with decreased efficiency. Acuity measurements indicate a drop in acuity less than that predictable from the supposed distance of the edge of the field defect from the fovea. It is suggested that the residual capacity is simply the integral of the types of responses found from retinal ganglion cells. Memory changes were analyzed in terms of a distinction between short-term and long-term processes. (Contractor's abstract)

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Cambridge U. [Psychological Lab.] (Gt. Brit.).

THE CURIOUS EYE OF COPILIA, by R. L. Gregory, II. E. Ross, and N. Moray. 1964, 4p. (AFOSR-64-1308) (AF EOAR-63-93) AD 444258 Unclassified

Also published in Nature, v. 201: 1166-1168, Mar. 21, 1964.

Nine living specimens of Copilia were examined. Exner's description was found to be accurate with regard to the female specimens, the males being very different. Using high-quality optical microscopes (bright-ground, dark-ground and phase contrast Leitz equipment) we found that the internal structure, muscles, ligaments and the nervous system could easily be observed in the living unstained specimen. In particular, the oscillatory movement of the posterior lens and receptor, as reported by Exner, was readily observable. (Contractor's abstract)

449

Cambridge U. [Sub-Dept. of Veterinary Anatomy] (Gt. Brit.).

UNIT ACTIVITY IN THE HYPOTHALAMUS, by B. A. Cross and I. A. Silver. Final technical rept. Jan. 31, 1963, 14p. (AF 61(052)301) AD 632507 Unclassified

A study of over 800 units in the hypothalamus and other forebrain areas of more than a hundred animals has confirmed and extended earlier observations on the characteristics of hypothalamic unit activity. The majority of recorded hypothalamic neurones had spontaneous rates of firing in the range of 1-10/sec, and exhibited a more regular pattern of firing than neurones in the cortex or thalamus. The responses of hypothalamic neurones revealed a marked degree of sensory convergence. Usually two or more sensory stimuli excited the same neurone, but inhibitory interactions between differing sensory modalities were also observed. There was little evidence that neurones having particular patterns of activity or responsiveness were situated exclusively in localized areas. Fast unresponsive neurones were common in the subthalamus but also occurred in the ventral thalamus and hypothalamus. Neurones firing in short rapid bursts were found commonly in the thalamus and occasionally in the hypothalamus. Adjacent neurones frequently showed dissimilar behavior. Hypoxia, hypercapnia and hypoglycaemia had a predominantly excitatory effect on neurones in the posterior and lateral hypothalamic areas, associated with augmented sympathetico-adrenal activity. (Contractor's abstract)

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Cambridge U. [Sub-Dept. of Veterinary Anatomy] (Gt. Brit.).

THE EFFECT OF OVARIAN HORMONES ON THE ACTIVITY OF HYPOTHALAMIC NEURONES, by B. A. Cross and I. A. Silver. Final technical rept. Apr. 24, 1964, 14p. (AFOSR-64-0986) (AF EOAR-62-47) AD 600381 Unclassified

Unit activity in the diencephalon of adult female rats under light urethane anaesthesia was recorded with steel microelectrodes and a polygraphic recording system. The responsiveness of neurones to pain and cold stimuli on the tail and mechanical probing of the cervix was examined. In dioestrous rats, injection of 1 or 10 μg of oestradiol intramuscularly increased the incidence of inhibitory effects of the standard stimuli in hypothalamic neurones while 1 μg of oestradiol produced no change. In a group of pseudopregnant rats, hypothalamic neurones showed a markedly depressed responsiveness to cervical probing similar to that previously observed in cyclic rats following injected progesterone. No corresponding hormonally induced changes in responsiveness were observed in thalamic neurones. (Contractor's abstract)

451

Cambridge U. Dept. of Zoology (Gt. Brit.).

MECHANISMS OF INTEGRATION OF PATTERNS OF BEHAVIOR: A. STUDY OF THE DEVELOPMENT AND INTEGRATION OF NEST BUILDING SKILLS IN CANARIES. B. CHANGES IN RESPONSIVENESS UNDER CONSTANT OR REPETITIVE STIMULATION. C. THE EFFECT OF AUDITORY DEPRIVATION OF BEHAVIOUR, by R. A. Hinde. Final technical rept. Jan. 31, 1964, 5p. (AFOSR-64-0736) (AF EOAR-63-26) AD 438238 Unclassified

The role of changes in tactile sensitivity of the brood patch in the integration of nestbuilding behavior of female canaries has been studied. This has involved work on the hormonal control of brood-patch development, including injection of steroids into normal and ovariectomized birds. Experiments have also been conducted on the induction of reproduction behavior in winter. The changes in reproductive behavior are being correlated with changes in ovarian histology. The moment to moment changes in strength of the mobbing response shown by chaffinches to owls is being analyzed and some of the underlying processes isolated. Techniques for the experimental deafening of birds have been investigated. (Contractor's abstract)

452

Canterbury U. [Dept. of Chemistry] Christchurch (New Zealand).

PHOTOMETRIC STUDY OF THE REACTION OF IODINE WITH ACTIVE NITROGEN, by C. G. Freeman and L. F. Phillips. [1964] [6]p. (AFOSR-64-1518) (AF AFOSR-63-264) AD 446348 Unclassified

Also published in Jour. Phys. Chem., v. 68: 362-367, Feb. 1964.

Photometric observations have been made on the flame produced when iodine vapor is mixed with active nitrogen from a microwave discharge. A mechanism of 7 reactions is proposed for the overall reaction. The rate constants for two of the reactions are given. The most conspicuous feature of the reaction flame is intense emission in the blue and ultraviolet, arising from reactions 5 and 6. Pink emission from the point of mixing is mainly due to reaction 7. The reaction is suggested as a means of producing energetic species of nitrogen molecules in order to study their behavior in the absence of nitrogen atoms. (Contractor's abstract)

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Canterbury U. Dept. of Chemistry, Christchurch (New Zealand).

PHOTOMETRIC OBSERVATIONS ON THE REACTIONS OF ACTIVE NITROGEN WITH CHLORINE AND BROMINE, by K. S. Raxworthy and L. F. Phillips. [1964] [3]p. incl. refs. (AFOSR-65-0886) (AF AFOSR-63-264) AD 617237 Unclassified

Also published in Canad. Jour. Chem., v. 42: 2928-2930, 1964.

The results of reactions of chlorine and bromine with active nitrogen, with production of metastable $A(^3\Sigma_u^+)$ nitrogen species, are presented. The chlorine reaction produces almost no emission other than a weak nitrogen afterglow. The bromine reaction, however, produces a bright orange NBr emission. Excited halogen molecules reacted in both cases to produce a very weak emission, which decayed in a manner similar to the decay of the weak nitrogen afterglow. These results are contrasted with iodine, which in the excited state produces intense emission in the blue and ultraviolet wavelengths.

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Carnegie Inst. of Tech. [Dept. of Chemistry] Pittsburgh, Pa.

A SEARCH FOR HOT RADICAL REACTIONS IN FLASH PHOTOLYSIS, by G. J. Mains. Final rept. Nov. 30, 1963, 54p. (AFOSR-J1521) (AF AFOSR-62-51) AD 429260 Unclassified

Flash photolysis of diethyl ketone produced carbon monoxide, butane, ethylene, ethane, propane, propionaldehyde, hydrogen and methyl ethyl ketone as products of decreasing importance. The observation of diethyl ketone-d_5 among the flash photolysis products of a mixture of diethyl ketone and diethyl ketone-d_{10} confirmed the importance of the propionyl radical at 24°C and its temperature dependence. While most of the products were explainable in terms of the low intensity photolysis mechanism, it was necessary to postulate reactions of vibrationally hot species to explain the production of hydrogen, propane, methyl ethyl ketone and the large relative yield of ethylene. Observed products from flash photolysis of diethyl mercury at room temperature were butane, ethylene, ethane, propane and hydrogen in decreasing importance. The reaction products from the ethyl mercury radical were not observed. Because of the relatively high yield of ethylene it was necessary to invoke mechanisms involving reactions of hot ethyl radicals including unimolecular decomposition and disproportionation reactions. (Contractor's abstract)

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Carnegie Inst. of Tech. [Dept. of Chemistry] Pittsburgh, Pa.

THE TEMPERATURE DEPENDENCE OF THE FLASH PHOTOLYSIS OF DIETHYL KETONE, by L. C. Fischer and G. J. Mains. [1964] 9p. incl. diagrs. tables, refs. (AFOSR-64-0298) (AF AFOSR-64-513) AD 434520 Unclassified

Also published in Jour. Phys. Chem., v. 68: 188-196, 1964.

The flash photolysis of diethyl ketone yielded carbon monoxide, butane, ethylene, ethane, propane, and hydrogen as gaseous products of decreasing importance. Propionaldehyde and methyl ethyl ketone were found among the liquid products. The observation of diethyl ketone-d_5 among the flash photolysis products of a mixture of diethyl ketone and diethyl ketone-d_{10} confirmed the importance of the propionyl radical at 24° and its temperature dependence. While most of the products were explainable in terms of the low intensity photolysis mechanism, it was necessary to postulate reactions of vibrationally "hot" species to explain the production of hydrogen, propane, and methyl ethyl ketone and the large yield of ethylene. Tentative values of 0.4 ± 0.1

and 0.15 ± 0.1 were assigned to the disproportion–recombination ratio of ethyl and proptonyl radicals tnto ethylene and proptonaledhyde and ethane and methyl ketene, respecttvely.

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Carnegie Inst. of Tech. [Dept. of Chemtstry]
Pittsburgh, Pa.

THE FLASH PHOTOLYSIS OF MERCURY DIETHYL, by L. C. Fischer and G. J. Mains. [1964] 7p. (AFOSR-64-2505) (AF AFOSR-64-513) AD 453823
Unclassified

Also published tn Jour. Phys. Chem., v. 68: 2522-2528, 1964.

The observed products from the flash photolysis of mercury diethyl at room temperature were butane, ethylene, ethane, propane, and hydrogen tn decreastng tmportance. Antictpated reaction products from the ethylmercury radical were not observed, and good values for a material balance were found. Because of the relatively htgh yield of ethylene tt was necessary to tnvoke mechanisms involving reactions of hot ethyl radicals tncluding unimolecular decomposition and disproportionation reactions, the latter resulting in the production of methyl radicals. A detailed analysis of the C_2 products based on the assumed mechanism indicated that about 10% of the ethylene may be attributed to the disproportionation of hot ethyl radicals; untmolecular decomposition of vibrationally exctted ethyl radicals was suggested to account for 40% of the ethylene formed. (Contractor's abstract)

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Carnegie Inst. of Tech. [Dept. of Computer Sctence]
Ptttsburgh, Pa.

A COMPUTER PROGRAM FOR DISCOVERING AND PROVING SEQUENTIAL RECOGNITION RULES FOR WELL-FORMED FORMULAS DEFINED BY A BACKUS NORMAL FORM GRAMMAR, by R. L. London. Intertm rept. May 1964, 88p. tncl. refs. (AFOSR-67-0259) (SD-146) Unclassifted

This report ts based upon a computer program which will discover rules for the recognitton of grammatical strings when given a simple Backus Normal Form grammar. The program attempts to prove that these rules are both necessary and sufftctent to charactertze grammatical strtngs. The matn mathematical techniques that are mechantzed are induction and case analysis. In addition the program ts capable of productng counter-examples. Since the program ts wrtting proofs, several (meta-) proofs are tncluded asserting the correctness of the produced proofs.

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Carnegie Inst. of Tech. [Dept. of Computer Science]
Pittsburgh, Pa.

AN EXAMPLE OF HUMAN CHESS PLAY IN THE LIGHT OF CHESS PLAYING PROGRAMS, by A. Newell and H. A. Simon. Aug. 1964, 75p. incl. illus. diagrs. refs. (AFOSR-67-0260) (SD-146) AD 619386 Unclassified

This paper trtes to show that a human's analysts of a chess position can be understood in the same terms we use for chess programs and other problem solvtng, t. e., based on simple functions to oe performed. However, they are tn some cases more subtle than those used tn present programs. And at htgher levels of tntegration, the subject engages tn means-ends analysis, working backward from a desired goal to set up a subgoal. These higher levels of organization are mtssing from chess programs, although the general means-ends analysis forms the basts of other problem solving programs.

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Carnegie Inst. of Tech. [Dept. of Computer Science]
Ptttsburgh, Pa.

SCADS: A PROGRAMMING SYSTEM FOR THE SIMULATION OF COMBINED ANALOG DIGITAL SYSTEMS, by J. C. Strauss and W. L. Gilbert. [1964] [173]p. incl. refs. (AFOSR-67-2518) (SD-146)
Unclassifted

The SCADS system has been designed and implemented on the Control Data G-20 computer tn order to facilttate the process of "properly programmtng" the digital computer to aid tn the solution of analog computer oriented programs. The class of problems whtch are solvable on an analog computer tncludes: (1) ordinary differential equations with specifted inttial conditions; (2) certain types of tntegral equations; (3) difference equations with specified starting conditions; (4) combtned systems of integro-differential-difference equations, and (5) the stmulatton of physical systems which can be charactertzed by equations of the above types. In addition, there are well-known analog techntques for obtatntng solutions to two-potnt boundary value problems and to many two-variable partial differential equations. It is probably safe to say that almost all problem formulations and solution techntques commonly used tn conjunction with analog computers can also be used tn wrtting SCADS programs.

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Carnegie Inst. of Tech. [Dept. of Mathemattcs]
Ptttsburgh, Pa.

INTEGRAL REPRESENTATIONS OF AXIALLY SYMMETRIC POTENTIAL FUNCTIONS, by A. E. Heins and R. C. MacCamy. [1963] 15p. tncl. refs. (AFOSR-66-2137) (AF AFOSR-64-647) AD 642975 Unclassifted

Also publtshed tn Arch. Rational Mech. and Anal., v. 13: 371-385, 1963.

Thts paper ts concerned with solutions of elltpttc partial differential equations tn three variables when there ts an axis of symmetry. The simplest example ts Laplace's equation in x, y, and z. Solutions whtch are symmetrtc about the z-axis are then functions $u(r, z)$ of z and $r^2 = x^2 + y^2$, satisfying $L_k(u) = u_{rr} + k\, r^{-1} u_r + u_{zz} = 0$, $k = 1$.

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

DECAY OF 3.5-MIN $_{53}I^{122}$, by S. Jha. [1963] 5p. incl. diagrs. (AFOSR-64-0796) (AF AFOSR-63-278) AD 436479 Unclassified

Also publtshed tn Phys. Rev., v. 132: 2639-2643, Dec. 15, 1963.

Scintillation spectrometer studies of the radiations from I^{122} have shown 564-kev (100), 680-kev (7), 780-kev (5), 1250-kev (1.1), 1420-kev (0.9), 1750-kev (complex, 2), 2180-kev (1), 2540-kev (0.2), 2740-kev, 2920-kev, 3170-kev, and 3450-kev gamma rays with the tntensities given tn the parenthests. From the gamma-gamma coincidence, positron-gamma coincidence, and the suming technique, it has been tnferred that the 564-, 1250-, 1350 ± 10-, 1950 ± 30-, 2350 ± 50-, 2530 ± 50-, 2750 ± 50-, 2970 ± 50-, 3100 ± 50-, and 3400 ± 50-kev levels in Te^{122} are exctted tn the decay of I^{122}. From the gamma-gamma angular correlation studies the 1350-kev level ts asstgned the sptn and parity 0^+. The log ft values of the positron decay to the ground, 564-, 1250-, 1340-kev states of Te^{122} have been estimated to be 4.6, 5.1, 6.2, and 6.2, respectively. The log ft value of the β^- decay of Sb^{122} to the 1350-kev state of Te^{122} has been estimated to be ≥ 9.7. (Contractor's abstract)

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

DECAY OF 66-MIN $_{49}In^{110}$, by T. D. Nainan, A. S. Johnston, and S. Jha. [1964] 4p. tncl. diagrs. table. (AFOSR-64-2059) (AF AFOSR-63-278) AD 452472 Unclassified

Also published in Phys. Rev., v. 135: B601-B604, Aug. 10, 1964.

A source of pure 66-mtn In^{110}, particularly free from 4.9-h In^{110m}, has been made by bombarding a natural tndium foil with about 100-mev protons, and chemtcally separating tin (predomtnantly Sn^{110}, whtch ts the parent of only 66-mtn In^{110} from the tndium target. (Contractor's abstract)

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

MÖSSBAUER EFFECT IN I^{127}, by F. De S. Barros, N. Ivantchev and others. [1964] [3]p. tncl. diagrs. refs. (AFOSR-65-0488) (AF AFOSR-63-278) AD 613819 Unclassifted

Also publtshed tn Phys. Ltrs., v. 13: 142-144, Nov. 15, 1964.

The Mössbauer spectrum of the 59-kev γ-ray of I^{127} was obtatned using a $ZnTe^{127m}$ source and a sodium paraperiodate ($Na_3H_2IO_6$) absorber, both at liquid hydrogen temperature. Several other todine compounds were also trted as absorbers. The lower limit of the mean life of the 59-kev level was calculated from the width of the Mössbauer ltne and was compared with electronically measured values. The mean life is somewhat smaller than the measured values, partly due to tncomplete crystalltzation of $ZnTe^{127m}$.

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Carnegie Inst. of Tech. Dept. of Physics, Pittsburgh, Pa.

EXCITED STATES OF IODINE-127, by S. Jha and R. Leonard. [1964] [6]p. tncl. diagrs. table, refs. (AFOSR-65-0489) (AF AFOSR-63-278) AD 613823 Unclassifted

Also publtshed in Phys. Rev., v. 136: B1585-B1590, Dec. 21, 1964.

The lifetime of the 59-kev first excited state of I^{127} has been measured using both xenon and tellurtum parents. An average of the 2 results ts 1.9 ± 0.3 msec. Angular correlation studies have also shown the multipolartty of the 59-kev γ-ray to be predomtnantly magnetic dipole with an electric quadrupole admixture of 0.6 ± 0.6%. Angular correlation studies have also been carrted out on 2 other cascades of I^{127}: (1) The 175-200-kev cascade showed an antsotropy of 5 ± 3% when the Xe^{127} source was tn the gaseous form, but when the source was adsorbed on charcoal an anisotropy of 30% was found. The smeartng of the angular correlation is attributed to the htghly tonized states of the γ-emitters resulting from electron capture; and (2) the 356-59-kev cascade exhibtted ar antsotropy of 0.498 ± 0.07 after geometric corrections. Thts permtts asstgnment of the value 5/2 for the spin of the 415-kev state, whtle the 356 ν-ray ts etther 9.3 or 85% electrtc quadrupole, depending on whtch of the 2 possible solutions ts selected. The lifetime of the 59-kev state after correction for internal conversion ts longer by a factor 67 ± 14 than predicted by the Wetsskopf estimate for an allowed magnetic dipole transition. Thts is consistent with the values observed for other 1-forbtdden M1 transitions and with the most recent theoretical estimates.

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

LOG ft FOR ALLOWED INNER BETA GROUPS FROM ODD-ODD ISOTOPES, by S. Jha and A. S. Johnston. 1964 [3]p. tncl. diagr. table. (AFOSR-65-0817) (AF AFOSR-63-278) AD 617861 Unclassifted

Also publtshed tn Compt. Rend. Internat'l. Cong. Phys.

Nucleaire, Paris (France), July 2-8, 1964, Paris, CRNS, v. 2: 1183-1185, 1964.

By obtaining the spectrum of γ-rays associated only with the positron emission and if the spectrum is not complicated, it is possible to analyze the γ-ray spectrum and deduce from it the intensities of the positron feedings for the different levels. In order to exploit this possibility the positron emitting source was wrapped in a plastic cover thick enough to absorb all the positrons and was viewed by 2 NaI(Tl) crystal detectors, facing each other, to detect the 2 annihilation quanta in coincidence. A third NaI(Tl) crystal detector at right angles detected the γ-ray spectrum gave, on analysis, the relative positron branching ratios for the excited states. This method does not give the relative intensities of the positrons feeding the ground and the first excited states. This number had to be determined independently or had to be taken from the work of other investigators. In all sources investigated, the log ft for the allowed positron decay to the second excited state of the daughter nucleus is more or less hindered. Such a hindrance could be attributed to the forbiddenness of the creation of 2 phonons in the process of beta decay.

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Carnegie Inst. of Tech. [Dept. of Physics] Pittsburgh, Pa.

LOW-LYING LEVELS OF EVEN-EVEN XENON ISOTOPES, by S. Jha, A. S. Johnston and others. [1964] [2]p. incl. diagrs. (AFOSR-65-0819) (AF AFOSR-63-278) AD 617863 Unclassified

Also published in Compt. Rend. Cong. Internat'l. Phys. Nucleaire, Paris (France), July 2-8, 1964, Paris, CRNS, v. 2: 458-459, 1964.

The levels of xenon isotopes are investigated by studying the radiations from cesium and iodine isotopes. The levels of Xe^{126} were investigated by studying the radiations from 1.6 min Cs^{126} using an equilibrium mixture of 96 min Ba^{126} and Cs^{126}. The levels of Xe^{128} were investigated by studying the radiations from the equilibrium mixture of 2.4 day Ba^{128} and 3 min Cs^{128} and from 25 min I^{128}. Cs^{130} and I^{130} are also studied to indicate additional levels.

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Case Inst. of Tech. [Dept. of Chemistry] Cleveland, Ohio.

SOME GERMANIUM MACROCYCLIC COMPLEXES, by J. N. Esposito, L. E. Sutton, and M. E. Kenney. Aug. 6, 1964, 14p. (Technical rept. no. 1) (AF 49-(338)773) AD 604117 Unclassified

The macrocylic germanium complexes, $hpGeF_2$, $hpGeCl_2$, $hpGeBr_2$, $hpGe(OH)_2$, $(hpGeO)_x$, $hpGe(OC_4H_9-n)_2$, $hpGe(OC_6H_5)_2$, $PcGeF_2$, $PcGeBr_2$, and $PcGeI_2$ are reported together with additional data on hpH_2, $PcGeCl_2$ and $(PcGeO)_x$. A comparison is made of the low frequency infrared spectra of the oxy, hydroxy and halo complexes. Evidence is given which indicates that $(hpGeO)_x$ is similar in structure to $(PcGeO)_x$. (Hp = hemiporphyrazine; Pc = phthalocyanine). (Contractor's abstract)

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Case Inst. of Tech. [Dept. of Mechanics] Cleveland, Ohio.

MELTING DECELERATING BODIES, by S. Ostrach. [1964] [25]p. incl. illus. diagrs. refs. (AFOSR-65-1156) (AF AFOSR-63-194) AD 620535 Unclassified

Also published in Nonlinear Problems of Engineering, New York, Academic Press Inc., 1964, p. 138-162.

An analysis is presented of the flow and heat transfer of a glassy viscous film of ablating material on the exterior surface of a body of revolution or a symmetric 2-dimensional body which enters the atmosphere at high speed and which experiences large deceleration and surface heating. The nonlinear problem associated with this type of ablation is considered. Results indicate that the ablation process can be theoretically described at the extremes in time, but more work is needed for intermediate times. An example is presented in which the ablative material is Pyrex.

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Case Inst. of Tech. [Dept. of Physics] Cleveland, Ohio.

GALVANOMAGNETIC INVESTIGATION OF THE FERMI SURFACE OF MAGNESIUM, by R. W. Stark, T. G. Eck, and W. L. Gordon. [1964] 9p. (AFOSR-64-1236) (AF AFOSR-62-222) AD 442803 Unclassified

Also published in Phys. Rev., v. 133: A443-A451, Jan. 20, 1964.

The galvanomagnetic properties of several single-crystal specimens of magnesium have been investigated. The results of this investigation are presented and a Fermi surface topology consistent with the data is discussed. Many of the detailed features of the galvanomagnetic properties are found to result from the effects of magnetic breakdown. The magnetic breakdown associated with the "giant orbit" which Priestley observed in his pulsed-field de Haas-van Alphen study of magnesium is found to be complete for magnetic-field strengths of 5400 G. An open orbit whose net direction is parallel to the hexagonal axis is observed for magnetic-field strengths as large as 70 kG. This orbit probably results from magnetic breakdown across three different energy gaps. (Contractor's abstract)

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Case Inst. of Tech. Dept. of Physics, Cleveland, Ohio.

MAGNETIC BREAKDOWN EFFECTS IN THE GALVANOMAGNETIC PROPERTIES OF ZINC, by R. W. Stark. [1964] [16]p. incl. diagrs. (AFOSR-64-0185) (AF AFOSR-64-536) AD 611495 Unclassified

Also published in Phys. Rev., v. 135: A1698-A1713, Sept. 14, 1964.

The galvanomagnetic properties of several single-crystal specimens of high-purity zinc were investigated. The results of this investigation are presented and a Fermi-surface topology consistent with the data is discussed. Many of the detailed features of the galvanomagnetic properties are found to result from the effects of magnetic breakdown. The open orbit parallel to the hexagonal axis is modified but not eliminated by magnetic breakdown at fields of about 17.5 kG. A 'giant orbit' of the type previously observed in magnesium is found in zinc. This orbit results from magnetic breakdown across the energy gap near K which separates the second-band hole sheet from portions of the third band electron sheets. The transition region of the magnetic breakdown which gives rise to the giant orbit is investigated in detail, and the large quantum oscillations which have been previously observed in the transport properties of zinc are shown to be a transition-region phenomenon. The oscillations appear to result from an oscillatory breakdown probability which, in turn, arises from oscillations in the density of states associated with the Landau levels of the needle-shaped portion of the Fermi surface of zinc. An analysis of the detailed shape of the oscillations indicated that the Landau levels of the needle are split into discrete spin levels with a very large effective g factor.

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Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

ON MOMENTS OF ORDER STATISTICS AND QUASI-RANGES FROM NORMAL POPULATIONS, by Z. Govindarajulu. [1963] 19p. (AFOSR-J1621) (AF AFOSR-62-72) AD 429252 Unclassified

Also published in Ann. Math. Stat., v. 34: 633-651, June 1963.

The lower bounds on the number of integrals to be evaluated is obtained in order to know the first, second and mixed (linear) moments of the normal order statistics (O. S.) in a sample of size N assuming that these moments are available for sample sizes less than N. Toward this, the recurrence relationships, identities, etc. among the moments of the normal order statistics, which have appeared in the literature have been collected with appropriate references. Also, these formulae are listed and stated in the most general form wherever possible. Simple and alternate proofs of some of these formulae are given. These results are also supplemented with new formulae or relationships. The lower moments of quasi-ranges in samples drawn from an arbitrary population symmetric about zero are expressed in terms of the moments of the corresponding O. S. Simple recurrence formulae among the expected values of quasi-ranges in samples drawn from an arbitrary continuous population are obtained. (Contractor's abstract)

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Case Inst. of Tech. [Statistical Lab.] Cleveland, Ohio.

RELATIONS AMONG MOMENTS OF ORDER STATISTICS IN SAMPLES FROM TWO RELATED POPULATIONS, by Z. Govindarajulu. [1963] 5p. (AFOSR-64-0573) (AF AFOSR-62-72) AD 434303; AD 446893 Unclassified

Also published in Technometrics, v. 5: 514-518, Nov. 4, 1963.

It is shown that the moments of order statistics in samples drawn from a population symmetric about zero can be expressed in terms of the moments of order statistics in samples drawn from the population obtained by folding the symmetric population at zero. Also, odd moments of the largest order statistic in samples of even sizes and even moments of the largest order statistic in samples of odd sizes drawn from the folded population can be expressed purely in terms of the moments of the order statistics in samples drawn from the symmetric population. The cumulative round off error involved in numerical evaluation of the moments of order statistics from the folded population, is not serious except for the mixed moments in which case a bound on the maximum error is available. An application is also considered. (Contractor's abstract)

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Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

AN ELEMENTARY INFORMATION PROCESSOR FOR OBJECT RECOGNITION, by J. C. Pennypacker. May 1963, 105p. (Rept. no. SRC-30-I-63-1) (AFOSR-5112) (AF AFOSR-63-125) AD 413370; AD 901749 Unclassified

A Concept is defined to be a class of objects whose members can be distinguished by processing its properties. A Property is defined to mean a partition of the set of all objects into disjoint classes. The concept is described by a Conception, which is a list structure. The conception of a concept is built up from elementary conceptions by a recursive process and is an abbreviated form of the description list structure described by R. B. Banerji in an earlier paper. A Processor, which consists of a series of computer flow charts, is described. The processor is capable of forming conceptions of known and new concepts and is capable of processing information relevant to these concepts. In addition, the processor is capable of elementary learning. (Contractor's abstract)

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Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

A HEURISTIC APPROACH TO SOLUTION OF CHECKERBOARD PUZZLES, by G. J. Hansen. 1964, 94p. incl. diagrs. (Rept. no. SRC-49-A-64-16) (AFOSR-64-2406) (AF AFOSR-63-125) AD 609570 Unclassified

The problem of reconstructing a checkboard cut into a number of straight edge pieces was solved by a digital computer program employing a varity of heuristics. The major heuristics used were considerations of the symmetry of the pieces, correct color combinations, optimal selection of the place on the board to fit the next piece, the optimal piece to select at each stage in fitting the puzzle together, pairing of the pieces, and selecting the first piece to be used in starting the puzzle. These heuristics were applied in order to simulate as closely as possible the way in which a human being would proceed in obtaining a solution. It was possible to minimize the number of tries necessary to obtain a solution, thus making the solution time reasonable. Two 8 x 8 checkerboard puzzles were tried. The first consisted of 12 pieces and was solved in 8 min. The second had 13 pieces and took 1 hr and 25 min. The recursive program was written in IPL-V and run on the Univac 1107 computer. (Contractor's abstract)

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Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

A THEORY OF SIMPLE CONCEPTS WITH APPLICATIONS, by T. G. Windeknecht. 1964, 122p. incl. refs. (Rept. no. SRC-53-A-64-19) (AFOSR-64-2407) (AF AFOSR-63-125) AD 609421 Unclassified

A theoretical study leading toward the solution of a class of inventory problems by digital computation is reported. Using a formal model of concepts in the activity of object recognition due to Banerji, a theory of simple concepts is constructed. The algebraic structure of the class of simple concepts is developed. A relationship between the formal notions of relevance and simplicity on the set of concepts is proved. The simple concepts are shown to be precisely that class that can be learned by a certain focusing strategy. Consideration of the characteristics of the set of simple concepts leads to a new technique for concept description, which is presented as a formalism. Progress on a concept learning machine based upon the proposed formalism for concept description is discussed. The machine will have a formidable capacity for self-organization, and appears to be applicable for solution of some of the inventory problems discussed. (Contractor's abstract)

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Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

THE CONCEPT OF FINITE REPRESENTABILITY, by E. B. Altman. 1964, 155p. incl. diagrs. tables, refs. (Rept. no. SRC-56-A-64-20) (AFOSR-64-2408) (AF AFOSR-63-125) AD 609420 Unclassified

A subclass of the context-free grammars is developed which is based solely upon the structural properties of the grammars. This subclass is utilized in the development of a partial hierarchy of the entire class of context-free grammars. In turn this hierarchy makes possible the extension of certain information theory measures beyond the classical finite state limitations. Various restriction upon the method of generating sentences are introduced and the consequences of these restrictions are studied, in a general way, using mainly the introduced notion of production indexing sets. (Contractor's abstract)

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Case Inst. of Tech. Systems Research Center, Cleveland, Ohio.

ADAPTIVE PATTERN RECOGNITION USING NON-LINEAR ELEMENTS, by A. N. Mucciardi. Oct. 1964, 131p. incl. diagrs. tables, refs. (Rept. no. SRC-65-A-64-22) (AFOSR-65-1701) (AF AFOSR-65-751) AD 623215 Unclassified

A pattern recognition device which computes a weighted sum of all products of its binary input variables is investigated. It is proven that this device can uniquely synthesize any real function of its inputs. The size of this device becomes prohibitive as the number of inputs increases and the concept of an incomplete device is introduced and discussed. A convergence proof of an adaptive training procedure for real outputs, based on the equivalence between this device and a multi-threshold linear device in a larger input space, is presented. A set of orthogonal property detectors is defined and shown to be numerically equal to the number of binary inputs. A computer simulation of a 64-input incomplete device shows that its generalizing abilities are more fully utilized with the aid of specific property detectors. A self-organizing technique consisting of periodically discarding low-weighted terms and replacing them with randomly chosen terms is discussed. Experiments conducted using this technique demonstrate that the learning and generalizing performances of the incomplete device are greatly improved if the device is free to change its structure according to a heuristic policy. (Contractor's abstract)

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Catholic U. of America. [Dept. of Aeronautical Engineering] Washington, D. C.

RESEARCH ON FLOW SEPARATION IN WESTERN EUROPE, by P. K. Chang. July 1963, 28p. (AFOSR-4854) (AF AFOSR-62-80) AD 419245 Unclassified

The major scientific countries—France, Germany, and especially England—are well aware of the importance of the problems of flow separation and have engaged extensively in research. However, except for the Institut fur Schiffbau der Universitat, Hamburg, and in limited scope at Skipmodelltanken, Trondheim, Norway, it is felt that no special research on this subject has been carried on. Hence, most of the work listed herein was done at the aerodynamic institutes. The main emphasis in this research is placed on the fields of (1) Flow Separation on Swept Wings, (2) Base Flow, (3) Interaction between Shock Wave and Boundary Layer, and (4) Generalized Concept of Flow Separation. (Contractor's abstract)

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Catholic U. of Amertca. [Dept. of Chemistry] Washtngton, D. C.

THE ELECTROCHEMICAL PROPERTIES OF METAL-HYDROGEN ALLOYS, by G. W. Castellan. Final rept. Jan. 4, 1963, 10p. (AFOSR-4561) (AF 49(638)475) AD 609399 Unclassified

An investigation was made to examine the rate of transmission of hydrogen through metals, both exothermic and endothermic hydrogen occluders, and from this examination to elucidate the mechanism of the process. In the case of palladium it is shown that, on an anodically activated surface in aqueous solution, the transmission is almost exclusively controlled by the diffuston through the bulk metal. However, the jump of a hydrogen atom from the metal surface to the tnterior of the metal is the next slowest step in the process. Using another method work was done with alloys of palladium and silver, 20% and 30% silver by weight. The results obtained with these alloys does not appear to agree with the observations of other investigators and this work will have to be extended and rechecked.

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Catholic U. of America. Dept. of Chemistry, Washington, D. C.

THE TRANSMISSION OF ELECTROLYTICALLY DEPOSITED HYDROGEN THROUGH A PALLADIUM MEMBRANE ELECTRODE. I. THE RATE EQUATIONS, by G. W. Castellan. [1964] 4p. incl. tables, refs. (AFOSR-65-0232) (AF 49(638)475) AD 611461 Unclassified

Also publtshed tn Jour. Electrochem. Soc., v. 111: 1273-1276, Nov. 1964.

A sequence of elementary steps is postulated to describe the transport of hydrogen through a palladium membrane electrode. The amount of hydrogen transmitted per square centimeter of the membrane is described by a current density, $-j$, while the rate of deposition of hydrogen per square centimeter is described by a polarization current density, $-i$. It is shown tn general, without reference to the particular mechanism, that j is a linear function of i at low values of i, and that the derivative, $(di/dj)_{i=0}$, is a linear function of the membrane thickness L, provided only that Fick's law in simple form holds; the slope of the plot of $(di/dj)_{i=0}$ vs L is independent of conditions on the exit side of the membrane. It is also shown in general that if conditions are the same on both sides of the membrane at equilibrium no more than one-half of the hydrogen deposited can be transmitted. The postulated mechanism predicts that the rate of transmission should reach a limiting value, $-j_m$, at high values of $-i$. For thin membranes, $1/(-j_m)$ should be a linear function of L. The slope of $1/(-j_m)$ vs L depends on the diffusion coefficient of hydrogen atoms in palladium and is independent of the rates of the surface reactions, although tn some instances it depends on θ_0, the equilibrtum coverage of the surface by hydrogen atoms.

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Catholic U. of America. Dept. of Chemtstry, Washington, D. C.

THE TRANSMISSION OF ELECTROLYTICALLY DEPOSITED HYDROGEN THROUGH A PALLADIUM MEMBRANE ELECTRODE. II. EXPERIMENTAL. OXIDIZING AGENTS AND HYDROGEN GAS ON THE EXIT SIDE, by R. A. LaPietra and G. W. Castellan. [1964] [4]p. incl. diagrs. table. (AFOSR-65-0233) (AF 49(638)475) AD 611346 Unclassified

Presented at meeting of the Electrochem. Soc., Los Angeles, Calif., May 6-10, 1962.

Also publtshed in Jour. Electrochem. Soc., v. 111: 1276-1279, Nov. 1964.

Hydrogen is deposited electrolytically on one side, the entrance side, of a palladium membrane at a rate $-i$ (amp/cm^2). The amount of hydrogen transmtted is measured by noting the change in normality of a solution of a strong oxidizing agent, e.g., Ce^{+4} of $S_2O_8^=$, on the other side, the exit side, and in other experiments by measuring the hydrogen evolved on the exit side volumetrically. The results with hydrogen on the exit side are apparently capable of description by the equations developed in Part I of this series, but the value of the diffusion coefficient obtained is lower than Barrer's value at 25°C by a factor of two to three. Possible reasons for this discrepancy are discussed briefly.

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Catholic U. of America. Dept. of Chemistry, Washington, D. C.

THE TRANSMISSION OF ELECTROLYTICALLY DEPOSITED HYDROGEN THROUGH A PALLADIUM MEMBRANE ELECTRODE. III. PRESSURE AND TEMPERATURE DEPENDENCE, by P. L. Damour and G. W. Castellan. [1964] 4p. incl. illus. diagrs. tables. (AFOSR-65-0234) (AF 49(638)475) AD 611460 Unclassified

Also published tn Jour. Electrochem. Soc., v. 111: 1280-1283, Nov. 1964.

An investigation of the pressure and temperature dependence of the maximum rate of transmtsston of hydrogen through palladium is described. The pressure dependence in the range from 0.329 to 1 atm indicates that the penetration-exit reaction, $H_{(ads)} = H$ (bulk), is the slowest surface reaction, but is nonetheless very fast having an exchange current density of about 0.8 amp/cm^2 at 1 atm pressure. From the temperature dependence it is found that at temperatures slightly below room temperature the diffusion coefficient can be represented by $D = 0.0260 \exp(-6800/RT)$ cm^2/sec. (Contractor's abstract)

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Catholic U. of America. [Dept. of Mathematics] Washington, D. C.

A LINEAR MAPPING OF THE SPACE OF DISTRIBUTION FUNCTIONS ONTO A SET OF BOUNDED CONTINUOUS FUNCTIONS, by E. Lukacs. Feb. 1, 1963, 6p. (AFOSR-64-1606) (AF AFOSR-61-32) AD 446897 Unclassified

In this paper, a characterization is given of the transforms of distribution functions which utilize also the continuity property. This assumption permits a more general approach by considering instead of an integral transform of distribution functions a linear mapping of the space of distribution functions. (Contractor's abstract)

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Catholic U. of America. [Dept. of Mathematics] Washington, D. C.

APPLICATIONS OF CHARACTERISTIC FUNCTIONS, by E. Lukacs and R. G. Laha. London, Charles Griffin and Co. Ltd., 1964, 202p. incl. refs. (Griffin's Statistical Monographs & Courses no. 14) (AFOSR-65-1591) (AF AFOSR-61-32) AD 620239 Unclassified

Applications of characteristic functions to problems of theoretical statistics are considered. Some multivariate distributions which occur in statistical problems are studied, and the distribution problem of statistics is solved in those cases where the integrals of the distribution function can be evaluated. Independent statistics are discussed and situations in which they determine the distribution functions of random variables, considered. Some regression problems, problems in the theory of stochastic processes, stability theorems, and identically distributed statistics are studied. Most theorems presented are given with detailed proofs. (Contractor's abstract)

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Catholic U. of America. [Dept. of Mathematics] Washington, D. C.

CHARACTERIZATION PROBLEMS FOR DISCRETE DISTRIBUTIONS, by E. Lukacs. [1963] 10p. (AFOSR-66-1677) (AF AFOSR-63-437) AD 641690 Unclassified

Also published in Proc. Internat'l. Symposium on Classical and Contagious Discrete Distributions, Montreal (Canada), 1963, p. 65-74.

Assumptions concerning the properties of the distributions of certain statistics, based on a sample from a population, will in general impose restrictions on the population distribution function. Characterization problems deal with the question of finding assumptions which determine the population distribution function at least to the extent that it belongs to a certain family of distribution functions. A great variety of assumptions is studied in connection with characterization problems: these problems were surveyed in papers presented at the third and fourth Berkeley symposiums. In this paper only a regression property of certain statistics is considered.

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Catholic U. of America. [Dept. of Physics] Washington, D. C.

ALPHA-PARTICLE RESONANCE, by C. Werntz. [1964] 6p. (AFOSR-64-0636) (AF AFOSR-62-56) AD 435946 Unclassified

Also published in Phys. Rev., v. 133: B19-B24, Jan. 13, 1964.

A phase-shift analysis of the elastic P-T cross section in the energy range 0.1 to 0.76 mev has been made. It is shown that the low peak observed at 0.3 mev is consistent with a 0(+) resonance at 0.5 = 0.1 mev. The shape of the observed cusp in the P-T elastic cross section at the threshold energy of the N-He_3 channel is used to demonstrate that the energy behavior of the singlet and triplet s-wave pnase obtained must be qualitatively unique. A direct comparison is made of the Breit-Wigner single-level approximation and the alternative two-channel scattering length description of the state. (Contractor's abstract)

487

Catholic U. of America. Dept. of Physics, Washington, D. C.

STATISTICAL MECHANICS OF QUENCHED SOLID SOLUTIONS WITH APPLICATION TO MAGNETICALLY DILUTE ALLOYS, by T. Morita. [1964] 5p. (AFOSR-65-1117) (AF AFOSR-63-445) AD 620534 Unclassified

Also published in Jour. Math. Phys., v. 5: 1401-1405, Oct. 1964.

For the motion of atoms in solid solutions or alloys prepared at high temperatures and cooled nonadiabatically, theories of phenomena related to internal degrees of freedom must account for the nonequilibrium distribution of atoms. However, such a system can be treated with the aid of a fictitious equilibrium system. The system is constructed such that its thermal equilibrium properties are the same as the properties of the non-thermal-equilibrium system. Thus one can treat nonequilibrium systems by applying well known thermal equilibrium techniques to the fictitious system. The method is illustrated via the example of a magnetically dilute alloy. Brout's result for a very dilute Ising system is obtained with the aid of the theory of classical fluids, without collecting diagrams. A method for applying the higher approximations developed for classical fluids to the present problem is suggested.

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Catholtc U. of Chile. [Lab. of Neurophysiology] Santiago.

ROLE OF TH? CEREBRAL CORTEX IN CLASSICAL AND INSTRUMENTAL CONDITIONED REFLEXES, by S. Middleton. Final technical rept. May 1, 1963-Apr. 30, 1964. Aug. 1964, 6p. (AFOSR-64-1441) (AF AFOSR-62-387) AD 604477 Unclassified

Summaries of psychophysiological reports are presented concerntng the role of the cerebral cortex in conditioned reflexes.

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Catholic U. of Chile. [Lab. of Neurophysiology] Santiago.

AN ELECTRICAL CORRELATE TO THE PROCESS OF LEARNING. EXPERIMENTS IN BLATTA ORIENTALIS, by J. V. Luco and L. C. Aranda. [1964] 3p. incl. diagr. table. (AFOSR-65-0298) (AF AFOSR-62-387) AD 612221 Unclassified

Also published tn Nature, v. 20: 1330-1331, Mar. 28, 1964.

The report deals with the question of differences between the electrical reaction of the nervous system of normal cockroaches compared with cockroaches forced to learn a new motor performance.

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Catholic U. of Chtle. Lab. of Neurophysiology, Santiago.

PLASTICITY OF NEURAL FUNCTION IN LEARNING AND RETENTION, by J. V. Luco. [1964] 25p. incl. illus. diagrs. table, refs. (AFOSR-65-1501) (AF AFOSR-62-387) AD 623062 Unclassified

Also publtshed in Bratn Function: RNA and Brain Function; Memory and Learning; Proc. Second Conf., Los Angeles, Calif., 1962, Los Angeles, California U. Press, v. 2: 135-159, 1964. (AFOSR-65-1499)

An electrophysical approach to the neural basis of plasticity, deftned broadly by the author as the central nervous system's quality of being versatile is discussed. The in vitro experiment was performed on the sixth abdominal and the metathoractc ganglion of Blatta orientalis. Stimulation of the nerve tracts which connect the ganglion with others eltcits several different types of responses, all recorded from the motor fibers and quite frequently from a single untt. The servile response ts characterized by fatigue properties, the labile response by its variable response to different frequency stimuli, and the intratetanic by the responses elictted after tetantc conditions are introduced. Afterdischarge, delayed, and natural responses are also described. Analysis of the six responses in ierms of their plasttctty or tendency toward modification by past expertence, indicated that the labile response reaction and the tntratetantc response are definitely plastic.

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[Catholic U. of Chile. Lab. of Physiology, Santiago]

[PEPTIDE NEUROHUMORS IN THE BRAIN] Final rept. Dec. 1963, 1v. (AFOSR-64-0015) (AF AFOSR-62-424) AD 429272 Unclassifted

The experiments described deal with the effects of ptneal and habenular extracts on renal excretion of Na, K, and water. These experiments were carrted out on the assumption thai the pineal gland would contain some of the substances active on hydro-mineral metabolism described in literature, such as adrenoglomerulotrophtn. The total extracts of the cerebral cortex, pineal, and epithalamus reduce the ovarian ascorbic actd when assayed in Parlow's test. Serotonin in doses of 25μg has a depleting action on the ovarian ascorbtc acid; melatontn does not. The extracts, 15 min after intravenous injection, increase the LH-ltke activity of the plasma in castrated rats treated with Estradiol and Progesterona. Serotonin in doses of 50μg did not produce this effect. The behavior of the extracts is that of a LH-releasing factor. (Contractor's abstract)

492

Centre National de la Recherche Scientifique, Paris (France).

LIGHT ENERGY CONVERSION IN NEURONAL MEMBRANES, by N. Chalazonitis. [1964] [31]p. incl. illus. diagrs. table, refs. (AFOSR-65-1293) (AF EOAR-63-114) AD 621413 Unclassified

Presenied at Symposium on Molecular Mechantsms in Photobiology, Wakulla Springs, Fla., Feb. 16-21, 1964.

Also published in Photochem. and Photobiol., v. 3: 539-559, 1964.

Photocurrents and decrease in membrane reststance have been shown by illuminating pigmented nerve cells, and vitally stained nerve fibers. Any photocurrent, of threshold value, can elicit repetitive electrical activity as an extrinsic outward current dose. In pigmented nerve cells, photocurrents are additive to pre-existing dark currents, thus modifying the frequency of the spontaneous activity. Light effects on electrogenic membrane were compared to those of IR. Both radiations decrease, with different yields, the membrane resistance. However, the initiated membrane currents are generally of opposite directions. Similarly, opposite direction photocurrents are elicited by specific illuminations of 2 intracellular pigments, haemoprotein or carotenoid, in some nerve cells. (Contractor's abstract)

493

Centre National de la Recherche Scientifique, Paris (France).

[PRESSURE CHAMBER FOR MICROELECTROPHYSIOLOGICAL TECHNIQUES] Caisson de

compression pour techniques mtcroelectrophysiologiques, by R. Chagneux. [1964] [7]p. incl. illus. diagr. (AFOSR-65-1294) (AF EOAR-63-114) AD 621281 Unclassified

Also published in Bull. Inst. Oceanog., v. 61: 2-8, 1964.

Thts research program on the effect of hyperbar gases on isolated nerve cells of Aplysia has involved the study and construction of a pressure chamber. The chamber is mainly composed of a cylindrical tube, with 2 glass port-holes allowing the illumination and observation of the biological preparations, and 2 moveable doors with a quick-closing system which permtt mtcromanipulation. Electrical connections assure all the various remote controls. Two taps, purge and stop, a manometer and a safety valve complete the equtpment of the chamber. The equipmeni meets the requirements of microelectrophysiological techniques and can submit the preparations to constant pressures of as much as 6 bars. (Contractor's abstract)

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Chicago U., Ill.

NATIONAL INTEGRATION AND POLITICAL DEVELOPMENT, by L. Binder. [1964] [10]p. incl. refs. (AFOSR-65-1162) (AF AFOSR-64-582) AD 621464 Unclassified

Also published in Amer. Political Sci. Rev., v. 58: 622-631, Sept. 1964.

The relationship between national integration and political development is explored. The two concepis are held io be situationally bound phenomena, and understanding is sought by exploring their different aspects io form a model raiher than by searching for concrete definitions of the two. National integration and an effective bureaucracy are considered to be strongly interdependent. The political relationship between the modernizing elite and the traditional mass ts thought to be the key issue in national iniegration. Given special atiention are Mosca's ideas of social type and polittical formula. In the model constructed, stable political forms will be shaped by the integrative process, if ai all. (Contractor's abstract)

495

Chicago U. [Commiiiee on Mathematical Biology] Ill.

ON THE REVERSIBILITY OF ENVIRONMENTALLY INDUCED ALTERATIONS IN ABSTRACT BIOLOGICAL SYSTEMS, by R. Rosen. [1963] 10p. (AFOSR-3204) (AF 49(638)917) AD 413635 Unclassified

Also publtshed in Bull. Math. Biophys., v. 25: 41-50, 1963.

The environmentally induced alierations tn structure of biological sysiems which were described previously are examined from the st.ndpoint of determtning under whai circumstances ihey can be reversed by further environmental tnteractions. For simplicity, consider only the case of biological systems possessing one metabolic and one genetic component. In the case of environmentally induced alteration of the metabolic component alone, a necessary and sufficient condition is given for the reversibility of the alteration. In the case of alteration of the genetic component, the situation becomes more complex; several partial results are given, but a full analysis is not available at thts time. Some possible biological implications of this analysts are discussed. (Contractor's abstract)

496

Chicago U. [Committee on Mathematical Biology] Ill.

AN AVOIDANCE LEARNING SITUATION. A NEURAL NET MODEL, by H. D. Landahl. [1964] 7p. (AFOSR-64-0959) (AF AFOSR-63-370) AD 439983; AD 436112 Unclassified

Also published in Bull. Math. Biophys., v. 26: 83-89, 1964.

A simple avoidance situation is constdered in terms of a neural net learning model. Data for the control situation can be represented by an expression having three parameters which determine the initial and the steady state activities together with transient aspects. The introduction of a learning parameter then allows one to calculate satisfactorily the results obtained in the experimental situation in which shock is applied. (Contractor's abstract)

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Chicago U. [Committee on Mathematical Biology] Ill.

AN ANALOG COMPUTER MECHANIZATION OF THE HODGKIN-HUXLEY EQUATIONS, by H. M. Martinez and H. D. Landahl. Oct. 1, 1964, 25p. (AF AFOSR-63-370) AD 608156 Unclassified

The Hodgkin-Huxley equations describing the action potentials for giant squid axons have been mechanized on the University of Chicago analog computer (Beekman EASE 2132) for the purpose of simulating a variety of experimental situations. The mechanizattor is described together wtth the fcllowtng results: (1) response to constant currents ranging from threshold to saturation, (2) response to 100 cps stnusoidal current at 2 amplitudes and 2 phases, and (3) the effect of removtng the potassium current term. (Contractor's abstract)

498

Chicago U. [Committee on Mathematical Biology] Ill.

ABSTRACT BIOLOGICAL SYSTEMS AS SEQUENTIAL MACHINES, by R. Rosen. [1964] 9p. (AFOSR-64-1851) (AF AFOSR-64-9) AD 453598; AD 444059 Unclassified

Also publtshed in Bull. Math. Btophys., v. 26: 103-111, 1964.

It is shown that a rather close relationship exists between the (M, R)-system, defined previously as prototypes of abstract biological systems, and the sequential machines which have been studied by various authors. The theory of sequential machines is reformulated in a way suitable for its application to the study of the intertransformability of (M, R)-systems as a result of environmental alteration. The important concept of strong connectedness is most useful in this direction, and is used to derive a number of results on intertransformability. Some suggestions are made for further studies along these lines. (Contractor's abstract)

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Chicago U. Committee on Mathematical Biology, Ill.

ABSTRACT BIOLOGICAL SYSTEMS AS SEQUENTIAL MACHINES. II: STRONG CONNECTEDNESS AND REVERSIBILITY, by R. Rosen. [1964] [8]p. (AFOSR-65-0967) (AF AFOSR-64-9) AD 614871 Unclassified

Also published in Bull. Math. Biophys., v. 26: 239-246, 1964.

It was previously shown that the abstract biological systems called (M, R)-systems could be regarded formally as sequential machines, and that when this was done, the reversibility of environmentally induced structural changes in these systems was closely related to the strong connectedness of the corresponding machines. In the present work it is shown that the sequential machines arising in this way are characterized by the property that the size of the input alphabet is very small compared with the size of the set of states of the machine. It is further shown that machines with this property almost always fail to be strongly connected. Therefore, it follows that one of the following alternatives holds: either most environmentally induced structural alterations are not environmentally reversible, or else many mappings in the category from which the (M, R)-systems are formed must not be physically realizable.

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Chicago U. Committee on Mathematical Biology, Ill.

TOWARD AN OPTIMAL DESIGN PRINCIPLE IN RELATIONAL BIOLOGY, by H. M. Martinez. [1964] [15]p. incl. diagr. (AFOSR-65-0968) (AF AFOSR-64-9) AD 614872 Unclassified

Also published in Bull. Math. Biophys., v. 26: 351-365, 1964.

A vulnerability criterion is posed for a biological system within the context of representing the system as a relational set, i.e., a collection of components whose interdependency is described by means of a set of binary relations. The criterion provides a numerical value for each representation and therefore a means for comparing one representation against another. Choice of the criterion is such that the larger a numerical value a representation has then the less vulnerable to destruction is the system represented. Other things beng equal, it is argued that the representation which endows the system with the least vulnerability is more likely to be a valid representation. A selection criterion is thereby acheived for narrowing down the choice of a priori representations. (Contractor's abstract)

501

Chicago U. [Dept. of Chemistry] Ill.

REACTIVE INTERMEDIATES IN CYCLOPROPANE CHEMISTRY, by W. G. Brown. Final rept. 1964, 7p. (AFOSR-64-1419) (AF AFOSR-63-80) AD 444507 Unclassified

Part I of this report summarizes the results of studies on the photolysis products of phenyl cycloalkyl ketones and presents some conclusions with regard to geometrical factors in Type II photolysis reactions. Part II deals with an expression of cyclopropyl hydrogen lability with allylic activation as measured by the base-catalyzed interconversion of cis- and trans-2, 3- dimethyl-1-methylenecyclopropane. (Contractor's abstract)

502

Chicago U. [Dept. of Mathematics] Ill.

ON THE PRINCIPLE OF THE EXCHANGE OF STABILITIES. I. THE ROCHE ELLIPSOIDS, by N. R. Lebovitz. [1963] [4]p. (AFOSR-65-1003) (AF AFOSR-62-136) AD 619113 Unclassified

Also published in Astrophys. Jour., v. 128: 1214-1217, Nov. 15, 1963.

The principle of the exchange of stabilities is discussed in the context of the Roche ellipsoids. The stability equations for the Roche ellipsoids are given, and it is shown that the vanishing of a characteristic frequency does not imply that the corresponding normal mode is stationary; nor does a stationary normal mode necessarily imply the occurrence of a point of bifurcation. It is concluded that despite the vanishing of a characteristic frequency at the onset of instability, there is no exchange of stabilities. (Contractor's abstract)

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Chicago U. [Dept. of Mathematics] Ill.

AN ELEMENTARY THEORY OF THE CATEGORY OF SETS, by F. W. Lawvere. [1964] 6p. (AFOSR-66-0033) (AF AFOSR-64-520) AD 641629 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 52: 1506-1511, Dec. 1964.

The author adjoins eight-first-order axioms to the usual first-order theory of an abstract Eilenberg-Mac Lane category to obtain an elementary theory with the following properties. (a) There is essentially only one category which satisfies these eight axioms together with the

additional (nonelementary) axiom of completeness, namely, the category $\mathcal{S}$ of sets and mappings. This theory distinguishes $\mathcal{S}$ structurally from other complete categories, such as those of topological spaces, groups, rings, partially ordered sets, etc. (b) The theory provides a foundation for number theory, analysis, and much of algebra and topology even though no relation ϵ with the traditional properties can be defined. The authors seems to have partially demonstrated that even in foundation, not substance but invariant form is the carrier of the relevant mathematical information.

504

Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

ABSORPTION OF Σ^- HYPERONS IN PHOTOGRAPHIC EMULSION NUCLEI, by B. Anderson, O. Skjeggestad, and D. H. Davis. [1963] [4]p. incl. diagrs. refs. (AFOSR-65-0463) (AF 49(638)209) AD 614213 Unclassified

Also published in Phys. Rev., v. 132: 2281-2284, Dec. 1, 1963.

396 Σ^- capture stars in nuclear emulsion have been analyzed. The new data have been combined with 231 similar events previously reported. The rate of hyperfragment emission from Σ^- stars is $(2.7^{+0.5}_{-0.4})\%$. Both this rate and an estimate of the frequency of cryptofragment formation are compared with the analogous quantities pertinent to K^- absorptions at rest. Evidence is presented that hyperfragments predominantly originate from Σ^- absorptions in the light elements of the emulsion, while cryptofragments are formed following Σ^- absorption in heavy nuclei.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A DETERMINATION OF THE SPIN OF $_{\Lambda}Li^8$, by D. H. Davis, R. Levi Setti, and M. Raymund. [1963] [5]p. incl. diagrs. table, refs. (AFOSR-65-0464) (AF 49(638)209) AD 614187 Unclassified

Also published in Nuclear Phys., v. 41: 73-77, 1963.

Forty-three events representing the decay $_{\Lambda}Li^8 \rightarrow \pi^- He^4 He^4$ have been collected. Evidence is presented which shows that this decay proceeds almost exclusively through states of Be^8. The predominance of the 2.9 mev 2 Be^8 level together with the angular distribution of the decay products for events involving this level suggest that the spin of $_{\Lambda}Li^8$ is 1. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

HYPERFRAGMENT PRODUCTION BY 4.5 GEV/c π^- MESON INTERACTIONS IN EMULSION NUCLEI. A REAPPRAISAL, by J. Zakrzewski, D. H. Davis, and O. Skjeggestad. [1963] [8]p. incl. diagrs. refs. (AFOSR-65-0836) (AF 49(638)209) AD 617872 Unclassified

Also published in Nuovo Cimento, Series X, v. 27: 652-659, Feb. 1, 1963.

The hyperfragment production by fast π^- meson interactions is shown to be well explained by the model of Jones et al (Phys. Rev., v. 127: 236, 1962). The short range hyperfragments are shown to be predominantly very heavy and not light as had been supposed. The conclusions of other investigators are examined with recourse to this fact. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

BINDING ENERGY OF Λ^0 HYPERONS IN HEAVY HYPERNUCLEI ($60 < A < 100$), by D. H. Davis, R. Levi-Setti and others. [1962] [3]p. incl. diagrs. table. (AFOSR-65-0837) (AF 49(638)209) AD 617044 Unclassified

Also published in Phys. Rev. Ltrs., v. 9: 464-466, Dec. 1, 1962.

In this note the binding energy of Λ^0 hyperons in heavy hypernuclei is studied. Measurements were made of 470 nonmesonic disintegrations of spallation fragments resulting from 2 Ilford K5 emulsion stacks exposed to a 800- mev/c K^--meson beam. The total visible energy histogram is given, and the upper limit of B_{Λ} is calculated as 35 mev. The details of five π-mesonic decays of similar hypernuclei are given, and it is noticed that the total visible energy release is much smaller than that usually associated with the mesonic decays of light hyperfragments. Results indicate that the upper limit of B_{Λ} may be set at 25 mev. A B_{Λ} vs $A_{core}^{-2/3}$ plot is given, and it is seen that the value for the Λ-nucleus potential well depth cannot much exceed 30 mev.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

RECENT INVESTIGATIONS OF THE LOW ENERGY COSMIC AND SOLAR PARTICLE RADIATIONS, by J. A. Simpson. 1963, 30p. (AF 49(638)1008) AD 434654 Unclassified

Also published in Pontificiae Acad. Scientiarum Scripta Varia, v. 25: 323-352, 1963.

The first part of this paper is a preliminary study of changes in intensity and spectrum of the solar modulated cosmic radiation over a solar activity cycle. Neutron intensity monitors responsive to changes in primary particle magnetic rigidity as low as approximately GV have been analyzed for the period 1952-1962. It appears that the experimental results are to be explained by the growth and decay of a modulation electrodynamical region bounding a large volume of interplanetary

space. The nonlinear growth and decay are functions of both solar activity and particle magnetic rigidity. The second part is a report on recent experiments to study the origin of 8°-35° mev primary protons shown to be continuously present during years near maximum solar activity. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

MAGNETOSPHERIC CUTOFF FOR 1.5-MEV EXTRATERRESTRIAL PROTONS, by C. Y. Fan, J. A. Simpson, and E. C. Stone. [1964] 3p. (AFOSR-64-1148) (AF AFOSR-62-23) AD 442831 Unclassifted

Also published in Phys. Rev. Ltrs., v. 12: 269-271, Mar. 16, 1964.

A study over the geomagnetic polar regions of the arrival of extraterrestrial low-energy protons during a period of low geomagnetic activity is important both for a physical description of the distant magnetosphere and for understanding the ionization of the upper atmosphere over the polar regions by solar flare protons. Investigations below about 20 mev have been possible only recently with detectors on polar orbiting satellites. Results are reported from an oriented satellite whose orbit passed over the geomagnetic pole carrying detectors sensitive to 1.5-mev protons from both the vertical and horizontal directions and insensitive to electrons. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

SOLAR FLARE HIGH ENERGY ALPHA PARTICLES AND THEIR STORAGE IN INTERPLANETARY SPACE, by G. K. Yates. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-65-0468) (AF AFOSR-62-23) AD 614217 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3077-3095, Aug. 1, 1964.

The present paper reports the results of measurements of the relativistic α particles by a scintillation counter telescope and a Cerenkov counter flown by high altitude balloon late during the solar flare event of Nov. 12, 1960. It showed that the sun does produce relativistic α particles. These high energy results, when compared with the fluxes of 50 to 120 mev per nucleon α particles measured by others at the same time, show that the kinetic energy and magnetic rigidity spectrums of the solar α particles are in the form of power laws. Further, the time variations in the solar α-particle flux observed here suggest an interesting model for the propagation and storage of solar accelerated particles in this event. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

LOCAL TIME DEPENDENCE OF NON-STÖRMER CUTOFF FOR 1.5-MEV PROTONS IN QUIET GEOMAGNETIC FIELD, by E. C. Stone. [1964] [6]p. incl. diagrs. table. (AFOSR-65-0469) (AF AFOSR-62-23) AD 613824 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3577-3582, Sept. 1, 1964

Two solid state detector telescopes, vertically and horizontally oriented, were launched into a polar orbit during a time of low geomagnetic activity. A small flux of 1.5-mev protons, interacting with the geomagnetic field as individual particles, was observed at all latitudes above a characteristic cutoff latitude. The observed vertical cutoff was 65° on the night side and 67° on the day side, as compared with a theoretical Störmer cutoff at 76°. The local time dependence was also apparent in the cutoff transition width characterized by the difference in the latitude at which the flux is first detectable and the latitude at which the maximum flux is first observed. On the night side, the transition width was about 1°, on the day side it was about 3° and variable. The horizontal cutoff latitudes were similar. Essentially identical results were obtained over north and south poles. These results are not adequately predicted by currently postulated cutoff theories and should be considered in the calculation of proton fluxes associated with polar-cap absorption. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

A MEASUREMENT OF THE PRIMARY PROTON FLUX FROM 10 TO 130 MILLION ELECTRON VOLTS, by E. C. Stone. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0470) (AF AFOSR-62-23) AD 613825 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3939-3945, Oct. 1, 1964.

A counter telescope, composed of 9 AuSi solid-state detectors for measuring the energy loss and range of vertically incident particles, was carried into a polar orbit by an oriented satellite on Dec. 12, 1961. The choice of detectors and absorbers allowed separation of protons and α particles with energies between 10 and 250 mev/nucleon. Although the quantity of data was limited by the failure of the vehicle transmitter, both the observed 85- to 130-mev proton flux and the α-particle flux are consistent with other 1961 observations. In addition, a proton flux of ~ 1 m^{-2} sec^{-1} $ster^{-1}$ mev^{-1} was measured in the energy range 10-85 mev, indicating that the quiet time spectrum was much "flatter" than the E^{-2} spectrum that others have observed at higher energies.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

SOME POSSIBILITIES FOR UNUSUAL LIGHT HYPERNUCLEI, by R. H. Dalitz and R. Levi-Setti. [1963] [13]p. incl. refs. (AFOSR-65-0471) (AF AFOSR-62-358) AD 614539 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 489-501, Oct. 16, 1963.

Some possibilities are considered concerning the stability, formation, and inentification of Λ-hypernuclei corresponding to core nuclei generally with $I \geq 3/2$ away from the stability valley. The identification of such hypernuclei may be rather informative concerning the existence and properties of such little-known nuclei. For neutron-rich species, e.g., ${}_{\Lambda}H^{6}$, ${}_{\Lambda}He^{8}$, the possible confusions of their major decay modes with and their separation from similar well-established modes of more abundant hypernuclei are discussed. The expectation that narrow resonance levels with lifetimes $\gtrsim 10^{-21}$s should exist for certain hypernuclear systems, e.g., the P-${}_{\Lambda}He^{4}$ system is also mentioned briefly since the production and observation of such resonance states could be achieved with existing techniques. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

THE BINDING ENERGY DIFFERENCE BETWEEN THE HYPERNUCLIDES ${}^{4}He_{\Lambda}$ AND ${}^{4}H_{\Lambda}$, by M. Raymund. [1964] [33]p. incl. diagrs. tables, refs. (AFOSR-65-0472) (AF AFOSR-62-358) AD 614740 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 555-587, May 1964.

Experimental and theoretical studies indicate a departure from charge symmetry for the mirror hypernuclides ${}_{\Lambda}He^{4}$ and ${}_{\Lambda}He^{4}$ amounting to a few tenths of a mev in the binding energies. A nuclear emulsion experiment utilizing 45 newly measured π-mesic decays of ${}_{\Lambda}He^{4}$ and ${}_{\Lambda}H^{4}$ is reported to give $\Delta_{\Lambda}B = {}_{\Lambda}B({}_{\Lambda}He^{4}) - {}_{\Lambda}B({}_{\Lambda}H^{4}) = (0.55 \pm 0.2\epsilon)$ mev. By additing events from the literature to this sample, a total of 214 π-mesic decays of these hypernuclides was obtained. This number proved sufficient to resolve the difficulties previously encountered in an experimental evaluation of $\Delta_{\Lambda}B$. Contamination by other hypernuclides, probably ${}_{\Lambda}He^{5}$ was eliminated from the ${}_{\Lambda}He^{4}$ sample by a strict recoil-range requirement $R_{rec} \geq 10\mu$m; on the other hand, no contaminants were found among the ${}_{\Lambda}H^{4}$ decays. The binding energy discrepancy between the πr and π pr decays of ${}_{\Lambda}H^{4}$ was found to be due to pion range measurement losses which are important mainly for the πr events $R_{\pi} \sim 4$ cm. The final value of $\Delta_{\Lambda}B$ for the latter sample is 0.30 ± 0.14 mev. Because a negative term in the theoretical calculation of $\Delta_{\Lambda}B$ is expected from a Coulomb energy increase in the He^{3} core of ${}_{\Lambda}He^{4}$, this positive experimental result is a strong indication of charge-symmetry violation in the ${}_{\Lambda}N$ interaction compatible with estimates of the virtual electromagnetic effects in $\Lambda \rightarrow \Lambda + \pi^{0}$ suggested by theoretical workers. (Contractor's abstract)

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

DISCUSSION OF PAPER BY E. J. STEGELMANN AND C. H. VON KENSCHITZKI, "ON THE INTERPRETATION OF THE SUDDEN COMMENCEMENT OF GEOMAGNETIC STORMS," by E. N. Parker and A. J. Dessler. [1964] [4]p. (AFOSR-65-0509) (AF AFOSR-64-521) AD 614168 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3745-3748, Sept. 1, 1964.

Stegelmann and von Kenschitzki state that rays computed from Fermat's principle cannot be taken literally for waves with periods above about 1 sec, because the wavelengths for these waves are larger than the distance over which the propagation velocity changes appreciably in the region of maximum hydromagnetic velocity. On the basis of ray tracing, only a small region at the subsolar point contributes to the initial rise of the sudden commencement, owing to the enormous refraction that takes place as the ray approaches the hydromagnetic velocity maximum. It clearly contradicts the general principle that the pressure on the entire boundary contributes to the compression; nevertheless it is suggested that a consideration of propagation time of hydromagnetic disturbances can lead to an understanding of phenomena like delay times and earlier arrival of sudden commencements at medium and high latitudes, and even a rough understanding of rise times. Parker and Dessler support this theory and conclude that the major part of the rise time of the sudden commencement at any point on the surface of the earth can be estimated from the hydromagnetic propagation times. But ray tracing breaks down, and more powerful methods must be employed to advance beyond the present state of approximate estimates.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

PRODUCTION OF HYPERFRAGMENTS BY THE INTERACTIONS OF 1.5 GEV/c K^{-} MESONS IN LITHIUM-LOADED EMULSIONS, by M. J. Beniston, R. Levi-Setti and others. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0510) (AF AFOSR-64-556) AD 613883 Unclassified

Also published in Phys. Rev., v. 134: B641-B648, May 11, 1964.

Hyperfragment production by some 31,000 interactions of 1.5 gev/c K^{-} mesons in Li-loaded K5 nuclear emulsions has been studied and compared with data from 0.8-gev/c and existing data from 1.5-gev/c K^{-} interactions in normal emulsions. The study of the prong number distributions of the hyperfragment parent stars

provides a sensitive method for determining the production rates of hyperfragments by K^- interactions with light C, N and O and heavy Ag and Br emulsion nuclei; these production rates are found to be $0.66 \pm 0.11\%$ and $5.20 \pm 0.20\%$, respectively. An appreciable proportion of mesonic hyperfragments $Z < 6$ and Li fragments have very short ranges $R_{HF} \leq 10\ \mu$; this fact indicates the possibility of contaminations of "light" hypernuclides among the assumed mesic spallation hyperfragments. The predominant part of the hyperfragment production stars which shows the emission of "short" prongs involves the disintegration of heavy nuclei, thus indicating that Coulomb-barrier criteria cannot be used in discriminating among light or heavy hyperfragment parent stars at high K^- momenta. No double hyperfragment was observed. One K^- interaction emitted 2 hyperfragments decaying nonmesically. The π^+ decay of a ${}_{\Lambda}He^4$ hyperfragment has been found. An estimate of the branching ratio R of the π^+ decay and π^- decay modes for the ${}_{\Lambda}He^4$ hypernucleus gives $R \leq 2.7 \pm 1.1\%$.

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Chicago U. Enrico Fermi Inst. for Nuclear Studies, Ill.

POSSIBLE EXISTENCE OF A p-He^3 RESONANCE WITH Q = 11 MEV PRODUCED IN ${}_{\Lambda}He^4$ DECAY, by M. J. Beniston, B. Krishnamurthy and others. [1964] 3p. incl. diagr. table, refs. (AFOSR-65-0827) (AF AFOSR 64-556) AD 629853 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 553-555, Nov. 2, 1964.

An effect in the π (= energy histogram from ${}_{\Lambda}He^4$ decays in nuclear emulsions has been observed, and is best interpreted as evidence for an excited state of Li^4 (10.62 ± 0.20) mev above decay to proton and He^3. The width observed is (0.23 ± 0.20) mev, which agrees with the pion energy resolution (about 0.40 mev) in nuclear emulsions only if the upper limit (0.43 mev) is taken. The narrow resonance width at this excitation energy could be understood in terms of an I = 2 state of Li^4 whose p-He^3 decay would be forbidden by isospin conservation. (Contractor's abstract)

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Chicago U. [Inst. for the Study of Metals] Ill.

PROPERTIES OF SOLUTIONS OF METALS IN MOLTEN SALTS, by N. H. Nachtrieb. Final technical rept. Jan. 26, 1964, 42p. incl. illus. diagrs. tables, refs. (AFOSR-64-0295) (AF 49(638)1076) AD 434538 Unclassified

Research into the properties of molten salts followed five lines of investigation: (1) nuclear magnetic resonance, (2) electrical conductance, (3) surface tension, (4) magnetic susceptibility, and (5) absorption spectra. Progress in each is summarized. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

PROBES FOR HIGH TEMPERATURE NUCLEAR MAGNETIC RESONANCE, by S. Hafner and N. H. Nachtrieb. [1964] 3p. (AFOSR-64-1549) (AF 49(638)1076) AD 446129 Unclassified

Also published in Rev. Scient. Instr., v. 35: 680-682, June 1964.

Two designs are described for single coil NMR probes and furnaces with the Varian wide line spectrometer (V-4210) to temperatures up to 1000°C. Their application to molten salt systems is outlined. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

NUCLEAR MAGNETIC RESONANCE IN MOLTEN SALTS. I. CHEMICAL SHIFT OF CRYSTALLINE AND MOLTEN THALLIUM SALTS, by S. Hafner and N. H. Nachtrieb. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1550) (AF 49(638)1076) AD 446111 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2891-2898, May 15, 1964.

Relatively large chemical shifts in the resonance frequency of the thallium nucleus are observed in both the crystalline and molten states of different thallium salts. Relative to $TlNO_3$, which appears to be the most ionic of all thallium salts studied, the Tl^{205} resonance frequency at fixed field increases in the order: $NO_3 < Cl^- < Br^- < I^-$. The results are interpreted in terms of a second-order paramagnetic contribution to the field at the Tl nucleus arising from an admixture of its excited states with the ground state, and the chemical shift is approximately proportional to the square of the overlap integral. Although cations and anions in the melts are partly associated, the NMR shifts of the Tl nucleus show that the cause arises from incipient covalency rather than polarization of the cation by the halide ions. In both the crystalline and molten states, a linear paramagnetic shift with temperature is observed, which is attributed to the enhanced overlap of excited states which are induced by thermal vibrations. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

PERTURBATION THEORY OF THE HEATS OF MIXING OF FUSED SALTS, by H. T. Davis and S. A. Rice. [1964] [11]p. (AFOSR-64-2182) (AF AFOSR-61-52) AD 452035 Unclassified

Also published in Jour. Chem. Phys., v. 41: 14-24, July 1, 1964.

A theory of the thermodynamic properties of molten salts including the effects of short-range attractive interactions has been developed. The analysis builds upon the work of Reiss, Katz, and Kleppa who showed that many of the thermodynamic properties of molten salt mixtures could be understood in terms of a model ionic melt consisting of rigid impenetrable ions interacting with a long-range Coulomb potential. The RKK theory is inadequate for the description of recent experimental measurements of the heats of mixing salts whose short-range attractive interactions are expected to be significant. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

POLARIZATION CONDUCTIVITY IN P-TYPE GERMANIUM, by S. Golin. [1963] 11p. (AFOSR-64-0429) (AF AFOSR-62-178) AD 436282 Unclassified

Also published in Phys. Rev., v. 132: 178-188, Oct. 1, 1963.

The ac conductivity of p-type Ge was measured over the frequency range of 102 to 105 cps and in the impurity conduction temperature range of 1.2° to 4.2°K. Doping by transmutation insured a constant donor to acceptor concentration ratio of 0.4. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

TEMPERATURE DEPENDENCE OF THE ULTRASONIC ATTENUATION IN GERMANIUM, by B. I. Miller. [1963] [7]p. (AFOSR-64-1237) (AF AFOSR-62-178) AD 442352 Unclassified

Also published in Phys. Rev., v. 132: 2477-2483, Dec. 15, 1963.

The ultrasonic attenuation in germanium has been measured as a function of temperature from 300 to 20°K and at frequencies of 4 to 132 mc/sec. The measurements were made using the pulse-echo technique with longitudinal sound pulses along the octahedral direction.

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Chicago U. Inst. for the Study of Metals, Ill.

SELF-DIFFUSION OF LIQUID ZINC, by N. H. Nachtrieb, E. Fraga, and C. Wahl. [1963] [3]p. incl. diagr. tables. (AFOSR-64-0440) (AF AFOSR-62-231) AD 435654 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2353-2355, Nov. 1963.

Self-diffusion in liquid zinc has been measured by the open capillary technique over the temperature range 450 to 600°. The results are described by the equation $D_{Zn} = 8.2 \times 10^{-4} \exp(-5090/RT)$. Satisfactory agreement with the Cohen-Turnbull free volume theory is found, and the diffusing particle appears to be the Zn^{+2} ion. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

HALL COEFFICIENTS OF LIQUID METALS, by A. J. Greenfield. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0177) (AF AFOSR-63-148) AD 456558 Unclassified

Also published in Phys. Rev., v. 135: A1589-A1595, Sept. 14, 1964.

The Hall coefficients R of 9 liquid metals were accurately measured using an alternating-current-alternating-magnetic-field method. Four of these metals have $R = R_0 \equiv 1/nec$, which is the value predicted by the free-electron model of liquid metals. The Hall coefficients of these metals, in units of 10^{-5} cm^3/C, are Hg, -7.6; Cd, -7.2; Zn, -5.2; and Sn, -4.4. The other 5 metals were found to have $R/R_0 < 1$, with Ga, -3.83; In, -5.3; Tl, -4.8; Pb, -3.7; and Bi, -3.0. The absolute experimental error for Ga is ± 2.5%. The experimental error for all other metals relative to Ga is approximately ± 1.5% except for Pb (± 12%). The free-electron model of liquid metals is discussed. The value of R/R_0 is compared with magnitude of the mean free path. Comparison is also made with the Hall coefficients of other allotropic forms of these metals.

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Chicago U. Inst. for the Study of Metals, Ill.

THEORIES AND MODELS OF ELECTRON BINDING IN SOLUTION, by J. Jortner, S. A. Rice, and E. G. Wilson. 1963, 55p. (AFOSR-64-1050) (AF AFOSR-63-369) AD 441496 Unclassified

Also published in Solutions Metal-Ammoniac Proprietes Physico-Chimiques, June 1963, p. 222-276.

The investigation of the bound and free states of electrons in liquids is of primary interest not only for the understanding of the properties of metal solutions, but also for the elucidation of the electronic structure of irregular systems. This article reviews the current theories of the electronic states of metal solutions and their relation to the properties of electrons in disordered media. The following systems are considered: Solutions of metals in polar solvents, Electrons in polar solvents, Metal-molten salt solutions, Excess electrons in nonpolar liquids. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XVI.

THE IDEAL IONIC MELT, by B. Berne and S. A. Rice. [1964] [16]p. (AFOSR-64-1525) (AF AFOSR-63-369)
AD 446400 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1347-1362, Mar. 1, 1964.

A theory is constructed to describe to first order the properties of a fused salt. The Rice-Allnatt theory of simple dense fluids is used in conjunction with the following assumptions: (1) oppositely charged ions are of nearly equal size and have identical electronic properties, except for the sign of the charge; (2) a negative ion is, on the average, surrounded by positive ions and vice versa; (3) short-range repulsive interactions occur only between pairs of oppositely charged ions; and (4) the role of the Coulomb potential makes an insignificant contribution to the direct dissipation of energy and momentum. These conditions are taken to define an ideal ionic melt, and integrodifferential equations for the singlet and pair distribution functions of this system are derived. From these there is obtained an expression for the ion mobility in a weak electric field. This expression predicts a deviation from the Nernst-Einstein relation. A recipe for calculating the thermal conductance and shear viscosity is outlined. Some comparisons of theory with experiment are made. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

PERTURBATION CALCULATIONS OF MIXED PAIR CORRELATION FUNCTIONS, by B. A. Lowry, H. T. Davis, and S. A. Rice. [1964] 5p. (AFOSR-64-1526) (AF AFOSR-63-369) AD 446401 Unclassified

Also published in Phys. Fluids, v. 7: 402-406, Mar. 1964.

A perturbation calculation of the change in pair correlation function (relative to some reference system) is presented for the case when the intermolecular pair potential is altered (relative to the same reference system). The analysis is developed in detail for the case of a very dilute solution of perturbing molecules in a host dense fluid, but the case of the pure fluid is also examined. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ROLE OF HARD-CORE COLLISIONS WITH LARGE ANGLE DEFLECTIONS IN THE KINETIC THEORY OF DENSE FLUIDS, by B. Berne and P. Gray. [1964] [8]p. (AFOSR-64-1527) (AF AFOSR-63-369)
AD 446347 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1582-1589, Mar. 15, 1964.

The validity of the Fokker-Planck equation is discussed within the framework of Kirkwood's time smoothing formalism. It is shown that the equation is equivalent to the Boltzmann equation for a dilute homogeneous system in which grazing binary collisions predominate. Using this as a mathematical prescription, the Rice-Allnatt equation is modified by replacing the Boltzmann collision integral by a Fokker-Planck operator, but leaving the excluded volume term unchanged. The kinetic and collisional transport coefficients derived from the modified equation are compared with those derived from the Chapman-Enskog equation, the Rice-Allnatt equation, and the Fokker-Planck equation. It is concluded that the role of the hard core collisions in the theory is to emphasize the importance of large angle deflections, which are not important in a dilute gas. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XV. SOME COMMENTS ON THE RICE-ALLNATT THEORY, by B. Berne and S. A. Rice. [1963] [11]p. incl. tables, refs. (AFOSR-64-1594) (AF AFOSR-63-369)
AD 446528 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1336-1346, Mar. 1, 1964.

In this paper, it is shown that, within the framework of the Rice-Allnatt theory of transport phenomena in simple dense fluids, the cross-correlation functions of the soft and hard forces are exactly zero. A relation is found between the soft doublet and soft singlet friction coefficients, and an approximate theory is developed for the soft components of the shear viscosity and the thermal conductivity. The main assumption in this approximation is that of small step diffusion. The soft doublet friction coefficient which is derived in the first part of the paper is then used to calculate values for the soft force contribution to the viscosity and thermal conductivity. It is shown that the equilibrium properties of simple liquids are not known with sufficient accuracy to allow a complete test of the R-A theory, but that the expressions in this theory seem to be moderately insensitive to the equilibrium properties used. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE KINETIC THEORY OF DENSE FLUIDS. XVII. THE SHEAR VISCOSITY, by B. A. Lowry, S. A. Rice, and P. Gray. [1964] [11]p. (AFOSR-64-2192) (AF AFOSR-63-369) AD 452355 Unclassified

Also published in Jour. Chem. Phys., v. 40: 3673-3683, June 15, 1964.

A theoretical study of the shear viscosity of dense fluids along with some measurements of the viscosity of liquid Ar is reported. It was found that the theory of Rice and Allnatt leads to predictions of the temperature dependence of the shear viscosity under conditions of constant volume in good agreement with experiment. Also, the magnitudes of the predicted shear viscosity

agreed very well at T = 128°K, p = 50 atm and moderately well at T = 90°K, p = 1.3 atm. The importance of obtaining accurate intermolecular pair potentials and pair correlation functions is discussed briefly. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

FORBIDDEN ELECTRONIC TRANSITIONS IN XeF_2 AND XeF_4, by E. S. Pysh, J. Jortner, and S. A. Rice. [1963] [15]p. (AFOSR-64-2193) (AF AFOSR-63-369) AD 452254 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2018-2032, Apr. 1, 1964.

Transition strengths have been measured for the weak 2330A band in XeF_2 (f = 0.002) and for the two weak bands in XeF_4 at 2280A (f = 0.009) and 2580A (f = 0.003). To investigate the origins of these weak transitions, the possibilities of vibronic and singlet-triplet transitions in XeF_2 and XeF_4 were examined. Using the Herzberg-Teller theory of vibronic transitions and a molecular orbital treatment of excited electronic states, estimated strengths of the relevant vibronic transitions have been calculated to the f = 0.001 for both XeF_2 and XeF_4. The vibronic band in XeF_2 borrows intensity from the symmetry allowed transition at 1580A (f = 0.45), while in XeF_4 the major contribution to the vibronic band is from the symmetry allowed transition at 1325A (f = 0.8). A temperature dependence of the intensity of the 2330A band in XeF_2 has been observed and found to be less than that predicted by the Herzberg-Teller theory. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

TRIPLET EXCITON BANDS IN AROMATIC CRYSTALS, by J. Katz, J. Jortner and others. [1963] [3]p. (AFOSR-64-2195) (AF AFOSR-63-369) AD 452362 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1897-1899, Oct. 1, 1963.

The purpose of this letter is to present a computation of the factor-group splittings for triplet exciton states in molecular crystals of naphthalene, anthracene, and several polyphenyls. The factor-group splittings are not as small as previously assumed, and are amenable to experimental observation. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE CALCULATION OF THE MOLECULAR FRICTION CONSTANT, by P. Gray and S. A. Rice. [1964] [2]p. (AFOSR-64-2196) (AF AFOSR-63-369) AD 452363 Unclassified

Also published in Jour. Chem. Phys., v. 40. 3671-3672, June 15, 1964.

The use of isotope-separation data to obtain experimental values of the mean-square force acting on a molecule in a liquid and the implications of this data for the theory of self-diffusion are discussed. (Contractor's abstract)

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Chicago U. Inst. for the Study of Metals, Ill.

ON THE EXCESS ELECTRON AND HOLE BAND STRUCTURES AND CARRIER MOBILITY IN NAPHTHALENE, ANTHRACENE, AND SEVERAL POLYPHENYLS, by J. I. Katz, S. A. Rice and others. [1963] [15]p. (AFOSR-64-2197) (AF AFOSR-63-369) AD 452387 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1683-1697, Oct. 1, 1963.

The excess electron and hole band structures of napthalene, anthracene, and several polyphenyls have been calculated in the tight binding approximation. In addition the anisotropy and the pressure dependence of the mobility tensor has been calculated in the constant-free-time and the constant-free-path approximations. The molecular wavefunctions were represented in the LCAO approximation using Huckel coefficients with the carbon atomic orbitals represented by the best available Hartree-Fock SCF carbon 2p ground-state function involving a linear combination of four Slater-type functions. By this choice of atomic orbitals, we hope to account properly for the behavior of the wave-function at the large internuclear distances relevant to this problem. (Contractor's abstract)

536

Chicago U. Inst. for the Study of Metals, Ill.

SOLVENT EFFECTS AND A TEST OF THE THEORY OF HYPOCHROMISM, by M. T. Vala, Jr. and S. A. Rice. [1963] [6]p. (AFOSR-64-2198) (AF AFOSR-63-369) AD 452364 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2348-2353, Nov. 1, 1963.

The hypochromism of the 2600A absorption band of isotactic polystyrene (relative to atactic polystyrene) was examined. There are important solvent effects which modify the magnitude of the hypochromism. The theory of Tinoco and Rhodes does not include explicit solvent interactions and cannot account for all our experiments. For the case of chloroform as solvent, the theory is in (fortuitous) agreement with experiment if calculations are performed carefully and convergence is established (± 10 rings for 2% residual). If the influence of the solvent may be neglected in this case, it may be concluded that the results obtained are consistent with the retention of local structure when isotactic polystyrene passes from the crystalline phase into solution. (Contractor's abstract)

537

Chicago U. Inst. for the Study of Metals, Ill.

GUEST-HOST INTERACTIONS: AN EXAMINATION OF THE SOLVENT-INDUCED SPECTRAL SHIFT IN A MODEL SYSTEM, by H. Y. Sun, S. A. Rice, and J. Jortner. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0539) (AF AFOSR-63-369) AD 614269 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3779-3786, Dec. 15, 1964.

The effect of a surrounding lattice of He atoms on the manifold of electronic states of the H_2^+ molecule ion is studied. One-center expansions of the molecular wavefunctions are employed, calculated by the Tibbs-Wannier method. The spherically averaged wavefunctions are in good agreement with the known exact solutions. A detailed study of the environmental effect of the He lattice leads to the prediction of a blue shift of the first electronic transition, arising from a delicate balance between changes in the impurity excitation energy, Coulomb, exchange, van der Waals, and 3-center interaction terms. The signs of the various energy changes are rationalized in terms of the overlap charge density. These results are compared with previous treatments of environmental spectral shifts based on continuum models. (Contractor's abstract)

538

Cincinnati U. [Dept. of Chemistry] Ohio.

THE ENERGETICS OF THE COMBINATION OF A PROTON AND HYDRIDE ION, by R. E. Dessy. Final rept. Sept. 1, 1963-Sept. 30, 1964, 11p. incl. diagr. tables. (AFOSR-65-0245) (AF AFOSR-63-417) AD 611152 Unclassified

The rate of addition of the 'Bumgbr' Grignard reagent to benzonitrile was found to be greatly accelerated by the addition of $LiClO_4$ or $(C_4H_9)_4NClO_4$. An investigation of the reaction mechanism leads to the suggestion that the phenomena represents an example of the activation of organometallic compounds by the presence of 'inert salts'. Studies in the area of carbanion stabilities are briefly summarized.

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City U. of New York. Queens Coll., Flushing, N. Y.

THE ADDITION OF KETONES TO SCHIFF BASES, by A. H. Blatt and N. Gross. [1964] 6p. incl. tables. (AFOSR-65-0005) (AF 49(638)796) AD 455942 Unclassified

Also published in Jour. Org. Chem., v. 29: 3306-3311, Nov. 1964.

The uncatalyzed addition of ketones to Schiff bases reported in the literature could not be repeated. The addition of a number of ketones to Schiff bases can be brought about by small amounts of hydrochloric acid but the reaction is of limited applicability. Probable reasons are given for the limited scope of the addition reaction, some inaccuracies in the earlier literature are corrected, and a brief description of the chemistry of the adducts is presented. (Contractor's abstract)

540

[Clemson U. Dept. of Physics, S. C.]

THE EFFECT OF ELASTIC STRAIN ON THE GALVANOMAGNETIC PROPERTIES OF SEVERAL METALS, by E. P. Stilwell, Jr. and M. J. Skove. Final rept. [1965] [1]p. (AFOSR-65-0561) (AF AFOSR-63-180) Unclassified

A list is presented of the work accomplished, the publications which have resulted, and the graduate students who have received training under this grant. The titles of the 3 publications are: (1) Elastic Strength of Tin Whiskers in Tensile Tests; (2) Evidence for Specular Reflection in Zinc and Cadmium Whiskers; and (3) The Effect of Elastic Strain on the Electrical Resistance of Copper and Zinc at 4.2°K.

541

Colorado State U. [Dept. of Mathematics and Statistics] Fort Collins.

SAMPLE SIZE REQUIRED TO ESTIMATE THE PARAMETER IN THE UNIFORM DENSITY WITHIN d UNITS OF THE TRUE VALUE, by F. A. Graybill and T. L. Connell. [1964] [7]p. incl. tables. (AFOSR-64-1639) (AF AFOSR-63-469) AD 446876 Unclassified

Also published in Jour. Amer. Stat. Assoc., v. 59: 550-556, June 1964.

A two-step procedure is given to find the sample size necessary to estimate the parameter θ in the uniform density within d units of the true value. It is demonstrated that an exact solution for all values of θ does not exist based on the maximum likelihood estimator.

542

Colorado U. [Dept. of Chemistry] Boulder.

BRIDGED POLYCYCLIC COMPOUNDS. XXVI. THE SOLVOLYSIS OF SOME 4-CHLORODIBENZO-BICYCLO 3.2.1 OCTADIENES, by S. J. Cristol and D. D. Tanner. [1964] [5]p. (AFOSR-64-1796) (AF AFOSR-62-79) AD 449065 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3122-3126, Aug. 5, 1964.

The solvolyses of exo- (II) and endo-4-syn-8-dichlorodibenzobicyclo octadiene and of exo-4-chlorodibenzobicyclo octadiene (V) have been studied. Acetolysis of III and V proceeds with good first-order kinetics to give the exo-acetate IV and its dichloro analog, respectively. The acetolysis of II to IV is accompanied by

epimerization to III, involving ion-pair intermediates. Solvolysis of II in pivalic acid gives the endo-pivalate. Various carbonium ions are considered as intermediates, and it is concluded that a classical benzylic carbonium ion can accommodate the results.

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Colorado U. Dept. of Chemistry, Boulder.

RELATIVE STABILITIES OF WEAK HYDROGEN BONDS TO NITROGEN, by P. J. Berkeley, Jr. and M. W. Hanna. [1964] [6]p. incl. diagrs. moles, refs. (AFOSR-65-0015) (AF AFOSR-63-216) AD 455824 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2530-2535, Oct. 15, 1964.

A semiclassical picture has been proposed to account for the stabilization of the weak hydrogen bonds formed between chloroform and nitrogen bases as the chloroform proton approaches the base, the H-C bond dipole interacts with the electric field produced by the electrical asymmetry of the base resulting in a reduction in the energy of the system. However, this approach is stopped when the exclusion forces become large in the vicinity of the sum of the van der Waals radii of hydrogen plus nitrogen. The electric field also causes polarization of the H-C bonding electrons toward the carbon atom, resulting in some further stabilization and in the reduction in the screening constant of the proton. It would be dangerous, of course, to extrapolate this point of view to shorter hydrogen bonds.

544

Colorado U. [Dept. of Physics] Boulder.

MAGNETIC RESONANCE OF Mn^{2+} DOPED LiF CRYSTALS, by T. T. Chang, W. H. Tanttila, and J. S. Wells. [1963] 4p. (AFOSR-65-0171) (AF AFOSR-62-345) AD 456593 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2453-2456, Nov. 1963.

The electron paramagnetic resonance of Mn^{2+} in powdered LiF was observed at x-band and room temperatures for various impurity concentrations. The highest concentration was examined at K-band and low temperatures to obtain additional information regarding the distribution of Mn^{2+} ions which were introduced chemically into the lattice in small amounts. In the highest concentration, the K-band spectra indicate that part of the Mn^{2+} goes into the powder in the form of clusters of Mn and F which are antiferromagnetic at helium temperatures. NMR linewidth measurements on the lithium nuclei at low temperatures are qualitatively explained by the antiferromagnetism. Comparisons between K-band spectra from chemically prepared powdered samples and single crystals grown from the melt indicate that the melt method is unsuitable for obtaining the solid solution required to examine the superhyperfine spectra.

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Colorado U. Dept. of Physics, Boulder.

BEHAVIOR OF THE SCATTERING AMPLITUDE FOR LARGE ANGULAR MOMENTUM, by A. O. Barut and J. Dilley. [1963] [8]p. incl. refs. (AFOSR-64-0540) (AF AFOSR-63-30) AD 442846 Unclassified

Also published in Jour. Math. Phys., v. 4: 1401-1408, Nov. 1963.

Langer's theory on the asymptotic behavior of the solution of differential equations is applied to angular momentum, giving stronger results than were possible hitherto by Born approximation.

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Colorado U. [Dept. of Physics] Boulder.

A SYMMETRY GROUP CONTAINING BOTH THE LORENTZ GROUP AND SU3, by A. O. Barut. Jan. 14, 1964, 3p. (AFOSR-64-1765) (AF AFOSR-63-30) AD 449081 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 2[illegible]-236, Apr. 10, 1964.

The purpose of this note is to present a group which contains the Lorentz group and accounts for other quantum numbers of strong interactions.

547

Colorado U. [Dept. of Physics] Boulder.

NUCLEON AND THE PION-NUCLEON TRAJECTORY DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT, by A. O. Barut and J. Dilley. Nov. 14, 1963, 4p. (AFOSR-64-1766) (AF AFOSR-63-30) AD 449079 Unclassified

Also published in Phys. Rev., v. 134: B873-B876, May 25, 1964.

The low-energy p-wave pion-nucleon scattering amplitude is represented by a single Regge pole in the direct channel with correct analytical properties. The three parameters of the trajectory at threshold have been determined.

548

Colorado U. Dept. of Physics, Boulder.

ON THE COUPLING CONSTANTS OF MASSLESS PARTICLES, by A. O. Barut. [1964] [2]p. (AFOSR-65-0473) (AF AFOSR-63-30) AD 613817 Unclassified

Also published in Phys. Ltrs., v. 10: 356-357, June 15, 1964.

The restrictions imposed on the most general form of

the form factors for massless particle coupling, which in the limit go over to the coupling constants, are given and the universality of the form factors is shown. Only invariance under the proper inhomogeneous Lorentz group is used.

549

Colorado U. Dept. of Physics, Boulder.

CONNECTION BETWEEN THE RELATIVISTIC AND NONRELATIVISTIC FORM OF THE NUCLEON-NUCLEON AMPLITUDE, by A. O. Barut and M. Samiullah. [1964] [3]p. (AFOSR-65-0474) (AF AFOSR-63-30) AD 613816 Unclassified

Also published in Phys. Rev., v. 135: B1356-B1358, Sept. 21, 1964.

The connection between the nonrelativistic and the relativistic amplitudes of the nucleon-nucleon scattering is obtained using a 2 component form of the latter. This connection involves simple functions of E and cosθ. It is then possible to translate the analysis of scattering and polarization experiments in terms of 1 set of amplitudes into the other.

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Colorado U. Dept. of Physics, Boulder.

DYNAMICAL SYMMETRY GROUP BASED ON DIRAC EQUATION AND ITS GENERALIZATION TO ELEMENTARY PARTICLES, by A. O. Barut. [1964] [4]p. incl. refs. (AFOSR-65-0475) (AF AFOSR-63-30) AD 614873 Unclassified

Also published in Phys. Rev., v. 135: B839-B842, Aug. 10, 1964.

The dynamical or exact symmetry group of the nonrelativistic Kepler problem, a symmetry group in four dimensions, is generalized to the Dirac equation and further to elementary particles. The former is a 10-parameter group of rank 2 isomorphic to a group in 5 dimensions, the latter a 16-parameter group of rank 4 isomorphic to a group in 6 dimensions. Both groups contain the real Lorentz group and couple the space-time quantum numbers with the internal quantum numbers. The 16-parameter group has a 15-parameter simple subgroup and contains 2 three-dimensional rotation groups, one for ordinary spin and one for isotopic spin. The concept of inhomogeneous dynamical group is introduced. The inhomogeneous group contains 2 new additive quantum numbers to describe the hypercharge and the baryon number and leads to a mass spectrum. The third component of isospin and the new additive quantum numbers commute with all the 6 generators of the Lorentz group. A further generalization leads to a group where all 3 isospin generators commute with the Lorentz group.

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Colorado U. Dept. of Physics, Boulder.

A NOTE ON THE SIGNATURES OF THE DOMINANT REGGE TRAJECTORIES, by Y.-C. Leung. [1964] [8]p. incl. diagr. refs. (AFOSR-65-0476) (AF AFOSR-63-30) AD 614537 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 865-872, Aug. 1, 1964.

By the requirements of the unitarity condition and the positive definiteness of the imaginary parts of the forward amplitudes, it has been shown that the dominant Regge trajectories of amplitudes that contribute to forward scattering passing through integer values of angular momenta in the interval $0 \leq t < 4\mu^2$, where t is the square of the momentum transfer and $4\mu^2$ is the square of the mass of the lowest intermediate state in the t-channel, must have definite signatures. The result is derived for amplitudes satisfying the Mandelstam representation.

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Colorado U. Dept. of Physics, Boulder.

SECONDARY DIFFRACTION PEAKS IN π N AND K-N SCATTERINGS, by A. O. Barut and W. S. Au. [1964] [3]p. incl. diagr. refs. (AFOSR-65-0477) (AF AFOSR-63-30) AD 613818 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 489-491, Oct. 12, 1964.

It is shown that the secondary peaks observed in π-N and K-N scatterings can be explained remarkably well, using even a very small spin-flip amplitude. By using more than one partial wave, even the wiggly structure on the secondary peaks can be explained.

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Colorado U. Dept. of Physics, Boulder.

I = 0 PION-PION AMPLITUDE AND σ DI-PION, by A. O. Barut and W. S. Au. [1964] [3]p. incl. diagrs. table, refs. (AFOSR-65-0815) (AF AFOSR-63-30) AD 616216 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 165-167, Aug. 3, 1964.

This note shown that the assumed existence of the ABC enhancement, the s-wave particle, together with the σ di-pion, s-wave resonance at around 400 mev, and unitarity implies that the whole I = 0 pion-pion amplitude is almost exactly known up to over 400 mev. The whole amplitude represents an entirely s-wave continuour virtual particle, and therefore the entire trajectory can be used whenever the I = 0, 2π system is exchanged.

554

Colorado U. Dept. of Physics, Boulder.

COMPLEX LORENTZ GROUP WITH A REAL METRIC: GROUP STRUCTURE, by A. O. Barut. [1964] [5]p. incl. diagr. tables, refs. (AFOSR-66-0459) (AF AFOSR-63-30) AD 630583 Unclassified

Also published in Jour. Math. Phys., v. 5: 1652-1656, Nov. 1964.

In the attempts to connect the Lorentz group and the internal symmetry of fundamental particles, a 16-parameter connected, noncompact group of rank 4 is studied in detail. The subgroup structure, Lie algebra and its complex extension (which is A_3 in Cartan's notation), little groups, the inhomogeneous groups, and the group invariants are discussed.

555

Colorado U. [Dept. of Psychology] Boulder.

A MULTIPLE-INDICATOR APPROACH TO ATTITUDE MEASUREMENT, by S. W. Cook and C. Selltiz. [1964] 20p. (AFOSR-64-2257) (AF AFOSR-63-436) AD 452401 Unclassified

Also published in Psychol. Bull., v. 62: 36-55, July 1964.

Most experimental research on attitudes has used crude measuring instruments, relying on aspects of research design and analysis to overcome ambiguities of interpretation permitted by the measuring instrument. This paper examines different types of instruments from the point of view of the kinds of evidence they provide as a basis for assessing attitudes and of the nature of the inferences involved. Five classes of techniques are discussed: (1) measures in which the material from which attitudes are inferred consists of self-reports of beliefs, feelings, behavior, etc., toward an object or class of objects; (2) observed overt behavior toward the object; (3) reactions to or interpretation of partially structured material relevant to the object; (4) performance on objective tasks where functioning may be influenced by dispostion toward the object; and (5) physiological reactions to the object. (Contractor's abstract)

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Colorado U. [Dept. of Psychology] Boulder.

MEASUREMENTS OF ATTITUDE AND ATTITUDE CHANGE, by S. W. Cook. Final rept. Sept. 1, 1964, 43p. incl. refs. (AFOSR-64-2258) (AF AFOSR-63-436) AD 452333 Unclassified

The goal of the project was to make a systematic and comprehensive study of the effect of an attitude upon a variety of responses. Depending upon the outcome of this work, certain responses were chosen as indicators of attitude. These responses were utilized as bases for the construction of attitude measures. The responses studied and the measures developed were classified in terms of the nature of the evidence they provided and the nature of the inferences drawn from responses to attitude direction and strength. Eight categories of potential measures were explored: (1) Overt behavior toward the attitudinal object; (2) Interpretation of and reactions to incomplete or ambiguous stimuli; (3) Adequacy of task performance; (4) Judgments of attitudinally relevant materials; (5) Choice of classificatory principles; (6) Perceptual responses; (7) Involuntary physiological responses, and (8) Verbal self-reports. The work carried out in each of these categories is described. (Contractor's abstract)

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Columbia U., New York.

DISPLAY OF SOUND SPECTROGRAPHS IN REAL TIME, by C. M. Harris and W. M. Waite. [1963] [1]p. (AFOSR-J613) (AF AFOSR 62-251) AD 414019 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 729, 1963.

A technique is described for displaying sound spectrographs in real time. The patterns are obtained by scanning the rectified output of a bank of filters and feeding the output into a standard PPI oscilloscope from a radar system. Thus, no specially constructed visual display unit is required. A method of changing the frequency resolution of the patterns so obtained is described. (Contractor's abstract)

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Columbia U. [Columbia Radiation Lab.] New York.

FINE STRUCTURE OF THE 3^2P TERM IN LITHIUM (Abstract), by B. Budick, H. Bucka and others. [1963] [1]p. (AFOSR-5447) (DA 36-039-sc-78330) Unclassified

A level crossing has been observed in the 3^2P term of atomic lithium at a field of 916(4) G. The signal is a superposition of 4 hyperfine level crossings with a peak-to-peak separation of approximately 2 G. From the relation between the crossing field and the fine structure splitting $\mu_o H/\Delta W = (g_s + 2g_\ell)/3g_\ell$ $(g_s + g_\ell) = 4/9$, a doublet separation of 0.0961(5) cm^{-1} was deduced. This is 12% lower than the splitting in the corresponding term in hyrodgen, and should be compared with the fine structure interval in the 2^2p term which is 8% lower than in the corresponding hydrogenic term.

559

Columbia U. [Columbia Radiation Lab.] New York.

ON THE DIFFRACTION OF LIGHT BY ULTRASONIC WAVES IN LIQUID MEDIA (Abstract), by H. Z. Cummins, N. Knable and others. [1963] [1]p. (AFOSR-5448) (DA 36-039-sc-78330) Unclassified

A 6328A He-Ne maser has been used to study the fine structure of the Debye-Sears effect with both traveling and standing ultrasonic waves. The frequency shifts predicted by Raman and Nath for the traveling wave case have been verified to within one part in 10^6. Measurements of several diffraction maxima produced with standing ultrasonic waves have shown that odd order maxima contain fine structure components shifted by odd harmonics of the ultrasonic frequency, while even order maxima contain components shifted by even harmonics in accord with the Raman-Nath theory.

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Columbia U. [Columbia Radiation Lab.] New York.

HIGH FIELD DOUBLE RESONANCE IN THE $(5s5p)^3P_1$ STATE OF CADMIUM (Abstract), by R. Kohler and P. Thaddeus. [1963] [1]p. (AFOSR-5449) (DA 36-039-sc-78330) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, N. Y., Jan. 23-26, 1963.

Also published in Bull. Amer. Phys. Soc., Series II, v. 8: 9, Jan. 23, 1963.

Double resonance in the $(5s5p)^3P_1$ state of the even cadmium isotopes has been observed at a frequency of 24 kmc and a magnetic field near 11,430 G. At this high field value, the $\Delta m = \pm 1$ components of the optical transition lie well outside the resonance line emitted by a lamp, and the $\Delta m = 0$ component alone is observed in resonance fluorescence. Microwave resonance is then detected by a change in the angular distribution, most conveniently at 90°, of the scattered light. Interaction with the neighboring fine structure states of the 5s5p configuration is sufficient to separate the $\Delta m = \pm 1$ transitions by many times their linewidth.

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR SPIN OF 14y. Cd^{113m} (Abstract), by M. N. McDermott, R. Novick and B. W. Perry. [1963] [1]p. (AFOSR-5450) (DA 36-039-sc-78330) Unclassified

Presented at meeting of the Amer. Phys. Soc., St. Louis, Mo., Mar. 25-28, 1963.

Also published in Bull. Amer. Phys. Soc., Series II, v. 8: 262, Mar. 25, 1963.

The nuclear spin of 14y. Cd^{113m} has been determined to be I = 11/2 by the optical double resonance technique. The $\Delta m_F = \pm 1$, $\Delta F = 0$ transitions have been observed in the F = 11/2 hyperfine level of the 5s5p $^3P_1$ state of Cd^{113m}. The determination is based on the unique field dependence of the low field Zeeman effect in the F = I state. The isotope was produced by an (n,γ) reaction on 99% pure Cd^{112} separated isotope. The 14y. Cd^{113m} was separated from the stable isotope in the electromagnetic mass separator at Argonne National Laboratory. About 10^{11} radioactive atoms were used in the experiment.

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Columbia U. [Columbia Radiation Lab.] New York.

NUCLEAR MOMENTS OF 14 yr Cd^{113m} (Abstract), by B. Perry, M. McDermott, and R. Novick. [1963] [1]p. (AFOSR-5451) (DA 36-039-sc-78330) Unclassified

The hyperfine structure constants of 14 yr Cd^{113m} have been determined by the optical double resonance studies of the $(5s5p)\ ^3P_1$ state. The magnetic dipole and electric quadrupole coupling constants are, respectively: A = -684.2(7) mc/sec and B = 174.1 (28) mc/sec. The signs of A and B have been determined with circularly polarized light. Neglecting nuclear structure and quadrupole antishielding corrections, the nuclear moments are $\mu = -1.085(10)$nm, Q = 0.79(8)b. The Cd^{113m} was produced by an (n,γ) reaction on separated Cd^{112}. After irradiation, the Cd^{113m} was separated from the Cd^{112} in the electromagnetic mass separator at the Argonne National Laboratories. Approximately 10^{11} atoms were used in the experiment.

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Columbia U. Columbia Radiation Lab., New York.

STIMULATED TWO-PHOTON DE-EXCITATION OF METASTABLE HYDROGEN AND SINGLY IONIZED HELIUM (Abstract), by I. D. Abella, M. Lipeles, and N. Tolk. [1963] [1]p. (AFOSR-5452) (DA 36-039-sc-78330) Unclassified

A calculation has been performed on the quenching effect of a ruby laser beam (λ = 6940A) on the 2S metastable levels in H and He^+. In the absence of perturbation, these levels are believed to decay with simultaneous emission of 2 photons. The de-excitation process considered here is the stimulated emission of a red photon accompanied by uv emission, resulting in 3 outgoing quanta. The contribution from the virtual 2P intermediate states to the differential cross-sections (omitting the $1 + \cos^2\theta$ factors) is given in cm^2/sr by $d\sigma(H)/d\Omega = 3.3 \times 10^{-24}$ and $d\sigma(He^+)/d\Omega = 15.2 \times 10^{-24}$. Summation over all the P states and integration over the continuum is expected to reduce these by a factor of less than 4.

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Columbia U. [Columbia Radiation Lab.] New York.

EVIDENCE FOR THE $(1s2s2p)^4P_{5/2}$ STATE OF LITHIUM (Abstract), by P. Feldman and R. Novick. [1963] [1]p. (AFOSR-5456) (DA 36-039-sc-78330) Unclassified

Presented at meeting of the Amer. Phys. Soc., New York, N. Y., Jan. 23-26, 1963.

Also published tn Bull. Amer. Phys. Soc., Sertes II, v. 3: 8, Jan. 23, 1963.

The negative helium ion ts belteved to exist tn the metastable (1s2s2p) $^4P_{5/2}$ state. The corresponding state in an atomtc beam of ltthtum was produced. Pietenpol has estimated the lifetime of the metastable ltthtum atom to be 1.6×10^{-5} sec, and tts energy ts about 55 v. The $^4P_{5/2}$ state can be produced by exchange exctlation of ground state Lt atoms. Expertmentally, a neutral ltthium beam was bombarded with low energy electrons and a molybdenum plate located 3 cm from the bombarder was used to detect photons and metastable atoms. A complex excitation curve was observed with thresholds at a few ev and 55 ev. The low energy threshold corresponds to exclltatton of atomic states of Lt. The magnitude of the 55 ev threshold ts consistent with the estimated lifetime of the $^4P_{5/2}$ state and a production cross-section of the order of 10^{-19} cm^2.

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Columbia U. [Columbia Radiatton Lab.] New York.

HANLE EFFECT IN THE 3^2P STATE OF ATOMIC LITHIUM (Abstract), by R. J. Goshen, H. Bucka and others. [1963] [1]p. (AFOSR-5457) (DA 36-039-sc-78330) Unclassified

Presented at meeting of the Amer. Phys. Soc., St. Louis, Mo., Mar. 25-28, 1963.

Also publtshed tn Bull. Amer. Phys. Soc., Series II, v. 8: 262, Mar. 25, 1963.

The zero-fteld level crosstng tn the 3^2P state of the ltthtum atom with a stgnal-to-notse of approximately 100:1 was observed. Light from a flow lamp was scattered from a dense atomtc beam and observed at 90° to the tncident light. The Hanle effect tn the 2^2P state was also studied. On the basis of the known lifettmes, the ltne widths should be tn the ratio 1:7. A ratio of 1:6 was observed. No special attempt was made to obtain a homogeneous fteld, nor was the field modulation made opttmum for each state. The ultraviolet ltght output was greatest when the rf discharge tn the lamp was maintatned at htgh argon pressure (10 torr), htgh voltage, and 650°C. Since the stgnal ts proportional to the product of osctllator strength and denstty of atoms, the atomtc beam oven had to be kept 100°-150°C hotter for the 3P state than for the 2P. The estimated effective pressure tn the beam was 1μ.

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Columbia U. Columbia Radiatton Lab., New York.

NUCLEAR SPIN AND DIPOLE MOMENT OF Cd^{115} (Abstract), by F. Byron, R. Novick and others. [1963] [1]p. (AFOSR-5458) (DA 36-039-sc-78330) Unclassifted

The nuclear sptn, magnetic hyperfine interaction constant, and nuclear magnetic moment of 2.3 day Cd^{115} have been determtned by the optical double resonance technique tn the (5s5p) $^3P_1$ atomic state. The nuclear sptn, I, and magnetic dipole constant, A, are: I = 1/2, A = -4483.7(10) mc/sec. Neglecting nuclear structure the magnetic moment ts: $\mu = -0.64694(15)\ \mu_N$. Thts value exhtbits the same anomalously small stze as the moments of Cd^{111} and Cd^{113}, also I = 1/2. The Cd^{115} was produced by an (n, γ) reactton on 90 % Cd^{114}. The Cd^{115} was tdentified from the decay of the resonances over a 6-day pertod, whtch gives a lifetime $\tau = 59(2)$ hr. This is in good agreement with the accepted value of $\tau = 56$ hr.

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Columbia U. Columbia Radiation Lab., New York.

HANLE EFFECT IN EXCITED STATES OF CHROMIUM (Abstract), by H. Bucka, B. Budick, and R. J. Goshen. [1963] [1]p. (AFOSR-5459) (DA 36-039-sc-78330) Unclassifted

Zero field crosstngs are observed in 2 exctted states of the chromtum atom. The states are $^7P_{234}$ of the $(3d)^5 4p$ and $^7P_{234}$ of the overlapping configuration $(3d)^4 4s4p$. Ltne widths of 2G and 10G were measured for the 2 triplets respectively. Since the transitions to the ground state occur at ~3590A and 4280A one was able to select each state with appropriate ftlters. A Schuler type hollow cathode lamp served as a source of resonance radiation. Ltght was scattered from an atomic beam and the fluorescence observed at 90° to the tncident ltght beam. The atomic beam oven was heated by electron bombardment. Oscillator strengths, deduced from the measured ltne widths, are in good agreement with optical spectroscoptc intenstty measurements.

568

Columbia U. Columbia Radiation Lab., New York.

LINE-WIDTHS IN MOLECULAR LIGHT SCATTERING (Abstract), by H. Z. Cummins, Y. Yeh and others. [1963] [1]p. (AFOSR-5460) (DA 36-039-sc-78330) Unclassifted

An opttcal maser hcmodyne spectrometer has been used to measure the ltne-width of the Rayletgh component of ltght scattered by dilute aqueous solutions of large polymer molecules Theoretical ltne-widths are derived from the colltsion narrowtng theory of Dicke. The theoretical and expertmental values are compared, and are shown to depend on the molecular diffuston constant. Observations of the angular dependence of ltght scattering have also been carrted out, and are used to determine the molecular stze through the standard Mie theory. Comparison of the results of these 2 measurements may be used to determine the molecular shape in some cases.

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Columbia U. Columbta Radiation Lab., New York.

OBSERVATIONS ON THE $(1s2s2p)\,^4P_{5/2}$ METASTABLE STATE IN LITHIUM (Abstract), by P. Feldman and R. Novick. [1963] [1]p. (AFOSR-5461) (DA 36-039-sc-78330) Unclassified

The $(1s2s2p)\ ^4P_{5/2}$ configuration in He^- and Li is metastable against radiation and autoionization via the Coulomb interaction. Lithium atoms in this state can be produced by exchange excitation (energy = 56 ev) of ground state Li atoms. Experimentally, a neutral lithium beam is bombarded with low energy electrons and collect ions resulting from the decay of metastable atoms 3 cm from the source. The excitation function, production cross-section ($\sigma \sim 10^{-19}$ cm^2) and the lifetime ($\tau = 5.1 \pm 1\mu$ sec) are measured. A theoretical estimate of the probability of autoionization resulting from the spin-spin interaction gives a lifetime of 16 μ sec. The sublevels of the $^4P_{5/2}$ state should have different lifetimes because of the mixing with the rapidly autoionizing $^2P_{1/2}$ and $^2P_{3/2}$ states ($\tau \sim 10^{-14}$ sec). Doubly excited metastable states in the other alkalis may be produced by excitation from the closed p shell in the (p^6s) configuration to (p^5sd) $^4F_{9/2}$ state.

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Columbia U. [Columbia Radiation Lab.] New York.

EXISTENCE OF METASTABLE AUTOIONIZING STATES IN THE ALKALI METALS (Abstract), by P. Feldman and R. Novick. [1963] [1]p. (AFOSR-5462) (DA 36-039-sc-78330) Unclassified

Short lived atomic states lying between the first and second ionization potentials in the alkalis can be produced by excitation of an electron from the highest closed shell in the atom. Such states were observed by Beutler in K, Cs, and Rb by the absorption of ultraviolet radiation in alkali vapors and in recent ionization cross-section measurements on K and Rb. Configurations of doubly excited states exist which violate the selection rules for autoionization via the Coulomb operator, and are therefore longer lived. The simplest case is the $(1s2s2p)\ ^4P_{5/2}$ state in lithium. Potassium was studied with the same apparatus used for lithium and a metastable autoionizing state was found at 17 ev with a lifetime $\approx 10^{-4}$ sec. The production cross section for this state is an order of magnitude smaller than that for the short-lived states.

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Columbia U. [Columbia Radiation Lab.] New York.

MEASUREMENT OF RUBIDIUM SPIN-EXCHANGE CROSS SECTION (Abstract), by P. Davidovits and N. Knable. [1963] [1]p. (AFOSR-5463) (DA 36-039-sc-78330) Unclassified

The cross section for Rb-Rb spin exchange collisions has been measured in the ground state of Rb^{87} by a determination of the band width of a ground state hyperfine transition. This is the F = 2, $m_f = 0 \rightarrow F = 1$, $m_f = 0$ transition at 6835 mc. The variation of this bandwidth with temperature is determined using a flask of oriented rubidium atoms and together with an independent measurement of the rubidium vapor density an exchange cross section may be computed. The vapor density is determined by a measurement of the absorption of white light by the $S_{1/2}$, $F = 1 \rightarrow P_{3/2}$ 7800A resonance line, using a high resolution spectrometer, the f value of the line being known. The value obtained is $\sigma_{exchange} = 85 \pm 10 \times 10^{-16}$ cm^2.

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Columbta U. [Columbta Radiation Lab.] New York.

LIFETIME OF THE $(1s2s2p)\ ^4P_{5/2}$ STATE OF LITHIUM (Abstract), by P. Feldman and R. Novick. [1963] [1]p. (AFOSR-5464) (DA 36-039-sc-78330) Unclassified

The lifetime of the $(1s2s2p)\ ^4P_{5/2}$ metastable state of lithium has been measured in a time-of-flight experiment. Atoms in this state are produced by electron bombardment of a Li atomic beam (excitation threshold = 55 ev) and are detected through their decay to a ground state ion and a free electron. The detector is movable over 3 cm and at its closest is 3 cm from the center of the source. In determining the lifetime from the observed decay, the Maxwellian velocity distribution of atoms in the source and the finite length of the electron bombarder must be taken into account. The preliminary result of $\tau = 7 \pm 3$ μsec may be compared with the estimated value of 16 μsec.

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Columbia U. Columbia Radiation Lab., New York.

OPTICAL DOUBLE RESONANCE IN RADIOACTIVE ATOMS: SPIN AND NUCLEAR MOMENTS OF THE GROUND STATE OF Cd^{109}, by M. N. McDermott and R. Novick. [1963] [12]p. incl. diagrs. tables, refs. (AFOSR-J1306) (DA 36-039-sc-78330) Unclassified

Also published in Phys. Rev., v. 131: 707-718, July 15, 1963.

The optical double-resonance technique has been employed for the study of the Zeeman effect and hyperfine structure of the $(5s5p)\ ^3P_1$ state of 470-day Cd^{109}. The nuclear spin, I, magnetic hyperfine interaction constant, A, and quadrupole interaction constant, B, are: I = 5/2, A = -1, 148.6 ± 2.0 mc/sec, and B = 1167.3 ± 2.0 mc/sec. If nuclear structure and quadrupole antishielding corrections are neglected, the corresponding nuclear moments are $\mu = -0.826(15)\mu N$ and $Q = +0.78(10)b$. These values are discussed in terms of the configuration mixing model of Arima and Horie. A number of the problems encountered in the application of the double resonance technique to radioactive atoms are discussed. The sensitivity of the method is limited

by the shot noise in the instrumentally scattered light. In the case of the present apparatus, Zeeman resonances are detectable with 2×10^6 cadmium atoms in the vapor phase.

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Columbia U. Columbia Radiation Lab., New York.

SPIN, HYPERFINE STRUCTURE, AND NUCLEAR MAGNETIC DIPOLE MOMENT OF O^{15}, by E. D. Commins and H. R. Feldman. [1963] [8]p. incl. diagrs. tables, refs. (AFOSR-J1404) (DA 36-039-sc-78330) Unclassified

Also published in Phys. Rev., v. 131: 700-707, July 15, 1963.

The nuclear spin and hfs splitting of O^{15} ($\tau_{1/2}$ = 124 sec) in the $^3P_2$ atomic ground state have been determined by the atomic beam magnetic resonance method. O^{15} was produced in the reaction $N^{14}(d, n)O^{15}$ by allowing a 5-mev deuteron beam from the Columbia Van de Graaff accelerator to impinge upon a gaseous N_2 target. The radioactive gas flowed continuously from the target chamber into the microwave discharge source of the atomic beam apparatus. A rotating-wheel deposition detector specially suited for short-lived radioactive atoms was used to detect the beam. The spin is found to be 1/2, in agreement with the shell-model prediction. The hfs splitting of O^{15} in the $^3P_2$ state is observed to be 1037.23 ± 0.07 mc/sec. and the nuclear magnetic dipole moment of O^{15} is deduced to be 0.7189 ± 0.0008 n.m. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

THE THEORY OF COLLISION BROADENING IN THE SUDDEN APPROXIMATION, by F. W. Byron, Jr. and H. M. Foley. [1964] [46]p. incl. diagr. tables, refs. (AFOSR-64-1365) (DA 36-039-sc-78330) AD 444467 Unclassified

Also published in Phys. Rev., v. 134: A625-A637, May 4, 1964.

A method is developed for calculating the cross section for line broadening in the limiting case in which important collisions may be considered to occur very rapidly with respect to the periods corresponding to the transitions in question. This method is essentially an extension of the familiar sudden approximation; reference is made throughout to the particular example of optical double resonance only for definiteness and because there are available experimental results for comparison with the theory. Assuming the impact model and considering the case when the energy levels in question are well resolved with respect to their width, an exact expression is found for resonant self-broadening in the usual weak rf field limit of interest in double resonance. For the case of very small oscillator strengths for the optical transition, the resonant broadening becomes sufficiently small so that second-order, intermediate-state processes dominate, and approximations must be made to effect sums over intermediate states. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

THE SELF-BROADENING OF OPTICAL DOUBLE RESONANCE LINES IN CADMIUM, by F. W. Byron, Jr., M. N. McDermott, and R. Novick. [1964] [46]p. incl. diagrs. refs. (AFOSR-64-1366) (DA 36-039-sc-78330) AD 444468 Unclassified

Also published in Phys. Rev., v. 134: A615-A624, May 4, 1964.

Collision broadening studies have been made of optical double resonance lines in cadmium. The results indicate that the collision frequency is velocity dependent, contrary to the usual theory of resonance self-broadening. This result supports the suggestion that the broadening results from interactions involving a number of intermediate states rather than only the initial and final states of optical transition. (Contractor's abstract, modified)

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Columbia U. Columbia Radiation Lab., New York.

SPIN AND NUCLEAR MOMENTS OF 245-DAY Zn^{65}. REDETERMINATION OF THE hfs OF Zn^{67} AND $\tau(^3P_1)$ OF ZINC, by F. W. Byron, Jr., M. N. McDermott and others. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1579) (DA 36-039-sc-78330) AD 446375 Unclassified

Also published in Phys. Rev., v. 134: A47-A55, Apr. 6, 1964.

The hfs of the (4s4p) $^3P_1$ state of 245-day Zn^{65} and of Zn^{67} has been determined by the optical double-resonance technique. The nuclear spin I and the hfs splittings are: Zn^{65}: I = 5/2, $\nu(7/2-5/2)$ = 1875.475(6) mc/sec, $\nu(5/2-3/2)$ = 1334.123(6) mc/sec; Zn^{67}: $\nu(7/2-5/2)$ = 2111.300(3) mc/sec, $\nu(5/2-3/2)$ = 1551.565(4) mc/sec. The hfs coupling constants, corrected to second order for interaction with the $^3P_2$ and $^3P_0$ states are: Zn^{65}: A(65) = +535.162(2) mc/sec, B(65) = +2.870(5) mc/sec; Zn^{67}: A(67) = +609.086(2) mc/sec, B(67) = -18.782(8) mc/sec. The ratio of the Zn^{65} and Zn^{67} quadrupole moments is Q(65)/Q(67) = -0.1528(3). The lifetime of the (4s4p) $^3P_1$ state of zinc was redetermined and found to be $\tau(^3P_1)$ = 20(2) μsec. The result includes a large correction for the effects of wall collisions. The theory of wall broadening of optical double-resonance lines is developed. (Contractor's abstract, modified)

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[Columbia U.] Columbia Radiation Lab., New York.

A STUDY OF THE FREE EVAPORATION OF ALKALI

HALIDE CRYSTALS BY USE OF VELOCITY SELECTED MOLECULAR BEAMS, by P. Kusch. 1964, 11p. (AFOSR-64-2220) (DA 36-039-sc-78330) AD 452524 Unclassified

Thts paper is a review of work done with students and collaborators tn the last few yr; none of tt describes new and unpublished work. The expertmental techniques that have been used to study the chemtcal compositton of the vapors of the alkalt haltdes will be described and later some data on the composttion of vapors as they effuse from an equilibrtum enclosure and as they leave a free crystal will be presented. The reader should refer to the ortginal papers for many of the experimental details.

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Columbia U. Columbia Radiation Lab., New York.

MICROWAVE SPECTRUM OF LITHIUM CHLORIDE, by D. R. Lide, Jr., P. Cahill, and L. P. Gold. [1963] 4p. tncl. illus. tables, refs. (AFOSR-64-0820) (DA 36-039-sc-90789) AD 438644 Unclassified

Also published tn Jour. Chem. Phys., v. 40: 156-159, Jan. 1, 1964.

The rotational transttions J = 0 → 1 tn the 3 lowest vibrational states of Li^7Cl^{35} and the 2 lowest vibrational states of Li^7Cl^{37} have been measured at a temperature of 600°-800°C. The molecular constants (in mc/sec) for Lt^7Cl^{35} are: $B_e = 21181.1 \pm 0.1$, $\alpha_e = 240.2 \pm 0.2$, $\gamma_e = 1.2 \pm 0.2$; those for Li^7Cl^{37} are: $B_e = 20989.9 \pm 0.1$, $\alpha_e = 236.9 \pm 0.2$. The internuclear distance is $r_e = 2.02067 \pm 0.00006$A. (The uncertainties represent maximum ltmtts of error.) A combination of the present results with mole.ular beam electric resonance data yields a dipole moment $\mu_v = 7.075 \pm 0.0885$ ($v = 1/2$) D for Lt^6Cl^{35}. Two-high-temperature microwave spectrometers of new design are described briefly. A tabulation of molecular constants for the complete series of alkali halide molecules ts included. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

NOTES ON RESOLUTION TN SCATTERING MEASUREMENTS, by P. Kusch. [1964] [4]p. incl. diagrs. table. (AFOSR-64-0821) (DA 36-039-sc-90789) AD 438645 Unclassifted

Also publtshed in Jour. Chem. Phys., v. 40: 1-4, Jan. 1, 1964.

The instrumental factors that determtne the resolution of an atomic beam apparatus in the measurement of total scatterng cross sections are discussed. A definition of resolution as the mtntmum scattering angle for which the efficiency of detection of scattering ts 50% is proposed. (Contractor's abstract)

581

Columbia U. Columbia Radiation Lab., New York.

LIFETIME AND hfs OF THE $(5s5p)^1P_1$ STATE OF CADMIUM, by A. Lurto and R. Novick. [1964] [7]p. tncl. diagrs. tables, refs. (AFOSR-64-1371) (DA 36-039-sc-90789) AD 444466 Unclassified

Also publtshed in Phys. Rev., v. 134: A608-A614, May 4, 1964.

The lifetime and hfs of the $(5s5p)\ ^1P_1$ state of cadmium have been measured by the level crossing technique. Coherence narrowing of the zero-field level crossing (Hanle effect) signal has been observed and found to be in agreement with Barrats theory. The lifetime obtained from 2 independent experiments is $1.66 \pm 0.05 \times 10^{-9}$ sec. Thts value is considerably smaller than earlter values. The ratio of this lifetime to the $(5s5p)\ ^3P_1$ state lifetime obtained by Byron et al. ts $6.95 \pm 0.30 \times 10^{-4}$, and tn good agreement with the results of Filippov and Kuhn. The dipole tnteraction constant $A\ (^1P_1)$ obtained for Cd^{111} ts $|A(^1P_1)| = 186 \pm 4$ mc/sec. This result is compared to that obtained by Heydenburg. Using the present lifetime measurement and the known hfs intervals for the $^3P_2$ and $^3P_1$ states one obtains the theoretical value of this constant $A\ (^1P_1) = 152 \pm 25$ mc/sec. The single electron hfs constants for the (5s51) configuration are tabulated. (Contractor's abstract)

582

Columbia U. Columbia Radiation Lab., New York.

g_J OF THE $(5s5p)\ ^3P_1$ LEVEL OF Cd AND THE $(6s6p)\ ^3P_1$ LEVEL OF Hg BY HIGH-FIELD DOUBLE RESONANCE, by R. Kohler and P. Thaddeus. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-2136) (DA 36-039-sc-90789) Unclassified

Also publtshed in Phys. Rev., v. 134: A1204-A1209, June 1, 1964.

An optical double resonance experiment at high magnetic fields has determined g_J for the $(5s5p)\ ^3P_1$ level of the even cadmtum isotopes to be 1.49 346(13), and g_J for the $(6s6p)\ ^3P_1$ level of the even mercury isotopes to be 1.486094(8). Resonance was observed tn all cases at a frequency of exactly 25 Gc/sec, and magnetic fields near 11430 G. At these high fields the Zeeman energy is of the order of 10^{-3} of the fine structure separations of the triplet terms of the (nsnp) configuration, and the $\Delta m = \pm 1$ transitions are split by 9.51(7) G for Cd, and by 2.99(7) G for Hg. This splitting represents several ltnewidths in the case of Hg, and many ltnewidths tn that of Cd. The average field of the two $\Delta m = \pm 1$ transitions, however, determtnes g_J to high precision independent of second-order corrections. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

THE COLLISION BROADENING OF DOUBLE RESONANCE LINE SHAPES (Abstract), by F. W. Byron, Jr. 1963, 1p. (AFOSR-5012) (AF AFOSR-62-65) AD 415215 Unclassified

Investigation, experimentally and theoretically, has been made of the collision broadening in optical double resonance. This is a case in which the energy levels are so closely spaced (10 - 100 mc/sec) that the collisions can be thought of as occurring very rapidly with respect to the atomic periods involved. Because of this extreme situation it is possible to obtain an exact expression for resonant self-broadening. Results obtained in cadmium, as well as other experiments by Brossel and his co-workers on zinc and mercury, are compared with these expressions, and the feasibility of measuring the effect under the most general circumstances is discussed.

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Columbia U. Columbia Radiation Lab., New York.

LEVEL CROSSINGS IN THE $(5s5p)^3P_1$ STATE OF RADIOACTIVE Cd^{107} AND Cd^{109}, by P. Thaddeus and M. N. McDermott. [1963] 5p. incl. illus. diagrs. tables, refs. (AFOSR-64-0249) (AF AFOSR-62-65) AD 431082 Unclassified

Also published in Phys. Rev., v. 132: 1186-1190, Nov. 1, 1963.

Four level crossings, which obey the selection rule $\Delta m_F = 2$, have been detected for hyperfine levels in the $(5s5p)^3P_1$ state of both 6.7-h Cd^{107} and 470-day Cd^{109} by observing the change in intensity at 90° of the resonance fluorescence of the 3261A intercombination line. The hyperfine interaction constants found from an analysis of the crossing point fields, and corrected for interaction with the adjacent fine structure states of the 5s5p multiplet, are $A_{107} = -853.543(6)$ mc/sec, $B_{107} = -165.279(5)$ mc/sec, $A_{109} = -1148.784(7)$ mc/sec, $B_{109} = -165.143(5)$ mc/sec. The ratios of the magnetic-dipole moments, and the electric-quadrupole moments, to within the effect of hyperfine anomalies, are $\mu_{107}/\mu_{109} = 0.742997(8)$; $Q_{107}/Q_{109} = 0.98871(4)$. (Contractor's abstract)

585

Columbia U. Columbia Radiation Lab., New York.

SPIN AND NUCLEAR MOMENTS OF 317-HOUR Cd^{107}, by F. W. Byron, Jr., M. N. McDermott, and R. Novick. [1963] 5p. incl. illus. diagrs. refs. (AFOSR-64-0274) (AF AFOSR-62-65) AD 431081 Unclassified

Also published in Phys. Rev., v. 132: 1181-1185, Nov. 1, 1963.

The Zeeman and hyperfine structure of the $(5s5p)\ ^3P_1$ state of 6.7-h Cd^{107} has been determined by optical double resonance. Positive identification of the isotope was obtained through the observation of the decay of the Zeeman resonance signals. The nuclear spin (I) magnetic hyperfine-structure coupling constant (A), and the quadrupole coupling constant (B), are $I = 5/2$, $A\ (^3P_1) = 854.2 \pm 1.0$ mc/sec, and $B\ (^3P_1) = -166 \pm 3$ mc/sec. Neglecting possible hyperfine structure anomalies and quadrupole shielding effects, the corresponding nuclear moments are $\mu_{107} = -0.6162(8)\ \mu_N$ and $Q_{107} +0.77(10)$b. These moments are compared with the predictions of the configuration mixing model of Nova, Arima, and Horie. The ratio of the Cd^{107} and Cd^{109} quadrupole moments is $Q_{107}/Q_{109} = 0.993(20)$; this result is independent of the shielding corrections. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

SPIN AND NUCLEAR MOMENTS OF 2.3-DAY Cd^{115} AND OF 43-DAY Cd^{115m}, by M. N. McDermott, R. Novick and others. [1964] 5p. (AFOSR-64-1122) (AF AFOSR-62-65) AD 441854 Unclassified

Also published in Phys. Rev., v. 134: B25-B29, Apr. 13, 1964.

This paper is devoted to the nuclear spins and moments of the radioactive isotopes of the Group II elements. (Contractor's abstract)

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Columbia U. Columbia Radiation Lab., New York.

LEVEL CROSSING DETERMINATION OF THE LIFETIME OF THE $\tau\ (^1P_1)$ AND $g_J\ (^3P_1)$ IN ZINC AND THE hfs OF Zn^{65} AND Zn^{67}, by A. Landman and R. Novick. [1963] 10p. (AFOSR-64-1580) (AF AFOSR-62-65) AD 446353 Unclassified

Also published in Phys. Rev., v. 134: A56-A65, Apr. 6, 1964.

Optical detection of level crossing in stable Zn^{67} and of 245-day Zn^{65}, using the intercombination line at 3076A, resulted in a precise determination of the ratios of the dipole and quadrupole hyperfine coupling constants in each of the isotopes to the Lande g factor. Using these results and the values of the dipole coupling constant for each isotope, as determined from double resonance experiments, values were obtained for the atomic g factor and "isolated" quadrupole interaction constants.

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Columbia U. Dept. of Astronomy, New York.

X-RAYS AND TYPE I SUPERNOVA REMNANTS, by L. Woltjer. [1964] [5]p. incl. diagr. table. refs. (AFOSR-65-0397) (AF 49(638)1358) AD 612439 Unclassified

Also published in Astrophys. Jour., v. 140: 1309-1313, Oct. 1, 1964.

Bowyer, Byron, Chubb, and Friedman (Nature, v. 201: 1307, 1964) have observed x-rays from a source that probably is to be identified with the Crab Nebula. Chiu and Salpeter (Phys. Rev. Ltrs., v. 12: 413, 1964) have suggested that these x-rays are thermal radiation from a neutron star—which then would be the stellar remnant of the Crab Nebula supernova. Knowledge of Type I supernova remnants are briefly reviewed and an alternative possibility is discussed, which may be of interest since the existence of neutron stars is still somewhat in doubt. Three Type I supernovae have been definitely recorded in our galaxy during historical times: In 1054 (Crab Nebula), in 1572 (Tycho's supernova) and in 1604 (Kepler's supernova). Some data on these supernovae and their radio and optical remnants are assembled. Most data are self-explanatory. The interstellar absorptions were estimated from Hiltner's (Astrophys. Jour. Suppl. No. 24, 1956) data on nearby O and B stars.

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Columbia U. [Dept. of Chemistry] New York.

ELECTRON SPIN RESONANCE SPECTRA OF METHYL-SUBSTITUTED DIHYDROPYRAZINE CATIONS AND RELATED RADICALS, by B. L. Barton and G. K. Fraenkel. [1964] 14p. (AFOSR-64-2504) (AF 49(638)520) AD 453966 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1455-1468, Sept. 1, 1964.

Electron spin resonance spectra have been obtained for the cation radicals of dihydropyrazine and its methyl-substituted derivatives, and of dihydroquinoxaline, 2,3-dimethyldihydroquinoxaline, dihydrophenazine, and N,N'-dihydro-4,4'-dipyridyl. (Contractor's abstract)

590

Columbia U. Dept. of Chemistry, New York.

OPTICAL PUMPING AND CHEMICAL REACTIONS, by R. J. McNeal, R. A. Bernheim and others. [1964] [6]p. incl. table, refs. (AFOSR-64-1490) (AF AFOSR-62-228) AD 446351 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1678-1683, Mar. 15, 1964.

Optical pumping in this paper refers to the orientation of the angular momenta of atoms and molecules by light. The phenomenon of spin exchange raises the possibility of the use of a gas of pumped atoms as a highly sensitive detector of free radicals. It is shown, however, that a suitable buffer gas may not have atoms of high atomic number, and may not be polar or aromatic and must be extraordinarily inert chemically. Examples are He, Ne, Ar, H_2, N_2, CH_4, C_2H_6, C_2H_4, and—for a short time—Co. These highly stable molecules decompose into radicals at ordinary temperature only under irradiation with vacuum ultraviolet photons or with particles. Optically pumped gases may be useful, therefore, in studying the reactions involved in vacuum uv photolyses of simple hydrocarbons. (Contractor's abstract)

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Columbia U. Dept. of Chemistry, New York.

SPIN RELAXATION OF OPTICALLY PUMPED RUBIDIUM ATOMS IN MOLECULAR BUFFER GASES, by R. J. McNeal. [1964] [10]p. incl. diagrs. table, refs. (AFOSR-64-1491) (AF AFOSR-62-228) AD 446143 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1089-1098, Feb. 15, 1964.

Short spin relaxation times for rubidium atoms, oriented by optical pumping, have been observed in the presence of benzene, ammonia, and dimethyl ether buffer gases. The disorientation cross sections of these gases in rubidium are obtained from relaxation times measured in mixtures with molecular nitrogen. The partial pressures of the gases were low compared to the nitrogen pressures in the mixtures, and the diffusion coefficient of rubidium in the mixtures was assumed to be the same as in pure nitrogen. The cross section of CO has also been obtained from the longer rubidium spin relaxation time in this gas. The cross sections of ammonia, dimethyl ether, and benzene are much larger than cross sections of other molecular buffer gases. A discussion of the relaxation processes in these gases is given. The large cross sections of polar gases with appreciable dipole moments are found to result from an interaction of the rubidium atoms with the electric field of the polar molecules during a collision. (Contractor's abstract, modified)

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Columbia U. Dept. of Chemistry, New York.

THEORY OF LINE WIDTHS IN ELECTRON SPIN RESONANCE SPECTRA: MOTION OF METHYL GROUPS, by J. H. Freed and G. K. Fraenkel. [1964] [8]p. incl. table, refs. (AFOSR-64-2209) (AF AFOSR-63-285) AD 452334 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3477-3484, Sept. 5, 1964.

Calculations show that modulation of the methyl-proton hyperfine splittings by rotational motion of the methyl groups can cause several interesting line-width effects. For a single methyl group, the central pair of lines is

predicted to be broader than the outer pair, and if the rotational motion is fast, so that nonsecular contributions are important, the central lines are non-Lorenizian in shape. The presence of large secular line-width effects of this type causes every third line in the spectra from radicals with either two or four equivalent methyl groups to be sharp compared to the other lines. The variation of the widths from line to line if the motions of the several methyl groups are uncorrelated with each other is different in detail from that found if they are interlocked so as to move in a completely correlated manner. Throughout the calculations, the line-broadening effects of such important mechanisms as the anisotropic intramolecular dipolar and g-tensor interactions were neglected.

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Columbia U. Dept. of Chemistry, New York.

REINTERPRETATION OF THE ELECTRON SPIN RESONANCE SPECTRUM OF THE O-XYLENE NEGATIVE ION, by J. R. Bolton. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-0011) (AF AFOSR-63-285)
AD 455785 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2455-2457, Oct. 15, 1964.

The electron spin resonance spectrum of the oxylene negative ion has been re-examined in view of a discrepancy between one of the previously reported splitting constants and the predictions of molecular orbital theory. The splitting constant has been found to be 1.81 G instead of ~0.2 G. The new values of the hyperfine splittings reported are in excellent agreement with the predictions of both molecular orbital and valence bond theory. A technique is described by which molecules such as O-xylene can be reduced. (Contractor's abstract)

594

Columbia U. Dept. of Electrical Engineering, New York.

OPTIMAL CONTROL OF DISCRETE SYSTEMS WITH CONSTRAINED INPUTS, by P. E. Sarachik and G. M. Kranc. [1964] [19]p. incl. table, refs. (AFOSR-64-1312) (AF AFOSR-63-284) AD 444267 Unclassified

Also published in Jour. Franklin Inst., v. 277: 237-255, Mar. 1964.

In this paper the optimal time problem is considered for discrete systems with multiple inputs and multiple outputs when each input may be subject to a different type of constrained in fashion. The method of solution presented is to imbed the individual input constraints in a more general overall constraint on the entire input vector. The solution for the general constraint is found and from this the optimum inputs for the original constraint conditions are obtained. It will be noted that in general the optimal control for discrete systems is not unique; in such cases the solution given here will yield that control with minimum constrained quantities among all the optimum controls. In addition the approach used here does not require that the system be normal although the computations will usually become more complicated for non-normal systems when one or more inputs are constrained in amplitude. (Contractor's abstract, modified)

595

Columbia U. [Dept. of Electrical Engineering] New York.

ON THE CONCEPTS OF CONTROLLABILITY AND OBSERVABILITY OF LINEAR SYSTEMS, by E. Kreindler and P. E. Sarachik. [1964] [8]p. incl. diagrs. refs. (AFOSR-64-1313) (AF AFOSR-62-284)
AD 444269 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 129-136, Apr. 1964.

The objectives of this paper are to give a self-contained presentation of the subject of controllability and observability (concepts due to Kalman) developed in a simple yet general and rigorous way; to introduce these concepts in terms of the output as well as in terms of the state; and to point out and illustrate some of the subtleties which exist in the timevarying case. (Contractor's abstract)

596

Columbia U. [Dept. of Mechanical Engineering] New York.

AN EXPERIMENTAL STUDY OF HEAT TRANSFER AT HIGH TEMPERATURE DIFFERENCES IN TURBULENT AIR FLOW BETWEEN A ROTATING CYLINDER AND A STATIONARY CONCENTRIC OUTER CYLINDER, by G. S. Longobardo and H. G. Elrod. Final rept. Oct. 1963, 16p. incl. diagrs. (AFOSR-64-0134) (AF 49(638)1001) AD 429097 Unclassified

Velocity and temperature data were obtained for the annulus between a rotating inner cylinder and a stationary outer cylinder. The data were obtained for air under circumstances such that appreciable variation of the transport properties and density would occur in a turbulent flow. These data make possible a test of current theories for the behavior of turbulent, variable-property flow.

597

Columbia U. Dept. of Mechanical Engineering, New York.

PEIERLS STRESS AND CREEP OF A LINEAR CHAIN, by J. H. Weiner and W. T. Sanders. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-1780) (AF AFOSR-63-228) AD 449252 Unclassified

Also published in Phys. Rev., v. 134: A1007-A1015, May 18, 1964.

The Frenkel-Koniorova dislocation model is modified by replacing the sinusoidal substrate force by one which is piecewise linear. Exact solutions are found for the static configuration and for the Peierls stress,

σ_p. Good agreement is found between these values of σ_p and those obtained previously for a 2-dimensional Rosenstock-Newell model. The atoms of the linear chain are then considered in random motion corresponding to thermal equilibrium and under an applied stress $\sigma < \sigma_p$. The time required for motion of the dislocation from one position of stable equilibrium to an adjacent one is computed by means of a rate-theory formulation adapted to the present type of problem in which the positions of all the atoms in the chain are required to vary in passing over the potential barrier. The theoretical transition times for an infinite chain are compared with analog computer results for a 6-atom chain and reasonably good agreement is found. (Contractor's abstract)

598

Columbia U. Dept. of Mechanical Engineering, New York.

DISLOCATION VELOCITIES IN A LINEAR CHAIN, by J. H. Weiner. [1964] [6]p. incl. diagrs. refs. (AFOSR-65-0783) (AF AFOSR-63-228) AD 616215 Unclassified

Also published in Phys. Rev., v. 136: A863-A868, Nov. 2, 1964.

Dislocation velocities as a function of applied stress are computed for a modified Frenkel-Kontorova model. The analysis is approximate in that only localized normal modes of motion (local modes) are considered, and it is found that steady-state velocities are attained because of imperfect transfer of energy between successive local modes. The significant stress parameter for this model is found to be the dynamic Peierls stress σ_{PD} with the property that dislocation motion will be maintained for any stress $\sigma > \sigma_{PD}$, without the aid of thermal motion, upon condition that the dislocation has surmounted one potential barrier while the stress is applied. For the model parameters here considered, $\sigma_{PD} \sim 10^{-2}\sigma_p$, where σ_p is the static Peierls stress. The model calculations show the extreme stress sensitivity of dislocation velocity at low velocities which has been observed experimentally. Finite-difference calculations show that the local-mode approximation gives reasonably good accuracy up to dislocation velocities approximately 0.7 the speed of wave propagation for infinite wave length in the linear chain.

599

Columbia U. [Dept. of Physics] New York.

[RADIO ASTRONOMY AT MILLIMETER WAVELENGTHS], by P. Kusch. Final rept. May 1, 1962-Apr. 30, 1963. Apr. 1963, 4p. (AFOSR-5228) (AF AFOSR-62-50) AD 415961 Unclassified

A radiotelescope designed to operate in the M band frequency region (50 kmc - 75 kmc) was constructed on the roof of the Columbia University Physics Building in 1959. This radiotelescope, with its 5-ft parabolic antenna, was used to study atmospheric absorption lines which are members of the O_2 spin reorientation spectrum and which are abundant near 60 kmc. It was also used to study the emission line near 53 kmc produced by the hyperfine splitting of hydrogenic nitrogen ions in the solar corona.

600

Columbia U. Electronics Research Labs., New York.

COST GUIDELINES FOR STUDY CONTRACTORS, by C. Walsh. Oct. 6, 1964, 17p. (Technical rept. no. T-1/306; rept. no. CU-44-64-AF-1113-ERL) (AF 49-(638)1113) AD 612963 Unclassified

The object of this study is to weigh the technical system potential against economic resources in terms of effectiveness per dollar spent. The number and types of systems considered by the various contractors will be substantial. Cost guidelines are thus required to insure that the economic resources are equally measured in all cases. Since the study results will form part of the basis of executive decisions the reported costs should be based on the experience and judgment of the participating contractors, rather than developed from arbitrary rules. The guidelines indicate the areas of substantial interest and seek to elicit supporting data to permit the proper evaluation of the stated costs.

601

Columbia U. [Electronics Research Labs.] New York.

DELAY LINE FILTERS FOR FREQUENCY MULTIPLIERS, by J. H. Wuorinen, Jr. July 1, 1963, 107p. (Rept. no. TR-T-1-193; CU-20-63-AF-113-ERL) (AF 49(638)1113) AD 439279 Unclassified

The results of a theoretical investigation of the performance of delay line filters are presented. The use of filters built up from electrical delay lines is suggested for applications requiring long frequency multiplier chains with a high degree of phase linearity. A Fourier approach to filter synthesis results in an arbitrary amplitude response with linear phase, but requires an infinite number of delays. A synthesis procedure is presented which is useful when the number of delays is limited. This procedure leads to a straightforward design when applied to the special class of filters for frequency multipliers. (Contractor's abstract)

602

Columbia U. [Electronics Research Labs.] New York.

TIME-OPTIMAL RENDEZVOUS STRATEGIES, by P. A. Meschler. [1963] 5p. incl. diagr. (AFOSR-64-0976) (AF AFOSR-62-144) AD 440151 Unclassified

Presented at Joint Automatic Control Conf., Minneapolis, Minn., June 19-21, 1963.

Also published in IEEE Trans. on Automatic Control, v. AC-8: 279-283, Oct. 1963.

This paper is concerned with the control of 2 distinct nth-order linear systems described in the standard state vector notation. Since both systems are of nth order their state vectors can be placed in the same n-dimensional phase space. A problem is formulated in which it is desired to transfer each system from separate initial states to some undetermined but coincident state (state vector rendezvous). This goal is to be accomplished in minimum time while the input vectors of both systems are amplitude constrained. Complete necessary and sufficient conditions which must be satisfied by time-optimal solutions are developed, and additionally, a technique for computing the optimum controls is given. (Contractor's abstract)

603

Columbia U. [Inst. of Flight Structures] New York.

BUCKLING OF THIN SHELLS UNDER EXTERNAL PRESSURE, by A. E. Armenakas and G. Herrmann. [1963] [16]p. (In cooperation with Northwestern Tech. Inst., Evanston, Ill.) (AFOSR-J1225) (AF 49(638)-430) AD 424360 Unclassified

Also published in Jour. Eng. Mech. Div.; Proc. Amer. Soc. Civil Eng., v. 89: 131-146, June 1963.

Expressions for the buckling value of the external pressure acting on thin cylindrical shells were earlier derived on the basis of various linear bending theories. For certain ranges of shell dimensions, however, these expressions yield substantially differing results. Moreover they do not take into account the effect of the change, during deformation, of the magnitude and direction of the pressure on the magnitude of the buckling load. In this investigation, a bending theory is used in establishing the value of the hydrostatic and constant-directional pressure for buckling; the results are compared with those of previous investigations. Furthermore, simplified but accurate expressions for the buckling pressure that are applicable to any combination of shell dimensions are presented. (Contractor's abstract)

604

Columbia U. [Inst. of Flight Structures] New York.

THERMOELASTIC DISSIPATION IN VIBRATING PLATES, by J. Ernst. [1963] 6p. incl. diagrs. (AFOSR-J1458) (AF 49(638)430) Unclassified

Presented at Summer Conf. Amer. Soc. Mech. Eng., Appl. Mech. Div., Ithaca, N. Y., June 24-26, 1963.

Also published in Jour. Appl. Mech., v. 30: 1-6, 1963.

The thermal dissipation associated with the natural modes of free vibration of a thermoelastic medium is obtained as an integral formula involving the mode of vibration and the temperature produced in the mode. The integral formula for dissipation is applied to an infinite isotropic plate, and numerical resuts are given for the 3 lowest, real, symmetric branches of the spectrum. Finally, it is shown that low-frequency extensional vibrations of plates can be adiabatic or isothermal, depending on whether adiabatic or isothermal boundary conditions are specified on the faces of the plate.

605

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

METHOD OF DETERMINING THE DEGREE OF FREE OSCILLATION OF A RADIALLY HETEROGENEOUS ELASTIC SPHERE, by Y. Sato and T. Usami. [1963] [12]p. incl. diagrs. table. (Contribution no. 635) (AFOSR-5492) (AF AFOSR-62-303) Unclassified

Also published in Bull. Earthquake Research Inst., v. 41: 331-342, 1963.

A method is proposed which gives a clue to the determination of the degree (m) of the free oscillation of the earth, or the azimuthal characteristic of the origin of disturbance. This method is based on the principle that the series of zero points of the guiding curve of spectrum peaks depends on the degree number m. If a specific spherical surface harmonics with a certain value of m has a series of zero points that conform to the zeros of the guiding curve of the observed spectral peaks, the degree number m is determined.

606

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

NOTE ON FOURIER ANALYSIS, by H. Jeffreys. [1964] [4]p. (Contribution no. 739) (AFOSR-65-2892) (AF AFOSR-62-303) AD 452908 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1441-1444, Oct. 1964.

In the search for empirical periodicities there is no advantage in carrying out computations except for periods that are submultiples of the length of the record. Coefficients for 4 such periods in the neighborhood of a maximum amplitude will yield by least squares estimates of a true period and its harmonic coefficients with a valid estimate of uncertainty. (Contractor's abstract)

607

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

ON THE M_1-COMPONENT OBTAINED BY GRAVIMETRIC TIDAL OBSERVATION (SCREENING OF GRAVITATIONAL FORCES), by I. Nakagawa. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-2893) (AF AFOSR-62-303) AD 624176 Unclassified

Presented at Fifth Internat'l. Symposium on Earth Tides, Brussels (Belgium), June 1964.

Also published in Special Contrib. Geophys. Inst., Kyoto U. (Japan), No. 4: 9-17, 1964.

Absorption of gravitational forces has mainly been investigated during periods of solar eclipse by several investigators, and it has been established that the absorption effect of gravitation, if it exists, does not exceed the noise level. The mass of the earth is larger than that of the moon and therefore the gravitational absorption due to the earth's mass itself should be larger than that due to the moon's mass. In the present paper, a trial to detect the absorption effect of the lunar gravitational forces by the earth's mass is described by using data obtained with an Askania gravimeter No. 111, installed at Kyoto, during a period of 1 yr. By the present investigation, it is ascertained that the gravitational absorption due to the earth's mass is about 4 μ/gal and that its value reaches a maximum 2 hr after the instant when the moon transited the meridian of the observation station. The value of amplitude obtained by observation is in good agreement with that predicted by theoretical calculation. But concerning the phase, there exists a difference of about 180° compared with that expected by theoretical calculation.

608

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

THE HINDU KUSH EARTHQUAKE OF MARCH 4, 1949 AS RECORDED IN EUROPE, by I. Lehmann. [1964] [11]p. (AF AFOSR-62-303) AD 612857 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1915-1925, Dec. 1964.

The European records from distances 36° - 50° of the deep Hindu Kush earthquake of Mar. 4, 1949 were studied. The many clearly recorded deep-focus reflections lend to the records a characteristic appearance which is repeated in many other shocks from the same focal region. The ratios of the amplitudes of these phases vary somewhat from one shock to another. In the shock here considered sP and sPP are exceptionally large at most stations; in the Italian stations they are not so large, while pP is a clear phase, pP is not very well defined at most other stations. Most of the 1949 records were from the old type long-period instruments having their highest magnification for periods from about 5 to 12 sec. It is shown in examples that the amplitude ratio PP:P may differ strongly at the same epicentral distance and also that pP may vary greatly with azimuth. The deficiency of station readings is noted. Travel times and their residuals are tabulated and travel times plotted vs epicentral distances. (Contractor's abstract, modified)

609

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

ON THE TRAVEL TIMES OF P AS DETERMINED FROM NUCLEAR EXPLOSIONS, by I. Lehmann. [1964] [17]p. (AF AFOSR-62-303) AD 436046 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 123-139, Feb. 1964.

A study has been made of the travel times of P waves as recorded from 14 shots on the Nevada Test Site (NTS) and from the Gnome (GN) shot. The travel times on different lines extending from the test sites were considered separately. Of special interest were the travel times obtained on the line joining the NTS and GN site. The two sets of travel times were in good agreement, but from epicentral distance 700 km onwards they were delayed and scattered. This was an indication of the presence of a low velocity layer at small depth on the line. Travel times on lines extending in other directions from the NTS differed somewhat but not very greatly from those on the NTS-GN line. (Contractor's abstract)

610

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

ON THE VELOCITY OF P IN THE UPPER MANTLE, by I. Lehmann. [1964] [7]p. incl. diagrs. (AF AFOSR-62-303) Unclassified

Published in Bull. Seismol. Soc. Amer., v. 54: 1097-1103, Aug. 1964.

The travel times of P in the upper mantle are considered. Usually the phases are more clearly recorded at epicentral distances beyond 15° and here the time-distance curves have appreciable curvature. At smaller distances the time-curves are nearly straight lines, that sometimes are cut off at distances less than 15°. Travel times have been calculated on various velocity assumptions so as to agree with the empirically determined travel times. For the uppermost mantle the velocity has been taken either to be constant or slightly increasing down to a depth sufficiently great for the phases to be recorded, though with small amplitudes, at least to distances of 15°, or a low velocity layer has been inserted that cuts off the time-curve at smaller distances. (Contractor's abstract, modified)

611

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

SOFT CORE SPECTRUM SPLITTING OF THE TORSIONAL OSCILLATION OF AN ELASTIC SPHERE AND RELATED PROBLEMS, by Y. Sato. [1964] [10]p. (Contribution no. 696) (AF AFOSR-62-303) AD 444020 Unclassified

Also published in Bull. Earthquake Research Inst., v. 42: 1-10, 1964.

The torsional oscillation of an earth model consisting of a homogeneous mantle and a soft homogeneous core is studied and the following matters are discussed and

proved: (1) When there is a soft core those modes are predominant which have nearly equal frequencies to that of a liquid core model; (2) These modes are very high radial higher modes, and a simple formula that gives the order number of them is presented; (3) Consecutive spectrum lines far stronger than the other ones sometimes have nearly equal amplitudes and frequencies which fact proves to be a kind of spectrum splitting phenomenon; and (4) Depending on the density and rigidity ratios of the core and mantle observable frequency is higher or lower than that of a liquid core model, and there is also a possibility of 2 spectrum peaks having nearly equal amplitudes. This phenomenon will be of use for the determination of the core rigidity by means of the observation of free oscillation periods. (Contractor's abstract)

612

Columbia U. Lamont Geological Observatory, Palisades, N. Y.

TRANSMISSION OF LOVE WAVES IN A HALF-SPACE WITH A SURFACE LAYER WHOSE THICKNESS VARIES HYPERBOLICALLY, by T. Takahashi. [1964] [15]p. incl. diagrs. refs. (Rept. no. C708) (AF AFOSR-62-303) AD 442265 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 611-625, Apr. 1964.

The propagation of Love waves in a layer over a half-space is theoretically studied for cases where the upper or lower boundary of the layer can be represented by a hyperbola. Curvilinear coordinates are used. Approximate solutions of various modes exist. Among the component harmonic waves of a mode, the representative one for each given position can be specified. This explains the position dependancy of phase velocity. The condition of transmission and reflection of Love waves for this model and the case in which one-half of the hyperbola is replaced by a straight line are discussed. (Contractor's abstract)

613

Columbia U. School of Engineering and Applied Science, New York.

ON A GASEOUS NUCLEAR ROCKET WITH MHD VORTEX FUEL CONTAINMENT, by K. O. Kessey and R. A. Gross. Oct. 1963 [36]p. incl. diagrs. tables. (Rept. no. 6) (AFOSR-64-0570) (AF 49(638)1254) AD 436083 Unclassified

The use of a hydromagnetically driven vortex as a means of separating fuel from propellant in a gaseous nuclear rocket is examined for configurations of practical interest. Theoretical limitations are given on radial mass flow rate for steady flow. The simultaneous compatible conditions of electric power, magnetic field strength, fuel-propellant composition (uranium 235 as fuel and hydrogen as propellant) and inelt composition are determined for steady separation in a critical system. Transport properties are estimated at 1 ev using kinetic theory. Reactor power requirements and thrust produced by several systems are determined. (Contractor's abstract)

614

Columbia U. [School of Engineering and Applied Science] New York.

DYNAMICS OF IONIZING SHOCK WAVES: SHOCKS IN TRANSVERSE MAGNETIC FIELDS, by C. K. Chu. [1964] [9]p. incl. diagrs. refs. (AFOSR-64-2253) (AF 49(638)1254) AD 452384 Unclassified

Also published in Phys. Fluids, v. 7: 1349-1357, Aug. 1964.

Shock waves propagating into a nonionized neutral gas and ionizing it are considered. A transverse magnetic field is assumed. Using a simple ionization model, it is found that the electric field ahead of the shock may not be arbitrarily imposed, but is determined by the shock structure. This fact was already pointed out by Lyubimov; this paper extends Lyubimov's results and puts them on a more convincing mathematical basis. The piston problem is solved for these shocks; it is found that for a given ionization temperature these shocks are pure gas dynamic shocks at low piston speeds, and approach classical hydromagnetic perpendicular shocks at high piston speeds. (Contractor's abstract)

615

Columbia U. School of Engineering and Applied Science, New York.

NORMAL IONIZING SHOCK WAVES. THE EFFECTS OF EQUILIBRIUM, DISSOCIATION AND IONIZATION, by R. Taussig. Aug. 1964, 57p. incl. diagrs. refs. (Rept. no. 14) (AFOSR-65-0034) (AF 49(638)1254) AD 609344 Unclassified

The steady state jump equations are solved numerically for plane, normal ionizing shock waves in an electromagnetic field. These solutions account for the effects of an upstream electric field parallel to the shock plane, and for the effects of dissociation and ionization across the shock front. Specific calculations are presented for diatomic hydrogen at 273°K and 100 μ pressure Hg with an applied magnetic field of 1.38 webers/m^2 perpendicular to the shock plane. The results are compared to corresponding ideal gas solutions, and basic differences in the downstream hydrodynamic variables between the gas and switch-on type shocks are discussed. Driving currents are computed for a shock wave followed by a current-driven rarefaction wave propagating down an annular shock tube. These computations compare favorably with previous experimental evidence, and confirm numerically analytic results of an approximate nature for hydromagnetic ionizing fronts.

616

Columbia U. [School of Engineering and Applied Science] New York.

GASEOUS NUCLEAR ROCKET WITH MHD VORTEX FUEL CONTAINMENT, by K. O. Kessey and R. A. Gross. [1964] [4]p. incl. diagr. tables, refs. (AFOSR-65-0572) (AF 49(638)1254) AD 614733 Unclassified

Also published in AIAA Jour., v. 2: 1461-1464, Aug. 1964.

One of the major problems in development of a nuclear rocket is the separation of the gaseous fuel from the propellant. In this report some potentialities and limitations of a hydromagnetically driven vortex separation system are examined for a practical nuclear rocket system. The size, flow limitations, composition of the exhaust gas, electrical power, and reactor power required by a hydromagnetic vortex, gaseous nuclear rocket reactor are determined. The simultaneous requirements for nuclear criticality, adequate fuel-propellant separation, input composition to maintain a steady state, and limits on electrical powerplant weight form the crux of an analysis of the system.

617

Columbia U. School of Engineering and Applied Science, New York.

STRONG IONIZING SHOCK WAVES, by R. A. Gross. Oct. 1964, 64p. incl. diagrs. refs. (Rept. no. 15) (AFOSR-65-1315) (AF 49(638)1254) AD 457225 Unclassified

Electromagnetically driven shock waves in hydrogen are theoretically studied for speeds up to relativistic conditions. In the progression from weak to relativistic shock speeds, various physical phenomena affect the shock wave. Dissociation, ionization, and the presence of an upstream electric field cause several important effects for slow (sub Alfvenic speed) normal ionizing shock waves. Switch-on shock behavior is extended to slow ionizing waves. The effect of radiation is investigated for both the optically thick and thin cases. Relativistic shock jump equations are solved for wave speeds approaching the speed of light. Thermonuclear shock solutions are examined. The shock jump equations and the shock tube problem are solved numerically. Wave stability is reviewed and some experimental results are discussed.

618

Columbia U. School of Engineering and Applied Science, New York.

TRANSPORT PROPERTIES OF HYDROGEN, by D. Brezing. Sept. 1964, 71p. incl. diagrs. tables, refs. (Rept. no. 13) (AFOSR-65-1319) (AF 49(638)1254) AD 609345 Unclassified

The transport properties of hydrogen are calculated for a pressure range from 10^{-6} atm to 10^{2} atm, and at temperatures up to 10^{6}°K. The Boltzmann formalism, which assumes binary collisions in the expressions for the transport properties of gas mixtures, is applied. Theoretical values, supported by experimental data whenever possible, are used for the atom-atom, atom-ion, and atom-electron collision cross sections. The collision integrals for all interactions are computed. Values of viscosity, thermal, and electrical transport coefficients, as well as the thermoelectric coefficients are calculated.

619

Columbia U. [School of Engineering and Applied Science] New York.

DYNAMICS OF IONIZING SHOCK WAVES. I. TRANSVERSE SHOCKS, by C. K. Chu. Jan. 1964, 45p. (Rept. no. 7) (AF 49(638)1254) AD 601110 Unclassified

A simplified mathematical model of ionizing shock waves in a magnetic field is considered. Roughly speaking, these shocks are an intermediate species between gas shocks and hydromagnetic shocks. The gas ahead of the shock will be assumed to be a perfect nonconductor, and that behind to be a perfect conductor. It is stipulated that the conditions be such that there is no precursor ionization. For simplicity, the energy required in the ionization process is ignored. Transverse shocks are also treated, in which the magnetic field is tangential to the shock front and thus transverse to its direction of propagation (in hydromagnetic usage, such shocks are sometimes called perpendicular shocks; they should not be confused with Alfvén discontinuities, which are also sometimes called transverse shocks). The solution of the algebraic jump conditions is also studied. (Contractor's abstract)

620

Columbia U. [School of Engineering and Applied Science] New York.

NORMAL IONIZING SHOCK WAVES, by R. Taussig. July 1964, 57p. (Rept. no. R-12) (AF 49(638)1254) AD 619206 Unclassified

Solutions to the steady-state jump equations are obtained for a normal ionizing shock wave propagating into a nonconducting, quiescent gas in an electromagnetic field. Comparison of these solutions to pure MHD shocks and ordinary gas shocks indicates that ionizing shocks are hybrids having some properties common to both MHD and gas shocks. Some completely novel effects are produced by the upstream electromagnetic field. A modified Rankine-Hugoniot function is derived and used to select physically reasonable shock solutions. Solutions analogous in some respects to detonation-deflagration waves have been found, and the Chapman-Jouguet condition is applied to them. (Contractor's abstract, modified)

621

Columbia U. School of Engineering and Applied Science, New York.

MAGNETOHYDRODYNAMIC ROTATION OF PLASMAS, by K. O. Kessey. 1963, 168p. incl. diagrs. tables, refs. (Rept. no. 1) (AFOSR-5220) (AF AFOSR-63-48) AD 418200 Unclassified

The rotation of an incompressible plasma is analyzed for the case when it is confined in an axisymmetrical cylindrical structure impressed with radial electric and axial magnetic fields. The analyses are concerned with steady and transient, one- and two-dimensional laminar flow of a nonviscous and viscous plasma with either small or very large electrical conductivity. The one-dimensional analysis, referred to as the "Zero Radial Mass Flux" (ZRMF), involves the azimuthal component of velocity only. The two-dimensional analysis, called the "Non-Zero Radial Mass Flux" (NRMF), deals with both the axiumuthal and radial components of velocity. On the basis of two physically interesting approximations, the "flat disc" and the "long cylinder," analytical solutions have been obtained for both the steady and unsteady velocity and pressure fields.

622

Columbia U. School of Engineering and Applied Science, New York.

MAGNETOGASDYNAMIC BOUNDARY CONDITIONS AT A CONDUCTING WALL, by T. E. Luzzi, Jr. 1963, 113p. incl. diagrs. refs. (Rept. no. 2) (AFOSR-5221) (AF AFOSR-63-48) AD 418180 Unclassified

Also published in Phys. Fluids, v. 7: 1329-1338, Aug. 1964. (AFOSR-64-2386; AD 452294)

Velocity boundary conditions at a conducting wall have been developed for the continuum magnetogasdynamic equations. The wall is separated from the fully ionized plasma by a Langmuir type sheath. The effect of the sheath on the single fluid plasma boundary conditions are studied. The potential of the wall may be either greater than, or less than, that of the plasma. Boundary conditions have been developed for both cases. For the case where the wall potential is greater than the plasma it is possible to have a slip velocity at the wall where no-slip would occur in an equivalent unionized gas flow.

623

Columbia U. School of Engineering and Applied Science, New York.

MAGNETOHYDRODYNAMIC SPECIES SEPARATION IN A GASEOUS NUCLEAR ROCKET, by R. A. Gross and K. O. Kessey. July 1963, 43p. incl. diagrs. refs. (Rept. no. 4) (AFOSR-5222) (AF AFOSR-63-48) AD 418182 Unclassified

Also published in AIAA Jour., v. 2: 295-301, Feb. 1964. (AFOSR-64-0895; AD 439863)

The possibility of steady flow separation of U-235 from hydrogen by magnetohydrodynamically spinning the fluid in a cylindrical vortex is treated. A gaseous nuclear rocket configuration is described and its model analyzed. The hydromagnetic equations are solved for the velocity distribution, pressure field, concentration of uranium and hydrogen, electrical power required, and dissipation rates as a function of Hartmann number, and radial Reynolds number. Results of gaseous reactor criticality calculations are given for both unshielded and shielded configurations. Some properties of a hydrogen plasma are presented. Potential rocket performance is given and some further technical problems discussed. The technology involved in this rocket concept is complex and little experience is available. However, the results of this analysis are encouraging and the means of attaining a large thrust rocket with very high specific impulse are seen.

624

Columbia U. School of Engineering and Applied Science, New York.

CONTINUUM RADIATION BEHIND A BLAST WAVE, by R. A. Gross. Aug. 1963 [54]p. incl. diagrs. (Rept. no. 5) (AFOSR-5363) (AF AFOSR-63-48) AD 422927 Unclassified

The principal results of idealized blast wave theory are presented and then extended to include the effects of ionization and radiation. The conditions required to maintain blast wave dynamic similarity with radiation are set forth. Electron density and continuum radiation are determined as a function of position behind a blast wave for the plain, cylindrical and spherical cases. (Contractor's abstract)

625

Columbia U. [School of Engineering and Applied Science] New York.

OBLIQUE DETONATION WAVES, by R. A. Gross. [1963] [3]p. (AFOSR-J1013) (AF AFOSR-63-48) AD 417721 Unclassified

Also published in AIAA Jour., v. 1: 1225-1227, May 1963.

The 2-dimensional, steady-flow equations for oblique detonation waves are developed, and solutions for the jump conditions are presented. A proof is presented that the corresponding Chapman-Jouguet condition for oblique detonation waves occurs when the downstream velocity component, normal to the wave, is sonic. (Contractor's abstract)

626

Columbia U. School of Engineering and Applied Science, New York.

DE-ACTIVATION OF NEON METASTABLES BY H_2, by T. C. Marshall. Jan. 1964 [66]p. incl. diagrs. tables, refs. (Rept. no. 6) (AFOSR-64-0571) (AF AFOSR-63-46) AD 436178 Unclassified

Measurements are reported of the total cross section for de-activation of neon metastables by inelastic collisions with hydrogen. Measurements were made by applying the methods of resonance radiation absorption and microwave diagnostics to the afterglow plasma following a weak pulsed discharge in the mixture of neon and hydrogen. The reaction which converts neon metastable energy into light has been analyzed spectroscopically and forms a large fraction of the total de-activating collisions of neon metastables by hydrogen. These results are applied in a discussion of the effects that internal energy balance may have upon such polyatomic collisions. Observations upon dc discharge plasmas have been made and evidence collected to support and extend the above conclusions. (Contractor's abstract, modified)

627

Columbia U. [School of Engineering and Applied Science] New York.

DYNAMICS OF IONIZING SHOCKS (Abstract), by C. K. Chu. [1963] [1]p. (AFOSR-64-0665) (AF AFOSR-63-48) Unclassified

Presented at meeting of the Amer. Phys. Soc., Cambridge, Mass., Oct. 1963.

Strong shock waves producing large degrees of ionization are studied using a one-dimensional simplified model of an ideal gas, which is nonconducting on the low pressure side and ideally conducting on the high pressure side of the shock. These shocks are properly classified and parametrized, and their properties are investigated. Specifically, the influences on the density and pressure ratios (considered as functions of the shock Mach number) due to the magnetic field strength, the electric field strength, the magnetic field orientation, and the ionization energy, are computed and catalogued. Many properties, not present in either gas-dynamical shocks or classical hydromagnetic shocks, are found and discussed in some detail.

628

Columbia U. [School of Engineering and Applied Science] New York.

ROTATING ELECTRICALLY CONDUCTING FLUIDS IN A LONG CYLINDER, by K. O. Kessey. [1964] [8]p. incl. diagrs. (AFOSR-64-1670) (AF AFOSR-63-43) AD 448285 Unclassified

Also published in AIAA Jour., v. 2: 864-871, May 1964.

A hydromagnetically generated vortex in an incompressible, viscous, cylindrically confined plasma is analyzed. Solutions for steady laminar one- and two-dimensional flow fields are obtained. The two-dimensional flow field involves impressed radial mass flow. The solutions for the pressure of the flow field with impressed radial mass flow are valid for small magnetic Reynolds number only. Results are given which have application to a gaseous nuclear rocket.

629

Commonwealth Scientific and Industrial Research Organization. Div. of Physics, Sydney (Australia).

THERMAL EXPANSION OF SILICA AT LOW TEMPERATURES, by G. K. White. [1964] 6p. (AFOSR-64-1777) (AF AFOSR-62-391) AD 449088 Unclassified

Also published in Cryogenics, Feb. 1964, p. 2-7.

The thermal expansivity of such glasses as pure silica, Vycor, or borosilicate is both negative and large in magnitude compared with expansivity of common crystalline solids such as quartz or copper. There is close agreement between pure vitreous silica and Vycor but the addition of soda and/or lime alters the behavior considerably. The fact that 3% B_2O_3 (in Vycor) has so little effect on the expansion suggests that the change observed in borosilicate is due primarily to the network-filling agents, namely Na_2O, which is present probably to the extent of about 4%. The soda-lime glass contains about 15% Na_2O and 9% CaO, and its expansion differs from the pure silica by much more than does the borosilicate. This soda-lime glass has a small negative expansion coefficient below 14°K. Quartz in the direction parallel to the optic or hexad axis also has a small negative coefficient at these temperatures but its volume coefficient remains positive. (Contractor's abstract)

630

Commonwealth Scientific and Industrial Research Organization. Div. of Physics, Sydney (Australia).

THE THERMAL EXPANSION OF COPPER AT LOW TEMPERATURES, by G. K. White. [1964] 13p. (AFOSR-65-0172) (AF AFOSR-62-391) AD 611968 Unclassified

Also published in Proc. Roy. Soc. (London), v. 280: 72-84, 1964.

The thermal expansion of copper has been determined at temperatures down to 2°K by means of an electrical capacitance technique. By measuring three-terminal capacitances in a ratio-transformer bridge length changes smaller than 10^{-9} cm can be detected in the capacitor-expansion cell. The linear expansion coefficient is given for below 10°K. These terms, identified respectively as electronic (e) and lattice (l) in origin, lead to the following values of the Gruneisen parameter: $\gamma_e = 0.63 \pm 0.06$, $\gamma_l = 1.72 \pm 0.03$ (γ_0). γ_e is compared with a theoretical free-electron value of 2/3, and the low temperature value of γ_e is compared with values of

1.75 to 1.77 calculated from elastic constants. At room temperature γ ($\sim = \gamma_\infty$) is 2.00, so that $\gamma_\infty - \gamma_0 \sim = 28$, which agrees well with the theoretical estimates of Barron for a close-packed cubic lattice. (Contractor's abstract, modified)

631

Commonwealth Scientific and Industrial Research Organization. Div. of Physics, Sydney (Australia).

THERMAL CONDUCTIVITY AT LOW TEMPERATURE OF NEUTRON-IRRADIATED BeO, by A. W. Pryor, R. J. Tainsh, and G. K. White. [1964] [16]p. incl. diagrs. table, refs. (AFOSR-65-1928) (AF AFOSR-62-391) AD 626892 Unclassified

Also published in Jour. Nuclear Materials, v. 14: 208-223, 1964.

Measurements are reported of the thermal conductivity of polycrystalline BeO in the temperature range 2°-300°K. Samples were measured in the normal state and then after receiving fast neutron doses of 2.0×10^{18} to 2.0×10^{20} nvt. These measurements were undertaken in order to study the phonon scattering from radiation-induced defects. For the unirradiated material the scattering is adequately described by a combination of phonon interaction processes, grain-boundary scattering, and point scattering from impurities of unknown origin. For the irradiated material, it is assumed that the defects consist predominantly of extensive planar clusters, which anneal in the temperature range 900°-1100°C, and of a lower concentration of point defects which anneal below 600°C. The thermal resistance introduced by irradiation begins to saturate at doses of about 5.0×10^{19} nvt owing to multiple scattering from the co-planar clusters. The measurements give an order-of-magnitude confirmation of earlier estimates of the defect concentration. (Contractor's abstract)

632

Communication Research Inst., Miami, Fla.

COMMUNICATION STUDIES ON TURSIOPS TRUNCATUS, by J. C. Lilly. Final annual rept. Mar. 1962-Feb. 1964. Feb. 1, 1964, 4p. (AFOSR-64-0176) (AF AFOSR-61-62) AD 431850 Unclassified

This paper calls attention to the large brain of Tursiops truncatus and comparisons are made of this brain with man's brain. The working hypothesis is proposed that there is a critical absolute brain size below which language, as we know it, is impossible and above which language, as we know it, is possible and even probable. Tursiops has a brain above this critical level soon after birth. Material from two separate research results on human children is cited. One giving the statistical average of the acquisition of the first stages of the basic elements of human speech, the other is the average brain weight at the same age. In each study there were several hundreds of cases. The critical size is shown to be approximately 900 to 1000 grams in the case of the human. Observations by the author on an infant Tursiops show that this animal did not acquire the precise clicking of the adult until its brain reached 1000 grams, measured at autopsy. Such results are suggestive that this species is quite capable of language behavior. The problem then resides in determining whether or not there is a natural language and/or whether Tursiops can acquire an artificial language.

633

Communication Research Inst., Miami, Fla.

AIRBORNE SONIC EMISSIONS OF TURSIOPS TRUNCATUS (M) (Abstract), by J. C. Lilly. [1964] [1]p. (AFOSR-65-1514) (AF AFOSR-63-415) Unclassified

Presented at Sixty-seventh meeting of the Acoust. Soc. Amer., New York, May 6-9, 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36: 1007, May 1964.

During the first few days in confinement, the usual large underwater sonic repertoire of the dolphin, Tursiops, can be recorded; airborne emissions are rare. During this time, some produce in air sounds usually heard under water, and then become air-silent. After 8 to 24 wks in confinement, the airborne emissions often start. These complex sounds in air are specified by their amplitude patterns, basic repetition rates, frequency spectra, time courses, and relations to underwater sounds produced concurrently and/or alternatively. Some recorded evidence for a degree of apparent time-course coupling of trains of some of these emissions to similar emissions from other sources is presented.

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Communication Research Inst., Miami, Fla.

COMMUNICATION STUDIES ON TURSIOPS TRUNCATUS, by J. C. Lilly. Final rept. Jan. 1-Nov. 30, 1964. [1964] [3]p. (AFOSR-65-1602) (AF AFOSR-63-415) AD 623814 Unclassified

A review is presented of research on the ability of the dolphin Tursiops truncatus to reproduce the sounds of human speech and to respond vocally appropriately to various vocal stimuli by a human. The physical variables used in analysis were the number of sonic bursts in the observer's presentation and the number of sonic bursts in the dolphin's replies; the durations of the individual bursts and the durations of the interburst silences. For tests where the stimulus was a list of from 1 to 10 nonsense syllables, the dolphin replied with the correct number in 82% of the cases. The dolphin voluntarily continued such difficult performance for periods from 12 to 20 min. Such vocal performance is unknown for any other animal except man.

635

Communication Research Inst., Miami, Fla.

ANIMALS IN AQUATIC ENVIRONMENTS: ADAPTATION OF MAMMALS TO THE OCEAN, by J. C. Lilly. [1964] 7p. incl. diagr. table, refs. (AFOSR-65-2945) (AF AFOSR-63-415) AD 628408 Unclassified

Also published in Handbook of Physiology Environment, 1964, p. 741-747.

This report contains the following topics: Origin of cetaceans; Adaptation; Brain weighis vs body length/body weight relationships; Tursiops truncatus, an experimental subject; Physiological functions; Respiration and ingestion; Nutrition; Natural vs unnatural existence; Sleep; Communication; Sonic and ultrasonic emissions; Language concepts.

636

Cork U. Coll. (Ireland).

RESEARCH ON COMPLEX FUNCTION THEORY, by P. B. Kennedy. Final technical repi. Sept. 10, 1963, 28p. (AFOSR-J1280) (AF EOAR-61-3) AD 424053 Unclassified

The Nevanlinna characieristic of the derivative of a meromorphic function quasi-bounded in the unit circle is studied; and also a contribution is made iowards the elucidation of ihe comparison of the characieristic of an entire funciion with its maximum modulus. Solutions are given to two of the problems raised by members of the Colloquium on Classical Function Theory ai Cornell U., 1961. Finally proofs are given of a theorem on lacunary Fourier series, improving a result due to Tomic, and of a theorem on rearrangement of series, relaied to a result due to Agnew. (Contracior's abstract)

637

Cork U. Coll. (Ireland).

LINEAR BOUNDARY-VALUE PROBLEMS. I. THE TORSION OF AN IRREGULAR POLYGON, by P. M. Quinlan. June 1963, 31p. incl. diagrs. (Technical rept. no. 1) (AFOSR-5161) (AF EOAR-62-43) AD 416348 Unclassified

Presentation is made of a new exact method of solving linear boundary value problems, of elliptic type, for regions bounded externally and, possibly, internally by polygons — problems previously attacked in some simplified case, by finite-difference and relaxation methods. The torsion problem is chosen as the most suitable medium to develop and exhibit the method, when the boundary conditions do not involve derivatives. (Contractor's abstract)

638

Cork U. Coll. (Ireland).

NON-LINEAR BENDING OF AN ANNULAR PLATE. II. INTEGRATION OF REISSNER'S AND VON KARMAN'S EQUATIONS, by V. G. Hart. June 1963, 44p. (Technical repi. no. 3) (AFOSR-5164) (AF EOAR-62-43) AD 416364 Unclassified

Concern is with the equilibrium of a thin annular plaie beni out of iis initial plane by transverse edge forces. The resulis of integrating the governing non-linear differential equations of Reissner are compared with the resulis of iniegrating von Karman's equations for this problem. (Contracior's abstract)

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Cork U. Coll. (Ireland).

LINEAR BOUNDARY-VALUE PROBLEMS. II. THE λ-METHOD FOR RECTANGULAR PLATES, by P. M. Quinlan. July 1963, 42p. incl. diagrs. tables. (Technical repi. no. 2) (AFOSR-5411) (AF EOAR-62-43) AD 424063 Unclassified

A comprehensive method of formulating the rectangular plate problem, under all boundary conditions and a wide range of loadings, is presenied. The particular iniegral is obtained as a double Fourier Sine Series, which is the compleie solution when the plate is simply supporied with all edges in the same horizontal plane. This is summed io a single series and transformed to a highly convergent series of negative exponentials in the plaie-variables Ui. The necessary calculus for differentiation and iniegration is established, from which the particular slopes, moments and shears follow whether for concentraied or line loads or loads distributed uniformly over polygonal regions. By treating a concentrated momeni as a force-pair, this case is deduced from thai of a concentraied load. The necessary complementary functions and the ensuing simultaneous equations for all boundary conditions are formulaied in a manner suited to programming for an electronic computer.

640

Cork U. Coll. (Ireland).

LINEAR BOUNDARY-VALUE PROBLEMS. III. THE λ-METHOD FOR POLYGONAL PLATES, by P. M. Quinlan. Apr. 1964, 47p. (Scientific rept. no. 1) (AFOSR-64-1294) (AF EOAR-62-43) AD 603734 Unclassified

Edge-functions and the λ-method for providing a particular integral or Green's function are combined io formulaie the necessary simultaneous equations governing the bending of a polygonal plate, with or withoui polygonal holes, under a wide range of loadings and boundary conditions. A particular feaiure is the development of the computer-formula approach, under which all cases are combined in a single formula compleie with the necessary computer indicaiors.

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[Cork] U. Coll. (Ireland).

NON-LINEAR BENDING OF AN ANNULAR PLATE BY TRANSVERSE EDGE FORCES, by V. G. Hart and D. J. Evans. [1964] [29]p. incl. diagrs. tables. (AFOSR-65-2043) (AF EOAR-62-43) AD 627464 Unclassified

Also published in Jour. Math. and Phys., v. 43: 275-303, Dec. 1964.

The problem is considered of the equilibrium of a thin annular plate bent out of its initial plane by transverse forces uniformly distributed along the edges. The Reissner and von Karman equations are solved for the annulus and for the asymptotic case of a large load or a very thin plate. Two sets of boundary conditions are considered in each of which the edges of the plate are clamped. In one case edge conditions of zero radial displacement are assumed and in the other the radial stress is zero. Analytic solutions are found to the von Karman equations in the form of asymptotic series, and the resultant estimates of the rapid rates of change of dependent variables encountered in the boundary layers are used to assist numerical integration of both von Karman and Reissner equations on a digital computer. Solutions of both equations are found to be in considerable agreement. (Contractor's abstract)

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

AN EXPERIMENTAL STUDY OF HYPERSONIC LOW-DENSITY VISCOUS EFFECTS ON A SHARP FLAT PLATE, by R. J. Vidal, T. C. Golian, and J. A. Bartz. 1964, 77p. (AF 49(638)952) Unclassified

Heat transfer and pressure data were obtained with sharp flat plate models at zero and large angles of attack in the CAL hypersonic shock tunnel. These high Mach number data (Mach 14 to 24) extend from the classical thin boundary layer regime to near-free-molecule conditions and are discussed within the framework of existing theory. The large angle-of-attack results verify viscous shock-layer theory and define the low-density conditions where transport effects at the shock wave first become important. The data obtained at zero angle of attack are compared with theory to define the fluid mechanism that governs the low-density effects. The strong shock-wave approximations, the vorticity interaction, and the shock-wave heating effects are unimportant in this case.

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

MAGNETIC SUSCEPTIBILITY OF 2^3S_1 HELIUM (Abstract), by J. T. McMullan and R. P. Hurst. [1963] 1p. (AFOSR-5010) (AF AFOSR-63-191) Unclassified

Using a wave function similar to that developed by Hylleraas and Undheim the energy and magnetic susceptibility of the 2^3S_1 state of helium have been computed. In this work up to a total of 35 terms were considered, of which many were explicitly dependent on the interelectron distance r_{12}. Since this function contains two non-linear parameters one can effectively allow one electron to be in a "1s" type orbital while the second is in a "2s" type orbital. This results in an accurate wave function with comparatively few terms. Thus with only 20 terms we obtain -2.1752278 a. u. where the experimental results is -2.1752294 a. u. Finally, it is reasonable to suppose that the computed magnetic susceptibility is quite good.

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Cornell Aeronautical Lab., Inc., Buffalo, N. Y.

MAGNETIC SUSCEPTIBILITY OF 2^3S_1 STATE OF HELIUM AND SOME LIKE IONS, by J. T. McMullan and R. P. Hurst. [1964] 5p. (Rept. no. CAL-RA-1761-P) (AFOSR-65-0441) (AF AFOSR-63-191) AD 612457 Unclassified

Also published in Phys. Rev., v. 135: 973-977, Aug. 17, 1964.

The magnetic susceptibility of the 2^3S_1 state of helium and some like ions is computed using a thirty-five term wave functions of the type originally proposed by Hylleraas and Undheim. It is found that it is possible to obtain highly accurate values for the magnetic susceptibility using this wave function if the parameters are accurately determined. Finally, an argument is given which suggests that the magnetic susceptibility obtained in the present work is accurate to at least five significant figures. (Contractor's abstract)

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[Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.]

INCOHERENT SCATTER OBSERVATIONS OF TRAVELING IONOSPHERIC DISTURBANCES, by G. D. Thome. [1964] [3]p. incl. diagrs. (AFOSR-65-2813) (AF 49(638)1156) AD 628272 Unclassified

Also published in Jour. Geophys. Research, v. 69: 4047-4049, Oct. 1, 1964.

The incoherent scatter technique is used to study large scale traveling ionospheric disturbances above Puerto Rico. Below the F-region maximum the measurements of disturbance amplitude, period, and direction of phase progression with time (downward) are consistent with the bottomside results of other workers. Above the maximum, however, the surfaces of constant phase are found to become vertical, disturbance amplitude becomes less, and the periods become greater. (Contractor's abstract)

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

RADAR BACKSCATTER FROM THE EARTH'S IONOSPHERE, by W. E. Gordon. [1964] 5p. tncl. diagrs. table, refs. (AF 49(638)-1156) Unclasstfied

Publtshed in IEEE Trans. Milttary Electron, v. MIL-8. July-Oct. 1964.

The role of radar backscatter observations in tonospheric studies is outltned. The theoretical developments are described that form the basis for ground-based measurements of electron density, electron temperature, ion temperature, and ionic composttion at ionospheric heights. Observations of the first three parameters have been successful. Observation of the fourth parameter, ionic composition, is a challenging problem and is being attempted.

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

SECULAR CHANGES IN THE SOLAR SYSTEM, by P. Goldreich. Feb. 1963, 74p. (AFOSR-4743) (AF AFOSR-62-191) AD 407165 Unclassified

This report contains the following articles: On the Incltnation of Satellite Orbits About an Oblate Precessing Planet; On the Eccentricity of Satellite Orbits in the Solar System; and An Explanation of the Frequent Occurrence of Near-Commensurate Mean Motions in the Solar Systems.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDROGEN MOLECULE. I. BASIC PROCESSES, by R. J. Gould and E. E. Salpeter. [1963] 33p. tncl. diagr. refs. (AFOSR-4959) (AF AFOSR-62-191) AD 413840 Unclassified

Also published tn Astrophys. Jour., v. 138: 393-407, Aug. 15, 1563.

An analysis is given of the various processes which determine the molecular concentration tn H I clouds. The most important mechanism for forming molecular hydrogen is association on the surface of the tnterstellar grains, the characteristic time for conversion to molecular form being about 300 mtllion yr. It ts shown that the range of gratn temperatures where thts recombination reaction ts efftctent ts cotncident with the range 5-20°K which ts expected to result from the tnteraction with the interstellar radiatton field. It is estimated that the efficiency (recombination coefftcient) of the process ts between 0.1 and 1. Regarding dissociative processes, photodissoctation through the forbidden transitton between the two Heitler-London states of the molecule, previously thought to be most important, ts shown to be negligible. Ionization and dissociation of a cloud by random encounters with O and B stars occurs about once every 100 million yr, so that if the grain recombination process is operative a balance results tn which the molecular abundance is roughly comparable to the observed atomic concentration. The cooling properties of molecular hydrogen are discussed. (Contractor's abstract)

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDROGEN MOLECULE. II. GALACTIC ABUNDANCE AND DISTRIBUTION, by R. J. Gould, T. Gold, and E. E. Salpeter. [1963] 18p. incl. diagrs. tables, refs. (AFOSR-64-0054) (AF AFOSR-62-191) AD 430667 Unclassified

Also published tn Astrophys. Jour., v. 138: 408-425, Aug. 15, 1963.

Observations of the distribution in space and velocity of gas clouds, together with considerations of dynamical astronomy, suggest that the total mass denstty near the galactic plane is appreciably higher than the observed density of visible stars and atomic hydrogen gas. The distribution of K giant stars is compatible also with a high density of "invisible" mass, and it is suggested here that this ts contributed by molecular hydrogen gas. Radii of Strömgren spheres for O and B stars are evaluated, and the average rates of dissociation and ionization of molecular hydrogen, due to random encounters of gas clouds with bright stars, are calculated. Using the rates for the association of hydrogen molecules on the surfaces of dust grains, calculated in the preceding paper, the mean equilibrium abundance ratio of molecular to atomic hydrogen is calculated. This ratio is found to be almost independent of the height above the galactic plane and to lie in the range 0.1-10. The effect of molecular hydrogen on the harmonic mean temperature of gas clouds is discussed. (Contractor's abstract)

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

THE INTERSTELLAR ABUNDANCE OF THE HYDROGEN MOLECULE, by R. J. Gould. Jan. 1963, 226p. (Rept. no. CRSR-120) (AF AFOSR-62-191) AD 414444 Unclassified

This report contains chapters on: Mechantsms for the formulation of molecular hydrogen; Dissociative processes for a static interstellar medium; and Dissoctative effects of clouds motions. Also included are 4 appendices: Appendix A: Photodissociation and photoiontzation; Appendix B: Velocity distribution of H I clouds; Appendix C: Stromgren spheres; and Appendix D: Problem in Brownian motion.

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Cornell U. [Center for Radiophysics and Space Research] Ithaca, N. Y.

ACCRETION OF INTERSTELLAR MATTER BY MASSIVE OBJECTS, by E. E. Salpeter. [1964] [5]p. (AFOSR-65-0104) (AF AFOSR-63-321) AD 455826 Unclassified

Also publtshed tn Astrophys. Jour., v. 140: 796-800, Aug. 15, 1964.

Observations of quasi-stellar radio sources have tndicated the existence tn the untverse of extremely massive objects of relatively small stze. The present note discusses the possible further growth in mass of a relatively massive object, by means of accretion of interstellar gas onto tt, and the accompanying energy release. Although there is no evidence for (and possibly some evidence against) quast-stellar radio sources occurring tnside ordinary galaxies, for the sake of concretgness we consider the fate of an object of mass M $> 10^6$ (masses in solar units throughout) tn an ordinary spiral galaxy somewhat like ours.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

EQUILIBRIUM MODELS FOR HELIUM-BURNING STARS. III. SEMI-DEGENERATE STARS OF SMALL MASS, by J. P. Cox and E. E. Salpeter. [1964] [4]p. tncl. diagrs. tables, refs. (AFOSR-65-0105) (AF AFOSR-63-321) AD 455738 Unclassifted

Also publtshed tn Astrophys. Jour., v. 140: 485-498, Aug. 15, 1964.

Equiltbrtum models are constructed for pure heliumburntng stars of small mass. Effects of nonrelativistic electron degeneracy on the equation of state and electron thermal conduction on the opactty are tncluded tn the calculations. It ts found that, for a star of given mass M, the central temperature attatns a maximum value $T_{c,\,max}$ when the central density ts a few times lower than that of a zero-temperature whtte-dwarf star of the same mass. A lower mass ltmtt M_{mtn} of about 0.35 $M_\odot$ ts dertved for pure heltum-burning stars. Properties of helium-burning stars with M near M_{min} are discussed, as is their evolution toward the whtte-dwarf stage. The early evolution of the models away from the tnttial heltum-burntng "main sequence" has been approximately followed to the stage where the mass fraction of heltum tn the convective core has been reduced to 10%. The models are found to evolve upward roughly along the helium-burntng matn sequence itself.

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Cornell U. Center for Radiophysics and Space Research, Ithaca, N. Y.

EQUILIBRIUM MODELS FOR HELIUM-BURNING STARS. IV. MASSIVE STARS AND NUCLEAR ABUNDANCES, by W. Deinzer and E. E. Salpeter. [1964] [11]p. tncl. diagrs. tables. (AFOSR-65-0106) (AF AFOSR-63-321) AD 455739 Unclassifted

Also publtshed tn Astrophys. Jour., v. 140: 499-509, Aug. 15, 1964.

Equtltbrtum models are constructed for pure heltum-burning stars of large mass M, where radiation pressure ts tmportant. The approach of extremely masstve models to fully convective, polytropes with n = 3 ts discussed. The early evolution of the models from the tnttial heltum-burntng matn sequence has been followed till the mass funct on x_α of helium tn the convective core is 0.02. The abundances of C^{12}, O^{16}, Ne^{20}, and Mg^{24} as a function of x_α were calculated for different masses M. The main final products are C and O for $M \lesssim 4$ (in solar untts), O for $M \sim 10$ to 100, and Mg for $M \sim 10^3$ to 10^5. The ftnal abundance of Ne ts fairly small for all masses. When x_α ts small, the energy production is largely from (α, γ) reacttons, and enhancement factors for the rate ϵ (over that for the triple-alpha reaction alone) are presented.

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Cornell U. [Center for Radiophystcs and Space Research] Ithaca, N. Y.

THE DIRECTION OF TIME AND THE EQUIVALENCE OF 'EXPANDING' AND 'CONTRACTING' WORLD-MODELS, by D. L. Schumacher. [1964] [5]p. (AFOSR-65-0407) (AF AFOSR-63-321) AD 612232 Unclassifted

Also published tn Proc. Cambridge Philos. Soc., v. 60: 575-579, 1964.

It is assumed tnttially that only the tncrease of entropy deftnes locally the sense of advance of time. Thts assumption, together with the feature of global cohere... of statistical processes, whtch is provided by the cosmic line-element, imply that there is a unique way of assoctating the standards with the cosmic statistical processes. There ts hence a connection between the sense of divergence of geodesics of fundamental observers and the cosmtc time-sense. This ts tn keeptng with the unmodified conservatton laws of gravitation and the analogous adiabatic conversation law qutte generally without dependence on the explicit form of the line element. These remarks correspond exactly to consequences of the 'elltptic' model tn the case of de Sitter space, obtatned by entirely separate geometrtcal considerations. A remark ts made with regard to the trreversibiltty associated with quantum measurement.

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Cornell U. Dept. of Btochemtstry, Ithaca, N. Y.

RESPIRATION DURING PHOTOSYNTHESIS, by H. V. Marsh, Jr., J. M. Gulmiche, and M. Gibbs. [1964] [13]p. tncl. tables, refs. (AFOSR-65-0359) (AF 49-(638)798) AD 611732 Unclassifted

Also published in Record Chem. Prog., v. 25: 259-271, Dec. 1964.

An attempt has been made to determine the effect of light on the operation of the tricarboxylic acid cycle in a green alga. Scenedesmus obliquus was incubated with acetate-1-C^{14}, acetate-2-C^{14} or pyruvate-3-C^{14}. Citrate, α-ketoglutarate, malate, succinate, and glutamate were isolated and degraded. Asparate was isolated but not degraded. Sufficient cells were used to obtain specific activity values for each compound without the addition of unlabeled carrier. A classical Krebs cycle is present in these cells. While light decreases the amount of acetate and pyruvate from entering the cycle by increasing lipid synthesis, light has no detectable effect on the turnover of the intermediates of the cycle. Acetate apparently entered the cycle exclusively as acetyl-CoA. This compound is apparently a port of entry into the cycle for pyruvate but in the light there is superimposed a carboxylation of pyruvate to malate. The malic acid formed in the light is not in complete equilibrium with other intermediates of the citric acid cycle. The metabolism of aspartic acid differs in the light and dark. Contrary to previous reports, glutamic acid derives solely from the tricarboxylic acid cycle.

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Cornell U. Dept. of Chemistry, Ithaca, N. Y.

CRITICAL OPALESCENCE OF BINARY MIXTURES: PERFLUOROTRIBUTYLAMINE ISOPENTANE, by P. Debye, D. Caulfield, and J. Bashaw. [1964] [4]p. incl. diagrs. refs. (AFOSR-65-0373) (AF AFOSR-62-12) AD 811930 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3051-3054, Nov. 15, 1964.

Critical opalescence of the binary liquid mixture perfluorotributylamine and isopentane is investigated. By combining light scattering and x-ray scattering measurements, data over a broad range of values of s/λ [$s = 2 \sin(\theta/2)$, λ is wavelength] are obtained. The second moment of the averaged intermolecular pair potential is determined. It is shown how deviations from straight line behavior in plots of reciprocal intensity vs $(s/\lambda)^2$ are determined by the shape of the intermolecular pair potential curve.

657

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

ON THE COEXISTENCE OF LIQUID PHASES IN METAL-AMMONIA SYSTEMS AND SOME SURFACE TENSION STUDIES ON THESE SOLUTIONS ABOVE THEIR CONSOLUTE POINTS, by M. J. Sienko. [1963] 18p. (AFOSR-64-0881) (AF AFOSR-82-218) AD 438673 Unclassified

Also published in Solutions Metal-Ammoniac Properties Physico-Chimiques, June 1963, p. 23-40.

The phase diagrams of metal-NH_3 systems are reviewed with particular attention to the miscibility gap in the Li, Na, and K systems. The unique character of the parabolic coexistence curves and their implications of long range forces are considered, together with a simple model of electron delocalization. The latter leads to predicted consolute concentrations of 3.9 atomic % M in NH_3, in remarkable agreement with observed values. The course of surface tension vs concentration has been investigated above the consolute temperature. Behavior is salt-like at low concentrations of M in NH_3 and metallic at high. Vestigial traces of the critical phenomena appear in the surface tension curves but, as expected, diminish with increased departure from the critical temperature. (Contractor's abstract)

658

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

A TWO-STAGE, TWO-CENTER DECARBOXYLATION, by M. J. Goldstein and G. L. Thayer, Jr. [1963] 2p. (AFOSR-64-1791) (AF AFOSR-63-142) AD 449089 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2673-2674, 1963.

Thermal decarboxylation of the α-pyrone-maleic anhydride adduct was chosen for study assuming (a) that this might legitimately be regarded as a Diels-Alder retrogression and (b) that the structural simplicity of the dienophilic fragment might simplify interpretation of the experimental results.

659

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

THE CATION RADICAL OF TETRAKIS(DIMETHYLAMINO)ETHYLENE, by K. Kuwata and D. H. Geske. [1964] 5p. incl. diagrs. refs. (AFOSR-64-1511) (AF AFOSR-63-188) AD 488115 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 88: 2101-2105, 1964.

Examination of the polarographic behavior of tetrakis(dimethylamino)ethylene (TDE) showed a two-step wave corresponding to oxidation to TDE^+ and TDE^{+2}. The cation radical TDE^+ was obtained by oxidation of TDE and reduction of TDE^{+2} as well as by the homogeneous reaction of TDE and TDE^{+2}. The electron spin resonance spectrum of TDE^+ was obtained. The assigned coupling constants are $a_N = 4.85 \pm 0.01$ (4 equivalent N^{14} nuclei), $a_H = 2.84 \pm 0.01$ (12 equivalent protons), $a_H = 3.28 \pm 0.01$ G (12 equivalent protons). The nitrogen coupling constant is discussed in relation to coupling constants for other nitrogenous cation radicals. Observation of two different methyl proton coupling constants is rationalized in terms of restricted rotation about the C-$N(CH_3)_2$ bond. (Contractor's abstract)

660

Cornell U. [Dept. of Chemistry] Ithaca, N. Y.

ORGANIC ELECTRO-OXIDATIONS, by D. H. Geske. Final rept. Oct. 31, 1964, 11p. (AFOSR-64-2249) (AF AFOSR-63-166) Unclassified

It was found possible to oxidize picrate ion on a platinum electrode in acetonitrile solution. A detailed study of the electrode process was undertaken by means of voltammetry, chronopotentiometry, and controlled potential coulometry. An overall reaction process is proposed which involves a very short-lived picryl radical that decays by at least two different reactions—the most predominant of which forms picric acid by nitrogen abstraction.

661

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

ON THE RADIAL DISTRIBUTION FUNCTION IN FLUIDS, by B. Widom. [1964] 4p. (AFOSR-64-1915) (AF AFOSR-63-324) AD 450330 Unclassified

Also published in Jour. Chem. Phys., v. 41: 74-77, July 1, 1964.

It is shown that if g(r) is the radial distribution function and $\varphi(r)$ the pair potential, then the function $F(r) = g(r) \exp[\varphi(r)/kT]-1$ has a number of properties analogous to those of the pair correlation function $G(r) = g(r) - 1$ which are known from the Ornstein-Zernike theory. The integral of F(r) over all space is related to the fluctuations in a certain well-defined physical quantity, in the same way that the integral of G(r) is related to fluctuations in density. The integral of F(r), furthermore, is shown to be always positive, so that on the average g(r) exceeds $\exp[-\varphi(r)/kT]$. Finally, it is shown that if one makes a hypothesis analogous to one which is familiar in the Ornstein-Zernike theory, then it follows that the pair correlation function g(r) cannot vanish more rapidly than the pair potential $\varphi(r)$ as $r \to \infty$. (Contractor's abstract)

662

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

DEGREE OF THE CRITICAL ISOTHERM, by B. Widom. [1964] 2p. incl. diagr. (AFOSR-65-0108) (AF AFOSR-63-324) AD 455798 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1633-1634, Sept. 15, 1964.

An argument is presented which indicates that if g is the degree of the critical isotherm, d the degree of the coexistence curve, and f the power of $|T_c - T|^{-1}$ with which the isothermal compressibility becomes infinite as the critical point is approached, then $g = 1 + fd$. The relation of this result to other theoretical and experimental facts is discussed. (Contractor's abstract)

663

Cornell U. Dept. of Chemistry, Ithaca, N. Y.

OCCUPATION PROBABILITIES IN THE LATTICE GAS, by J. M. J. Van Leeuwen. [1964] 4p. incl. table. (AFOSR-65-1116) (AF AFOSR-63-324) AD 620477 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2959-2962, Nov. 15, 1964.

A lattice-gas model is considered which consists of N particles distributed among V/ν_0 cells of equal volume ν_0. A set of relations obtained by Widom for the probabilities f_r that an empty cell is surrounded by r filled cells is rederived and extended. The consequences of the relations for the partition function, the correlation functions, and partially coupled systems are discussed.

664

Cornell U. [Dept. of Engineering Physics] Ithaca, N. Y.

INVESTIGATION OF THE OXIDATION OF COPPER BY ELECTRON DIFFRACTION, by E. Yoda and B. M. Siegel. [1963] 4p. (AFOSR-J1573) (AF AFOSR-62-7) AD 427630 Unclassified

Also published in Jour. Appl. Phys., v. 34: 1512-1515, May 1963.

The manner in which the oxide phase nucleates and grows on copper single crystals exposed to oxygen at a pressure of 1 x 1/100 mm of Hg and at temperatures between 300 and 400°C has been investigated by reflection electron diffraction and electron microscopy. Widely spaced oxide crystallites oriented with the (110) direction parallel to the (110) direction of the copper form and continue to grow at these temperatures even after the removal of the oxygen atmosphere. No polycrystalline phase was observed to form under these conditions, but the intensities of the copper spot pattern and Kikuchi lines decreased during exposure to oxygen and partially recovers in intensity during subsequent heat treatment.

665

Cornell U. [Dept. of Physics] Ithaca, N. Y.

K-BETA EMISSION SPECTRA OF ARGON AND KCl, by R. D. Deslattes. [1964] [9]p. (AFOSR-64-1741) (AF 49(638)402) AD 448286 Unclassified

Also published in Phys. Rev., v. 133: A390-A398, Jan. 20, 1964.

Measurements of the K beta region of argon gas, and potassium and chloride in KCl are reported. These spectra were obtained in fluorescence and recorded by means of a vacuum, two-crystal spectrometer using calcite crystals. Under high-energy fluorescent excitation, the chlorine spectrum differs only slightly from that obtained under electron bombardment. Differences

if any in the potassium spectrum are not apparent. The argon spectrum does not seem to have previously examined with sufficient resolution and intensity linearity to allow such comparison. The spectra are discussed together in an attempt to clarify some of the problems associated with the chlorine valence emission band.

666

Cornell U. [Dept. of Physics] Ithaca, N. Y.

K-BETA SPECTRA OF ARGON AND KCl. VI. SATELLITE EXCITATION, by R. D. Deslattes. [1964] 9p. (AFOSR-64-1742) (AF 49(638)402) AD 448288 Unclassified

Also published in Phys. Rev., v. 133: A399-A407, Jan. 20, 1964.

A model for double-vacancy, single-jump satellites was considered for the case of the K-beta spectra of argon, and argon-like ions. The excitation thresholds implied by this model were investigated by quasimonochromatic fluorescence for the K-beta spectrum of chlorine in KCl. Significant alterations in the spectrum, depending on the character of the primary radiation, are reported for this case. From these observations, the initial states for certain of the more prominent spectral features have been identified as belonging to the configuration KM. (Contractor's abstract)

667

Cornell U. [Dept. of Physics] Ithaca, N. Y.

ARGON K ABSORPTION EDGE BY THE COUNTER RESPONSE-METHOD, by H. W. Schnopper. [1964] 2p. (AFOSR-64-2348) (AF 49(638)402) AD 452252 Unclassified

Also published in Phys. Rev., v. 133: A627-A628, Feb. 3, 1964.

The fine structure of the argon K absorption edge has been observed by measuring the response of an argon-filled proportional counter as a function of the incident x-ray energy. It is shown that the response of a thin counter is proportional to the K-shell contribution to the linear absorption coefficient. The fine structure observed in this method is then shown to be the same as is recorded in the conventional absorption method. (Contractor's abstract)

668

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

[NON-ISENTROPIC GAS DYNAMICS]. Final rept. Sept. 1959-Mar. 31, 1963. July 17, 1963, 4p. (AFOSR-5147) (AF 49(638)674) AD 411194 Unclassified

Inviscid boundary layer is studied and its behavior when the flow is characterized by a strong magnetic field. (Contractor's abstract)

669

Cornell U. Graduate School of Aeronautical Engineering, Ithaca, N. Y.

[HIGH SPEED AERODYNAMICS WITH REAL GAS EFFECTS] by W. R. Sears. Final rept. May 1, 1962-Apr. 30, 1964. June 15, 1964, 3p. (AFOSR-34-1138) (AF AFOSR-62-201) AD 601730 Unclassified

Summaries are given of researches in the following fields: Magneto-dynamics of high-temperature gases; Gasdynamics of real and chemically reacting gases; and Dynamics of rarefied gases. A bibliography is given of the 15 publications generated under this grant.

670

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

ANALOG STUDIES OF UPSTREAM-INCLINED WAVES IN MAGNETO-GASDYNAMIC FLOW, by L. S. Iwan. Dec. 1963, 39p. (Rept. no. NP-13) (AF AFOSR-62-201) AD 435901; AD 437750 Unclassified

An analog was devised to study two dimensional magneto-gasdynamic flow for the case of aligned magnetic and velocity fields and a perfectly-conducting compressible fluid. The analog consists of stretched elastic sheets in an incompressible fluid. The elastic sheets are analogous to a magnetic field and produce a body force on the fluid when displaced from their equilibrium positions. The differential equations describing the system are the same as the magneto-gasdynamic equations for the case cited, except for the expression for the body force in the momentum equations. Analysis of the analog system reveals striking similarities between the small disturbance propagation characteristics of that system and magneto-gasdynamics. In particular, it is shown that it is possible to simulate the conditions under which forward-inclined disturbance waves are predicted in magneto-gasdynamics flows about bodies. (Contractor's abstract)

671

Cornell U. [Graduate School of Aeronautical Engineering] Ithaca, N. Y.

THE DYNAMICAL EQUATIONS OF PARTIALLY IONIZED GASES, by G. D. Brinker. Sept. 1963, 87p. (AF AFOSR-62-201) AD 428797 Unclassified

The dynamical equations for each component of a partially ionized monatomic gas are presented in two forms. These formulations should be most useful in analyzing the effects of ionization in such nonequilibrium regions as plasma oscillation and boundary layers. Using a perturbed Maxwellian distribution to evaluate the collision integrals, the appropriate transfer

equations for the multi-component gas have been given. These transfer equations simplify greatly when the gas is assumed to be very lightly ionized and are reduced to the equations of a single-fluid-with-conduction model. Secondly, the equations for a three-fluid model are derived. In this model the properties of each species are defined in terms of its own motion, and not in terms of the total mass motion as in the one-fluid model. This model provides a useful physical interpretation of Joule heating effects.

672

Dartmouth Coll., Hanover, N. H.

THE PHOTOELECTRIC CROSS SECTIONS OF Sn, Ta AND Au AT 2.62 MEV, by F. Titus. Nov. 1963, 16p. incl. illus. diagr. tables, refs. (AFOSR-J1242) (AF 49(638)634) AD 424314 Unclassified

Also published in Nuclear Phys., v. 69: 179-185, July 1965.

The photoelectric cross sections of Sn, Ta, and Au at 2.62 mev have been measured in terms of the differential Compton scattering cross section at the same energy. The measured cross sections are in barns; 0.11 ± 0.03, 0.47 ± 0.05, and 0.74 ± 0.06 for Sn, Ta, and Au respectively. These cross sections are considerably smaller than those tabulated by Grodstein and also than cross sections extrapolated from the theoretical work of Pratt. (Contractor's abstract)

673

Dartmouth Coll., Hanover, N. H.

ISOTHERMAL FLOW OF SUPERFLUID HELIUM (Abstract), by J. N. Kidder and H. A. Blackstead. [1964] [1]p. (AFOSR-65-0400) (AF AFOSR-63-74) AD 612350 Unclassified

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 437, 1964.

Measurements have been made of the isothermal, gravitational flow of superfluid helium at 1.09°K in a circular cross section capillary. The capillary is 0.025 cm internal diam and 170 cm long. Flow between 2 concentric reservoirs is induced by mechanical displacement of the fluid in the outer reservoir. The inner reservoir is a microwave resonant cavity. The pressure gradient and the fluid velocity are calculated from the cavity resonant frequency and the geometry of the system. The pressure gradient along the capillary varied from 1 to 5×10^{-3} dy/cm^3 during the flow measurements, the latter value representing the limit of resolution of the apparatus. The fluid velocity extrapolated to zero pressure gradient is 1 cm/sec, which is interpreted as the superfluid critical velocity. The normal fluid component of the liquid is assumed to be flowing as well as the superfluid, but the observed pressure gradients are too small to be caused by laminar viscous flow at the observed velocities. The pressure gradient has a non-linear dependence on the fluid velocity, for velocities greater than the critical value, similar to that of ordinary turbulent flow, but the calculated Reynolds number indicates that this cannot be turbulence in the normal fluid.

674

Dartmouth Coll., Hanover, N. H.

[FUNCTIONAL ANALYSIS AND PROBABILITY THEORY], by E. Albert, D. R. Ostberg, and W. E. Ritter. Final technical rept. Oct. 1, 1962 - Sept. 30, 1963. Nov. 1963, 6p. (AFOSR-J1351) (AF AFOSR-63-126) AD 428455 Unclassified

A brief description of the research to be done under this contract by the participating members is given. No technical information is contained in the document.

675

Delaware U. [Dept. of Electrical Engineering] Newark.

PHOTOEMISSION STATISTICS FOR NARROWBAND SIGNALS, by L. P. Bolgiano, Jr. [1964] 5p. (AFOSR-64-2506) (AF AFOSR-63-2) AD 453743 Unclassified

Also published in Proc. Third Internat'l. Cong. on Quantum Electronics, Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 187-191, 1964.

A photoelectron probability distribution, with a variance which could be interpreted as simultaneously representing both wave and particle fluctuations, was computed by Mandel by associating photons stochastically with Gaussian random waves. This probability distribution for the number of photoelectrons ejected by a random signal of limited bandwidth has the form of the distribution giving the number of indistinguishable Bose-Einstein particles to be found in a limited region of phase space at thermal equilibrium. A derivation is given which leads to Mandel's distribution as a general probability distribution for the number of occurrences of a discrete event which reoccurs randomly in time. The Poisson distribution is a limiting form of Mandel's distribution. Because the Poisson distribution is the more familiar distribution, it helps explain the derivation by reviewing a popular derivation leading to the Poisson distribution, with a view towards considering how the derivation might be modified so as to take into account the impossibility of measuring rapid electromagnetic signal variations without using adequately wide bandwidths. (Contractor's abstract)

676

Delaware U. Dept. of Electrical Engineering, Newark.

COMMUNICATION CHARACTERISTICS OF PHOTOELECTRIC DETECTION, by J. H. Deal, Jr. Master's thesis. June 1964, 68p. (Technical rept.) (Rept. no. TR-Q41) (AFOSR-65-0027) (AF AFOSR-63-2) AD 628546 Unclassified

The probabilistic nature of the photoelectric conversion process augments other sources of noise in limiting the precision with which electromagnetic signals may be measured with a photoelectric detector. This report develops procedures for considering this added uncertainty in signal measurements of interest for radio type communication at optical frequencies. A probabilistic model of an ideal photodetector is used, in conjunction with the classical wave theory of thermal noise, to compute uncertainties associated with the lack of predictibility inherent in both photoelectric conversion and

thermal processes. It is shown how the uncertainty in the detector output may be characterized by a signal-to-noise ratio, and also how decision criteria for signal detection may be based on the probability functions which characterize the detector output. (Contractor's abstract)

677

Delaware U. Dept. of Electrical Engineering, Newark.

QUANTUM LIMITATIONS TO ELECTROMAGNETIC SIGNAL MEASUREMENTS, by L. P. Bolgiano, Jr. Final rept. Jan. 1, 1963 - Dec. 31, 1964, 14p. (AFOSR-65-0028) (AF AFOSR-63-2) AD 610422 Unclassified

It was found possible to develop a mathematical theory of communication which includes quantum effects, and as is also important, reduces to the mathematics of classical communication theory when quantum effects can be neglected. Because photoelectric detection is used universally at optical frequencies, and because it lends itself to a simpler theoretical description, earlier publications have considered the statistics of photo detection - how they differ for coherent and incoherent signals, and the consequences of these differences for information transmission. The work was concentrated in two major areas: (1) Statistics of Photodetection, and (2) Quantum Statistical Analysis of Communication.

678

Delaware U. [Dept. of Psychology] Newark.

INDIVIDUATION AND SOCIALIZATION—A THEORY OF ASSIMILATION IN LARGE ORGANIZATIONS, by R. C. Ziller. [1964] 20p. (AFOSR-65-0071) (AF AFOSR-62-95) AD 455659 Unclassified

Also published in Human Relations, v. 17: 341-360, 1964.

In this paper, the origins of the need for independence-dependence in a social setting are examined in terms of the more basic need for ego identity. The consequences of the need for ego identity in terms of social behavior are explored, related theories are re-examined on the basis of this developing framework, and the implications of the framework are projected to a number of social problems but particularly the problem of the socialization process in large organizations. (Contractor's abstract)

679

Documentation Inc., Bethesda, Md.

MANAGEMENT CONTROL DATA SYSTEM OF THE U.S. AIR FORCE OFFICE OF SCIENTIFIC RESEARCH. Final technical rept. Nov. 1963, 48p. (AFOSR-64-0109) (AF 49(638)1212) AD 430142 Unclassified

MCDS is a centralized, automated total system designed to fulfill the information requirements of the U. S. Air Force Office of Scientific Research in the management of basic research. The scope of the system covers: (1) control of all proposal data from the time of receipt until a specific action completes the proposal phase; (2) the procurement cycle which is initiated upon the acceptance of a proposal; (3) the storage of all obligated purchase actions in a historical file from beginning to completion of a research effort; and (4) a completed file which is a repository for all completed research investigations which are not a function of the active program. The purpose of this research was to analyze the needs of AFOSR's management personnel and to develop a comprehensive system which would furnish the output requirements of AFOSR management. (Contractor's abstract)

680

Dublin U. Trinity Coll. (Ireland).

THE EFFECT OF MECHANICAL VIBRATION ON THE BREAK-UP OF A CYLINDRICAL WATER JET IN AIR, by L. Crane, S. Birch, and P. D. McCormack. [1964] 10p. incl. illus. diagrs. refs. (AFOSR-64-1890) (AF EOAR-63-76) AD 450003 Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 743-751, 1964.

An account of experimental investigation into the effects of high amplitude high frequency mechanical vibration on the break-up characteristics of a liquid jet in air is given. The main phenomenon of imposed periodicity of drop spacing and uniformity of drop size is described, along with several other interesting phenomena. Graphical relationships between parameters such as vibration frequency, amplitude and break-up length are established. While the results largely confirm Rayleigh's original linear analysis with respect to the wavelength of maximum instability, considerable discrepancy is revealed in the magnitude of the amplification factor and considerable departure from linearity is indicated. (Contractor's abstract)

681

Dublin U. Coll. (Ireland).

FLUX LIMITS FOR HIGH-ENERGY γ-RAYS FROM QUASI-STELLAR AND OTHER RADIO SOURCES, by J. H. Fruin, J. V. Jelley and others. [1964] 2p. incl. table. (AFOSR-64-1761) (AF EOAR-63-80) AD 449061 Unclassified

Also published in Phys. Ltrs., v. 10: 176-177, June 1, 1964.

A system of two Cerenkov light detectors in fast coincidences to observe pulses of light from showers in the atmosphere was used. Preliminary measurements were made on clear moonless nights, to establish flux limits for γ-rays from the quasi-stellar sources 3C147, 3C196, 3C273, and have also observed the Crab Nebula and the magnetic variable at 53 Cam. Observations were carried out by comparing counting rates on the

source with regions 30° distant in azimuth, alternatively East and West, at the same zenith angle. Detection rates for showers varied with zenith angle but were about 100 showers/min at the zenith, with random rates set at about 2 counts/min. Observations were made between Jan. and Apr. 1964. (Contractor's abstract)

682

Duke U. [Dept. of Mathematics] Durham, N. C.

COMPLETELY MONOTONE SEQUENCES AS INVARIANT MEASURES, by R. Scoville. [1964] [12]p. (AFOSR-65-0320) (AF AFOSR-61-51) AD 611998 Unclassified

Also published in Trans. Amer. Math. Soc., v. 112: 318-329, Aug. 1964.

Let $a = \{a_n\}$ be a completely monotone sequence of real numbers with $\Sigma_0^\infty a_n = 1$. Form a "building" consisting of length a_n, with a_{n+1} lying above a_n. Let T move points 1 level upward whenever possible, otherwise let T drop the point to the bottom level B_0 and apply a measure-preserving transformation S of B_0. To define S represent B_0 as a building corresponding to Δ_a, its base as a building corresponding to $\Delta^2 a$, and so on. The resulting transformation T_a, which preserves Lebesque measure, can also be represented as a transformation T acting continuously on the space of increasing sequences of non-negative integers. In the latter representation T is independent of a, but has an invariant measure μ_a determined by a. Any invariant probability measure for T is of the form μ_a for some a. T is ergodic relative to μ_a only if $a_n = \theta^n(1-\theta)$ for some $0 \leq \theta < 1$. Some results concerning the spectrum of T in this case are that when $\theta < \frac{1}{2}$, T has no prime roots of unity as eigenvalues, and all powers of T are ergodic. When restricted to the set U of unbounded sequences T is 1:1 and onto. By applying the Kryloff-Bogoliouboff decomposition theorem to the Borel system (T, U) it is possible to obtain the classical representation $a_n = \int_0^1 t^n d F_a(t)$, where F_a is an increasing function on [0, 1]. An inversion formula for F_a can also be obtained in this way. (Math. Rev. abstract)

683

Duke U. [Dept. of Mathematics] Durham, N. C.

RESEARCH IN PARTIAL DIFFERENTIAL EQUATIONS, by J. J. Gergen. Final technical rept. Jan. 4, 1963, 7p. (AF AFOSR-61-51) AD 295190 Unclassified

Papers and reports prepared under the project are listed. The list includes 14 papers published in mathematical journals, one published in a conference proceedings, and one available at the U. S. Department of Commerce, Office of Technical Services. Seven papers either submitted or accepted for publication are noted. (Contractor's abstract)

684

Duke U. Dept. of Mathematics, Durham, N. C.

OPEN IDEALS IN C(X), by L. A. Hinrichs. [1964] [9]p. (AFOSR-65-1004) (AF AFOSR-62-162) AD 618835 Unclassified

Also published in Pacific Jour. Math., v. 14: 1255-1263, 1964.

A group topology on the ring C(X), of all real-valued, continuous functions on X, is said to have the ideal closure property (I. C. P.), in case the closure of any ideal is simply the intersection of all maximal ideal containing it. This paper considers which ideals of C(X) can be open with respect to such a topology. A characterization of such ideals is given and it is shown that the family $\mathfrak{L}$, of all such ideals, is itself a fundamental system of neighborhoods of zero with respect to a ring topology having I. C. P. The 2 extremes are considered where $\mathfrak{L}$ is the family of all ideals and where $\mathfrak{L}$ consists only of finite intersections of maximal ideals. Finally it is shown that if P is a countable discrete subset of the Stone-Cech compactification of X, then $\cap \{M^p; p \in P\} \notin \mathfrak{L}$ if and only if P is C-embedded in $X \cup P$.

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Duke U. [Dept. of Physics] Durham, N. C.

RADIATION CHEMISTRY IN THE SOLID STATE AS STUDIED WITH ELECTRON PARAMAGNETIC RESONANCE, by W. Gordy. Jan. 16, 1963, 19p. (AFOSR-J1297) (AF AFOSR-62-327) AD 424220 Unclassified

Presented at Internat'l. Conf. on Radiation Research, Army Natick Labs., Natick, Mass., Jan. 14-16, 1963.

This report contains: Characteristic ESR Patterns of Some Common Free Radicals; Nuclear Effects in the ESR of Hydrocarbon Free Radicals; Radiation Effects on Polypeptides; Oxygen Effect in Radiation Damage; and Chemical Protection from Ionizing Radiation.

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Duke U. [Dept. of Physics] Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SINGLE CRYSTALS OF SUGARS, by H. Ueda. [1963] [6]p. (AFOSR-64-0048) (AF AFOSR-62-327) AD 431087 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2185-2190, 1963.

Single crystals of lactose hydrate, sucrose, methyl-d-glucoside, glucoronolactone, d-glucosamine-HCl, and diacetone sorbose were irradiated at 77°K and their e. s. r. spectra were observed immediately after irradiation or after annealing at 193°K. These sugars also were irradiated at room temperature, and their e. s. r. spectra were observed at this temperature. The

position of the substituted functional group in a substitute sugar molecule is more accessible to radiation damage than other positions in the molecule. Therefore, the positions are selectively damaged by irradiation. For this reason, the e. s. r. spectra of irradiated single crystals of sugar derivatives differ greatly from those found in the unsubstituted parent sugars. The free radicals formed in sugars by irradiation at 77°K are transformed by subsequent annealing. These transformation processes can be explained by a change in the configuration of the radical species in most instances. However, there are a few cases where the transformation includes migration of the free-radical site. (Contractor's abstract)

687

Duke U. [Dept. of Physics] Durham, N. C.

MILLIMETER WAVE SPECTROSCOPY OF UNSTABLE MOLECULAR SPECIES. 1. CARBON MONOSULFIDE, by R. Kewley, K. V. L. N. Sastry and others. [1963] [5]p. (AFOSR-64-1912) (AF AFOSR-62-327) AD 450510 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2856-2860, Dec. 1, 1963.

The carbon monosulfide species CS^{32} and CS^{34} are investigated with a millimeter wave spectrometer designed for the study of short-lived molecules in the frequency range from 60,000 to 300,000 mc/sec. Spectroscopic constants were obtained. The spectrometer is described. Carbon monosulfide is not a free radical in that it has no resultant electronic moment. However, it is a very unstable molecular species and requires for its detection experimental methods similar to those employed for unstable free radicals. The present spectrometer was used in obtaining more complete information on its rotational constants. (Contractor's abstract)

688

Duke U. [Dept. of Physics] Durham, N. C.

APPLICATION OF ELECTRON SPIN RESONANCE TO THE DETERMINATION OF HYDROPEROXIDES, by H. Ueda. [1963] [2]p. (AFOSR-64-1962) (AF AFOSR-62-327) AD 452296 Unclassified

Also published in Anal. Chem., v. 35: 2213-2214, Dec. 1963.

There are few examples in which ESR has significant importance as an analytical technique. The experimental result, which is reported in this paper, will find an application to the determination of hydroperoxides in a solution. The solutions of 1, 1-diphenyl-2-picryl hydrazyl (DPPH) in benzene, and in the case of tert-butyl hydroperoxide (BHPO) in several other solvents, were prepared. To these solutions, BHPO (containing 10% of tert-butyl alconol), cumene hydroperoxide (CHPO), peracetic acid (PAA) or metachloroperbenzoic acid (CPBA) was added and after a definite interval of time the ESR spectra were observed. The ESR measurements were made on an X-band spectrometer at room temperature and the spectra were recorded as the second derivatives. The solvents used were reagent grade and were not treated to remove any dissolved oxygen. (Contractor's abstract)

689

Duke U. [Dept. of Physics] Durham, N. C.

FURTHER STUDIES OF RADIATION EFFECTS ON THE PROTEINS AND THEIR CONSTITUENTS, by R. A. Patten and W. Gordy. [1964] [16]p. (AFOSR-64-1963) (AF AFOSR-62-327) AD 452297 Unclassified

Also published in Radiation Research, v. 22: 29-44, May 1964.

The ESR patterns of γ-irradiated proteins have been obtained and compared with those of molecular and mechanical mixtures of their constituent amino acids. As in previous studies, the ESR patterns most often found are those characteristic of glycine and cystine (or cysteine) residues. Evidence is found, however, for free radicals formed from alanine and certain other residues in some of the proteins. Pronounced effects of atmospheric gases and of temperature changes are observed. The ESR patterns of the molecular mixtures of the amino acids are unlike either those of the mechanical mixtures or those of the proteins. (Contractor's abstract)

690

Duke U. [Dept. of Physics] Durham, N. C.

ELECTRON SPIN RESONANCE STUDIES OF IRRADIATED SINGLE CRYSTALS OF METHACRYLAMIDE, by H. Ueda. [1964] [10]p. (AFOSR-64-1980) (AF AFOSR-62-327) AD 452403 Unclassified

Also published in Jour. Polymer Sci., v. 2: 2207-2216, 1964.

Irradiated single crystals of methacrylamide were studied by electron spin resonance. Irradiations were made at 77 and 288°K and measurements were made at 77, 193, and 293°K. Only chemical changes explain these spectra. The original scission is C-C breakage between ($CONH_2$) and $CH_2 = C(CH_3)$-, and C-H breakage between $CH_2 = C\text{-}(CONH_2)\,CH_2$- and H; these small fragments react with methacrylamide and finally produce two free radicals at room temperature. These two free radicals are the ones which propagate or terminate the polymerization. (Contractor's abstract)

691

Duke U. [Dept. of Physics] Durham, N. C.

MICROWAVE AND MILLIMETER WAVE SPECTRA OF HYDRAZOIC ACID, by R. Kewley, K. V. L. N. Sastry, and M. Winnewisser. [1964] [15]p. (AFOSR-64-1981) (AF AFOSR-62-327) AD 452298 Unclassified

Also published in Jour. Molec. Spectros., v. 12: 387-401, Apr. 1964.

Five rotational transitions were recorded for each of the abundant species of hydrazoic acid and hydrazoic acid-d. Both molecules have normal centrifugal distortion behavior. The spectroscopic constants derived from the measurements are given. An important part of the study was a reinvestigation of the J = 0-1 transition of HN_3 which gave $eq_{aa}Q = +4.65 \pm 0.25$ mc/sec for the NH nitrogen N-14 nucleus. (Contractor's abstract)

692

Duke U. [Dept. of Physics] Durham, N. C.

MILLIMETER-WAVE MOLECULAR-BEAM SPECTROSCOPY: ALKALI CHLORIDES, by P. L. Clouser and W. Gordy. [1964] [8]p. (AFOSR-64-1920) (AF AFOSR-64-493) AD 450517 Unclassified

Also published in Phys. Rev., v. 134: A863-A870, May 18, 1964.

The pure rotational spectra of the alkali chlorides were investigated in the 0.96- to 3-mm range of the microwave region with the molecular-beam spectrometer earlier developed at Duke U. Introduction of Teflon microwave lenses and high-pass microwave filters improved this spectrometer so that measurements into the submillimeter region were possible, to an accuracy of better than one part in 1 million. Dunham's solution for the diatomic molecule was applied in interpretation of data. Improved values and derived quantities such as potential coefficients, isotopic mass ratios, moments of inertia, and internuclear distances are reported. For most of these quantities, the accuracies obtained surpass those from previous measurements. (Contractor's abstract)

693

Duke U. [Dept. of Physics] Durham, N. C.

EXTENSION OF SUBMILLIMETER WAVE SPECTROSCOPY BELOW A HALF-MILLIMETER WAVELENGTH, by G. Jones and W. Gordy. [1964] [2]p. (AFOSR-64-1921) (AF AFOSR-64-493) AD 450511 Unclassified

Also published in Phys. Rev., v. 135: A295-A296, July 20, 1964.

The earlier measurements in the region above one-half mm were made with harmonic generators driven by cm-wave klystrons. Attempts to extend the coverage below a half-mm with cm-wave fundamental energy failed. Recently, however, klystrons in the 5-mm range with output power of the order of 100 mW have become available. (Contractor's abstract)

694

Duke U. [Dept. of Physics] Durham, N. C.

CENTRIFUGAL DISTORTION EFFECTS AND STRUCTURE OF HYDRAZOIC ACID FROM THE MILLIMETER WAVE ROTATIONAL SPECTRA, by M. Winnewisser and R. L. Cook. [1964] [6]p. (AFOSR-65-0110) (AF AFOSR-64-493) AD 455799 Unclassified

Presented at 1964 Spring meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Also published in Jour. Chem. Phys., v. 41: 999-1004, Aug. 15, 1964.

Hydrazoic acid is a slightly asymmetric rotor with an abnormally large A_0 rotational constant. Recently, the rotational spectra of HN_3 and DN_3 have been reported from this laboratory. Subsequently, the rotational spectra of $^{15}HN^{14}N^{14}N$ and $^{14}HN^{14}N^{15}N$ have been investigated to yield an improved structure of hydrazoic acid and to study the influence of the c. m. position on centrifugal-stretching terms. Earlier work did not allow a reliable structure calculation since only the sum $(B_0 + C_0)$ was determined. However, the study of the millimeter wave spectra has enabled the determination of both A_0 and $(B_0 - C_0)$, and the evaluation of the internuclear distances. Values of the rotational constants are $^{14}N^{14}N^{15}NH$: $A_0 = 616916$ mc/sec, $B_0 = 11667.54$ mc/sec, $C_0 = 11427.86$ mc/sec; and $^{15}N^{14}N^{14}NH$: $A_0 = 616868$ mc/sec, $B_0 = 11641.76$ mc/sec, $C_0 = 11405.08$ mc/sec. The centrifugal-distortion effects of the high K_{-1} transitions can be accounted for only with the introduction of P^6 distortion constants.

695

Duke U. [Dept. of Physics] Durham, N. C.

ENERGY MIGRATION AND ISOTOPIC EFFECTS IN IRRADIATED SOLIDS AT LOW TEMPERATURE, by W. V. Bouidin and W. Gordy. [1964] [9]p. (AFOSR-65-0111) (AF AFOSR-64-493) AD 455922 Unclassified

Also published in Phys. Rev., v. 135: A806-A814, Aug. 3, 1964.

Energy migration to impurity molecules of hydrogen and methane trapped in solid matrices of argon and krypton at low temperature is shown to occur. The solid containing the impurity molecules in minute quantities was irradiated at 4.2°K with γ rays from Co^{60}, and the free radicals produced by dissociation of impurity molecules were measured from the intensity of their electron spin resonance signals. For concentrations of 0.001 mol fraction of CD_4 in A or Kr, over 500 times as many molecules of CD_4 were dissociated as would be expected from the same quantity of pure CD_4 given the same exposure dose. It is concluded that the dissociation of the dilute impurity is produced almost wholly by the energy absorbed by the matrix and transferred to the impurity molecules. In the

mixed isotopic species-HCD_3, H_2CD_2, and H_3CD it is shown from the relative strength of the ESR signals of H and D atoms that the C-H bond has about 5 times greater probability of being broken by the migrating energy than has a given C-D in the same molecule. This large isotopic effect is attributed to more rapid escape of H over D from the parent molecule within the lattice. (Contractor's abstract)

696

Duke U. Dept. of Physics, Durham, N. C.

SUBMILLIMETER-WAVE SPECTRA OF HCl AND HBr, by G. Jones and W. Gordy. [1964] [4]p. incl. illus. diagr. tables, refs. (AFOSR-65-0410) (AF AFOSR-64-493) AD 612322 Unclassified

Also published in Phys. Rev., v. 136: A1229-A1232, Nov. 30, 1964.

The $J = 0 \rightarrow 1$ transitions of HCl and HBr have been measured in the wavelength regions of 0.59 and 0.48 mm, respectively. These measurements led to the following values of molecular constants: for HCl^{35}, $\nu_0 = 625\,919.24 \pm 0.52$ mc/sec, $eQq = 63.0 \pm 2.8$ mc/sec, $C_I \approx 0$, $B_0 = 312\,991.30 \pm 0.26$ mc/sec, $B_e = 317\,587$ mc/sec, $r_0 = 1.2838_7$ A, $r_e = 1.2745_5$ A; for HBr^{79}, $\nu_0 = 500\,675.24 \pm 0.52$ mc/sec, $eQq = 535.4 \pm 1.4$ mc/sec, $C_I = 0.29 \pm 0.20$ mc/sec, $B_0 = 250\,360.78 \pm 0.13$ mc/sec, $B_e = 253\,790$ mc/sec, $r_0 = 1.4243_9$ A, $r_e = 1.4146_0$ A; and for HBr^{81}, $\nu_0 = 500\,519.41 \pm 0.26$ mc/sec, $eQq = 447.9 \pm 1.4$ mc/sec, $C_I = -0.31 \pm 0.20$ mc/sec, $B_0 = 250\,282.88 \pm 0.13$ mc/sec, $B_e = 253\,710$ mc/sec, $r_0 = 1.4140_2$ A, $r_e = 1.4146_0$A.

697

Duke U. Dept. of Physics, Durham, N. C.

MILLIMETER WAVE SPECTROSCOPY OF UNSTABLE MOLECULAR SPECIES. II. SULFUR MONOXIDE, by M. Winnewisser, K. V. L. N. Sastry and others. [1964] [5]p. incl. illus. diagrs. tables, refs. (AFOSR 65-0411) (AF AFOSR-64-493) AD 612323 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1687-1691, Sept. 15, 1964.

Several spectral transitions of the gaseous free radical SO have been observed in the millimeter wave region. Analysis of the observed lines confirms that the molecule has a $^3\Sigma$ ground state and leads to the rotational constants $B_0 = 21\,523.75$ mc/sec and $D_0 = 0.0334$ mc/sec, also to the magnetic coupling constants $\lambda = 158\,209.4$ mc/sec and $\gamma = -164.52$ mc/sec. The assignments and analysis are confirmed by a close fitting, within approximately 1 mc/sec, of all measured and calculated frequencies, and by the Zeeman effect which is measured and analyzed for several transitions. (Contractor's abstract)

698

Duke U. Dept. of Physics, Durham, N. C.

ELECTRON PARAMAGNETIC RESONANCE OF VANADYL IONS TRAPPED IN RNA AND DNA, by W. Snipes and W. Gordy. [1964] [2]p. incl. diagr. (AFOSR-65-1120) (AF AFOSR-64-493) AD 620482 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3661-3662, Dec. 1, 1964.

Electron resonances in RNA and DNA with a variety of intensities and line shapes have been found, most of which have been attributed to the transition elements in the nucleic acid samples. In the present investigation, a well-resolved spectrum of 8 components was found in 3 commercially obtained samples of RNA. The octet appears to be a hyperfine structure arising from the ^{51}V nucleus, for which I, the nuclear spin quantum number, = 7/2. The electron paramagnetic resonance spectrum is that of the vanadyl ion VO^{2+} trapped in some manner in the RNA molecule. Whether these vanadyl ions have a biological origin and function is not known.

699

Duke U. [Dept. of Physics] Durham, N. C.

MILLIMETER WAVE SPECTRUM OF SULFUR MONOXIDE (Abstract), by M. Winnewisser, K. V. L. N. Sastry, and W. Gordy. [1964] [1]p. (AF AFOSR-64-493) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

With a new type of millimeter wave spectrometer for the study of short-lived molecules, we have detected 4 rotational transitions in SO, a short-lived gaseous free radical in a $^3\Sigma$ electronic ground state. The observed frequencies are 99 299.85, 127 177.44, 138 178.60, and 172 181.46 mc/sec. An assignment of the frequencies to a particular transition is still somewhat uncertain, but it is hoped that a definite assignment and analysis will be possible soon. With a magnetic field of only 4 G, all lines show a Zeeman triplet. With an electric-field strength of 1500 v/cm, we could not detect any Stark splitting. Earlier efforts to detect the microwave spectrum of SO failed but led to detection of lines attributed to S_2O and SO_2.

700

Duke U. [Dept. of Physics] Durham, N. C.

NUCLEAR ^{33}S HYPERFINE STRUCTURE IN THE ESR

OF γ-IRRADIATED CYSTINE DI-HYDROCHLORIDE, by J. Hadley and W. Gordy. [1964] [1]p. (AF AFOSR-64-493) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Hyperfine components of ^{33}S nuclear magnetic coupling have been detected in the electron spin resonance of free radicals produced by irradiation of single crystals of cystine di-hydrochloride. The ^{33}S in the sample was in its natural abundance of 0.74%. Preliminary analysis of the data indicates that the principal radical formed in the crystal at room temperature is the disulfide radical RSS, although the g tensor indicates that the monosulfide radical RS of the form postulated by Kurita and Gordy is also present.

701

Duke U. [Medical Center] Durham, N. C.

COGNITIVE STRUCTURING, FIELD DEPENDENCE-INDEPENDENCE AND THE PSYCHO-PHYSIOLOGICAL RESPONSE TO PERCEPTUAL ISOLATION, by C. M. Culver, S. 1. Cohen and others. June 1963, 10p. (AFOSR-64-1304) (AF AFOSR-63-57) AD 444259 Unclassified

Also published in Proc. Soc. Biol. Psychiat; Eighteenth Annual Conv. and Scientific Program, Atlantic City, N. J. (June 7-9, 1963), 1963, p. 119-126.

This study investigated the effects of an individual difference variable (the body-field dimension) and an experimentally manipulated situational variable (amount of prior information given to subjects) on the psychophysiological response to a 2-hr perceptual isolation experience. Both body and field subjects showed more GSR nonspecifics when undergoing the low-information experimental condition than the high-information control condition. However, the experimental and control conditions had a differential effect on the groups' heart rate levels: field-experimental and body-control subjects showed a higher heart rate than did their field-control and body-experimental counter-parts. These physiological differences, which only approached significance, were discussed in terms of possible different patterns of physiological arousal in the two groups. (Contractor's abstract)

702

Duke U. Medical Center, Durham, N. C.

PHYSIOLOGIC DISCRIMINATION AND BEHAVIORAL RELATIONSHIPS IN HUMAN INSTRUMENTAL CONDITIONING, by L. A. Graham, S. 1. Cohen, and B. M. Shmavonian. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-64-1957) (AF AFOSR-63-57) AD 450319 Unclassified

Presented at annual meeting of the Soc. of Psychophysiological Research, Detroit, Mich., Oct. 13, 1963.

Also published in Psychosomatic Med., v. 26: 321-336, July-Aug. 1964.

Thirty-three human subjects were exposed to a discrimination instrumental-conditioning design in which the response was a punch-avoidance. The patterns of behavior associated with vague instructions were observed, as were the GSR and heart-rate changes accompanying the different behavioral responses. It was found that GSR discrimination occurred prior to avoidance learning, whereas heart-rate discrimination occurred only with avoidance itself. Some implications of the relationships between the physiologic changes and acquired motor behavior are discussed with regard to the production of hypertensive cardiovascular disease. (Contractor's abstract)

703

Duke U. [Medical Center] Durham, N. C.

BODY AND FIELD PERCEPTUAL DIMENSION AND ALTERED SENSORY ENVIRONMENTS, by S. 1. Cohen and A. J. Silverman. Annual rept. Oct. 1962 - Oct. 1963. Oct. 1963, 35p. (AF AFOSR-63-57) AD 427213 Unclassified

A total of 406 subjects have been tested for perceptual mode and used in a series of experiments over the past 3 yrs. One hundred and five subjects were body-oriented: 212 fell into a middle range and 75 have been field-oriented. In the experiments now being conducted many subjects are being studied in a number of experimental sessions so that the scope of the individual samples will be considerably broadened. The investigations described in this report and previous reports have been undertaken to delineate more carefully differences in body-oriented and field-oriented subjects. Differences in autonomic and behavioral conditioning characteristics together with differences in discrimination learning have been studied. One of the results of this series of experiments may be to lead to the development of techniques to influence the efficiency with which goal directed behavior is maintained or to influence the rapidity of learning complex perceptual and motor tasks (e.g., tasks which are carried out in response to certain signals).

704

Duke U. Medical Center, Durham, N. C.

PERCEPTUAL MODE AND PAVLOVIAN TYPOLOGY, by P. Hein, S. 1. Cohen, and B. M. Shmavonian. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-1364) (AF AFOSR-64-57) AD 616825 Unclassified

Also published in Recent Advances in Biol. Psychiat.; Proc. Nineteenth annual Conv. and Scientific Program, Soc. Biol. Psychiat., Los Angeles, Calif., (May 1-3, 1964), ed. by J. Wortis. New York, Plenum Press, v. 7: 71-76, 1964.

Eleven field-dependent and 11 field-independent subjects were compared in an autonomic conditioning design using one reinforced and 4 nonreinforced colored lights.

The galvanic skin response data indicate that the field-independent group demonstrate more responsiveness and "activation" as well as greater differentiation in their specific responses to the reinforced when compared to the einforced lights.

705

Dynamic Science Corp., South Pasadena, Calif.

SEVENTEENTH AFOSR CONTRACTORS' MEETING ON LIQUID PROPELLANT ROCKET AND AIR-BREATHING COMBUSTION RESEARCH; ABSTRACTS OF PAPERS, Pasadena, Calif., July 6-8, 1964 [32]p. (AFOSR-64-0258) (AF 49(638)1151) AD 623846 Unclassified

Abstracts from papers given at the meeting are presented. Combustion instability and supersonic combustion are given special consideration. Detonative combustion, liquid jets, hot gas temperature profiles, and other aspects of liquid rocket motors are also considered.

706

Dynatech Corp., Cambridge, Mass.

TOROIDAL MEMBRANE UNDER INTERNAL PRESSURE, by J. L. Sanders, Jr. and A. A. Liepins. [1963] [6]p. incl. diagrs. table. (AFOSR-64-0918) (AF 49(638)1096) AD 407750 Unclassified

Presented at AIAA Launch and Space Vehicle Shell Structure Conf., Palm Springs, Calif., Apr. 1-3, 1963.

Also published in AIAA Jour., v. 1: 2105-2110, Sept. 1963.

In the case of a circular toroidal membrane under internal pressure there is no solution of the linear membrane equations for which the displacements are continuous. One possible resolution of the difficulty depends on introduction of an internal bending boundary layer. Another possibility more appropriate for very thin shells is to resort to the nonlinear membrane theory. The present paper is concerned with another method of solving the nonlinear membrane equations of this problem. The equations are reduced to a linear second order differential equation for the rotation of shell elements in which the coefficient of the undifferentiated term contains a large parameter. The equation is amenable to asymptotic methods of integration and the solution is obtained in terms of two analytic functions of a single variable. These two functions together with their first derivatives and certain integrals pertinent to the problem are tabulated in this paper. With the help of these tables the title problem can be solved for practical ranges of the parameters without resort to further machine calculations.

707

Edinburgh U. [Dept. of Physiology] (Gt. Brit.).

SMOOTH MUSCLE RESPONSES AS ALTERED BY HUMORAL BACKGROUND, by L. M. Pickford. Final rept. Dec. 31, 1964 [22]p. incl. diagrs. refs. (AFOSR-65-0664) (AF EOAR-62-79) AD 614478 Unclassified

In man, monkey, rat and dog oxytocin normally has a vasodilator effect. Following surgical or chemical sympathetic denervation oxytocin becomes a vasoconstrictor. The dilator effect can be restored by infusing adrenaline or stimulating the sympathetic nerves. Oxytocin also becomes a vasoconstrictor when the circulating concentration of estrogens is raised either naturally in the presence of estrogens (as in rats in estrus) or experimentally. In dogs the dilator response to oxytocin can be restored by giving atropine, and then either infusing adrenaline or stimulating the sympathetic nervous system. (Contractor's abstract)

708

Electro-Optical Systems, Inc., Pasadena, Calif.

INVESTIGATION OF THE PHENOMENA IN CROSSED-FIELD PLASMA ACCELERATORS, by M. R. Denison and R. W. Ziemer. 1963, 48p. (AFOSR-5185) (AF 49(638)1063) AD 414092 Unclassified

Presented at AIAA Fifth Biennial Gas Dynamics Symposium, Physico-Chemical Diagnostics of Plasmas, Evanston, Ill., Aug. 14-16, 1963.

The acceleration of a plasma by means of a crossed field accelerator is beset by problems which as yet do not have adequate explanations. The experimentally observed effects include: the sudden drop in thrust with increasing magnetic field strength, extremely unsymmetrical electrode heating, and lack of acceleration in some closed channel accelerators. These problems also have their counterparts in MHD generators. In order to obtain a better understanding of the physical phenomena associated with J x B acceleration, an analytical and experimental diagnostic study was undertaken. A primary objective is to determine and understand the current density distribution in the discharge region. (Contractor's abstract)

709

Electro-Optical Systems, Inc., Pasadena, Calif.

PLASMA DIAGNOSTICS STUDIES FOR CROSSED FIELD ACCELERATORS, by A. Proudian. Mar. 1963, 30p. (AFOSR-5074) (AF 49(638)1063) AD 415622 Unclassified

Diagnostic methods investigated include: Spectroscopic and Interferometric Methods -- Optical Interferometry, Continuum Intensity, Line Shape (Series Limit), and Relative and Absolute Line Intensity Measurements; Measurements Involving the Use of Particle Beams -- Electron scattering, Charge Exchange, and Excitation of Target Gas. (Contractor's abstract)

710

Erlangen U. (Germany).

[MAXIMAL HOLOMORPHIC AND MEROMORPHIC REPRESENTATION, II] Maximale holomorphe und meromorphe abbildungen, II, by K. Stein. [1964] 49p. incl. refs. (AFOSR-65-2972) (AF EOAR-62-40) AD 627547 Unclassified

Also published in Amer. Jour. Math., v. 86: 823-868, Oct. 1964.

Theorem I: Let $f: X \to Y$ be a holomorphic map of the irreducible complex space X into the complex space Y. Suppose that an analytic subset $A \neq \varphi$ of X exists such that $f|A:A \to Y$ is proper, and such that $r(f|A) = f(f)$. Then a complex base (f^*, Y^*) of f exists. It has dim $Y^* = r(f)$. If X is normal, so is Y^*. If X and Y are normal, the ring of holomorphic functions on X which strictly depend on f is isomorphic to a ring which is entire and finite over the ring of holomorphic functions on Y. Other properties of maximal holomorphic maps are studied. For instance, a maximal holomorphic map induces an epimorphism on the fundamental groups if the spaces are irreducible.

711

Flight Sciences Lab., Inc., Buffalo, N. Y.

A PARAMETRIC STUDY AND SURVEY OF THE THEORETICAL PERFORMANCE OF THE SUBSONIC COMBUSTION RAMJET, by B. Omilian. Oct. 1963, 84p. (AFOSR-5351) (AF 49(636)1173) AD 433723 Unclassified

The performance of the subsonic combustion ramjet over the range from mach 3 to 8 is presented, showing the effects of systematic variations in component efficiencies and flight conditions. Fuels considered are hydrogen, ethylene, and pentaborane. Performance predictions in the literature are reviewed and compared, and differences discussed. The present results are included in the comparison. (Contractor's abstract)

712

Florence U. (Italy).

[STUDIES ON THE ASTRONOMICAL ORIENTATION OF LITTORAL AMPHIPODS IN THE EQUATORIAL ZONE. IV. DAILY DIFFERENTIAL COMPENSATION FOR THE AZIMUTHAL MOTION OF THE SUN IN A SOMALILAND POPULATION OF TALORCHESTIA MARTENSII WEBER] Recerche sull'orientamento astronomico di anfipodi litoraii della zona equatoriale. IV. Compensazione differenziale giornaliera del moto azimutale dei sole in una popolazione somala di Talorchestia Martensii Weber, by A. Ercolini. [1964] 11p. incl. diagrs. refs. (AFOSR-66-1109) (AF EOAR-64-55) AD 639537 Unclassified

Also published in REDIA, v. 49: 119-126, 1964.

A shifting experiment has been carried out by keeping the animals under a rhythm of artificial light-darkness 3 hr in advance in respect to the normal one. The results obtained in 19 tests of solar orientation (from the 7th to the 10th day from the beginning of the treatment) show that the capacity of differential compensation of the solar azimuth velocity is essentially regulated by internal information. Some ambiguities of behavior observed during the tests do not permit, however, the exclusion of the influence of external information on the orientated behavior of the animals, at least during a transitory period in the process of phase-displacement.

713

Florida State U. Dept. of Chemistry, Tallahassee.

SYNTHESIS OF PEPTIDE POLYMERS WITH REPEATING SEQUENCES, by D. F. DeTar, W. Honsberg and others. [1963] 2p. (AFOSR-65-1250) (AF AFOSR-62-279) AD 621665 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 65: 2873-2874, 1963.

A general route was developed to an important class of peptide polymers having known repeating sequences in chains of random length. The active ester method was found to be the most suitable for preparing L-Asp-(OCH_3)-Gly-Giy$)_n$ with average degrees of polymerization estimated to be 25 or more. The polymerization is monitored by the NMR spectra in trifluoroacetic acid solutions. Comparable results were obtained with (Asp-(OCH_3)-Phe-Gly$)_n$ and (His-Gly-Gly$)_n$ from the corresponding tripeptide derivatives and (Phe-Giy$)_n$ from HBr · H · -Phe-Giy-ONP.

714

Florida State U. [Dept. of Physics] Tallahassee.

THE Al^{27} (p, α)Mg^{24} REACTION WITH 3 TO 12 MEV PROTONS, by K. L. Warsh, G. M. Temmer, and H. R. Blieden. Feb. 11, 1963, 9p. (AFOSR-J960) (AF AFOSR-62-423) AD 416061 Unclassified

Also published in Nuci. Phys., v. 44: 329-337, 1963.

Excitation curves and angular distributions of α-particle groups from the reaction $Ai^{27}(p, \alpha)Mg^{24}$ have been determined between 3 and 12 mev proton energy. The behavior of the excitation curves signifies that the reaction proceeds through the compound nucieus process. The large asymmetries in the angular distributions about 90° in the center-of-mass system might lead one to believe that there are important contributions from direct reaction processes; however, the shapes of the angular distributions vary quite rapidly with energy, much more rapidly than should be the case for direct reactions. Aiso, large asymmetries are observed in the angular distributions to highly excited states. A direct reaction ieading to these states would have to proceed by a very complicated process, which would make such an assumption improbabie. The resonances seen in the excitation curves are too widely separated to correspond to individuai ieveis at these excitation energies (15-23 mev) and must be regarded as fluctuation in levei density. (Contractor's abstract, modified)

715

Florida State U. [Dept. of Physics] Tallahassee.

THE REACTION Na^{23} (p, α)Ne^{20} FROM 3 TO 12 MEV, by K. L. Warsh, G. M. Temmer, and H. R. Blieden. [1963] 6p. (AFOSR-64-0519) (AF AFOSR-63-440) AD 436160 Unclassified

Aiso pubiished in Nuci. Phys., v. 46: 45-50, 1963.

The excitation curves were measured for the ground-state and first-excited state α-particie groups from the reaction $Na^{23}(p, \alpha)Ne^{20}$ between 3 and 12 mev proton energy, as weil as angular distributions for the ground-state and first three excited-state α transitions, at 10.0 mev bombarding energy. Excited states of Ne^{20} up to the tenth were observed, inciuding two new ones at 5.60 and 7.02 mev. (Contractor's abstract)

716

Florida State U. [Dept. of Physics] Tallahassee.

LOW-ENERGY CHARGED-PARTICLE-INDUCED FISSION, by G. R. Choppin, J. R. Meriwether, and J. D. Fox. [1963] 4p. (AFOSR-64-0535) (AF AFOSR-63-440) AD 436159 Unclassified

Also published in Phys. Rev., v. 131: 2149-2152, Sept. 1, 1963.

The excitation functions for the proton and deuteron induced fission of Th^{232} and U^{238} have been determined in the energy range of 3-12 mev. The excitation functions were measured using direct counting with p,n junction counters, gross counting with a recoil catching technique, and radiochemical measurement of certain fission product nuclides. In addition, the ratio of the peak-to-valley values of the fission fragment kinetic-energy spectrum were determined as a function of bombarding energy. Breaks in the ratio curve at certain bombarding energies are interpreted in terms of competition between fission and nucleon evaporation. (Contractor's abstract)

717

Florida State U. [Dept. of Physics] Tallahassee.

ELASTIC SCATTERING OF α PARTICLES BY C^{12} IN THE BOMBARDING ENERGY RANGE 10 TO 10 MEV, by E. B. Carter, G. E. Mitchell, and R. H. Davis. Oct. 7, 1963, 13p. (AFOSR-64-1146) (AF AFOSR-63-440) AD 442824 Unclassified

Also published in Phys. Rev., v. 133: B1421-B1433, Mar. 23, 1964.

The scattering of α particles by C^{12} has been studied in the bombarding energy range 10 to 19 mev. Many anomalies were observed in the excitation curves which correspond to O^{16} compound system energy levels in the excitation energy range 14 to 21 mev. Fifteen detailed angular distributions were measured and the data have been analyzed with a smooth cutoff model which was modified to include appropriate resonant phase shifts. The spins and parities of the more prominent resonances have been assigned. Real well depths of 100 mev or more were required in an optical-model analysis to yield theoretical cross sections comparable with experimental values. In general, optical-model fits were not satisfactory. Two series of levels in O^{16} were observed which obey rotational band systematics. The substantial widths of the band members suggest an α-particle cluster configuration for these excited states. (Contractor's abstract)

718

Florida State U. [Dept. of Physics] Tallahassee.

INELASTIC SCATTERING OF 6- TO 19-MEV α PARTICLES FROM CARBON, by G. E. Mitchell, E. B. Carter, and R. H. Davis. [1964] 12p. (AFOSR-64-1147) (AF AFOSR-63-440) AD 442823 Unclassified

Also published in Phys. Rev., v. 133: B1434-B1445, Mar. 23, 1964.

The inelastic scattering of α particles from C^{12} was studied in detail. The 4.43-mev γ rays were observed from 6- to 17-mev bombarding energy; the particles were observed from 10 to 19 mev. Analysis of the γ-ray data yielded the following specific conclusions: (1) Near 13.1-mev excitation energy in O^{16} there is apparently a 2^+ level in addition to the well known 1^- level. (2) The 13.27-mev level is 3^-, as previously reported. (3) The previously unassigned state at 13.88 mev is 4^+. (4) A previously unreported level at 14.80 mev has a low spin value. Numerous additional levels were found. The "two-channel" coupled equations approximation predicts many of the qualitative features of the particle angular distributions. Since the coupling is very strong, calculations for C^{12} illustrate well some of the features of this approximation. (Contractor's abstract)

719

Florida State U. [Inst. of Molecular Biophysics] Tallahassee.

RESEARCH IN PHOTOBIOLOGY AND PHOTOCHEMISTRY, by H. Gaffron. Final rept. Apr. 1, 1963 - Apr. 30, 1964. June 23, 1964, 6p. (AFOSR-64-1192) (AF AFOSR-62-190) AD 602756 Unclassified

Work in the following areas is briefly summarized: stepwise photooxidation of ascorbate by illuminated flavin in homogenous solution; reversibility of herbicide action; use of isolated chloroplasts as light-absorbing constituents in artificial photooxidations; light-induced acetate assimilation in algae; simultaneous release of H_2 and O_2 from adapted algae in light when CO_2 is absent.

720

Florida State U. [Inst. of Molecular Biophysics] Tallahassee.

FLAVIN SPECIFIC AND MANGANESE DEPENDENT ACTION OF CERTAIN HERBICIDES ON PHOTOREACTIONS IN VITRO, by P. Homann. [1964] [1]p. (AFOSR-65-1285) (AF AFOSR-62-190) Unclassified

Also published in Plant Physiol., Suppl., v. 39: 33, 1964.

Substituted ureas are very efficient herbicides due to their ability to stop oxygen evolution in photosynthesis. Nothing is known about the mechanism. These herbicides strongly influence some dye-sensitized light reactions in vitro, provided the sensitizing dyes are flavins. It was found that the herbicides CMU (N-p-chlorophenyl-N', N'-dimethyl urea) and DCMU (N-p-dichlorophenyl-N', N'-dimethyl urea) form charge transfer complexes with excited flavin. Hydrophilic molecules, i.e., tryptophane or tyrosine, are able

to do the same but they exhibit no specificity as to the type of sensitizer. They inhibit equally well the anaerobic photoreduction of phthaleins, acridines and thiazines. CMU and DCMU by contrast show no effect whatever with acridine or thiazine photo-reduction and only a negligible inhibition with the phthalein dye. Among all substances tested as inhibitors of the bleaching of dyes, only the substituted ureas are so highly lipophilic that they accumulate in the lipid phase of the chloroplast. Inasmuch as DCMU is more lipophilic than CMU, it is the more effective herbicide. Certain effects of the substituted ureas in vitro become manifest only in the presence of manganese, a striking parallelism to events taking place in the living chloroplast.

721

Florida State U. [Inst. of Molecular Biophysics] Tallahassee.

PHOTOCHEMISTRY AND METAL CATALYSIS: STUDIES ON A FLAVIN SENSITIZED OXIDATION OF ASCORBATE, by P. Homann and H. Gaffron. [1964] [21]p. incl. diagrs. tables, refs. (AFOSR-65-1286) (AF AFOSR-62-190) AD 621285 Unclassified

Presented at Symposium on Molecular Mechanisms in Photobiology, Wakulla Springs, Fla., Feb. 16-21, 1964.

Also published in Photochem. and Photobiol., v. 3: 499-519, 1964.

The interaction between ascorbate, diketogulonate, manganous ion, oxygen, illuminated flavins, and phenylureas was investigated. These photochemical reactions in aqueous solutions exhibit peculiar reaction kinetics, which resemble certain processes of photosynthesis in living plants. The reaction mechanisms are proposed. It is concluded that organic compounds such as 3-(p-chlorophenyl)-1, 1-dimethylurea form stable charge transfer complexes with excited flavin molecules.

722

Florida U., Gainesville.

UPPER BOUNDS FOR PERMANENTS OF (0,1)-MATRICES, by H. Minc. [1963] 3p. (AFOSR-64-0711) (AF AFOSR-62-168) AD 436493 Unclassified

Also published in Bull. Amer. Math. Soc., v. 69: 789-791, Nov. 1963.

Bounds for permanents of general (0,1)-matrices and for permanents of certain subclasses of (0,1)-matrices are of combinatorial significance and yet virtually the only known upper bound for the permanent is the product of row sums of A. A significant upper bound is given for the permanent of a general (0,1)-matrix.

723

Florida U. Dept. of Psychology, Gainesville.

SLEEP PATTERNS IN YOUNG ADULTS: AN EEG STUDY, by R. L. Williams, H. W. Agnew, Jr., and W. B. Webb. [1964] 6p. incl. diagr. tables. (AFOSR-65-2681) (AF AFOSR-62-13) AD 628254 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol. Jour., v. 17: 376-381, 1964.

EEG sleep stages do not appear in any consistent temporal sequence from night to night in a given subject nor in a group of subjects. The typical young adult in our study spent an individually characteristic relative amount of time in each sleep stage each night. The length of stages was short, usually less than 10 min, with the exception of stage 1-REM which ranged up to 39 min in length. Our subjects characteristically changed stages fewer times on successive nights. The number of sleep stage changes differed among subjects. The stage change was usually smooth, moving from one stage to the next when sleep was deepening, but less smooth, often 'jumping' more than a stage during arousal from deeper levels. The EEG sleep stages were found to be most prevalent in certain thirds of the night. The greatest amounts of stages 4 and 3 were found in the first third, 1-REM in the last third of the night. Stage 2 is more evenly distributed throughout the night. (Contractor's abstract)

724

Florida U. Dept. of Psychology, Gainesville.

THE EFFECTS OF STAGE FOUR SLEEP DEPRIVATION, by H. W. Agnew, Jr., W. B. Webb, and R. L. Williams. [1964] 3p. incl. table. (AFOSR-65-2682) (AF AFOSR-62-13) AD 629171 Unclassified

Also published in Electroencephalog. and Clin Neurophysiol. Jour., v. 17: 68-70, 1964.

Individuals may be deprived of stage 4 sleep without a deprivation of the quantitative amount of sleep, i.e. they may be 'moved' from stage 4 sleep into other stages of sleep without awakening. The 'movement' of sleep, in this experiment, did not occur consistently into any other stage. Such deprivation of stage 4 sleep results in a significant increase in this type of sleep during a recovery night. These results, particularly the latter, would suggest a requirement for this type of sleep. When comparing our results with the Dement study, we might also describe our findings as suggestive of a psychic need, or propose that 'stage 4 deprivation' results in a requirement for sleep associated with this type EEG activity. The latter interpretation is preferred. (Contractor's abstract)

725

Florida U. Engineering and Industrial Experiment Station, Gainesville.

RESPONSE OF ELASTIC STRUCTURE TO RANDOM EXCITATIONS OF VARIOUS CORRELATIONS, by M. R. P. Trubert. Aug. 1963, 60p. incl. illus. diagrs. (AFOSR-5319) (AF AFOSR-62-313) AD 416302; AD 419341 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1009-1022, July 1963. (Title varies)

It is shown that it is possible to determine the response of a linear continuous structure (cantilever beam) to random loadings of various correlations by a semiexperimental method. The mathematical aspect of the problem is stated. The spatial transfer function representing the dynamic characteristics of the structure is determined experimentally by a cross-correlation technique. The response to various correlated loadings is computed and a comparison is made with the response determined experimentally. The effect of the correlation is noted. (Contractor's abstract)

726

Florida U. Engineering and Industrial Experiment Station, Gainesville.

RESPONSE OF A NONLINEAR BEAM TO RANDOM EXCITATION, by R. E. Herbert. May 1964, 22p. incl. diagrs. refs. (AFOSR-64-0386) (AF AFOSR-62-313) AD 444475 Unclassified

For abstract see item no. 727, Vol. 7.

727

Florida U. Engineering and Industrial Experiment Station, Gainesville.

RANDOM VIBRATIONS OF NONLINEAR ELASTIC STRUCTURES, by R. E. Herbert. May 1964, 37p. (AFOSR-64-0887) (AF AFOSR-62-313) AD 602486 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 2090-2094, Nov. 1964. (AFOSR-65-1233; AD 622639)

The theory of the Markoff process and the associated Fokker-Planck equation is used to investigate the large vibrations of a hinged, axially restrained, elastic beam driven by white noise. An expression for the joint probability-density function of the first N modal amplitudes is obtained and used to derive an approximate expression for the mean-squared displacement. Numerical integration of the exact expression for the mean-squared displacement indicates a reduction of this quantity as compared to the linear theory. Calculations also show a range of applicability of the derived approximate expression. Furthermore, computations show that the first node still gives a good estimate of the mean-squared displacement, but the coupling effects of the nodes are so strong, for sufficiently large deflections, that the effect of the higher modes must be taken into account when computing the mean-squared value of the first mode.

726

Florida U. Engineering and Industrial Experiment Station, Gainesville.

ON THE STRESSES IN A NONLINEAR BEAM SUBJECT TO RANDOM EXCITATION, by R. E. Herbert. Aug. 1964, 23p. incl. diagrs. refs. (AFOSR-64-1038) (AF AFOSR-62-313) AD 606810 Unclassified

The method of equivalent linearization is used to investigate the effects of the membrane force on the stresses in a simply supported Bernoulli-Euler beam subject to random excitation. It is shown that, while the mean-square membrane stress is negligible compared to the mean-square bending stress, the former nevertheless has the effect of reducing the latter. Furthermore, this reduction is less significant for higher driving frequencies, thereby reducing any 'nonlinear safety factor' that might be considered. (Contractor's abstract)

729

Fordham U. Dept. of Chemistry, New York.

SMALL RING COMPOUNDS, by E. J. Moriconi. Final rept. Oct. 1, 1961 - Sept. 30, 1963. Nov. 15, 1963, 6p. (AFOSR-J1369) (AF AFOSR-62-18) AD 426566 Unclassified

This report contains progress reports on the following topics: (1) Ring expansion reaction; (2) Heteropolar Ozonization of Aza-aromatics and their N-oxides; (3) Origin of the carbonyl doublet in 2-indanone and trans-Hexahydro-2-indanone; (4) NMR studies of N-hydroxy-2-pyridone ⇌ 2-hydroxypyridine-1-oxids equilibria; (5) Synthesis of fused aza-aromatic cyclobutadisne derivatives; quinoxalino-[2, 3-c] cyclobutadiene; (6) Synthesis of strained azabicyclooctanes; 7- and 2-azabicyclo [4. 2] octanes; (7) Fused-ring aromatic azetes. 3-diazooxindoles and 2-diazoindoxyls; and (8) Valence tautomerism of the aza-cyclooctatriene ring system.

730

Fordham U. [Dept. of Chemistry] New York.

HETEROPOLAR OZONIZATION OF AZA-AROMATICS AND THEIR N-OXIDES, by E. J. Moriconi and F. A. Spano. [1964] 9p. incl. tables, refs. (AFOSR-64-0664) (AF AFOSR-62-16) AD 436500 Unclassified

Also published in Jour. Amer. Chsm. Soc., v. 86: 38-46, 1964.

Ths ozonization of four aza-aromatics [1-methyl-(II) and 3-methylisoquinoline (II), acridine (III), and phenanthridine (IV) and fivs aza-aromatic N-oxides [quinoline-1-(V), phenanthridine-5-(VI), acridine-10-

(VII), isoquinoline-2-(VIII), and 3-methylisoquinoline-2-oxides (IX)] are reported. Initial electrophilic ozone attack on III, IV, I, and II led to carbocyclic ring-cleaved carboxylic acids; simultaneous nucleophilic ozone attack at the C-atom adjacent to (4), or conjugated with (1), the aza-atom produced cyclic amides. Relative to isoquinoline, the methyl group in I and II deactivated the aza-aromatic ring to electrophilic ozone attack. Generally, initial nucleophilic ozone attack on aza-aromatic N-oxides led to cyclic hydroxamic acids and cleavage of the C=N aromatic bond (to nitroaldehydes) as primary products. With ozone as an electrophile, further ozonization of the former led to deoxygenated products, cyclic amides. Phthalic acid was also obtained from VIII and IX. In almost all cases, solvent effects were noted. N → O and C=O absorption frequencies of reactants and products are tabulated. (Contractor's abstract)

731

Fordham U. Dept. of Chemistry, N. Y.

PYROLYSIS AND PHOTOLYSIS OF 1-METHYL-3-DIAZOOXINDOLE. BASE DECOMPOSITION OF ISATIN 2-TOSYLHYDRAZONE, by E. J. Moriconi and J. J. Murray. [1964] [8]p. incl. diagrs. refs. (AFOSR-65-0374) (AF AFOSR-62-18) AD 611726 Unclassified

Also published in Jour. Org. Chem., v. 29: 3577-3584, Dec. 1964.

Pyrolysis of 1-methyl-3-diazooxindole (I) in refluxing ethanol led to 1,1'-dimethylisoindigo (II) and 1,1'-dimethylisatinazine (III), and in the presence of pyridine N-oxide produced II, III, and 1-methylisatin (IV). Photolysis of I in ethanol gave 3-ethoxy-1-methyloxindole (V); photolysis in cyclohexene led to two geometric cyclopropane isomers (VI and VII) resulting from cis addition to the cycloolefin, and in hexane solution containing 1, 1-diphenylethylene produced the spirooxindole (VIII). Compounds II, IV, III, and V-VIII were probably formed by appropriate reaction with the pyrolytically and photolytically generated oxindolyene acting as a singlet. This same oxindolylene also displayed triplet character in the e.s.r. spectrum at 4°K, in reaction with oxygen to form IV, and with photolytically generated Cl· atoms and Cl_3C· free radicals (from CCl_4) to yield 3-chloro-3-trichloromethyl-1-methyloxindole. At room temperature, I reacted with bromine and triphenylphosphine to form 3,3-dibromo-1-methyloxindole and the phosphazine adduct (IX), respectively. Pyrolysis of IX led to the triphenylphosphine, II and III, but no ylide. (Contractor's abstract)

732

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

RESEARCH ON HIGH ENERGY PHYSICS INVESTIGATIONS USING NUCLEAR EMULSIONS, by M. A. Pomerantz and D. F. Davis. Final rept. Feb. 1, 1961 - Jan. 31, 1963, 7p. (AFOSR-4999) (AF 49-(638)1023) AD 415118 Unclassified

Results of an experiment to measure the K meson total absorption cross section are reported. A stack of Ilford G5 emulsion 10 x 10 square centimeters in cross sectional area and 20 cm long was exposed to a beam of 1.3 bev/c K mesons. An effort was made to measure the variation in intensity of the K particles with distance along the beam by counting the number of their interactions. In the experiment a beam of pure K particles was produced at the target. (Contractor's abstract)

733

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

STUDY OF PROPERTIES OF MEDIUM-WEIGHT NUCLEI, by D. M. Van Patter, A. K. Sen Gupta, and R. Mohindra. Final rept. Nov. 1, 1962 - Oct. 31, 1963, 10p. (AFOSR-J1254) (AF AFOSR-62-217) AD 424350 Unclassified

The investigations were primarily concerned with the nuclear structure of the even-even nuclei Ni^{60}, Ni^{62}, Zn^{64} and Zn^{66}. The properties of their low-lying states were examined by the detection of γ-radiations produced during bombardment by protons with energies of about 4.4 to 5.1 mev provided by the Bartol-ONR Van de Graaff accelerators. For such incident energies the compound nucleus mechanism is expected to predominate. If, moreover, many compound states are excited, then one would expect statistical reaction theory to describe the reaction process. Therefore target thicknesses were deliberately chosen to be rather thick (about 150 kev) in order to average over at least one thousand compound states. The angular distributions of (p, p'γ) radiations resulting from inelastic proton scattering were of major interest for these experiments. These distributions, together with the absolute γ-ray production cross sections, were then compared with theoretical predictions using statistical reaction theory. (Contractor's abstract)

734

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

ZERO-SPIN ASSIGNMENT FOR THE 2.05-MEV STATE OF Ni^{62} FROM A (p, p'γ-γ) ANGULAR CORRELATION MEASUREMENT, by A. K. Sen Gupta and D. M. Van Patter. [1963] 4p. incl. diagrs. refs. (AFOSR-J1447) (AF AFOSR-62-217) AD 424350 Unclassified

Also published in Phys. Rev., v. 131: 318-321, July 1, 1963.

The γ-γ angular correlation of the 0.88-1.17-mev cascade, following excitation of the 2.05-mev state of Ni^{62} by the (p, p') reaction has been measured for angular separations of 90° to 180° at an average bombarding

energy of 4.71 mev. Convincing agreement was found with the correlation expected for a 0(Q)2(Q)0 cascade, thereby providing a unique zero-spin assignment for the second level of Ni^{62}. This assignment accounts for the measured isotropy (within ± 3%) of the 0.66-mev cascade transition with respect to the incident beam, as well as the lack of an observed ground-state transition. It is concluded that the measurement of a 0(Q)2(Q)0 γ-γ angular correlation following (p, p') excitation provides a promising method for the unique identification of zero-spin states in medium-weight even-even nuclei. (Contractor's abstract, modified)

735

[Franklin Inst.] Bartol Research Foundation, Swarthmore, Pa.

FILMS OF SEPARATED ISOTOPES BY VACUUM EVAPORATION, by P. N. Trehan. [1963] [2]p. incl. diagr. (AFOSR-65-0132) (AF AFOSR-62-217) AD 455967
Unclassified

Also published in Nuclear Instr. and Methods, v. 27: 471-472, 1963.

A method for preparing films of separated isotopes of Ni, Cr and Mo, by vacuum evaporation, is discussed. It is possible to prepare films of thickness varying from few $\mu g/cm^2$ to few mg/cm^2 on gold or platinum backing. (Contractor's abstract)

736

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

STUDIES OF THE LOW-LYING ENERGY LEVELS OF Zn^{64} AND Zn^{66} FROM MEASUREMENTS OF (p, p'γ) RADIATIONS, by A. K. Sen Gupta and D. M. Van Patter. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-0133) (AF AFOSR-62-217) AD 455735
Unclassified

Also published in Nuclear Phys., v. 50: 17-32, 1964.

An experimental investigation of the (p, p'γ) radiations from semi-thick targets of Zn^{64} and Zn^{66} has been carried out. Good agreement has been obtained for the angular distribution measurements, and level spins have been assigned on this basis. The measured cross sections, however, show some disagreement with theoretical values, which are particularly pronounced for the first 2^+ states in both Zn^{64} and Zn^{66}. The studies of the stronger γ-rays suggest the following levels and the spins and parities: Zn^{64}; 0.993(2^+), 1.604(2^+), 1.904(0^+), 2.321(4^+) and 2.616(0^+); Zn^{66}; 1.037(2^+), 1.865(2^+), 2.363(0^+) and 2.462(4^+?) mev. Some additional weaker γ-rays have also been observed in both the isotopes. The collective nature of the first 2^+ states in Zn^{64} and Zn^{66} being known, the (2, 0, 4) triplets that are seen in both these isotopes suggest that some kind of vibrational motion could account for these low-lying excited states. The present measurements indicate that (p, p'γ) reaction studies provide a promising method for searching for such triplets in medium-weight even nuclei. (Contractor's abstract)

737

Franklin Inst. Bartol Research Foundation, Swarthmore, Pa.

ON THE SECOND 2^+ LEVEL OF Ni^{56}, by S. M. Shafroth and G. T. Wood. [1964] [2]p. incl. diagr. (AFOSR-65-0620) (AF AFOSR-63-401) AD 616199
Unclassified

Also published in Compt. Rend. Cong. Internat'l. Phys. Nucleaire, Paris (France) (July 2-8, 1964) Paris, CRNS, v. 2: 476-477, 1964.

This note investigates the 2^+ level of Ni^{56} by studying the radiations from Cu^{56}, Ni^{60}, Ni^{62}, and Ni^{64}, all appear to show harmonic structure with two-phonon triplets, whereas Ni^{58} may be in a transitional region having some vibrational and some shell model properties. The study gives a measurement of δ, the E2/M1 mixing ratio for the $2^{+\prime} \rightarrow 2^+$ transition, which illuminates this point. Two window counters and a spectrum counter are used to record coincidence spectra.

736

Free U. of Brussels (Belgium).

[NEUROPHYSIOLOGICAL CORRELATES OF SENSORY PERCEPTION], by F. Bremer and J. E. Desmedt. Final rept. Dec. 1, 1956 - Dec. 31, 1962. Jan. 25, 1963, 12p. (AF 61(052)120) AD 632592
Unclassified

The contents of this report are: Corpus callosum; Neuropharmacology of cholinergic systems in the reticulo-cortical complex; Centrifugal control in auditory system; Auditory IV area; Analysis of mode of operation of the olivo-cochlear efferent axons; Effect of stimulation of reticular formation on cortical evoked potentials; Effect of chronic partial deafferentiation of cortical areas on their functional properties; Binocular interaction in visual cortex of cats; Cerebello-cerebral relations; Technical developments in the laboratory.

739

Free U. of Brussels (Belgium).

GENETIC REPLICATION AND MACROMOLECULAR SYNTHESES IN TEMPERATE BACTERIOPHAGES, by R. Thomas. Final technical rept. Sept. 30, 1963, 14p. (AFOSR-J1374) (AF EOAR-62-17) AD 428400
Unclassified

Superinfection experiments using chloramphenicol, or shift down to block protein syntheses, show that the early syntheses are not mutant-specific nor even species-specific. A number of conditional defective (suppressor sensitive, sus) mutants of λ have been

isolated and partly characterized by functional and recombinational analysis. The final purpose is to identify the genes involved in the early functions.

740

Free U. of Brussels (Belgium).

ON THE CONTROL OF THE REPLICATION OF TEMPERATE BACTERIOPHAGES SUPERINFECTING IMMUNE HOSTS, by R. Thomas and L. E. Bertani. [1964] [13]p. incl. tables, refs. (AFOSR-65-2742) (AF EOAR-62-17) AD 627766 Unclassified

Also published in Virology, v. 24: 241-253, Nov. 1964.

When lysogenic bacteria are superinfected with phage that is blocked by the immunity of the host and, at the same time, with a mutant (or a related heteroimmune phage) that is insensitive to the immunity of the host, as a rule, only the immunity-insensitive phage is capable of replicating. Those rare particles of immunity-sensitive type that are found in the progeny arise often (if not always) by recombination between the immunity-insensitive phage and either the superinfecting, immunity-sensitive phage or the prophage. Similar results have been obtained with two unrelated systems: the noninducible phage P2 (hosts: Escherichia coli C and Shigella dysenteriae) and the inducible phage λ (host: Escherichia coli K-12). These observations suggest that the genetic replication of a temperate phage in an immune host is blocked directly as a result of the interaction between an 'immunity substance' and the phage chromosome, rather than only indirectly, through repression of the synthesis of a diffusible 'initiator' necessary to initiate replication of the phage chromosome; or, alternatively, that the above-mentioned 'initiator' is not freely diffusible in the host cells. (Contractor's abstract)

741

Free U. of Brussels (Belgium).

ACTIVATION OF THE EFFERENT COCHLEAR BUNDLE IN THE PIGEON (Abstract), by J. E. Desmedt and P. Delwaide. [1963] [1]p. (AFOSR-J844) (AF EOAR-63-46) AD 416523 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 809, 1963.

An efferent cochlear bundle was demonstrated anatomically in the pigeon. Techniques have been developed for stereotaxic stimulation thereof in pigeons prepared under Fluothane anesthesia and immobilized by transection of cervical spinal cord plus injection of Flaxedil. Responses to tone pips or clicks were recorded oscillographically from the exposed round window. When the testing sounds are preceded by delivery of say, 30 shocks at 300/sec to the region of the efferent cochlear bundle close to the midline (histologically controlled), the cochlear microphonic (CM) potential is potentiated while the neural (N_1) spike is reduced. These effects were titrated as equivalent dB changes in sound energy and they have not exceeded +6 dB equivalents for CM and -6 dB equivalents for N_1. Corresponding figures for the cat's olivocochlear bundle are +4 dB equivalents for CM and -25 dB equivalents for N_1. The marked contrast in potency for gating out neural responses evoked by sound in these two species raises questions about (1) behavioral significance of efferent bundle in birds, and (2) mode of action on the inner ear. (Contractor's abstract)

742

Free U. of Brussels (Belgium).

EXTRA-RETICULAR FEEDBACK CONNECTIONS IN THE AUDITORY SYSTEM OF MAMMAL AND BIRD, by J. E. Desmedt. Final scientific rept. Jan. 1 - Dec. 31, 1963. Jan. 28, 1964, 7p. (AFOSR-64-0734) (AF EOAR-63-46) AD 436495 Unclassified

The mode of operation of several parts of the feedback control system related to acoustic input was investigated in acute experiments on cats and pigeons. New methods were developed, namely, procedures for spinal transection, stereotaxis, and control of the physiological status of the preparation in the pigeon experiments. The type of control exerted by the crossed olivo-cochlear bundle (OCB) of the cat on the transduction of sound waves into nerve impulses in the inner ear was examined. It was shown that OCB-conditioned responses to click present a peculiar latency-voltage relation and this phenomenon has a number of implications relevant to sensory processing. The functional properties of the uncrossed OCB were demonstrated for the first time. The uncrossed fibers exert inhibitory effects on the input and their parameters of activity and neurochemical properties have been investigated. In the pigeon the efferent cochlear bundle (ECB) described by Boord in 1961 was shown to suppress auditory nerve activity and potentiate the cochlear microphonic. While this system appears homologous to the OCB system described by Rasmussen in mammals, it differs significantly in several respects.

743

Free U. of Brussels (Belgium).

THEORY OF FREEZING, by R. Brout. [1963] [16]p. incl. diagrs. refs. (AFOSR-64-1960) (AF EOAR-63-51) AD 452429 Unclassified

Also published in Physica, v. 29: 1041-1056, 1963.

A theory of freezing is first developed from the point of view of molecular field theory. The fundamental approximation is thus the neglect of the enhancement of fluctuations before freezing. Two methods are developed. The first makes use of the information gained by crystallization by calculating the entropy change through information theory. The second is based on more fundamental methods of statistical mechanics. A value is found for the freezing point at fixed density. It is then shown that the sum on ring diagrams in a cluster expansion in the medium of a hard sphere

fluid presents singularities both for freezing and condensation. The condensation singularity is suppressed by the mechanism of condensation into the liquid phase, whereas a further singularity corresponding to freezing is not so suppressed. This singularity occurs at exactly the same temperature as that quoted above. In this way, one has a theory of critical fluctuation in freezing corresponding to that of Ornstein and Zernike in the case of condensation. The relation to a dielectric formalism is indicated.

744

Free U. of Brussels (Belgium).

BROKEN SYMMETRY AND THE MASS OF GAUGE VECTOR MESONS, by F. Englert and R. Brout. 1964, 3p. incl. refs. (AFOSR-65-0097) (AF EOAR-63-51) AD 455984 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 321-323, Aug. 31, 1964.

It is shown that in certain cases vector mesons do indeed acquire mass when the vacuum is degenerate with respect to a compact lie group.

745

Free U. of Brussels (Belgium).

A POSSIBLE THEORETICAL ARGUMENT WHICH ELIMINATES THE (HITHERTO) UNREALIZED REPRESENTATIONS OF SU(3), by F. Englert and R. Brout. [1964] [2]p. (AFOSR-65-0098) (AF EOAR-63-51) AD 455983 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 682-683, June 15, 1964.

Lagrangians invariant under the direct product of the baryon gauge group and SU(3) are invariant under the smaller group U(3). Only certain representations of U(n) are factorizable into representations of the baryon gauge group and another group which realizes the adjoint group of SU(n). The general form of allowed direct products in the factorized representation is given for n = 3. Applications to physical models including the Sakata model are discussed. The use of U(3) and strict baryon conservation would eliminate the hitherto physically unrealized representations of SU(3).

746

Free U. of Brussels (Belgium).

NATURE OF THE CRYSTALLINE SOLID AT ELEVATED TEMPERATURES, by R. Brout, S. Nettel, and H. Thomas. [1964] [3]p. incl. diagrs. (AFOSR-65-0418) (AF EOAR-63-51) AD 612521 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 474-476, Oct. 12, 1964.

Some calculations based on Brout's theory of freezing (Physica, v. 29: 1041, 1963) indicate that the single-particle density distribution for a molecular solid behaves much like that for a liquid for temperatures well below the freezing point, but well above the Debye temperature.

747

Free U. of Brussels (Belgium).

RESPONSE FUNCTIONS, SUPERCONDUCTIVITY AND FERROMAGNETISM IN THE MANY FERMION SYSTEM, by H. Stern and R. Brout. [1964] [24]p. incl. diagrs. refs. (AFOSR-65-0419) (AF EOAR-63-51) AD 612317 Unclassified

Also published in Physica, v. 30: 1689-1712, 1964.

At the phase transition, the anomalies of thermodynamic and static response functions coincide due to the fact that the free energy, expressed in terms of response functions at imaginary frequency including zero, has its pole at zero frequency. In this paper, a study is made of the divergences arising from the modification of the vertex function. The diamagnetic current is related to the free energy via the Ward Identity so that the specific heat anomaly inevitably gives rise to the Meissner effect. Below the transition the system adjusts to the singularity by going into the BCS condensed state. The similarity between BCS theory and ferromagnetism is shown through a Weiss field approach and diagrammatically by including special correlations between k and -k. Its importance for an understanding of the broken symmetry problem is discussed. Finally, the parallel behavior of the susceptibility and specific heat of a Bloch ferromagnet is demonstrated. (Contractor's abstract)

748

Free U. of Brussels (Belgium).

HIGH PLEIOTROPY OF STREPTOMYCIN MUTATIONS IN ESCHERICHIA COLI, by M. Couturier, L. Desmet, and R. Thomas. [1964] [5]p. incl. tables. (AFOSR-64-1714) (AF EOAR-64-10) AD 448262 Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 16: 244-248, 1964.

Bacteria mutants selected for their resistance to streptomycin (resistant Smr, or dependent Smd) frequently manifest characters which have no obvious relation with the Smr or Smd character itself. This report discusses the highly pleiotropic character of many Smr mutation in E. Coli K 12, strain C600. This pleiotropy is in some ways similar to that of allele-specific supersuppressors, and it is shown that most Smr (or Smd) derivatives of C600 express three new characters and there is a complete correlation in that each strain expresses either all three or none.

749

Free U. of Brussels (Belgium).

GENETIC REPLICATION AND MACROMOLECULAR SYNTHESES IN TEMPERATE BACTERIOPHAGES, by R. Thomas. Final rept. Oct. 1, 1964, 8p. (AFOSR-64-2231) (AF EOAR-64-10) AD 608793
Unclassified

Experiments involving mixed superinfection of lysogenic bacteria with an homologous phage and an immunity-insensitive mutant show that the repressor of immunity blocks altogether transcription and replication directly. A new method allows (a) preferential isolation of those conditional defective mutations which affect early functions and (b) isolation of sus mutants which are well corrected by bacterial suppressors. There is direct evidence for Spotts and Stanier's hypothesis that the bacterial gene controlling the response to streptomycin is involved in the determination of the structure of ribosomes. Many streptomycin-resistant mutants (which are now known to be altered in the structure of their ribosomes) behave much as pleiotropic suppressors. The exact structure of ribosomes probably contributes to the specificity of the translation process.

750

Free U. of Brussels (Belgium).

[CONTRASTS BETWEEN CENTRAL ACTIONS OF CONIINE AND STRYCHNINE] Contrastes entre les actions centrales de la coniine et de la strychnine, by V. La Grutta and J. E. Desmedt. [1964] [8]p. incl. illus. (AFOSR-65-0309) (AF EOAR-64-10) AD 612318
Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 151: 289-296, 1964.

The action of coniin or hemlock alcaloid has been analyzed in the cat and in the pigeon with the spinal cord transected at C_2 and immobilized with Flaxedil(R). The intravenous injection of 40-60 mg/kg coniin elicits convulsive hypersynchronous activity in the telencephalon but does not modify the spontaneous electrical activity of the spinal cord. These effects contrast with those of strychnine which, in similar preparations, elicits convulsions restricted to the spinal cord. Furthermore the liminal doses of coniin are similar in pigeon and cat, whereas strychnine is about 20 times less active in the pigeon than in the cat. Coniin also antagonizes the olivo-cochlear post-synaptic inhibition without modifying the response evoked by sound in the auditory nerve. Coniin is thus the first drug, besides strychnine and brucine, shown to depress this inhibition. Significant differences namely in the intensity and rapidity of the antagonism suggest that the mode of action of coniin differs from that of strychnine. The interest of the tests used for the screening of strychnine-like actions is stressed. (Contractor's abstract)

751

Free U. of Brussels (Belgium).

[ANALYSIS OF SOMESTHETIC EVOKED POTENTIALS IN MAN] Analyse des potentiels évoqués somesthésiques chez l'homme (Abstract), by J. de Becker, J. Manil, and J. E. Desmedt. [1964] [1]p. (AFOSR-66-0773) (AF EOAR-65-57) AD 632902
Unclassified

Also published in Rev. Neurol., v. 112: 255, 1964.

The components of parietal evoked potentials have been analyzed by systematically correlating the evoked responses to digital stimuli of varying intensities or frequencies. The authors have been able to evoke given components preferentially because of their low thresholds or tendency to follow higher frequencies of stimulation. The threshold and characteristics of the evoked potential components may be defined by the curve showing the percentage of shocks perceived at a certain stimulus intensity.

752

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

CONTRIBUTIONS IN NON-EQUILIBRIUM STATISTICAL MECHANICS AND THERMODYNAMICS, by I. Prigogine. Final technical rept. Dec. 1961 - June 1964. June 30, 1964. 224p. incl. diagrs. refs. (AFOSR-65-1059) (AF EOAR-62-16) AD 617790
Unclassified

Apart from a thermodynamic study of the hydromagnetic stability problem for a system far from equilibrium, the essential matter of this report consists in a number of applications and extensions of the general statistical mechanical theory of irreversible processes previously developed. Generalized kinetic equations are obtained for non-uniform systems as for systems in external fields of arbitrary strength. The resulting expressions for the transport coefficients are analyzed and shown to be equivalent, at all orders in a perturbation expansion, to the forms obtained from the autocorrelation function formulas. The latter are further discussed for the quantum case, for which an extension of the kinetic approach is also outlined. In the field of classical plasma physics, the study of an unstable plasma has exhibited the stabilization mechanism associated to the correlations, and the equation for an inhomogeneous plasma far from equilibrium has been derived. Finally, a rigorous statistical mechanical formulation is given for the hydrodynamics of a relativistic plasma.

753

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

THERMODYNAMICS OF SPIN SYSTEMS IN SOLIDS, by J. Jeener, H. Eisendrath, and R. Van Steenwinkel. [1964] [13]p. incl. diagrs. refs. (AFOSR-65-1082) (AF EOAR-62-16) AD 618438 Unclassified

Also published in Phys. Rev., v. 133: A478-A490, Jan. 20, 1964.

Quasiequilibrium states of the spin system in a solid are described in terms of one Zeeman temperature for each spin species plus one dipole-dipole temperature, T_D. Energy and entropy are calculated and used to predict the steady state of processes such as cross relaxation. It is predicted and demonstrated by an experiment on the nuclear spins in LiF that the state of the dipole-dipole system has a strong influence on such steady states. Continuous wave and pulse spectroscopy are discussed for systems with low T_D. Techniques are proposed to measure T_D and one Zeeman temperature simultaneously, using coherent pulse instrumentation, and for preparing a state of low T_D in a large magnetic field by complete adiabatic demagnetization followed by sudden magnetization. A density matrix formalism is proposed for the description of quasiequilibrium situations in the case of spins with unequally spaced energy levels. Finally the influence of the nonsecular part of the spin-spin Hamiltonian on the quasi-equilibrium states is estimated by a perturbation calculation, and the resulting description includes the cases of low- or zero-magnetic field and partly or completely overlapping absorption lines. (Contractor's abstract)

754

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

KINETIC EQUATION FOR AN INHOMOGENEOUS PLASMA FAR FROM EQUILIBRIUM, by R. Balescu and A. Kuszell. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-2778) (AF EOAR-62-16) AD 627939 Unclassified

Also published in Jour. Math. Phys., v. 5: 1140-1149, Aug. 1964.

A kinetic equation for a nonuniform plasma is derived from the Liouville equation by a general diagram technique. It describes the evolution of a small spatial inhomogeneity in a plasma whose velocity distribution is far from equilibrium (and hence time-dependent). The equation is valid for short and long times, within the ring approximation. Its explicit form is obtained by the exact closed solution of a singular integral equation. The kinetic equation is non-Markoffian and, contrary to the corresponding homogeneous equation, keeps a trace of this character even in the limit of long times. Only when the velocity distribution and the two-body correlation function reach thermal equilibrium does the equation reduce to a Markoffian limit. The latter is identical with the kinetic equation derived earlier by Guernsey. The treatment of unstable inhomogeneous plasmas is briefly indicated. (Contractor's abstract)

755

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

TRANSPORT EQUATION OF A BROWNIAN PARTICLE IN AN EXTERNAL FIELD, by P. Resibois and H. T. Davis. [1964] [15]p. (AFOSR-65-2677) (AF EOAR-62-16) AD 628373 Unclassified

Also published in Physica, v. 30: 1077-1091, 1964.

The general theory of irreversible processes developed by I. Prigogine and coworkers is applied to the particular problem of the motion of a heavy charged particle (mass M) moving in a fluid of light particles under the influence of an external electric field. The results obtained recently by J. Lebowitz and E. Rubin are recovered using a completely different technique; to the lowest order in γ the Brownian particle obeys a Fokker-Planck equation. The higher order corrections are also discussed and special attention is focused on the effect of the field during a collision process between the Brownian particle and the fluid: this effect can, however, be incorporated in a velocity dependent correction to the Fokker-Planck collision term. (Contractor's abstract)

756

Free U. of Brussels. [Dept. of Chemical Physics] (Belgium).

KINETIC EQUATIONS AND STATIONARY STATE FOR A SYSTEM IN A UNIFORM EXTERNAL FIELD, by G. Severne. [1964] [24]p. incl. refs. (AFOSR-65-2881) (AF EOAR-62-16) AD 628374 Unclassified

Also published in Physica, v. 30: 1365-1366, 1964.

In an extension of the formalism developed by I. Prigogine and his collaborators, the generalized equations of evolution are derived for a system in the presence of an external field of arbitrary strength and time dependence, but uniform in space. The basic new feature of both the non-Markoffian and the asymptotic equations consists in the field dependence of the collision term. The explicit form of these field corrections is worked out for a simplified description of a plasma in a constant electric field, and the limit of validity of the usual kinetic equations is specified. The generalized equation of evolution introduces a corrective term linear in the electric field which, for the stationary state, is precisely such as to ensure the complete equivalence with the linear response function formulation of the stationary state, i.e. with the Kubo formula. (Contractor's abstract)

757

Free U. of Brussels. Lab. of Animal Morphology (Belgium).

[EFFECTS OF α-LIPOIC ACID ON NUCLEIC ACID METABOLISM IN AMPHIBIAN AND CHICKEN EMBRYOS] Effets de l acide α-lipoique sur le metabolisme

des acides nucleiques chez les embryons de batraciens et de poulet, by V. Heilporn-Pohl and J. Quertier. [1963] [20]p. (AFOSR-65-2243) (AF 61(052)356) AD 629462 Unclassified

Also published in Develop. Biol., v. 9: 155-175, Apr. 1964.

Both the oxidized and the reduced forms of lipoic acid inhibit neural tube closure in pleurodeles and in chicken embryos. Oxidized lipoic acid inhibits the incorporation of H3-uridine and H3-cytidine into DNA; it inhibits the stage which involves the reduction of the ribonucleosides to the deoxyribonucleosides: in fact, the incorporation of H3-deoxyuridine is little or not ail affected by this substance. The action of reduced lipoic acid and reduced triphosphopyridine nucleotide on the reduction of ribose to deoxyribose is just the opposite of that exerted by oxidized lipoic acid. The addition of TPNH to oxidized lipoic acid prevents the inhibition of the incorporation of the ribonucleosides normally observed with oxidized lipoic acid. (Contractor's abstract)

758

Free U. of Brussels. [Lab. of Animal Morphology] (Belgium).

ROLE OF SULFHYDRYL AND DISULFIDE GROUPS IN MORPHOGENESIS, by J. Brachet. Final rept. Apr. 1, 1962 - Apr. 30, 1963. May 31, 1963, 10p. (AFOSR-4852) (AF EOAR-61-31) AD 413860 Unclassified

A study was conducted to compare the morphostatic effects of mercaptoethanol and α-lipoic acid on amphibian eggs, chick embryos, nucleate and anucleate fragments of the giant unicellular alga Acetabularia mediterranea. The organisms treated with mercaptoethanol or lipoic acid, as well as lethal hybrids between amphibians, were subjected to substances such as ATP and Krebs cycle substrates to obtain, if possible, a resumption of morphogenesis. (Contractor's abstract)

759

Free U. of [West] Berlin (Germany).

RESEARCH ON CLUSTERING OF GALAXIES, by R. Wielen. Jan. 1963, 34p. (Technical rept.) (AFOSR-4753) (AF 61(052)335) AD 408301 Unclassified

According to the contract the following studies on clustering of galaxies have been planned: (1) The existence and evolution of superclusters should be proved. Therefore statistical methods must be applied to the existing catalogue of clusters. The theoretical foundation has been developed by Dr. Just. His results are given in the appendix. (2) The richness distribution of clusters of galaxies should be the subject of the second part of the investigations. Especially the influence of systematic and random errors on the richness-distribution should be studied.

760

Free U. of [West] Berlin (Germany).

SOME REMARKS ON THE POSITION OPERATOR IN IRREDUCIBLE REPRESENTATIONS OF THE LORENTZ-GROUP, by W. Weidlich and A. K. Mitra. [1963] 14p. (AFOSR-64-0284) (AF EOAR-62-66) AD 431494 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 385-398, Oct. 10, 1963.

The form of the position operator for relativistic particles in different spinor bases is derived and its uniqueness is proved. The transformation properties of the position operator under all Lorentz transformations and their physical meaning are considered. (Contractor's abstract)

761

Free U. of [West] Berlin (Germany).

RESEARCH ON VOLUME CONDITIONED STIMULI AFFECTING SALT AND WATER EXCRETION, by O. H. Gauer. Final rept. Oct. 1, 1962 - Jan. 31, 1964. Mar. 15, 1964, 4p. (Rept. no. 2) (AFOSR-64-0992) (AF EOAR-62-75) AD 600342 Unclassified

Humoral effects and changes of renal hemodynamics during left atrial distension, competition of osmotic and volume conditioned stimuli in trained animals and the effect of body water immersion on plasma volume and a diuretic factor in the plasma were investigated. Results are given. (Contractor's abstract)

762

Free U. of [West] Berlin (Germany).

[THE EFFECT OF ADH ON IMMERSION DIURESIS] Die Beeinflussung der Badediurese durch Adiuretin, by P. Eckert. [1964] 1p. (AFOSR-65-2842) (AF EOAR-65-63) AD 629211 Unclassified

Also published in Arch. Ges. Physiol., v. 281: 1964.

Immersing human subjects in a neutral-temperature water bath for several hours generally triggers a diuresis accompanied by a considerable increase in water clearance. In order to study the efferent mechanism of this diuresis, four subjects were tested to determine whether and under what circumstances diuresis was inhibited by ADH. The following results were obtained: Immersion diuresis was reduced to original diuretic levels by injections of ADH (0.5-1.0 milliunits/kg), just as a comparable polyuria caused by water-drinking was decreased. In addition continuous ADH infusion (0.25 milli-units/kg/30 min.) completely blocked the onset of immersion diuresis. These results are in agreement with the hypothesis that inhibition of ADH-secretion plays an important part in immersion diuresis.

763

Free U. of [West] Berlin (Germany).

[THE EFFECT OF SHORT-TERM OCCLUSION OF THE PORTAL VEIN ON DIURESIS AND ARTERIAL BLOOD PRESSURE IN THE UNANESTHETIZED RAT] Über den Einflub kurzzeitiger Abklemmung der Vena portae auf die Diurese und den arteriellen Blutdruck der wachen Ratte, by F. J. Haberich, O. Aziz, and P. E. Nowacki. [1964] 1p. (AFOSR-65-2843) (AF EOAR-65-63) AD 629210 Unclassified

Also published in Arch. Ges. Physiol., v. 281: 1964.

Arterial cannulae were implanted in rats for blood pressure measurements, and inflatable cuffs were implanted around the portal vein. The animals were lightly intoxicated with ether, hydrated, and catheterized. After a short control period the portal vein was occluded for 20-60 sec. Beginning 30-60 sec after the onset of occlusion, the blood pressure fell 20-50 mm Hg and remained low for 1-2 min. Occlusion for 30 sec or longer caused diuresis to stop for several min (anuric phase) and remain decreased for 20-30 min (antidiuretic phase). The diuresis returned to its original level in 30-40 min. Occlusion for 20 sec or less had only a weak anti-diuretic effect. This phenomenon cannot be explained by the short-term fall in the blood pressure. It is probably due to a massive outpouring of ADH, since the blood exhibits strong antidiuretic activity during the decreased diuresis.

764

Free U. of [West] Berlin (Germany).

[THE DIFFERENT DIURETIC EFFECTS OF WATER AND ISOTONIC SALINE INFUSION INTO THE PORTAL VEIN AND VENA CAVA OF THE UNANESTHETIZED RAT] Über das unterschiedliche Verhalten der Diurese bei intraportalen und intracavalen Infusionen von Wasser und 0,9% NaCl-Lösung an der wachen Ratte, by F. J. Von Haberich, O. Aziz, and P. E. Nowacki. [1964] 1p. (AFOSR-65-2964) (AF EOAR-65-63) AD 628372 Unclassified

Also published in Arch. Ges. Physiol., v. 279: 1964.

Fine cannulae were implanted in the portal vein and inferior vena cava of female rats so that normal blood flow was not disrupted during the month-long experimental period. Solutions at physiological temperature were infused at a constant rate (3ml/hr). Diuresis was measured by catheterization. When distilled water was infused for a short time (20 min equal to 1 ml), only the portal route resulted in an increased diuresis (up to 180%). Water infusion for an hour by the two different routes was distinguished by the latency period prior to the onset of diuresis and by the maximum diuretic values. The differences were statistically significant (p less than 0.01 or p less than 0.06). A one-hour infusion of 0.9% NaCl (3 ml/hr) the portal route led to no rise in diuresis, while the caval infusion produced a distinct increase. These findings show that an osmotic stimulus in the region of the portal vein or liver triggers a response that leads to an increase in diuresis.

765

Free U. of [West] Berlin (Germany).

[A HUMORAL FACTOR RESPONSIBLE FOR IMMERSION DIURESIS] Untersuchungen zur Frage der humoralen Auslösung der Badediurese, by H. J. Linkenbach, D. Kaiser and others. [1964] 1p. (AFOSR-65-2965) (AF EOAR-65-63) AD 627952 Unclassified

Also published in Arch. Ges. Physiol., v. 279: 1964.

Diuresis was induced in human subjects by maintaining them in a horizontal position and/or immersing them in a neutral-temperature water bath, and their sera were tested for diuretic activity on alcohol-anesthetized rats. The sera from "Fasting-sitting" subjects usually showed no or very slight anti-diuretic effect, but the sera from the horizontal and immersed subjects caused a 20-80% increase in diuresis. A quantitative relationship between this rise in diuresis and the subject's urine volume at the time of blood withdrawal was not found. After standing at room temperature for 20 hrs, the diuretic immersion serum usually showed a considerably decrease in efficacy (ranging to total loss of effectiveness), while its effect was generally preserved after standing at 2-4°C for the same length of time. This probably implies the participation of a thermolabile diuretic substance in immersion diuresis.

766

Fulmer Research Inst., Ltd., Stoke Poges, Buckinghamshire (Gt. Brit.).

STABILITY OF LOWER BORON HALIDES, by P. Gross, C. Hayman and others. Final technical rept. Aug. 22, 1963, 46p. (Rept. no. 154/12) (AFOSR-J1463) (AF 61(052)405) AD 426428 Unclassified

Boron is transported in a stream of boron trifluoride as lower boron fluoride between 1100 and 1400°C. The transport at 1 atm corresponds to 0.1 to 0.5% conversion to monofluoride, for whose standard heat of formation a value of -28 ± 3 kcal is estimated. The experiments show that simultaneously another lower boron fluoride is formed.

767

Fulmer Research Inst., Ltd., Stoke Poges, Buckinghamshire (Gt. Brit.).

HEATS OF FORMATION OF α'-BERYLLIUM CHLORIDE AND α- AND β-BERYLLIUM NITRIDE, by P. Gross, C. Hayman and others. Sept. 1964 [20]p. incl. illus. diagrs. tables, refs. (Rept. no. R 163/SR 1) (AFOSR-66-0344) (AF 61(052)447) AD 630633 Unclassified

The heat of formation of α'-$BeCl_2$(s), [$\Delta H°_{f298}$

(α'-$BeCl_2$) = -117.1 ± 0.4 kcal], of α-Be_3N_2 [$\Delta H°_{f298}$ (α-Be_3N_2) = -141.0 ± 1.6 kcal] and of β-Be_3N_2 [$\Delta H°_{f298}$ (β-Be_3N_2) = -136.7 ± 1.5 kcal] have been determined by combustion of the metal and the nitrides in Cl_2. A value $\Delta H°_{f298}$ α-Be_3N_2 = -140.5 ± 0.3 kcal has been obtained by reaction of the metal with NH_3.

768

Fulmer Research Inst., Ltd., Stoke Poges, Buckinghamshire (Gt. Brit.).

HEATS OF FORMATION OF COMPOUNDS CONTAINING B, Be, Al AND Li, by P. Gross. Final rept. Dec. 31, 1964, 5p. (Rept. no. R 163/18) (AFOSR-65-1048) (AF 61(052)447) AD 470919 Unclassified

A brief review of the work performed is presented. A preliminary value ΔH_{f298} = +27.4 ± 5.8 kcal is derived for the heat of combination of the oxides in $9Al_2O_3 \cdot 2B_2O_3$. Measurements on the heat of solution of $Al_2O_3 \cdot Li_2O$ have been made. X-ray powder photographs of Li_3AlF_6 in a wide temperature range indicate the existence of five forms of the compound designated α, β, γ, δ, and ϵ in order of stability at increasing temperatures. The heat of the reaction 2LiF (crystal) + BeF_2 (glass) = Li_2BeF_4 (crystal) is measured to be $\Delta H°_r$ = -5.3 ± 0.5 kcal.

769

Galway U. [Dept. of Chemistry] (Ireland).

SPECTRAL PROPERTIES OF THE PHYCOBILINS. II. PHYCOERYTHROBILIN, by P. O'Carra, C. OhEocha, and D. M. Carroll. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0035) (AF 61(052)409) AD 454660 Unclassified

Also published in Biochem., v. 4: 1343-1350, Sept. 1964.

The bile pigment phycoerythrobilin, isolated from phycoerythrins, is shown to be a chemically unaltered prosthetic group of these biliproteins. Additional properties and reactions of phycoerythrobilin have been determined and a bilidiene IXα structure, isomeric with mesobiliviolin IXα, is proposed for it. Such a structure has been erroneously associated in the past with a pigment preparation termed mesobilirhodin, and a pigment isolated R-phycoerythrin. This latter, which was originally regarded as phycoerythrobilin, is shown to have been a urobilinoid artifact of the native prosthetic group. Phycoerythrobilin is isomerized by concentrated HCl to a mesobiliviolin and a urobilin which differs from i- and d-urobilin in that it forms refractory covalent linkages with thiol compounds, including the apoprotein of phycoerythrins. A pigment obtained from d-urobilin by isomerization is closely related to phycoerythrobilin, though not identical with it, and the two pigments are considered to be side-chain isomers. (Contractor's abstract)

770

Galway U. [Dept. of Chemistry] (Ireland).

STRUCTURAL AND BIOSYNTHETIC STUDIES OF THE PHYCOBILINS, by C. ÓhEocha. Final technical rept. Aug. 29, 1963, 19p. (AFOSR-J1171) (AF EOAR-62-36) AD 422696 Unclassified

A survey was made of the biliproteins of cryptomonad algae. Structural studies of the phycobins of R-phycoerythrin are reported; one of these was obtained in a pure state from C-phycocyanin. The fluorescence spectra of R-phycocyanin are discussed.

771

Galway U. [Dept. of Chemistry] (Ireland).

BILIPROTEINS OF CRYPTOMONAD ALGAE, by C. ÓhEocha, P. O'Carra and D. Mitchell. [1964] [10]p. (AFOSR-64-1176) (AF EOAR-62-36) AD 442635 Unclassified

Also published in Proc. Roy. Irish Acad., v. 63: 191-200, 1964.

Phycoerythrins and phycocyanins have been isolated and characterized from eight species of cryptomonads (Division Cryptophyta, Class Cryptophyceae, Order Cryptomonadales). Their absorption spectral characteristics are compared with those of previously described cryptomonad biliproteins. Fluorescence spectra of cryptomonad biliproteins are recorded for the first time. Denaturation and hydrolysis studies of phycocyanins from cryptomonads indicate that they contain two dissimilar colored prosthetic groups, or chromophores, one of which has been identified with the pigment of C-phycocyanin.

772

General Applied Science Labs., Inc., Westbury, N. Y.

EXPERIMENTAL SOUND FIELD DISTRIBUTIONS OF A JET WITH A STATIONARY ACOUSTIC SOURCE, by S. Shtsky. May 1963, 19p. incl. illus. diagrs. (Technical rept. no. 351) (AFOSR-5322) (AF 49(636)-194) AD 417281; AD 418381 Unclassified

Measurements are made in the far field of an axisymmetric jet using a non-convecting ultrasonic source located on the jet axis. Reasonable comparisons are found with the results of an analytic model based on parallel flow and boundaries. Experiments were then carried out on a water table in which a two dimensional configuration was simulated under conditions of parallel steady jet flow, and of wavy jet flow. The results confirmed indications that the wavy flow in a jet is responsible for the diffusion of sound field directionality.

773

General Applied Science Labs., Inc., Westbury, N. Y.

LINEARIZED VISCOUS FREE MIXING WITH STREAMWISE PRESSURE GRADIENTS, by M. H. Steiger and M. H. Bloom. [1964] [4]p. incl. diagr. refs. (AFOSR-64-0910) (AF 49(636)991) AD 439665 Unclassified

Also published in AIAA Jour., v. 2: 263-266, Feb. 1964.

Sets of similar solutions applicable within a linearized approximation are derived for two-dimensional compressible and axisymmetric incompressible viscous free mixing with streamwise pressure gradients. Viewed as eigenfunctions these solutions can be superposed to represent arbitrary initial conditions. However, it is observed that only one solution of the family possesses a net momentum defect (or excess) different from zero. This mode decays exponentially in the normal direction and has a stronger streamwise persistence than any of the other solutions that have exponential normal decays; it is usually referred to as the similar solution. (Contractor's abstract)

774

General Applied Science Labs., Inc., Westbury, N. Y.

REVIEW OF PROBLEMS IN APPLICATION OF SUPERSONIC COMBUSTION, by A. Ferri. May 14, 1964 [107]p. incl. diagrs. table, refs. (AFOSR-64-1471) (AF 49(636)991) AD 604441 Unclassified

Presented at Seventh Lanchester Memorial Lecture, Royal Aeronautical Soc., London (Gt. Brit.). May 14, 1964.

Also published in Jour. Roy. Aeronaut. Soc., v. 68: 575-597, Sept. 1964. (AFOSR-64-2387; AD 451878)

The problem of air-breathing engines capable of flying at very high Mach numbers is described briefly. Possible performance of supersonic combustion ramjets is outlined briefly and the supersonic combustion process is described. Two mechanisms of combustion are outlined: one is supersonic combustion controlled by convection process, and the second is controlled by diffusion. The parameters related to the combustion process are discussed in detail. Data and analyses of reaction rates and mixing phenomena are represented; the flame mechanism is discussed, and experimental results are presented.

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General Applied Science Labs., Inc., Westbury, N. Y.

AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF IGNITION AND AXI-SYMMETRIC TURBULENT FLAME PROPAGATION IN HYDROGEN-AIR MIXTURES AT SUPERSONIC SPEEDS, by J. Tamagno and N. Trentacoste. July 1964, 69p. incl. illus. diagrs. table, refs. (Technical rept. no. 445) (AFOSR-64-1472) (AF 49(638)991) AD 604429 Unclassified

The report is concerned with the experimental study of turbulent combustion processes in high speed flows and the comparison of the experimental results with those obtained by means of a newly available numerical approach for the computation of flows with diffusion and finite rate chemistry. It is shown that stable ignition may be insured in a jet of hydrogen-air or ethylene-air mixture by a pilot flame of small dimensions and very low heat liberation compared to that of the main stream (of the order of 0.4%). Under proper conditions the premixed jet is ignited without fluctuations, periodic flashes or oscillations. A strong dependence of the flame propagation velocity on the mixture composition has been found experimentally for given constant flow conditions, i.e., flow velocity and total temperature of the mixture. This dependence correlated well with the predictions of the numerical computations.

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General Applied Science Labs., Inc., Westbury, N. Y.

LINEARIZED APPROXIMATIONS TO THE BOUNDARY LAYER EQUATIONS, by J. A. Schetz and J. Jannone. June 1964, 74p. (Technical rept. no. 448) (AFOSR-64-1473) (AF 49(638)991) AD 604430 Unclassified

The general subject of linearized approximations to the boundary layer equations as a source of approximate solutions for viscous flow problems is considered from a unified viewpoint. The various methods based upon this concept which have been proposed in the literature are reviewed and applied to two specific nonsimilar flow problems in order to affect a comparison of quantitative results. Within this framework some new work is presented. Linearization in the von Mises plane is considered in some detail, and typical results are compared with those obtained by the conventional physical plane linearization techniques. In this regard, the use of the total pressure rather than the velocity as the dependent variable is shown to have important advantages, both conceptual and quantitative, even for constant pressure flow problems when subjected to a linearized treatment. Finally, specific recommendations are made as to the approach best applied to a specific type of physical problem.

777

General Applied Science Labs., Inc. [Westbury] N. Y.

SUPERSONIC COMBUSTION PROGRESS, by A. Ferri. [1964] [7]p. (AFOSR-64-1953) (AF 49(638)991) AD 450318 Unclassified

Also published in Astronaut. and Aeronaut., v. 2: 32-37, Aug. 1964.

A ramjet is presented using supersonic combustion controlled by mixing which appears to be of great interest, because such a scheme promises very good performances for a large Mach-number range without the necessity of variable-geometry inlets and variable-geometry nozzles.

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General Applied Science Labs., Inc., Westbury, N. Y.

INITIAL BOUNDARY LAYER EFFECTS ON LAMINAR FLOWS WITH WALL SLOT INJECTION, by J. A. Schetz and J. Jannone. [1963] [4]p. (AFOSR-64-2478) (AF 49(638)991) AD 453963 Unclassified

Also published in Jour. Heat Transfer, 1964, p. 1-4.

An analytical investigation of the effects of an initial splitter plate boundary layer on the flow field associated with the slot injection of a gas in laminar flow is presented. The analysis is based on the method of collocation, using profiles generated by a modified Oseen approximation to the momentum equation, and the results are presented in terms of the effects on skin friction and heat transfer coefficients. It is shown that the initial boundary layer thickness can be an important parameter in describing the flow field.

779

[General Applied Science Labs., Inc., Westbury, N. Y.]

MIXING PROCESSES IN SUPERSONIC COMBUSTION, by A. Ferri, G. Moretti, and S. Slutsky. [1965] [59]p. incl. diagrs. refs. (AFOSR-65-1310) (AF 49(638)991) AD 619390 Unclassified

Presented at Symposium on Appl. Math. and Mech., Washington, D. C., May 11-14, 1964.

The problem of combustion and mixing of fuel and air in a supersonic stream is considered. Hypersonic flight seemingly necessitates a ramjet engine using this principle. Analytic approaches to the problem developed in relation to the fluid-dynamic and chemical problems are reviewed. Three principal steps are discussed concerning (1) the nature of the chemical system in the absence of mixing or diffusion effects, (2) the above-1-dimensional chemistry, combined with mixing using a boundary layer type of analysis, and (3) 2-dimensional or axially symmetric combustion processes which take place within rigid boundaries and with large pressure gradients.

780

General Dynamics/Astronautics, San Diego, Calif.

INFRARED TRANSMISSION THROUGH THE ATMOSPHERE, by A. E. S. Green and M. Griggs. [1963] [10]p. incl. diagrs. tables. (AFOSR-64-0273) (AF 49-(638)561) AD 432743 Unclassified

Also published in Appl. Opt., v. 2: 561-570, June 1963.

An analytic expression for transmission in terms of optical path and pressure is combined with an analytical expression for equivalent atmospheric path length in terms of height and slant angle to yield a single expression for transmission in terms of height and slant angle. Separate equations are developed for carbon dioxide absorption, and for water vapor absorption. The latter may be used with almost any water vapor distribution in the atmosphere. A function due to Chapman is used instead of the usual secant factor for slant paths in order to extend the use of the equations to angles of incidence up to 90°. Wavelength dependent parameters are presented based upon Zachor's analytic fits to laboratory data.

781

General Dynamics/Astronautics, San Diego, Calif.

HIGH-RESOLUTION STUDIES OF TYPE III SOLAR EMISSION AT 11.4-METER WAVELENGTH, by W. C. Erickson. [1963] [11p. (AF 49(638)561) AD 629343 Unclassified

Also published in Jour. Geophys. Research, v. 68: 3169-3179, May 15, 1963.

Enhanced solar radio emission was observed during May and June 1962 at a wavelength of 11.4 m (26.3 mc/s) by the Clark Lake antenna (a full description of the antenna is in press). Two emission regions were observed. They were of large angular size (about 2 to 3 solar radii in diameter), they fluctuated rapidly in amplitude (periods about 4 sec or less), and they appeared to rotate with the sun and to have been located at distances of about 2.0 and 2.5 solar radii from the sun's center. Correlation with sweptfrequency data indicates that most or all of the observed emission was of spectral type III. On the basis of these data plasma levels corresponding to densities of 8.5 x 1000000 electrons/cc are estimated to have been at heights of 2.0 and 2.5 solar radii over the active regions. These estimates agree well with the coronal streamer model of Newkirk. The average brightness distribution of one of the emission regions is found to be consistent with the 'core and halo' model proposed by Weiss and Sheridan.

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General Dynamics/Astronautics, San Diego, Calif.

MAGNETIC FIELD DIFFUSION ASSOCIATED WITH AN IONIZING SHOCK WAVE INTERACTING WITH AN ELECTROMAGNETIC FIELD, by J. Rosciszewski and A. Kritz. [1964] [2]p. incl. diagr. (AFOSR-65-2487) (AF 49(638)1357) AD 629260 Unclassified

Also published in Phys. Fluids, v. 7: 1393-1394, Aug. 1964.

The diffusion of the magnetic field is calculated assuming linearized flow behind the shock wave or arbitrary strength.

783

General Dynamics Corp. General Atomic Div., San Diego, Calif.

CHEMICAL REACTIONS USING MODULATED FREE RADICAL BEAMS, by W. L. Fite. Final rept. Oct. 1, 1962 - Sept. 30, 1963, Oct. 22, 1963, 29p. incl. diagrs. refs. (Rept. no. GA-4682) (AFOSR-J1362) (AF 49-(638)1191) AD 428699 Unclassified

Although the research was unable to make high quality quantitative measurements on the $H + D_2 \rightarrow HD + D$ reaction, the experience gained points important directions for state-of-the-art improvements. Turning to the $H + D_2$ case, it is clear that at least one of the following technical advances must be made to ensure the success of such measurements: (1) a D_2 purity higher than 99.5% must be obtained and if the signal-to-noise ratio is to be increased by a factor of 10, the purity of the D_2 should exceed 99.995%, since the HD impurity problem was one of noise; (2) better trapping than simple condensation at a 4°K surface must be employed. The present state-of-the-art is probably adequate to carry out detailed studies of reaction collisions between hydrogen atoms and deuterated hydrocarbons using electron impact ionization.

784

General Dynamics Corp. General Atomic Div., San Diego, Calif.

SCATTERING OF ATOMIC BEAMS BY POLYCRYSTALLINE NICKEL, by J. N. Smith, Jr. Nov. 5, 1963, 30p. incl. diagrs. refs. (Rept. no. GA-4665) (AFOSR-5439) (AF 49(638)1192) AD 429760 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2520-2527, May 1, 1964.

The results of recent experimental studies of the scattering of beams of Kr, Ar, Ne, He and D_2 from polycrystalline nickel targets are presented and compared with the findings of other investigations of the phenomenology of heavy particle scattering at a solid surface. In the present experiments, as in certain earlier experiments utilizing alkali halide cleavage planes, large deviations from diffuse (cosine law) scattering are observed, which have not yet been satisfactorily interpreted. The present series of experiments tends to support a model for the scattering mechanism in which a fraction of the incident molecules are scattered diffusely and the remainder are scattered preferentially. From experimental observations, it is inferred that the slower particles in the incident beam contribute to the diffuse component while the faster particles are scattered preferentially. In addition, an angular variation in the degree of thermal accommodation of the incident particles is observed.

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General Dynamics Corp. General Atomic Div., San Diego, Calif.

INTERACTIONS BETWEEN HYDROGEN AND OXYGEN ATOMS AND SURFACES, by J. N. Smith, Jr. Final rept. Oct. 1, 1962 - Oct. 31, 1964, 19p. incl. refs. (Rept. no. GA-5762) (AFOSR-64-2388) (AF 49(636)-1192) AD 608592 Unclassified

The ultimate goal of the research is to provide data concerning the transfer of energy and momentum between atoms and molecules and a solid surface in free molecule flow, and to investigate other processes that may occur in the gas-surface interaction. The program was conducted to provide the necessary boundary conditions to be used in the calculation of aerodynamic drag coefficients in rarefied gas flow. The modifications of the basic modulated atomic-beam machine used in the experiments are summarized. The general experimental method is discussed in some detail; however, experimental results are only outlined as the bulk of the work has been published previously; abstracts of these publications are included as appendices.

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General Dynamics/Electronics, Rochester, N. Y.

HIGH-INTENSITY SOUND PROPAGATION, by D. T. Blackstock. Final rept. Nov. 1, 1961 - Sept. 30, 1963, 3p. (AFOSR-J1239) (AF 49(638)1118) AD 424311 Unclassified

A program of basic research on high-intensity sound is described. A number of problems, both theoretical and experimental, were studied. In general, the emphasis was on the effect which viscosity and heat conduction have on periodic, finite-amplitude (high-intensity) waves.

787

General Dynamics/Electronics, Rochester, N. Y.

THERMOVISCOUS ATTENUATION OF PLANE, PERIODIC, FINITE-AMPLITUDE SOUND WAVES, by D. T. Blackstock. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-1030) (AF 49(636)1118) AD 440984 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 534-542, Mar. 1964.

The propagation of a plane progressive wave of finite amplitude in a thermoviscous fluid is considered. The wave is taken to be purely sinusoidal in shape at its source. The approach is through Burgers equation, which is a very good approximation of the exact equations of fluid motion when effects of nonlinearity and dissipation are relatively small but definitely not negligible. A complicated but exact solution of Burgers' equation is analyzed. The nature of the solution is found to depend strongly on a parameter gamma, which represents the importance of nonlinearity relative to dissipation.

788

General Dynamics/Electronics, Rochester, N. Y.

APPROXIMATE EQUATIONS GOVERNING FINITE-AMPLITUDE SOUND IN THERMOVISCOUS FLUIDS, by D. T. Blackstock. May 1963, 47p. (Rept. no. GD1463 52) (AF 49(638)1118) AD 415442 Unclassified

The equations of motion for viscous, thermally conducting, inert fluids of arbitrary equation of state are approximated so as to account as simple as possible for effects of nonlinearity and dissipation. The purpose is to obtain a general improvement of the classical wave equation. The approximation method is basically the same as the one used by Lighthill (1956) to derive Burgers' equation for unbounded, progressive, plane waves in a perfect gas. Besides encompassing the case treated by Lighthill, the equations are applicable for nonplanar waves, for interacting waves, and for waves subject to boundary-layer effects. Moreover, the fluid need not be a perfect gas. Important simplifications arise when either boundary-layer or mainstream dissipation is negligible. When only mainstream losses are important, the assumption of plane progressive waves leads to Burgers' equation. Two forms of Burgers' equation are given. One is suitable for initial-value problems and the other is suitable for boundary-value problems.

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General Dynamics/Electronics, Rochester, N. Y.

COMMUNICATION AND INFORMATION THEORY ASPECTS OF THE NERVOUS SYSTEM, by E. Agalides. Annual summary rept. Oct. 1, 1962 - Sept. 30, 1963, 57p. incl. illus. diagrs. tables, refs. (AFOSR-64-0825) (AF 49(638)1185) AD 437348 Unclassified

The contents of this report are: Multicoding-Unichannel and Multicoding-Multichannel Coding Theories of the Nervous System; Stimuli Transmission by the Giant Axon of Cambarus and Homarus Americanus; Neuron Simulators; Electromechanical Stimulator for Exerting Pressure on Skin Sensory Receptors; Piezoelectric Mechanical Transducer System and Terminology Used in Shannon's Theorem.

790

General Dynamics/Electronics, Rochester, N. Y.

THE EFFECT OF ACOUSTIC WAVES ON THE PACINIAN CORPUSCLE: A PRESSURE-SENSORY RECEPTOR OF THE SKIN, by E. Agalides. [1964] [18]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0294) (AF 49(638)1185) AD 611462 Unclassified

Also published in Trans. New York Acad. Sci., Ser. II, v. 26: 670-687, Apr. 1964.

Experiments were made which show that a mechanical stimulation of the pressure sensitive skin receptor, called the pacinian corpuscle, can be effected by acoustic waves. It was further possible to show that no coupling between the sensory receptor and the stimulator took place. The characteristics of the transmitting medium and of the transducers used are listed.

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General Electric Co. Advanced Technology Lab., Schenectady, N. Y.

ON THE DISPERSED TWO-PHASE FLOW IN THE LAMINAR FLOW REGIME, by N. Zuber. Jan. 1963 [58]p. incl. diagrs. refs. (Rept. no. 63GL50) (AFOSR-4632) (AF 49(638)1153) AD 413515 Unclassified

Also published in Chem. Eng. Sci., v. 19: 897-917, 1964.

The time-dependent, dispersed, two-phase flow problem for the laminar flow regime is formulated. In agreement with Burgers' description of the flow, the analysis takes into account the effect of both the motion and the presence of other particles. The steady-state solution of the governing set of equations is applied to an analysis of sedimentation and of fluidization (batch, cocurrent and countercurrent). Good agreement with experimental data is shown. The steady-state results give a formulation and a confirmation of the basic premise in the theory of Elgin and Lapidus for vertical two-phase flow systems. The theory of kinematic waves proposed by Kynch and by Lighthill and Whitham is used to analyze the transient response, i.e., the diffusion process, and to predict the diffusivity in two-phase flow. The kinematic wave theory is used also to predict the operating limits imposed on the system by the flooding phenomenon.

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

RESEARCH ON THE INTERACTION OF GASES WITH NONMETALLIC SURFACES, by G. Ehrlich and B. McCarroll. Final rept. Feb. 1964, 7p. (Rept. no. 64GC0267M) (AFOSR-64-0475) (AF 49(638)791) AD 435174 Unclassified

Progress is reported on achieving a better understanding of the elementary atomic and molecular processes occurring when simple gases interact with a solid surface, with particular emphasis upon energy transfer in atomic collisions and the act of activation in dissociative adsorption. This report first takes up those investigations involving the ion microscope. This is followed by work on collision processes, depending mainly on theoretical analyses of the mechanics of these events, and by subsidiary studies of several related experimental effects.

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

TRAPPING AND ENERGY TRANSFER IN ATOMIC COLLISIONS WITH A CRYSTAL SURFACE. II. IMPURITIES, by B. McCarroll. [1963] [10]p. incl. diagrs. tables, refs. (AFOSR-64-0483) (AF 49(638)-791) AD 435182 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1317-1326, Sept. 1, 1963.

The influence of surface impurities and internal impurities on (1) atomic condensation on a solid, (2) equilibration of the newly captured atom with the solid, and (3) the accommodation coefficient, are examined through calculations with a one-dimensional semi-infinite analog in the harmonic approximation. The general equation for the semi-infinite lattice (arbitrary composition) and impinging gas atom are specialized to a pure lattice with a surface impurity (variable mass and bonding), and a pure lattice with a defective third atom (variable mass and bonding). For the surface impurity: a decrease in coupling K decreases the condensation efficiency. Decreasing either the mass M or K decreases the rate of thermalization of a captured atom. There is a maximum in the condensation efficiency when M is varied. Light surface atoms do increase the accommodation coefficient. For the internal impurity: a weakening if impurity bonding decreases both trapping efficiency and rate of thermalization. Light impurities decrease the condensation efficiency, but increase the thermalization rate. The effect of the internal impurity on the accommodation coefficient is negligible.

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

CONDENSATION AND ENERGY TRANSFER ON

CRYSTALS, by B. McCarroll and G. Ehrlich. Mar. 20, 1963, 17p. (Rept. no. 63RL3291M) (AFOSR-64-0776) (AF 49(638)791) AD 435184 Unclassified

The collision of atoms with crystalline surfaces has an analogue in the semi-infinite linear chain of harmonically coupled particles struck on one end by an incident particle. Using this simple model, four different effects have been evaluated and compared with experiment: (1) the variation of the condensation efficiency with the mass of the impinging particle and with the strength of binding to the lattice; (2) the de-excitation of these atoms immediately after capture; (3) the efficiency of energy transfer to the lattice (accommodation coefficient) for collisions in which capture does not occur; and (4) the influence of defects on these quantities.

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General Electric Co. General Electric Research Lab., Schenectady, N. Y.

AN ATOMIC VIEW OF ADSORPTION, by G. Ehrlich. Feb. 1964, 28p. incl. illus. diagrs. tables, refs. (Rept. no. 64RL3575M) (AFOSR-64-0777) (AF 49-(638)791) AD 435185 Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 349-364, 1964.

Modern experimental techniques, particularly flash desorption, field emission, and field ion microscopy, coupled with advances in ultrahigh vacuum technology, have made it possible to attain a detailed description of adsorption phenomena from routine measurements. Recent advances in the understanding of elementary atomic processes at the gas-solid interface, gained by these methods, are reviewed with particular emphasis on two topics: (1) the relation between surface structure and atom binding in physical adsorption as well as the chemisorption; (2) the kinetics of atomic condensation and equilibration.

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General Electric Co. [General Electric Research Lab.] Schenectady, N. Y.

PREPARATION TECHNIQUES FOR GROWTH OF SINGLE CRYSTALS OF NONMETALLIC MATERIALS, by E. M. Clausen and J. W. Rutter. Final rept. June 1, 1963 - May 31, 1964. June 1964, 34p. (Rept. no. R64GC0279M) (AF 49(638)1247) AD 602945 Unclassified

The report describes two techniques for growth of high-purity single crystals of nonmetallic materials using r-f induction-heating equipment in a frequency range of 5 to 100 mc. One technique used for single-crystal growth was the Verneuil method using an induction-coupled plasma as a heat source instead of the conventional mixture of combustible gases. The second crystal growth technique investigated was floating-zone melting using r-f induction heating. The shape of the freezing liquid-solid interface appeared to be an important factor in crystal growth by this technique.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

GENERATION OF ORBITS BY GENERALIZED HILL CURVES, by V. G. Szebehely. [1963] [10]p. (AFOSR-J738) (AF 49(638)814) AD 414119 Unclassified

Also published in Jour. Franklin Inst., v. 275: 371-380, May 5, 1963.

Two-degrees-of-freedon dynamical systems are investigated by extending the application of zero velocity or Hill curves. A general set of dynamical problems including the restricted problem of three bodies—is established, and it is shown that the presented system possess zero velocity curves. The general problem of using the Hill curves for orbit generation is solved, and several examples are given.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ON ISOTACH ORBITS, by V. Szebehely. [1963] [14]p. (AFOSR-J1026) (AF 49(638)814) AD 419736 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 13: 192-205, 1963.

Investigations of special cases of the restricted problem of three bodies utilize the family of zero velocity curves, often referred to as Hill curves. It is known that certain regions of possible motion can be established by means of these curves, that orbits might exhibit cusps at the Hill curves, that some numerically obtained periodic orbits show "similarity" to the Hill curves, etc. The general relation between the zero velocity curves and orbits for certain classes of dynamical problems (including the restricted problem) is investigated and conditions which give precise analytical meaning to the above mentioned similarity are established.

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General Electric Co. [Space Sciences Lab.] Philadelphia, Pa.

APPLICATION OF THE RESTRICTED PROBLEM OF THREE BODIES TO SPACE MECHANICS, by V. Szebehely. [1963] [31]p. (AFOSR-J1290) (AF 49-(638)814) AD 424210 Unclassified

Also published in Space Sci. Rev., v. 2: 219-249, 1963.

The most celebrated problem of dynamics, the problem

of three bodies, is defined in the first chapter and it is shown how the probleme restreint is obtained from the general formulation. This is followed by a historical review of the restricted problem from the point of view of space dynamics applications and the present state of the art is described in some detail. The third and final chapter reviews the major activities in the field of space mechanics and their relation to the restricted problem are pointed out. The purpose of this compte rendu is to demonstrate two theses. Firstly, based on the history of the restricted problem of three bodies, it will be shown that combining recent advances in computer technology and in analytical dynamics with modern topological techniques, a terr firma exists for a new attack on this classical problem. The second thesis is that the restricted problem of three bodies plays a central role in celestial mechanics and in space dynamics.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

ON THE STABILITY OF THE EQUILIBRIUM SOLUTIONS OF THE PLANE RESTRICTED THREE BODY PROBLEM IN THE SENSE OF LIAPOUNOV, by S. E. Moskowitz. Final rept. Apr. 1964, 28p. (Rept. no. R64SD34) (AFOSR-64-0361) (AF 49(638)814) AD 438857 Unclassified

The stability of the five equilibrium solutions of the plane restricted three body problems is investigated in a topological sense of Liapounov. This aspect of motion has always been a subject of considerable interest primarily because the stability criteria were derived from linearizing the dynamical equations. It is shown that the question cannot be resolved by means of existing theorems governing the first approximation since these cases belong to an exceptional class which Liapounov had termed critical. The stability of the equidistant positions and instability of the collinear solutions are established however in accordance with a less restrictive definition by using surfaces which are formed from the Jacobi integral.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

MAGNETOHYDRODYNAMIC PROPULSION, by A. Sherman. Jan. 1963, 27p. incl. diagrs. refs. (Rept. no. R63SD5) (AFOSR-4636) (AF 49(638)914) AD 295721 Unclassified

Within the present report the entire area of magnetohydrodynamic propulsion is reviewed. To begin with continuous flow plasma accelerators are discussed, and the current status of theoretical and experimental studies presented. Both the normal crossed field devices and the so-called Hall accelerators are described. It is shown that these devices offer the promise of efficient operation in the 2-4000 sec specific impulse range. Next the pulsed plasma accelerator with electrodes is considered. Experimental results with confined rail type devices are shown to yield high efficiencies for specific impulses greater than 5000 seconds for times of operation on the order of days. Similar results at lower specific impulses are not yet available. Finally, the experimental work on the pulsed electrodeless device is described, and it is shown that as yet relatively low efficiencies have been obtained. Some of the causes of such low efficiencies are discussed. The extension of this concept to the traveling wave machine is also included. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

MAGNETOHYDRODYNAMIC BOUNDARY LAYERS, by A. Sherman. Jan. 1963, 34p. incl. diagrs. (Rept. no. R63SD4) (AFOSR-4637) (AF 49(638)914) AD 294720 Unclassified

A review of those new phenomena which arise in magnetohydrodynamic boundary layers is presented in this report. The first topic discussed due to its simplicity and relation to boundary layer flows is the Rayleigh problem. Here it is shown that the introduction of magnetohydrodynamic forces leads to basic changes in the nature of the flow. Next the basic boundary layer equations are deduced and the conditions necessary to yield similar solutions deduced. In succeeding sections incompressible and compressible boundary layers are treated with attention paid to the appropriate external boundary conditions. Finally, boundary layer phenomena arising when $R_m \to \infty$ are considered in order to illustrate some new phenomena within the framework of boundary layer theory. (Contractor's abstract)

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

FUNDAMENTALS OF MHD FLOW, by A. Sherman. Final rept. June 1964, 12p. incl. refs. (AFOSR-64-1425) (AF 49(638)914) AD 617562 Unclassified

Magnetohydrodynamic phenomena associated with crossed field devices are investigated. The working medium was assumed to be a partially ionized plasma at relatively low temperatures (1500-3000°K), so that magnetic Reynolds numbers were assumed to be much less than one. As a result, it was typically assumed that the applied magnetic field was not distorted by currents flowing in the plasma, although for some problems this simplification was not necessary. Several studies were made of the properties of the low temperature plasmas of interest. Then a large number of channel flow problems were analyzed and reported upon. Some magnetohydrodynamic boundary layer phenomena were next reviewed, and following this a broad review was made of the propulsion and power generation application areas. New concepts were developed for the macroscopic description of the non-equilibrium ionization idea.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

LINEARIZED ANALYSIS OF MHD FLOW STABILITY, by G. W. Sutton and E. Witalis. Jan. 1964, 11p. (Rept. no. R64SD5) (AF 49(638)914) AD 429173 Unclassified

The quasi one-dimensional compressible flow equations for a magnetohydrodynamic power generator were analyzed for one-dimensional instabilities by means of linearized perturbations. The gas was assumed to be ideally compressible, inviscid, nonheat-conducting, with an electrical conductivity that depends on local temperature. The results indicate that large instabilities cannot exist, confirming the previous approximate results of Wright and refuting the original claims of Velikhov.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

NON-EQUILIBRIUM IONIZATION AND MAGNETOHYDRODYNAMIC PHENOMENA, by A. Sherman. Doctoral thesis, May 1964, 126p. (Rept. no. R64SD36) (AF 49(638)914) AD 600526 Unclassified

The present report deals with the interaction between non-equilibrium ionization phenomena in a plasma and the non-uniform flow of that plasma. The phenomenon of non-equilibrium ionization is first analyzed for a stationary plasma in the presence of an electric field. It is then shown that similar phenomena will exist in a moving plasma in the presence of a magnetic field. Based on these concepts the appropriate species equations are derived and combined to yield a single fluid theory of the phenomena in question. By this device it is shown that in general the electrical conductivity may be expressed as a function of the current density. Using this idea and assuming simple functional dependencies the Hartmann flow is solved despite the nonlinearity of the problem. Numerical solutions are also obtained when the Hall effect is present. Based on these calculations certain unexpected limitations on the physical parameters of the problem appear.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

STRUCTURAL RESPONSE TO INTENSE ELECTROMAGNETIC RADIATION, by R. C. Good, Jr. Second annual technical rept. Mar. 1, 1962 - Feb. 28, 1963, 80p. incl. illus. diagrs. tables, refs. (AFOSR-5096) (AF 49(638)1030) AD 413974 Unclassified

An exploding wire apparatus has been used to study conversion of electrical energy into strain energy in glass samples that have been either irradiated by the electromagnetic waves emitted by the wire or enveloped by plasma formed by the wire. The strain energy left permanent marks on the sample as discoloration, weight loss, and surface cracks. These were used to confirm the theoretical analysis as to method and to dimensions. Conversion of energy within the sample was postulated to involve thermal absorption, diffusion, and strain. The thermal diffusion equation was solved and values computed for the heating and cooling portions of the pulse. By linking the quantity of material heated with experimental measurements, an overall absorption coefficient for glass of 10^3 cm and an energy deposition of 1/2 joule/sq cm was found.

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General Electric Co. Space Sciences Lab., Philadelphia, Pa.

DIRECT MEASUREMENT OF VELOCITY DISTRIBUTION FUNCTIONS, by E. P. Muntz. Aug. 1964, 62p. incl. diagrs. tables, refs. (Rept. no. R64SD59) (AFOSR-64-1599) (AF 49(638)1152) AD 604252; AD 608545 Unclassified

Also published in Rarefied Gas Dynamics; Proc. Fourth Internat'l. Symposium, Toronto U. (Canada) (July 14-17, 1964), ed. by J. H. de Leeuw. New York, Academic Press, v. 2: 128-150, 1966.

A method for measuring velocity distribution functions in rarefied gas flows was investigated. The technique is a direct determination, accurate to within one percent, which does not significantly disturb the flow under investigation. It is shown that accurate measurements can be made of the Doppler profile of emission lines excited by an electron beam. The method depends upon the tendency of high energy electrons to transfer relatively little momentum to the nuclei when they excite the electronic levels of gas molecules. The technique presented could be used in the study of normal shock waves and other investigations in rarefied gas dynamics research.

808

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

A FEASIBILITY STUDY OF THE MEASUREMENT OF ION DENSITIES BEHIND AIR SHOCKS BY INTRODUCING SMALL AMOUNTS OF LITHIUM VAPOR, by B. Cary and W. Nickels. Sept. 1963, 50p. (Rept. no. R63SD82) (AF 49(638)1157) AD 423565 Unclassified

Preliminary experiments indicated that ionization equilibrium is attained in the shock tube behind strong shocks in argon and that the boundary layer appears to electrically insulate the gas from the metal tube walls. The anomalous method was used to measure the amounts of lithium vapor injected into the shock heated air and it is concluded that concentrations of 300 ppm could be maintained within a factor or two. Experimental data is presented which suggest that the presence of the lithium vapor has no great effect upon either the vibrational relaxation rate of nitrogen or

the overall dissociation rate of oxygen. Interferometric evidence indicated that the bulk dissociation processes did equilibrate behind M 18 shock waves in air although Stark measurements by the 4603A lithium line suggest that ionic equilibrium is not attained.

809

General Electric Co. Space Sciences Lab., Philadelphia, Pa.

RESEARCH ON HYPERSONIC RAREFIED PLASMA FLOWS, by S. M. Scala. Final rept. Oct. 15, 1963 - Oct. 14, 1964. Nov. 13, 1964, 32p. (AFOSR-64-2471) (AF 49(638)1283) AD 609496 Unclassified

A modified form of the Chapman and Enskog transport theory for gas mixtures was developed for a neutral, binary mixture with disparate molecular weights. The difficulties in the past have been that the usual Chapman and Enskog theory was based on a single time scale for the molecular relaxation. As pointed out by Grad, this relaxation occurs on a multiple time scale, and this fact is exploited in deriving a modified Chapman and Enskog theory.

810

General Mills, Inc., Minneapolis, Minn.

ELECTRICAL CHARACTERISTICS OF GRAIN BOUNDARIES IN COMPOUND SEMICONDUCTORS, by R. K. Mueller. Final rept. June 28, 1963 [20]p. incl. diagrs. refs. (Rept. no. 2404) (AFOSR-64-1092) (AF 49(638)-628) AD 600321 Unclassified

The principal effort was directed toward the preparation of low-angle grain boundaries in indium antimonide (InSb) and the study of their electrical and galvanomagnetic properties with the ultimate objective of relating these properties to the structure of the boundary.

811

General Mills, Inc., Minneapolis, Minn.

PHOTOCONTROLLED SURFACE CONDUCTANCE IN ANODIZED InSb, by R. K. Mueller and R. L. Jacobson. [1964] [6]p. (AFOSR-64-1744) (AF 49(638)628) AD 448291 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1524-1529, May 1964.

Anodized p-type InSb, cooled to the extrinsic conduction range in the dark, was found to have an n-type inversion layer at the surface. Illumination changes the n-type inversion layer to a p^+ accumulation layer; any intermediate surface condition can be obtained by controlled exposure. A method for determining the surface conductance of the inversion layer is described. This method utilizes high impedance grain boundary barrier to avoid shunting of surface conduction by bulk conduction. The highest surface conductance on unilluminated anodized samples was found to 100 umhos/square. Spectral response measurements show that photons in the energy range 0.8 to 3.5 ev are effective. The effect is believed due to photoemission of electrons from the InSb into the oxide. Transient response measurements for light on and off conditions on n- and p-surfaces support this model.

812

General Mills, Inc., Minneapolis, Minn.

InSb DIODES UNDER CONTROLLED SURFACE CONDITIONS, by K. N. Maffitt and R. K. Mueller. [1964] [2]p. (AFOSR-64-1745) (AF 49(638)628) AD 448292 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1563-1564, May 1964.

The surface of anodized InSb cooled in the dark can be changed from n type over a conductance minimum to p type by controlled illumination. The characteristics of alloyed diodes on n- and p-type base material were studied at 78 °K under controlled surface conditions. Under optimal surface conditions the voltage-current characteristic follows the relation predicted by Sah et al, for space-charge generation currents. An effective minority carrier lifetime of 2.4×10^{-9} for n-type and 2.8×10^{-9} for p-type InSb is required to fit the data. An anomalous capacitance is observed only if an inversion layer exists at the surface.

813

General Motors Corp. Allison Div., Indianapolis, Ind.

RAIL TYPE PULSED PLASMA ACCELERATION, by T. L. Rosebrock, D. L. Clingman, and D. G. Gubbins. Final rept. Apr. 1963, 123p. (Rept. no. EDR3255) (AFOSR-5070) (AF 49(638)864) AD 467202 Unclassified

Descriptive equations for the acceleration process are derived, including effects of nonparallel electrodes; analog solutions for the equations are presented. The plasma mass-velocity distribution is discussed. Analytical treatments are presented for the generalized magnetic field, copper gas ionization and conductivity, energy efficiency, system energy distribution, plasma-electrode interaction, supplementary magnetic fields, and alkali salt propellants. Specific items of instrumentation are described. Experimental studies for both fast and slow circuits are discussed in which electrode geometries, propellant materials, propellant mass, plasma dispersion, pressure effects, external magnetic fields, electrode conditioning, electrode materials, electrode erosion, and propellant geometry are considered. Vapor-deposited film propellants are found to provide a basis for considerable optimism in regard to the future of pulsed plasma accelerators.

814

General Precision, Inc. [Librascope Group] Glendale, Calif.

RESEARCH ON THE ANALOGICAL SIMULATION OF NEURAL BEHAVIOR. Final rept. Mar. 1961 - Mar. 1963, 25p. (AFOSR-4952) (AF 49(638)1021) AD 414014 Unclassified

This report summarizes research focused on three major problem areas: (1) Nerve network theory; (2) Electronic models of the neuron; (3) Gas ion models of the neuron. The general objective of this research has been to advance knowledge of the information processing capabilities of neural systems.

815

General Precision, Inc. [Librascope Group, Glendale, Calif.]

NEURAL THEORY AND MODELING; PROCEEDINGS OF THE 1962 OJAI SYMPOSIUM, Ojai, Calif., Dec. 4-6, 1962, ed. by R. F. Reiss. Stanford U. Press, 1964, 427p. incl. illus. diagrs. refs. (AFOSR-64-1694) (AF 49(638)1232) Unclassified

This book, comprising twenty-one papers read at the symposium, presents various approaches to general and specific problems of the single neuron and of small, intermediate and large neural systems. Analytic techniques range from elementary quantitative and logical models to differential and field equations, including "black-box" models of sensory-motor systems, digital-computer simulation programs, and electronic and gas-ion analogs. The first group of papers deals with broad theoretical problems and general modeling techniques. The second group of papers presents data, theories, and models of particular neural systems. Systems analyzed are primarily those of the invertebrates. Such systems lend themselves readily to analysis, since they are simple and experimentally accessible compared with the vertebrate control nervous systems heretofore more widely used in modeling studies.

816

General Precision, Inc. Aerospace Research Center, Little Falls, N. J.

RESEARCH IN THE RESTRICTED PROBLEMS OF THREE AND FOUR BODIES, by P. B. Richards, I. S. Bernstein and others. Final technical rept. Nov. 1964, 4p. incl. diagr. (AFOSR-64-2492) (AF 49(638)1325) AD 609613 Unclassified

Leontovic has established the stability of the triangular critical points of the planar restricted three-body problem. This theory can now be applied to the restricted problems of three and four bodies in the investigation of stability properties of known periodic motions. Two separate studies have been conducted in the restricted four-body problem. One dealt with the determination of particular solutions of the linearized equations of motion in the neighborhood of the L_1 libration point of the restricted three-body problem. The second part of the restricted four-body study has been concerned with the existence of periodic trajectories of the nonlinear equations of motion. The Poincare method of small parameters was successfully used to establish the existence of periodic trajectories in the neighborhoods of the libration points.

817

General Precision, Inc. Aerospace Research Center, Little Falls, N. J.

SOME PERIODIC SOLUTIONS OF A FOUR-BODY PROBLEM, by J. Cronin, P. B. Richards, and L. H. Russell. [1964] [6]p. incl. diagr. (AFOSR-65-0617) (AF 49(638)1325) AD 614295 Unclassified

Also published in ICARUS, v. 3: 423-428, Dec. 1964.

A four-body problem which is a model for the motion of a particle or vehicle in the Sun-Earth-Moon system is obtained by rotating the barycenter B of the two massive bodies in a restricted three-body configuration about a third massive body. It is shown that this problem can be regarded as a perturbation of the restricted three-body problem where the perturbation parameter is the mass of the third body divided by the cubed distance from the third body to B. It is proved that under certain conditions, especially with a restriction on the magnitude of the perturbation parameter, the particle of negligible mass has a periodic motion near each of the libration points of the restricted three-body problem; a method for estimating the restriction on the magnitude of the perturbation parameter is described.

818

Geneva U. (Switzerland).

A BIBLIOGRAPHY ON FUNCTIONAL EQUATIONS, by G. I. Targonski. Annual summary rept. no. 1, Apr. 30, 1963, 74p. incl. refs. (AFOSR-4973) (AF 61(052)-602) AD 414115 Unclassified

This is a bibliography on the literature of functional equations, up to approximately the middle of 1962. In order to compile such a bibliography, it was necessary first to define a Functional Equation. This has been done in the past several ways, some of which appear too wide, others too narrow. In the most general case, a Functional Equation is an equation which serves to determine one, or more unknown functions, or classes of such functions. In this sense, every differential, -difference, and integral equation is also a Functional Equation; to compile a bibliography on such a wide class is almost certainly impossible and most certainly unnecessary.

819

Genoa U. [Neurosurgical Clinic] (Italy).

SLEEP INDUCING MECHANISMS IN THE BRAIN STEM,

by G. F. Rossi. [1963] [20]p. (AFOSR-J1421) (AF 61(052)461) AD 427581 Unclassifled

Also published in Electroencephalog. and Clin Neurophysiol. Jour., Suppl. 24: 113-132, 1963.

A sleep inducing influence in the brain stem, has its origin in structures located in the caudal part of the brain stem, mainly in the medulla oblongata and in the pons. Some findings suggest that neural processes underlying the light phase of sleep take place in the rostral medulla and caudal pons, while those responsible for deep sleep occur in the rostral half of the pons. The sleep inducing structures, or at least those responsible for deep sleep, appear to belong to the reticular formation. Reticular neurones having sleep inducing function and reticular neurones of the activating system seem intermingled at the same level of the brain stem. A continuous, tonic activity is probably going on in both types of neurones. Sleep and wakefulness would result from competition between them.

830

Genoa U. [Neurosurgical Clinic] (Italy).

VISUAL CORTICAL RESPONSES EVOKED BY STIMULATED LATERAL GENICULATE BODY AND OPTIC RADIATIONS IN AWAKE AND SLEEPING CATS, by M. Palestini, M. Pisano, and others. [1964] [14]p. (AFOSR-64-1196) (AF EOAR-62-106) AD 442838 Unclassifled

Also published in Exper. Neurol., v. 9: 17-30, 1964.

Electrical potentials were evoked in the visual cortical area of intact unanesthetized cats by single-shock stimulation of the lateral geniculate body and optic irradiations. Several (50-200) cortical responses were recorded during each one of the three following behavioral conditions: light sleep (electroencephalographic synchronization); deep or activated sleep (electroencephalographic desynchronization); and wakefulness. The relations between amplitude of the fourth and fifth components of the evoked potentials and state of alertness were studied. The mean amplitude of the cortical responses to thalamic stimulation is maximum during activated sleep and minimum during light sleep. The degree of thalamic and of cortical excitability during light sleep seems to be different.

821

Genoa U. Neurosurgical Clinic (Italy).

A HYPOTHESIS ON THE NEURAL BASIS OF CONSCIOUSNESS, by G. F. Rossi. [1964] [11]p. incl. diagrs. (AFOSR-64-2267) (AF EOAR-62-106) AD 452385 Unclassifled

Also published in Acta Neurochirurg., v. 12: 187-197, 1964.

The following hypothesis concerning the neural events responsible for the changes of consciousness is formulated: the regulation of the level of consciousness under physiological conditions is achieved by the interplay of two opposite competing mechanisms: a facilitating or arousing mechanism and an inhibitory or sleep inducing one; the most important neural structures involved belong to the brain stem. The experimental findings on which the hypothesis is based are reported and discussed; particular emphasis is placed on studies showing that the decrease of the level of consciousness (or sleep) may occur via an active mechanism. The possible clinical implications of the hypothesis are mentioned.

822

Genoa U. [Neurosurgical Clinic] (Italy).

[EFFECT OF UNILATERAL SELECTIVE LESIONS ON "SPECIFIC" AND "NON-SPECIFIC" STRUCTURES IN THE PONS ON EEG ACTIVITY DURING DEEP SLEEP] Effetti di lesioni unilaterali selettive di strutture "specifiche' ed "aspecifiche" del ponte sull'attivita' elettroencefalografica del sonno profondo, by O. Candia and K. Minobe. [1963] [3]p. (AFOSR-64-0952) (AF EOAR-64-11) AD 439985 Unclassifled

Also published in Boll. Soc. Ital. Biol. Sper., v. 39: 1566-1568, 1963.

The study shows that the fast low voltage activity of deep phase of sleep in the cat is altered by a cut through the pons, and is not due to a lesion in a specific spot in the pons but to the whole rostral part.

823

Genoa U. Neurosurgical Clinic (Italy).

[STUDY OF CORTICAL EXCITABILITY DURING SLEEP AND WAKEFULNESS: CYCLE OF EXCITABILITY OF THE VISUAL CORTEX OF THE CAT] Studio dell'eccitabilita' corticale durante il sonno e la veglia: ciclo di eccitabilita' della corteccia visiva nel gatto, by M. Palestini, M. Pisano and others. [1963] [3]p. (AFOSR-64-1856) (AF EOAR-64-11) AD 450106 Unclassifled

Also published in Boll. Soc. Ital. Biol. Sper., v. 39: 1662-1664, 1963.

Evoked potentials on the EEG were caused by a pair of electric shocks delivered to cats during sleeping and waking. Results indicate that visual cortex is more excitable in sleep than in wakefulness.

824

Genoa U. Neurosurgical Clinic (Italy).

NEUROPHYSIOLOGIC MECHANISMS OF SLEEP, by G. F. Rossi. Final rept. Oct. 1963 - Sept. 1964. Sept. 30, 1964, 8p. incl. refs. (AFOSR-64-2063) (AF EOAR-64-11) AD 452299 Unclassified

The report summarizes the results obtained on the experimental study of the neurophysiology of sleep and

arousal. Most of the experiments were devoted to the study of the anatomical identification of the brain stem sleep inducing structures. Other experiments have been performed to investigate on the excitability of the cerebral cortex during sleep by electrical stimulation of the cerebral cortex.

825

Georgetown U. Dept. of Physics, Washington, D. C.

VIBRATIONAL ENERGY LEVELS OF IONIC MOLECULES BOUND BY CLASSICAL FORCES, by E. J. Finn. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-64-0262) (AF AFOSR-62-160) AD 432528 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2423-2428, Nov. 15, 1963.

Theoretical vibrational energy levels of LiI, NaCl, and InF are computed by means of the first-order WKB approximation. Two classical vibrational potentials are studied for each molecule. The first consists of a Coulombic attraction and an exponential repulsion term, while the second potential adds a polarizability term to the first. Analysis of the data shows that at very low v a power series $(v + 1/2)$ adequately represents the energy levels, while at very high v the energy levels approach those of a hydrogenlike atom. Further, the first energy difference curves show positive curvature at all v for all cases. Formulas are presented that accurately yield the vibrational energies at all v. (Contractor's abstract)

826

Georgetown U. [Dept. of Physics] Washington, D. C.

ON THE USE OF THE WBK METHOD FOR OBTAINING ENERGY EIGENVALUES, by C. L. Beckel, J. Nakhleh, and Y. R. Chowdary. [1964] [7]p. (AFOSR-64-1045) (AF AFOSR-62-160) AD 441498 Unclassified

Also published in Jour. Chem. Phys., v. 40: 139-145, Jan. 1, 1964.

A general method is proposed for evaluation of the second-order WBK energy integral. The domain of the potential is extended into the complex plane by expansion in Taylor's series about the classical turning points. The method is illustrated by application to the one-dimensional harmonic oscillator for which the second-order integral is exactly zero. Application is also made to a typical molecular potential, the Heitler-London potential for hydrogen. In the latter problem 'exact' eigenenergies, accurate to about 0.2 cm, are obtained by a Runge-Kutta integration of the Schrodinger equation. These are compared with first-order WBK energies obtained with and without use of the Langer-Kemble radical correction, and with second-order WBK energies obtained with and without use of the Langer-Kemble correction.

827

Georgia Inst. of Tech. School of Chemistry, Atlanta.

MECHANISMS OF NUCLEOPHILIC SUBSTITUTION IN PHOSPHATE ESTERS, by J. R. Cox, Jr. and O. B. Ramsay. [1964] [36]p. incl. diagrs. tables, refs. (AFOSR-66-1617) (AF AFOSR-62-163) AD 640173 Unclassified

Also published in Chem. Rev., v. 64: 317-352, July 24, 1964.

This report reviews the literature through Dec. 1963 concerning mechanisms of nucleophilic substitution in phosphorus-(V) esters. Emphasis is placed on catalytic processes which may serve as models for catalysis by biological systems such as enzymes.

828

Georgia U. Bioelectronic Computer Lab., Athens.

DIGITAL RECORDING AND ANALYSIS OF PSYCHOPHYSIOLOGIC EXPERIMENTS, by H. Zimmer. [1964] [20]p. incl. tables, refs. (AFOSR-65-0578) (AF AFOSR-63-257) Unclassified

Also published in Data Acquisition and Processing in Biology and Medicine, ed. by K. Enslein, New York, Pergamon Press, 1964.

A data collection system for the recording of autonomic nervous system variables was constructed in order to facilitate data reduction for a number of experiments in which autonomic nervous system reactions are of interest as the dependent variables. This system is employed in experiments on pain perception, feedback of emotional reactions, the subject's facilitation or inhibition of his autonomic reactions by self-initiated signals, and the conditioning of autonomic nervous system reactions to critical symbols and their generalization to related symbols. It has now become apparent that the data reduction speed provided by this system opens up entirely new fields of experimentation.

829

Georgia U. [Dept. of Chemistry] Athens.

A THERMODYNAMIC STABILITY SCALE FOR STABLE, ISOLABLE FREE RADICALS, by R. C. Lamb and C. T. Clark. Final technical rept. Oct. 1, 1961 - Sept. 30, 1963. Nov. 1963, 28p. (AFOSR-J1520) (AF AFOSR-62-53) AD 429279 Unclassified

During the report period, seven galvinoxyl derivatives were placed on an approximate stability scale based on their affinities for the H atom furnished by diphenylpicrylhydrazine (in benzene), although the stability scale is not very accurate, it appears to be essentially correct. The thermodynamic groundwork on which the scale is based allows the ΔF values to be cross-checked. Four experiments on the galvinoxyl-diphenylpicrylhydrazine system were also performed in 90% tert. butyl alcohol-10% benzene. The value

obtained for ΔF is +0.97 = 0.02 kcal at 30°. Free radical scavenger experiments with Koelsch's radical are reported.

630

Georgia U. Dept. of Chemistry, Athens.

CHEMICAL AND ENZYMATIC STUDIES ON THE CONVERSION OF CHEMICAL ENERGY TO LIGHT, by G. E. Philbrook. Final technical rept. June 1964 [24]p. incl. diagrs. (AFOSR-64-1271) (AF AFOSR-62-73 and AF AFOSR-63-44) AD 602798 Unclassified

The work covered involved chemical and enzymatic studies on the conversion of chemical energy to light. The initial studies were devoted to studying the methods for the preparation and purification of luminol and its analogs. The second category of work involved the discovery of the chemiluminescence of indole and certain of its derivatives. Extensive studies were made of the relationship between the conditions of the reactions and the intensity of the light emission and to a study of the chemical nature of the chemiluminescent reaction. The third group of studies was devoted to the attempted preparation of cinnolines with the object of determining whether or not these compounds were chemiluminescent. The fourth category involved studies of the action of chlorine dioxide as an oxidizing agent. The fifth category involved the study of the chemiluminescence of lophine and its derivatives.

631

Georgia U. Dept. of Chemistry, Athens.

CHEMILUMINESCENT INTENSITIES FROM SUBSTITUTED LOPHINES, by G. E. Philbrook and M. A. Maxwell. [1964] [6]p. incl. diagr. (AFOSR-64-1850) (AF AFOSR-63-44) AD 449979 Unclassified

Also published in Tetrahedron Ltrs., v. 19: 1111-1116, 1964.

A series of 14 compounds, derivatives of lophine bearing substituent groups in the 3 and/or 4 positions of the 2-phenyl group were prepared. All gave satisfactory elemental analyses and satisfactory IR and UV absorption spectra, as well as satisfactory chemiluminescence data. The intensities were determined using a 1P21 photo tube coupled to a sensitive amplifier and a pen recorder. The chemiluminescent intensities were determined in a medium consisting of 70% dimethylsulfoxide-30% water, 1 N. in NaOH. The concentration of lophine derivatives was 1.5×10^{-3} M. Oxygen was bubbled through the solutions continuously. The intensity rose to a maximum in 1-2 min and then fell over a 10-20 min period to a nearly constant value lasting from 2-12 hrs, depending on the compound.

832

Georgia U. Dept. of Chemistry, Athens.

ORGANIC PEROXIDES. III. THE BEHAVIOR OF CYCLOHEXANEFORMYL PEROXIDE IN THE PRESENCE OF EXCESS STABLE RADICALS. THE SIMULTANEOUS DETERMINATION OF KINETICS AND FREE RADICAL EFFICIENCIES IN THE THERMAL DECOMPOSITIONS OF FREE RADICAL INITIATORS, by R. C. Lamb and J. G. Pacifici. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1534) (AF AFOSR-64-543) AD 446136 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 914-918, Mar. 5, 1964.

The first-order rate constants and free radical efficiencies in the thermal decompositions of cyclohexaneformyl peroxide in benzene in the temperature range 30°-50°C were determined spectrophotometically by measuring the fading of galvinoxyl, which was present in excess. Experiments in which α, γ-bis-(diphenylene)-β-phenylallyl (BDPA) and DPPH were used as scavengers in benzene at 45°C gave results similar to those obtained in the galvinoxyl experiments. All of the experiments indicate a low free radical efficiency (24% or less) for the decomposition of cyclohexaneformyl peroxide in benzene. The volatile products formed in the decomposition of cyclohexaneformyl peroxide in benzene containing excess galvinoxyl are ester, acid, bicyclohexyl, cyclohexane, and cyclohexene. (Contractor's abstract)

833

Geotechnical Corp., Garland, Tex.

OPERATIONAL MAGNIFICATION AND PHYSICAL ENVIRONMENT OF SEISMOGRAPH STATIONS, by S. A. Alsup and J. W. Guyton. [1964] [10]p. (AF 49(638)-1150) AD 439247 Unclassified

Also published in Geophysics, v. 29: 188-196, Apr. 1964.

Maximum satisfactory operational magnifications of 115 standardized seismograph stations in the United States range from 30,000 to 630,000 and are used to evaluate the sites relative to one another. Grouping the sites according to physiographic province, rock type, distance from cultural features, and type of installation shows distinct correlation between physical environment and operating magnification. Regional variations of magnification capability are closely related to physiographic provinces; local variation within a province is as great as the variation of physical environment.

834

Geotechnical Corp., Garland, Tex.

STUDY OF SHORT-PERIOD SEISMIC NOISE, by J. W.

Guyton. Semiannual technical summary rept. no. 3, July 31 - Dec. 31, 1963, 1v. (Technical rept. no. 64-1) (AF 49(638)1150) AD 431768 Unclassified

The contents of this report are: Systematic deviations of magnitude from body waves at seismograph stations in the United States; Average signal-to-noise ratios for 26 seismograph stations in the United States; Data processing facility; Shallow refraction study of seismometer installations; and Effectiveness of air-to-ground coupling for acoustic waves at the Wichita Mountain Seismological Observatory.

835

Giannini Controls Corp. [Astromechanics Research Div.] Malvern, Pa.

THE EFFECT OF ELASTICITY ON THE STABILITY OF MANNED ROTATING SPACE STATIONS, by F. J. Frueh and J. M. Miller. May 1964, 28p. (Rept. no. TR-02-004) (AFOSR-64-0991) (AF 49(638)1015) AD 602486 Unclassified

A basic investigation of the effects of structural flexibility of the rotating space station concept in terms of system stability is presented. The results of the analyses were formed into general stability criteria using the fundamental characteristics of the space station system. The criteria show the relationship between applied forces, configuration flexibility and configuration damping and are presented in a manner suitable for preliminary analysis of future design concepts.

836

Giannini Controls Corp. [Astromechanics Research Div.] Malvern, Pa.

SEPARATED FLOW IN CURVED CHANNELS WITH SECONDARY INJECTION, by H. A. Curtiss, O. G. Feil, and D. J. Liquornik. May 25, 1964, 44p. (Rept. no. TR-020-01) (AFOSR-64-0860) (AF 49(638)1218) AD 602487 Unclassified

Injection of secondary fluid flow into a primary flow confined in a curved channel is shown to be a powerful technique for use in fluid state amplification. The secondary injection continuously and progressively alters the separation characteristics of the confined primary flow, resulting in large proportional changes in the channel output flows. A fundamental study of the method with incompressible, turbulent boundary layer flow in a range of varying curvature channels was conducted to learn about the flow characteristics and passage shape parameters relevant to proportional amplification. Several injection methods and velocities were investigated with the main emphasis on the effects of this injection on the flow characteristics within the channels. Preliminary analytical techniques were developed which compared favorably with the experimental results. An overall comparison of the mass flow and momentum gains obtainable for various injection and channel configurations is presented.

837

Giannini Scientific Corp., Santa Ana, Calif.

EXPERIMENTAL RESULTS IN HIGH-SPECIFIC-IMPULSE THERMO-IONIC ACCELERATION, by A. C. Ducati, G. M. Giannini, and E. Muehlberger. [1964] [3]p. incl. diagr. tables. (AFOSR-64-2032) (AF 49-(638)1161) AD 451197 Unclassified

Also published in AIAA Jour., v. 2: 1452-1454, Aug. 1964.

Using hydrogen as a propellant, specific impulse values in excess of 10,000 sec (corresponding to an exhaust velocity of approximately 60 miles/sec) have been achieved. Although the flowaccelerating mechanisms of this thrustor are not yet completely understood, research work is progressing in both the analytical and experimental phases. Based on experimental results, it is believed that the thermoionic thrustor can attain specific impulse values approaching 2 ,00 sec and thrust density values of over 200 psf (of thrusting area). The thermo-ionic thrustor retains the arcjet engine's advantages of beam neutralization, comparatively high thrust, simple power-conditioning requirements, and compact size. In addition, it can operate at constant specific impulse by changing the electrical power input and propellant flow rate.

838

Giannini Scientific Corp., Santa Ana, Calif.

HIGH SPECIFIC IMPULSE THERMO-IONIC ACCELERATION, by A. C. Ducati, E. Muehlberger, and G. Giannini. [1964] [21]p. incl. illus. diagrs. table. (AIAA paper no. 64-668) (AFOSR-64-2033) (AF 49-(638)1161) AD 451184 Unclassified

Presented at AIAA Fourth Electric Propulsion Conf., Philadelphia, Pa., Aug. 31- Sept. 2, 1964.

The low arc chamber pressure is one of the basic operating conditions of the high specific impulse thrustor. The hollow anode remains the largest development problem. The anode heats up to an extremely high temperature and then melts. A method to spread the discharge of a hydrogen arc column on a wide surface of the anode has not yet been found. The arc has a tendency to stick in a single spot of the anode producing extremely high current densities which result in damage to the parts. Operation at still lower pressures might help, but the results are not known. The easiest artifice to avoid a high current density on the anode is to rotate the arc in such a way that a spot appears only a fraction of the time in any particular position. At very high current levels the anode spot tends to remain along the shortest path of the current. To avoid this and to produce an arc attachment without any preferred position, perfect symmetry of the connection is necessary. In this case a relatively weak magnetic field introduced at the right point will cause the rotation of the anode spot. With a few turns in series with the arc, perfect rotation can be obtained if the symmetry of the connections is good.

839

Glasgow U. Dept. of Chemistry (Scotland).

STUDIES IN RING EXPANSION, by G. L. Buchanan. Dec. 31, 1964, 35p. (Scientific rept. no. 2) (AF EOAR-63-36) AD 628733 Unclassified

In contrast to an enolizable dimedone derivative, the non-enolizable 2-methyl-2-(2'-benzoyl ethyl)-dimedone was cyclised to 1-methyl-4-phenyl bicyclo (3, 3, 1)non-2-en -8. 9-dione. The infrared spectrum of this and other non-enolizable β diketones shows a split carbonyl band. This phenomenon was investigated. A new cycloheptene synthesis previously reported was applied to the synthesis of a compound related to the alkaloid colchicine.

840

Gothenburg U. [Dept. of Biology] (Sweden).

INVERSE ENZYMATIC CHANGES IN NEURONS AND GLIA DURING INCREASED FUNCTION AND HYPOXIA, by A. Hamberger and H. Hyden. [1963] [5]p. (AFOSR-J467) (AF 61(052)248) AD 407894 Unclassified

Also published in Jour. Cell Biol., v. 16: 521-525, 1963.

Following stimulation of the vestibular nerve in the rabbit, respiratory enzyme activities increased in Deiters' nerve cells. The anaerobic glycolysis was found to decrease concomitantly by 25 to 40%, suggesting a Pasteur effect. By contrast, in the surrounding glia the anaerobic glycolysis increased and the respiratory enzyme activity decreased, suggesting a Crabtree effect. The evidence is discussed for a regulatory metabolic mechanism operating between the neutron and its glia. Hypoxia of 8% O_2 caused an increase of both oxygen consumption and CO_2 production in the nerve cells, but did not change the glia values.

841

Gothenburg U. [Dept. of Biology] (Sweden).

A BIOCHEMICAL GLIA ERROR IN THE PARKINSON DISEASE, by G. Gomirato and H. Hyden. [1963] [8]p. (AFOSR-64-1062) (AF 61(052)248) AD 441505 Unclassified

Also published in Brain, v. 86: 773-780, 1963.

Biopsies of globus pallidus from cases of Parkinson's disease were analyzed by microchemical methods with respect to the amounts and the base compositions of the glial and the neuronal RNA. In pronounced cases of Parkinson's disease, increased amounts of RNA were found in both glial and neurons. The glial RNA base composition was markedly altered, with increased adenine and decreased guanine and uracil values. The nerve cell RNA showed less pronounced changes. Bilateral RNA analyses of one case permitted a timing and correlation of biochemical and clinical findings. The conclusion was drawn that in the three-link chain: glial-neuroneffector organ, the primary biochemical error of the glia in Parkinson's disease secondarily affects the RNA synthesis of the neuron, manifesting itself finally in muscle tremor and rigidity.

842

Gothenburg U. [Dept. of Biology] (Sweden).

RNA—A FUNCTIONAL CHARACTERISTIC OF THE NEURON AND ITS GLIA, by H. Hyden. [1964] [40]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1500) (AF 61(052)248) AD 623057 Unclassified

Also published in Brain Function: RNA and Brain Function; Memory and Learning; Proc. Second Conf., Los Angeles, Calif., 1962, Los Angeles, Calif. U. Press, v. 2: 29-68, 1964. (AFOSR-65-1499)

A discussion is presented of functional aspects of brain RNA and the relationship between the neuron and its glia. Special emphasis has been placed on compartmentalization of the brain RNA, quantitative aspects, and base composition characteristics, even of fractions of nerve cells. The distribution of brain RNA, as well as the characteristics of neuronal RNA and glial RNA during stimulation and during a learning experiment are discussed.

843

Gothenburg U. [Dept. of Biology] (Sweden).

RESEARCH ON INTRA NEURONAL MECHANISMS FOR INFORMATION STORAGE, by H. Hyden. Mar. 31, 1963, 7p. (Technical rept. no. 1) (AFOSR-4845) (AF EOAR-62-29) AD 413650 Unclassified

This report describes microchemical and biophysical analyses of neurons and the glia surrounding each nerve cell body. The aid was to study, on the cellular level, the amount and composition of RNA, the amount of proteins, respiratory enzyme and ATP-ase activities during stimulation and in a learning situation in rats. Isolated, fresh cells were used for these studies. Inverse biochemical changes and result of kinetic studies showed that the neuron and its glia are linked in an energetic system. This inverse relationship between neuron and glia was shown to exist also with respect to RNA synthesis. The rate of the enzyme reactions increased by 100% in the neuron due to stimulation. The glia, however, did not change in that respect.

844

Gothenburg U. [Dept. of Biology] (Sweden).

CHANGES IN RNA CONTENT AND BASE COMPOSITION IN CORTICAL NEURONS OF RATS IN A LEARNING EXPERIMENT INVOLVING TRANSFER OF HANDEDNESS, by H. Hyden and E. Egyházi. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-65-2518) (AF EOAR-63-28) AD 628366 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 52: 1030-1035, Oct. 1964.

The RNA content and base ratios of cortical neurons were studied in rats during transfer of handedness. Corresponding neurons in the contralateral part of the same cortex served as controls. The RNA content increased significantly in these neurons which have large nuclei relative to the cytoplasmi mass. The (G + C)/ (A + U) ratio of the RNA decreased, indicating that the new RNA produced during learning is of the messenger type.

845

Gothenburg U. Dept. of Pharmacology (Sweden).

FUNCTIONAL SIGNIFICANCE OF DRUG-INDUCED CHANGES IN BRAIN MONOAMINE LEVELS, by A. Carlsson. [1964] [19]p. incl. diagrs. refs. (AFOSR-4851) (AF EOAR-61-44) AD 413972 Unclassified

Also published in Prog. Brain Research, v. 8: 9-27, 1964.

The actions of various agents interfering with formation, degradation, storage, and release of catecholamines and 5-hydroxytryptamine is discussed in the light of recent evidence that these monoamines serve as transmitters in the central nervous system. Depletion of transmitter stores can be brought about by different mechanisms, which are not equivalent from the functional point of view. Blockade of monoamine uptake by the storage granules produced by reserpine thus leads to depletion of the transmitter stores and to blockade of transmission. On the other hand, displacement of transmitter from the storage sites of the granules by less active transmitter analogues, e.g. metaraminol (formed from a-methyl-m-tyrosine) and D-adrenaline, does not result in any readily detectable impairment of transmission. Thus blockade of the uptake mechanism of the storage granules seems to be an essential component in the action of reserpine. This is further supported by the better time correlation of the pharmacological actions of reserpine to the blockade of the uptake mechanism than to the tissue amine levels. The data support the view that the granules do not merely serve as stores of transmitter but are directly involved in the transmission mechanism. The usefulness and limitations of various agents, e.g. monoamine precursors and analogues, and inhibitors of enzymes responsible for the formation and degradation of monoamines are discussed. The pitfalls arising from the lack of a direct correlation between amine levels and functions are emphasized.

846

Gothenburg U. Dept. of Pharmacology (Sweden).

EVIDENCE FOR A ROLE OF DOPAMINE IN EXTRAPYRAMIDAL FUNCTIONS, by A. Carlsson. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0943) (AF EOAR-61-44) AD 617981 Unclassified

Also published in Acta Neuroveget., v. 26: 484-493, 1964.

Dopamine (=3-hydroxytyramine) is the immediate precursor in the biosynthesis of noradrenaline. In brain it probably also serves as a neurotransmitter, particularly in the extrapyramidal system. About 80% of the brain dopamine occur in the neostriatum. The intraneuronal localization of dopamine has been demonstrated by means of histochemical techniques. Reserpine causes dopamine to disappear from the brain and produces a parkinsonian syndrome. The central actions of reserpine can be partially counteracted by increasing the concentration of dopamine in brain through administration of the precursor L-3,4-dihydrophenylalanine = L-DOPA. In brains of parkinson patients the concentration of dopamine has been found markedly lowered; the parkinson syndrome is favorably influenced by increasing the dopamine concentration through L-DOPA administration.

847

Gothenburg U. [Dept. of Pharmacology] (Sweden).

BIOCHEMISTRY AND PHYSIOLOGY OF BRAIN DOPAMINE, by A. Carlsson. Feb. 8, 1964, 13p. (AFOSR-64-0737) (AF EOAR-63-14) AD 436491 Unclassified

Dopamine is a catecholamine, formerly known as an intermediate in the formation of noradrenaline and adrenaline. Recent studies indicate that it also serves a function of its own. It occurs in particularly high concentrations in certain parts of mammalian brain, e.g., the corpus striatum. It has become possible to localize dopamine at the cellular level by means of a histochemical technique. Dopamine has been shown to occur in neurons and probably serves as a transmitter. Dopamine occurs in different functional systems. In the retina it appears to be involved in the control of light sensitivity, and in the median eminence in the control of anterior pituitary secretions. In the corpus striatum and certain parts of the brain stem it appears to function at a high level of integration and may play an important role in the syndromes induced by e.g. reserpine and chlorpromazine, both of which interfere with dopamine metabolism.

848

Gothenburg U. [Dept. of Pharmacology] (Sweden).

ANALYSIS OF THE Mg^{++} ATP DEPENDENT STORAGE MECHANISM IN THE AMINE GRANULES OF THE ADRENAL MEDULLA, by A. Carlsson, N.-A. Hillarp, and B. Waldeck. [1963] [38]p. (AFOSR-64-1167) (AF EOAR-63-14) AD 442786 Unclassified

Also published in Acta Physiol. Scand., v. 59: Suppl. 215: 5-38, 1963.

Bovine adrenal medullary granules were isolated and incubated with radioactive adrenaline, noradrenaline, dopamine, 5-hydroxytryptamine or tyramine. The influence of various factors on the uptake of these

monoamines was studied. A large number of enzyme inhibitors have been tested. The most significant findings so far is that -SH groups seem to be essential for the uptake mechanism. A lipid component or nonpolar sites in a protein structure seem to be essential. A number of adrenergic blocking agents caused a blockade of the amine uptake, suggesting structural similarity between binding sites of the uptake mechanism and adrenergic receptors. Segontin (N-(diphenylpropyl)-amphetamine) proved to be the most potent inhibitor of the uptake mechanism known so far, apart from reserpine.

849

Gothenburg U. [Dept. of Pharmacology] (Sweden).

EFFECT OF CHLORPROMAZINE OR HALOPERIDOL ON FORMATION OF 3-METHOXYTYRAMINE AND NORMETANEPHRINE IN MOUSE BRAIN, by A. Carlsson and M. Lindqvist. [1963] [5]p. (AFOSR-64-1169) (AF EOAR-63-14) AD 442788 Unclassified

Also published in Acta Pharmacol. Toxicol., v. 20: 140-144, 1963.

The accumulation in mouse brain of the catecholamine metabolites 3-methoxytyramine and normetanephrine brought about by inhibition of monoamine oxidase was found to be enhanced by small doses of chlorpromazine and haloperidol, but phenoxybenzamine (bensylyt) and promethazine were ineffective. Hypothermia could be eliminated as a causative factor. The effect is, it is suggested, due to a compensatory activation of monoaminergic neurons after blockade of monoaminergic receptors.

850

Gothenburg U. [Dept. of Pharmacology] (Sweden).

EFFECTS OF SOME PHARMACOLOGICALLY ACTIVE AMINES ON THE UPTAKE OF ARYLALKYLAMINES BY ADRENAL MEDULLARY GRANULES, by J. Jonasson, E. Rosengren, and B. Waldeck. [1964] [5]p. (AFOSR-64-1186) (AF EOAR-63-14) AD 442790 Unclassified

Also published in Acta Physiol. Scand., v. 60: 136-140, 1964.

The effects of reserpine, chlorpromazine and related compounds on the uptake of catecholamines by the adrenal medullary granules from the cow has been studied in vitro. Both types of drugs were found to be competitive inhibitors of the adrenaline uptake by the granules. Thus they compete with adrenaline for the same groups in the uptake mechanism for catecholamines. Tryptamine was also found to accumulate in the granules but not by the same mechanism as used by the catecholamines and 5-hydroxytryptamine, as Mg^{++}, ATP and reserpine did not have any influence on the uptake. The K_m values for the uptake of adrenaline and 5-hydroxytryptamine were 8×10^{-4} and 1.1×10^{-4} respectively.

851

Gothenburg U. [Dept. of Pharmacology] (Sweden).

EVIDENCE OF DOPAMINE-CONTAINING NEURONS IN THE RETINA OF RABBITS, by J. Haggendal and T. Malmfors. [1963] [2]p. (AFOSR-64-1187) (AF EOAR-63-14) AD 442792 Unclassified

Also published in Acta Physiol. Scand., v. 59: 295-296, 1963.

This investigation was performed in order to study the identity of the catechol amine found in the retina. The experiments were performed on rabbits, one on retinas from 4 animals and another on retinas and choroids from 13 both albino and pigmented rabbits. The results show that dopamine is the dominating catechol amine in the retina of rabbits. The noradrenaline found in the retina is probably localized to the adrenergic neurons demonstrated there with the fluorescence microscopical technique. From biochemical experiments such treatment lowers the noradrenaline level while the dopamine level in the brain is only slightly influenced.

852

Gothenburg U. Dept. of Pharmacology (Sweden).

TIME CORRELATION BETWEEN THE EFFECTS OF RESERPINE ON BEHAVIOUR AND STORAGE MECHANISM FOR ARYLALKYLAMINES, by A. Carlsson, J. Jonasson, and E. Rosengren. [1963] [4]p. incl. diagr. (AFOSR-64-2162) (AF EOAR-63-14) AD 451923 Unclassified

Also published in Acta Physiol. Scand., v. 59: 474-477, 1963.

The time course of the effect of reserpine on the ability of the adrenal medullary granules to take up arylalkylamines in vivo has been studied. It was observed that there was a closer correlation in time between the effects of the drug on the uptake of the amines by the granules and behavior than between the latter and the tissue amine content. The finding is in accordance with a hypothesis that new-formed arylalkylamines are at first transferred to sites in the granules where they are easily available for physiological release.

853

Gothenburg U. Dept. of Pharmacology (Sweden).

BRAIN AND HEART CATECHOLAMINE LEVELS AFTER L-DOPA ADMINISTRATION IN RESERPINE TREATED MICE: CORRELATIONS WITH A CONDITIONED AVOIDANCE RESPONSE, by L. S. Seiden and A. Carlsson. [1964] [4]p. incl. diagrs. (AFOSR-64-2163) (AF EOAR-63-14) AD 451924 Unclassified

Also published in Psychopharmacologia, v. 5: 178-181, 1964.

Mice were tested with reserpine before receiving an injection of L-DOPA. At various times after the

L-DOPA injection they were sacrificed and the brains and hearts were analyzed for their catecholamine content. Effects on the conditioned avoidance response were further analyzed using reserpine and L-DOPA, and the correlations between the two were discussed. (Contractor's abstract)

854

Gothenburg U. Dept. of Pharmacology (Sweden).

β-HYDROXYLATION OF TYRAMINE IN VIVO, by A. Carlsson and B. Waldeck. [1963] [4]p. incl. diagr. table. (AFOSR-64-2164) (AF EOAR-63-14) AD 452029 Unclassified

Also published in Acta Pharmacol. Toxicol., v. 20: 371-374, 1963.

The rapid formation of octopamine from tyramine by adrenergic nerves is demonstrated in vivo. Evidence in support of the existence of both intra- and extraneuronal binding sites for tyramine is presented. The further investigation of these phenomena may throw light on the pharmacological actions of indirectly acting sympathomimetics. (Contractor's abstract)

855

Gothenburg U. Dept. of Pharmacology (Sweden).

DISCLOSURE OF LABILE MONOAMINE FRACTIONS IN BRAIN AND THEIR CORRELATION TO BEHAVIOUR, by J. Haggendal and M. Lindqvist. [1964] [7]p. incl. diagrs. table, refs. (AFOSR-64-2165) (AF EOAR-63-14) AD 452024 Unclassified

Also published in Acta Physiol. Scand., v. 60: 351-356, 1964.

The recovery rates of brain monoamines after disruption of long-term treatment of rabbits with reserpine (0.2 mg/kg/day) and after single doses of the drug (0.2 and 1.0 mg/kg) have been compared. No clearcut difference in recovery rates between the two types of treatment could be detected. In both cases normal values were reached only after several weeks. From the 3rd to the 4th day the animals showed a normal gross behavior in spite of low monoamine levels. Brain monoamines and behavior were studied in chronically treated rabbits during the 24 hrs following the daily injection. A temporal correlation between the changes in the remaining low monoamine levels and behavior was demonstrated, which is in contrast to observations made in animals receiving a single dose for the first time. It appears that chronic reserpine treatment results in removal of large physiologically inert monoamine fractions, thus disclosing small, labile, functionally essential fractions.

856

Gothenburg U. Dept. of Pharmacology (Sweden).

EFFECTS OF CHLORPROMAZINE, HALOPERIDOL AND RESERPINE ON THE LEVELS OF PHENOLIC ACIDS IN RABBIT CORPUS STRIATUM, by N.-E. Andén B.-E. Roos, and B. Werdinius. [1964] [10]p. incl. diagrs. table, refs. (AFOSR-64-2369) (AF EOAR-63-14) AD 452340 Unclassified

Also published in Life Sci., v. 3: 149-158, 1964.

Chlorpromazine and haloperidol produce a transient increase of 3, 4-dihydroxyphenylacetic acid and a somewhat slower, more prolonged increase of homovanillic acid in the rabbit corpus striatum. Phenoxybenzamine, promethazine and pentobarbital were ineffective. Reserpine gave the same effects but a little more long-lasting rise as regards homovanillic acid. It seems as if chlorpromazine and haloperidol reduce the elimination rate of these acids and possibly also increase their synthesis. The effects of reserpine may presumably be explained by the depletion of the dopamine and, in addition, by a delayed disappearance of the acids. (Contractor's abstract)

857

Gothenburg U. Dept. of Pharmacology (Sweden).

A METHOD FOR THE FLUORIMETRIC DETERMINATION OF 3-METHOXYTYRAMINE IN TISSUES AND THE OCCURRENCE OF THIS AMINE IN BRAIN, by A. Carlsson and B. Waldeck. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1292) (AF EOAR-63-14) AD 620709 Unclassified

Also published in Scand. Jour. Clin. and Lab. Invest., v. 16: 133-138, 1964.

A fluorimetric method for the determination of small amounts of 3-methoxytyramine, (MT), in tissues is described. After separation on ion-exchange column, MT is converted to a strongly fluorescent compound. Interference of dopamine (DA), is eliminated either by column separation or differential oxidation. MT is demonsirated in brain of some mammals indicating a role of catechol-O-methyl transferase in the degradation of DA in this tissue. (Contractor's abstract)

858

Gothenburg U. Dept. of Pharmacology (Sweden).

DEMONSTRATION AND MAPPING OUT OF NIGRO-NEOSTRIATAL DOPAMINE NEURONS, by N.-E. Andén, A. Carlsson and others. [1964] [8]p. incl. refs. (AFOSR-64-1858) (AF EOAR-64-30) AD 450102 Unclassified

Also published in Life Sci., v. 3: 523-530, 1964.

In normal rats, dopamine-storing nerve terminals are found in the neostriatum and dopamine-containing nerve cells in the substantia nigra, mainly in the pars compacta. After electrolytic lesions in the substantia nigra or the internal capsule the histochemical fluorescence and the dopamine content of the neostriatum were markedly reduced. Removal of the neostriatum produced an increased fluorescence of the dopamine nerve

cells of the substantia nigra and of their axons central to the lesion. These axons ascend as a nerve tract in the internal capsule towards the neostriatum. The data give strong evidence for the existence of nigro-neostriatal dopamine neurons, which probably contain most or all of the dopamine present in the neostriatum. (Contractor's abstract)

859

Gothenburg U. Dept. of Statistics (Sweden).

SELECTED BIBLIOGRAPHY ON NON-NORMALITY, ed. by H. Hyrenius, I. Adolfsson and others. Göteborg, Elanders Boktryckeri Aktiebolag, 1964, 108p. incl. refs. (Publication no. 12) (AFOSR-65-1030) (AF 81(052)459) AD 817929 Unclassified

The bibliography presented is a part of a larger research project, which is designed to study the effects on normal-theory statistical methods arising when the underlying assumption of a normal universe is not fulfilled. Only abstracts from the most important scientific journals plus those further references which were found in articles in these journals are included.

880

Göttingen U. [Inst. of Physiology] (Germany).

ELECTROPHYSIOLOGICAL STUDIES OF THE OLFACTORY BULB, by R. Von Baumgarten. Final technical rept. Sept. 30, 1963, 17p. (AFOSR-J1318) (AF EOAR-62-93) AD 424238 Unclassified

Studies on the neuropharmacological influence on single nerve cells, the slow-wave activity, and behavioral mechanisms of the olfactory bulb were performed in rabbits and fish. The effects of electrophoretic administration of acetylcholine, noradrenaline, and serotonin to single nerve cells in the olfactory bulb was investigated using 5-barreled micropipette electrodes. The majority of sensitive cells responded to electrophoretic administration of acetylcholine, noradrenaline, and serotonin by a decrease in their spontaneous rate of activity. The onset of the effect and the return to control levels of activity were delayed in each instance (2-10 sec and 3-20 sec respectively).

881

Grafix, Inc., Albuquerque, N. M.

A GENERAL ADAPTIVE MOTOR LEARNING PROGRAM FOR A DIGITAL COMPUTER, PART I, SECTIONS I AND II, by G. R. Bussey. Final technical rept. Dec. 30, 1964, 99p. (AFOSR-85-0275, Pt. 1) (AF 49(638)1203) AD 611334 Unclassified

The goal of this research effort is the ultimate realization of a practical adaptive system which would be an adequate basis for a robot with manlike capabilities--say, one filling the role of man in an unhospitable space environment. Consequently, and effort has been made from the very beginning to incorporate the rudiments of all the major subsystems thought necessary and to attain a realistic drive subsystem of the complexity believed essential to an automation which not only has a variety of jobs to do but must in addition improve itself in general and take care of its physical needs. Because some successful work had already been done in the area of perception, it was decided to concentrate on the effector or motor side of the adaptive system problem, with the perceptual processes being merely simulated at first by any practical means at hand.

882

Grafix, Inc., Albuquerque, N. M.

A GENERAL ADAPTIVE MOTOR LEARNING PROGRAM FOR A DIGITAL COMPUTER, PART II, SECTIONS III AND IV, by G. R. Bussey. Final technical rept. Dec. 30, 1964, 107p. (AFOSR-85-0275, Pt. 2) (AF 49-(638)1203) AD 611335 Unclassified

The object of the research has been to achieve a working program that effectively demonstrates a general ability to learn non-specific motor tasks. Thus, the report consists of a working computer program. The program is described in detail with explanatory text keyed to flow charts. The program is given, along with instructions for running it.

863

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

AIR VEHICLE FLIGHT PATH OPTIMIZATION. Final status rept. May 1963, 38p. (AFOSR-4907) (AF 29-(800)2671) AD 415465 Unclassified

The means generally available for treatment of optimal air vehicle flight paths are limited from the viewpoint of practical numerical computations. The method of gradients has been applied to air vehicle problems of maximum range, minimum fuel, and minimum time subject to various constraints with considerable success. Two versions of the gradient method, gradient projection and a gradient/penalty function technique for handling terminal constraints have been employed. An integral form of penalty function has been introduced for incorporation of two limit boundaries in the altitude-Mach number chart: one a minimum altitude limit and the second a Mach number versus altitude envelope corresponding to powerplant and structural limitations. The differing versions of the gradient method have been investigated in range, fuel, and time computations for a hypothetical Mach 3 vehicle, the aim being to assess the relative merits of these versions from the viewpoint of speed of convergence of the successive approximations scheme.

864

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SINGULAR EXTREMALS IN LAWDEN'S PROBLEM OF

OPTIMAL ROCKET FLIGHT, by H. J. Kelley. [1963] [3]p. (AFOSR-J1519) (AF 29(600)2871) AD 427942
Unclassified

Presented at AIAA Summer meeting, Los Angeles, Calif., June 17-20, 1983.

Also published in AIAA Jour., v. 1: 1578-1580, July 1963.

The problem of optimal rocket flight in an inverse square law force field has been studied extensively by Lawden and Leitmann. Periods of zero thrust, intermediate thrust, and maximum thrust are possible subarcs of the solution according to analysis of the Euler-Lagrange equations and the Weierstrass necessary condition. Arcs of intermediate thrust have been examined recently by Lawden; however, the question of whether or not such arcs actually may furnish a minimum has been left unresolved. The singular extremals of Lawden's problem are derived by means of the Legendre-Clebsch necessary condition applied in a transformed system of state and control variables. These are obtained as circular orbits along which the thrust is zero and intermediate thrust arcs are found in Lawden's analysis. Since these solutions satisfy only the weak form of the Legendre-Clebsch condition, i.e., the extremals are singular in the transformed system of variables, the question of their minimality remains unanswered.

885

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

RESEARCH ON "OPTIMIZATION THEORY" AND AEROSPACE APPLICATIONS. Aug. 1963, 33p. (AFOSR-5233) (AF 49(838)1207) AD 415957
Unclassified

The mathematical studies presented include Research in Successive Approximation Techniques, The Relation of Transversal Surface Theory to Necessary Conditions, Study of Singular Extremals, Trefftz-Friedrichs Duality Principle, as well as Optimal Multistage Rocket Flight and Other Discontinuous Variational Problems.

866

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

A TRAJECTORY OPTIMIZATION TECHNIQUE BASED UPON THE THEORY OF THE SECOND VARIATION, by H. J. Kelley, R. E. Kopp, and H. G. Moyer. [1964] [24]p. incl. refs. (AFOSR-84-2413) (AF 49(638)1207) AD 453605
Unclassified

Presented at AIAA Astrodynamics Conf., New Haven, Conn., Aug. 19-21, 1983.

Also published in Prog. Astronaut. and Aeronaut., v. 14: 559-582, 1964.

A successive approximation method based upon the theory of the second variation is developed. In the early stages of computation, the process behaves much like the gradient/penalty function process with boundary conditions met only approximately. In the terminal stage, convergence more rapid than that of a gradient method is achieved with "exact" satisfaction of boundary conditions an integral part of the process. Since the equations of variation of the Euler-Lagrange equations are employed in the computational scheme, only slight additional effort is required to perform a check of the generalized Jacobi (Mayer) condition.

867

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SOLUTION OF VARIATIONAL PROBLEMS BY MEANS OF A GENERALIZED NEWTON-RAPHSON OPERATOR, by R. McGill and P. Kenneth. May 1984, 28p. incl. diagrs. table, refs. (Rept. no. RE-176J) (AFOSR-65-0317) (AF 49(638)1207) AD 481845; AD 611738
Unclassified

Also published in AIAA Jour., v. 2: 1761-1788, Oct. 1964.

This paper presents the development of an indirect method for solving variational problems by means of an algorithm for obtaining the solution to the associated nonlinear two-point boundary value problem. The method departs from the usual indirect procedure of successively integrating the nonlinear equations and adjusting arbitrary initial conditions until the remaining boundary conditions are satisfied. Instead, an operator is introduced which produces a sequence of sets of functions which satisfy the nonlinear system formed by the state equations and the Euler-Lagrange equations. Under appropriate conditions this sequence converges uniformly and rapidly (quadratically) to the solution of the nonlinear boundary value problem. The computational effectiveness of the algorithm is demonstrated by three numerical examples. (Contractor's abstract)

868

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SEVERAL TRJACTORY OPTIMIZATION TECHNIQUES. PART I: DISCUSSION, by R. E. Kopp and R. McGill. 1983, 25p. incl. refs. (Rept. no. GRD-119, Pt. 1) (AFOSR-65-0318) (AF 49(838)1207) AD 815154
Unclassified

Also published in Computing Methods in Optimization Problems, ed. by A. V. Balakrishnan and L. W. Neustadt. New York, Academic Press, 1984, p. 65-89.

Several numerical approaches for solving problems arising in optimizing trajectories are discussed. The basic concepts underlying the gradient method, the second variation method, and a generalized Newton-Raphson method are presented in a very elementary manner by considering an ordinary minimum problem with a side constraint. The results obtained when the basic concepts are extended to the variational problem and the computational algorithms are then discussed.

Finally, in the conciuding remarks, advantages and disadvantages of each method are reviewed, and a comparison is made between the second variation method, which might be considered a direct method, and the generalized Newton-Raphson method, normaily considered as an indirect method. Part II of this paper provides an application of the 3 methods to a specific problem. (Contractor's abstract)

869

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

SEVERAL TRAJECTORY OPTIMIZATION TECHNIQUES. PART II: APPLICATION, by H. G. Moyer and G. Pinkham. 1963, 11p. incl. diagrs. (Rept. no. GRD-119, Pt. II) (AFOSR-85-0603) (AF 49(638)1207) AD 815155 Unclassified

Also published in Computing Methods in Optimization Problems, ed. by A. V. Balakrishnan and L. W. Neustadt. New York, Academic Press, 1964, p. 91-105.

The appiication of the 3 optimization methods - steepest descent, second variation, and generalized Newton-Raphson - to the probiem of minimum time, low thrust, circle-to-circle transfer is discussed. Details of computationai techniques that have proved successful in practice are presented. The number of iteration cycies and the time used by the computer are given for each method. (Contractor's abstract)

870

Grumman Aircraft Engineering Corp., Bethpage, N. Y.

DISCONTINUOUS VARIATIONAL PROBLEMS, by H. G. Moyer. Dec. 1964, 26p. incl. diagrs. refs. (Memo no. RM-252J) (AFOSR-65-2525) (AF 49(638)1207) AD 617270 Unclassified

Aiso published in Proc. IBM Scientific Computing Symposium on Control Theory and Appiications, Thomas J. Watson Research Center, Yorktown Heights, N. Y. (Oct. 19-21, 1964), p. 211-221.

This paper analyzes variational probiems that specify jump discontinuities in the state variabies. The solution extremais are required to jump when they reach a manifoid of dimension n-q (n is the number of state variables). Two approaches to these probiems are presented. The first approach is geometricai and therefore ioses most of its practicaiity as the number of state variabies is increased beyond two. However, it provides vaiuabie diagnostic insight. The boundary of the reachabie set is regarded as a wavefront that is determined by wavelets. This principle is used to construct the wavefront just after the discontinuity and to determine the normai to its tangent plane. Of course the Lagrange muitipiier vector is parallei to this normal. When q is equai to one there are at most two directions in which the extremal can be continued. The second approach is anaiytic and therefore much more flexible and powerfui. The Lagrange multipliers are obtained from a set of nonlinear equations. They are underdetermined when q is greater than one. After the discontinuity the extremals fill an n-dimensionai volume regardless of the value of q.

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[Gustavus-Adolphus Coll., St. Peter, Minn.]

OPINION CHANGE AS A FUNCTION OF COMMUNICATION-ATTITUDE DISCREPANCY, by J. O. Whittaker. [1963] [10]p. incl. diagr. tabies. (AFOSR-84-0005) (AF AFOSR-82-188) AD 435506 Unclassified

Presented at meeting of the Southwestern Psychoiogicai Assoc., Dallas, Tex., 1983.

Also published in Psychol. Repts., v. 13: 783-772, 1963.

Experiments were designed to ascertain the relation between extent of change of opinions and the degree of discrepancy. A curvilinear relation was observed in questionnaire data from 107 Ss, i.e., smaller and larger discrepancies had iess effect than medium size discrepancies for communications on several different issues and on judgments of autokinetic movement. (Contractor's abstract)

872

[Gustavus-Adoiphus Coll., St. Peter, Minn.]

PARAMETERS OF SOCIAL INFLUENCE IN THE AUTOKINETIC SITUATION, by J. O. Whittaker. [1964] [8]p. (AFOSR-64-0837) (AF AFOSR-62-188) AD 438392 Unclassified

Also published in Sociometry, v. 27: 88-95, Mar. 1964.

Two experiments were conducted to determine the effects of a confederate's judgments on those of subjects as a function of the discrepancy or distance between them. In the first experiment, smaller discrepancies produced larger positive judgmental shifts than did discrepancies of greater magnitude. When very smaii discrepancies were empioyed in the second experiment, however, it was discovered that a curvilinear relationship exists between judgmentai shift and subject-confederate discrepancy.

873

[Gustavus-Adoiphus Coll., St. Peter, Minn.]

COGNITIVE DISSONANCE AND THE EFFECTIVENESS OF PERSUASIVE COMMUNICATIONS, by J. O. Whittaker. [1984] [9]p. inci. tabies, refs. (AFOSR-85-0595) (AF AFOSR-82-188) AD 814735 Unclassified

Aiso pubiished in Public Opinion Quart., v. 28: 547-555, 1984.

Festinger's theory of cognitive dissonance assumes that dissonant cognitive eiements create tension and that

dissonance leads to tension-reducing behavior. It follows that the greater the discrepancy between the position taken in the communication and the attitude held by the listener, the greater will be the dissonance and, consequently, the greater the change. The results of this experiment show, however, that an important variable determining the effectiveness of persuasive communications is the discrepancy between the position or stand presented in the communication and the position of the audience. There is an optimal discrepancy that results in maximum shifts; smaller or larger discrepancies yield negligible positive or negative shifts, while extremely large discrepancies cause significant negative or boomerang effects.

674

Hamline U., St. Paul, Minn.

ON GAUSSIAN MEASURES EQUIVALENT TO WIENER MEASURE, by D. E. Varberg. [1964] [12]p. (AFOSR-65-0343) (AF AFOSR-63-35) AD 612436
Unclassified

Also published in Trans. Amer. Math. Soc., v. 113: 262-273, Nov. 1964.

The question is investigated of when 2 Gaussian measures are equivalent in the case where 1 of the measures is Wiener measure. Necessary and sufficient conditions are given for equivalence, and an explicit formula is found for the Radon-Nikodyn derivative. These results are based on a paper by Woodward (Trans. Amer. Math. Soc., v. 100: 459-460, 1961). The sufficiency results are obtained by examining the question of when it is possible to represent a Gaussian process by means of a linear transformation of the Wiener process, and this in turn has led to the consideration of Gaussian processes having factorable covariance functions. (Math. Rev. abstract)

675

Harvard U. Cruft Lab., Cambridge, Mass.

FINITE TIME SELF-OPTIMIZING SYSTEMS, by K. S. Narendra, and L. E. McBride, Jr. Nov. 13, 1963 [27]p. incl. diagrs. (Technical rept. no. 422) (AFOSR-64-0311) (Nonr-186616) AD 430094
Unclassified

A correlation method proposed earlier for the optimization of linear systems by altering parameters to reduce a mean-square error criterion is extended to the cases of transient operation, non-quadratic criteria and time varying systems. Stability analysis indicates that the open-loop self-optimizing system is stable regardless of the speed with which the parameters are altered. When parameters of a closed-loop system are permitted to vary rapidly with time, it is found that the problem becomes analogous to that of optimal terminal control, and its solution is a generalization of the methods of optimal programming. (Contractor's abstract)

876

Harvard U. Cruft Lab., Cambridge, Mass.

LARGE SIGNAL THEORY OF AVALANCHE TRANSISTOR CIRCUIT OPERATION, by J. S.-T. Huang and A. A. Pandiscio. Sept. 16, 1963 [174]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 424) (AFOSR-64-0329) (Nonr-166616) AD 429605
Unclassified

The present study is concerned with the transient analysis of avalanche transistor pulse circuits from which fast current pulses are obtained. The transistor, when properly biased in the avalanche mode, is seen to exhibit a negative resistance at the collector-emitter terminals. The existence and significance of a reactive element associated with such negative resistance are thoroughly discussed. (Contractor's abstract)

677

Harvard U. Cruft Lab., Cambridge, Mass.

EXISTENCE OF QUADRATIC TYPE LIAPUNOV FUNCTIONS FOR A CLASS OF NONLINEAR SYSTEMS, by K. S. Narendra and R. M. Goldwyn. Aug. 1, 1963, 29p. incl. diagrs. (Technical rept. no. 415) (AFOSR-64-0344) (Nonr-166616) Unclassified

The report deals with the construction of Liapunov functions for nonlinear systems related to the Lur'e problem. The method presented consists in developing a quadratic type Liapunov function - called a spanning Liapunov function (SLF) - for an associated linear system, and modifying it suitably for the nonlinear case. Using this approach, a theorem of Popov for the Lur'e problem is derived and is extended to the case with "m" nonlinearities. Conditions for the existence of a Liapunov function of this form for the case of a gain $0 < l(\sigma) < \bar{l}$ in the Lur'e problem are derived. The results are used to construct Liapunov functions for certain specific systems. (Contractor's abstract)

876

Harvard U. Cruft Lab., Cambridge, Mass.

NYQUIST'S PROBLEM IN PULSE TRANSMISSION THEORY, by D. W. Tufts. Sept. 20, 1963 [30]p. incl. diagrs. (Technical rept. no. 425) (AFOSR-64-0345) (Nonr-166616) AD 424940 Unclassified

The problem, posed by Nyquist, of jointly optimizing the transmitter and receiver in a pulse amplitude modulation system is reformulated and analyzed in some detail. Nyquist's problem has not been completely solved in this report. The main results are that, using a mean square criterion, the optimum receiver for each message value can be represented as a matched filter followed by a tapped delay line and a sampler. The optimum tap gains are unique, and formulas are given for this set of gains and for the associated value of the mean square error. (Contractor's abstract)

679

Harvard U. Cruft Lab., Cambridge, Mass.

ELECTRIC FIELD EFFECTS IN PARAMAGNETIC RESONANCE, by E. B. Royce. Feb. 12, 1963 [152]p. incl. diagrs. tables, refs. (Technical rept. no. 379) (AFOSR-64-0605) (Nonr-166616) AD 401690
Unclassified

The electric field effects in paramagnetic resonance consists of shifts in resonance frequency produced by the application of a uniform electric field to the magnetic resonance sample. These electric field shifts arise through variations in the crystal field splittings under the influence of the applied electric field. In a

non-piezoelectric sample, two mechanisms are considered to be important in producing the electric field induced variation in crystal field. The optical mode ionic polarization of the crystal lattice, in which the anion and cation sublattices move with respect to each other, produces a variation in the local crystalline environment of the magnetic ion and hence, in its crystal field interaction; the electronic polarization of the magnetic ion alters its interaction with its crystalline surroundings, again producing a variation in the crystal-field interaction. Effects of electrostriction and piezoelectric distortion are mentioned but not treated in this work. (Contractor's abstract)

880

Harvard U. Cruft Lab., Cambridge, Mass.

QUANTUM-THEORETICAL COMPARISON OF NONLINEAR SUSCEPTIBILITIES IN PARAMETRIC MEDIA, LASERS, AND RAMAN LASERS, by N. Bloembergen and Y. R. Shen. July 19, 1983 [49]p. incl. diagrs. refs. (Technical rept. no. 417) (AFOSR-84-0606) (Nonr-186818) AD 417508; AD 418122 Unclassified

General expressions for complex nonlinear susceptibilities in the presence of damping have been derived which describe simultaneously parametric, maser and Raman maser effects. If the applied fields are near resonances of the atomic system and have a magnitude equal to or larger than the linewidths, the different effects become inextricably mixed. It is still possible to consider the total polarization, which is a mixture of all linear and nonlinear effects, as a source term reacting with the electromagnetic fields. Joint equations of the dynamical variables of the modes and the density matrix elements of the general nonlinear medium can be written down, although explicit steady state solutions require the retention of only a few terms in a Fourier series expansion, truncation of non-resonant terms, and other approximations. (Contractor's abstract)

881

Harvard U. Cruft Lab., Cambridge, Mass.

CONDITIONS FOR OPTIMUM DIGITAL COMMUNICATION WITH APPLICATION TO DELTA MODULATION, by T. Fine. Mar. 5, 1963 [41]p. incl. diagrs. refs. (Technical rept. no. 399) (AFOSR-84-0619) (Nonr-186816) AD 405053 Unclassified

A procedure for optimization of a class of binary communication systems is presented and applied. The message set or transmitter input is taken to be a real-valued sample sequence from a stochastic process with discrete parameter. The transmitter may be any time-varying, nonlinear operator with domain of the real valued input and range to the binary numbers. The transmission medium of noisy channel linking the transmitter and receiver is to be characterized by the conditional probabilities of all possible received binary sequences given any transmitted sequence. The receiver may be any real-valued, time-varying, nonlinear operator on the received binary sequences. The optimization conditions obtained are discussed and the relationship between an optimum communication system and a delta modulation system indicated. It is shown that, for the quadratic loss function and any noisy channel, a delta modulation system is an allowable representation of the optimum binary system. Preliminary results on an extended digital communication system model are discussed and areas for further research are indicated. (Contractor's abstract)

882

Harvard U. Cruft Lab., Cambridge, Mass.

EXTENSIONS OF LINEAR, LEAST-SQUARES SAMPLING THEORY, by D. W. Tufts and N. Johnson. Apr. 10, 1983, 1v. incl. diagrs. refs. (Technical rept. no. 407) (AFOSR-84-0620) (Nonr-188816) AD 411848 Unclassified

This paper presents some new results in the interpolation theory of random processes. These results are applied to the problem of reconstructing a random waveform from instantaneous samples. The main concern is with the removing of some of the restrictions of the interpolation method that is based on the ordinary sampling theory. In particular it is not assumed that an infinite number of samples is available, nor that the sampled random process is band-limited. On the other hand, the authors wish to preserve the practical (but not theoretical) simplicity of the type of interpolation that corresponds to time-invariant filtering. (Contractor's abstract)

883

Harvard U. Cruft Lab., Cambridge, Mass.

GENERATION OF QUADRATIC-TYPE LIAPUNOV FUNCTIONS FOR LINEAR TIME-VARYING SYSTEMS, by K. S. Narendra and R. M. Goldwyn. Nov. 22, 1983 [23]p. incl. diagrs. refs. (Technical rept. no. 421) (AFOSR-84-0689) (Nonr-188818) AD 433982 Unclassified

In this report the existence of Common Liapunov Functions (CLF'S) for linear time-varying systems is discussed. For a negative feedback system with G (s) in the forward path and a gain k (t) in the feedback path, it is shown that a sufficient condition to ensure the existence of CLF and hence stability is that $1/k + G(s)$ be a positive real function. For specific time-varying systems, Liqpunov functions that are explicit functions of time are found to increase the stability range of a parameter over that given by the CLF. An analysis of the behavior of the Liapunov function V in the V-V phase plane yields further insight into the problem of stability and leads to the generation of Liapunov functions for an additional class of time-varying systems. In the final section this approach is compared with the well-known Floquet Theory for periodic systems. (Contractor's abstract)

884

Harvard U. Cruft Lab., Cambridge, Mass.

AN ADAPTIVE PROCEDURE FOR CONTROLLING UNDEFINED LINEAR PROCESSES, by K. S. Narendra and D. N. Streeter. Nov. 8, 1963 [32]p. incl. diagrs. tables. (Technical rept. no. 420) (AFOSR-64-0690) (Nonr-186616) AD 434895 Unclassified

An adaptive procedure is described and demonstrated which causes a reduction of the mean-square error of a linear stationary random process, without explicit knowledge of the characteristics of the process. The procedure involves recursive simultaneous adjustment of an arbitrary number of parameters in a feedback compensator. The adjustment is based on estimations of the error gradient in the space of the adjustable parameters. (Contractor's abstract)

885

Harvard U. Cruft Lab., Cambridge, Mass.

ON THE PARTIAL DIFFERENTIAL EQUATION FOR THE CONDITIONAL PROBABILITY DISTRIBUTION FOR NONLINEAR DYNAMIC SYSTEMS WITH NOISY MEASUREMENTS, by R. L. Kashyap. Dec. 2, 1963, 18p. (Technical rept. no. 432) (AFOSR-64-0691) (Nonr-186616) Unclassified

The partial integro-differential equation has been derived for the conditional probability density distribution of the output of a nonlinear system excited by nonadditive white Gaussian noise, with nonlinear measurements corrupted by white Gaussian noise. This equation reduces to the well-known Kolmogoroff forward equation when there are no measurements. The usefulness of the differential equation is demonstrated by deriving from it, for linear systems, the Wiener-Kalman filter.

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Harvard U. Cruft Lab., Cambridge, Mass.

OPTIMUM PULSE SHAPES FOR TRANSMITTERS WHICH ARE BOTH PEAK POWER LIMITED AND AVERAGE POWER LIMITED, by D. W. Tufts and D. A. Shnidman. Nov. 12, 1963 [16]p. incl. diagrs. (Technical rept. no. 428) (AFOSR-64-0693) (Nonr-186616) AD 434875 Unclassified

For any stable linear system, an explicit formula is derived for the input waveform p(t) which maximizes the output waveform amplitude at a prescribed time instant. The problem and the results are closely related to the matched filter problem of radar theory and the bang-bang problem of optimal control theory. In addition to the obvious direct applications in signal design, the results can also be used indirectly since they provide a standard of performance for more realistic situations where additional constraints are important.

887

Harvard U. Cruft Lab., Cambridge, Mass.

A LOCK-ON PROBABILITY ANALYSIS FOR THE INITIAL SYNCHRONIZATION OF PHASE-LOCKED LOOPS, by R. J. McLaughlin. Feb. 3, 1963 [91]p. incl. diagrs. refs. (Technical rept. no. 372) (AFOSR-64-0904) (Nonr-186616) AD 433689 Unclassified

This report presents a general method for the calculation of the lock-on time as a function of the initial phase (angular) error and initial frequency (angular velocity) error, in the absence of noise, with particular reference to the specially-important phase-locked-loop characterized by a nonlinear differential equation. As a result of the presence of saddle-points in the phase-space of the differential equations of phase-locked loops, it is shown that for any value of the initial frequency error, the lock-on time will be indefinitely large for a value of the initial phase error sufficiently close to a saddle-point separatrix, and that the lock-on time varies as the negative logarithm of the distance of the initial point from the separatrix when this distance is sufficiently small. An explicit formula is given for the equation for the phase-locked-loop. (Contractor's abstract)

888

Harvard U. Cruft Lab., Cambridge, Mass.

TEMPERATURE DEPENDENCE OF OPTICAL HARMONIC GENERATION IN KH_2PO_4 FERROELECTRICS, by J. P. van der Ziel. Apr. 7, 1964, 1v. incl. illus. diagrs. tables, refs. (Technical rept. no. 431) (AFOSR-64-1344) (Nonr-186616) AD 601393 Unclassified

Optical second harmonic generation from KH_2PO_4 and KD_2PO_4 platelets was measured as a function of temperature, above and below the ferroelectric transition point, between 77°K and 300°K. The nonlinear process is expressed by a third rank susceptibility tensor relating the second harmonic polarization to a quadratic function of the applied fields. A phenomenoiogical theory is developed to account for the observed changes in the linear and nonlinear susceptibilities at the transition point. Relations between the tensor elements above and below the ferroelectric transition are obtained. The difficulties encountered in the experiment in the ferroelectric phase due to domains, and in the interpretation of the experimental data are discussed. The effects of atomic substitution on the relative values of the second harmonic susceptibilities was investigated by measurements at 300°K on the following isomorphs: KH_2PO_4, KH_2AsO_4, KD_2PO_4 and $NH_4H_2PO_4$. These substitutions have important effects on the low frequency dielectric and linear optical properties.

889

Harvard U. Cruft Lab., Cambridge, Mass.

STARK EFFECTS ON THE QUADRUPOLE COUPLING

OF Cl^{35} IN SODIUM CHLORATE, by F. A. Collins. Jan. 21, 1964, 73p. incl. diagrs. tables, refs. (Technical rept. no. 435) (AFOSR-64-1346) (Nonr-186816) AD 601428 Unclassified

It is shown that the direct response of the covalently bonded chlorate group to fields and field gradients is equally as important as the solid state effects due to local field effects and the change in the lattice-sum contribution to the quadrupole coupling.

890

Harvard U. Cruft Lab., Cambridge, Mass.

SOME INEQUALITY CONSTRAINT PROBLEMS IN THE CALCULUS OF VARIATIONS, by W. F. Denham. Apr. 16, 1964, 24p. incl. diagrs. (Technical rept. no. 436) (AFOSR-64-1347) (Nonr-186616) AD 601842 Unclassified

Four related memoranda dealing with inequality constraints in the calculus of variations are collected in this report. The first is a detailed derivation of the solution to a problem appearing in (AIAA Jour., v. 1: 2544-2550, 1963). The second is the solution to the simplest possible problem including both a control variable and a state variable inequality constraint. The third adds a slight complexity to the second leading to transcendental equations in the solution. The fourth is a description of a straightforward method of calculating neighboring extremal paths when an interval of the nominal extremal is on a control variable or a first-order state variable inequality constraint boundary. (Contractor's abstract)

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Harvard U. Cruft Lab., Cambridge, Mass.

ON THE CONJUGATE POINT CONDITION FOR THE CONTROL PROBLEM, by J. V. Breakwell and Y.-C. Ho. Mar. 26, 1964, 1v. incl. diagrs. (Technical rept. no. 441) (AFOSR-64-1348) (Nonr-186618) AD 601392 Unclassified

In this report the conjugate point condition was derived in the classical calculus of variations from a control-theoretic point of view. The relationship of conjugate point condition to relative minimum in optimal control problem is discussed. (Contractor's abstract)

892

Harvard U. Cruft Lab., Cambridge, Mass.

INTERACTION OF SIGNAL AND NOISE IN A NONLINEAR SYSTEM, by P. Trafton and D. W. Tufts. July 27, 1964 [48]p. incl. diagrs. (Technical rept. no. 450) (AFOSR-64-2214) (Nonr-186618) AD 607255 Unclassified

An experimental system has been constructed which simulates the detection stage of a receiver. With the application of periodic bursts of sine-wave plus Gaussian noise at the input, the output of this system is a nonstationary random process. The addition of noise to the signal suppresses the mean at the output for the half-wave linear detector. However, the mean is unchanged for the half-wave square-law detector. The non-stationary variance is seen to vary between two values which can be easily measured. Output signal-to-noise ratio is greater for the half-wave square-law device than for the half-wave linear device. Addition of a clipper to the half-wave linear device decreases the signal-to-noise ratio. Detection characteristics of the half-wave linear and half-wave square-law devices are found to be equivalent and the clipper degrades the detection characteristic. (Contractor's abstract)

893

Harvard U. Cruft Lab., Cambridge, Mass.

GENERATING FUNCTIONS OF ABSTRACT GRAPHS WITH APPLICATIONS, by C. V. Ramamoorthy and D. W. Tufts. Mar. 24, 1964 [59]p. incl. diagr. refs. (Technical rept. no. 439) (AFOSR-64-2215) (Nonr-186618) AD 607254 Unclassified

The generating function of a graph is a function of the complex variable z which has the property that interesting attributes of the graph can be extracted from it by numerical operations. The generating function can be written as a standard rational function of z, and the denominator is called the characteristic function of the graph. This latter function can also be obtained independently. The computation of the generating function involves either matrix inversions or application of formulas that take into account the topological characteristics of the graph. When the given graph has certain orderly topological features, the topological method gives the generating function explicitly even when the graph contains an extremely large number of nodes. However, if the graph has been chosen at random, often no advantage can be derived from a topological characterization. The matrix method can then be applied, but computational complexity restricts the size of graphs which can be analyzed. (Contractor's abstract, in part)

894

Harvard U. Cruft Lab., Cambridge, Mass.

JOINT OPTIMIZATION OF TRANSMITTER AND RECEIVER IN PULSE AMPLITUDE MODULATION, by D. W. Tufts and D. A. Shnidman. July 14, 1964 [22]p. incl. diagrs. refs. (Technical rept. no. 444) (AFOSR-64-2216) (Nonr-186616) AD 607094 Unclassified

Jointly optimum transmitted waveforms and linear time-varying receivers are specified for Pulse Amplitude Modulation systems which are subject to two kinds of interference, noise and intersymbol interference. The mean-square error in the receiver's reproduction of the random message sequence is used as the performance criterion. The joint optimization is carried out in detail for the case of signaling through a noisy RC filter. Special emphasis is placed on the

empirical exploration of performance variations caused by different choices of the message correlation matrix. (Contractor's abstract)

895

Harvard U. Cruft Lab., Cambridge, Mass.

NONLINEAR OPTICAL PROPERTIES OF SOLIDS, by P. S. Pershan. [1964] [8]p. incl. refs. (AFOSR-65-1393) (Nonr-186616) Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb 11-15, 1963), New York, Columbia U. Press, v. 2: 1513-1520, 1964.

The nonlinear optical properties of solids are discussed. Theoretically, all effects can be described by adding to the linear Maxwell's equation a current element that is nonlinearly related to the E and H fields. The most general form of Maxwell's equations can be considered to be: $\nabla \times \underset{\sim}{E} = -(1/c)\,\partial \underset{\sim}{B}/\partial t$ $\nabla \times \underset{\sim}{B} = (1/c)\,\partial \underset{\sim}{E}/\partial t + (4\pi/c)\underset{\sim}{J}$ where $\underset{\sim}{J}$ is a suitable macroscopic average of the microscope current elements. $\underset{\sim}{J}$ can be expressed in terms of macroscopic electric dipole moment per unit volume, $\underset{\sim}{P}$, the magnetic dipole moment per unit volume, M, and the electric quadrupole moment per unit volume, Q: $\underset{\sim}{J} = \partial \underset{\sim}{P}/\partial t + c\ \nabla \times \underset{\sim}{M} - \partial (\nabla \cdot Q)/\partial t$. In this investiation the equations are discussed when $\underset{\sim}{J}$ is not simply linearly related to either $\underset{\sim}{E}$ or $\underset{\sim}{H}$.

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Harvard U. Cruft Lab., Cambridge, Mass.

PARTIAL DIFFERENTIAL EQUATIONS FOR DENSITIES OF RANDOM PROCESSES, by T. Fine. May 4, 1964, 12p. (Technical rept. no. 445) (Nonr-186616) AD 604005 Unclassified

The Fokker-Planck-Kolmogorov (FPK) equation appears to be of wider applicability than is commonly realized. It is proved that the density functions for a wider class of vector random processes than just the Markov processes satisfy the FPK equations. Furthermore, an analogous derivation will yield a different partial differential equation applicable to multivariate densities for scalar random processes. The central technique is the evaluation of time derivatives of the characteristic function for the random variables of interest by two different methods; the comparison of the two different expressions for the time derivatives then yields the desired partial differential equations.

897

Harvard U. Cruft Lab., Cambridge, Mass.

STABILITY OF CERTAIN NONLINEAR DIFFERENTIAL EQUATIONS USING THE SECOND METHOD OF LIAPUNOV, by R. M. Goldwyn and K. S. Narendra. Mar. 18, 1963, 40p. (Technical rept. no. 403) (Nonr-186616) AD 409174; AD 410078 Unclassified

An approach is proposed for the construction of Liapunov functions for certain types of second and third-order nonlinear systems. If the system is described by a vector differential equation, a Liapunov function which ensures stability of the linear system for all values is called a common Liapunov function (CLF) in the given range. While it may prove difficult to determine such a CLF, a Liapunov function may be selected to ensure the stability of the linear system over the entire range of the parameters. Under certain conditions, this Liapunov function may be easily modified for use as a Liapunov function for a nonlinear system in which there are functions of the state variables. Using this approach, sufficient conditions are determined for the stability of a differential equation in terms of the bounds on certain functions.

898

Harvard U. Cruft Lab., Cambridge, Mass.

MULTI-PARAMETER SELF-OPTIMIZING SYSTEMS USING CORRELATION TECHNIQUES, by K. S. Narendra and L. E. McBride, Jr. June 5, 1963 [25]p. incl. diagrs. (Technical rept. no. 413) (AFOSR-5333) (Nonr-186632) AD 413402; AD 413511 Unclassified

A class of self-optimizing systems is described which continually alters its parameters to reduce a mean-square performance criterion. The change in each parameter is determined from an error gradient in parameter space computed by cross-correlation methods which are independent of signal spectra and require no test signal or parameter perturbation. Application of this technique to both open-loop and closed-loop systems are included, and it is shown that a combination of such self-optimizing systems is a possible solution to the adaptive control problem.

899

Harvard U. Cruft Lab., Cambridge, Mass.

THEORY OF THE TERMINATED INSULATED ANTENNA IN A CONDUCTING MEDIUM, by R. W. King. June 3, 1963 [50]p. incl. diagrs. refs. (Technical rept. no. 412) (AFOSR-5334) (Nonr-186632) Unclassified

The general problem of the insulated antenna in an isotropic homogeneous medium of infinite extent is reviewed under the assumption that the medium is sufficiently conducting to permit the application of coaxial line theory. The currents and associated electromagnetic fields for the completely insulated antenna are obtained and the directional properties of the latter explained by comparison with a collinear array. An antenna in which only a central portion is insulated, while the ends are bare, is analyzed in terms of the theories of the insulated and bare antenna. This is done both for the case when the structure is driven by generators at the junctions of the bare and insulated sections and for the case when it is driven by means of an internal coaxial feeder in the manner of a sleeve dipole. Finally,

the center-driven insulated antenna with bare ends is investigated and its field is compared with that of the antenna driven at the junctions of the bare and insulated sections. (Contractor's abstract)

900

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF THE SLOT TRANSMISSION-LINE AND SLOT ANTENNA, PART 2. A COAXIAL AMPLITUDE-INSENSITIVE PHASE-DETECTION SYSTEM, by R. W. Burton. Jan. 20, 1963 [12]p. incl. diagrs. (Technical rept. no. 398) (AFOSR-64-0604) (Nonr-186632) AD 401892 Unclassified

A coaxial amplitude-insensitive phase-detection system is discussed in detail. The system employs the hybrid junction in a balanced detector configuration to render a null reading independent of the relative magnitude of both the reference and the unknown signals. A theoretical formulation, experimental results and evaluation of errors are presented.

901

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF CIRCULAR ARRAYS. 6. PLAN FOR PRACTICAL APPLICATION TO ARRAYS OF TWENTY OR FEWER ELEMENTS, by R. B. Mack and E. W. Mack. May 1, 1963, 1v. (Technical rept. no. 386) (AFOSR-64-0611) (Nonr-186632) AD 425554 Unclassified

The quasi-zeroth-order theory of linear antennas is presented in a form for engineering applications which avoids intricate mathematical details. The theory is packaged as a Fortran II program which computes radiation patterns, admittances, and current distributions of an array of dipoles or monopoles which are spaced so that they divide the circumference of a circle into an even number of parts. The user need only supply input data cards to the program.

902

Harvard U. Cruft Lab., Cambridge, Mass.

SCATTERING BY A PERFECTLY CONDUCTING CYLINDER IN A COMPRESSIBLE PLASMA, by S. R. Seshadri, I. L. Morris, and R. J. Mailloux. Apr. 15, 1963 [22]p. incl. diagrs. (Technical rept. no. 409) (AFOSR-64-0614) (Nonr-186632) AD 413340 Unclassified

The scattering of a plane electromagnetic (EM) or plasma (P) wave by a perfectly conducting and rigid circular cylinder immersed in an isotropic, compressible plasma is treated. Expressions for all the physical quantities of interest are obtained in the form of infinite series. For the case of a plane EM wave incidence, numerical results for the current induced on the surface of the cylinder, the total scattering cross sections and the back-scattering cross section, are obtained as a function of $k_{eo}a$ for various values of the plasma frequency, where a is the radius of the cylinder and k_{eo} is the wave number of the EM wave in free space.

903

Harvard U. Cruft Lab., Cambridge, Mass.

TABLES OF THE GENERALIZED STIRLING NUMBERS OF THE FIRST KIND, by W. F. Pickard. Mar. 1, 1963 [11]p. incl. tables. (Technical rept. no. 404) (AFOSR-64-0616) (Nonr-186632) AD 405054 Unclassified

The generalized Stirling numbers of the first kind are defined, certain of their basic properties discussed, and tables given for the square grid k = 0(1)10 and j = 0(1)10 with i = - 10(1)10. (Contractor's abstract)

904

Harvard U. Cruft Lab., Cambridge, Mass.

A STUDY OF ARRAYS OF DIPOLES IN A SEMI-INFINITE DISSIPATIVE MEDIUM, by K. Sivaprasad and R. W. P. King. Nov. 18, 1963 [20]p. incl. diagrs. (Technical rept. no. 391) (AFOSR-64-0702) (Nonr-186632) Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-11: 240-256, May 1963.

The radial electric fields of horizontal dipoles in a semi-infinite dissipative medium are studied using the asymptotic expansion of a single dipole. An arrangement similar to an end-fire pattern of two broadside arrays in an infinite medium is used to investigate the possibility of obtaining a directed beam in the desired direction. After some important modifications, motivated by the nature of propagation in the medium, a suitable arrangement is found to give a directed beam.

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Harvard U. Cruft Lab., Cambridge, Mass.

THE ADMITTANCE OF BARE CIRCULAR LOOP ANTENNAS IN A DISSIPATIVE MEDIUM, by R. W. P. King, C. W. Harrison, Jr., and D. G. Tingley. Aug. 5, 1963 [30]p. incl. diagrs. tables. (Technical rept. no. 419) (AFOSR-64-1342) (Nonr-186632) Unclassified

Also published in IEEE Trans. Antennas and Propagation, v. AP-12: 434-438, July 1964.

The normalized input admittance of thin bare circular loop antennas has been evaluated from the theory of T. T. Wu. Computations have been made for loops in air and in an infinite homogeneous isotropic dissipative medium. A comparison is also made with Storer's theory of the loop. Numerical results are given in the form of graphs for several wire sizes and for loops up to 2.5 wavelengths in circumference. The properties

of the medium are represented by the ratio α/β in the range from zero (perfect dielectric) to one (good conductor); α and β are the imaginary and real parts of the complex propagation constant $k = \beta - j\alpha = \omega\sqrt{\mu(\epsilon - j\sigma/\omega)}$ where μ is the permeability, ϵ the dielectric constant and σ the conductivity of the medium. (Contractor's abstract)

906

Harvard U. Cruft Lab., Cambridge, Mass.

THE IMPERFECTLY CONDUCTING CYLINDRICAL TRANSMITTING ANTENNA, by R. W. P. King and T. T. Wu. Mar. 27, 1964, 1v. incl. diagrs. refs. (Technical rept. no. 440) (AFOSR-64-1343) (Nonr-186632) AD 601643 Unclassified

The properties of a cylindrical antenna with a continuous ohmic resistance along its length are of interest in the design of certain types of directive broad-bond antennas. Conventionally, the contribution by ohmic resistance to the distribution of current and the impedance is contained in a particular integral that is either ignored or treated as a higher order correction to formulas derived for perfectly conducting antennas. An alternative and more useful form has been developed in which the integral equation for the current is rearranged to permit the introduction of a complex propagation constant k. An approximate solution of this equation is then obtained in terms of the three trigonometric functions, sin (h - |z|) cos kz - cos k h and cos 1/2 k0z-cos 1/2 k0h where k0 is the free-space wave number. Expressions are derived for the coefficients of these functions and for k. Explicit formulas are given for the distribution of current and the admittance.

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Harvard U. Cruft Lab., Cambridge, Mass.

CURRENTS, CHARGES, AND NEAR FIELDS OF CYLINDRICAL RECEIVING ANTENNAS, by R. W. P. King. Aug. 19, 1964 [26]p. incl. diagr. (Technical rept. no. 453) (AFOSR-64-2453) (Nonr-186632) AD 608262 Unclassified

The cylindrical center-loaded receiving antenna in an incident linearly polarized plane-wave field was analyzed. Approximate expressions were obtained for the distributions of current and charge that involve three trigonometric terms with suitably defined coefficients. These are much more accurate than the usual zero-order currents and charges, and much simpler than higher-order iterated solutions. The complex effective length was determined. Formulas were also obtained for the reradiated or scattered field very near the antenna in the important special case when the antenna lies in the plane of the incident wave front. These are useful in certain applications that involve radio frequency hazards.

908

Harvard U. Cruft Lab., Cambridge, Mass.

RADIATION FROM AN ELECTROMAGNETIC SOURCE IN A HALF-SPACE OF COMPRESSIBLE PLASMA-SURFACE WAVES, by S. R. Seshadri. Mar. 5, 1963, 21p. (Technical rept. no. 396) (Nonr-186632) AD 409175; AD 410077 Unclassified

The radiation characteristics of a line source of magnetic current are studied for the case in which the source is situated in a half-space of isotropic, compressible plasma which is bounded on one side by a perfectly conducting, rigid plane screen. In addition to the electromagnetic and plasma space waves, the line source excites a boundary wave. This boundary wave is a coupled wave. It has associated with it both a magnetic field component and the pressure term. This is in contrast to the space waves which can be decomposed into an electromagnetic (EM) mode with no pressure term and a plasma (P) mode with no magnetic field associated with it. The characteristics of this boundary wave are evaluated. The boundary wave propagates for all frequencies and the power carried by the boundary wave becomes smaller as the frequency is increased.

909

Harvard U. Cruft Lab., Cambridge, Mass.

A REEXAMINATION OF SURFACE CONDUCTIVITY, by W. F. Pickard. Sept. 27, 1963, 20p. (Technical rept. no. 408) (Nonr-186632) AD 425562 Unclassified

The problem of calculating the surface conductivity at an electrolyte-solid interface is reconsidered. Some of the limitations of the existing definitions and theoretical approaches are pointed out, and the problem is reworked to include the effects of non-zero space charge and ion concentration on the conductivity. An approximate method is presented for calculating the mobility of an ion in a non-neutral environment. These considerations are illustrated by the problem of the local conductivity in a cylindrical pipe and the local conductivity near a half-plane.

910

Harvard U. Cruft Lab., Cambridge, Mass.

SCATTERING OF UNIDIRECTIONAL SURFACE WAVES, by S. R. Seshadri. Feb. 15, 1963, 20p. incl. illus. (Technical rept. no. 402) (Nonr-186632) AD 401694 Unclassified

A perfectly conducting plane screen embedded in a gyrotropic medium is shown to be able to support a unidirectional surface wave. Such a surface wave is assumed to be incident on the top of a semi-infinite screen. At the edge, the incident power is converted partly into a reflected surface wave which travels on the bottom of the screen and partly into a space wave. The angular distribution of the radiated energy as well

as the power-reflection and the power-transmission coefficients are evaluated. Total reflection is shown to occur for a certain band of frequencies.

911

Harvard U. Cruft Lab., Cambridge, Mass.

SOLVING THE EQUATIONS OF UNIFORM FLOW, by W. F. Pickard. Jan. 15, 1963, 23p. incl. illus. (Technical rept. no. 400) (Nonr-1d6632) AD 401893 Unclassified

The problem of solving the equation for uniform flow in an open channel is reduced to that of evaluating three simple integrals. Practical methods of computing these integrals are discussed.

912

Harvard U. Cruft Lab., Cambridge, Mass.

TABLES FOR THE STEP-BY-STEP INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS OF THE FIRST ORDER, by W. F. Pickard. Mar. 25, 1963, 7p. (Technical rept. no. 406) (Nonr-186632) AD 409173; AD 410076 Unclassified

A study is made of the step-by-step integration of ordinary differential equations of the first order by means of formulas obtained from the Gregory-Newton backward interpolating formula. Tables of relevant constants are presented.

913

Harvard U. Dept. of Chemistry, Cambridge, Mass.

STRUCTURES OF BIOLOGICALLY ACTIVE MOLECULES, by W. N. Lipscomb. Final rept. Nov. 30, 1963, 6p. (AFOSR-64-1110) (AF 49(638)809) AD 601692 Unclassified

A bibliography of 10 references is given on the molecular and crystal structure of some biologically active molecules.

914

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE LOCATION OF THE ZEROS OF SOME INFRAPOLYNOMIALS WITH PRESCRIBED COEFFICIENTS, by J. L. Walsh and O. Shisha. [1964] [7]p. incl. refs. (AFOSR-65-0350) (AF 49(638)574) AD 611909 Unclassified

Also published in Pacific Jour. Math., v. 14: 1103-1109, 1964.

Some nth infrapolynomials are considered on some special sets S with respect to simple n-sequences. The location of real and non-real zeros of the infrapolynomials A(z) is established for cases when S is contained in a disc and a finite interval and A(z) is real and non-real. The results are applied to some special cases of infrapolynomials. From the results on infrapolynomials, Marden's theorem that the number of zeros of a given complex polynomial over a set S at which S subtends and angle $< \pi/(p+1)$ is $\leq p$ is derived.

915

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON CERTAIN ALGEBRAS OF ANALYTIC FUNCTIONS, by K. V. R. Rao. [1964] [5]p. (AFOSR-64-2280) (AF AFOSR-63-393) AD 452386 Unclassified

Also published in Michigan Math. Jour., v. 11: 231-235, 1964.

Given a Riemann surface W, and the set of all analytic functions of bounded characteristic on W, together with the constants. If W1 and W2 are hyperbolic plane regions and the algebras are isomorphic, then W1 and W2 are conformally equivalent. The present note extends this result to the case where W1 and W2 are hyperbolic Riemann surfaces of arbitrary finite genus. To contrast the result with known characterizations of conformal structure in terms of bounded analytic functions, it is shown that a hyperbolic Riemann surface of finite genus may not admit nonconstant bounded analytic functions. The complex-valued homomorphisms of a general class of algebras is determined. Homomorphisms of certain algebras of rational functions are discussed. The conformal structure of a hyperbolic surface W of finite genus is determined by the set of analytic functions of bounded characteristic on W. The general class of algebras considered is discussed.

916

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

THE CONVERGENCE OF SEQUENCES OF RATIONAL FUNCTIONS OF BEST APPROXIMATION, by J. L. Walsh. [1964] [13]p. (AFOSR-64-2365) (AF AFOSR-63-393) AD 452356 Unclassified

Also published in Math. Ann., v. 155: 252-264, 1964.

The present writer has constructed a table of rational functions of best approximation, where the degrees of numerator and denominator are prescribed, and has studied especially the question of possibility of approximation. The purpose of the present paper is to study sequences of that table (clearly analogous to the table of Pade) especially with reference to degree of approximation and to overconvergence of various subsequences. Consideration is given the degree of convergence, some preliminary results, overconvergence as a consequence of a certain degree of convergence, regions and degree of convergence of sequences of best approximation according to various norms, and exact geometric degree of convergence. The present results, in their study of regions of convergence and limit points of poles of the approximating sequences, are qualitatively similar to older results on the Pade table due to Montessus de Ballore.

917

Harvard U. Dept. of Mathematics, Cambridge. Mass.

SURPLUS FREE POLES OF APPROXIMATING RATIONAL FUNCTIONS, by J. L. Walsh. [1964] [6]p. (AFOSR-64-2489) (AF AFOSR-63-393) AD 453797 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 52: 896-901, Oct. 1964.

Under broad conditions, rational functions which approximate on a point set E of the z plane to a function analytic on E and meromorphic in a region containing E have free poles which the respective poles of f(z). However, if the rational functions have an excess of free poles, the question arises as to the asymptotic behavior of those poles, and the possible effect on degree of convergence on E and elsewhere if those poles are suppressed. The present note makes a contribution to this study, in both general theory and by specific examples.

918

Harvard U. [Dept. of Mathematics] Cambridge, Mass.

ON THE LOCATION OF THE ZEROS OF A POLYNOMIAL WHOSE CENTER OF GRAVITY IS GIVEN, by Z. Rubinstein and J. L. Walsh. [1964] [14]p. (AFOSR-64-2490) (AF AFOSR-63-393) AD 454016 Unclassified

Also published in Jour. D'Anal. Math., v. 12: 129-142, 1964.

Proof of two lemmas involving centers of gravity of zeros has indicated various applications in the geometry of zeros. The object of the present study is to indicate further applications in the same field.

919

[Harvard U. Dept. of Mathematics, Cambridge Mass.]

KLEINIAN GROUPS, by L. V. Ahlfors. [1964] [7]p. (AFOSR-65-0092) (AF AFOSR-63-393) AD 455631 Unclassified

Presented at Ann. Sci. Conf. of Belfer Graduate School of Science, Yeshiva U., Sept. 24, 1962.

Also published in Scripta Math., v. 27: 97-103, [1964].

In Poincaré's terminology, arbitrary discontinuous groups of linear transformations are called Kleinian groups, while the groups with an invariant circle are said to be Fuchsian. This report proves 2 theorems concerning the dimensions of spaces of quadratic differentials that are associated naturally with a given Kleinian group: (1) dim $Q(\Delta') \neq$ dim $Q(\Delta_0)$. Let Δ' be the complement of $\bar{\Delta}_0$, or, more generally, any union of orbits distinct from Δ_0. Assume outright that Δ'/Γ is likewise compact. (2) If the quadratic differentials are restricted by $|\varphi| = O(\rho^{-1})$ and by $\int_{\Delta'/\Gamma} |\varphi| \, dx\,dy < \infty$ then dim $Q(\Delta') \neq$ dim $Q(\Delta_0)$ whenever Δ_0 is simply connected.

920

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

THE QUANTUM THEORY OF OPTICAL COHERENCE, by R. J. Glauber. [1963] [11]p. incl. refs. (AFOSR-J917) (AF 49(638)589) AD 416564 Unclassified

Also published in Phys. Rev., v. 130: 2529-2539, June 15, 1963.

A fully coherent field is defined as one whose correlation functions satisfy an infinite succession of stated conditions. Various orders of incomplete coherence are distinguished, according to the number of coherence conditions actually satisfied. It is noted that the fields historically described as coherent in optics have only first-order coherence. On the other hand, the existence, in principle, of fields coherent to all orders is shown both in quantum theory and classical theory. The methods used in these discussions apply to fields of arbitrary time dependence. It is shown, as a result, that coherence does not require monochromaticity. Coherent fields can be generated with arbitrary spectra.

921

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

ON PARTIALLY CONSERVED CURRENTS, by S. Coleman. [1963] [9]p. (AFOSR-J1608) (AF 49(638)589) AD 427622 Unclassified

Also published in Ann. Phys., v. 24: 37-45, Oct. 1963.

It is observed that the hypothesis of partially conserved leptonic weak interaction currents, which has been proposed by several authors, implies that the fundamental meson-baryon interaction be invariant under a certain group constructed from these currents. The only candidate for this group consistent with experiment and that does not require the introduction of an exorbitant number of spinless mesons is the eight-dimensional rotation group. The associated meson-baryon coupling is one first proposed by Gursey. This group does not seem to have any connection with the approximate symmetries of strong interactions; thus we reject the notion of partially conserved currents.

922

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

COHERENT AND INCOHERENT STATES OF THE RADIATION FIELD, by R. J. Glauber. [1963] [23]p. incl. refs. (AFOSR-64-0520) (AF 49(638)589) AD 434418 Unclassified

Also published in Phys. Rev., v. 131: 2766-2788, Sept. 15, 1963.

Methods are developed for discussing photon statistics of arbitrary radiation fields in fully quantum-mechanical terms. In order to keep the classical limit of quantum electrodynamics plainly in view, extensive use is made of the coherent states of the field. These states, which reduce the field correlation functions to factorized forms, are shown to offer a convenient basis for the description of fields of all types. Although they are not orthogonal to one another, the coherent states form a complete set. Any quantum state of the field may be expanded in terms of them in a unique way. Expansions are also developed for arbitrary operators in terms of products of the coherent state vectors. These expansions are discussed as a general method of representing the density operator for the field. A particular form is exhibited for the density operator which makes it possible to carry out many quantum-mechanical calculations by methods resembling those of classical theory.

923

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

A NINTH BARYON, by J. Schwinger. [1964] [3]p. (AFOSR-64-1241) (AF 49(638)589) AD 442853
Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 237-239, Mar. 2, 1964.

This note reports some results obtained by elementary calculations from a new field theory of matter. The theory is an attempt to explore the otherwise inaccessible substratum of the nuclear world with the aid of an analogy between nucleonic charge N and electrical charge Q. Fundamental fields and physical particles are presumed to be in direct correspondence for the leptons. The dynamics of the leptonic world is described by the vector electromagnetic field A which is coupled to the exactly conserved charge Q, and by the vector field Z which interacts with exchanges of electrical charge and is responsible for the phenomenological weak interactions.

924

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

DEPARTURES FROM THE EIGHTFOLD WAY: THEORY OF STRONG INTERACTION SYMMETRY BREAKDOWN, by S. Coleman and S. L. Glashow. [1964] [11]p. (AFOSR-64-1754) (AF 49(638)589) AD 449260
Unclassified

Also published in Phys. Rev., v. 134: B671-B681, May 11, 1964.

Three kinds of departure from exact unitary symmetry are considered: medium-strong interactions which leave only isospin and hypercharge as good symmetries, electromagnetism, and weak interactions. The existence of an octet of scalar mesons that give the possibility of symmetry-breaking tadpole diagrams are postulated.

925

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

MIXING OF ELEMENTARY PARTICLES, by S. Coleman and H. J. Schnitzer. [1964] [10]p. (AFOSR-64-1755) (AF 49(638)589) AD 449095
Unclassified

Also published in Phys. Rev., v. 134: B863-B872, May 25, 1964.

Particle mixing is studied in a field-theoretic context, as a further approximation to the pole approximation. Although particle mixing is well suited for treating spinless particles, another approximation, also a further approximation to the pole approximation, called vector mixing, is better for treating particles of spin one. Vector mixing is applied to several processes involving the mixing of the particles by the interaction that breaks unitary symmetry.

926

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

FIELD THEORY OF MATTER, by J. Schwinger. [1964] [15]p. (AFOSR-64-2048) (AF 49(638)589) AD 452517
Unclassified

Also published in Phys. Rev., v. 135: B816-B830, Aug. 10, 1964.

A speculative field theory of matter is developed. Simple computational methods are used in a preliminary survey of its consequences. The theory exploits the known properties of leptons by means of a principle of symmetry between electrical and nucleonic charge. There are fundamental fields with spins 0, 1/2, 1. The spinless field is neutral. Spin 1/2 and 1 fields can carry both electrical and nucleonic charge. The multiplicity of any nonzero charge is 3. Explicit dynamical mechanisms for the breakdown of unitary symmetry and for the muon-electron mass difference are given. A more general view of lepton properties is proposed. Mass relations for baryon and meson multiplets are derived, together with approximate couplings among the multiplets.

927

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

MASS FORMULAS AND MASS INEQUALITIES FOR REDUCIBLE UNITARY MULTIPLETS, by S. Coleman, S. L. Glashow, and D. J. Kleitman. [1964] [4]p. (AFOSR-64-2049) (AF 49(638)589) AD 452518
Unclassified

Also published in Phys. Rev., v. 135: B779-B782, Aug. 10, 1964.

For irreducible unitary multiplets of elementary particles, the Gell-Mann-Okubo mass formula is equivalent to the assertion that the effective masses transform under SU(3) like a superposition of a singlet and the

neutral member of an octet. We consider the implications of this assertion for reducible unitary multiplets. We find weaker mass formulas, which allow for the mixing between different irreducible components; moreover, we find that certain inequalities must be satisfied. Specific examples are described. (Contractor's abstract)

928

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

THE CLEBSCH-GORDON SERIES FOR SU(3), by S. Coleman. [1964] [2]p. (AFOSR-64-2514) (AF 49(638)-589) AD 453819 Unclassified

Also published in Jour. Math. Phys., v. 5: 1343-1344, Sept. 1964.

A method is explained for the calculation of the reduction of direct products of irreducible representations of SU(3). The method is believed to be simpler and more efficient than the usual algorithms.

929

Harvard U. [Lyman Lab. of Physics] Cambridge, Mass.

FIELD THEORY OF MATTER. II, by J. Schwinger. [1964] [4]p. (AFOSR-65-0465) (AF 49(638)1380) AD 453822 Unclassified

Also published in Phys. Rev., v. 136: B1821-B1824, Dec. 21, 1964.

A qualitative dynamical interpretation is given for observed regularities on non-leptonic phenomena in strong, electromagnetic, and weak interactions. These regularities are presented in the framework of a recently proposed field theory of matter (Phys. Rev. Ltrs., v. 12: 237, 1964 and Phys. Rev., v. 135: B816, 1964).

930

Harvard U. Lyman Lab. of Physics, Cambridge, Mass.

DEPARTURES FROM THE EIGHTFOLD WAY. II. BARYON ELECTROMAGNETIC MASSES, by S. Coleman and H. J. Schnitzer. [1964] [4]p. (AFOSR-64-2550) (AF 49(638)1380) AD 453967 Unclassified

Also published in Phys. Rev., v. 136: B223-B226, Oct. 12, 1964.

The leading nontadpole contributions to the electromagnetic mass splittings of the baryons are calculated. Best fits to experiment are used for the nucleon form factors; the strange baryon form factors are obtained from these by unitary symmetry. Account is taken of the breakdown of unitary symmetry by using experimental masses in intermediate states and by including the effects of theta-omega mixing. These calculations and the assumption of tadpole dominance are used to fit the six mass splittings of baryons and pseudoscalar mesons with one free parameter. All of the splittings are in good agreement with experiment except for the kaon splitting, which has the right sign but only 2/3 of the proper magnitude.

931

Harvard U. Medical School, Boston, Mass.

RECEPTIVE FIELDS OF CELLS IN STRIATE CORTEX OF VERY YOUNG, VISUALLY INEXPERIENCED KITTENS, by D. H. Hubel and T. N. Wiesel. [1963] [9]p. incl. diagrs. table, refs. (AFOSR-64-0543) (AF AFOSR-63-410) AD 436177 Unclassified

Also published in Jour. Neurophysiol., v. 26: 994-1002, Nov. 1963.

In a series of studies on the cat over the past 5 yr we have recorded from single cells in the striate cortex and mapped receptive fields using patterned retinal stimulation. The results suggest that connections between geniculate and striate cortex, and between cortical cells, must be highly specific. Indeed, cells in the striate cortex respond in such a characteristic way that departures from the normal adult physiology should be easily recognizable. In the present study we have made similar experiments in kittens ranging in age from 1-3 weeks. Our purpose was to learn the age at which cortical cells have normal adult-type receptive fields, and to find out whether such fields exist even in animals that have had no patterned visual stimulation.

932

Harvard U. Medical School, Boston, Mass.

EFFECTS OF VISUAL DEPRIVATION ON MORPHOLOGY AND PHYSIOLOGY OF CELLS IN THE CAT'S LATERAL GENICULATE BODY, by T. N. Wiesel and D. H. Hubel. [1963] [16]p. incl. illus. diagrs. tables, refs. (AFOSR-64-0544) (AF AFOSR-63-410) AD 436176 Unclassified

Also published in Jour. Neurophysiol., v. 26: 978-993, Nov. 1963.

Kittens were subjected to deprivation of form and light in one eye, at various ages and for various periods. In kittens with the lids of one eye sutured from birth for 3 months, most geniculate cells with input from the deprived eye had normal receptive fields, with an on-center and an off-periphery, or the reverse. The normal process by which the peripheral suppression demonstrable in retinal ganglion cells is increased at the geniculate level was observed. The over-all activity of layers fed by the deprived eye was, however, [illegible]ished, and a few cells had sluggish responses and receptive fields with abnormally large centers. Marked histological changes were present in layers fed by the deprived eye. No obvious histological changes were found in the retinas, optic nerves, superior colliculi, or striate cortex. Lid closure for comparable periods in 2-month-old, visually experienced kittens produced

similar but less severe histological changes in the lateral geniculate bodies. No changes were seen in an adult cat visually deprived by lid suture of one eye for 3 months.

933

Harvard U. Medical School, Boston, Mass.

SINGLE CELL RESPONSES IN STRIATE CORTEX OF KITTENS DEPRIVED OF VISION IN ONE EYE, by T. N. Wiesel and D. H. Hubel. [1963] [15]p. incl. illus. diagrs. refs. (AFOSR-64-0545) (AF AFOSR-63-410) AD 436158 Unclassified

Also published in Jour. Neurophysiol., v. 26: 1003-1017, Nov. 1963.

Recordings were made from striate cortex of kittens in which one eye had been deprived of vision either from birth or subsequently, and for various periods of time. Kittens deprived from birth for 2-3 mo showed profoundly defective vision in the deprived eye. Visual placing and following reactions were absent, and there was no hint of any ability to perceive form. Pupillary light reflexes were nevertheless normal. In kittens deprived from birth, the great majority of cortical cells were actively driven from the normal eye, with normal receptive fields. On the other hand, only 1 cell out of 84 was at all influenced by the deprived eye, and in that cell the receptive fields in the two eyes were adnormal. A few cells could not be driven from either eye. In one 2-month-old kitten monocularly deprived the corneal electroretinograms were normal in the two eyes.

934

Harvard U. [School of Dental Medicine] Cambridge, Mass.

HYPOTHALAMIC SECRETORY FACTOR FOR ADRENOCORTICOTROPIC HORMONE (SF-ACTH), by P. L. Munson. Final technical rept. Jan. 16, 1963, 8p. (AFOSR-49-2) (AF 49(638)740) AD 415479 Unclassified

Research on the biological assay and purification of the hypothalamic secretory factor for ACTH (HSF-ACTH) has been described. Extracts of hypothalamic tissue are evaluated by testing for decrease in adrenal ascorbic acid (as an indicator of endogenous or exogenous ACTH) in three types of rats. Rats anesthetized with pentobarbital are used to estimate proper dose levels and to detect nonspecific stressful contaminants. Rats anesthetized with pentobarbital and treated with morphine, which do not respond to moderate stimulation by nonspecific substances, are used to estimate the amount of HSF-ACTH, but they also respond to ACTH. Hypophysectomized rats are used to estimate the amount of exogenous ACTH that may contaminate the HSF-ACTH preparations.

935

Hawaii U. [Dept. of Sociology] Honolulu.

PREDICTIVE MODEL FOR INTRA-GROUP NEGOTIATION, by O. J. Bartos. Final rept. Feb. 1, 1962 - June 31, 1964, 10p. incl. tables. (AFOSR-64-1440) (AF AFOSR-62-314) AD 604471 Unclassified

The study had the following objectives: (1) To test the assumption of maximization of expected utility. (2) To test the assumption that the impact of a speech depends only on which proposal it endorses. (3) To test the assumption that each negotiator speaks with a fixed probability. (4) To design a model that deals with negotiations in which majority (rather than unanimous) agreement is required. (5) To define optimal negotiation strategies. (6) To consider training expert negotiators.

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Hawaii U. [Dept. of Sociology] Honolulu.

A MODEL OF NEGOTIATION AND THE RECENCY EFFECT, by O. J. Bartos. [1964] [16]p. incl. diagr. tables, refs. (AFOSR-65-0072) (AF AFOSR-62-314) AD 455740 Unclassified

Also published in Sociometry, v. 27: 311-326, Sept. 1964.

The paper describes a mathematical model of negotiation based on the von Neumann-Morgenstern theory of utility and on the Bush-Mosteller stochastic model of learning. It is shown that the model implies a "recency effect," i.e., that the later a proposal is introduced in a negotiation session, the more it influences the final decision. This implication is tested on data gathered from experimental sessions involving 35 five-man groups. It is shown that the so-called "mediator" behaves as predicted by the model: he is most likely to endorse the most recently endorsed proposals.

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Hawaii U. [Dept. of Sociology] Honolulu.

CONCESSION-MAKING IN EXPERIMENTAL NEGOTIATIONS, by O. J. Bartos. Nov. 16, 1964, 42p. incl. diagrs. tables, refs. (AFOSR-65-0729) (AF AFOSR-62-314) AD 617798 Unclassified

Two seemingly contradictory hypotheses about concession-making were considered: (1) that concession-making occurs only as a result of the negotiator's failure (experienced when opponent lowers his offers); and (2) that it occurs only as a result of reciprocity (as a reaction to an opponent's concession-making). A total of 87 5-man experiments, bearing upon these hypotheses, were conducted. The findings were somewhat unexpected in that they suggested that an opponent's behavior determines a negotiator's behavior far less than one might expect: by and large, a negotiator's demands depended on his own previous demands. To the extent, however, to which an opponent's behavior was influsntial, the "reciprocity" hypothesis appeared

to be more nearly correct than the "failure" hypothesis. It was found, furthermore, that concession-making tended to be a rather bad strategy, that a negotiator making few concessions tended to receive higher payoff than the negotiator who made many concessions. It was also shown that the deadline could play an important role in determining the final payoff, and that, were the time alloted for negotiation much shorter, concession-making might have been a more profitable strategy than it actually was.

938

Hebrew U., Jerusalem (Israel).

EFFECTS OF THREE LEVELS OF REALISTIC STRESS ON DIFFERENTIAL PHYSIOLOGICAL REACTIVITIES, by S. Kugelmass. Final rept. Aug. 19, 1963, 24p. (AFOSR-J1144) (AF EOAR-63-61) AD 423120 Unclassified

Using police trainees in controlled realistic lie detection stress situation it was found that (1) GSR results were essentially similar to those obtained in mild experimental situations and far superior to heart rate change results. (2) An analysis of GSR reactivity showed a strong relationship to basic conductance and is significantly related to ethnic origin.

939

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

STRICTLY ANTIPODAL SETS, by B. Grünbaum. [1963] [6]p. incl. diagrs. (AFOSR-J925) (AF EOAR-63-63) AD 416509 Unclassified

Also published in Israel Jour. Math., v. 1: 5-10, Mar. 1963.

A subset A of E^3 is called strictly antipodal provided that for every pair X_1, X_2 of points of A there is a pair H_1, H_2 of parallel supporting planes of such that $H_i \cap A = \{X_i\}$. The main result asserts that a strictly antipodal set has at most five points. This strengthens a recent result of Croft. (Contractor's abstract)

940

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

REAL INVERSION AND JUMP FORMULAE FOR THE LAPLACE TRANSFORM. PART I, by Z. Ditzian and A. Jakimovski. [1963] [20]p. (AFOSR-64-0213) (AF EOAR-63-63) AD 432573 Unclassified

Generalizations of the Laplace asymptotic method are obtained and real inversion formulae of the Post-Widder type for the Laplace transform are generalized.

941

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

A SIMPLE PROOF OF A THEOREM OF MOTZKIN, by B. Grünbaum. [1964] [3]p. incl. diagrs. (AFOSR-65-1032) (AF EOAR-63-63) AD 619762 Unclassified

Also published in Koninkl. Nederl. Akad. Wetensch. Proc., Indag. Math., Ser. A, v. 67: 382-384, 1964.

A new proof is presented of T. S. Motzkin's theorem that a 3-dimensional convex polytope, with each vertex and face incident to a number of edges which is a multiple of 3, has an even number of edges. The proof consists of two theorems: the first dealing with a special case of Motzkin's theorem in which each vertex has valence 3, and the second concerning the parity of faces and connected components of a 3-valent graph.

942

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

ADDITION AND DECOMPOSITION OF CONVEX POLYTOPES, by W. J. Firey and B. Grünbaum. [1964] [10]p. incl. refs. (AFOSR-65-1033) (AF EOAR-63-63) AD 619761 Unclassified

Also published in Israel Jour. Math., v. 2: 91-100, June 1964.

This paper presents a new addition for convex polytopes, which is a modification of a process presented earlier by H. Minkowski and which may be considered as a special case of the addition of generalized curvature functions. The new addition is such that the known results on planar decomposition in terms of vector addition have valid analogs in higher dimensions.

943

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

SELF-CIRCUMFERENCE OF CONVEX SETS, by B. Grünbaum. [1964] [3]p. incl. diagrs. (AFOSR-65-1401) (AF EOAR-63-63) AD 622441 Unclassified

Also published in Colloq. Math., v. 13: 55-57, 1964.

Let K be a convex body in the plane, and let $z \in$ int K. A norm is defined by the Minkowski functional $\|x\|_{K,z} = \inf \{\lambda > 0 | x - z \in \lambda(K - z)\}$. For an oriented closed curve C let the length of C in the metric derived from $\| \ \|_{K,z}$ be denoted by $L_{K,z}(C)$; the self-circumference of K is $L(K) = \inf \{L_{K,z}(\mathrm{bd}K) | z \in \mathrm{int}\, K\}$, where bdK is taken in either of the two possible orientations. In this investigation Golab's conjecture that $L(K) \leq 9$ for every convex body K in the plane is proved. The proof is dependent on the lemma that for every planar convex body K there exists an affine-regular hexagon circumscribed about K. For such a hexagon H with center at origin, it is proved that $L_{K,O}(\mathrm{bd}H) \leq 9$.

944

Hebrew U. [Dept. of Mathematics] Jerusalem (Israel).

A COUNTEREXAMPLE TO A PROBLEM OF SZ.-NAGY, by S. R. Foguel. [1964] [3]p. (AFOSR-65-1403) (AF FOAR-65-27) AD 621264 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 788-790, Oct. 1964.

An operator in a Hilbert space with uniformly bounded powers is constructed which is not similar to a contraction. (An operator P is a contraction if $\|P\| \leq 1$.) This furnishes a negative answer to a surmise made by Sz.-Nagy in a former paper that if T is an operator in euclidean space, not invertible, such that its iterates have a common bound, T is similar to a contraction.

945

Hebrew U. Dept. of Physics, Jerusalem (Israel).

SIMULTANEOUS DIFFRACTION IN ANTHRACENE, by L. Cohen, B. S. Fraenkel, and Z. H. Kalman. Jan. 1963, 8p. incl. diagrs. tables. (Technical rept. no. 2) (AFOSR-4732) (AF 61(052)222) AD 407669 Unclassified

Also published in Acta Cryst., v. 16: 1192-1195 Dec. 1963.

An analytical method is used to index the (100) simultaneous diffractions in (monoclinic) anthracene. The expected pattern of diffractions is calculated and compared with experimental observations. The computations are amenable to desk calculators. Simultaneous diffractions from 23 different pairs of planes are identified and tabulated for anthracene using copper K α radiation.

946

Hebrew U. Dept. of Physics, Jerusalem (Israel).

HYPERFINE INTERACTIONS IN THE GROUND STATE AND 21.7-KEV STATE OF Eu^{151} IN EUROPIUM IRON GARNET, by I. Nowik, and S. Ofer. [1963] 23p. incl. diagrs. tables, refs. (Technical note no. 8) (AFOSR-5061) (AF 61(052)347) AD 414125 Unclassified

Also published in Phys. Rev., v. 123: 241-245, Oct. 1963.

The hyperfine interaction of the ground state and 21.7 kev state of Eu^{151} in europium iron garnet have been measured at 300, 81 and 20°K using the technique of Mossbauer absorption. Values of (335 ± 50) kOe, (570 ± 35) kOe and (670 ± 100) kOe were found for effective magnetic fields acting on the Eu nuclei in europium iron garnet at the temperatures of 300, 81 and 20°K respectively. These values are in agreement with theoretical calculations of the non-diagonal matrix elements associated with the admixture of states produced by the exchange interaction. The value of the quadrupole interaction of the ground state of Eu^{151} in europium iron garnet was found to be (-240 [100)mc/sec at 81°K. The results yield an assignment of a spin of 7/2 for the 21.7 kev level and a value of μ = (2.54 ± 0.15) n m for the magnetic moment of this level.

947

Hebrew U. Dept. of Physics, Jerusalem (Israel).

EFFECTIVE MAGNETIC FIELD AND GRADIENT OF ELECTRIC FIELD ACTING ON THE NUCLEUS OF Eu IN EUROPIUM IRON GARNET, by G. Gilat and I. Nowik. [1963] [4]p. incl. diagrs. refs. (AFOSR-J1578) (AF 61(052)347) AD 427596 Unclassified

Also published in Phys. Rev., v. 130: 1361-1364, May 15, 1963.

The internal effective magnetic field (H_{eff}) and the electric field gradient acting on europium nuclei in europium iron garnet has been calculated. The nondiagonal matrix elements connected with the admixture of states produced by the exchange interaction give the main contribution to these fields. The temperature dependence of these fields is compared with the dependence of the magnetic moment of the ion as calculated by Wolf and Van Vleck. The effective magnetic field at 0°K turns out to be 7 x 10^5Oe, whereas, the electric field gradient at 0°K is eq/h = -555 mc/sec per b. In an Appendix the paramagnetic correction for the internal magnetic field acting on the nucleus of Eu in the presence of an external magnetic field is also calculated as a function of temperature. At room temperature $H_{int} = 1.54\ H_0$. (Contractor's abstract)

948

Hebrew U. Dept. of Physics, Jerusalem (Israel).

A STUDY OF CONDUCTION ELECTRON POLARISATION IN FERROMAGNETIC GADOLINIUM USING PERTURBATION OF γ - γ CORRELATIONS, by S. G. Cohen, N. Kaplan and others. [1963] [2]p. incl. diagr. table, refs. (AFOSR-64-0755) (AF 61(052)347) AD 436505 Unclassified

Also published in Phys. Ltrs., v. 7: 91-92, Nov. 1, 1963.

In this work, lutecium nuclei within trivalent lutecium ions, situated as dilute impurities in ferromagnetic gadolinium, have been used as a probe to estimate the local polarization of the conduction electrons. The sign and magnitude of the magnetic field acting on these lutecium nuclei have been obtained, using the technique of measuring the perturbation of the angular correlation of a cascade of nuclear γ-rays.

949

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ELECTRON DENSITY IONIZATION RATE AND APPROACH TO THERMAL EQUILIBRIUM BEHIND SHOCK WAVES BY MEANS OF MICROWAVE TECHNIQUES, by W. Low. Final scientific rept. Oct. 1964, 24p. incl. refs. (AFOSR-65-1138) (AF 61(052)401) AD 619093 Unclassified

The following subjects were investigated: (1) Improvement in the microwave diagnostics of shock waves; (2) Time dependence and shape of microwave attenuation in shocks of air at pressures of 1 and 5 mm Hg; (3) Measurements of the peak microwave attenuation of shock waves in argon and neon; (4) The effect of constrictions and taper sections on the shock speed and on microwave attenuation; (5) Experiments with an electrical discharge shock tube; (6) Construction of a 4mm Fahry-Perot interferometer; and (7) Testing a 4mm carcinotron. Three papers were published as a result of this work.

950

Hebrew U. [Dept. of Physics] Jerusalem (Israel).

MICROWAVE MEASUREMENTS ON SHOCK WAVES IN AIR, by M. Dvir and W. Low. [1963] [5]p. incl. illus. diagrs. refs. (AFOSR-65-1237) (AF 61(052)-401) AD 621345 Unclassified

Also published in Proc. Sixth Internat'l. Conf. on Ionization Phenomena in Gases, Paris (France) (July 8-13, 1963), v. 4: 325-329 [1963].

The microwave attenuation by shock waves in air is investigated in the Mach no. range of 8-12 and at pressures of 1-5 mm Hg. It is shown that an analysis of the time dependence of the attenuation yields important information regarding (a) the maximum electron-density, (b) the build-up of the electron density and the beginning of the shock, (c) the electron density near the contact surface, and (d) the length of the heated slug section. An investigation has also been made of the effect of transitions from a larger diameter shock tube to a smaller tube on the maximum microwave attenuation, on its time dependence, and on the Mach no. In particular, the effect of shorter and larger taper sections is studied, as well as abrupt transitions for various Mach numbers and initial pressures.

951

Hebrew U. Dept. of Physics, Jerusalem (Israel).

MICROWAVE ATTENUATION BY SHOCKED HEATED AIR, by M. Dvir and W. Low. [1964] [9]p. incl. illus. diagrs. refs. (AFOSR-65-1238) (AF 61(052)401) AD 621559 Unclassified

Also published in Phys. Fluids, v. 7: 578-586, Apr. 1964.

The microwave attenuation of air in Mach range 8-12 is investigated at initial pressures of 5 mm Hg. It is shown (a) that the experimental peak attenuation is larger than given by conventional theory; and (b) that the time dependence of the attenuation curve gives important information regarding the build-up of the ionization as a function of time, the contact surface and the zone behind it. It is found that the microwave attenuation rises approximately linearly as a function of time to its peak value. The testing time is shorter than that predicted from ideal shock theory but sufficient to establish quilibrium. The electron density changes abruptly upon arrival of the driver gas. However, an appreciable electron density exists over a large region behind the contact surface indicating strong interface mixing. It is also shown that the nature of the surface of the shock tube influences the peak attenuation and the time dependence of this attenuation.

952

Hebrew U. Dept. of Physics, Jerusalem (Israel).

RESEARCH IN SOFT X-RAY AND FAR ULTRA-VIOLET SPECTROSCOPY, by E. Alexander and B. S. Fraenkel. Annual technical rept. Jan. 31, 1963, 12p. (AFOSR-4595) (AF EOAR-62-33) AD 401030 Unclassified

The following research was carried out: Building and adjustment of instruments for research in the vacuum ultra-violet; Investigation into spectra obtained by the sliding spark method from the electrodes and from the insulator; High spectra of Cu in the 100-200 A region, and the dependence of their intensities on electrical parameters; Determination of W(74) lines in the 100-200 A region; and Investigation into spectra of light elements in the 100-200 A region. A method for obtaining absorption measurements of gases in the far ultra-violet has been developed. (Contractor's abstract)

953

Hebrew U. Dept. of Physics, Jerusalem (Israel).

ORTHORHOMBIC ELECTRON SPIN RESONANCE SPECTRUM OF U^{3+} IN CaF_2, by E. Mahlab, V. Volterra and others. [1963] [3]p. incl. diagrs. (AFOSR-J1581) (AF EOAR-63-64) AD 427598 Unclassified

Also published in Phys. Rev., v. 131: 920-922, Aug. 1, 1963.

An orthorhombic spectrum of U^{3+} in CaF_2 was measured. The orthorhomhic X, Y axes are found to lie in the (110) plane and the Z axis perpendicular to these axes. The X axes are at $\pm(19 \pm 1)°$ with the [1$\bar{1}$0] direction. There are, in general, twelve inequivalent magnetic sites. The g factors corresponding to one set of axes are $g_x = 1.38 \pm 0.01$, $g_y = 2.85 \pm 0.02$, and $g_z = 2.94 \pm 0.01$. Various models explaining this spectrum are discussed. The most likely model is that of an interstitial F^- in the second-nearest neighbor position. (Contractor's abstract)

954

Hebrew U. Dept. of Physics, Jerusalem (Israel).

EVIDENCE FOR TETRAGONAL DISTORTIONS FROM E.S.R. SPECTRA IN CRYSTALS OF CALCIUM OXIDE, by W. Low and J. T. Suss. [1964] [6]p. incl. diagr. table, refs. (AFOSR-64-0756) (AF EOAR-63-64) AD 438240 Unclassified

Also published in Solid State Commun., v. 2: 1-6, 1964.

The line width of the cubic e.s.r. spectra of iron group elements in single crystals of calcium oxide depends on the orientation of the symmetry axis with respect to the external magnetic field. It is found that the narrowest line width is along the (111) direction and the widest line along the (100) direction.

955

Hebrew U. Dept. of Physics, Jerusalem (Israel).

THE GROUND STATES AND RELATIVE STARK SPLITTINGS OF SOME TRIVALENT RARE EARTH IONS IN THE CUBIC CRYSTAL FIELD OF CALCIUM FLUORIDE, by U. Ranon. Mar. 1964, 22p. incl. diagrs. refs. (Rept. no. IA-697) (AFOSR-65-2305) (AF EOAR-63-64) AD 628401 Unclassified

The ratios B_4/B_6 of the cubic crystal field parameters are calculated from electron spin resonance on CaF_2; Nd^{3+} and CaF_2;Dy^{3+}, and the results are used to show that the ratio A_4/A_6 is not constant, as required by the point charge model. A linear expression of A_4/A_6 as a function of Z is constructed from the available data. The integrals $< r^4 >$ and $< r^6 >$ of Freeman and Watson are used in deducing B_4/B_6 for the trivalent rare earth ions. Eigenfunctions and eigenvalues of Lea, Leask and Wolf are employed in deducing the ground states and relative Stark splittings of the rare earth ions. Optical spectra are discussed.

956

Hebrew U. Dept. of Physics, Jerusalem (Israel).

PARAMAGNETIC RESONANCE OF Yb^{3+} IN $CaWO_4$, by U. Ranon and V. Volterra. [1964] [3]p. (AFOSR-65-2544) (AF EOAR-63-64) AD 626363 Unclassified

Also published in Phys. Rev., v. 134: A1463-A1465, June 15, 1964.

Paramagnetic resonance of Yb(3+) was observed in single crystals of CaWO4 at 20°K and 3 cm. A tetragonal as well as two rhombic spectra were found. The spectra arise from Yb(3+) ions at Ca(2+) sites and the rhombic symmetry is caused by charge compensation at next-nearest-neighbor Ca(2+) sites. The possibility of W(6+) substitution is discussed.

957

Hebrew U. Dept. of Physics, Jerusalem (Israel).

THE PREPARATION OF SOURCES OF Co^{57} FOR MÖSSBAUER EXPERIMENTS HAVING NARROW UNSPLIT EMISSION LINES, by A. Mustachi. [1964] [2]p. incl. diagr. refs. (AFOSR-64-2064) (AF EOAR-64-24) AD 451719 Unclassified

Also published in Nuclear Instr. and Methods, v. 26: 219-220, 1964.

A detailed procedure for the preparation of sources of Co^{57} for Mossbauer experiments, having narrow unsplit emission lines, is described.

956

Hebrew U. Dept. of Physics, Jerusalem (Israel).

MAGNETIC HYPERFINE INTERACTIONS AND RELAXATION PHENOMENA IN PARAMAGNETIC Dy_2O_3, by S. Ofer, B. Khurgin and others. [1964] [2]p. incl. diagr. (AFOSR-64-2123) (AF EOAR-64-24) AD 451576 Unclassified

Also published in Phys. Ltrs., v. 11: 205-206, Aug. 1, 1964.

This paper describes observations of the magnetic hyperfine splittings in the recoil-free absorption of the 26 kev gamma rays from $Dy^{161}m$ in Dy^{161} situated in paramagnetic polycrystalline Dy^{203}.

959

Hebrew U. Dept. of Physics, Jerusalem (Israel).

A METHOD OF DIFFERENTIATING BETWEEN ATOMIC SPECTRA OF HIGH DEGREES OF IONIZATION, by E. Alexander, U. Feldman, and B. S. Fraenkel. [1964] [8]p. incl. illus. diagrs. tables. (AFOSR-64-2149) (AF EOAR-64-70) AD 451567 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 4: 501-506, 1964.

It has been found that the intensity of spectra obtained in the vacuum u.v. with a triggered vacuum spark rises monotonely with the degree of ionization, when compared with their intensity from a sliding spark. In this way, differentiation between spectral lines of different degrees of ionization can be made for elements with Z greater than 25. Various aspects of the variation in intensity of spectra obtained by these methods are discussed. (Contractor's abstract)

960

Hebrew U. Dept. of Psychology, Jerusalem (Israel).

CORRELATES OF AMBIVALENCE, RISK-TAKING

AND RIGIDITY, by A. Minkowich. June 1, 1964, 63p. incl. tables, refs. (Scientific rept. no. 1) (AFOSR-64-1486) (AF EOAR-63-62) AD 604585 Unclassified

An examination was made of the relationships of over 40 variables in 3 samples of subjects. The variables belonged to 5 classes: (1) Personality traits (ambivalence toward parents, siblings and authority figures, hostility toward the same figures, manifest anxiety, vacillation tendencies in risk taking and perception); (2) Socialization experiences (amount of parental reward and punishment experienced during childhood, frequency of psychological discipline and corporal punishment administered by each of the parents, strictness of religious upbringing); (3) Perceptual styles (field dependence, perceptual rigidity, intolerance of ambiguity); (4) Social attitudes and cognitive styles (authoritarianism, dogmatism); (5) Risk-taking behavior (playful risk, financial risk, physical risk, risk of prestige).

961

Henri Rousselle Hospital, Paris (France).

RELATION OF THE VISCERAL AFFERENTS TO THE ACTIVITY OF THE BRAIN STEM RETICULAR FORMATION, by P. C. Dell. Final technical rept. Feb. 10, 1959 - June 30, 1963, 24p. (AFOSR-64-1270) (AF 61(052)229) AD 602784 Unclassified

Summaries of research on (1) Bulbar control of mesencephalic reticular activation and the ensuing changes in galvic skin reflex, pupillary reactions and cortical arousal, (2) Reticular control of sensory system, (3) Vigilance and motor integration, and (4) Reticular activating system and the control of Respiration are presented.

962

Henri Rousselle Hospital, Paris (France).

VISCERAL AFFERENT ACTIVITY EFFECT ON BRAIN STEM RETICULAR FORMATION, by P. C. Dell. Technical final rept. July 1, 1963 - June 30, 1964. July 1, 1964 [9]p. (AFOSR-64-1651) (AF EOAR-63-52) AD 605727 Unclassified

The following themes were the object of investigations: (1) Afferent projections acting on the bulbar structures implied in the control of the reticular activating system (RAS). (a) Role of afferents of the IXth and Xth cranial nerves. (b) Role of afferents of spinal origin. (2) Ascending effects synchronized with the activity of the respiratory centers. (3) Comparative study of the immediate and delayed components of reticular responses.

963

Herman Föttinger Inst. für Strömungstechnik. Technische Universität, Berlin-Charlottenburg (Germany).

ON THE INSTABILITY AND NON-LINEAR DEVELOPMENT OF A DISTURBED SHEAR LAYER, by A. Michalke. May 31, 1963, 31p. (Technical note no. 2) (AFOSR-5170) (AF 61(052)412) AD 416371 Unclassified

An attempt is made to calculate approximately the non-linear development of a disturbed shear layer. The disturbance of the shear layer was obtained by the methods of the inviscid linearized stability theory. By means of the eigenfunctions of the problem the streamlines of the disturbance motion were calculated. It was found that the disturbance of the shear layer is represented by two vortex sheets which will be superposed to the vorticity distribution of the undisturbed shear layer. According to Rosenhead's simplification the non-linear development was calculated by replacing the continuously distributed vorticity by a number of individual vortices and computating the motion of this vortices caused by the mutual induction. It was found that the disturbed shear layer rolls up and a concentration of vorticity results.

964

[Herman Föttinger Inst. für Strömungstechnik]. Technische Universität, Berlin-Charlottenburg (Germany).

GROWTH OF VELOCITY FLUCTUATIONS LEADING TO TURBULENCE IN FREE SHEAR FLOW, by R. Wille. June 30, 1963, 96p. (AFOSR-5325) (AF 61-(052)412) AD 418294 Unclassified

A special case of transition from laminar to turbulent flow is discussed: namely, a laminar free boundary layer, as it occurs at free jets near the nozzle, passes through the stages of meandering, vortex formation, and decay of laminar vortex flow. Hydrodynamic stability theory has been applied to the boundary layers of axisymmetric and two-dimensional jets. For experimental data the hot-wire technique has been applied. In many details experiment and theory are in good agreement, e.g. the frequencies of amplified velocity fluctuations. The characteristic data of vortex flow have been experimentally investigated using a Karman vortex street as model flow. The existence of a critical vortex number could be verified for one special case. The influence of the jet velocity profile at the origin of the jet on the axial and radial distribution of the mean velocity and the turbulent fluctuations has been studied experimentally. An experimental arrangement for producing free Couette flow is described and a first experimental analysis of the highly instable Couette jet is given.

985

Herner and Co., Washington, D. C.

A CASE STUDY IN THE APPLICATION OF CRANFIELD SYSTEM EVALUATION TECHNIQUES, by S. Herner, F. W. Lancaster, and W. F. Johanningsmeier. 1964, 14p. (AFOSR-64-2259) (AF 49(838)1182) AD 808743 Unclassified

Presented at 148th meeting of the Amer. Chem. Soc., Chicago, Ill., Aug. 30 - Sept. 4, 1964.

An account is given of a project performed on behalf of the U.S. Navy Bureau of Ships Technical Library to evaluate the effectiveness of a computerized information retrieval system based on the Engineers Joint Council system of role indicators and links. The evaluation method used was that developed by Cleverdon in the ASLIB Cranfield Project. The search program involved all major combinations of appropriate descriptors and role indicators. Once the searches were performed, the documents produced were submitted to compilers of the original questions. A basis was obtained for computation of relevance ratios. Recall ratios were determined by actually doing a total check of the specimen collection to locate all documents that had any possible relevance to 10 of the test questions. The greatest cause of noise in the search results was searching errors, and the most frequently occurring type of searching error was the failure to select crucial terms or concepts in translating the questions into the language of the system. The question was different on analysis for reasons for failure to retrieve documents that were relevant to search questions. Here, indexing errors contributed more heavily to the cause of failure.

988

Herner and Co., Washington, D. C.

MATHEMATICS, MECHANICS, AND STATISTICS FOR THE INFORMATION SCIENCE CURRICULUM OR, WHAT MATHEMATICS DOES AN INFORMATION SCIENTIST NEED? by R. A. Fairthorne. 1963, 2p. (AFOSR-64-0238) (AF 49(638)1261) AD 432794 Unclassified

Presented at Twenty-sixth annual meeting of the Amer. Doc. Inst., Chicago, Ill., Oct. 1963.

Also published in Automation and Scientific Commun., p. 39-40.

Mathematics for the Information Scientist corresponds with the 'Modern Mathematics' advocated for secondary schools. Information Scientists must be both 'literate' and 'numerate'. Finding empirical principles, usually 'Postulates of Impotence', must precede mathematical deduction and theorem proving.

987

Herner and Co., Washington, D. C.

BASIC PARAMETERS OF RETRIEVAL TESTS, by R. A. Fairthorne. [1964] [3]p. (AFOSR-65-0593) (AF 49(638)1261) AD 616174 Unclassified

Also published in Proc. Amer. Documentation Inst., Philadelphia, Pa., Oct. 5-8, 1964, v. 1: 343-345, 1964.

Retrieval tests involve comparison of 2 partitions of the collection, by the system and by the tester. Parameters should hold good both for all-but-not-only (ABNO) and only-but-not-all (OBNA) systems; when there are no items of the type invoked; and when "discrimination" is separated from "identification." Thus they are functions of those parameters of the 2 x 2 contingency table unaltered, except for sign, by row or column interchange. These are interpreted in documentary terms.

968

Howard U., Washington, D. C.

ON INDUCED TRANSITIONS AND LINE SHIFTS IN THE ROTATION-VIBRATION SPECTRA OF PRESSURIZED DIATOMIC GASES, by R. D. Sharma and G. C. Turrell. [1983] [9]p. (AFOSR-64-0220) (AF AFOSR-83-167) AD 432509 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2638-2646, Nov. 15, 1963.

A simple model is developed for a collision pair consisting of a polar diatomic molecule and a perturbing inert gas atom. The effects of long-range forces arising from the dipole and quadrupole moments of the polar molecule on its rotation-vibration spectrum are considered. Detailed calculations are carried out to obtain the integrated intensities of the induced Q branches and the rotational line shifts in the spectra of HCl- and HBr-inert gas mixtures. The calculated results for both phenomena agree in magnitude with the experimental data without the use of adjustable parameters. The results are also consistent with the observed temperature dependences of the Q-branch intensities. In its present form the theory is unable to reproduce quantitatively either the fine structure of the Q branch or the J dependence of the line shifts.

969

Hull U. Dept. of Chemistry (Gt. Brit.).

THE REACTION OF HYDROGEN ATOMS WITH OXYGEN AND WITH ETHANE, by R. R. Baldwin and A. Melvin. [1984] [7]p. incl. diagrs. tables, refs. (AFOSR-84-1886) (AF EOAR-63-31) AD 449999 Unclassified

Also published in Jour. Chem. Soc. (London), May 1964, p. 1785-1791.

Values of the Arrhenius parameters for the reaction $H + O_2 = OH + O$ have been obtained by combining estimates from shock tube studies at 1650°K, from flame studies at 1100°K, from studies of the $H_2 + O_2$ reaction at about 800°K, and from atomic reaction studies at 300°K. Statistical treatment gives $\log_{10} k_2 = 11{\cdot}313 \pm 0{\cdot}28 - (16,490 \pm 700)/4{\cdot}576T$ in l. mol^{-1} sec^{-1} units. Similar treatment of values for the reaction $H + C_2H_6 = H_2 + C_2H_5$ from flame studies at 1100°K, from the inhibiting action of ethane on the $H_2 + O_2$ at 813°K, and from low-temperature studies of the reaction of H or D atoms with ethane gives $\log_{10} k_{14} = 11{\cdot}117 \pm 0{\cdot}25 - (9710 \pm 580)/4{\cdot}576T$.

970

Hull U. Dept. of Chemistry (Gt. Brit.).

INHIBITION OF THE HYDROGEN + OXYGEN REACTION BY N- AND ISO-BUTANE, by R. R. Baldwin and R. W. Walker. [1964] [11]p. incl. diagrs. tables, refs. (AFOSR-64-1887) (AF EOAR-63-31) AD 450001 Unclassified

Also published in Trans. Faraday Soc., v. 60: 1236-1246, July 1964.

The inhibiting action of n- and iso-butane on the $H_2 + O_2$ reaction was examined over the temperature range 480-520°C in KCl-coated vessels. The second limit is reduced almost linearly as the mole fraction of hydrocarbon is increased, so that the efficiency of inhibition can be assessed by the mole fraction of inhibitor required to halve the unhibited limit. The marked dependence of inhibitor mole fraction on oxygen mole fraction shows that the main termination process is the reaction of H atoms with the hydrocarbon, though the decrease in inhibitor mole fraction with decreasing hydrogen mole fraction implies a significant contribution from the reaction of O or OH (or both) with the hydrocarbon. The butyl radicals appear to undergo predominantly a reaction with oxygen giving HO_2 and an olefine.

971

Hull U. Dept. of Chemistry (Gt. Brit.).

INHIBITION OF THE HYDROGEN-OXYGEN REACTION BY PROPANE, by R. R. Baldwin. [1964] [12]p. incl. diagrs. tables, refs. (AFOSR-64-1888) (AF EOAR-63-31) AD 450002 Unclassified

Also published in Trans. Faraday Soc., v. 60: 527-538, Mar. 1964.

The inhibiting action of propane on the second limit of the $H_2 + O_2$ reaction was studied over a wide range of mixture composition. The results were similar to those obtained with ethane and indicate that the main primary termination reaction is a removal of hydrogen atoms by propane. Removal of hydroxyl radicals, or oxygen atoms, though less important, accounts for secondary effects. Results indicate that the ultimate termination reaction is the reaction of the propyl radicals, formed in the large excess of phosphorus trichloride. This is considered to be evidence that the phosphinic acid exists in tautomeric equilibrium with the phosphonous acid form, the preparation of ferrocenylphosphonous dipiperide, the first known phosphorus amide of ferrocene, is reported.

972

Hull U. Dept. of Chemistry (Gt. Brit.).

THERMAL AND ISOTHERMAL EXPLOSIONS IN THE INHIBITION OF THE $H_2 + O_2$ REACTION BY HYDROCARBONS. INHIBITION BY NEOPENTANE, by R. R. Baldwin and R. W. Walker. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-2486) (AF EOAR-63-31) AD 629245 Unclassified

Also published in Trans. Faraday Soc., v. 60: 1760-1768, Oct. 1964.

Studies of the inhibiting action of neopentane on the second limit of the hydrogen + oxygen reaction shows that its behavior resembles that of methane, and differs markedly from that of ethane, propane, n- and isobutane. These latter hydrocarbons inhibit the limit because the alkyl radicals formed in the primary termination processes react predominantly with oxygen to form an olefine and the inert HO_2 radical. A similar reaction is not possible with the neopentyl radical, so that there is no direct inhibition, and a 'degenerate' inhibition mechanism occurs, in which the inhibition is due to reaction products which have not reached a stationary concentration. Under these conditions, the normally isothermal explosion boundary becomes thermal in character, and confirmation of this change is provided by the effects of different inert gases and vessel diameters.

973

IIT Research Inst., Chicago, Ill.

ANALYTICAL INVESTIGATION OF COMBUSTION INSTABILITY IN SOLID PROPELLANT ROCKETS, by F. L. Schuyler. Final rept. July 1, 1961-July 30, 1963. 77p. (Rept. no. A6002) (AF 49(638)1094) AD 424195 Unclassified

An analysis has been performed to formulate an aerothermochemical model for the combustion of solid rocket propellants in the presence of erosion. A two-dimensional laminar boundary layer analysis has been used to describe the flow, temperature, and concentration fields in the gas phase adjacent to the solid surface. The temperature dependence of the gas-phase reaction rate constant and of the solid pyrolysis have been described by Arrhenius expressions. A parallel investigation has been conducted to study the mechanisms of the chemical reactions involved with the burning of nitrocellulose type propellants.

974

Illinois Inst. of Tech., Chicago.

ROLE OF X-RAY INTENSITIES ON CRYSTAL PERFECTION STUDIES, by L. V. Azaroff. [1963] [16]p. (AFOSR-J1127) (AF AFOSR-62-71) AD 421715 Unclassified

Also published in Crystallography and Crystal Perfection, 1963, p. 109-124.

Present x-ray diffraction theory is based on an artificial "mosaic" crystal proposed by Darwin. In terms of this model, crystal perfection can be related to the intensity of an x-ray reflection via two factors called primary and secondary extinction. It is possible to evaluate these two terms independently either by comparing the reflecting powers of a single reflection at different x-ray wavelengths or by comparing several hkl reflections using the same wavelength. This analysis yields an effective thickness for the "mosaic" blocks and an average value for their relative tilts. It is then possible to interpret Darwin's model of a crystal in terms of dislocation theory. Relatively large concentrations of point defects in a crystal modify its electron density distribution sufficiently to affect the x-ray intensities. If the intensities are measured accurately and are suitably processed, they can be used to synthesize "difference" electron densities capable of disclosing the imperfections present. Both of the above procedures have been used successfully and are illustrated by applications to silicon and zinc oxide crystals. The possible limitations of electron density methods are illustrated by a study of indium antimonide. (Contractor's abstract)

975

Illinois Inst. of Tech. Dept. of Metallurgical Engineering, Chicago.

SUPPRESSION OF THE BAUSCHINGER EFFECT AND CHANGES IN FLOW PATTERN OF DUCTILE METALS CAUSED BY CYCLIC TORSIONAL STRAINS, by N. H. Polakowski. [1963] 11p. incl. illus. diagrs. refs. (AFOSR-64-0412) (AF 49(638)308) Unclassified

Presented at Sixty-sixth annual meeting of the Amer. Soc. for Testing and Materials, Atlantic City, N. J., June 23-28, 1963.

The Bauschinger effect, defined as the difference in yield stresses for continued and reversed straining, essentially disappears after a series of stress cycles of decreasing amplitude. This applies to annealed and initially cold-worked metals alike, although in the latter case the change is accompanied by an over-all decrease of the yield stress (fatigue softening). The attenuation of the Bauschinger effect also leads to a conspicuous change in the deformation mode of cold-worked (drawn, stretched) metals during subsequent continuous torsion. The ordinarily observed propagation of flow by Lüders-type shear bands recedes or, if the initial work-hardening was moderate, it can be completely suppressed and replaced by homogeneous flow. This is indicative of a relation between the degree of work softening and the development and subsequent stabilization of the Bauschinger effect with increasing prestrain.

976

Illinois U. [Charged Particle Research Lab.] Urbana.

PHOTOMICROGRAPHY OF ELECTRICALLY SPRAYED HEAVY PARTICLES, by C. D. Hendricks, Jr., R. S. Carson and others. [1963] [6]p. (AFOSR-176) (AF AFOSR-63-107) AD 406645 Unclassified

Presented at AIAA Electric Propulsion Conf., Colorado Springs, Mar. 11-13, 1963.

Also published in AIAA Jour., v. 2: 733-737, Apr. 1964. (AFOSR-64-1671)

One of the methods used to produce charged droplets, based on the electrical spraying of liquids from the tip of a conducting capillary tube, is briefly described. High-speed photomicrographs are shown which reveal details of the spraying mechanism at atmospheric pressure and at a pressure of about 10^{-5} torr for both stationary and pulsed conditions. The pictorial evidence is interpreted and discussed in terms of the physical constants of the liquids and the external parameters. Distributions of specific charge for several different liquids are presented and discussed briefly. The possibility of predicting and controlling the specific-charge distribution by electrical means is examined and recent achievements presented.

977

Illinois U. Charged Particle Research Lab., Urbana.

ELECTRICAL SPRAYING OF MACROSCOPIC LIQUID PARTICLES UNDER PULSED CONDITIONS, by R. S. Carson. Jan. 15, 1964, 91p. incl. illus. diagrs. refs. (Rept. no. CPRL-1-64) (AFOSR-64-1470) (AF AFOSR-63-107) AD 604428 Unclassified

An historical treatment is used to point out that an important application of electrical spraying is in the electrical propulsion field. It was found that glycerine, Octoil, and Octoil doped with tetra-no-butylammonium picrate readily spray from the end of a fine capillary, maintained at a high d-c potential, in short periodic bursts which continue over a prolonged time interval of at least several hours. New techniques are presented for determining the specific-charge spectra of the droplets emitted in selected intervals during the spraying pulses by time-of-flight mass spectrometry, and for taking photomicrographs of the liquid surface at any instant before, during, and after the spraying pulses. A method for synchronizing the spraying to an external pulses is indicated.

978

Illinois U. Charged Particle Research Lab., Urbana.

THE STABILITY OF ELECTRIFIED LIQUID SURFACES, by J. M. Schneider. Mar. 5, 1964, 99p. incl. illus. diagrs. refs. (Rept. no. CPRL-2-64) (AFOSR-64-1474) (AF AFOSR-63-107) AD 604431 Unclassified

The study pertains to the stability of electrified liquid surfaces. The emphasis is placed upon the stability conditions which apply to liquids sprayed from a small cylindrical capillary tube. For the case of low flow rates a particular value of applied electric potential exists, above which, the liquid surface is unstable due to electrostatic forces. Calculations of the value of the minimum spraying potential are made using a modification of a theory originated by Rayleigh. The values of the minimum spraying potential thus obtained are compared to values determined from calculations made by Zeleny. For the case of high flow rates the jet is unstable under the action of surface tension provided that the wavelength of any disturbance on the jet is greater than the circumference of the jet. If charge is present on the jet, the forces due to the charge promote stability if the wavelength of the disturbance is greater than 0.6 times the circumference of the jet. If the wavelength of the disturbance is less than 0.6 times the circumference of the jet, the effect of charge on the jet promotes instability.

979

Illinois U. Charged Particle Research Lab., Urbana.

PARAMETERS INFLUENCING THE CHARGE-TO-MASS RATIO OF ELECTRICALLY SPRAYED LIQUID PARTICLES, by J. J. Hogan. Dec. 15, 1963, 127p. incl. illus. diagrs. tables, refs. (Rept. no. CPRL-2-63) (AFOSR-64-1478) (AF AFOSR-63-107) AD 604583 Unclassified

A theoretical study of the electrical dispersion process is presented. The study includes: (1) surface energy minimization of the dispersed system of particles, (2) solution of Poisson's equation and the influence of space charge on the specific charge of the emitted particles, and (3) the influence of the conductivity and temperature of the liquid on the generation of charged particles. It is proposed that an equilibrium is established among the voltage drop across the liquid meniscus at the capillary tip, the space charge in the vicinity of the source, and the surface energy minimization process—and that the specific charge of emitted drops is established as a result of this equilibrium.

980

Illinois U. Coordinated Science Lab., Urbana.

THE SCATTERING MATRIX: NORMALIZED TO COMPLEX n-PORT LOAD NETWORKS, by R. A. Rohrer. May 1964, 33p. incl. diagrs. (Rept. no. R-206) (AFOSR-64-1115) (DA 26-043-AMC-0073(E)) AD 601157 Unclassified

The scattering matrix was normalized to complex n-port loads and some of the elementary properties of this generalized scattering matrix are discussed. The normalized scattering matrix was obtained in a straightforward manner from both the current-basis and voltage-basis scattering matrices. These matrices are presented from the intuitively attractive viewpoint of measures of the deviation of actual circuit behavior. The optimal matching condition employed was the specialization to the time-invariant case of that obtained for complex, time-varying n-port networks excited by arbitrary wave-forms. (Contractor's abstract)

981

Illinois U. Coordinated Science Lab., Urbana.

PROPERTIES OF CLASSES OF PATHS, by W. Mayeda. May 1964, 14p. incl. diagrs. (Rept. no. R-212) (AFOSR-64-1117) (DA 28-043-AMC-00073(E)) AD 601155 Unclassified

The properties of paths between a pair of vertices in a nonoriented linear graph have been discussed by several papers. This paper gives the properties of a class of paths where each class consists of all possible paths between a pair of vertices in a nonoriented, non-separable linear graph. It is clear that such properties should be known when one synthesizes a s.c. switching network which satisfies a set of given switching functions. An interesting application of classes of paths is to obtain all possible trees in a linear graph which is shown at the end of the paper. (Contractor's abstract)

982

Illinois U. Coordinated Science Lab., Urbana.

ON AN IMPROVED DIAGNOSIS PROGRAM, by S. Seshu. May 1964, 14p. incl. diagr. (Rept. no. R-207) (AFOSR-64-1118) (DA 28-043-AMC-00073(E)) AD 601156 Unclassified

In an earlier paper an IBM 7090 program for the diagnosis of asynchronous circuits was described. The present note describes an improved version written for the CDS-1604 computer. The principal

improvements are in flexibility and intelligence. The present program was written as a tool of research in the problem of self-diagnosis in electronic digital computers. (Contractor's abstract, in part.

983

Illinois U. Coordinated Science Lab., Urbana.

CROSSED FIELD CHARGED PARTICLE DELAY LINES, by H. G. Slottow. June 1964, 171p. incl. illus. diagrs. refs. (Rept. no. R-214) (AFOSR-64-1353) (DA 28-043-AMC-00073(E)) AD 602090 Unclassified

Crossed electric and magnetic fields are used to focus a beam of charged particles and to control the drift velocity of these particles. The novel and useful properties are: (1) the time delay can be varied continuously and rapidly; (2) the frequency band is potentially very wide. A discussion of the effects that limit bandwidth is presented and several means for reducing the limitations are described. In particular, a hyperboloidal structure is described that can maintain equal flight times in circular delay lines; the use of plasmas is discussed, and the field averaging properties of high energy electrons is analyzed. Experiments are described in which electrons or ions drifting at speeds less than 10^4 meters/sec delay signals by as much as 50 μsec. Results, usually in the form of oscillograms, show the effects of space charge, and in the case of tenuous plasmas, the effects of pressure on the shapes of video pulses. (Contractor's abstract)

984

Illinois U. Coordinated Science Lab., Urbana.

ROLE OF THE GENERALIZED LIPSCHITZ CONDITION IN FINITE-TIME STABILITY AND IN THE DERIVATION OF THE MAXIMUM PRINCIPLE, by S. D. Agashe. June 1964, 26p. (Rept. no. R-215) (AFOSR-64-1354) (DA 28-043-AMC-00073(E)) AD 602143 Unclassified

The main purpose of the report was to show how important the generalized Lipschitz condition is in proving certain properties of varied solutions of differential equations. These are particularly useful in consideration of finite-time stability and in deriving the Pontryagin maximum principle. It was shown that if a system satisfies a generalized Lipschitz condition in the state variables, it is finite-time stable with respect to the initial stage. If it satisfies a generalized Lipschitz condition in the control, it is finite-time stable with respect to the control. In deriving the maximum principle using the calculus of variations approach, an implicit assumption was made that for sufficiently small variations of the optimum control, the terminal conditions of the problem can still be met. This assumption was shown to be valid if a generalized Lipschitz condition is satisfied.

985

Illinois U. Coordinated Science Lab., Urbana.

CONTROL OF CO-OPERATIVE SYSTEMS: THE RENDEZVOUS PROBLEM, by D. L. Gieseking. July 1964, 52p. incl. diagrs. refs. (Rept. no. R-218) (AFOSR-64-1355) (DA 28-043-AMC-00073(E)) AD 603015 Unclassified

A study of optimal rendezvous strategies for cooperative controlled systems is presented. By rendezvous, it is meant that the systems approach each other in such a way that the system's velocities and accelerations are the same when the positions become the same. A solution to the single-input problem, using the calculus of variations, is given when the performance index is the integrated-square-error plus weighted control. A solution to the multi-input problem, using Pontryagin's maximum principle, is given for the same performance index. The performance index is rewritten in terms of the stacked state vectors. The rendezvous conditions are adjoined as constraints to the performance index using Lagrange multipliers. Due to the complexity of the problem, the control law will be open loop, in general.

986

Illinois U. Coordinated Science Lab., Urbana.

A PERFORMANCE MEASURE FOR GAME-PLAYING PROGRAMS, by E. G. Manning. May 1964, 39p. incl. diagrs. (Rept. no. R-208) (AFOSR-64-1557) (DA 28-043-AMC-00073(E)) AD 601621 Unclassified

A performance measuring procedure for a class of games is described. An example of the use of the procedure is given, with results. Further work to be done with the heuristic program at hand as well as with a new heuristic program is proposed. Lastly, another use of the safe-unsafe theorem, as a valuable aid to understanding heuristic programs, is suggested

987

Illinois U. Coordinated Science Lab., Urbana.

SYNTHESIS OF PROBABILISTIC COMMUNICATION NETS, by H. M. Barnard. May 1964 [54]p. incl. refs. (Rept. no. R-209) (AFOSR-64-1558) (DA 28-043-AMC-00073(E)) AD 601620 Unclassified

In this thesis the necessary and sufficient conditions for an expected value terminal capacity matrix to be realized as a net with a tree structure are developed. There are two reasons for the constraint that the net have a tree structure. First, it is well known in the classical communication synthesis problem that if a realization exists, then a realization with a tree structure always exists. Secondly, since the path between two vertices in a tree is unique Fu's equation for computing the expected value terminal capacity for these vertices reduces to a simple form. The expected value terminal capacity for vertices i and j in a tree net is

the product of the edge probabilities in the path between vertices i and j multiplied by the edge weight which has the minimum value in that path.

988

Illinois U. Coordinated Science Lab., Urbana.

TIME OPTIMAL CONTROL OF NON-LINEAR SAMPLED-DATA SYSTEMS, by S. M. Win. May 1984 [72]p. incl. diagrs. refs. (Rept. no. R-210) (AFOSR-64-1559) (DA 28-043-AMC-00073(E)) AD 601822 Unclassified

Procedures for the investigation of controllability, attainability and reachability of sampled-data systems with saturation constraints are presented. Necessary and sufficient conditions for complete controllability, attainability and reachability of single-input, time-invariant, sampled-data systems with saturation constraints are given. Conditional controllability, attainability and reachability are introduced and sufficient conditions are derived. Complete controllability and attainability of time-varying systems are investigated also. Simple sufficient conditions are derived when the system matrices are either asymptotic to constant matrices or periodic. Procedures for the formulation of optimal strategies are discussed. The optimal strategy used in this thesis involves forcing the system to the boundary surface first, and then to the desired state.

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Illinois U. Coordinated Science Lab., Urbana.

SOME APPLICATIONS OF LINEAR GRAPHS, by W.-K. Chen. May 1964 [51]p. incl. diagrs. refs. (Rept. no. R-211) (AFOSR-64-1560) (DA 28-043-AMC-00073(E)) AD 801623 Unclassified

The following topics are discussed: On the modifications of flow graphs; Flow graphs and bipartite graphs; An extension of the star-mesh transformation; A simplified way of solving a system of simultaneous linear equations; and On signal-flow graphs.

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Illinois U. Coordinated Science Lab., Urbana.

SENSITIVITY CONSIDERATIONS IN OPTIMAL SYSTEM DESIGN, by R. A. Rohrer and M. Sobral. June 1964, 25p. incl. diagrs. (Rept. no. R-213) (AFOSR-64-1581) (DA 28-043-AMC-00073(E)) AD 443853 Unclassified

The sensitivity of a control system is usually taken to be the normalized variation of some desired characteristic with the variation of plant or controller parameters. Rather than the usual absolute sensitivity described above, a new definition of relative sensitivity is introduced for the optimal control problem, wherein the system performance is always compared with its optimum under the given circumstances. The implications of the relative sensitivity and its relevance to optimal system design are discussed in detail. Moreover, a theoretical approach to the problem of system optimization when plant parameters are subject to change is presented. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

ON QUASI-LINEAR SEQUENTIAL MACHINES, by H. Y. Chang. July 1964 [41]p. incl. diagrs. refs. (Rept. no. R-216) (AFOSR-64-1562) (DA 28-043-AMC-00073(E)) AD 442308 Unclassified

The thesis investigates the realizability of quasi-linear sequential machines, machines that are linear in the feedback variables but not necessarily in the input variables. First it is shown that many of the properties of linear sequential machines also apply to quasi-linear sequential machines. A number of sets of states in a quasi-linear sequential machine have certain algebraic properties that are reflected by the symmetries in the state diagram. A necessary and sufficient condition is obtained for a given connection matrix of a completely specified sequential machine, with the given coding of states, to be realizable as a quasi-linear sequential machine making use of minimal number of feedback lines. A canonical realization is discussed which enables one to realize any arbitrary state diagram as a quasi-linear sequential machine using a sufficiently large number of memory elements. (Contractor's abstract)

992

Illinois U. Coordinated Science Lab., Urbana.

PRINCIPLES AND APPLICATIONS OF UNISTOR GRAPHS, by G. G. Dodd. July 1964, 47p. incl. diagrs. refs. (Rept. no. R-217) (AFOSR-64-1583) (DA 28-043-AMC-00073(E)) AD 604095 Unclassified

New properties and applications of unistor graphs are presented. A technique for solving a set of linear equations is derived and an alternative graphical representation of an active network is given. Communication nets are treated for the first time by unistor graph techniques. A unistor is an oriented edge connecting two vertices in a graph. A flow exists in the oriented edge with a value equal to the product of the edge weight and the weight of the initial vertex. The unistor is characterized by flow, potential, admittance, and directedness-four properties also found in linear equations and electrical networks. It is shown that a unistor graph can represent a matrix and the determinant and cofactors can be evaluated by using directed trees and directed 2-trees.

993

Illinois U. Coordinated Science Lab., Urbana.

MEMORY EFFECTS IN THE CURRENT-VOLTAGE CHARACTERISTICS OF THIN FILM SANDWICHES, by

hy G. Riddle. July 1964, 21p. incl. illus. diagrs. (Rept. no. R-219) (AFOSR-64-1564) (DA 28-043-AMC-00073(E)) AD 443854 Unclassified

Some new electrical effects were found in thin insulating films sandwiched hetween metal film electrodes. Most measurements were made on Al-Al_2O_3-Au three-layer devices which were produced hy vacuum deposition and anodization. The dielectric thickness was 100 to 1000 A. Electrical measurements were made in darkness and under vacuum. Currents through the insulator were measured as a function of applied voltage. Fresh films displayed an exponential dependence of current on voltage at low voltages. If the sandwiches were exposed to more than a few volts, they underwent an irreversible "forming" process. The formed sandwiches displayed interesting current-voltage relationships, including instabilities, negative resistance, and memory effects.

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Illinois U. Coordinated Science Lab., Urbana.

A STUDY OF NONLINEAR SECOND ORDER SYSTEMS, hy J. K. Aggarwal. July 1964 [97]p. incl. diagrs. table, refs. (Rept. no. R-223) (AFOSR-64-1565) (DA 28-043-AMC-00073(E)) AD 443855 Unclassified

Nonlinear second order systems, which are described hy a pair of coupled first order differential equations, were studied. The behavior of trajectories in the neighborhood of a singular point and the behavior of trajectories in the large were examined.

995

Illinois U. Coordinated Science Lab., Urbana.

NONLINEAR NETWORK ANALYSIS - THE PARAMETRIC APPROACH, by L. O. Chua and R. A. Rohrer. July 1964, 186p. incl. diagrs. tables, refs. (Rept. no. R-224) (AFOSR-64-1566) (DA 28-043-AMC-00073(E)) AD 604039 Unclassified

This work presents a unified theory of nonlinear RLC networks using an entirely new approach--the parametric approach. The class of networks considered includes any arbitrary time-invariant, nonlinear RLC network whose elements can be characterized by a unicursal curve. In particular, curves which are multiple-valued functions of both terminal variables such as the hysteresis curves are admissible. Through the use of Stieltjes integrals, a generalization of the concepts of 'content' and 'co-content' as well as 'energy' and 'co-energy' is made which leads directly to a generalization of the Legendre transformation. It is then shown that the equilibrium equations of such networks can always be formulated mathematically as a system of algebraic-differential equations. The Schauder fixed point theorem and the principle of contraction mapping are then used to formulate a number of existence theorems on the solutions of nonlinear resistive networks.

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Illinois U. Coordinated Science Lab., Urbana.

REALIZATION OF THE A-MATRIX OF HALF-DEGENERATE RLC NETWORKS, by A. Dervisoglu. July 1964, 56p. incl. diagrs. refs. (Rept. no. R-225) (AFOSR-64-1567) (DA 28-043-AMC-00073(E)) AD 603686 Unclassified

The necessary and sufficient conditions for a matrix to he realizable as the A-matrix of an RLC network are developed. The RLC network is assumed to he nondegenerate or half-degenerate and is assumed to have a connected resistive part. First it is shown that if there exists a realization then the given matrix A can he factored into two matrices: one a diagonal matrix of positive entries and the other a symmetric-skewsymmetric (hybrid) matrix. It is shown that the given matrix A has a realization with a half-degenerate or non-degenerate RLC network which has a connected resistive part if and only if the factorization exists and both the terminal matrix and the circuit matrix are realizable.

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Illinois U. Coordinated Science Lab., Urbana.

THE SENSITIVITY OF GENERAL MULTIVARIABLE FEEDBACK SYSTEMS, hy J. B. Cruz, Jr. and W. R. Perkins. Aug. 1964 [12]p. incl. diagrs. (Rept. no. R-227) (AFOSR-64-1568) (DA 28-043-AMC-00073(E)) AD 604096 Unclassified

The new approach recently proposed by the authors for treating the parameter variation problem for a class of multivariable systems is extended to a general feedback configuration for multivariable systems. It is shown that the general linear, multivariable, feedback system can he represented by two plant transfer function matrices and three controller transfer function matrices. A formula for the sensitivity matrix of the general structure is derived. Also, sufficient conditions are obtained for assuring a feedback design that is less affected by parameter variations than another feedback design with the same overall transfer matrix. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

ON CERTAIN RELAXATION OSCILLATIONS: CONFINING REGIONS, hy P. J. Ponzo and N. Wax. July 1964 [43]p. incl. diagrs. (Rept. no. R-228) (AFOSR-64-1569) (DA 28-043-AMC-00073(E)) AD 603688 Unclassified

Relaxation oscillations described by the generalized Lienard equation are investigated in the phase and Lienard planes. When f(x), g(x), and $F(x) = \int_0^x f(u)du$ are subject to certain restrictions, a number of analytic curves can be obtained in these planes which serve as bounds on solution trajectories. Piece-wise connection of such bounding curves provide explicit

annular regions with the property that solution trajectories on the boundary of an annulus move to the interior with increasing time, t. The Poincare-Bendixson theorem then guarantees at least one periodic orbit within such an annulus. It is shown that the periodic orbits which are isolated by this means are unique within the annulus, hence orbitally stable. (Contractor's abstract in part)

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Illinois U. Coordinated Science Lab., Urbana.

ON CERTAIN RELAXATION OSCILLATIONS: ASYMPTOTIC SOLUTIONS, by P. J. Ponzo and N. Wax. July 1964 [47]p. incl. diagrs. (Rept. no. R-229) (AFOSR-64-1570) (DA 28-043-AMC-00073(E)) AD 603687 Unclassified

Periodic solutions of the generalized Lienard equation are investigated in the phase and Lienard planes. Certain comparison equations are obtained by modifying the functions f(x), g(x), $F(x) = \int_0^x f(u)du$ so that the resulting equations may be integrated to within an error of order μ^{-2}.

1000

Illinois U. Coordinated Science Lab., Urbana.

ANOMALOUS CURRENT PEAKS IN THE I-V CHARACTERISTIC FOR TUNNELING BETWEEN TWO SUPERCONDUCTORS, by M. G. Craford, R. N. Peacock and others. Aug. 1964, 9p. incl. diagrs. (Rept. no. R-232) (AFOSR-64-1571) (DA 28-043-AMC-00073(E)) AD 604097 Unclassified

A study was made of the two-superconductor tunneling characteristics of sandwiches of Nb-Nb Oxide-In. Observation was made of not only the dc Josephson effect (a zero-voltage tunneling supercurrent), but also, at finite voltages, dc current peaks of comparable magnitude. A similar effect has been seen in junctions exhibiting dc zero-voltage currents apparently due to low critical current superconducting shorts.

1001

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL MATCHING OF NONLINEAR n-PORT NETWORKS, by R. A. Rohrer and J. P. Herner. July 1964, 22p. incl. diagrs. (Rept. no. R-221) (AFOSR-64-1898) (DA 28-043-AMC-00073(E)) AD 605419 Unclassified

The classical calculus of variations is applied to find the conditions for maximum energy transfer in nonlinear n-port networks. The general matching problem is discussed, and the sufficient conditions for the optimal load network are given in terms of the time domain behavior of the network. The optimal match for a tunnel diode is given as a specialization of the general results. (Contractor's abstract)

1002

Illinois U. Coordinated Science Lab., Urbana.

THE LOGIC ORGANIZER AND DIAGNOSIS PROGRAMS, by S. Seshu. July 1964, 88p. incl. diagrs. tables. (Rept. no. R-226) (AFOSR-64-1899) (DA 28-043-AMC-00073(E) and AF 49(638)1383) AD 605927 Unclassified

The first part of the report is a user's manual for those wishing to use the system of programs for the diagnosis of sequential switching circuits. The second part is a programmer's manual. Detailed description of the individual sub-routines, including calling sequences and peculiarities are given. This system of programs was developed as a tool in the experimental study of self-diagnosis in electronic digital computers. The system consists of two programs--the organizer (5000 instructions) and the sequential circuit analyzer (10,000 instructions) with about 1500 instructions in common.

1003

Illinois U. Coordinated Science Lab., Urbana.

AN EXTENSION OF DASHER SYNTHESIS, by B. D. Elliott. Aug. 1964, 41p. incl. diagrs. refs. (Rept. no. R-231) (AFOSR-64-1900) (DA 28-043-AMC-00073(E) and AF 49(638)1383) AD 605420 Unclassified

A study is given of conditions under which a specified nonminimum phase transfer function may be realized as a cascade of common terminal RC structures, each of which realizes a pair of complex zeros. Specifically, conditions are derived which must be satisfied by a driving point admittance if a section producing a pair of zeros in a portion of the right half-plane is to be removed and an RC function is to remain. The simplest section parameters consistent with this objective are chosen and inequalities are derived which assure positive solutions for the unspecified constants. A technique is also derived for the conversion of the complete admittance description of a common terminal section to a physical network based on node insertion in the admittance matrix and sufficient inequalities are given. (Contractor's abstract)

1004

Illinois U. Coordinated Science Lab., Urbana.

INITIATION OF ELECTRICAL BREAKDOWN IN ULTRAHIGH VACUUM, by D. Alpert, D. A. Lee and others. Aug. 1964, 1v. incl. illus. diagrs. refs. (Rept. no. R-234) (AFOSR-64-1902) (DA 28-043-AMC-00073(E)) AD 605426 Unclassified

Existing theories for the initiation of electrical breakdown are reviewed, together with the experimental observations on which they are based. Experiments described have extended the available data on electrical breakdown between broad area electrodes under ultrahigh vacuum conditions. The results are interpreted

on the basis of a single picture which explains and relates the phenomena of predischarge currents and the initiation of breakdown.

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Illinois U. Coordinated Science Lab., Urbana.

GENERATIONS OF TREES WITHOUT DUPLICATIONS, by W. Mayeda and S. Seshu. July 1964, 16p. (Rept. no. R-220) (AFOSR-64-2137) (DA 28-043-AMC-00073(E) and AF 49(638)1383) AD 604653 Unclassified

The purpose of this note is to describe a procedure for generating all trees of a linear graph without duplication. The trees are generated in a systematic fashion by elementary tree transformations (replacement of one branch), and hence the sign computation is performed simply. Since the procedure guarantees that there is no duplication, networks in which the number of trees exceeds the fast memory available in a computer, can be handled. The procedure requires that one generate a starting tree, which is easy to do on a machine, and that one compute the fundamental cut-sets for a given tree, which is again easy to do.

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Illinois U. Coordinated Science Lab., Urbana.

DISTRIBUTED NETWORK SYNTHESIS AND APPROXIMATION IN THE TIME DOMAIN, by R. A. Rohrer, J. A. Resh, and R. A. Hoyt. July 1964 [23]p. incl. diagrs. refs. (Rept. no. R-222) (AFOSR-64-2358) (DA 28-043-AMC-00073(E)) AD 607711 Unclassified

Conditions are obtained for the realization of the best approximation to a desired time domain input-output relation by means of a distributed network of a given class. Practical constraints are considered in obtaining the optimal (one-dimensional) spatial dependence for a series R-L, shunt G-C distributed network. The general results are specialized to L-C and R-C lines. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

STATE MODELS OF ACTIVE RLC NETWORKS, by A. Dervisoglu. Dec. 1964, 13p. incl. diagrs. (Rept. no. R-237) (AFOSR-65-0256) (DA 28-043-AMC-00073(E)) AD 609700 Unclassified

In active RLC networks in which dependent sources are controlled by passive elements, the existence of a tree which contains all voltage sources as branches and all current sources as chords is only a necessary condition for a unique solution. Unlike the passive case, the order of state vector depends not only on the topology of the network but also on the controlling coefficients of the dependent sources in the network. Furthermore, in a passive case if state variables are the currents of inductors and voltages of capacitors, at most the first derivative of the input vector u may appear in the state model but in an active case the nth derivative may appear, where n is the number of reactive elements in the network.

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Illinois U. Coordinated Science Lab., Urbana.

A DESCRIPTIVE LIST OF PLATO LESSON PROGRAMS 1960-1964, by E. R. Lyman. Nov. 1964, 6p. incl. refs. (Rept. no. R-186) (AFOSR-65-0257) (DA 28-043-AMC-00073(E)) AD 609699 Unclassified

For the past three years, the Coordinated Science Laboratory has been developing an automatic teaching system called PLATO (Programmed Logic for Automatic Teaching Operation) in order to explore the possibilities of automation in individual instruction. In the course course of development 43 lesson programs have been written for the system to illustrate or demonstrate the flexibility of the system for instruction. This report lists and briefly describes the nine sequences (24 lessons) which were written for the tutorial logic and the eleven sequences (17 lessons) written for the inquiry logic. The version of the PLATO system for which the lessons were written is specified in each instance. PLATO I and PLATO II lessons are no longer operable on the PLATO system because the PLATO I and PLATO II systems are now obsolete.

1009

Illinois U. Coordinated Science Lab., Urbana.

LIMIT CYCLES IN A CERTAIN CLASS OF SAMPLED-DATA CONTROL SYSTEMS, by R. A. Werner. Dec. 1964, 91p. incl. diagrs. (Rept. no. R-238) (AFOSR-65-0258) (DA 28-043-AMC-00073(E) and AF 49(638)-1383) AD 610099 Unclassified

This paper discusses periodic, unforced solutions (called limit cycle solutions) to the state and output equations of a certain class of nonlinear sampled-data control systems. The class of systems consists of a linear plant, a single nonlinearity, a sample and hold element and a single feedback loop. Two different methods are given for determining the possible existence and the solutions for the limit cycles. An approximate method for determining possible existence and output solutions for limit cycles is also given. Finally, a certain kind of stability of limit cycle solutions is defined, and sufficient conditions for the stability and instability of limit cycles are developed. (A limit cycle is defined as a periodic trajectory in the state space; i.e., it is an unforced, periodic, steady state solution to the state space equations of the system.) (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

CRYSTALLIZATION OF THE SUPERCONDUCTOR

Nb_3Sn, by W. C. Leung. May 1963, 35p. incl. illus. diagrs. tables, refs. (Rept. no. R-170) (AFOSR-5476) (DA 36-039-AMC-02208(E)) Unclassified

Studies and experiments on the crystallization of Nb_3Sn have been done on the basis of the following information: (1) Nb_3Sn is stable at 900°C and above, (2) appreciable amounts of Nb can be dissolved in Sn at 1200°C, and (3) nucleation and growth are the result of the continuous supersaturation at a particular location in a saturated solution. Experimental results clearly indicate that crystallization of Nb_3Sn will occur from a saturated solution of niobium in tin; however, due to excessive nucleation only polycrystalline clusters of Nb_3Sn crystals were achieved. More detailed studies and experimental investigation are required to obtain the optimum conditions for single crystal growth.

1011

Illinois U. Coordinated Science Lab., Urbana.

ATOMIC PROCESSES IN HELIUM-KRYPTON AND HELIUM-XENON MIXTURES, by C. L. Chen. June 1963, 31p. incl. illus. diagrs. table, refs. (Rept. no. R-171) (AFOSR-5477) (DA 36-039-AMC-02208(E)) Unclassified

The momentum transfer collision frequency of thermal electrons with neutrals in a decaying plasma established in helium-krypton and helium-xenon mixtures of known proportions were measured by microwave interferometer at gas temperatures of ~200 to 600°K. The energy dependences of the momentum transfer cross sections of electrons with krypton and xenon atoms deduced from these measurements are given. Mobilities of Kr^+ and Xe^+ in helium and in their respective parent gas have also been determined. A study of the pressure dependence of the characteristic time constants of the electron density decay at fixed ratios of krypton to helium and xenon to helium concentrations yields the three body conversion frequency of atomic krypton and xenon ions to their respective molecular ions.

1012

Illinois U. Coordinated Science Lab., Urbana.

UPPER BOUNDS FOR THE MEAN LIFE OF SELF-REPAIRING SYSTEMS, by J. Kruus. July 1963 [38]p. incl. diagrs. tables, refs. (Rept. no. R-172) (AFOSR-5478) (DA 36-039-AMC-02208(E)) AD 418174 Unclassified

Upper bounds are obtained for the mean life of a self-repairing system consisting of several identical machines, spare parts, and the necessary connecting and wiring mechanism. No detailed knowledge is assumed about the machines, except that each is by itself capable of performing the function required of the system, and that three of these machines may be interconnected to diagnose and direct the repair of a suspected fault in a fourth machine. The time required for diagnosis and repair is a random variable. System mean life is obtained by selecting random machine lifetimes for a system simulated on an electronic computer. The switching mechanism is assumed to function without failures. The computation time is of the order of .2 msec for each time a machine is put into operation. System mean life is found to be quite sensitive to changes in the stress factor of spare machines.

1013

Illinois U. Coordinated Science Lab., Urbana.

ON THE SYNTHESIS OF OPTIMUM MULTIVARIABLE SYSTEMS, by R. Narayanasamy. July 1963 [75]p. incl. diagrs. refs. (Rept. no. R-173) (AFOSR-5479) (DA 36-039-AMC-02208(E)) AD 418160 Unclassified

A system with a feedback configuration is considered and this system is represented by an equivalent cascade systems. Two independent transfer matrices represented in the cascade system are first synthesized. The transfer matrices in the feedback configuration are then solved from the transfer matrices in the cascade system. There is chosen one of the transfer matrices in the cascade system to minimize the effect of certain disturbances in the system outputs and system sensitivity with respect to plant parameter variations. Also, system stability and physical realizability of the controllers in the feedback configuration are considered in the choice of this transfer matrix.

1014

Illinois U. Coordinated Science Lab., Urbana.

ON NETWORKS AND BI-COMPLETE GRAPHS, by J. A. Resh. July 1963 [66]p. incl. diagrs. refs. (Rept. no. R-174) (AFOSR-5480) (DA 36-039-AMC-02208(E)) AD 418172 Unclassified

Mathematically, a communication network is a network (bi-complete linear graph) whose edge weights are restricted to be nonnegative. In the physical interpretations which generated this interest, the property which occupies the center of attention is the capacity of the network for supporting a flow from one terminal to another. It is this preoccupation with "generalized plumbing" that distinguishes the theory of communication networks from other mathematical systems dealing with weighted graphs.

1015

Illinois U. Coordinated Science Lab., Urbana.

BASHKOW'S A MATRIX FOR ACTIVE R. L. C. NETWORKS, by A. Dervisoglu. July 1963 [12]p. (Rept. no. R-175) (AFOSR-5481) (DA 36-039-AMC-02208(E)) AD 420507 Unclassified

In 1957 Bashkow described a new method of network

analysis. According to this method if voltages across capacitances and currents through inductances are used as dependent variables, a set of first order differential equations is obtained as, $y = A\,y + F$ in which y is the column matrix of dependent variables and F represents the sources. Bryant later obtained an explicit form of A matrix for RLC networks. There is a discussion of the active RLC case such that the order of complexity of the network is equal to the number of reactive elements in the network.

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Illinois U. Coordinated Science Lab., Urbana.

EFFECTS OF ELECTRON-SURFACE INTERACTION IN IONIZATION GAUGES, by W. C. Schuemann, J. L. de Segovia, and D. Alpert. Aug. 1963 [19]p. incl. diagrs. refs. (Rept. no. R-180) (AFOSR-5495) (DA 36-039-AMC-02208(E)) AD 427830
Unclassified

A systematic study of an anomalous nonlinearity in ionization gauges was made, indicating the magnitude of possible errors in ionization gauge readings. The errors are particularly enhanced after O_2 has been introduced into the system. Evidence was provided for interpreting the effect as due to dissociative ionization by electron impact at the grid surface. At low values of grid current, there is an enhanced rate of production of such ions accompanied by a reduced rate of collection in a Bayard-Alpert gauge.

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Illinois U. Coordinated Science Lab., Urbana.

THE EULER-POISSON EQUATION AND OPTIMAL LINEAR CONTROL, by R. A. Rohrer and M. Sobral. July 1963 [18]p. incl. diagr. refs. (Rept. no. R-176) (AFOSR-5496) (DA 36-039-AMC-02208(E))
AD 427076 Unclassified

The calculus of variations is applied to the problem of finding the optimum control for a completely controllable nth order stationary linear system with quadratic performance index. A simple procedure, which involves only factoring a $2n^{th}$ order even polynomial into a product of anti-Hurwitz and Hurwitz polynomials, emerges from the first variation. Moreover, an easily performed test for the sufficiency of such solutions as optimal is obtained from the second variation. Conditions under which the closed loop system is stable for the optimum control law are discussed.

1018

Illinois U. Coordinated Science Lab., Urbana.

MINIMIZATION OF ATMOSPHERIC TURBULENCE EFFECTS ON HIGH-RESOLUTION SYNTHETIC APERTURE SYSTEMS, by D. M. Diamond. Sept. 1963 [69]p. incl. diagrs. refs. (Rept. no. R-179) (AFOSR-5497) (DA 36-039-AMC-02208(E))
AD 426965 Unclassified

A method of processing the received signals in a synthetic aperture radar system to remove the effects of atmospheric turbulence is proposed. An appropriate mathematical model of the synthetic system and the manner in which it is affected by atmospheric turbulence is developed. The model thus developed is used as the basis for a processing procedure which matches the first few terms of a Fourier series to the phase error effect caused by the atmospheric turbulence. Several examples of a computer simulation are used to illustrate the results of such processing. (Contractor's abstract)

1019

Illinois U. Coordinated Science Lab., Urbana.

A STUDY OF THE PROJECTIONS ON ELECTRODES AND THEIR EFFECT ON ELECTRICAL BREAKDOWN IN VACUUM, by H. E. Tomaschke. Jan. 1964 [109]p. incl. illus. diagrs. tables, refs. (Rept. no. R-192) (AFOSR-64-0312) (DA 36-039-AMC-02208(E))
AD 429464 Unclassified

The present investigation was undertaken to investigate the characteristics of projections that exist on electrode surfaces and to determine the correlation between the geometry of the projections and the prebreak-down current-voltage characteristics of the electrodes. Fowler-Nordheim plots of the prebreakdown currents predicted that the projections should be of the order of 10^{-4}-10^{-5} cm in diameter and have a length about ten times the diameter. Direct observations of electrode profiles with an electron microscope confirmed that projections of the predicted size and shape did exist on the electrode surface. Electrical breakdown resulted in the disappearance of one or more projections and sometimes caused the formation of new projections.

1020

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL MATCHING OF LINEAR NETWORKS, by R. A. Rohrer. Dec. 1963 [31]p. incl. diagrs. (Rept. no. R-187) (AFOSR-64-0313) (DA 36-039-AMC-02208(E)) AD 429416 Unclassified

Given the time domain specification for any (or any two) of the networks--the source network, the matching network, and the load network--specify the remaining network(S) so that the maximum total energy is transferred from the source to the load for arbitrary source voltages. This problem can be solved (i.e., the matching network can be specified, its realizability being an open question) in general by means of the classical calculus of variations, which yields time domain specifications for the unknown network and simple conditions which show the limitations on the applicability of the results. The further question of when the specified matching networks can actually be realized (or to what extent they can be approximated) is included.

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Illinois U. Coordinated Science Lab., Urbana.

AUTOMATA AND SEQUENTIAL MACHINES, A SURVEY, by H. Y. Chang. June 1963 [42]p. incl. diagrs. tables, refs. (Rept. no. R-168) (AFOSR-64-0347) (DA 36-039-AMC-02208(E)) AD 420855 Unclassified

A brief study of the application of concepts of automata theory to analysis and synthesis of sequential machines has been made. The investigation was taken from an engineer's viewpoint and was by no means complete. After defining models of sequential machines, two ways of characterizing a machine, namely, the input-output signal set (or regular expression) method and the computer program method, were indicated. The discussion on analysis of machines was concentrated on experiment-performing, a way to examine a machine's structure by merely applying inputs and observing output's and machine decompositions. Lastly, some of the results and difficulties related to state-reduction and state-assignment in machine synthesis procedures were mentioned.

1022

Illinois U. Coordinated Science Lab., Urbana.

AN ALGORITHM FOR THE SYNTHESIS OF LARGE SEQUENTIAL SWITCHING CIRCUITS, by J. Elsey. May 1963 [53]p. incl. diagrs. tables, refs. (Rept. no. R-169) (AFOSR-64-0599) (DA 36-039-AMC-02208(E)) AD 18163 Unclassified

This thesis develops and presents an algorithm for synthesizing asynchronous sequential switching circuits. The algorithm has certain properties which make it useful and applicable to large switching circuits such as the control unit of a digital computer. The steps in the algorithm are systematic and simple permitting a solution to be obtained in a relatively short amount of time. The resulting design is not optimum in that the circuit has the minimum number of states or minimum amount of logic.

1023

Illinois U. Coordinated Science Lab., Urbana.

OF DIRECT FIXED-TIME OPTIMIZATION OF INVERTIBLE SYSTEMS, by S. J. Kahne. June 1963, 65p. incl. diagrs. refs. (Rept. no. R-162) (AFOSR-64-0600) (DA 36-039-AMC-02208(E)) Unclassified

A numerical technique for calculating the optimal control for a class of systems and constraints is described. Nonlinear, time-varying deterministic systems subject to hard state space and hard control space constraints are considered. Three numerical procedures are developed to perform the optimization. A technique for the minimization of a scalar function of a vector variable is described where the components of the vector are constrained by upper and lower bounds. This minimization procedure is incorporated in a method of constraint mapping which maps the state space constraints into the control space. An iterative technique for the optimization is demonstrated which generally converges to a local minimum of the performance index.

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Illinois U. Coordinated Science Lab., Urbana.

NUMERICAL STUDIES OF STRONG SHOCK WAVES. PART IV: DESCRIPTION OF 1604 PROGRAM, by J. K. Aggarwal and B. L. Hicks. Aug. 1963 [23]p. incl. diagrs. (Rept. no. 1-123) (AFOSR-64-0601) (DA 36-039-AMC-02208(E)) Unclassified

The details of the program for CDC 1604 used to study Boltzmann difference equation for a strong shock wave are described. The main flow diagrams are shown. The salient differences from the ILLIAC counterpart are pointed out. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

AN OPTIMIZATION TECHNIQUE FOR PULSE WIDTH MODULATED SYSTEMS, by R. W. Kafka. May 1963, 92p. incl. diagrs. tables, refs. (Rept. no. R-163) (AFOSR-64-0607) (DA 36-039-AMC-02208(E)) Unclassified

A procedure for the design of a controller to optimize a certain class of pulse width modulated systems is presented. The process to be controlled is time-invariant, of arbitrary order and excited by a sequence of pulses generated from information available at arbitrary sampling instants. Input information to the system is quite general and includes random and deterministic phenomena. Identification of the plant is accomplished using state variable notation and linear estimation techniques. Prediction of the future plant behavior is also performed with these techniques and the controller is designed to optimize the predicted plant performance by minimizing a measure of the future system errors. The mechanized optimal control law or controller program, develops the pulse to be applied at any sampling instant by specifying the pulse width and associated sign.

1026

Illinois U. Coordinated Science Lab., Urbana.

SYNTHESIS OF SOME DISTRIBUTED RC NETWORKS, by C. A. Hesselberth. Aug. 1963 [84]p. incl. illus. diagrs. refs. (Rept. no. R-164) (AFOSR-64-0608) (DA 36-039-AMC-02208(E)) AD 418171 Unclassified

A certain distributed RC structure can be used to obtain rational open-circuit transfer impedances. In addition, one of the driving-point impedances turns out to be rational. Hence, one of the open-circuit voltage transfer functions is also rational. Furthermore, by

considering various subcircuits and distributions of resistance and capacitance it is possible to realize other rational open-circuit voltage transfer functions and rational short-circuit transfer admittances. Connecting these networks in series extends the class of functions realizable with such structures. Using a basic distributed RC network along with an external resistor and capacitor, it is possible to obtain a null in the open-circuit voltage transfer function over a certain restricted range of frequencies. However, the shape of the notch is shown graphically to be a function of the null frequency. A lossy dielectric in the distributed network is found to shift this range of frequencies upwards and alter the notch characteristics in much the same way as in the low-pass filter.

1027

Illinois U. Coordinated Science Lab., Urbana.

A NEW APPROACH TO THE SENSITIVITY PROBLEM IN MULTIVARIABLE FEEDBACK SYSTEM DESIGN, by J. B. Cruz, Jr. and W. R. Perkins. Aug. 1963 [13]p. incl. diagrs. refs. (Rept. no. R-177) (AFOSR-64-0609) (DA 36-039-AMC-02208(E)) AD 418175 Unclassified

A new point of view for the parameter variation problem in linear multivariable systems is proposed. The output deviations due to parameter variations for an open loop realization are related by a sensitivity matrix to the output deviations due to parameter variations for a closed loop (feedback) realization. By means of a performance index involving this sensitivity matrix, conditions are obtained for insuring that the feedback realization is less affected by parameter variations than an open loop realization having the same nominal transfer characteristics. A procedure based on this new sensitivity formulation is given for designing a multivariable feedback system.

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Illinois U. Coordinated Science Lab., Urbana.

DESIGN AND PERFORMANCE OF A POLARITY COINCIDENCE DETECTOR, by M. Raether and D. Bitzer. Aug. 1963 [27]p. incl. diagrs. (Rept. no. R-178) (AFOSR-64-0610) (DA 36-039-AMC-02208(E)) AD 418173 Unclassified

A synchronous detector based on the polarity coincidence principle has been constructed and tested. The theory of operation is discussed with special emphasis on the influence of correlation between samples and the influence of error sources. Details of the construction are presented and test results are discussed.

1029

Illinois U. Coordinated Science Lab., Urbana.

NONLINEAR OSCILLATIONS IN A SECOND ORDER SYSTEM, by P. J. Ponzo. Jan. 1964 [106]p. incl. diagrs. refs. (Rept. no. R-193) (AFOSR-64-0703) (DA 36-039-AMC-02208(E)) AD 433472 Unclassified

Relaxation oscillations are investigated. A number of analytic curves are obtained which serve as upper and lower bounds on solution trajectories in this plane. In many cases, piecewise connection of such bounding curves provide annular regions within which periodic orbits lie. The number, location, stability and amplitude bounds of periodic solutions may be determined in this manner. When the method is applied to the equation of van der Pol, the upper and lower bounds obtained for the amplitude of the unique periodic solutions compare favorably with the known asymptotic expansion of the amplitude.

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Illinois U. Coordinated Science Lab., Urbana.

GENERAL TOPOLOGICAL ANALYSIS OF LINEAR SYSTEMS, by W.-K. Chen. Jan. 1964 [65]p. incl. diagrs. refs. (Rept. no. R-191) (AFOSR-64-0704) (DA 36-039-AMC-02208(E)) AD 433495 Unclassified

The material in this thesis can be divided into two major parts: the first part deals with methods of simplification of flow graphs, and the second part deals with general topological analysis of network determinants. It is shown that a general network determinant can be evaluated by means of directed trees and directed 2-trees. There is no sign problem. The products of such directed trees and directed 2-trees will automatically give the correct signs. Furthermore, this new method can be applied to either the node-admittance matrix or the loop-impedance matrix. Some applications of directed linear graphs, such as determining the stability of a system and inverting matrices, are also discussed. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

LINEAR CONTROL LAWS FOR SINGULAR LINEAR SYSTEMS, by M. Sobral. Jan. 1964 [39]p. incl. diagr. (Rept. no. R-188) (AFOSR-64-0705) (DA 36-039-AMC-02208(E)) AD 433814 Unclassified

For a class of quadrate performance indices the optimal control law is a combination of maximum effort (bang-bang) and singular. The singular control law is linear and it is optimal in a hyperplane in the n-dimensional state-space. For practical purposes it is desirable to restrict the class of admissible control laws to be linear. This investigation presents a method of finding a linear control law which is optimal in the sense that it is the singular control law in the singular surface and the best possible linear law elsewhere. Classical calculus of variations and the more sophisticated maximum principle of Pontryagin are the mathematical tools used.

1032

Illinois U. Coordinated Science Lab., Urbana.

THE USE OF ADAPTIVE CONSTRAINED DESCENT IN SYSTEMS DESIGN, by T. Murata. Dec. 1963 [40]p. incl. diagrs. table. (Rept. no. R-189) (AFOSR-64-0706) (DA 36-039-AMC-02208(E)) AD 433721 Unclassified

This paper describes the application of an iterative method, the adaptive constrained descent, to system design where system parameters are constrained by both upper and lower limits. The method used is essentially a direct search method, not dependent on the use of derivatives or power series approximations. The technique insures convergence and initial guesses can be arbitrarily chosen in some cases. This fact makes it possible to design networks directly from given characteristics using a high-speed digital computer.

1033

Illinois U. Coordinated Science Lab., Urbana.

A MODULAR REALIZATION OF SYMMETRIC SEQUENTIAL MACHINES, by D. W. Rain. Doctoral thesis, Nov. 1963 [38]p. incl. diagrs. refs. (Rept. no. R-183) (AFOSR-64-0707) (DA 36-039-AMC-02208(E)) AD 433821 Unclassified

A class of sequential machines which display certain symmetries in their state diagrams is investigated with emphasis on the cascade-parallel interconnection of elementary, rather than arbitrarily complex, asynchronous sequential machines. It is shown that additional feedback around a (Huffman model) machine may be used to eliminate certain states of the state diagram. This feedback is restricted only in that the delay through the feedback path must be greater than the delay associated with the secondary variables around which the feedback is made. Then it is shown that interconnections of elementary modules yield machines that have symmetric state diagrams, and that feedback may be used to create certain asymmetries.

1034

Illinois U. Coordinated Science Lab., Urbana.

A PLATO PROGRAM FOR INSTRUCTION AND DATA COLLECTION IN MATHEMATICAL PROBLEM SOLVING, by J. A. Easley, Jr., H. M. Gelder, and W. M. Golden. Jan. 1964 [36]p. incl. illus. diagrs. (Rept. no. R-185) (AFOSR-64-0709) (DA 36-039-AMC-02208(E)) AD 434249 Unclassified

Solution of programming problems has been taken in the development of a special teaching logic for the PLATO II computer-based teaching system. This teaching logic, called PROOF, takes advantage of the flexibility and student-controlled sequencing made available in the laboratory or inquiry mode of programming PLATO.

1035

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL LINEAR SWITCHING FOR SINGULAR LINEAR SYSTEMS, by R. A. Rohrer and M. Sobral. Mar. 1964 [28]p. incl. diagrs. refs. (Rept. no. R-196) (AFOSR-64-0891) (DA 36-039-AMC-02208(E)) AD 435680 Unclassified

The bounded-input control of a linear, time-invariant system with quadratic performance index is discussed from the standpoint of simple implementation. In particular the admissible control is constrained to be a linear function of the states fedback through a saturating amplifier. The resulting controlled system not only exhibits the usual maximum-effort mode of operation, but also the terminal singular behavior where linear control is in evidence.

1036

Illinois U. Coordinated Science Lab., Urbana.

OPTIMAL SINGULAR SOLUTION FOR LINEAR, MULTI-INPUT SYSTEMS, by R. A. Rohrer and M. Sobral. Apr. 1964, 21p. (Rept. no. R-199) (AFOSR-64-1114) (DA 36-039-AMC-02208(E)) AD 601177 Unclassified

The optimal singular control for a useful class of systems was obtained. Linear, stationary systems with multiple inputs when subject to performance indices quadratic in the state variables, but explicitly independent of the control variables may be optimally governed by singular control. The means of obtaining the singular behavior and control of derived and an explicit formula for the singular control is provided. (Contractor's abstract)

1037

Illinois U. Coordinated Science Lab., Urbana.

APPLICATION OF LINEAR GRAPHS TO ELECTRICAL NETWORKS, SWITCHING NETWORKS AND COMMUNICATION NETS, by W. Mayeda. Apr. 1964 [149]p. incl. diagrs. refs. (Rept. no. R-203) (AFOSR-64-1116) (DA 36-039-AMC-02208(E)) AD 601197 Unclassified

This paper is divided into three parts: The first part shows how linear graphs are used in analysis of electrical networks. The proof for the topological formulas of transfer functions of passive networks without mutual couplings given here is the first formal and precise proof in this field. By the use of topological formulas, such a passive network can be analyzed by a digital computer. The second part discusses the application of linear graphs to switching networks by starting with exploration of the properties of paths in a linear graph. Then the necessity of realizing a cut set matrix (or circuit matrix) is discussed. The third part discusses a rather new field which is many-ports flow problems which is called the theory of communication nets.

1038

Illinois U. Coordinated Science Lab., Urbana.

SUPPRESSION OF NOISE EFFECTS IN PULSE WIDTH MODULATED SYSTEMS, by H. J. Stein. Jan. 1964 [54]p. incl. diagrs. tables, refs. (Rept. no. R-190) (AFOSR-64-1130) (DA 36-039-AMC-02208(E)) AD 437495 Unclassified

Investigation is made of a sampled data feedback system, consisting of a lead type pulse width modulator, a general (n-th order), linear, time-invariant plant, and unity feedback. The closed loop system is assumed to be stable, and it is assumed that plant time constants are of the order of, or shorter than, the pulsing period. The modulator is assumed to be imperfect (noisy), in that it emits pulses, the durations of which differ from the correct values. The deviation of the pulse width is assumed to be a Gaussian random variable with zero mean and a given standard deviation, and it is assumed that there is no correlation between samples at different sampling instants. Equations are derived which predict the probability distribution of the plant output after any number of sampling instants.

1039

Illinois U. Coordinated Science Lab., Urbana.

HEART RATE CORRELATES OF INSIGHT, by R. A. Avner. Apr. 1964 [42]p. incl. tables, refs. (Rept. no. R-198) (AFOSR-64-1132) (DA 36-039-AMC-02208(E)) AD 600554 Unclassified

The heart rate (HR) was found to be inadequate as an isolated intersubject correlate of mental work. It does not appear that reliable specific patterns will be found as long as respiration effects force use of procedures which cause uncertainty of HR-change identification. A possible answer to this problem would be a recording method by which respiration changes were used to adjust automatically for respiration effects in HR. Between the extremes of threat of physical punishment and what is essentially a vigilance task, there might be other situations in which insight leads to reliable HR patterns. Until effects of respiration on HR are eliminated, the possibility is small of finding reliable patterns more subtle than a large step function.

1040

Illinois U. Coordinated Science Lab., Urbana.

SELF-DIRECTED INQUIRY IN CLINICAL NURSING INSTRUCTION BY MEANS OF THE PLATO SIMULATED LABORATORY, by M. Blitzer. Dec. 1963 [66]p. incl. illus. diagrs. tables. (Rept. no. R-184) (AFOSR-64-1359) (DA 36-039-AMC-02208(E)) AD 437586 Unclassified

A portion of a medical-surgical nursing study unit was programmed for use on the PLATO system. It was presented to a group of student nurses, six students obtaining information by self-directed inquiry in the PLATO simulated laboratory and seven students in the control group attending their regular class with regular instructor. The experimental and control groups did not differ significantly on a pre-test of subject matter knowledge. A comparison of post-test results showed a difference in favor of the PLATO group that was significant at the .09 level.

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Illinois U. Coordinated Science Lab., Urbana.

ELECTRON COLLISIONS IN NEON PLASMA, by C. L. Chen. Apr. 1964 [21]p. incl. diagrs. table, refs. (Rept. no. R-201) (AFOSR-64-1360) (DA 36-039-AMC-02208(E)) AD 439438 Unclassified

The momentum transfer collision frequencies of electrons with neon ions and neutral atoms were measured in a decaying neon plasma over the temperature range from 200 to 600°K. The temperature-density dependence of the electron-ion collision frequency and the energy dependence of the momentum transfer cross sections of electrons with neon atoms was determined.

1042

Illinois U. Coordinated Science Lab., Urbana.

SPIN RELAXATION OF OPTICALLY PUMPED CESIUM, by F. A. Franz. Doctoral thesis, Apr. 1964 [99]p. incl. diagrs. tables, refs. (Rept. no. R-202) (AFOSR-64-1361) (DA 36-039-AMC-02208(E)) AD 439436 Unclassified

Spin relaxation of optically pumped cesium vapor has been measured as a function of buffer gas pressure for various inert gases. Disorientation cross sections have been found to be 5.3×10^{-24} cm^2 for neon, 8.0×10^{-23} cm^2 for argon, 2.1×10^{-21} cm^2 for krypton, and 4.6×10^{-20} cm^2 for xenon. The diffusion coefficients of cesium in neon and argon were found to be 0.40 cm^2/sec and 0.23 cm^2/sec, respectively. Disorientation cross sections and diffusion coefficients have also been determined for molecular nitrogen. The results are $\sigma = 4.7 \times 10^{-23}$ cm^2, $D_o = 0.22$ cm^2/sec for $N_2{}^{14}$; $\sigma = 5.3 \times 10^{-23}$ cm^2, $D_o = 0.20$ cm^2/sec for $N_2{}^{15}$. The agreement of these values with existing theory is discussed. (Contractor's abstract)

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Illinois U. Coordinated Science Lab., Urbana.

DETECTION OF RATE CHANGES IN PERIODIC PHENOMENA, by R. A. Avner. Oct. 1964, 15p. incl. tables. (Rept. no. R-235) (AFOSR-65-0251) (DA 36-039-AMC-02208(E)) AD 609698 Unclassified

The objective of this paper is to show with what probability differences between numbers of observed events within a pair of time intervals may be ascribed to specified changes in rate of a periodic phenomenon.

In the example given above it might be required to say with what probability the observed difference of (25 - 10) = 15 events might be ascribed to an actual rate change of 0, 5, 10, 12, etc., events per interval. Such measures are valid for the class of phenomena, such as human heart rate, for which magnitude of rate change is relatively unrelated to base rate.

1044

Illinois U. Coordinated Science Lab., Urbana.

DYNAMIC STABILITY OF THE RESONANT CIRCUIT ELECTRICALLY SUPPORTED GYRO, by D. R. Allen. Aug. 1963 [46]p. incl. diagrs. (Rept. no. R-166) (AFOSR-5494) (DA 36-039-sc-85122) AD 427032 Unclassified

The electrically supported gyro is a free, two-axis gyro which employs a spherical metal rotor, shielded from stray magnetic fields and supported without physical contact in ultra-high vacuum by servo-controlled high-voltage electric fields. The rotor is initially accelerated by induction motor techniques but spins freely with virtually no friction during gyro operation. An analysis is made of the static and dynamic properties of a unique rotor support servo called the resonant-support servo. Because the resonant-support servo is dynamically unstable, three general methods of stabilizing the servo are described and analyzed.

1045

Illinois U. [Dept. of Chemistry] Urbana.

A STUDY OF METAL ALKYLS, by T. L. Brown. Final rept. Mar. 1, 1963 4p. (AFOSR-4621) (AF 49(638)466) AD 454654 Unclassified

The research described in this final report has been concerned principally with the properties of so-called electron-deficient metal alkyls. These compounds are characterized by unusual molecular structures, in which certain elements exhibit bonding to neighbor atoms in greater number than the number of electrons originally available for bonding. One therefore speaks of multi-center bonds, in which a single electron pair serves to bond more than two nuclear centers. Attention has been concentrated upon organolithium compounds, with some work being done on two other organometal systems of interest.

1046

Illinois U. Dept. of Chemistry, Urbana.

A SHOCK TUBE WITH QUADRUPOLE MASS FILTER FOR MONITORING HIGH-TEMPERATURE REACTION KINETICS, by D. Gutman, A. J. Hay, and R. L. Belford. Interim rept. Jan. 1, 1962-Sept. 1, 1964, 46p. incl. illus. diagrs. (Research rept. no. 1) (AFOSR-64-2410) (AF AFOSR-62-245 and AF AFOSR-64-588) AD 609775 Unclassified

During the term of these grants, all the equipment necessary to study fast chemical reactions with a shock tube and mass spectrometer were built. All the separate components were assembled, tested and in most cases modified to improve performance. Preliminary test results were obtained in the form of ion current-vs -time curves for shocked pure argon and for dilute N_2 in Ar. A preliminary test of the N_2O dissociation reaction was performed. Several new ideas in shock tube instrumentation were developed and are discussed in Section 2. The shock studies in the nonreacting systems were conducted to calibrate the system and also to determine the limits of sensitivity and range of applicability of this method of studying reactions. Some of the early results are discussed in Section 3. Some observations based on the work to date and plans for continuation are discussed briefly in section 4.

1047

Illinois U. [Dept. of Mathematics] Urbana.

SOME IMPLICATIONS OF THE GENERALIZED GAUSS-BONNET THEOREM, by R. L. Bishop and S. I. Goldberg. [1964] [28]p. (AFOSR-4817) (AF AFOSR-62-129) AD 453835 Unclassified

Also published in Trans. Amer. Math. Soc., v. 112: 508-535, Sept. 1964.

One of the most significant aspects of differential geometry is that which deals with the relationship between the curvature properties of a Riemannian manifold M and its topological structure. One of the results in this connection is the (generalized) Gauss-Bonnet theorem which relates the curvature of compact and oriented even-dimensional manifolds with an important topological invariant, viz., the Euler-Poincare characteristic. In the 2-dimensional case, the sign of the Gaussian curvature determines the sign of the characteristic. Moreover, if the Gaussian curvature vanishes identically, so does the characteristic. In higher dimensions, the Gauss-Bonnet formula is not so simple; this aspect is discussed.

1048

Illinois U. [Dept. of Mathematics] Urbana.

ON THE TOPOLOGY OF POSITIVELY CURVED KAEHLER MANIFOLDS, by R. L. Bishop and S. I. Goldberg. [1963] [6]p. (AFOSR-64-1617) (AF AFOSR-62-129) AD 446886 Unclassified

Also published in Tohoku Math. Jour., v. 15: 359-364, Dec. 1963.

Theorem: A complete holomorphically pinching Kaehler manifold with holomorphic pinching >11/13 has the homotopy type of complex projective space. It is the purpose of this paper to improve the bounds thereby resulting in a corresponding improvement of the constant 11/13 in the above theorem. In fact, it is shown that the bounds obtained are the best possible that can be derived by considering only the algebra of the curvature tensor (at one point). The main result is the following: A complete holomorphically pinched

Kaehler manifold with holomorphic pinching >4/5 has the homotopy type of complex projective space.

1049

Illinois U. [Dept. of Mathematics] Urbana.

A COMPLEX-VARIABLES PROOF OF HÖLDER'S INEQUALITY, by L. A. Rubel. [1964] [1]p. (AFOSR-65-1409) (AF AFOSR-63-460) AD 622638 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 999, Dec. 1964.

A complex-variables proof is presented for Hölder's inequality which states that if $f, g \geq 0$, if $p > 1$, and if $1/p + 1/q = 1$, then $\int fg \leq \{\int f^p\}^{1/p} \{\int g^q\}^{1/q}$. Replacing f^p by f and g^q by g, and writing $1/q = s$, it is proved that $\phi(s) \leq 1$ for $0 < s < 1$, where $\phi(s) = \int f^{1-s} g^s / \{\int f\}^{1-s} \{\int g\}^s$. Proof involves the maximum modulus principle.

1050

Illinois U. [Dept. of Mathematics] Urbana.

BOUNDED APPROXIMATION BY POLYNOMIALS, by L. A. Rubel and A. L. Shields. [1964] [18]p. incl. diagrs. (AFOSR-65-1410) (AF AFOSR-63-460) AD 621641 Unclassified

Also published in Acta Math., v. 112: 145-162, Dec. 2, 1964.

For an arbitrary bounded open set G in the complex plane, consideration is given to the problem of which functions in G can be obtained as the bounded pointwise limits of polynomials in G. Roughly the answer is that a function is such a limit if and only if it has a bounded analytic continuation throughout a certain bounded open set G* that contains G. The major portion of the paper is spent in establishing the following theorem: Let G be a bounded open set in the plane and let f be a bounded analytic function in G. If there is a function F, analytic in G* and agreeing with f in G, with $|F(z)| \leq M$ in G*, then there is a sequence of polynomials $\{p_n\}$ such that (1) $\lim p_n(z) = F(z)$ $(z \in G^*)$ (2) $|p_n(z)| \leq M$ $(z \in G^*; n = 1, 2, \ldots)$. Conversely, if there is a sequence of polynomials converging to f at each point of G, and uniformly bounded in G, then there is a bounded analytic function F in G* that agrees with f in G.

1051

Illinois U. [Dept. of Mathematics] Urbana.

BOUNDED APPROXIMATION BY POLYNOMIALS, by L. A. Rubel and A. L. Shields. [1963] [3]p. (AFOSR-65-1413) (AF AFOSR-63-460) AD 621259 Unclassified

Also published in Bull. Amer. Math. Soc., v. 69: 591-593, July 1963.

For an arbitrary bounded open set in the complex plane, the problem is considered of which complex-valued functions in the set can be obtained as the bounded pointwise limits of a sequence of polynomials. The following theorem is presented: Given an arbitrary bounded open set G in the complex plane, and a complex-valued function f defined on G. There exists a sequence $\{p_n\}$ of polynomials that are uniformly bounded on G and that converge pointwise on G to f and only if f has an extension F that is bounded and holomorphic on G*, where G* is the inside of the outer boundary of G. Since the proof for the general case is long and complicated, only the proof for the special case when G is connected is presented.

1052

Illinois U. [Dept. of Mathematics] Urbana.

ON SEPARATION BY HARMONIC FUNCTIONS, by L. A. Rubel. [1963] [6]p. (AFOSR-65-2599) (AF AFOSR-63-460) AD 627946 Unclassified

Also published in Acta Math., v. 15: 175-176, 1964.

The paper concerns the following question which was posed to many mathematicians, among them some experts in potential theory: For which values of n is the following statement true. If f is a superharmonic function on Euclidean space E (n), h a subharmonic function there, and $f \leq h$ everywhere, then there exists a harmonic function g such that $f \leq g \leq h$ everywhere. The answer is that the statement holds only for n = 1, where it becomes the familiar assertion that a concave function f that lies below a convex function h may be separated from h by a linear function g.

1053

Illinois U. Dept. of Mathematics, Urbana.

TAUBERIAN THEOREMS FOR SUM SETS, by P. Erdos, B. Gordon and others. [1963] [13]p. (AFOSR-65-2640) (AF AFOSR-63-460) AD 627948 Unclassified

Also published in Acta Arith., v. 9: 177-189, 1964.

The sums formed from the set of non-negative powers of 2 are just the non-negative integers. It is easy to obtain "abelian" results to the effect that if a set is distributed like the powers of 2, then the sum set will be distributed like the non-negative integers. This paper is concerned with converse, or "Tauberian" results. The main theme is the following question: if the set of sums formed from a given set of positive real numbers resembles an arithmetic progression, how much must the original set resemble a set of constant multiples of powers of 2?

1054

Illinois U. [Dept. of Mining, Metallurgical and Petroleum Engineering] Urbana.

DISLOCATION DAMPING IN SEMICONDUCTORS AND ABRUPT VERSUS SMOOTH KINKS, by T. Ninomiya, R. Thomson, and F. Garcia-Moliner. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0797) (AF AFOSR-62-179) AD 616633 Unclassified

Also published in Jour. Appl. Phys., v. 35: 3607-3613, Dec. 1964.

A previous dragging point model of disiocation mobility is modified and applied to the dislocation damping data in Si and Ge. The motion of built-in kinks along a dislocation is considered to be responsible for the damping. In contrast to the abrupt kink model, the free motion of the kinks is impeded by the dragging points. The predictions of this model are compared with those made on the basis of the abrupt kink model, with regard to (a) damping, (b) estimated kink width, and (c) dislocation mobility. The dragging-point model seems to give a more consistent picture, although direct experimental verification of the presence of dragging points is not yet available. An improved table of derived parameters for the dragging-point theory of disiocation mobility is given based on additional information from damping measurements in Ge.

1055

Illinois U. Dept. of Mining, Metallurgical and Petroleum Engineering, Urbana.

DIFFUSION OF OXYGEN AND NITROGEN BETWEEN SPECIAL INTERSTITIAL SITES IN SOLID SOLUTION IN YTTERBIUM, by G. Mah and C. Wert. [1964] [4]p. incl. diagrs. (AFOSR-64-0443) (AF AFOSR-62-192) AD 436175 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 230: 16-19, Feb. 1964.

Internal-friction peaks caused by diffusion of oxygen and nitrogen have been observed in ytterbium. They are thought to be caused by the redistribution, under stress, of strain dipole around an interstitial oxygen or nitrogen and a neighboring substitutional impurity. With the use of a simple geometrical model, diffusion coefficients for oxygen and nitrogen between special interstitial sites have been calculated.

1056

Illinois U. [Dept. of Mining, Metallurgical and Petroleum Engineering] Urbana.

DIFFUSION OF GASES IN SPECIAL INTERSTITIAL SITES IN HAFNIUM, by E. Bisogni, G. Mah, and C. Wert. [1964] [6]p. (AFOSR-64-2447) (AF AFOSR-62-192) AD 453615 Unclassified

Also published in Jour. Less Common Metals, v. 7: 197-204, 1964.

Both nitrogen and oxygen have been found to cause internal friction peaks to appear in reactor-grade Hf. The mechanism of the peak is discussed in terms of redistribution of strain dipoles formed by the interstitial impurity atoms with the substitutional impurity atoms. The diffusion coefficients were calculated from a simple two position model.

1057

Illinois U. Dept. of Mining, Metallurgical and Petroleum Engineering, Urbana.

HIGH TEMPERATURE NUCLEAR MAGNETIC RESONANCE PROBE, by R. L. Odie and C. P. Flynn. [1964] [2]p. incl. diagrs. (AFOSR-65-0796) (AF AFOSR-62-192) AD 616208 Unclassified

Also published in Rev. Scient. Instr., v. 35: 1611-1612, Nov. 1964.

An r-f probe was developed which is simple, rugged, and capable of operating at a considerably high temperature, i.e., 1300°C. The probe assembly consists of 2 basic parts: (1) a ceramic coil former, which contains the sample chamber and (2) a stainless steel shield enclosing the coil former. A thermocouple passes through a hole in the shield and into the coil former, thereby allowing the specimen temperature to be monitored during an experiment.

1056

Illinois U. [Dept. of Physics] Urbana.

RADIOTRACER STUDIES OF GOLD ADSORPTION AND DESORPTION ON CLEAN MOLYBDENUM SURFACES, by E. von Goeler and E. Lüscher. [1963] [5]p. incl. diagrs. table. (AFOSR-J1555) (AF 16(603)49) AD 427403 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1217-1221, 1963.

The adsorption and desorption of gold on heat-cleaned surfaces of polycrystalline molybdenum was studied at a residual gas pressure of 2×10^{-9} torr. A radiotracer method was used in a differential pumping system. The sticking coefficient was measured to be $s = 0.99 \pm 0.01$ at beam densities up to 10^{11} particles/cm^2 sec. The desorption probability per unit time was found to obey a relation $w = w_0 \exp(-E/kT)$ with $w_0 = 2 \cdot 10^{13}$ sec^{-1} and $E = 4.2 \pm 0.2$ ev. (Contractor's abstract)

1059

Illinois U. [Dept. of Physics] Urbana.

MAGNETOCONDUCTIVITY AND POLAR SCATTERING IN MODERATELY IONIC CRYSTALS, by F. Garcia-Moliner. [1963] [12]p. (AFOSR-J1101) (AF 49(636)-526) AD 420773 Unclassified

Also published in Phys. Rev., v. 130: 2290-2301, June 15, 1963.

The dc transport problem in a polar crystal, in the range of optical mode scattering, is studied within a weak-coupling model for the electron-phonon interaction. A full variational calculation is performed in the presence of a magnetic field and carried out to high accuracy on a digital computer. It is stressed that the physical effects should be discussed in 'magnetoconductivity,' rather than conventional 'magnetoresistivity' terms, corresponding to the type of experimental arrangement frequently used for these materials. The model, which is, in principle, restricted to a small coupling constant ($\alpha \ll 1$), has some interesting dispersive properties and is used as a working tool for an over-all picture of the transport problem in its full complexity, when a magnetic field is present.

1060

Illinois U. Dept. of Physics, Urbana.

HIGH-TEMPERATURE DIELECTRIC CONSTANT OF POTASSIUM CHLORIDE, by P. V. Sastry and T. M. Srinivasan. [1963] [5]p. incl. diagrs. refs. (AFOSR-64-0751) (AF 49(638)529) AD 436492 Unclassified

Also published in Phys. Rev., v. 132: 2445-2449, Dec. 15, 1963.

A dispersion of the dielectric constant of zone-purified potassium chloride has been observed at temperatures above 650°C and in the frequency range between one and ten mc/sec. The data are interpreted in terms of the Debye equations and the assumption that the dipoles are vacancy pairs. The activation energy for reorientation of a vacancy pair is found to be 1.04 ev and the heat of formation of a vacancy pair is found to be 1.34 ev. These quantities have been calculated by Tharmalingam and Lidlard as 1.15 and 1.28 ev, respectively. The dielectric data yield an absolute number of vacancy pairs that is at least a factor of ten larger than is acceptable.

1061

Illinois U. [Dept. of Physics] Urbana.

Z_2 AND Z_3 COLOR CENTERS IN KCl AND KBr, by H. Ohkura. [1964] [6]p. (AFOSR-64-2526) (AF 49-(638)529) AD 453826 Unclassified

Also published in Phys. Rev., v. 136: A446-A451, Oct. 19, 1964.

The optical and electron-spin-resonance properties of potassium-chloride and -bromide crystals which contain divalent strontium ions have been examined. The conversion of the Z_2 optical absorption band into the Z_3 band has been studied and two new absorption bands have been discovered. One of these bands, the S band, appears to be due to optical transitions to excited states of the Z_2 center which lie above the excited state responsible for the Z_2 band. The second band, the Z_3 band, is interpreted as an exciton absorption band associated with the Z_3 center.

1062

Illinois U. Dept. of Physics, Urbana.

SOLID STATE AND NUCLEAR RESULTS FROM MÖSSBAUER STUDIES WITH I^{129}, by D. W. Hafemeister, G. DePasquali, and H. deWaard. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-65-0772) (AF 49(638)1048) AD 616037 Unclassified

Also published in Phys. Rev., v. 135: B1089-B1101, Sept. 7, 1964.

In this note the Mössbauer effect of the 26.8-kev transition in I^{129} is studied in a number of iodine compounds with the following results: The isomeric shifts for the alkali iodides are found to be linearly dependent on the number of 5p holes in the iodine ion. From this discrepancy, a calibration of the isomeric shift scale in terms of the 5s-electron density is obtained, and from this calibration a relative change of nuclear radius is computed. The isomeric shifts for some iodates indicate that their 5s-electron density has increased 18% over that of iodides, which is caused by the partial removal of 5p electrons from iodine in the I-O bonds resulting in reduced screening of the 5s electrons. The quadrupole splitting of KIO_3 was used to determine the I^{129} quadrupole ratio, $Q_{26.8}/Q_{gnd} = 1.23 \pm 0.02$, and the recoilless fraction f was found to deviate from 0.26 by less than 25% for all alkali iodides at 80°K.

1063

Illinois U. Dept. of Physics, Urbana.

LIFETIME OF THE EXCITED F_A CENTER, by G. Spinolo and F. C. Brown. [1964] [5]p. incl. diagrs. table, refs. (AFOSR-64-2390) (AF AFOSR-62-215) AD 453615 Unclassified

Also published in Phys. Rev., v. 135: A450-A454, July 20, 1964.

Recent experimental results show that the radiative lifetime of the F center is as long as 0.58 μsec in KCl and 1.1 μsec in KBr. Similar pulsed luminescence and photoconductivity measurements are reported on the F_A center in KCl and KBr.

1064

Illinois U. Dept. of Physics, Urbana.

ELECTRON HALL MOBILITY IN THE ALKALI HALIDES, by R. K. Ahrenkiel and F. C. Brown. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0800) (AF AFOSR-62-215) AD 616210 Unclassified

Also published in Phys. Rev., v. 136: A223-A231, Oct. 5, 1964.

New results are presented on the mobility of electrons in alkali-halide crystals down to the temperature of liquid helium. An improved technique was used to observe the transient Hall effect for electrons released from color centers by light. Optical-mode scattering with mobility dependent upon exp (Θ/T) was generally observed above 40°K. The Debye temperature Θ can be compared with the optical-mode frequency of the material, whereas the magnitude of the scattering can be used to estimate band and polaron mass parameters. Mobilities as high as 15,000 cm^2/v-sec, depending upon F-center density, were observed for lightly colored crystals of KBr at 7°K. Similar high mobilities were found for KI and a sample of zone-refined KCl, but the largest mobility observed in NaCl was 1200 cm^2/v-sec. The low-temperature mobility in KBr could be reduced an order of magnitude by optically converting F centers to F' and α centers. The original mobility could then be restored by illumination in the F' band at low temperature.

1065

Illinois U. [Dept. of Physics] Urbana.

A NEW CATALOGUE OF EARTHQUAKE FAULT PLANE SOLUTIONS, by H. D. Fara. [1964] [27]p. (AF AFOSR-62-419) AD 451385 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1491-1517, Oct. 1964.

The earthquake fault plane solutions available to spring, 1964 in the literature are listed in standard form.

1066

Illinois U. [Dept. of Physics] Urbana.

ON THE POSSIBILITY OF THE SEISMIC DETECTION OF EXPLOSIONS FROM THE SIGNS OF FIRST ONSETS, by A. E. Scheidegger. [1964] [7]p. (AF AFOSR-62-419) AD 451386 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1529-1535, Oct. 1964.

It is shown that, for an earthquake region, critical areas can be derived, inside which one would expect seismic stations to observe a dilatation in the first onsets. Thus, if compressions are observed inside the critical area, one has grounds for the assumption that the earthquake was an explosion. As an example, critical areas are calculated for Turkmenia and the Tien Shan region.

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Illinois U. [Dept. of Physics] Urbana.

A SPECIALIZED TYPE OF SEISMIC RESEARCH, by A. E. Scheidegger. Final rept. Sept. 1, 1962-Dec. 1, 1964, 40p. (AF AFOSR-62-419) AD 608466 Unclassified

The aim of the research project was to investigate the relation of the mechanism of natural seismic foci to the prevailing tectonic stress field in an area. After the determination of this relation, a criterion for distinguishing natural seismic shocks from explosions was to be established. The stages of the investigations were the following: (1) The possible theoretical relationships between focal mechanisms and tectonic stresses were analyzed, (2) The data of focal mechanisms ('fault plane solutions') available in the literature were collected and tabulated in a uniform fashion, (3) The best statistical means for averaging the various parameters of fault plane solutions of earthquakes were developed, (4) The statistical connection between focal mechanisms and the tectonic stress field was established, and (5) A criterion for distinguishing seismic from artificial shocks was proposed.

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Illinois U. [Dept. of Physics] Urbana.

THE TECTONIC STRESS AND TECTONIC MOTION DIRECTION IN EUROPE AND WESTERN ASIA AS CALCULATED FROM EARTHQUAKE FAULT PLANE SOLUTIONS, by A. E. Scheidegger. [1964] [10]p. (AF AFOSR-62-419) AD 451390 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 1519-1528, Oct. 1964.

The statistics of fault plane solutions of earthquakes is further analyzed and it is shown that, to find a best axis or best plane to a set of axes, the eigenvectors of a certain matrix must be calculated. The justification for this procedure follows from the same argument as that of Fisher who showed that the best of a series of directions is obtained by forming the vector sum. The eigenvector technique is then applied to the pertinent axes of fault plane solutions of earthquakes that occurred in Europe and Western Asia. It is shown that, in this region, the local mechanisms of the earthquakes tend to orient themselves in such a fashion that the P axes coincide with the principal horizontal stress directions, the latter being normal to the geographically prominent features.

1069

Illinois U. Dept. of Physics, Urbana.

NON-OHMIC TRANSPORT IN SEMICONDUCTORS IN A MAGNETIC FIELD, by D. Matz and F. Garcia-Moliner. [1964] [15]p. (AFOSR-64-1782) (AF AFOSR-63-326) AD 449074 Unclassified

Also published in Phys. Stat. Solidi, v. 5: 495-509, 1964.

Shockley's hot electron picture for semiconductors in high electric fields is extended to include arbitrary (though "non-quantizing") magnetic fields. The effects

are then more diversified and offer wider experimental possibilities. While preserving the original simplicity of Shockley's model, its scope can be extended by including a reduction of the power input due to the deflection caused by the Lorentz force. Explicit calculations are carried out for an idealized isotropic model which Conwell used to interpret the experimental data for n-Ge in zero magnetic field. This involves interactions of electrons with acoustic and covalent optical modes. This model calculation is designed to illustrate the main physical features of an extended Shockley picture. The results here derived are discussed from the point of view of the planning and analysis of experimental investigations which may bear on the subject.

1070

Illinois U. Dept. of Physics, Urbana.

WARM-CARRIER RESISTIVITY IN IMPURE N-InSb IN A MAGNETIC FIELD, by D. Matz and F. Garcia-Moliner. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-0161) (AF AFOSR-63-326) AD 611621 Unclassified

Also published in Phys. Stat. Sol., v. 7: 205-222, 1964.

The influence of a transverse magnetic field on the warm carrier behavior of the conductivity and resistivity is studied for different scattering mechanisms. An electron temperature model of the Shockley type is used throughout. For a calculation of the conductivity, the coefficient Beta of the quadratic deviation from Ohm's law vanishes in high magnetic fields. For a calculation of the resistivity it saturates to a constant value (not including quantization). Only for polar optical scattering at low temperatures the saturation value has opposite sign to that of Beta in a low magnetic field. The theory is applied to some resistivity measurements in impure n-InSb at 77°K. It is concluded that these can be essentially explained by a combination of polar optical scattering and ionized impurity scattering.

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Illinois U. [Dept. of Psychology] Urbana.

INTERACTION PROCESS AND TASK OUTCOME IN EXPERIMENTALLY-CREATED NEGOTIATION GROUPS, by J. E. McGrath and J. W. Julian. [1963] [22]p. incl. refs. (AFOSR-65-2174) (AF AFOSR-63-69) AD 625568 Unclassified

Also published in Jour. Psychol. Studies, v. 14: 117-138, 1963.

Data were obtained from 60 experimentally-created, four-person negotiation groups. Each consisted of one representative from each of three campus religious foundations plus a graduate student who served as non-partisan chairman. Each negotiation group was required to develop unanimous agreement on its proposed solution to a socio-political topic on which the foundations held sharply constrasting views. The study focused on analyses of the negotiation process and investigation of relationships between the negotiation process and measures of negotiation effectiveness.

1072

Illinois U. [Dept. of Psychology] Urbana.

MEDIATION AND FORGETTING, by J. A. Adams. [1964] [10]p. (AFOSR-64-1162) (AF AFOSR-63-135) AD 442845 Unclassified

Also published in Psychol. Repts., v. 14: 591-600, 1964.

An experiment was performed to test the hypothesis that the presence of mediation reduces verbal forgetting. During original learning experimental groups acquired two classes of multiple mediators that intervened between the stimulus and response members of a paired-associate list (A-C). An AB-BC-AC paradigm was used for experimental groups. Control groups did not have the mediators and simply learned the A-C list. All groups recalled the A-C list after either three or seven days. There were 20 Ss in each group. Experimental groups were not found superior to control groups in recall, as hypothesized. One type of mediation actually produced retention inferior to that of control groups.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

ELECTRICAL CONDUCTIVITY OF POTASSIUM CHLORIDE, by L. Y. Wei. [1963] [5]p. (AFOSR-64-2098) (AF 49(638)417) AD 451344 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2709-2713, Nov. 1963.

Potassium was evaporated onto a KCl crystal at 77°K under a vacuum of 10^{-9} Torr. Conductivity measurements were made before and after the film was annealed at room temperature. For the stable film, Ohm's law is obeyed up to about 25 v/cm. The preannealed film became very unstable in a field near 250 v/cm and the current-voltage relation is nonlinear. The experimental results strongly suggest that in the stable film, the conduction is by the mechanism of impurity conduction subject to the Schottky effect while in the unsettled film, the currents, though mainly carried by electrons, are decisively controlled by mobile ions.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

A MICROWAVE FREQUENCY DYNAMIC CROSSED-FIELD PHOTOMULTIPLIER, by O. L. Gaddy and D. F. Holshouser. [1963] [10]p. incl. illus. diagrs. refs. (AFOSR-J371) (AF AFOSR-62-250) AD 407328 Unclassified

Also published in Proc. IEEE, v. 51: 153-162, Jan. 1963.

A new type dynamic secondary emission electron multiplication system is described which possesses the advantages of electrostatic electron multipliers while overcoming their major disadvantage, i.e., loss of gain at high frequencies due to electron transit time dispersion. In the dynamic crossed-field electron multiplication system, electrons are multiplied in a field configuration consisting of a high-frequency electric field and a crossed steady magnetic field near a single secondary emitting electrode. The analysis of the system is presented, and an experimental photomultiplier device is described which utilizes this principle.

1075

Illinois U. [Electrical Engineering Research Lab.] Urbana.

AN INTERNALLY REFLECTING OPTICAL RESONATOR WITH CONFOCAL PROPERTIES, by D. F. Holshouser. [1963] [6]p. incl. illus. diagrs. (AFOSR-65-0436) (AF AFOSR-62-250) AD 612316 Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 1453-1456, 1964.

A confocal system is defined as an optical resonator using spherical mirrors; advantages of the confocal system over the planar mirror are that the diffraction losses for the former can be much lower and its alignment is less critical. The confocal resonator has the following basic properties: (1) a ray leaving one mirror at the axis is reflected back to that point by the opposing mirror after a single reflection; (2) a ray parallel to the axis leaves one mirror and returns to that point after three reflections; and (3) the path length for a complete transit of any ray leaving the axis at one mirror is independent of the ray angle. A configuration for such a confocal resonator is derived mathematically; with it confocal properties may be obtained without reflecting coatings. A semi-confocal optical maser was fabricated from a 50-mm-long, 6-mm-diameter cylindrical rod with one ground end and one coated to give a few percent transmission. The material was Schott barium crown glass doped with neodymium. Stimulated emission was obtained, and threshold input energy at room temperature was less than for a planar ruby of the same dimensions.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

MICROWAVE AND ELECTRO-OPTICAL PROPERTIES OF CARBON DISULFIDE, by O. L. Gaddy, D. F. Holshouser, and R. E. Stanfield. [1964] [6]p. incl. illus. diagrs. (AFOSR-65-0439) (AF AFOSR-62-250) AD 612314 Unclassified

Also published in Proc. Third Internat'l. Cong. on Quantum Electronics, Paris (France) (Feb. 11-15, 1963), v. 2: 1679-1686, 1964.

Carbon disulfide is an excellent microwave dielectric, whose Kerr constant and breakdown can be enhanced by cooling. The microwave power required in a parallel-plane travelling wave Kerr cell is limited at 3 Gc by the conductor losses rather than by the dielectric losses. On the basis of the calculations and experimental results, it appears that a Kerr cell no longer than one meter could provide continuous and complete light modulation with microwave power less than 25 watts. Carbon disulfide has three rather obvious advantages over solid-state materials in that it is much easier to pour liquid out of a bottle than to grow a nearly perfect crystal, and the nonuniform birefringence produced by dielectric loss induced temperature gradients is less of a problem with a liquid.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

PHOTOMULTIPLICATION WITH MICROWAVE RESPONSE, by O. L. Gaddy and D. F. Holshouser. [1964] [6]p. incl. illus. diagr. (AFOSR-65-0440) (AF AFOSR-62-250) AD 612315 Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 1717-1722, 1964.

In this paper, some recent results of an investigation of a new kind of photomultiplier which is capable of microwave response are presented. In this method of amplification, called dynamic crossed-field electron multiplication (DCFEM), the energy for electron multiplication is obtained from a microwave electric field rather than an electrostatic field, and the multiplication takes place upon a single secondary emitting electrode. This method provides a rigid control of electron transit time through phase focusing thereby making possible a large amplification of weak photoelectron currents varying at microwave rates.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

STIMULATED EMISSION IN THE SUBMILLIMETER REGION, by R. J. Strain and P. D. Coleman. [1963] [21]p. incl. diagrs. (AFOSR-4774) (AF AFOSR-62-267) AD 406391 Unclassified

Presented at Orlando Millimeter and Submillimeter Conf., Jan. 9, 1963.

It is proposed that the exchange coupled pairs of chromium in dark ruby represent a potent system for the realization of a maser in the submillimeter region. The greatest strength of this system is the fact that it may be pumped with broadband light. The feasibility of this system is substantiated by an approximate analysis of

of the white light pumping cycle. The experiment used to observe the transitions is an optical pumping experiment, because scattered light is used as an indicator of microwave activity. It differs from conventional optical pumping in the use of low temperature rather than pumping to establish the initial conditions, and the use of microwave thermal radiation to disturb this condition. Since a cavity is used in the microwave circuit, the resolution is high, and the results indicate the line widths of the submillimeter transitions.

1079

Illinois U. [Electrical Engineering Research Lab.] Urbana.

LOGICAL STRUCTURE OF ENVIRONMENT AND ITS INTERNAL REPRESENTATION, by H. von Foerster. [1963] [12]p. (AFOSR-J1542) (AF AFOSR-63-7) AD 427409 Unclassified

Also published in Proc. Internat'l. Design Conf., Aspen, Colo., 1962, Zeeland, Herman Miller, Inc., 1963.

A discussion is presented of the structure of the optimum environment of man. The analysis is developed in terms of game theory where man is faced with decision-making under insufficient information as to the unpredictable forces of nature. It is concluded that a coalition structure is much stronger than a competitive structure where the "whole is more than the sum of its parts". When the parts are interacting in the form of a superadditive composition, the logical structure of environment is a triple interaction between at least two observers and that which can be communicably observed; and to have order, not chaos, to communicate, there must be certain constraints in the internal structure of the observing systems.

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Illinois U. Electrical Engineering Research Lab., Urbana.

CONSTRAINT ANALYSIS OF MANY-DIMENSIONAL RELATIONS, by W. R. Ashby. May 1964, 16p. incl. diagrs. (Technical rept. no. 2) (AFOSR-64-1367) (AF AFOSR-63-7) AD 604042 Unclassified

As part of an attempt to apply information theory to the internal activities of large systems, a preliminary study was made of the simplifications possible when the data about the linkage between variables was merely whether the linkage was zero or non-zero. The study thus became a study of how to simplify an n-ary relation. The idea is here treated rigorously, and a method is developed for detecting and measuring the degree of essential simplicity. The individual relation is made to generate a sequence of progressively simpler relations; where it comes in the sequence determines and measures its degree of essential simplicity. The method may be useful when one wishes to consider relations (or systems) that, while involving very large numbers of variables, retain some simplicity derived from the sub-relations that formed them.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

COGNITRON THEORY, by R. J. Swallow. June 1964, 243p. incl. diagrs. tables. (AFOSR-65-0582) (AF AFOSR-63-7) AD 614006 Unclassified

The Cognitron is a net of artificial neurons, sensory neurons, and muscles whose properties were chosen with the intent that they conform to a diversified amount of physiological and psychological data. This paper rigorously analyzes the behavior of small nets of its artificial elements in order to indicate some of the similarity between their behavior and human mental behavior. Results indicate that the conditioned reflex-like activity of these small nets is reinforced to a degree dependent on a property of the nets closely resembling one's intuitive idea of the "newness" of the nets' input and internal pulse states. It is suggested that the newness is the rewarding property governing reinforcement in the animal mind and that this reinforcement property generalizes the rewarding and punishing effects of food and pain stimuli, respectively so as to include the rewarding effects of "new" environments. It is also suggested that chain conditioned reflex activity in the animal does not exceed a few steps because the response becomes "old", loses its rewarding effects, and thus prevents any further conditioned reflex activity which involves that particular response.

1082

Illinois U. [Electrical Engineering Research Lab.] Urbana.

ON STRUCTURAL ANALYSIS OF MANY VALUED LOGIC, by H. S. H. Na, H. von Foerster, and G. Gunther. Apr. 1964, 169p. (AFOSR-64-1381) (AF AFOSR-63-6) AD 604045 Unclassified

Traditional logic deals with systems of two binary variables, i.e., each variable being two valued. Boolean system deals with n binary variables. In this paper systems with n variables, each being m valued, are studied. Such systems are divided into three classes: balanced, whenever n = m; under-balanced, whenever m < n; and over-balanced whenever m > n. Some of the structural properties of these systems, e.g., reducibility and decomposability, as well as those of the components (i.e., individual functions), e.g., resolvability are considered. Relations among various (m, n)-systems are partially established.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

A NEW CLASS OF TUNABLE RC NULL NETWORKS, by D. A. Calahan. [1963] 20p. (AFOSR-J460) (AF AFOSR-63-177) AD 406998 Unclassified

Also published in Proc. Midwest Symposium, Wisconsin, May 1963.

The problem of synthesis of a variable-null, grounded lumped element RC network is considered. Necessary and sufficient conditions for realization are discussed, although complete realizability conditions are not derived. An approximation scheme is developed which allows a transmission zero to be varied along the imaginary axis while maintaining a reasonable null characteristic. Measurements on physical models are given.

1084

[Illinois U. Electrical Engineering Research Lab., Urbana]

MILLIMETER WAVE GENERATION BY MULTIPLE QUANTUM CONVERSION (Abstract), by D. P. Akitt and P. D. Coleman. [1964] [2]p. (AFOSR-65-0443) (AF AFOSR-63-272) AD 614092 Unclassified

Presented at Second annual Rev. of Electronics, Illinois U., Urbana, Nov. 17-18, 1964.

During this experiment 1 watt of power was produced at 105 Gc by a travelling wave multiple photon interaction in HCN gas, which possibly is the most power produced by a quantum electronics scheme in the low mm-λ portion of the spectrum. The J = O, J = 1 levels of HCN provide a 2 level system with a natural frequency Ω88.6 Gc, with a pumping frequency ω = 35 Gc ($\approx\Omega/3$), and power being produced at odd harmonics of ω. The interaction region containing HCN consists of a moderate length of RG 96/μ rectangular waveguide. Field strengths of the order of 25 kv/cm, necessary to produce high harmonic power, are produced by a commercially available Sylvania magnetron. The fundamental power propagates in the TE_{10} mode and the harmonic is produced in the TE_{30} mode. A coupler at the end of the interaction region extracts the harmonic power.

1085

Illinois U. [Electrical Engineering Research Lab.] Urbana.

VACUUM-GRATING MONOCHROMATOR FOR THE 100μ - 2500μ REGION (Abstract), by R. Roldan. [1964] [1]p. (AFOSR-65-0449) (AF AFOSR-63-272) Unclassified

Presented at Second annual Rev. of Electronics, Illinois U., Urbana, Nov. 17-18, 1964.

A vacuum-grating monochromator is described covering the spectral region from 100-2500μ. The instrument has an f/2.3, on axis optical system in Littrow mount. Several echelette gratings are used to span the region of interest. Filter gratings used in O^{th} order, quartz plates, NaCl and black polyethylene remove the higher frequency radiation coming from a mercury arc used as a source. A Golay Cell is employed as the detector together with a synchronous rectifier and the signal is displayed in a conventional recorder. Preliminary spectra of H_2O in the region from 300-600 reveal 9 strong bands in agreement with the predictions of Benedict. These spectra show a resolution of 12μ at 500μ and required a scanning time of approx. 1 hr with an apparent S/N ratio of 10.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

INDUCTION, PREDICTION, AND DECISION-MAKING IN CYBERNETIC YSTEMS, by W. R. Ashby. [1963] [12]p. (AFOSR-64-2006) (AF AFOSR-64-7) AD 451576 Unclassified

Also published in Induction: Some Current Issues, Middletown, Wesleyan U. Press, 1963, p. 55-66.

The concepts of induction and deduction, as they came to us from the Greeks, were associated with the assumption that they might give a truth that would hold universally without any limit or condition. This assumption, implying that the process ends with an infinite quantity of information, is rejected, for no human or mechanical system can process more than a finite quantity. When the processes of induction and deduction are re-examined in the forms in which they are actually used in human thought processes, they are found to follow the same basic methods, and to be subject to the same basic laws, as when they are used in machines.

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Illinois U. [Electrical Engineering Research Lab.] Urbana.

[THE PROBLEM OF FORMALIZATION OF THE TRANSCENDENTAL-DIELECTIC LOGIC, WITH SPECIAL REGARD TO THE LOGIC OF HEGEL] Das Problem einer Formalisierung der Transzendental-Dialektischen Logik, by H. Heimsoeth, J. Derbolav and others. [1964] [59]p. incl. diagrs. refs. (AFOSR-65-0698) (AF AFOSR-64-480) AD 617860 Unclassified

Also published in Hegel-Studien, Suppl. 1: 65-123, 1964.

In this investigation, the problem of the formalization of transcendental-dialectic logic, which is the basis of German idealism, is considered. A direct investigation is made of the existing historical writings of authors Kant, Fichte, Hegel and Schelling in the language of a formal calculus. A new statement of the essential problem, which revealed itself in the development of the positive philosophy from Kant to Schellings on the basis of a transclassical formalism, is treated here. Questions such as what is transcendental appearance, subjectivity, introspection, and transference of thoughts are entirely independent, so that they represent the main problem of idealism, and are investigated through their formal logical structure.

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Indiana U. Dept. of Chemistry, Bloomington.

DISTRIBUTION AND RELAXATION OF VIBRATIONALLY

EXCITED OXYGEN IN FLASH PHOTOLYSIS OF OZONE, by R. V. Fitzsimmons and E. J. Bair. [1964] [6]p. incl. diagrs. table, refs. (AFOSR-66-0593) (AF 49(636)1257) AD 632176 Unclassified

Also published in Jour. Chem. Phys., v. 40: 451-458, Jan. 1964.

Absolute absorption by a sequence of bands in the Schumann-Runge series arising from oxygen molecules in vibrationally excited levels of the ground state formed by secondary processes of the flash photolysis of ozone was measured as a function of time. Measurements of bands arising from states v'' = 13 through v'' = 19 are analyzed in terms of a continuously generated initial distribution which relaxes to room temperature in single quantum steps. The vibrational relaxation rate constants are large and are interpreted as an efficient transfer of vibrational energy between ozone and excited oxygen. The relaxation process is consistent with a single quantum step model, and if deviations from this model are real, they are secondary. Vibrationally excited oxygen is formed initially in all of the observed states. (Contractor's abstract, in part)

1089

Indiana U. Dept. of Chemistry, Bloomington.

SPECTROMETRIC STUDIES OF FAST REACTIONS, by E. J. Bair. Final rept. Oct. 1, 1963 [17]p. incl. diagrs. tables, refs. (AFOSR-J1616) (AF AFOSR-62-36) AD 427636 Unclassified

Reprints of the following 2 papers published during the investigation are included in this report: (1) Reactions of nitrogen-hydrogen radicals. I. NH_2 recombination in the decomposition of ammonia, and (2) Distribution and relaxation of vibrationally excited oxygen in flash photolysis of ozone.

1090

Indiana U. [Dept. of Chemistry] Bloomington.

A CONFIGURATION INTERACTION STUDY OF THE GROUND STATE OF THE H_3^+ MOLECULE, by R. E. Christoffersen. Dec. 1963, 1v. incl. diagrs. tables, refs. (AFOSR-64-0001) (AF AFOSR-62-163) AD 430893 Unclassified

A configuration interaction calculation on the ground state of H_3^+ has been done using Slater-type orbitals of the form 1s, 2s, $2p_x$, $2p_y$, $2p_z$ to form the basis set. The calculation was effected by approximating the exact wave function for the system by a linear combination of configurations, each of which is a properly antisymmetrized function constructed from the basis orbitals, and by applying the variation theorem to the approximate wave function. The most stable geometry for H_3^+ is an equilateral triangle. The best energy obtained for the equilateral triangle was -1.33264 Hartrees at R = 1.6575 Bohrs. The fundamental vibrational frequencies for the ground state have also been calculated.

1091

Indiana U. Dept. of Chemistry, Bloomington.

DIAMAGNETIC NUCLEAR SHIELDING CONSTANTS FOR NEUTRAL ATOMS, by R. A. Bonham and T. G. Strand. [1964] [2]p. incl. table. (AFOSR-64-1495) (AF AFOSR-62-322) AD 446140 Unclassified

Also published in Jour. Chem. Phys., v. 40: 3447-3448, June 1, 1964.

The purpose of this note is to present the results for the diamagnetic shielding constants for the neutral atoms from Z = 2 to Z = 100 using a Hartree-Fock electron density function for the atoms Z = 2 to Z = 36, and a Thomas-Fermi-Dirac (TFD) electron density function for the atoms from 2 to 100.

1092

Indiana U. Dept. of Chemistry, Bloomington.

THE THEORY OF ELECTRON SCATTERING FROM MOLECULES. II. MOLECULAR HYDROGEN, by R. A. Bonham and T. Iijima. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-64-1497) (AF AFOSR-62-322) AD 446125 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2266-2272, Nov. 1963.

Expressions for the differential cross sections for the total electron scattering (including all inelastic processes) and the elastic electron scattering from molecular hydrogen have been derived. The total molecular intensity has been computed with both the Wang and Weinbaum molecular wave functions and the effect of the chemical bond on these calculations is discussed. The binding effects should contribute only small corrections to the usual interpretation of diffraction results for the case of H_2 unless extremely small angle scattering data were available.

1093

Indiana U. Dept. of Chemistry, Bloomington.

MODIFICATION TO THE NEWTON-RAPHSON METHOD FOR THE FITTING OF NONLINEAR FUNCTIONS BY LEAST SQUARES, by T. G. Strand, D. A. Kohl, and R. A. Bonham. [1963] [4]p. incl. tables. (AFOSR-64-1496) (AF AFOSR-62-322) AD 446356 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1307-1310, Sept. 1, 1963.

A modification to the regularly used methods for the fitting of nonlinear functions by least squares is

presented. The modified method converges in fewer cycles of the iterative solution than the unmodified Newton-Raphson method, and in certain cases, the modification makes the iteration converge from starting vectors for which the unmodified method diverges. A numerical example is given, where the modification is used with the Newton-Raphson method to obtain an analytical expression for the Thomas-Fermi-Dirac potential function of an atom. The solutions from the modified method are discussed in relation to the results of the unmodified ones for different starting values of the parameters.

1094

Indiana U. Dept. of Chemistry, Bloomington.

ANALYTICAL EXPRESSIONS FOR POTENTIALS OF NEUTRAL THOMAS-FERMI-DIRAC ATOMS AND THE CORRESPONDING ATOMIC SCATTERING FACTORS FOR X RAYS AND ELECTRONS, by R. A. Bonham and T. G. Strand. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1499) (AF AFOSR-62-322) AD 446362 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2200-2204, Nov. 1, 1963

Approximate analytical expressions for the electrostatic potentials of neutral Thomas-Fermi-Dirac atoms have been obtained by fitting a sum of three exponential terms to the tabulated values by least-squares methods. The six different parameters used for each atom are expressed as functions of the atomic number. The corresponding expressions for the radial electron density, the mean-square radius, the diamagnetic susceptibility, the atomic scattering factors for x rays and the atomic scattering factors for electrons according to the first Born approximation are given. The accuracy of the approximate expressions are discussed in relation to results obtained from the tabulated values of the electrostatic potential and from the corresponding electron density.

1095

Indiana U. [Dept. of Chemistry] Bloomington.

X-RAY SCATTERING FACTOR OF A HYDROGEN ATOM IN A HYDROGEN MOLECULE, by T. Iijima and R. A. Bonham. [1963] [2]p. (AFOSR-64-1500) (AF AFOSR-62-322) AD 446363 Unclassified

Also published in Acta Cryst., v. 16: 1061-1062, Oct. 1963.

The effective scattering factor of a hydrogen atom in a hydrogen molecule was calculated and the magnitude was found to be generally less than that for an isolated hydrogen atom. This fact was interpreted as due to migration of electrons away from the nucleus into the bond. The x-rays and electrons in the wave length region usually used in structural analysis work are mainly sensitive to the contraction of the overall size of the electron cloud of the hydrogen atoms in molecular hydrogen as compared with their size in the free state. The enhancement of the electron density in the neighborhood of the bond or the nucleus is accomplished by a decrease of density on the side of the nucleus away from the bond. The latter effect is the most significant one in the calculation of the corrections to the x-ray scattering factor for atomic hydrogen in molecular hydrogen.

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Indiana U. Dept. of Chemistry, Bloomington.

THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. III. NATURAL ORBITALS FOR H_2, by S. Hagstrom and H. Shull. [1963] [6]p. incl. tables, refs. (AFOSR-64-1520) (AF AFOSR-63-362) AD 445930 Unclassified

Also published in Rev. Modern Phys., v. 35: 624-629, July 1963.

It has seemed desirable to explore the natural orbital representation of H-molecule wave functions in detail with an accurate H_2 wave function. The results of this study are presented in this paper using the wave function obtained by Hagstrom. This function represents an expansion in terms of configurations of products over basis orbitals. The latter were chosen in elliptical coordinates. It can be said that the present calculations confirmed in detail previous surmises about (1) the invariance of the natural orbital expansion, (2) its utility in wave-function comparison, (3) the similarities between He and H_2, (4) the rough additivity of correlation energies of different types.

1097

Indiana U. Dept. of Chemistry, Bloomington.

THE NATURE OF THE TWO-ELECTRON CHEMICAL BOND. VI. NATURAL ORBITAL ANALYSIS FOR HeH^+, by B. G. Anex and H. Shull. [1964] [13]p. (AFOSR-64-1522) (AF AFOSR-63-362) AD 446371 Unclassified

Also published in Molecular Orbitals in Chemistry, Physics, and Biology, New York, Academic Press, 1964, p. 227-239.

This paper presents a contribution to the understanding of the detailed course of events that occurs in passing from the separated atoms of He + H^+ through the heteropolar hydride, HeH^+, to the united atom of Li^+. The molecule ion HeH^+ represents the simplest heteropolar two-electron chemical bond.

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Indiana U. Dept. of Chemistry, Bloomington.

ELECTRON DIFFRACTION DETERMINATION OF THE MOLECULAR STRUCTURE OF THE BUTYL HALIDES. V. THE STRUCTURE AND CONFORMATIONAL

ANALYSIS OF ISOBUTYL CHLORIDE, by G. H. Pauli, F. A. Momany, and R. A. Bonham. [1964] [3]p. incl. diagrs. tables, refs. (AFOSR-64-1537) (AF AFOSR-64-602) AD 446127 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 1286-1288, Apr. 5, 1964.

The structure and conformational analysis of gaseous isobutyl chloride has been carried out by the sector-microphotometer method of electron diffraction. The molecular parameters for the bonded distances were calculated. About 80% of the molecules at room temperature were in the conformer where the chlorine is gauche to one methyl group and trans to the other. The gauche angle for this conformer was found to be 66 degrees. A summary of the data on the available structural parameters for butyl halide molecules is given.

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Indiana U. Dept. of Chemistry, Bloomington.

ANALYTICAL EXPRESSIONS FOR THE HARTREE-FOCK POTENTIAL OF NEUTRAL ATOMS AND FOR THE CORRESPONDING SCATTERING FACTORS FOR X RAYS AND ELECTRONS, by T. G. Strand and R. A. Bonham. [1964] [6]p. incl. diagrs. tables. (AFOSR-64-1538) (AF AFOSR-64-602) AD 446132 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1686-1691, Mar. 15, 1964.

Approximate analytical expressions for the Hartree-Fock potential of neutral atoms to Z = 36 have been obtained by fitting the radial electron density with an analytical expression by least squares. The accuracy of the approximate expressions is discussed in relation to results obtained by numerical calculations from the Hartree-Fock wavefunctions for the atoms.

1100

Indiana U. [Dept. of Chemistry] Bloomington.

ON THE CALCULATION OF MULTICENTER TWO ELECTRON REPULSION INTEGRALS INVOLVING SLATER FUNCTIONS, by R. A. Bonham, J. L. Peacher, and H. L. Cox, Jr. [1964] [4]p. (AFOSR-64-1539) (AF AFOSR-64-602) (AF AFOSR-64-602) AD 446133 Unclassified

Also published in Jour. Chem. Phys., v. 40: 3083-3086, May 15, 1964.

Integral transforms are used to evaluate many-center two-electron repulsion integrals involving Slater s-type functions. The reduction of a general four-center integral of this type to a form convenient for computational purposes is presented. The technique described has the important advantage that all lesser many-center and one-center integrals can be obtained from the four-center case by proper choice of constants. The form of the result is such that simple single-precision numerical techniques yield rapid and accurate evaluations of many-center integrals. Several numerical examples are presented.

1101

Indiana U. Dept. of Chemistry, Bloomington.

CALCULATION OF ELECTRON SCATTERING FACTORS. I. NONRELATIVISTIC THEORY, by J. Karle and R. A. Bonham. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1540) (AF AFOSR-64-602) AD 446131 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1396-1401, Mar. 1, 1964.

Scattering factors for the elastic scattering from uranium and argon of 40-kv electrons have been obtained by partial wave analysis. In the case of argon both Thomas-Fermi-Dirac and Hartree-Fock fields were used in the calculation. For uranium, only the Thomas-Fermi-Dirac field was utilized. Various approximate techniques for obtaining the partial waves as well as direct numerical integration of the Schrodinger equation were employed. For the first time accurate numerical solutions of the electron scattering problem in the kv energy range, within the framework of the usual non-relativistic scattering theory, have been obtained.

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Indiana U. Dept. of Chemistry, Bloomington.

ON PLANETARY ELECTRON CORRECTIONS TO ELECTRON DIFFRACTION INTENSITY DATA, by T. Iijima and R. A. Bonham. [1964] [4]p. incl. diagrs. (AFOSR-65-0013) (AF AFOSR-64-602) AD 455823 Unclassified

Also published in Jour. Phys. Chem., v. 68: 3146-3149, Nov. 1964.

A new technique for correcting electron diffraction intensity data for planetary electron scattering from molecules in the gas phase is presented. The procedure does not make any assumptions about the molecular structure but still guarantees that the radial distribution will remain positive. Corrections to the peak areas in the resulting radial distribution function are discussed and the possible application of the technique to the analysis of x-ray scattering data from liquids is pointed out. (Contractor's abstract)

1103

Innsbruck U. Inst. for Theoretical Physics (Austria).

THE CROCCO THEOREM IN MAGNETOGASDYNAMICS, by F. Cap. Apr. 9, 1963, 5p. (Technical note no. 1) (AFOSR-5247) (AF 61(052)675) AD 416532 Unclassified

Crocco's theorem establishing a connection between entropy gradients and vorticity is derived for a plasma

(MHD theory). The theorem was applied to a plasma of infinite conductivity and the conditions permitting potential flow, i.e. vanishing vorticity, are discussed.

1104

Innsbruck U. Inst. for Theoretical Physics (Austria).

POTENTIAL FLOW IN MAGNETO GAS DYNAMICS, by F. Cap. Apr. 9, 1963, 6p. (Technical note no. 2) (AFOSR-5248) (AF 61(052)675) AD 416360 Unclassified

Also published in Ann. Physik, v. 7: 197-200, 1963. (AFOSR-64-0304; AD 440597)

The differential equation of compressible potential flow and the St. Venant-Wantzel equation were derived for a plasma with infinite conductivity. Gasdynamic methods are applied to solve the potential equation and Bernouille's equation. The efflux formula is discussed. (Contractor's abstract)

1105

Innsbruck U. Inst. for Theoretical Physics (Austria).

APPLICATION OF VARIATIONAL METHODS FOR THE SOLUTION OF GASDYNAMIC AND MAGNETO-GASDYNAMIC PROBLEMS, by F. Cap and G. Muller. Feb. 25, 1964, 7p. (Scientific rept. no. 8) (AFOSR-65-0927) (AF 61(052)675) AD 614051 Unclassified

Because a change from subsonics to supersonics involves a change in the type of potential equation of gasdynamics and magnetogasdynamics, a uniform solution is impossible. In the variational principle presented in this paper, this difficulty does not arise. The variational method given allows numerical calculation of the magnetogasdynamic subsonic to supersonic transition of 2-dimensional steady potential flows of a plasma.

1106

Innsbruck U. Inst. for Theoretical Physics (Austria).

INTERPRETATION OF MAGNETOGASDYNAMIC FLOW PATTERNS, by F. Cap and H. Friedel. Apr. 25, 1964, 17p. incl. diagrs. tables. (Scientific rept. no. 10) (AFOSR-65-0928) (AF 81(052)375) AD 814050 Unclassified

For initial magnetic fields of 0, 1000, 5000 and 10,000 gauss the 2-dimensional steady flow of a plasma in a nozzle is constructed using the magnetogasdynamic characteristics method of F. Cap. (Contractor's abstract)

1107

Innsbruck U. Inst. for Theoretical Physics (Austria).

SOME PRACTICAL EXAMPLES OF ONE-DIMENSIONAL UNSTEALY POTENTIAL FLOWS IN MGD, by F. Cap and F. Herrnegger. June 14, 1964, 18p. incl. diagrs. tables. (Scientific rept. no. 11) (AFOSR-65-0929) (AF 61(052)675) AD 614052 Unclassified

For initial magnetic fields of 5000 and 50,000 gauss, the 1-dimensional unsteady flow of a plasma in a tube is constructed using the magnetogasdynamic characteristics method of F. Cap. (Contractor's abstract)

1108

Innsbruck U. Inst. for Theoretical Physics (Austria).

MAGNETOGASDYNAMIC WAVES OF SMALL AMPLITUDE, by F. Cap and H. Friedel. July 14, 1964, 13p. incl. diagrs. (Scientific rept. no. 12) (AFOSR-65-0930) (AF 61(052)675) AD 613621 Unclassified

In this note the propagation of magnetogasdynamic waves with small amplitude is studied by two methods. In the first, calculations are based on linearized equations, the propagation of plane waves being studied in a medium at rest. In the second, perturbations of a more general type are examined and the theory of characteristics applied. Both methods yield consistent results proving the existence of fast and slow magnetoacoustic waves.

1109

Innsbruck U. Inst. for Theoretical Physics (Austria).

SHOCK WAVES, by F. Cap and F. Herrnegger. Sept. 9, 1964, 14p. incl. diagrs. (Scientific rept. no. 13) (AFOSR-65-0931) (AF 61(052)675) AD 814053 Unclassified

The basic equations for stationary magnetohydrodynamic shock waves are given as well as the laws of conservation following from them and the shock equations. The evolutionary conditions for fast and slow shock waves are discussed by the shock polar diagram. Waves, both parallel and oblique to the magnetic field, are considered.

1110

Innsbruck U. Inst. for Theoretical Physics (Austria).

VORTEX THEOREMS AND POTENTIAL FLOW IN MGD, by F. Cap and H. Friedel. Sept. 25, 1964, 9p. incl. diagr. (Scientific rept. no. 14) (AFOSR-65-0932) (AF 81(052)675) AD 613823 Unclassified

Necessary conditions for the existence of a velocity potential in magnetogasdynamics (MGD) are derived on the basis of general MGD vortex theorems. Two types of MGD flows fulfilling these conditions are given: 1-dimensional and 2-dimensional flows with transversal magnetic fields. Finally, the existence of a potential equation for the special case of a longitudinal magnetic field is shown. (Contractor's abstract)

1111

Innsbruck U. Inst. for Theoretical Physics (Austria).

INTERACTION BETWEEN MAGNETIC FIELD AND FLOW FIELD FOR PLASMAS OF INFINITE CONDUCTIVITY, by F. Cap and G. Kerer. Oct. 15, 1964, 6p. incl. diagrs. (Scientific rept. no. 17) (AFOSR-65-0933) (AF 61(052)675) AD 617553 Unclassified

Assuming that the boundary curve of a 2-dimensional steady flow is given analytically and that the magnetic field in the whole flow domain is vertical to the flow velocity, the magnetic field at the domain is calculated. The magnetic field at the boundary is also calculated for a flow coming from an idealized nozzle and for the circulation flow, and from these results the differential equation for the former field is simplified. Finally it is proved that for a 2-dimensional steady flow $\vec{v} = (v_x, v_y, 0)$ and $\vec{H} = (0, 0, H_z)$, the 2 equations curl $[\vec{v} \times \vec{H}] = 0$ and $\vec{H} = \text{constant} \cdot \rho$ are identical.

1112

Innsbruck U. Inst. for Theoretical Physics (Austria).

VARIATIONAL METHODS FOR THE SOLUTION OF TWO-DIMENSIONAL STEADY MAGNETOGASDYNAMIC FLOWS, by F. Cap and G. Mueller. Sept. 23, 1964, 12p. (Scientific rept. no. 19) (AFOSR-65-0934) (AF 61(052)675) AD 613624 Unclassified

In a former paper, a variational problem was presented for 2-dimensional steady magnetogasdynamic potential flow. This note continues the investigation and introduces a variational problem using polar coordinates, which is solved by the Ritz method. The boundary condition given is that the radial component of the velocity has to vanish on the cylinder surface. A solution is presented by expansion into a series.

1113

Innsbruck U. Inst. for Theoretical Physics (Austria).

GASDYNAMIC METHODS IN MHD FLOW, by F. Cap, G. Kerer and others. Final rept. Jan. 1, 1963-Dec. 31, 1964, 41p. incl. refs. (Summary rept. no. 1) (AFOSR-65-1045) (AF 61(052)675) AD 619094 Unclassified

During this investigation, the following was accomplished: (1) It was proven that potential flow can exist in a plasma under certain conditions; (2) A theorem was derived connecting vorticity, the geometrical form of the magnetic field, Ohmic heating and entropy gradients; (3) A perturbational approach was developed for deriving solutions for a plasma with finite electrical conductivity from solutions for a plasma with infinite electrical conductivity; (4) A method for the solution of 2-dimensional steady potential flow of a plasma, using characteristics in the hodograph plane, was found; and (5) A variational method was discovered by which the transition from subsonic, i.e., $a^2 + V^2 < v^2$, to supersonic, i.e., $a^2 + V^2 > v^2$, through transonic, i.e., $a^2 + V^2 \approx v^2$, can be calculated numerically.

1114

Innsbruck U. Inst. for Theoretical Physics (Austria).

NUMERICAL METHODS IN GASDYNAMICS AND MGD by F. Cap and F. Herrnegger. Dec. 21, 1964 [17]p. incl. diagrs. refs. (Scientific rept. no. 18) (AFOSR-65-1805) (AF 61(052)675) AD 622093 Unclassified

Methods for estimating solutions of differential equations in gasdynamics are presented relevant to their applications to magnetohydrodynamics. The differential equations considered are confined to those of second order with two variables, that is, to unsteady 1-dimensional and steady 2-dimensional problems. General principles of error compensation are considered. Methods of estimation include methods of variations, difference methods, methods of characteristics, and methods of transformations.

1115

Innsbruck U. Inst. for Theoretical Physics (Austria).

THE PRESSURE HILL AND THE ADIABATIC ELLIPSE IN MAGNETOGASDYNAMICS, by F. Cap and R. Skarics. July 25, 1963 [9]p. incl. tables. (Technical note no. 3) (AFOSR-65-2312) (AF 61(052)675) AD 429506 Unclassified

On the basis of Bernoulli's equations for a potential flow in magneto-gasdynamics, a modified Saint-Venant Wantzel formula of efflux is derived. Pressure as a function of the velocity of efflux is calculated for magnetic field strengths of 0, 5,000, and 10,000 gauss. The equation of a modified adiabatic ellipse is deduced with the aid of an auxiliary quantity for calculation, closely basing on gas dynamics. Furthermore, expressions interrelating the flow velocity, the modified Mach number, and the modified critical Mach number are studied. (Contractor's abstract)

1116

Innsbruck U. [Inst. for Theoretical Physics] (Austria).

APPROXIMATIVE SOLUTION OF THE MAGNETOHYDRODYNAMIC EQUATIONS FOR FINITE CONDUCTIVITY, by F. Cap and G. Kerer. July 25, 1963, 3p. (Technical note no. 4) (AF 61(052)675) AD 428977 Unclassified

Proceeding from the basic equations for steady two-dimensional potential flow, the basic magnetogasdynamical equations are linearized by means of perturbation calculations disregarding gravity, friction and thermal conduction.

1117

Institut d'Optique, Paris (France).

SIMULTANEOUS DETERMINATION OF SCATTERING PARAMETER AND MEAN FREE PATH OF CONDUCTION ELECTRONS IN THIN FILMS, by M.-L. Theye. [1964] [4]p. incl. diagrs. (AFOSR-64-1778) ((AF EOAR-63-48) AD 449197 Unclassified

Also published in Jour. Phys., v. 25: 194-197, Jan.-Feb. 1964.

Combined study of the optical properties and of the electrical resistivity of a thin film of known thickness, enables simultaneous unequivocal determination of both the mean free path l of the conduction electrons, and the fraction p of them which is specularly reflected on the two planes limiting the film. The method described, applied to thin Au films, shows that the scattering parameter p may be different from zero for thin films prepared by vacuum evaporation on amorphous substrates and annealed at suitable temperatures.

1118

Institut d'Optique, Paris (France).

METER AMPLIFIER FOR CONDUCTIVITY MEASUREMENTS IN LOW-CONDUCTIVITY LIQUIDS, by I. Wilmanns. [1964] [2]p. (AFOSR-64-2120) (AF EOAR-63-48) AD 451579 Unclassified

Also published in Jour. Scient. Instruments, v. 41: 400, June 1964.

A simple measurement circuit is described which permits simultaneously the surveyance of the washing action of demineralized water and of the reclaiming action of the deionization column.

1119

Institut d'Optique, Paris (France).

OPTICAL PROPERTIES OF INHOMOGENEOUS FILMS, by F. Abeles. [1964] [18]p. incl. diagrs. tables. (AFOSR-65-0157) (AF EOAR-63-48) AD 611494 Unclassified

Also published in Proc. Symposium on Ellipsometry in the Measurement of Surfaces and Thin Films, Washington, D. C. (Sept. 5-6, 1963), p. 41-58.

The inhomogeneous films investigated have a refractive index n which is a function of the single coordinate z, the axis Oz having the direction of the normal to the planes which limit the layer. The discussion is limited to non-absorbing films, although mention is made of the possibilities of using the same methods for absorbing layers. Three different methods of computation are described: (1) use of the differential wave equation; (2) WKB approximation; and (3) replacement of an inhomogeneous layer by a pile of homogeneous films.

1120

Institut d'Optique, Paris (France).

[A NEW SYNCHRONOUS RECTIFIER] Un nouveau redresseur synchrone, by L. Wilmanns. [1964] [2]p. incl. diagrs. (AFOSR-65-0745) (AF EOAR-63-48) AD 615071 Unclassified

Also published in Jour. Phys. (Paris), v. 25: 173A-174A, Nov. 1964.

Circuits using synchronous rectifiers are in general very complicated. This paper describes a circuit, consisting of two transistors (n-p-n and p-n-p) with single ended reference input and no drift. It is easy to obtain time constants of several seconds.

1121

[Institut National d'Hygiene]. Marseille (France).

THE VISUALLY EVOKED POTENTIALS RECORDED TRANSCRANIALLY IN NORMAL MAN, by H. J. P. Gastaut. Final rept. Oct. 31, 1964 [30]p. incl. illus. diagrs. refs. (AFOSR-65-1686) (AF EOAR-64-15) AD 624103 Unclassified

A study was made of the relationships between the EEG and the behavior or sensory-motor functions of normal man. An evaluation was made of the utility of the Phasotron. An investigation was made of the different aspects of the visually-evoked potentials recorded transcranially in healthy and diseased man.

1122

Institute for Advanced Study, Princeton, N. J.

PROPERTIES OF CERTAIN TYPES OF WILD SURFACES IN E^3, by C. E. Burgess. [1964] [14]p. incl. refs. (AFOSR-65-1398) (AF 49(638)253) AD 621401 Unclassified

Also published in Amer. Jour. Math., v. 86: 325-338, Apr. 1964.

Let S be a wild 2-sphere in E^3 such that S + IntS is a topological cube, and let W be the set of all wild points on S. It is shown that if S_1 is a 2-sphere in S + IntS such that $W \subset S_1$, then S_1 is wild at each point of W. Also if W is a subset of a tame Cantor set in E^3, then there is a tame 2-sphere S_2 such that $S \cdot S_2 = W$ and $S_2 \subset S + \mathrm{Ext}S$. The results for 2-spheres are used to obtain similar theorems for connected 2-manifolds in a 3-manifold.

1123

Institute for Advanced Study, Princeton, N. J.

HARMONIC EXTENSIONS, by M. Morse. [1963] [9]p. (AFOSR-4925) (AF AFOSR-62-227) AD 453836 Unclassified

Also published in Monatsh. Math., v. 67: 317-325, 1963.

In this paper the analytic case of the theory of Schoenflies extension problems or more precisely with a classical theorem on harmonic extension is studied.

1124

Institute for Advanced Study, Princeton, N. J.

ON THE BORN APPROXIMATION IN THE POTENTIAL SCATTERING OF PARTICLES WITH ARBITRARY SPINS, by F. Calogero and J. M. Charap. [1964] [17]p. (AFOSR-64-0552) (AF AFOSR-63-42) Unclassified

Also published in Ann. Phys., v. 26: 55-71, Jan. 1964.

The Born approximation to the scattering amplitude is discussed for the potential scattering problem with many channels and arbitrary spins. This is done for the full amplitude in both the representation in which magnetic quantum numbers are diagonal and in the helicity representation, and for the partial wave amplitude in the helicity representation. Spin-orbit interactions are also treated. A discussion of the asymptotic behavior for large momentum transfer is given, on the basis of which it is conjectured that for a specified class of potentials the Regge poles will retreat to the left-hand J-plane for high energies. (Contractor's abstract)

1125

Institute for Advanced Study, Princeton, N. J.

THE CONTINUATION IN TOTAL ANGULAR MOMENTUM OF PARTIAL-WAVE SCATTERING AMPLITUDES FOR PARTICLES WITH SPIN, by J. M. Charap and E. J. Squires. [1963] [15]p. (AFOSR-64-0798) (AF AFOSR-63-42) AD 436478 Unclassified

Also published in Ann. Phys., v. 25: 325-339, Dec. 1963.

An assumed one-dimensional dispersion relation is used to define a continuation in total angular momentum of the helicity scattering amplitude, for particles with arbitrary spin. The result, which is a generalization of the Froissart-Gribov formula for zero spin, agrees with that discussed previously for potential models. It is shown that cross-channel unitarity imposed certain restrictions on the weight functions. The existence of certain kinematic zeros of the amplitude, corresponding to the decoupling of sense and nonsense channels, is proved in general, and finally it is shown that the presence of the nonsense-nonsense amplitude does not affect the large z behavior, which is still dominated by Regge poles.

1126

Institute for Advanced Study, Princeton, N. J.

ASYMPTOTIC BEHAVIOUR FOR LARGE IMAGINARY VALUES OF ANGULAR MOMENTUM OF THE AMPLITUDES FOR THE SCATTERING OF A DIRAC PARTICLE ON A CENTRAL SCALAR POTENTIAL, by F. Calogero and J. M. Charap. [1964] [0]p. incl. diagr. refs. (AFOSR-65-0478) (AF AFOSR-63-42) AD 614206 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 1665-1684, June 16, 1964.

It is proved that the analytically continued partial-wave amplitudes for the scattering of a Dirac particle on a central scalar potential which may be expressed as a superposition of Yukawa functions vanishes as $|\mathrm{Im}J| \to \infty$. The potential has to be further restricted so that it vanishes at small distances and is weak. The method of proof is based on the phase approach to scattering theory. (Contractor's abstract)

1127

Institute for Advanced Study, Princeton, N. J.

ON MASSIVE AND MASSLESS PHOTONS, by N. Dombrey. [1964] [11]p. (AFOSR-65-0479) (AF AFOSR-63-42) AD 614184 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 1696-1706, June 16, 1964.

The vanishing of the longitudinal mode of massive photon as the photon mass goes to zero in gauge-invariant electrodynamics is investigated. A distinction between 2 forms of gauge-invariant amplitudes is made in order to clarify this limit; conditions are then obtained so that the limiting process is smooth. From these conditions results on the equality of particle charge which are usually derived by means of Ward's identity can be obtained.

1128

Institute for Advanced Study, Princeton, N. J.

THE ELIMINATION OF CRITICAL POINTS OF A NON-DEGENERATE FUNCTION ON A DIFFERENTIABLE MANIFOLD, by M. Morse. [1964] [60]p. incl. refs. (AFOSR-65-1040) (AF AFOSR-63-357) AD 617854 Unclassified

Also published in Jour. Anal. Math., v. 13: 257-316, 1964.

M is a compact, connected, orientable differentiable n-manifold of class C^∞, and f is a non-degenerate function of class C^∞. This note reveals certain fundamental topological characteristics of M by combining the study of the critical points of f with the study of certain differentiable submanifolds of M associated with the

respective critical points of f and termed bowls of f. An attempt is made to modify f so as to eliminate as many critical points as possible, replacing f by another non-degenerate function. This is accomplished mainly through the development of a theorem concerning bowls and the existence of a non-degenerate function without critical points in a given neighborhood.

1129

Institute for Advanced Study, Princeton, N. J.

CONDITIONED DIFFERENTIABLE ISOTOPIES, by W. Huebsch and M. Morse. [1964] 25p. (AFOSR-65-1041) (AF AFOSR-63-357) AD 618619
Unclassified

Also published in Proc. Internat'l. Colloq. on Differential Anal., Bombay (India), 1964, p. 1-25.

In proving some of the recent theorems in differential topology, deeper reduction theorems and differentiable isotopies are required than those which have been presented. This note establishes one such theorem, concerning O-related diffeomorphisms. A Euclidean n-space with rectangular coordinates is used, and two special types of diffeomorphisms; ξ-diffeomorphisms and perispherical diffeomorphisms, are introduced and developed in proving the theorem.

1130

Institute for Advanced Study, Princeton, N. J.

REMARKS ON THE POLYNOMIAL BOUNDEDNESS IN THE MANDELSTAM REPRESENTATION, by Y. S. Jin and A. Martin. [1964] [7]p. incl. diagr. refs. (AFOSR-66-0449) (AF AFOSR-64-42) AD 630447
Unclassified

Also published in Jour. Math. Phys., v. 5: 1406-1412, Oct. 1964.

The Mandelstam representation is a statement about the region of analyticity and asymptotic behavior (polynomial boundedness) of a scattering amplitude. In virtue of the unitarity condition, however, these two are not completely independent. Some physical consequences, e.g., uniqueness, polynomial boundedness of the total cross section, etc., which have been already derived from the Mandelstam representation, are shown to be preserved, even if the polynomial boundedness is replaced by a somewhat weaker assumption. By making use of unitarity, analyticity, and crossing symmetry, the following type of scattering amplitude $F = E + M$, where E is an entire function in both variables s and t, while M denotes a Mandelstam-type function with finite number of subtraction, is shown to be ruled out. Similarly, $F = EM$ is also ruled out, if one imposes the additional restriction that E should increase less fast than an exponential in one variable while the other is finite. (Contractor's abstract)

1131

Institute for Advanced Study, Princeton, N. J.

REGGE-KHURI REPRESENTATION FOR PHOTOPRODUCTION, by Y. S. Jin and H. A. Rashid. [1964] [14]p. (AFOSR-66-0453) (AF AFOSR-64-42) Unclassified

Also published in Nucl. Phys., v. 58: 611-624, 1964.

The Gribov-Froissart continuations of various multipole amplitudes of the photo-pion production process into the complex J-plane are introduced. Assuming the meromorphy of these interpolated multipole amplitudes in the complex J-plane, the Regge-Khuri representation for the photo-pion production is obtained. The contribution of the nucleon Regge pole to the low-energy M_{1-} amplitude is briefly discussed. (Contractor's abstract)

1132

Institute for Advanced Study, Princeton, N. J.

SHELL MODEL OF BARYONS, by P. G. O. Freund and B. W. Lee. [1964] [4]p. incl. tables. (AFOSR-66-0454) (AF AFOSR-64-42) AD 630367 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 592-595, Nov. 16, 1964.

Consideration is given to some implications of the hypotheses that (1) baryons are built up on spin-1/2 fermions belonging to a unitary triplet (which are termed baryonettes); (2) within a baryon, these baryonettes move in a self-consistent central field, exhibiting a shell structure; (3) coupled spin-unitary-spin symmetry is not an intrinsic symmetry of the 'fundamental' Lagrangian, but a symmetry of the baryon wave function (in terms of baryonette coordinates) in the central-field approximation. This symmetry is broken by the residual interaction between baryonetts which is not accounted for by the central field. The basic triplet is assumed to have the charge structure (2/3, -1/3, -1/3), just as quarks, but for the present the baryon number b of baryonettes is left unspecified. Both LS -and jj-coupling shell models of baryons are discussed.

1133

Institute for Advanced Study, Princeton, N. J.

INTRINSICALLY BROKEN U(6) ⊕ U(6) SYMMETRY FOR STRONG INTERACTIONS, by K. Bardakci, J. M. Cornwall and others. [1964] [4]p. incl. table. (AFOSR-66-0474) (AF AFOSR-64-42) AD 630509
Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 698-701, Dec. 7, 1964.

The results of investigations that lead to the symmetry group SU(6) are extended to relativistic quantum field theory. A chain of symmetries is produced which culminates in the relationship $W_6 \equiv U(6) \oplus U(6)$. The largest members of this chain are intrinsically broken; i.e., there does not exist a total Lagrangian that

posseses W_6 symmetry, since the kinetic energy and mass terms will automatically break it. The symmetry will make sense in terms of a strong-coupling limit.

1134

Institute for Advanced Study, Princeton, N. J.

METHOD OF THE SELF-CONSISTENT FIELD GENERAL RELATIVITY AND ITS APPLICATION TO THE GRAVITATIONAL GEON, by J. B. Hartle and D. R. Brill. [1964] [8]p. (AFOSR-65-0145) (AF AFOSR-64-42) AD 611486 Unclassified

Also published in Phys. Rev., v. 135: B271-B278, 1964.

Concentrations of radiation held together for a long time by their own gravitational attraction ('geons') have been studied for nearly a decade. The previous analyses are extended to the case where gravitational waves are the source of the geon's mass energy. To analyze these solutions of the free-space Einstein equations with persistent features, an approximation method is developed to treat small ripples on a strongly curved background metric. The background metric describes the large-scale persistent features of the geon and is taken to be spherically symmetric. The waves superimposed on this background have an amplitude small enough to so that their dynamics can be analyzed in the linear approximation; however, their wavelength is so short, and their time dependence so rapid that their energy is appreciable and produces the strongly curved background metric in which they move. The Einstein equations are investigated in this limit of short wavelength. It is found that the large-scale features of thin-shell spherical gravitational geons-in fact, of thin-shell spherical geons constructed from any field of zero rest mass-are identical to those of the spherical electromagnetic geons analyzed previously.

1135

Institute for Advanced Study, Princeton, N. J.

LARGE SYMMETRY BREAKING AND MASS RELATIONS, by C.-H. Woo. [1964] [4]p. (AFOSR-64-0147) (AF AFOSR-64-42) AD 611489 Unclassified

Also published in Phys. Rev., v. 135: B1352-B1355, Sept. 21, 1964.

The effects of symmetry breaking on the multiplet structure of composite particles are studied. The Sakata triplet is used for illustrations, and simple special models are studied where some mass regularities remain even in the presence of a fairly large symmetry breaking.

1136

Institute for Advanced Study, Princeton, N. J.

SCALAR DI-PION RESONANCE AND THE NUCLEON AXIAL FORM FACTOR, by C.-H. Woo. [1964] [3]p. (AFOSR-65-0148) (AF AFOSR-64-42) AD 611488 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 308-310, Mar. 16, 1964.

It is shown that the inclusion of a scalar di-pion resonance at m = 400 mev and γ = 50 mev can improve the agreement between theoretical and experimental information on the nucleon axial form factor.

1137

Institute for Advanced Study, Princeton, N. J.

CONNECTION BETWEEN THE ASYMPTOTIC BEHAVIOR AND THE SIGN OF THE DISCONTINUITY IN ONE-DIMENSIONAL DISPERSION RELATIONS, by Y. S. Jin and A. Martin. [1964] [6]p. (AFOSR-65-0150) (AF AFOSR-64-42) AD 611483 Unclassified

Also published in Phys. Rev., v. 135: B1369-B1374, Sept. 21, 1964.

Starting from one-dimensional dispersion relations (either fixed-transfer or partial-wave), information on the sign of absorptive part which follows from unitarity, and in some cases analyticity in the Mandelstam ellipse in the t plane and polynomial boundedness, we derive various consequences of physical interest, e.g., a high-energy lower bound on the forward scattering amplitude, the minimum fluctuation of the sign of the discontinuity across the left-hand cut in the partial-wave dispersion relations, etc. In the derivations, the positiveness of the absorptive part plays an essential role by allowing us to construct a Herglotz function which has a well-known asymptotic behavior.

1138

Institute for Advanced Study, Princeton, N. J.

NUMBER OF SUBTRACTIONS IN FIXED-TRANSFER DISPERSION RELATIONS, by Y. S. Jin and A. Martin. [1964] [3]p. (AFOSR-65-0151) (AF AFOSR-64-42) AD 611491 Unclassified

Also published in Phys. Rev., v. 135: B1375-B1377, Sept. 21, 1964.

Assuming the minimal requirements necessary to derive the Froissart bound, the number of subtractions for the fixed-momentum-transfer dispersion relation in the unphysical region $0 < t < 4\ \mu^2$ turns out to be 2. In the proof, the positiveness of all the derivatives of absorptive part with respect to t at t = 0 is used. Physical implications and applications of this result are briefly discussed.

1139

Institute for Scientific Information, Philadelphia, Pa.

THE USE OF CITATION DATA IN WRITING THE

HISTORY OF SCIENCE, by E. Garfield, I. H. Sher, and R. J. Torpie. Final rept. Dec. 31, 1964, 1v. incl. diagrs. tables. (AFOSR-65-1317) (AF 49(638)1256) AD 466578 Unclassified

A study is reported which tested the hypothesis that citation indexes are useful heuristic tools for the historian. In this approach, the history of science is regarded as a chronological sequence of events in which each new discovery is dependent upon earlier discoveries. Models of history were constructed consisting of chronological maps or topological network diagrams. Two such models were used here. The first is based on the events in the history of DNA as described by Dr. Isaac Asimov in The Genetic Code. The second is based on the bibliographic citation data contained in the documents which are the original published studies of events represented in the Asimov book. The interdependences of linkages among 40 major events (nodes) included in both network diagrams were mapped and compared. The study confirmed 65% (28 of 43) of the historical dependencies in the Asimov network by corresponding linkages established by citations. In addition, 31 citation connections were found which did not correspond to any historical dependencies noted in The Genetic Code.

1140

Institute for Scientific Information, Philadelphia, Pa.

MECHANIZED INDEXING METHODS AND THEIR TESTING, by J. O'Connor. Nov. 1963, 13p. (AFOSR-5154) (AF AFOSR-62-257) AD 611613 Unclassified

Also published in Jour. Assoc. Comput. Machinery, v. 11: 437-439, Oct. 1964.

Methods of mechanized indexing (subject indexing by computer) which have been proposed are systematically summarized. Every suggested method consists of some document preparation process mostly or wholly mechanical) followed by the application of indexing rules to the prepared document. A comprehensive document preparation is described from which proposed methods can be derived by selection. It includes full text input, document place (title, abstract, etc.) marking, sentence and paragraph marking, pronoun replacement, and other syntactic marking. It also includes addition of thesaurus headings, position numbers, weighted frequencies, closely associated expressions, importance measures, and reference information.

1141

Institute for Scientific Information, Philadelphia, Pa.

CORRELATION OF INDEXING HEADINGS AND TITLE WORDS IN THREE MEDICAL INDEXING SYSTEMS, by J. O'Connor. [1964] [10]p. incl. tables. (AFOSR-84-1389) (AF AFOSR-62-257) AD 444452 Unclassified

Also published in Amer. Doc., v. 15: 96-104, Apr. 1964.

The Montgomery-Swanson study of Index Medicus heading-title correlations is discussed. Some presently unanswered questions relevant to practical use of their automatic indexing technique are indicated. Contrasted with the 86% heading-title correlation figure which they found for Index Medicus are the following ranges (based on small samples): Index-Handbook of Cardiovascular Agents: 19-45%; Merck Sharp and Dohme Retrieval System: 40-68%; NIH Research Grants Index: 13-39%. (Contractor's abstract)

1142

Instituto de Investigacion de Ciencias Biologicas, Montevideo (Uruguay).

[NEUROBIOLOGY, CELL ULTRASTRUCTURE, BIOPHYSICS AND ELECTROPHYSIOLOGY] by J. Sas, C. Appeltauer and others. Annual final rept. 1963-1964 [10]p. (AFOSR-64-1434) (AF AFOSR-63-313) AD 604470 Unclassified

Reports on the following topics are summarized: neurobiology, cell ultrastructure, nerve regeneration, and conditioned reflexes.

1143

Instituto de Investigaciones Cerebrales, Mexico City, Mex.

SLEEP INDUCING MECHANISMS, by R. Hernandez-Peon. Final technical rept. Mar. 1964, 27p. (AFOSR-64-0735) (AF AFOSR-62-364) AD 436525 Unclassified

The behavioral and electrographic effects produced by the intracerebral application of minute crystals of various chemical substrates were studied in cats with descending cannulae permanently implanted in their brains. An extensive exploration was made from the most rostral part of the forebrain to caudal parts of the hindbrain. It was found that acetylcholine alone, or plus eserine, and carbachol elicited the two stages of sleep when applied to any point of a highly circumscribed anatomical pathway.

1144

Instituto de Investigaciones Cerebrales, Mexico City, Mex.

CHOLINERGIC PATHWAYS FOR SLEEP, ALERTNESS AND RAGE IN THE LIMBIC MIDBRAIN CIRCUIT, by R. Hernandez-Peon, G. Chavez-Ibarra and others. 1963, 4p. (AFOSR-64-0741) (AF AFOSR-62-364) AD 436506 Unclassified

Also published in Acta Neural Latinoamer., v. 8: 93-96, 1962.

In cats with cannulae permanently implanted in the brain, cholinergic stimulation evoked: (1) sleep along the limbic forebrain-limbic midbrain circuitry; medial forebrain bundle lesions posterior to previously tested

hypnogenic sites blocked cholinergic sleep; (2) alertness from septum to mesencephalic reticular formation via dorsal hypothalamus; (3) rage from septum to peri-aqueductal grey substance; and (4) autonomic and motor effects from loci immediately above and below hypnogenic pathways.

1145

Instituto de Neurologia, Montevideo (Uruguay).

ATTENTION, HABITUATION AND CONDITIONING AS RELATED TO THE BRAIN WAVES, by E. Garcia-Austt, J. Bogacz and others. Final technical rept. May 1, 1960-Apr. 30, 1964, 15p. incl. refs. (AFOSR-64-1841) (AF AFOSR-63-312) AD 607374 Unclassified

The primary aim of the research program was to obtain an objective appreciation of the time pattern of attention, habituation and other forms of learning in man. The second aim was to study the mechanism of this sensory control. Two possibilities, which do not exclude each other, were suggested: (1) a direct inhibitory action upon the specific pathways from the receptor up to the cerebral cortex, and (2) an indirect centrifugal action through the muscular mechanism regulating the energy of the stimulus. It was proposed to determine the role of the pupillary and ocular muscles in visual evoked response changes.

1146

Instituto de Neurologia, Montevideo (Uruguay).

CENTRIFUGAL CONTROL OF COCHLEAR INFLOW, by R. Vellutl, W. Buno, and E. Garcia-Austt. [1964] [1]p. (AFOSR-65-0966) (AF AFOSR-63-312) AD 618260 Unclassified

Also published in Proc. Sixth Cong. of the Latinamer. Assoc. of Physiol. Sci., Vina del Mar (Chile), Nov. 23-28, 1964, p. 95.

Results are presented for 59 experiments conducted on 42 guinea-pigs. The guinea-pigs were awake and free, with permanent electrodes implanted in the middle ear near the round window. In most experiments the ear-bones were removed, and the acoustic stimuli was delivered by an earphone connected to the middle ear through an implanted tube. Cochlear microphones and action potentials of the auditory nerve were recorded on magnetic tape. Continuous averaging of 35 to 40 responses was performed with a photo-optic-electronic method.

1147

Instituto de Quimica Fisica, Madrid (Spain).

SURFACE REACTION OF IRON WITH THIO- AND PHOSPHORUS-ORGANIC COMPOUNDS DISSOLVED IN HYDROCARBONS, by J. Llopis, J. M. Gamboa and others. Apr. 30, 1963, 105p. (AF 61(052)523) AD 412357 Unclassified

The use of compounds labelled with S-35 or P-32 permits the study of the surface interaction of extreme pressure lubrication additives with Fe. Hexadecane has been used as solvent. The efficiency of the radiochemical method has been emphasized. In the work here described, the behavior of a series of butyl sulphides and polysulphides up to the tetrasulphide has been studied. A mechanism to explain the surface reaction has been postulated, taking into account the lability of the S atoms in the molecules. The presence of oxygen increases the reactivity of mono- and disulphides, but decreases that of the mercaptans, this diminution being more important in the case of tri- and tetrasulphides. A mechanism to explain the action of oxygen in this sulphuration reaction has been proposed. The behavior with Fe of tricresyl phosphate and tributyl phosphite has been studied. In both cases a decisive influence of oxygen in the kinetics of the surface reaction has been observed.

1148

Instituto Geofisico de Huancayo, Lima (Peru).

PRELIMINARY MEASUREMENT OF H-ALPHA FLARE SPECTROGRAMS, by M. Ishitsuka, O. Takahashi and others. Feb. 1963, 22p. (AF 49(638)637) AD 437506 Unclassified

A spectrograph for observing solar flare spectra is being built. With the spectrograph, 22 spectrograms were taken successively with short time intervals, in a narrow spectral region centered in the hydrogen H-alpha line, throughout a solar flare event detected on Sept. 7, 1962. Several of the spectrograms were traced with a microphotometer. Observed profiles are compared.

1149

Instituto Geografico y Catastral. Observatorio Central Geofisico, Toledo (Spain).

CRUSTAL PHASES ACROSS THE IBERIAN PENINSULA REGION, by G. Payo. [1964] [23]p. incl. diagrs. table, refs. (AFOSR-65-2037) (AF 61(052)657) AD 616016 Unclassified

Also published in Ann. Geofisica (Rome), v. 17: 523-545, 1964.

A large collection of seismograms from near earthquakes recorded at Toledo Observatory have been revised in order to get the characteristics of the crustal phases for the Iberian Peninsula Region. After a careful determination of the parameters of the earthquakes, by using all the Spanish Seismological Stations, 39 of them have been selected and grouped in three characteristic groups corresponding to the regions named Algeria, Alboran Sea and rest of the Peninsula, which have been studied comparatively.

1150

Instituto Geografico y Catastral. Observatorio Central Geofisico, Toledo (Spain).

A SEISMIC PROBABILITY MAP, by J. M. Munuera. [1964] [15]p. incl. diagrs. tables, refs. (AFOSR-65-2248) (AF 61(052)657) Unclassified

Also published in Ann. Geofis. (Rome), v. 17: 547-561, 1964.

The material included in two former papers which sums 3307 shocks corresponding to 2360 years, up to 1960, was reduced to a 50 years period by means of the weight obtained for each epoch. The weighting factor is the ratio 50 and the amount of years for every epoch. The frequency has been referred over basis VII of the international seismic scale of intensity, for all cases in which the earthquakes are equal or greater than VI and up to IX. The sum of products: frequency and parameters previously exposed, is the probable frequency expected for the 50 years period.

1151

Instituto Geografico y Catastral. [Observatorio Central Geofisico] Toledo (Spain).

[BACKGROUND NOISE ON THE S.S.S. STANDARD INSTRUMENTS] Ruido de Fondo en los Sismógrafos Standard del Servicio de Sismología, by A. Lopez Arroyo. 1964, 1v. incl. diagrs. tables, refs. (AFOSR-65-2318) (AF 61(052)657) AD 628023 Unclassified

A study of noise observed on the Toledo and Malaga seismographs of the World-wide Standardized Seismograph Network is given. For both sets of instruments, LP and SP, the noise is classified in microseisms and disturbances. The spectrum of LP and SP microseisms is obtained and compared with previous data. A minimum of the amplitude in the neighborhood of 2 cps, already observed at many sites of the USA, is also shown for Toledo and Malaga; whereas the maximum of the spectrum around 4 - 8 sec, established by Brune and Oliver and considered by them as a major result of observational seismology is not clearly defined. Annual variation of microseismic period and amplitude is analyzed and the ratio AH/AZ derived; Observation shows the existence of a predominant period of microseisms at the two places considered.

1152

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

COMBUSTION OF SOLID PROPELLANTS AND FLAMES STRUCTURES, by C. Sanchez Tarifa. Final rept. Apr. 1, 1962-Apr. 1, 1963, 1v. (AFOSR-5216) (AF EOAR-62-90) AD 416546 Unclassified

Work on combustion of solid double-base propellants has been finished. The studies on flames structures, which comprise the hydrogen-oxygen flame with spherical symmetry, will be continued. In the last part of the program studies on heterogeneous combustion processes were initiated. They comprise the study of two-dimensional flame propagation in liquid fuels; ignition and combustion of liquid layers and ignition properties of inhibited fuel mists.

1153

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

UNIDIMENSIONAL THEORY OF SUPERSONIC COMBUSTION, by I. Da-Riva. May 1, 1963, 22p. (AFOSR-5260) (AF EOAR-62-91) AD 416526 Unclassified

This paper outlines a generalized unidimensional theory of supersonic combustion. It considers a stream of oxidizer flowing along a tube with lateral fuel supply governed by a certain injection law and the combustion occurring in conditions in which the pressure is kept constant. The principal results obtained by using the simple model under consideration are: (1) If the injecting of fuel does not impart kinetic energy to the flow, the mixing process, even supposing it takes place in ideal conditions, appreciably lowers the upper limit to the practicability of supersonic combustion (the dissociation limit). (2) As for the lengths required for combustion to take place, the estimate arrived at by this method is practically the same as that obtained by assuming that the mixing and the reaction are two independent processes. (3) In most of the cases considered the diffusion governs the process; in other words, the flow is closer to chemical-equilibrium than to frozen-flow conditions.

1154

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

ON THE STRUCTURE OF LAMINAR DIFFUSION FLAMES, by A. Linan. June 1, 1963, 40p. incl. diagrs. refs. (Technical rept. no. FM 63-2) (AF EOAR-63-43) AD 437646; AD 432822 Unclassified

The structure of laminar diffusion flames is analyzed in the limiting case of large, although finite, reaction rates. It is shown that the chemical reaction takes place only in a very thin region or chemical boundary layer where convection effects may be neglected. Then the temperature and mass fraction distributions within the reaction zone are obtained analytically. The flame position, rates of fuel consumption, and temperature and concentration distributions outside of the reaction zone may be obtained by using the assumption of infinite reaction rates. For large Reynolds numbers mixing and combustion take place in boundary layers and free mixing layers. And again analytical solutions are obtained for the temperature and mass fraction distributions outside of the reaction zone.

1155

Instituto Nacional de Tecnica Aeroespacial, Madrid (Spain).

SOME RESULTS IN SUPERSONIC COMBUSTION, by I. Da-Riva, A. Linan and E. Fraga. [1964] [28]p. incl. diagrs. refs. (AFOSR-64-2026) (AF EOAR-63-43) AD 451191 Unclassified

Presented at Internat'l. Council of the Aeronautical Sciences Fourth Cong., Paris (France), Aug. 24-23, 1964.

Some basic aspects of supersonic combustion are discussed, concerning the use of airbreathing engines for the propulsion of space vehicles within the atmosphere. The advantages and drawbacks of using diffusion flames for supersonic combustion are discussed. An analysis of the supersonic turbulent mixing process is included. The influence on the flow field of the heat addition due to the diffusion flame is also analyzed. Finally, chemical kinetic nonequilibrium effects with special emphasis on flame extinction are treated by considering, first, the laminar diffusion case and, afterwards, a tentative extension to the turbulent case.

1156

Instituto Nacional de Tecnica Aeroespaciai, Madrid (Spain).

FIFTH AFOSR CONTRACTORS' MEETING ON CHEMICAL KINETICS OF PROPULSION; ABSTRACTS OF PAPERS, Madrid (Spain), Sept. 2-4, 1964. [1964] 45p. (AFOSR-65-1268) (AF EOAR-63-43) AD 622582 Unclassified

Abstracts are presented for twenty-two papers presented at the Fifth AFOSR Contractors' Meeting on Chemical Kinetics of Propulsion. Topics covered are mainly concerned with the combustion and reaction processes of propellant systems.

1157

Instituto Tecnologico de Aeronautica, Sao Paulo (Brazil).

EXPERIMENTS WITH AN EXTERNAL JET FLAP, by M. J. Krieger. [1963] 36p. incl. illus. diagrs. (AFOSR-4730) (AF 49(638)583) AD 407051 Unclassified

A study was made of several external-jet-flap configurations, tested between end plates in a blower-type wind tunnel. Comparison is also made with a trailing edge jet flap tested under the same conditons. Tests were made at a Reynolds number of 1.7×10^5 and at jet momentum coefficients up to 2.616, through a range of angles of attack from 0 to 35°. (Contractor's abstract)

1158

International Business Machines Corp. [Thomas J. Watson Research Center] Yorktown Heights, N. Y.

A THEORY OF NONLINEAR NETWORKS, II, by R. K. Brayton and J. K. Moser. [1964] [24]p. incl. diagrs. refs. (AFOSR-64-1818) (AF 49(638)1139) AD 449257 Unclassified

Also published in Quart. Appl. Math., v. 22: 81-104, July 1964.

In this paper the existence and the form of the mixed potential function for complete electrical networks is derived using a graph theoretic approach. Some well-known results for electrical networks are discussed and rederived starting with the existence of a mixed potential function. In the last section a theorem on the existence of periodic solutions for periodically excited nonlinear circuits is proved.

1159

International Business Machines Corp. [Thomas J. Watson Research Center] Yorktown Heights, N. Y.

STABILITY CRITERIA FOR LARGE NETWORKS, by R. K. Brayton. [1964] [5]p. incl. diagrs. (AFOSR-64-2319) (AF 49(638)1139) AD 452428 Unclassified

Also published in IBM Jour. Research and Development, v. 8: 466-470, Sept. 1964.

An arbitrarily large network of bistable tunnel diode switching circuits is analyzed for stability. One condition derived indicates that increasing the total 'fan' of each circuit might tend to make the whole network unstable. This condition is independent of the tunnel-diode characteristic. Another condition is also derived which depends on this characteristic but does not involve the total 'fan'. Finally, two general theorems which were proved in another paper are stated and discussed in terms of their applicability to certain classes of large networks and of the types of conditions for stability that can be obtained.

1160

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

ON THE EFFECT OF COMPONENT TOLERANCES IN THE BALANCED-PAIR TUNNEL-DIODE CIRCUIT, by R. K. Brayton. [1964] [6]p. incl. diagrs. (AFOSR-64-2320) (AF 49(638)1139) AD 452313 Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 351-356, Sept. 1964.

The purposes of this study are (1) to determine for the balanced-pair tunnel-diode circuit the minimum amount of control required when specified parameter imbalances are present and (2) to illustrate a method of analysis using perturbation theory which can be applied to nonlinear, almost symmetrical circuits.

1181

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

A STABILITY THEORY FOR NONLINEAR MIXED INITIAL BOUNDARY VALUE PROBLEMS, by R. K. Brayton and W. L. Miranker. (AFOSR-85-1023) (AF 49(638)1139) AD 818851 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 17: 358-376, 1964.

The notion is discussed of complete stability of mixed initial boundary problems for systems of partial differential equations, either linear or nonlinear. A method of constructing Liapunov functionals is given from which the stability statement is obtained. A theorem is then presented which shows that complete stability follows from the existence of a Liapunov functional. A number of examples are presented.

1162

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

SOLID TRANSPORT RATE IN THE VAPOR-SOLVENT GROWTH SYSTEM ZnS:I, by F. Jona and G. Mandel. [1964] [4]p. (AFOSR-64-1251) (AF 49(638)1201) AD 442819 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 187-190, 1964.

Measurements of the rate of solid transport have been carried out in the system ZnS:I with two different sealed-tube geometries. The cubic ZnS crystals obtained are comparable in size and quality to those grown from HCl. With increasing pressure, the transport mechanism is at first diffusion-then convection controlled. In the range of diffusive flow, the pertinent theory for multireaction multi-component systems is in satisfactory agreement with the experimental data.

1163

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. J.

CHEMICAL EQUILIBRIA IN THE GERMANIUM-IODINE AND GERMANIUM-BROMINE SYSTEMS BY WEIGHT-LOSS MEASUREMENTS, by F. Jona, R. F. Lever, and H. R. Wendt. [1964] [5]p. (AFOSR-64-1252) (AF 49(638)1201) AD 442813 Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 413-417, Apr. 1964.

Simple heterogeneous equilibria can be elucidated by determining the total amount of solid that goes in the gas phase under the action of a known amount of gaseous solvent at a given temperature. This method was first tested satisfactorily with the germanium-iodine system, for which thermodynamic data are already available, and then applied to the germanium-bromine system. The data make it possible to calculate the ratio between total density of germanium atoms and total density of halogen atoms in the gas phase within a wide range of temperatures and pressures. These calculations enable one to predict the direction and the amount of diffusive vapor transport in closed or open vapor growth systems.

1164

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

THE EQUILIBRIUM BEHAVIOR OF THE SILICON-HYDROGEN-CHLORINE SYSTEM, by R. F. Lever. [1964] [8]p. (AFOSR-64-2105) (AF 49(838)1201) AD 451735 Unclassified

Also published in IBM Jour. Research and Development, v. 8: 460-465, Sept. 1964.

The composition of the gas phase is calculated for various temperatures, pressures, and chlorine-to-hydrogen ratios for the two-phase system consisting of solid silicon in equilibrium with the gas phase. It is shown that in the range of variables most frequently used for vapor growth of silicon, the principal species under equilibrium conditions are H_2, HCl, $SiHCl_3$, and $SiCl_2$.

1185

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

APPLICATION OF SPIN-WAVE THEORY TO EuS, by S. H. Charap and E. L. Boyd. [1964] [8]p. (AFOSR-84-1201) (AF 49(638)1230) AD 443010 Unclassified

Also published in Phys. Rev., v. 133: 811-818, Feb. 3, 1964.

Magnetization data for EuS powder in zero field and at liquid-helium temperatures has been obtained by nuclear magnetic resonance of both the Eu^{151} and Eu^{153} nuclei.

1188

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

EPR OF EXCHANGE-COUPLED PAIRS OF Eu^2 IN CaO AND SrO, by B. A. Calhoun and J. Overmeyer. [1964] [2]p. (AFOSR-84-1202) (AF 49(638)1230) AD 443011 Unclassified

Also published in Jour. Appl. Phys., v. 35: 989-990, Mar. 1964.

The EPR spectra of isolated Eu^{2+} ions have been studied in crystals of CaO and SrO. The g values and hyperfine constants are the same in both crystals. The values for the exchange interactions agree with those inferred from the magnetic properties of the europium chalcogenites.

1167

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

SPECIFIC HEAT OF EuS, by V. L. Moruzzi and D. T. Tearey. [1963] [5]p. (AFOSR-64-1203) (AF 49(638)-1230) AD 443013 Unclassified

Also published in Solid State Commun., v. 1: 127-131, 1963.

Specific heat measurements of EuS between 10 and 35°K show a sharp peak at 16.2°K. The measurements are analyzed using the constant coupling approximation, and it is shown that the dominant exchange interaction is between nearest neighbor Eu^{++} ions.

1168

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

FERROMAGNETIC EUROPIUM COMPOUNDS, by T. R. McGuire and M. W. Shafer. [1964] [5]p. (AFOSR-64-1205) (AF 49(638)1230) AD 443014 Unclassified

Also published in Jour. Appl. Phys., v. 35: 984-988, Mar. 1964.

Ferromagnetism has been found in several divalent europium compounds. The materials investigated can be divided into three groups, europium chalcogenides, europium halogens, and europium silicates. Magnetic information on these compounds are summarized and theoretical results reviewed.

1169

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

MAGNETIC RESONANCE STUDIES OF THE CUBIC ANTIFERROMAGNET $RbMnF_3$, by M. J. Freiser, R. J. Joenk and others. [1964] [5]p. incl. diagrs. (AFOSR-65-1985) (AF 49(638)1379) AD 627200 Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism, Nottingham (Gt. Brit.), Sept. 7-11, 1964, p. 432-436.

The propertles of the cubic antiferromagnet $RbMnF_3$ are studied by means of antiferromagnetic resonance and Mn^{55} nuclear resonance. The possibility of observing non-linear interactions between the two antiferromagnetic resonance modes is discussed. The temperature variation of the anisotropy has been measured up to 77°K. It has been found to agree within experimental error with Wolf's molecular field treatment of the dependence of K on M and with the assumption that $M/M_0 = B_{5/2}(T/T_N)$ with $T_N = 82.6°$ as obtained from specific heat measurements. The nuclear magnetic resonance measurements are refined and extended to applied fields of 27kOe yielding a value of the unpulled nuclear magnetic resonance frequency of 686.2 mc/sec. The half-width at half-maximum is independent of field at fields large enough to eliminate domain effects and is found to be 280 kc/sec, about an order of magnitude less than the Suhi-Nakamura linewidth. An as yet unexplained anomaly occurs when the pulled nuclear frequency is 380 mc/sec.

1170

International Business Machines Corp. Thomas J. Watson Research Center, Yorktown Heights, N. Y.

MAGNETIC PARAMETERS IN NiF_2, by R. J. Joenk and R. M. Bozorth. [1964] [4]p. incl. diagrs. table. (AFOSR-65-2581) (AF 49(638)1379) AD 629293 Unclassifled

Also published in Proc. Internat'i. Conf. on Magnetism, Nottingham (Gt. Brit.), Sept. 7-11, 1964, p. 493-496.

Using the Moriya model of weak ferromagnetism in NiF_2 we have derived from magnetic measurements the various parameters: the canting angle of the spin φ_0 = 0 39° and the anisotropy field H_M = 15.3 kOe that causes it, the axial anisotropy fieid H_A = 36.9 kOe that maintains the antiferromagnetic vectors perpendicular to the tetragonal axis, the exchange fieid H_E = 1130 kOe and the splitting factor $\bar{g}$ = 2.31. These quantities are obtained from measurements of moment as a function of field and temperature with the additional use of the antiferromagnetic resonance data of Richards, confirmed by Wheeler, to fix the constant H_A. (Contractor's abstract)

1171

Iowa State U. Dept. of Chemistry, Ames.

REACTIONS OF RESONANCE STABILIZED ANIONS. PART IX. CONDENSATIONS OF AROMATIC ALDEHYDES IN DIMETHYL SULFOXIDE SOLUTION. PART X. PREPARATION AND PUMMERER REARRANGEMENT OF β-KETOSULFOXIDES, by G. A. Russell, H.-D. Becker, and G. J. Mikol. [1963] [9]p. incl. diagrs. tables, refs. (AFOSR-64-0128) (AF AFOSR-63-38) AD 431075 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 3406-3414, Nov. 5, 1963.

An asymmetric tricarbon condensation involving an aromatic aldehyde diphenylmethane, and the solvent dimethyl sulfoxide has been found to occur in the presence of potassium t-butoxide. The condensation product readily undergoes an elimination reaction to yield either of two isomeric triarylpropenes. The mechanism of the condensation reaction has been established by isolation of all probable intermediates. The preparation of β-ketosulfoxides from aromatic esters and dimethyl sulfoxide is described. Acid-catalyzed rearrangement of these β-ketosulfoxides leads to the formation of methyl hemimercaptals of α-ketoaldehydes.

1172

Iowa State U. Dept. of Chemistry, Ames.

NATURE OF THE POLAR EFFECT IN REACTIONS OF ATOMS AND RADICALS. II. REACTION OF CHLORINE ATOMS AND PEROXY RADICALS, by G. A. Russell and R. C. Williamson, Jr. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1504) (AF AFOSR-63-38) AD 446120 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2357-2364, June 20, 1964.

The attack of chlorine atoms upon substituted toluenes and of peroxy radicals upon substituted cumenes has been found to show a polar effect best correlated by σ^+ constants. Polar effects in the oxidation of substituted styrenes were found, but the rates of autooxidation of benzyl phenyl ethers were found to be insensitive to the nature of substituents. No polar effect could be found when the reactivities of styrenyl and p-nitrostyrenyl radicals toward molecular oxygen were compared.

1173

Iowa State U. Dept. of Chemistry, Ames.

DIRECTIVE EFFECTS IN ALIPHATIC SUBSTITUTIONS XXV. REACTIVITY OF ARALKANES, ARALKENES, AND BENZYLIC ETHERS TOWARD PEROXY RADICALS, by G. A. Russell and R. C. Williamson, Jr. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-1505) (AF AFOSR-63-38) AD 446120 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2364-2367, June 20, 1967.

The competitive oxidation of a number of aralkanes, aralkenes, and benzyl ethers has been performed and their reactivities toward the derived peroxy radicals measured. The reactivities are fairly independent of the structure of R in ROO. To explain the rates of oxidation of the pure compounds, it must be assumed that termination rate constants are dependent upon the structures of the peroxy radicals. This observation is consistent with the rate minima observed in the autooxidation of numerous binary mixtures.

1174

Iowa State U. Dept. of Physics, Ames.

SOUND DISPERSION IN SUBSTITUTED METHANE-INERT GAS MIXTURES, by J. R. Olson and S. Legvold. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0260) (AF AFOSR-62-319) AD 437086 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2902-2908, Dec. 1, 1963.

Binary halomethane-noble gas mixtures were examined ultrasonically. The methanes used were CF_4, CHF_3, and CCl_2F_2 and the noble gases were Ar, Ne, and He. Results obtained show that the reciprocal relaxation times for these mixtures vary linearly with the concentration. Also, Ar-X collisions are less effective, He-X collisions are much more effective, and Ne-X collisions differ little from X-X collisions in vibrational energy transfer. X represents the dispersive gas. Theoretical values of Z_{10}^{AB}, the mean collision lifetime of an A molecule in an ortherwise pure gas of B molecules, were calculated according to the Schwartz, Slawsky, and Herzfeld theory. Intermolecular potentials appropriate for the treatment of the data were examined and it was found that the Lennard-Jones 6:12 potential was appropriate for the noble gases, and the 7:26 form was appropriate for the halomethanes. (Contractor's abstract)

1175

Iowa State U. Dept. of Physics, Ames.

SOUND ABSORPTION IN BINARY MIXTURES OF HALOMETHANE GASES, by M. L. Wang, R. R. Boade, and S. Legvoid. [1964] [2]p. incl. diagr. table. (AFOSR-65-2626) (AF AFOSR-62-319) AD 628426 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3679-3880, Dec. 15, 1964.

Results of sound absorption measurements on binary mixtures of CH_2F_2, CHF_3, CF_4 and CCl_2F_2 are given. The mixtures show no evidence of multiple dispersion. The observed relaxation times are discussed in relation to a theory of Calvert and Amme.

1176

Iowa State U. [Dept. of Mathematics] Iowa City.

RICCATI MATRIX DIFFERENTIAL EQUATIONS AND NON-OSCILLATION CRITERIA FOR ASSOCIATED LINEAR DIFFERENTIAL SYSTEMS, by W. T. Reid. [1963] [21]p. (AFOSR-JI271) (AF AFOSR-62-78) AD 424341 Unclassified

Also published in Pacific Jour. Math., v. 13: 665-685, 1963.

The purpose of the present paper is to study in more detail the concept of a principal solution of a non-oscillatory linear matrix differential system, together with related problems for the associated Riccati matrix equation. In particular, certain aspects considered previously in variational context only are here divorced from such limitations.

1177

Iowa State U. Dept. of Mathematics, Iowa City.

PRINCIPAL SOLUTIONS OF NONOSCILLATORY LINEAR DIFFERENTIAL SYSTEMS, by W. T. Reid.

[1964] [27]p. (AFOSR-65-0344) (AF AFOSR-63-438) AD 612312 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 9: 397-423, Dec. 1964.

A summary is presented of recent work done by the authors in the methods of analysis of factorial designs, including both fractional replications and confounded designs. The general methods of analysis described herein not only facilitate the analysis in individual cases, but also they throw light on possible methods of constructing designs with various desirable properties.

1178

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

SIMULTANEOUS OBSERVABILITY AND THE LOGIC OF QUANTUM MECHANICS, by J. C. T. Pool. June 1964, 1v. (Rept. no. SUI 63-17) (AFOSR-5268) (AF AFOSR-62-122) AD 417667 Unclassified

The axiomatization of quantum mechanics formulated by G. W. Mackey is based on several physically plausible axioms. Heuristic interpretations of the properties of the collection of all observable quantities and the collection of all states of a physical system motivate these axioms. The axioms characterize a logical structure consisting of a sigma-orthocomplete, orthomodular, orthocomplemented, partially ordered set, called a logic, and a sigma-convex, sufficient set of probability gages on the logic. The elements of the logic, called questions, are interpreted as mathematical constructs representing the experimental propositions concerning the physical system, while each probability gage represents a possible state of the physical system.

1179

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

STATISTICAL THEORY OF ENERGY-LEVEL SPACING DISTRIBUTIONS FOR COMPLEX SPECTRA, by H. S. Leff. June 1963, 194p. (Rept. no. SUI 63-23) (AFOSR-5269) (AF AFOSR-62-122) AD 417373 Unclassified

The present work includes four main objectives: (1) to give precise mathematical definitions for the mth order spacing distributions without specifying a particular ensemble, (2) to obtain a connection between ensembles of Hermitian matrices and ensembles of unitary matrices, (3) to introduce an entire class of 'generalized' ensembles for which various statistical properties can be calculated formally, and (4) to use the formalism of (1) to find the mth order distributions for series of levels with mixed spins and parities.

1180

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

CONTRASTS AND CONFLICTS OF S-MATRIX AND FIELD THEORY, by M. Dresden. June 1963, 48p. (Rept. no. SUI 63-21) (AFOSR-5293) (AF AFOSR-62-122) AD 419389 Unclassified

The framework of the various field theories is outlined briefly. Since the motivation of the S-matrix approach stems in part from a dissatisfaction with field theory, it is important to examine the underlying assumptions of the different field theories. There is a brief description of the assumptions made by Stapp ("The Stapplan Way") in his axiomatic discussion of S-matrix theory. In addition to a description of the axioms, there are also a number of remarks, comments, and criticisms of these axioms. The S-matrix criticism of the notions of usual field theory is re-examined as is the manner in which the new postulates are supposed to circumvent the field theoretic difficulties.

1181

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

THE INFLUENCE OF INITIAL CORRELATIONS ON THE APPROACH TO EQUILIBRIUM, by G. L. Jones. Dec. 10, 1963, 8p. (AFOSR-64-1976) (AF AFOSR-62-122) AD 452508 Unclassified

Also published in Jour. Math. Phys., v. 5: 651-658, May 1964.

The irreversible behavior of a particle under the influence of fixed scattering centers is investigated in the weak coupling limit. An ensemble is introduced which statistically describes the scattering centers as well as the particle. This allows the treatment of correlations between the particle and the scattering centers. A new diagrammatic method is used to investigate high-order terms in the perturbation theory. This method yields quite explicit information about the way in which the influence of initial correlations will disappear. In particular, it is quite clear that as one goes to higher order in the perturbation theory one must wait longer times for the influence of initial correlations to disappear. For completeness, The Boltzmann equation is derived and solved to lowest order in the interaction strength.

1182

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

APPLICATION OF NONLOCAL FIELD OPERATORS TO A SYSTEM OF HARD-SPHERE BOSE, by K. W. Wong. [1964] [6]p. (AFOSR-64-1968) (AF AFOSR-64-517) AD 452501 Unclassified

Also published in Jour. Math. Phys., v. 5: 637-642, May 1964.

Some relationships of the nonlocal field operators and the usual free-field operators are obtained. The interaction Hamiltonian derived with the help of these relationships is compared with the pseudopotential recently obtained by Liu and Wong. A study of the fluid dynamical equations at extreme low temperature has been made.

1183

Iowa State U. [Dept. of Physics and Astronomy] Iowa City.

CLASS OF ENSEMBLES IN THE STATISTICAL THEORY OF ENERGY-LEVEL SPECTRA, by H. S. Leff. [1964] [6]p. (AFOSR-64-1969) (AF AFOSR-64-517) AD 452502 Unclassified

Also published in Jour. Math. Phys., v. 5: 763-768 June 1964.

The investigation of a large class of ensembles in the statistical theory of energy-level spectra is initiated.

1184

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

ON THE DEFINITION OF SCATTERING IN RELATIVISTIC QUANTUM FIELD THEORY, by R. Fong. [1964] [15]p. incl. refs. (AFOSR-65-0412) (AF AFOSR-64-517) AD 612309 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1422-1436, Sept. 1, 1964.

A relativistic interacting theory for neutral bosons and in which there can be no stable bound states is studied. The theory is obtained by embedding two-particle relativistic quantum mechanics in quantum field theory by means of a procedure recently given by Sudarshan. This results in a theory in which there is scattering in the two-particle channel only. An 'interacting' field operator $\psi(x)$ is defined for the theory. It is then found that under the usual formulation of axiomatic quantum field theory $\psi(x)$ must be regarded as a 'local free-field operator'. However, there is inherent in $\psi(x)$ scattering information. A new asymptotic condition for field operators is then proposed, whereby this scattering information may be extracted. A heuristic discussion of the physical significance of the asymptotic condition is also given. (Contractor's abstract)

1185

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

A METHOD OF SOLVING THE MANY-BODY K-MATRIX WITH A YUKAWA INTERACTION POTENTIAL, by K. W. Wong. [1964] [37]p. (AFOSR-65-0413) (AF AFOSR-64-517) AD 612310 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 816-818, Nov. 1964.

The problem of solving the many-body K-matrix with a Yukawa potential can be formulated approximately into solving a potential of the form $\sum_{l=1}^{M} \sum_{l=o}^{\infty} \sum_{m=1}^{l}$ $a_l(k')b_l(k)Y_{lm}(k'|_p)Y^*_{lm}(k|_p)$. It is shown in this note how to approximate the matrix in terms of this finite series.

1186

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

A METHOD OF SOLVING THE MANY-BODY K-MATRIX, by K. W. Wong. Nov. 1964 [8]p. incl. refs. (AFOSR-65-0414) (AF AFOSR-64-517) AD 612311 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 591-598, Nov. 1, 1964.

The theory of many-body systems with strong interactions involves the problem of solving a K-matrix. This note discusses how to handle the K-matrix with an approximation method to the interaction potential. The classes of Bose statistics and Fermi statistics are treated. For the Fermi case the K-matrix equation with and without hole-hole interaction is considered.

1187

Iowa State U. Dept. of Physics and Astronomy, Iowa City.

HARD-SPHERE APPROACH TO THE EXCITATION SPECTRUM IN LIQUID HELIUM II, by L. Liu L. S. Liu, and K. W. Wong. [1964] [7]p. incl. diagrs. refs. (AFOSR-65-0415) (AF AFOSR-64-517) AD 612348 Unclassified

Also published in Phys. Rev., v. 135: A1166-A1172, Aug. 31, 1964.

The excitation spectrum of a Bose system of hard spheres is obtained in a high-density calculation including multiple scattering processes. The hard-sphere interaction is represented by a non-Hermitian pseudopotential constructed in a previous work, and the T-matrix method of Brueckner and Sawada is adopted with modifications to take into account the non-Hermitian property of the Hamiltonian. The inclusion of multiple scattering is found essentially to give a screening effect to the two-body interaction in a many-body medium. The screening factor is studied within certain approximations and is shown to play a very important role in determining the shape of the excitation spectrum. The effect of depletion of particles from the zero-momentum state due to particle interaction is also included in a self-consistent way and is found to be very small. The

calculated spectrum is then applied to liquid helium and there is a good qualitative agreement with experiments. Especially, a roton-type dip exists in the spectrum. (Contractor's abstract)

1188

Istituto Documentazione della Associazione Meccanica Italiana, Milan (Italy).

A PROJECT FOR AUTOMATIC SENTENCE ANALYSIS, by E. von Glasersfeld. [1964] [9]p. (AFOSR-65-0860) (AF EOAR-64-54) AD 617865 Unclassified

Also published in Beitrage Sprachkunde und Informationsverarbeitung, No. 4: 38-46, 1964.

The newly organized language research section of IDAMI in Milan is conducting an experimental investigation on automatic English sentence analysis. This investigation has 2 purposes: (1) to elaborate and improve the automatic correlation procedure of von Glasersfeld and Burns, and implement it in a computer program by means of a "Multistore" system; and (2) to use syntactic correlation procedure to isolate semantic factors for the analysis or interpretation of the meaning of English sentences, and employ these semantic factors in the correlation procedure in order to reduce the output of semantically unacceptable sentence analysis.

1189

Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin (Italy).

[RESEARCH IN SOLID-STATE PHYSICS AT THE LABORATORY FOR ELECTRON MICROSCOPY OF THE ISTITUTO ELETTROTECNICO NAZIONALE] Richerche di fisica dei solidi presso il Laboratorio di Microscopia Elettronica dell'IEN, by G. Bonfiglioli. [1964] [12]p. incl. illus. diagrs. table. (AFOSR-65-0763) (AF 61(052)328) AD 616465 Unclassified

Also published in Fisica Stato Solido; Convegno indetto dello Società Lombarda di Fisica, Pavia (Italy) (July 16-18, 1962) 1964, p. 3-14.

Several subjects which have been or are being investigated at the laboratory are surveyed. First, alkali halide thermoluminescence above room temperature: a model is proposed, using a second order kinetics, that accounts well for a number of experimental results rather poorly explained by previous theories. Experiments are then mentioned on intrinsic electroluminescence of ZnS specimens, undergoing linear voltage transients. The results are compared with those predictable on the basis of a mathematical development of Zalm's theory. Electron microscopy studies of tracks of fission products in mica are discussed, and mention is made of experiments on surface electrical conductivity in metals.

1190

Istituto Elettrotecnico Nazionale Galileo Ferraris, Turin (Italy).

GRAPHITE DEFECTS OBSERVED BY ELECTRON MICROSCOPY, by G. Bonfiglioli and A. Mojoni. Sept. 1963 [10]p. incl. illus. refs. (Technical note no. 1) (AFOSR-5436) (AF EOAR-63-87) Unclassified

Also published in Jour. Appl. Phys., v. 35: 683-685, Mar. 1964. (AFOSR-64-1214; AD 443020)

Structural defects of natural graphite are characterized by Newton-ring-like electron microscopic contrast. Pictures are given, evidencing their aspect, their peculiar distribution (often corresponding to linear alignment), and their behavior at high temperatures. A discussion is presented concerning related theoretical and experimental results of other authors and in particular the relationship of these defects to radiation damage.

1191

Istituto Elettrotecnico Nazionale [Galileo Ferraris] Turin (Italy).

Cu REPRECIPITATION AND ELECTROLUMINESCENCE IN ZnS SINGLE CRYSTALS, by G. Bonfiglioli and A. Suardo. [1964] [2]p. incl. illus. diagr. (AFOSR-65-0751) (AF EOAR-63-87) Unclassified

Also published in Phys. Ltrs., v. 13: 197-198, Dec. 1, 1964.

The results of this investigation demonstrate the occurrence of a large aging effect in Cu-doped electroluminescent ZnS single crystals. This suggests that the ac electroluminescent behavior of this material is influenced by reprecipitation of the cu-rich phase within the host matrix.

1192

Istituto Elettrotecnico Nazionale [Galileo Ferraris] Turin (Italy).

PRINCIPLES OF SELF-MODULATING DERIVATIVE OPTICAL SPECTROSCOPY, by G. Bonfiglioli and P. Brovetto. [1964] [8]p. incl. diagrs. table. (AFOSR-65-0752) (AF EOAR-63-87) AD 616457 Unclassified

Also published in Appl. Opt., v. 3: 1417-1424, Dec. 1964.

This paper presents the theoretical principles underlying a new technique of optical spectroscopy, characterized by the fact that the record of a spectrum, differentiated and efficiently purified of noise, is obtained in a direct and simple way. The interest of derivative optical spectroscopy is evidenced by calculations showing for a typical case the gain to be expected. A set of equations is then given showing the dependence of the new spectrometer performance on the principal design parameters. (Contractor's abstract)

1193

Istituto Nazionale di Ottica, Florence (Italy).

MUTUAL TIME INFLUENCE OF BLUE AND RED ELECTRORETINOGRAPHIC RESPONSES, by A. M. Ercoles. [1963] [8]p. (AFOSR-J641) (AF EOAR-63-4) AD 414016 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 239-246, Mar.-Apr. 1963.

Electroretinographic responses elicited by a sequence of stimuli of constant duration with various frequencies, are recorded from a dark adapted eye; for each value of frequency three different types of stimulation have been used; different types of stimulation have been used; a sequence of blue flashes, a sequence of red flashes and a sequence of blue and red flashes in succession. The results show, for each type of stimulation used, the expected decrease in amplitude of the scotopic b-wave, either when the frequency of stimulation increases or during each experimental set. The point to be emphasized is that the above said decrease in amplitude, in the case of combined red-blue stimulation attains a value which differs with respect to those recorded in the case of homo-chromatic stimulations. In conclusion, the influence of blue stimulation on the next red response is different with respect to that exerted by red stimulation on the next blue response.

1194

Istituto Nazionale di Ottica, Florence (Italy).

RESEARCH ON RETINAL MECHANISMS AND RESPONSES, by M. Bittini, A. M. Ercoles and others. Oct. 31, 1963, 60p. (AFOSR-64-0103) (AF EOAR-63-4) AD 429779 Unclassified

The present report is divided into the following six parts: (a) The interactions between the responses to visual stimuli stabilized on the retina; (b) The investigation of the effects of the stimulation of one eye on the ERG recorded from the other eye; (c) Some peculiar interaction effects occurring under differential binocular adaptation; (d) The acquisition times relative to the learning of various visual functions are reported; (e) Some suprathreshold phenomena which find their explanation in terms of retinal interaction effects possibly mediated through lateral inhibition; (f) Some irregularities of sensitivity to luminance differences which are unexpected when the smooth behavior of the Weber-Fechner function is taken in mind.

1195

Istituto Nazionale di Ottica, Florence (Italy).

ANALYSIS OF SHIFTS AND DEFLECTIONS OF BASELINE IN ELECTRORETINOGRAPHIC RECORDS, by L. Ronchi and G. Bottai. [1963] [29]p. (AFOSR-64-1059) (AF EOAR-63-4) AD 441484 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 16: 617-645, Nov.-Dec. 1963.

All the events distorting the base line, in absence of light stimulation, have been qualitatively and quantitatively analyzed. Their characteristics (such as size, duration and rate of rise) have been compared to the corresponding characteristics of assumed undistorted ERG responses, and, in addition, the possible interferences between response to light and artifact have been examined. The conclusion is that in some cases ERG response is so distorted that it must be unavoidably rejected; in some other cases the correction for distortion may be evaluated, and lastly, there are some artifacts which are so brief that they may occur during the course of ERG response without affecting the preceding and the following portions of baseline. Thus, the availability of responses is strictly connected to the degree of sophistication of the subject.

1196

Istituto Nazionale di Ottica, Florence (Italy).

SIMULTANEOUS CONTRAST EFFECTS AT THE CENTER OF FIGURES SHOWING DIFFERENT DEGREES OF SYMMETRY, by L. Ronchi and G. Bottai. [1964] [17]p. (AFOSR-64-1060) (AF EOAR-63-4) AD 441506 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19: 84-100, Jan.-Feb. 1964.

The brightness at the cross-point of two black stripes of equal thicknesses intersecting with one another has been measured under a number of experimental conditions. The observer was well adapted to the luminance of the background. In some cases a bright break or a bright flash are perceived at the cross-zone; in some other cases such an effect is not tested. In particular, the degree of symmetry of the figure plays an important role; the greater the degree of symmetry, the greater the spatial fidelity of the visual system, as far as the perception of the cross-point is concerned. Also the length of the stripes plays an important role.

1197

Istituto Nazionale di Ottica, Florence (Italy).

CONTRAST SENSITIVITY AND SPEED OF READING UNDER DIFFERENTIAL BINOCULAR ADAPTATION, by L. Ronchi and M. Conticelli. [1964] [15]p. (AFOSR-64-1061) (AF EOAR-63-4) AD 441507 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19: 69-83, Jan.-Feb. 1963.

Two experiments are reported which show that differential binocular adaptation in some cases is advantageous, with respect to the case where the eyes are adapted to the same level, in other cases it is not. More precisely, when the dynamic aspect of the process of adaptation to light is taken into account, visual performance is lesser in the case where the two eyes are simultaneously adapting to light than in the case where they are adapting one after the other. When the static aspect of adaptation is taken into account (and the

observer is presented with an empty field, in order to render the adaptational state as constant as possible), the greater performance is reported when the two eyes are adapted to the same level. The nature of the mechanism subserving the reported effect is discussed.

1198

Istituto Nazionale di Ottica, Florence (Italy).

VISUO-MOTOR REACTION TIME UNDER DIFFERENTIAL BINOCULAR ADAPTATION, by M. Conticelli and S. Fujiwara. [1964] [12]p. incl. diagrs. (AFOSR-64-2159) (AF EOAR-63-4) AD 451926 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19: 177-188, Mar.-Apr. 1964.

Visuo-motor reaction time (RT) relative to a suprathreshold stimulus has been determined both in binocular and in monocular vision. Binocular RT is found to be slightly lower than monocular RT in the case where the two eyes are adapted to the same level. An enhancement of the difference between binocular and monocular RT is found in the case of differential binocular adaptation. It is as if the dark-adapted non-viewing eye would impair, from time to time, the perception mediated through the light-adapted viewing eye.

1199

Istituto Nazionale di Ottica, Florence (Italy).

NON-INDEPENDENCE OF RED AND BLUE ERG RESPONSES EVOKED BY INTERMITTENT STIMULATION, by A. M. Ercoles. [1964] [7]p. (Rept. no. 1061) (AFOSR-64-2480) (AF EOAR-63-4) AD 453821 Unclassified

Also published in Proc. Symposium on Physiology of Flicker; Second Symposium of the Internat'l. Soc. for Clinical Electroretinography, Sept. 1963, p. 522-528.

ERG responses have been recorded from the normal human eye using the following stimuli: a series of red pulses, one of blue pulses and a combined red-blue series. Stimulus frequency varied between 7.1 and 41.2 stim/sec. The essential finding is that the action exerted by a red stimulus upon the next blue one differs from that exerted by a blue stimulus upon the next red one: the response to red having a greater amplitude than the response to blue, in the combined red-blue series, while the red and blue responses have the same size in the homochromatic series. The red response in the combined red-blue series is larger than the red response in the homochromatic series, at least for frequencies under 11.0 stim/sec, while the blue response is larger in the combined sequence than in the homochromatic one, at least for frequencies over 11.0 stim/sec.

1200

Istituto Superiore di Sanità, Rome (Italy).

EFFECT OF DRUGS ON CENTRAL NERVOUS SYSTEM NEURONES, by V. G. Longo. Final technical rept. July 1, 1963, 16p. (AFOSR-5107) (AF 61(052)399) AD 414045 Unclassified

The present report exposes the results obtained during an investigation on the effects of drugs on the electrical activity of single cortical neurones. During the course of this investigation the following drugs were injected: eserine, scopolamine, amphetamine, tryptamine, and lysergic acid diethylamide (LSD). Although it is not possible with the present limited data to arrive at any clear-cut conclusion, some comments and indications in regard to future development of the research are the following: (1) In the sensorimotor cortex there seems to be some layers that have many cells responding with increased firing rate after application of external stimuli; (2) Both eserine and amphetamine provoke an increase in firing of single neurones; and (3) The "flattening of the EEG tracing provoked by tryptamin and LSD seems to be related, at least where it is concerned with the limbic cortex, with a diminution of cellular activity.

1201

Itek Corp., Waltham, Mass.

APPLICATION OF THE GALOIS CONNECTION TO INFORMATION SYSTEMS, by R. F. Barnes and R. W. Robinson. Final rept. Sept. 15, 1964 [31]p. incl. diagrs. table. (Rept. no. Itek 9078-1) (AFOSR-64-1868) (AF 49(638)1229) AD 607396 Unclassified

The authors' inquiry into the quantitative aspects of the concepts of similarity as applied to a simple variety of library systems led to the consideration of a large family of association schemes. Each scheme was uniquely determined by a particular transformation function--a map from the set of similarity coefficients for terms (or documents) to the set of similarity coefficients for documents (or terms). The transformations considered preserve the property of nonnegativity for sets of similarity coefficients, which allows one to show that there is a set of coefficients left fixed by any chosen transformation. This set of coefficients depends on the chosen transformation and represents exactly the degree of association demanded by consistency with the chosen transformation. Thus, for any transformation one arrives at a set of similarity coefficients which corresponds to it. An iterative method was advanced for the computation of the fixed set of similarity coefficients, and the particular analytic questions remaining center upon this method.

1202

Johns Hopkins U. Dept. of Biophysics, Baltimore, Md.

AN ISOLEUCINE ACCEPTOR sRNA FROM E. COLI TRANSFERRING ISOLEUCINE INTO POLYPEPTIDE IN RESPONSE TO POLYURIDYLIC ACID (Abstract), by F. Gonano and G. von Ehrenstein. [1964] [1]p. (AFOSR-65-0955) (AF 49(638)1304) Unclassified

Presented at meeting of the Federation Amer. Soc. Exper. Biol., Atlantic City, N. J., Apr. 9-14, 1964.

Also published in Federation Proc., v. 23: Mar.-Apr. 1964.

Two isoleucine acceptor sRNA's were obtained in about equal amounts by a 300 transfer counter current distribution of E. coli B sRNA. Isoleucine was charged to both of them by a purified isoleucine activating enzyme. Isoleucine bound to the first peak is incorporated into polypeptide in response to poly UA (5:1), whereas isoleucine bound to the second peak is incorporated in response to poly U and copolymers with a high uridylic acid content. Three amino acids, phenylalanine, leucine and isoleucine have so far been found to be incorporated in response to poly U. These apparent coding ambiguities show that the requirements for coding for amino acids are less stringent in this system than in natural protein synthesis.

1203

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

INFRARED SPECTRA OF $SiH_3C{\equiv}CH$ AND $SiD_3C{\equiv}CH$, by R. B. Reeves, R. E. Wilde, and D. W. Robinson. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-84-1416) (AF 49(838)468) AD 444454 Unclassified

Also published in Jour. Chem. Phys., v. 40: 125-131, Jan. 1964.

Low-resolution infrared silylacetylene and silylacetylene-d3 enabled the fundamental vibrational frequencies to be assigned to normal modes of motion. Also, many of the overtone and combination bands were tentatively assigned. Argon-matrix spectra at 4.2°K were helpful in assigning nearly degenerate vibrations, particularly the Si-C stretching motion. Medium-resolution spectra enabled approximate values to be obtained for the band origins and Coriolis coupling constants of most of the perpendicular-type fundamentals.

1204

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

RARE GAS ION REACTIONS WITH AMMONIA, by G. R. Hertel and W. S. Koski. [1964] [3]p. (AFOSR-84-1542) (AF 49(638)481) AD 446349 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 88: 1683-1685, May 5, 1984.

The fractional yields and the relative cross sections for rare gas ion reactions with ammonia have been determined for the 3 to 200 e.v. energy region. The results are in rough agreement with the Massey-Burhop theory; however, anomalies are present. The implication of these results is discussed with respect to the recently proposed mechanism for rare gas sensitization for the production of hydrazine in the gas phase radiolysis of ammonia.

1205

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

GAS PHASE REACTIONS BETWEEN CARBON TETRACHLORIDE AND MASS ANALYZED IONS OF NITROGEN BETWEEN 3 AND 200 E.V., by E. R. Weiner, G. R. Hertel and W. S. Koski. [1964] [6]p. (AFOSR-64-1543) (AF 49(638)481) AD 448123 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 788-793, Mar. 5, 1984.

A tandem mass spectrometer has been constructed to study ion-molecule and charge-transfer reactions. A primary ion beam is generated and mass analyzed in the first mass spectrometer. An ion lens system adjusts the beam acceleration to a desired value between 3 and 200 v and focuses it into a reaction chamber containing a target gas. Secondary ions formed in the reaction chamber are extracted at right angles to the primary beam, through an exit slit into the second mass spectrometer where they are mass analyzed. Z-Direction deflection plates in the second spectrometer permit the observation of secondary ions possessing momentum in the direction of the primary ion beam. Thus, the reactions involving momentum transfer as well as charge transfer may be studied.

1206

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

HOT ATOM CHEMISTRY, by W. S. Koski. Final rept. Oct. 1983, 1v. (AFOSR-J1377) (AF 49(838)481) AD 426571 Unclassified

The contents of this report are: Rare gas ion reactions with ammonia; Gas phase reactions between carbon tetrachloride and mass analyzed ions of N between 3 and 200 ev; and Positive bromine ion bombardment of solid butane and benzene.

1207

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

CROSS SECTIONS FOR THE SINGLE CHARGE TRANSFER OF DOUBLE-CHARGED RARE-GAS IONS IN THEIR OWN GASES, by G. R. Hertel and W. S. Koski. [1984] [2]p. (AFOSR-65-0235) (AF 49(638)1301) AD 811614 Unclassified

Also published in Jour. Chem. Phys., v. 40: 3452-3453, June 1, 1964.

In the case of doubly charged ions passing through their own gases at relatively low energies, cross-section measurements of single-electron transfers require experimental techniques which differentiate between the single charge transfers and the resonant double exchanges.

1208

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

ARGON-DEUTERIUM HYDRIDE ION REACTION, by M. A. Berta and W. S. Koski. [1964] [4]p. (AFOSR-65-0236) (AF 49(638)1301) AD 611915 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5098-5101, 1964.

Reactions of HD^+ with argon have been studied using a tandem mass spectrometer. In the first two reactions, attention was centered on the isotope effect, and the ratio ARH^+/ARD^+ between 2 and 25 ev varied from 1.3 to 1.9, respectively. In the charge transfer reaction, the cross section was measured from 2 to 70 ev, and indications were obtained that the reacting HD^+ ions were in vibrationally excited states.

1209

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

CROSS SECTIONS FOR SOME GAS-PHASE SINGLE-CHARGE-TRANSFER REACTIONS OF N_2^{++} AND Ar^{++}, by E. R. Weiner, G. R. Hertel, and W. S. Koski. [1963] [2]p. (AFOSR-65-0372) (AF 49(638)1301) AD 611739 Unclassified

Also published in Jour. Chem. Phys., v. 39: 3538-3539, Dec. 15, 1963.

Results are summarized of measurements of the charge transfer cross sections for a single-electron transfer to a doubly charged ion for the reactions $N_2^{++} + N_2 = N_2^+ + N_2^+$, $N_2^{++} + H_2O = N_2^+ + H_2O^+$, and $Ar^{++} + Ar = Ar^+ + Ar^+$.

1210

Johns Hopkins U. [Dept. of Chemistry] Baltimore, Md.

INFRARED SPECTRUM OF METHYLSILYL-D_3-ACETYLENE, by R. B. Reeves and D. W. Robinson. [1964] [3]p. (AFOSR-64-2430) (AF 49(638)1430) AD 453738 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1699-1701, Sept. 15, 1964.

The near- and far-infrared spectra are reported for the molecule $D_3SiCCCH_3$ and the far-infrared spectrum for $H_3SiCCCH_3$ supplementing earlier work. All of the infrared-active vibrations have been found and assigned to normal modes. The Q branches of most of the perpendicular bands have been resolved and rotationally assigned. Coriolis coupling constants have been calculated.

1211

Johns Hopkins U. Dept. of Chemistry, Baltimore, Md.

SPECTRA OF MATRIX-ISOLATED WATER IN THE "PURE ROTATION" REGION, by D. W. Robinson. [1963] [3]p. incl. diagr. table, refs. (AFOSR-64-1507) (AF AFOSR-63-93) AD 446124 Unclassified

Also published in Jour. Chem. Phys., v. 39: 3430-3432, Dec. 1963.

The infrared spectra of matrix-isolated water in neon, argon, krypton, and xenon solids near 4°K have been obtained between 29 and 60 cm^{-1}. The few lines that are observed depend strongly on the matrix material and are in good agreement with lines in the ν_1 and ν_2 vibrational bands. This observation confirms the widely held belief that the fine structure in the near-infrared spectrum has a rotational or hindered-rotational origin. (Contractor's abstract)

1212

Johns Hopkins U. [Dept. of Mathematics] Baltimore, Md.

GEODESIC PARALLEL COORDINATES IN THE LARGE, by P. Hartman. [1964] [23]p. incl. diagr. refs. (AFOSR-65-1796) (AF AFOSR-62-45) AD 626485 Unclassified

Also published in Amer. Jour. Math., v. 86: 705-727, Oct. 1964.

Let M be a 2-dimensional manifold with a Riemannian metric, C a jordan curve on M, $\gamma(r)$ the set of points on M a distance r from C, and L(r) the length of the curve $\gamma(r)$. It is first noted that even in the euclidean plane with C a C^∞ curve, the function L(r) need not be continuous. However, under very mild differentiability conditions, L(r) is shown defined and well behaved outside of at most a closed set of r-values of Lebesque measure zero. Various inequalities used formerly by Fiala and Ahlfors are shown valid, even taking into account the exceptional set and the possible discontinuities of L. Several results are given on isoperimetric inequalities and related equations.

1213

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

TURBULENT SHEAR FLOW. Final rept. July 1, 1957 - Dec. 31, 1962. May 1963, 7p. (AFOSR-5323) (AF 49(638)248) AD 413904 Unclassified

The initial problems were the effect of rotation (about

the symmetry axis) on a round turbulent jet, and the effect of "sweep back" on a slot jet. The former was pursued with reasonable success; the latter proved too difficult a configuration to realize with precision. Therefore the normal exit case was pursued in some detail. The radial turbulent jet was also studied. These may be the first measurements made in such a configuration. Finally, in order to permit a more basic study, it was attempted to generate a nearly homogeneous turbulent shear flow. The technique is to introduce a non-uniform grid into a wind-tunnel test section. Preliminary work gave a fairly good, linear mean velocity profile, but the turbulence is still far from homogeneous.

1214

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

TWO TURBULENT SHEAR FLOWS. I. A PLANE JET. II. A RADIAL JET, by G. Heskestad. June 1963, 202p. (AF 49(638)248) AD 605595 Unclassified

Results from hot-wire measurements in a plane turbulent jet and a radial turbulent jet are reported. The plane jet was found to be approximately self-preserving sufficiently far downstream, where measurements of the intermittency and data for calculating the energy balance of the turbulent motion were made. Measurements were also made of the Reynolds number effect on the centerline development of the turbulent intensity and the flatness factor of the velocity derivative at a fixed downstream centerline-location. The radial jet was observed not to attain the degree of self-preservation noted for the plane jet in the range of the measurements. The mean velocity profiles were quite similar, but the meansquare turbulent velocity profiles were similar only away from the centerline, and the lateral intermittency distributions were highly dissimilar. Data for the energy balance was obtained at a convenient downstream location.

1215

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

CONCEPT OF FIELD MODES IN FLUID MECHANICS, by C. Kaplan. Apr. 1964, 58p. (AFOSR-64-0719) (AF 49(683)496) AD 600964 Unclassified

A new and novel method for studying the behavior of magnetohydrodynamic fields has been used to explore steady incompressible two-dimensional linearized fluid flow with finite viscosity. This method, based on the central idea of splitting the behavior of a flow field into independent modes of behavior, is then applied to the often-treated and well-known case of viscous incompressible flow over a semi-infinite flat plate immersed in an unbounded uniform stream.

1216

Johns Hopkins U. Dept. of Mechanics, Baltimore, Md.

ANALOG COMPUTER RESEARCH INTO THE ENERGY EXCHANGE BETWEEN GASES AND SOLIDS, by M. Rogers. May 1964, 222p. incl. diagrs. refs. (AFOSR-64-1001) (AF 49(638)496) AD 605159 Unclassified

A comparison is made between various models of the interaction. A description is given of the circuitry and techniques used to investigate the problem of energy exchange between gases and solids. Bounds on the applicability and interpretation of data obtained solely from computational experiments, whether performed with an analog or a digital computer, are delineated in some detail. Data are presented which was obtained in a series of analog computer experiments in gas surface interactions using several variations of a very simple model of the interaction potential, the lattice, and the physical state of the solid, particularly temperature. For the majority of the research, a non-linear coupling (potential) was used between gas particles and surface atom. Several major approximations were made in the formulation of the models investigated.

1217

Johns Hopkins U. [Dept. of Mechanics] Baltimore, Md.

A GENERALIZED LARGE DEFORMATION BEHAVIOUR FOR FACE-CENTERED CUBIC SOLIDS - HIGH PURITY COPPER, by J. F. Bell. [1964] [20]p. incl. diagrs. tables, refs. (AFOSR-65-1739) (AF 49(638)-1067) AD 625968 Unclassified

Also published in Philos. Mag., v. 10: 107-126, July 1964.

The stage III deformation of high purity copper single crystals of initially single slip orientations is found, through the Taylor aggregate theory, to be in close qualitative and quantitative agreement with Bell's generalized, temperature-dependent, dead annealed face-centered cubic polycrystalline stress-strain law. Parabolic stage III deformation is shown to be determinable from stage II measurement for all orientations. Thus, in dead annealed face-centered cubic polycrystals the wave speeds and strain of large amplitude plastic compression waves are governed by a constitutive relation whose origin is in the stage III deformation of face-centered cubic single crystals. The 49 high purity copper single crystal tension tests examined are found to have the same stage III parabola in the data of the several investigators. The stage III deformation, whose parabola coefficient is dependent upon the temperature of the test and the melting poing of the metal, is shown to be independent of the length of stage I and stage II deformation. (Contractor's abstract)

1218

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

THE SPECTRA OF THE DOUBLY AND TRIPLY IONIZED RARE EARTHS, by G. H. Dieke and H. M. Crosswhite. [1963] [12]p. incl. illus. diagrs. tables, refs. (AFOSR-J908) (AF AFOSR-63-104) AD 415882 Unclassified

Also published in Appl. Opt., v. 2: 675-686, July 1963.

The present status of our knowledge of the structure of the spectra of the doubly and triply ionized spectra of the rare earths is derived partly from experimental data of the emission spectra of the free ions which provide the energy level scheme in great detail but are difficult and laborious to analyze. For the lower levels knowledge of the structure comes from the crystal absorption and fluorescence spectra. In all cases approximate theoretical calculations of the energies are essential. (Contractor's abstract)

1219

Johns Hopkins U. [Dept. of Physics] Baltimore, Md.

SPECTROSCOPIC INSTRUMENTATION FROM THE USER'S POINT OF VIEW, by G. H. Dieke and D. F. Heath. 1964, 4p. (AFOSR-65-0446) (AF AFOSR-63-104) AD 612639 Unclassified

Presented at Conf. on Photographic and Spectroscopic Optics, Internat'l. Commission for Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

Experimentation with a 5-meter vacuum Ebert Fastie spectrograph is reported; the experimentation was into very high resolution, particularly in the vacuum ultraviolet. Orders were separated by an order sorter with cross dispersion: above 2000A a quartz prism was used and below, a grating with a concave mirror. Both order sorters performed adequately. A 600,000 resolving power was achieved. The spectrograph apparently will give in the vacuum UV above 1000A a resolution and wave number accuracy obtainable only for the visible and adjacent regions. Except for very special light sources, resolution and wave number accuracy are determined by actual line width rather than by performance of the spectrograph.

1220

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

THE SPECTRA OF DOUBLY AND TRIPLY IONIZED RARE EARTHS, by G. H. Dieke. Final rept. Dec. 31, 1964, 5p. incl. diagr. refs. (AFOSR-65-0576) (AF AFOSR-63-104) Unclassified

Energy levels of the 4 lowest configurations of the doubly, i.e. praseodymium, gadolinium, holmium, and ytterbium, and triply, i.e. praseodymium, meodymium, and erbium, ionized rare earth atoms were obtained from the vapor emission spectra of these elements. Previous work has been chiefly concentrated on the doubly ionized atoms, as the important parts of the spectra of the triply ionized atoms lie in the vacuum ultraviolet below 2000A. The chief purpose in obtaining the energy levels of the free ions is to compare them with the energy levels of the same ions obtained from crystal spectra and thus have a direct evaluation of the influence of the solid state forces.

1221

Johns Hopkins U. Dept. of Physics, Baltimore, Md.

MESON RESONANCE PRODUCTION IN π^+–d INTERACTIONS AT 1.23 BEV/C, by R. Kraemer, L. Madansky and others. [1964] [11]p. incl. diagrs. refs. (AFOSR-65-0139) (AF AFOSR-63-234) AD 455935 Unclassified

Also published in Phys. Rev., v. 136: B496-B506, Oct. 26, 1964.

A report is made of the study of production and decay properties of the η^0, ω^0, ρ^0, and π^0 mesons produced in π^+–d collisions at 1.23 bev/c in the Berkeley 72-in bubble chamber. The production processes are analyzed in terms of π^+-neutron interactions through the use of an impulse model. A clear enhancement due to the $N_{1/2}$ (1688) resonance is observed in the π^0 (charge exchange) production cross section. The mass of the η^0 meson is found to be $m_{\eta 0} = 552 \pm 3$ mev with a branching ratio of $(\eta^0 \rightarrow \text{all neutrals})/(\eta^0 \rightarrow \pi^+ \pi^- \pi^0) = 3.6 \pm 0.8$, and the partial width $\Gamma(N_{1/2}^* (1688) \rightarrow p + \eta^0) < 2$ mev. The central value of the ω^0-meson peak is found to be $m_{\omega 0} = 781 \pm 2$ mev), with a branching ratio $(\omega^0 \rightarrow \text{all neutrals})/(\omega^0 \rightarrow \pi^+\pi^-\pi^0) = 8 \pm 3\%$, and an upper limit of 5% for decay into 2 charged pions. The production of the ω^0 is found to be inconsistent with the single-vector-meson exchange model. (Contractor's abstract)

1222

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

THE RELATION OF THALAMIC CELL RESPONSE TO PERIPHERAL STIMULI VARIED OVER AN INTENSIVE CONTINUUM, by V. B. Mountcastle, G. F. Poggio, and G. Werner. [1963] [28]p. incl. diagrs. tables, refs. (AFOSR-64-1079) (AF AFOSR-62-31) AD 441478 Unclassified

Also published in Jour. Neurophysiol., v. 26: 807-834, Sept. 1963.

Those cells of the ventrobasal nuclear complex of the thalamus which are responsive to the steady position and to movements of the joints have been studied by the method of single unit analysis, in unanesthetized, deafferented-head monkeys. These cells, their related peripheral afferents, and their intervening second-order cells form a system which functions to detect the angular positions of the joints, and which details by its thalamocortical discharge pattern and frequencies the direction and rate of movement, and the steady positions of the limbs. The independent variable, joint angle, has been controlled with an instrument allowing independent variation of the speed of rotation and the extent of the angle turned, and scaled along true ratio scales. The zeros of these scales are set by the threshold, or edge of the excitatory angle, for

each cell studied. Thalamic cell discharges were measured in terms of impulses per unit time, and the validity of measurement established.

1223

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

THE VARIABILITY OF CENTRAL NEURAL ACTIVITY IN A SENSORY SYSTEM, AND ITS IMPLICATIONS FOR THE CENTRAL REFLECTION OF SENSORY EVENTS, by G. Werner and V. B. Mountcastle. [1963] [20]p. incl. diagrs. refs. (AFOSR-64-1080) (AF AFOSR-62-31) AD 441480 Unclassified

Also published in Jour. Neurophysiol., v. 26: 958-977, Nov. 1963.

The time intervals between consecutive discharges of single ventrobasal thalamic neurons, both when active in the absence of intentional peripheral stimuli and when driven by steady sensory stimulation, were measured in unanesthetized mecaque monkeys. Some statistical parameters of these interval sequences were estimated, with the hope of determining which quantitative aspects of neural impulse trains may be of importance for the central neural representation of sensory events, and for discrimination. The standard deviation is a constant percentage of the mean interval for populations of discharge intervals during that activity of thalamic neurons evoked by steady peripheral stimuli.

1224

Johns Hopkins U. Dept. of Physiology, Baltimore, Md.

THE FUNCTIONAL PROPERTIES OF VENTROBASAL THALAMIC NEURONS STUDIED IN UNANESTHETIZED MONKEYS, by G. F. Poggio and V. B. Mountcastle. [1963] [32]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1081) (AF AFOSR-62-31) AD 441470 Unclassified

Also published in Jour. Neurophysiol., v. 26: 775-806, Sept. 1963.

The method of single unit analysis has been used to study the functional properties of the third-order neurons of the lemniscal component of the somatic afferent system. These cells compose the ventrobasal nuclear complex, the thalamic relay nucleus of the system. The experiments were made on unanesthetized monkeys whose heads were made free of pain by an intracranial retrogasserian neurectomy, and by transection of the ascending branches of the cervical plexus. Those functional properties of thalamic cells which we define as static were studied in these unanesthetized animals. The properties of the mode of the adequate exciting peripheral stimulus and the locus of the peripheral field have been determined for nearly 1,000 thalamic neurons, 98% of which was later shown by the reconstruction of serial sections to be located within the cytoarchitectural confines of the ventrobasal nuclear complex.

1225

Johns Hopkins U. [Dept. of Physiology] Baltimore, Md.

FUNCTIONAL PROPERTIES OF NEURONS IN THE LATERAL CERVICAL NUCLEUS OF THE CAT, by E. Oswaldo-Cruz and C. Kidd. [1964] [14]p. (AFOSR-64-1083) (AF AFOSR-62-31) AD 441489 Unclassified

Also published in Jour. Neurophysiol., v. 27: 1-14, 1964.

A study was made of the functional properties of cells in the lateral cervical nucleus in lightly anesthetized cats. The large majority was activated by natural stimulation of the skin by either gentle movement of hairs or by slight mechanical displacement of the skin. They were related to small, continuous, precisely delineated receptive fields on the ipsilateral body surface; these fields were never observed to change in size or position while a given cell was under observation. Surround or lateral inhibition was never observed. No single cell was found which could be made to vary the rate of its discharge by gentle rotation of a joint. The methods used did not reveal a topographic representation of the body surface within the nucleus. Cells of the nucleus respond to brief electrical stimuli applied to their cutaneous receptive fields with a brief burst of impulses. The latency and number of impulses in this burst are a function of the intensity and frequency of the stimulus, and of its position within the receptive field. These studies suggest that synaptic transmission in the nucleus occurs with a considerable safety factor.

1226

Johns Hopkins U. [Dept. of Physiology] Baltimore, Md.

[SINGLE UNIT STUDIES OF CORTICAL AND SUBCORTICAL FUNCTION IN UNRESTRAINED ANIMALS]. Final technical rept. 1963, 8p. (AFOSR-64-1435) (AF AFOSR-62-31) AD 604469 Unclassified

A preparation was devised which allowed study of the central nervous system of primates in the unanesthetized state, without provocation of pain, using the method of single unit analysis. Studies were made of the neurons of the ventrobasal nuclear complex, the thalamocortical input stage of the somatic afferent system. The highly specific nature of the lemniscal system in terms of place and quality were found to be as certain and precise in the waking animal as they had previously been found to be in the anesthetized one. The temporal capacity of the lemniscal system was found to be greater in the former state than the later by an entire order of magnitude. A quantitative study was made of the relation between thalamic cell response and the driving peripheral stimulus, as the latter is varied along an intensive continuum.

1227

Jonker Business Machines, Inc., Gaithersburg, Md.

A MODEL INFORMATION RETRIEVAL NETWORK FOR GOVERNMENT, SCIENCE AND INDUSTRY. A PROPOSED BASIC CONFIGURATION FOR A NATIONAL SYSTEM OF INTERLINKING INFORMATION RETRIEVAL NETWORKS. May 1964, 259p. (AFOSR-64-0942) (AF 49(638)1209) AD 600221 Unclassified

The report describes the technical, organizational and financial aspects of a model Information Retrieval Network which could be made operational at the present time.

1228

Kansas State U. [Dept. of Chemtcal Engineering] Manhattan.

HEAT TRANSFER TO MAGNETOHYDRODYNAMIC FLOW IN A FLAT DUCT, by L. E. Erickson, C. S. Wang and others [1964] [11]p. incl. diagrs. table, refs. (AFOSR-64-2254) (AF AFOSR-64-463) AD 452359 Unclassified

Also published in Jour. Appl. Math. and Phys. (ZAMP), v. 15: 408-418, 1964.

The case with the constant wall temperature and with viscous and electrical dissipation, which is constdered in this paper was previously tnvestigated by Nigam and Singh. However, the Joule's heating term tn their paper was wrongly represented, rendering their results tnvalid. The purpose of this paper is to present the results of the exact solution of the same problem with the use of a finite difference analysts. The fluid properties are assumed to be constant. A magnetic field ts tmposed perpendicularly to the duct walls, and there ts a net electrical current flow parallel to the walls and perpendicular to the flow direction with a variable external resistance connecting the two end plates. The velocity profile is the fully developed Hartmann profile The temperature profile is uniform at the beg.nning of the thermal entrance region which is under consideration. Viscous and electrical dissipation effects are not neglected.

1229

Kansas State U. [Dept. of Chemtcal Engineering] Manhattan.

CONVECTIVE MODEL OF HARTMANN FLOW, by L. T. Fan, C. L. Hwang, and W. S. Hwang. [1964] [2]p. tncl. diagr. (AFOSR-65-0564) (AF AFOSR-64-463) AD 615183 Unclassified

Also publtshed in AIAA Jour., v. 2: 1859-1860, Oct. 1964.

An analysis of the residence time distribution of a tracer in the fluid flowing through a continuous flow system is one of the important tools in the study of dynamic and dispersion characteristics of the system. In this note the restdence time distribution of steady magnetic flow in a parallel plate channel with a uniform transverse magnetic field, called the Hartmann flow, is analyzed. The residence time distribution function for Hartmann flow is developed.

1230

Kansas State U. Dept. of Physics, Manhattan.

THE CRYSTALLOGRAPHY OF SOLID NITROGEN OXIDES. SODIUM HYPONITRITE--POTASSIUM NITRITE, by R. D. Dragsdorf, S. C. Chang, and R. L. Hollis Final rept. Aug. 3, 1964, 94p. incl. illus. diagrs. tables, refs. (AFOSR-64-1469) (AF AFOSR-61-24) AD 604476 Unclassified

The purpose of the research was to study the crystal structure of sodium hyponitrite and potassium nitrite by the x-ray diffraction method. Three forms of sodium hyponitrite, i.e., anhydrous, octa, and pentahydrate, were obtained. Rotation and zero-level Weissenberg photographs were obtained and analyzed. Patterson projection, Patterson function, Harker section, and electron density contour maps were calculated. The crystal structure of potassium nitrite was redetermined. The cell dimensions were refined by improving the experimental techniques and employing the method of the least squares to minimtze error. Instead of a monoclinic unit cell as reported, a rhombohedral cell seems most probable for the KNO_2 crystal. The molecule is planar. A phase transformation was found at -17.7°C. The thermal properties near the transition were measured.

1231

Kansas State U. [Dept. of Psychology] Manhattan.

A VERSATILE ELECTRONIC TRACKING APPARATUS (VETA), by D. Trumbo, R. Eslinger and others. [1963] [8]p. (AFOSR-J674) (AF AFOSR-62-17) AD 413463 Unclassifted

Also published in Perceptual and Motor Skills, v. 16: 649-656, 1963.

An electronic tracking and scoring system which gives access to relatively complete response data is described. Input, output, error and acceleration data are recorded on magnetic tape and may either be read out for visual inspection or read directly into analog computers and correlators for further analysis. An important feature of the system is that it readily permits the programming of various complex wave form inputs of either regular or irregular patterns in sequences of any length. Type or pattern of input may be varied between trials. The system is highly automated and easily caltbrated.

1232

Kansas U. Dept. of Chemistry, Lawrence.

EXPERIMENTAL EVALUATION OF LIQUID-JUNCTION POTENTIAL, by I. V. Nelson and R. T. Iwamoto. [1963] [5]p. incl. diagr. tables, refs. (AFOSR-J635) (AF AFOSR-61-8) AD 414920 Unclassified

Also published in Anal. Chem., v. 37: 867-871, June 1963.

The feasibility of using the half-wave potential of the ferrocene, ferricinium ion; benzylferrocene, benzylferricinium ion; tris(4,7-dimethyl-1,10-phenanthroline)-iron(II), tris(4,7-dimethyl-1,10-phenanthroline)iron(III), and bis(2,9-dimethyl-1,10-phenanthroline)copper(I), bis(2,9-dimethyl-1,10-phenanthroline)copper(II) couples for the evaluation of liquid-junction potential has been tnvestigated. Of the four redox systems dtudied, the 4,7-DMPhFe(II), 4,7-DMPhFe(III) couple is the best, particularly for evaluating changes in liquid-junction potential in voltammetric studies. (Contractor's abstract)

1233

Kansas U. [Dept. of Chemistry] Lawrence.

MECHANISM OF INORGANIC REACTIONS: BRIDGE MECHANISM IN ELECTROCHEMICAL OXIDATION AND REDUCTION OF METAL IONS, by R. T. Iwamoto. Final rept. Oct. 1, 1961-Dec. 31, 1962. Nov. 11, 1963, 3p. (AFOSR-J1367) (AF AFOSR-61-8)
AD 426575 Unclassified

To obtain information fundamental to understanding the mechanism of inorganic oxidation-reduction reactions, in particular of those involving a bridged activated complex, use of nonaqueous solvents and of an electrode was proposed. An investigation of various carboxylic acids as electron mediators in inorganic electrochemical oxidation-reduction reactions was begun. A reaction between Cu(II) ion and Cu metal in acetic acid was uncovered. A study of the polarographic behavior of Ni(II) in acetonitrile in the presence of chloride was made to obtain information on how the coordination sphere around an ion influences behavior of the ion in solution. One of the important problems in the studies on the nature and behavior of inorganic ions in nonaqueous media is the effect of residual water. Formation constants of aquo-copper(II) complexes is acetone were investigated and prepared for publication. (Contractor's abstract, modified)

1234

Kansas U. Dept. of Chemistry, Lawrence.

VOLTAMMETRY AND ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF HALONITROBENZENE ANION RADICALS, by T. Kitagawa, T. P. Layloff, and R. N. Adams. [1963] [2]p. incl. table. (AFOSR-65-0524) (AF AFOSR-62-14) AD 614291
Unclassified

Also published in Anal. Chem., v. 35: 1086-1087, July 1963.

Electron paramagnetic resonance (EPR) spectra of halonitrobenzene anion radicals was studied, using unsubstituted nitrobenzene for comparison. The results are summarized in a table. Halonitrobenzenes were reduced using dimethylformamide containing 0.1M tetraethylammonium perchlorate as supporting electrolyte. It was found that all 3 iodonitrobenzenes lose their iodine, all 3 chloronitrobenzenes retain their chlorine, only the orthobromonitrobenzene loses the bromine, and only the ortho-fluoronitrobenzene retains the flourine.

1235

Kansas U. Dept. of Chemistry, Lawrence.

CORRELATION OF SOLVENT EFFECTS ON ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF THE NITROBENZENE ANION RADICAL, by J. Q. Chambers, III, T. P. Layloff, and R. N. Adams. [1964] [2]p. incl. diagrs. (AFOSR-65-0525) (AF AFOSR-62-14) AD 613924 Unclassified

Also published in Jour. Phys. Chem., v. 68: 661-662, Mar. 1964.

The electron paramagnetic resonance spectrum of the nitrobenzene anion radical was obtained by electrolysis in dimethylformamide(DMF)-water mixtures using tetraethylammonium perchlorate as the supporting electrolyte. The spectra were obtained with slow magnetic field sweeps so that proton coupling constants could be evaluated accurately. There exists a 1:1 correlation between the N^{14} coupling constant (a_N) and the doublet splitting of the para hydrogen $a_{H(d, p)}$. Thus, for every a_N there is a unique $a_{H(d, p)}$. This relationship between a_N and $a_{H(d, p)}$ for DMF-H_2O mixtures includes all solvent systems studies to date with the exception of Ward's spectrum in tetrahydrofuran.

1236

Kansas U. Dept. of Chemistry, Lawrence.

EFFECT OF METAL IONS ON NUCLEAR HYPERFINE COUPLING CONSTANTS IN EPR SPECTRA, by T. Kitagawa, T. P. Layloff, and R. N. Adams. [1964] [2]p. incl. diagr. (AFOSR-65-0526) (AF AFOSR-62-14)
AD 613856 Unclassified

Also published in Anal. Chem., v. 36: 935-926, Apr. 1964.

The effects of metal ions on the nuclear hyperfine coupling constants of the electron paramagnetic resonance (EPR) spectra of a variety of anions of aromatic nitro compounds were investigated. The anion radical of p-chloronitrobenzene was selected as a model system since its EPR spectrum consists of 3 well resolved triplets resulting from interaction of the unpaired electron with the N^{14} nucleus, 2 equivalent (ortho) protons and 2 more equivalent (meta) protons. The radical anions were generated electrochemically in dimethylformamide (DMF) containing the metal ions to be investigated as supporting electrolytes. The effect of the metal ion on the N^{14} coupling constant (a_N) was investigated.

1237

Kansas U. Dept. of Chemistry, Lawrence.

OPERATIONAL AMPLIFIER CIRCUITS FOR CONTROLLED POTENTIAL CYCLIC VOLTAMMETRY II, by J. R. Alden, J. Q. Chambers, and R. N. Adams. [1963] [6]p. incl. diagrs. (AFOSR-65-0527) (AF AFOSR-62-14) AD 614195 Unclassified

Also published in Jour. Electroanal. Chem., v. 5: 152-157, 1963.

Several practical, inexpensive, operational amplifier (OA) circuits are described which are particularly useful in single sweep and cyclic voltammetry at stationary electrodes. Specific adaptations of OA's to electroanalytical instrumentation were made some time ago by Booman and coworkers and DeFord among others. Highly finished polarographic instruments have been

designed by Kelly and coworkers. The instruments described herein are functional, devoid of multipurpose appendages, and specifically oriented towards solid elsctrode applications. Their reliability has been provsn by continuous operation fcr several yr in a variety of modern electroanalytical operations. The units function satisfactorily with aqueous or nonaqueous electrochemical systems. The instruments consist of the basic OA potentiostat coupled with a cyclic voltage scanning input. Two forms of cyclic scanner are described, a mechanical or motor driven unit, and an OA integrator nstwork which is more versatile. Cyclic voltammetry appears to have great utility, and, since any cyclic unit can be used for single sweep operation, no purpose is seen for building single sweep polarographs as such.

1238

Kansas U. Dept. of Chemistry, Lawrence.

TRIANGULAR WAVE CYCLIC VOLTAMMETRY. I, by Z. Galus, H. Y. Lee, and R. N. Adams. [1963] [6]p. incl. diagrs. refs. (AFOSR-65-0528) (AF AFOSR-62-14) AD 613737 Unclassified

Also published in Jour. Electroanal. Chem., v. 5: 17-22, 1963.

Cyclic voltammetry using moderately slow sweep rates, and hence pen and ink recording, is advantageous for examining the overall mechanisms of complex organic electrode processes. The method is particularly well suited to the study of organic oxidations at solid electrodes. When coupled with single sweep peak voltammetry for measuring charge transfer rates and other kinetic parameters, it can be a powerful tool for the study of organic electrode processes.

1239

Kansas U. Dept. of Chemistry, Lawrence.

APPLICATION OF ELECTRON PARAMAGNETIC RESONANCE TECHNIQUES IN ELECTROCHEMISTRY, by R. N. Adams. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0539) (AF AFOSR-62-14) AD 614538 Unclassified

Also published in Jour. Electroanal. Chem., v. 8: 151-162, 1963.

The roles of electrochemistry and elsctron paramagnetic resonance (EPR) are discussed, including the contributions of each technique to the problsms of the other. EPR has contributed to electrochemistry by (1) the detection and identification of radical intermediates in electrode reactions and (2) providing information about solution interactions of radical ions which contribute to a fuller understanding of these sntities as oxidation-reduction intermediates. Elsctrochemistry has contributed to EPR, especially in the generation of anion radicals, by offering wider range of experimental conditions than previously available.

1240

Kansas U. Dept. of Chemistry, Lawrence.

ISOTOPIC MOLECULES: SEPARATION BY RECYCLE GAS CHROMATOGRAPHY, by J. W. Root, E. K. C. Lee, and F. S. Rowland. Interim technical rept. 1962-1963. [Sept. 1963] [9]p. incl. diagrs. refs. (AFOSR-64-0024) (AF AFOSR-62-15) AD 429769 Unclassified

Also published in Science, v. 143: 676, 1964.

Gas chromatographic columns, greatly extended in length by the use of paired columns in a recycling apparatus, have been used to separate butane (n-C_4H_{10}) from deuterated butane (n-C_4D_{10}) and methane (CH_4) from deuterated methane (CD_4). The separation of monotritiated cyclobutane (C_4H_7T) from cyclobutane (C_4H_8) is nearly complete. This procedure is generally applicable to a wide variety of separations of isotopic molecules. (Contractor's abstract)

1241

Kansas U. Dept. of Chemistry, Lawrence.

POLAROGRAPHIC EVALUATION OF THE FORMATION CONSTANTS OF AQUO-COPPER(II) COMPLEXES IN ACETONE, by I. V. Nelson and R. T. Iwamoto. [1964] [3]p. incl. diagrs. tables. (AFOSR-64-1515) (AF AFOSR-63-220) AD 446370 Unclassified

Also published in Inorg. Chem., v. 3: 661-663, May 1964.

Formation constants for the four aquo-copper(II) complexes $Cu(H_2O)^{+2}$, $Cu(H_2O)_2^{+2}$, $Cu(H_2O)_3^{+2}$, and $Cu(H_2O)_4^{+2}$ in acetone have been evaluated. Log k values are 1.75, 1.50, 1.00, and 0.75 in 0.1 M $LiClO_4$ solution and 1.75, 1.25, 0.80, and 0.65 in 0.1 M $(C_2H_5)_4NClO_4$ solution. (Contractor's abstract)

1242

Kansas U. Dept. of Chemistry, Lawrence.

VOLTAMMETRIC EVALUATION OF THE STABILITY OF TRICHLORIDE, TRIBROMIDE, AND TRIIODIDE IONS IN NITROMETHANE, ACETONE, AND ACETONITRILE, by I. V. Nelson and R. T. Iwamoto. [1964] [4]p. incl. table, refs. (AFOSR-64-1516) (AF AFOSR-63-220) AD 446374 Unclassified

Also published in Jour. Electroanal. Chem., v. 7: 218-221, 1964.

The formation constants of trichloride, tribromide, and triiodide ions in acetonitrile and tribromide and triiodide ions in nitromethane and in acetone have bsen evaluated from electrochemical data. In addition, lower limits for ths formation constant of the trichloride ion in acstone and in nitromethane have bsen calculated.

The order of stability of the trihalides in these three aprotic solvents is Cl_3^- > Br_3^- > I_3^-, the reverse of that found in water. (Contractor's abstract)

1243

Kansas U. Dept. of Chemistry, Lawrence.

ELECTROCHEMICAL BEHAVIOR OF COPPER IONS AND SILVER ION IN HYDRACRYLONITRILE AND SOME RELATED NITRILES, by F. Fanka, Jr. and R. T. Iwamoto. [1964] [10]p. incl. tables, refs. (AFOSR-64-2208) (AF AFOSR-63-220) AD 452290 Unclassified

Also published in Jour. Electroanal. Chem., v. 8: 55-64, 1964.

The electrochemical behavior of copper ions in hydracrylonitrile and related nitriles has been investigated It is of interest to note that in hydracrylonitrile copper(II) ion is solvated by the nitrile group, whereas in I : I alcohol-nitrile mixtures, it is solvated by the hydroxyl group. This unusual situation appears to be due to the fact that hydracrylonitrile (dielectric constant, 65), I : I ethanol-acetonitrile mixture (dielectirc constant, 32), and I : I I-butanol—propionitrile mixture are polar solvent systems and, therefore, favor the more polar solvated form of copper(II) ion. This, in hydracrylonitrile has the solvent molecules oriented with the nitrile group attached to copper(II) ion and the hydroxyl group sticking out and forming a polar outer sheath and in I : I alcohol—nitrile mixture has alcohol rather than nitrile molecules in the coordination sphere. Nitrile-solvated copper(II) ion with an outer sheath consisting only of alkyl groups behaves like a non-polar solute. Except for the fact that silver(I) ion is reduced at potentials more positive than those at which copper (I) ion is reduced, the electro chemical reduction of silver(I) ion in hydracrylonitrile and related nitriles is similar to that of copper(I) ion. (Contractor's abstract)

1244

Kansas U. Dept. of Chemistry, Lawrence.

CONTRIBUTION OF INTERIONIC FORCES TO THE THERMAL CONDUCTIVITY OF DILUTE ELECTROLYTE SOLUTIONS, by R. J. Bearman. [1964] [2]p. (AFOSR-65-1131) (AF AFOSR-63-376) AD 619619 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3924-3925, Dec. 15, 1964.

The contribution λ_{ion} of interionic forces to the thermal conductivity of dilute electrolyte solutions is calculated on the basis of the Debye-Hückel model. It is found to vary as κ^3 or (concentration)$^{3/2}$ according to the expression $\lambda_{ion} = 1/3 \times (e^2/\epsilon T)\Sigma_\beta z_\beta^2 c_\beta D_\beta$, where κ is the inverse Debye length, e is the $\lambda_{ion} = 1/3\kappa(e^2/\epsilon T)\Sigma_\beta z_\beta^2 c_\beta D_\beta$, where κ is the inverse Debye length, e is the electronic charge, ϵ is dielectric constant of solvent, z is charge number, c_β is concentration of dissolved ion β in units of number of ions per cubic centimeter, and D_β is the self-diffusion coefficient of the ion.

1245

Kansas U. [Dept. of Physics] Lawrence.

LIQUID NITROGEN/ARGON BUBBLE CHAMBER DESIGN PROJECT, by R. Stump. Final rept. [1963] 6p. incl. diagr. (AFOSR-4969) (AF AFOSR-61-86) AD 414166 Unclassified

This report discusses a project undertaken with the purpose of designing some equipment for research in high-energy physics, and of planning experiments to be done at the ZGS accelerator at the Argonne National Lab. Three lines of investigation were followed: the design of a bubble chamber suitable for use with liquid nitrogen or liquid argon; the design of a spark chamber for some specific experiments; and the detailed investigation of several experiments.

1246

Karolinska Inst., Stockholm (Sweden).

SYMPATHETIC VASODILATOR OUTFLOW, by B. Uvnas. Final technical rept. Mar. 29, 1963 [11]p. incl. illus. diagrs. refs. (AFOSR-4849) (AF 61(052)-502) AD 413763 Unclassified

Excitation of the sumpathetic vasodilator outflow by hypothalamic and medullary stimulation causes a concomitant increase of cardiac contractile force and of skeletal muscle blood flow indicating those effects being integral parts of the reaction pattern elicited by intracerebral activation of the sympathetic vasodilator system. Vasodilatation due to excitation of cholinergic vasodilator nerves produced a decrease in peripheral resistance amounting to about 70% of the decrease caused by metabolic vasodilatation. It is considered that vasodilator nerve activity produces an arteriolar dilatation whereas vasodilatation due to inhibition of vasoconstrictor nerve activity or following muscular contraction induces relaxation of smooth muscles in both arterioles and precapillary sphincters.

1247

Karolinska Inst., Stockholm (Sweden).

SYMPATHETIC VASODILATOR OUTFLOW, by B. Uvnas. Final rept. Nov. 13, 1963 [6]p. incl. diagrs. table. (AFOSR-65-1529) (AF EOAR-64-27) AD 623792 Unclassified

Under this investigation, sympathetic vasodilator nerves to the skeletal muscles in dogs were activated by: (1) Electrical hypothalamic stimulation in anesthetized dogs; (2) Electrical hypothalamus stimulation in unanesthetized dogs by chronically implanted electrodes; and (3) External stimuli (firing shot) to unanesthetized dogs. Activation of sympathetic vasodilator nerves seems to be associated with a behavior reaction pattern that could be interpreted as due to fear. The occurrence of

sympathetic vasodilator fibers to the skeletal muscles of various species was also investigated. Vasodilator fibers were found in the 5 different species of beasts studied, but not in 7 species of apes and lemurs investigated. The observation has a bearing on the undissolved question concerning the existence of sympathetic vasodilator fibers to the skeletal muscles in man. (Contractor's abstract)

1248

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

QUANTITATIVE STUDIES ON PIGMENT MIGRATION AND LIGHT SENSITIVITY IN THE COMPOUND EYE AT DIFFERENT LIGHT INTENSITIES, by C. G. Bernhard and D. Ottoson. [1964] [14]p. (AFOSR-64-1699) (AF 61(052)21) AD 448274 Unclassified

Also published in Jour. Gen. Physiol., v. 47: 465-478, Jan. 1964.

Comparative electrophysiological and histological studies were made on the functional significance of the secondary iris pigment migration for the sensitivity of the eye in the noctuid moth Cerapteryx graminis. The pigment position at different adapting light intensities was studied as well as the influence of different positions on the sensitivity of the eye. Adapting light intensities above a certain value hold the pigment in light position. At a 3 log units lower intensity the pigment is brought into dark position and at light intensities between these limiting values the pigment attains intermediate positions. The results indicate that at light intensities between the limiting values the pigment shifts closely follow the changes in intensity of the environmental light.

1249

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF DENTAL ENAMEL. IV. THE MINERALIZATION OF NORMAL HUMAN ENAMEL, by B. Angmar, D. Carlstrom, and J. E. Glas. [1963] [12]p. (AFOSR-J350) (AF 61(052)-386) AD 408006 Unclassified

Also published in Jour. Ultrastruct. Research, v. 8: 12-23, 1963.

The mineralization pattern of normal permanent enamel of ten human incisors was studied with quantitative contact microradiography. A detailed description of the technique is given. The general trend in the mineralization pattern consisted in a smooth decrease in the amount of mineral salts from the surface of the enamel toward the dentinenamel junction. This decrease varied considerably in individual samples, the extreme values being 0.7 and 4.4% mineral salts by weight. A simultaneous investigation with polarized light microscopy revealed no correlation between the birefringence and the mineral content. Permanent enamel was found to be nonimbibable with immersion liquids other than water. The influence of the hydration state of enamel on the polarized light picture is also discussed in detail.

1250

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

STUDIES ON THE ULTRASTRUCTURE OF DENTAL ENAMEL. V. THE STATE OF WATER IN HUMAN ENAMEL, by D. Carlstrom, J. E. Glas, and B. Angmar. [1963] [6]p. (AFOSR-J351) (AF 61(052)386) AD 408005 Unclassified

Also published in Jour. Ultrastruct. Research, v. 8: 24-29, 1963.

The changes in birefringence of normal enamel upon heating could be interpreted as being caused by loss of water. The water in enamel was found to be bound in two different ways. A small part, which is very loosely bound, is probably related to the organic matrix whereas the greater part is firmly bound to the mineral phase.

1251

Karolinska Inst. Dept. of Medical Physics, Stockholm (Sweden).

ULTRASTRUCTURE OF BIOLOGICAL CALCIFICATIONS, by D. Carlstrom. Final technical rept. Oct. 31, 1963, 8p. (AFOSR-J1320) (AF EOAR-62-11) AD 424237 Unclassified

The optical properties of normal and carious dental enamel were related to its ultrastructural organization. A crystallographic investigation of otoliths from 58 vertebrate species showed that these calcified bodies could consist of 5 different minerals. The binding mode of carbonate in mineral and biological apatites has been investigated by physical methods. A new structure for carbonate apatites is proposed.

1252

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

A CRYSTALLOGRAPHIC STUDY OF VERTEBRATE OTOLITHS, by D. Carlstrom. [1963] [23]p. (AFOSR-64-1175) (AF EOAR-62-11) AD 442991 Unclassified

Also published in Biol. Bull. 125: 441-463, Dec. 1963.

The crystallographic properties of otoliths from 58 vertebrate species were investigated by means of polarization microscopy and x-ray diffraction. The otoliths occur as statoconia, microstatoliths, and statoliths. Usually only one kind is present in the labyrinth but in some vertebrates a combination of two or all three types may be found. While statoliths and microstatoliths always are polycrystalline, statoconia may either be polycrystalline or single crystals. Five different minerals, viz, apatite, calcite, aragonite,

vaterite and calcium carbonate monohydrate, compose the endogenous otoliths in the vertebrate labyrinth. Some elasmobranch have in addition exogenous statoconia consisting of sea-sand. The distribution of statoliths and/or statoconia, their texture and their composition within the vertebrate series, show remarkable consistencies; within each class the same kind of static bodies is usually present.

1253

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

POLARIZATION MICROSCOPY OF DENTAL ENAMEL WITH REFERENCE TO INCIPIENT CARIOUS LESIONS, by D. Carlström. [1963] [42]p. (AFOSR-64-1691) (AF EOAR-62-11) AD 447702 Unclassified

Also published in Advan. Oral Biol., v. 1: 255-296, 1963.

The aim of the present contribution is to indroduce the reader to some recent concepts of special interest for the future development of the polarization microscopy of dental tissues. Attention was paid to the different factors contributing to the polarized light image of dental enamel and to the advantages and disadvantages of the technique compared with other ultrastructural modes of investigation.

1254

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

GLOW, SENSITIVITY CHANGES AND PIGMENT MIGRATION IN THE COMPOUND EYE OF NOCTURNAL LEPIDOPTERA, by G. Hoglund. [1963] [6]p. (AFOSR-J1413) (AF EOAR-62-13) AD 427524 Unclassified

Also published in Life Sci., v. 2: 275-280, 1963.

In this investigation the size of the glowing area in the night moth's compound eye was recorded photographically. The photographs were used to correlate pigment position and electrophysiological measurements of the eyes' threshold at different stages of adaption. There was a gradual increase in the glowing area during the course of dark adaptation accompanied by a decrease in the threshold to light. The glowing area sometimes appeared during dark adaptation after the ganglia had been mechanically removed or treated with cocaine or nicotine. In these isolated retinae, as in the intact eyes, there was a relation between the size of the glowing area and the threshold, and the glowing area disappeared first in a locally illuminated part of the eye. These results suggest that essential functional properties of the intact eyes are at least temporarily retained after the abolition of the ganglionic activity.

1255

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

ON THE RELATION BETWEEN PIGMENT POSITION AND LIGHT SENSITIVITY OF THE COMPOUND EYE IN DIFFERENT NOCTURNAL INSECTS, by C. G. Bernhard, G. Hoglund, and D. Ottoson. [1963] [14]p. (AFOSR-64-0962) (AF EOAR-62-13) AD 439980 Unclassified

Also published in Jour. Insect Physiol., v. 9: 573-586, 1963.

In contrast to the rapid smooth dark-adaptation curve of day-flying insects lacking migratory secondary iris pigment, the adaptation curve of nocturnal moths and other night-flying insects, equipped with migratory secondary iris pigment, has in principle a diphasic course. During the second phase the eyes of the latter group acquire a considerably higher sensitivity than the dark-adapted eyes of the insects lacking secondary iris pigment. In comparative electrophysiological and histological investigations further evidence is presented for the conclusion that the second phase of the dark-adaptation curve is due to the migration of the secondary iris pigment from dark position to light position. The prerequisites for the appearance of the pigment migration and the second phase of the dark-adaptation curve are discussed. The variations in latency and temporal course of the second phase in the same species, and in different species, are discussed and attributed to variations in the time course of the secondary iris pigment migration.

1256

Karolinska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

RECEPTOR SENSITIVITY AND PIGMENT POSITION IN THE COMPOUND EYE OF NOCTURNAL LEPIDOPTERA, by G. Hoglund. [1963] [4]p. (AFOSR-64-1713) (AF EOAR-63-7) AD 448267 Unclassified

Also published in Life Sci., v. 2: 862-865, 1963.

Recent investigations on nocturnal moths have shown the relation between the position of the secondary pigment and the sensitivity of the eye. The results of the present investigation suggest that the threshold changes in darkness are due to variations in the light reduction caused by changes in the pigment position, while the receptor sensitivity remains constant. During illumination the light reducing effect of the pigment when located proximally causes the receptors to become adapted to an illumination lower than the light intensity to which the eye is exposed. The receptor adaptation thus compensates for the reduction of the light. This suggests that constantly illuminated eyes possess larger quantities of photochemical substance if the pigment is positioned proximally than if the pigment is located distally or absent.

1257

Karoltnska Inst. [Dept. of Medical Physics] Stockholm (Sweden).

INSECT CORNEAL NIPPLE ARRAY—A NATURAL IMPEDANCE TRANSFORMER (Abstract), by W. H. Miller, C. G. Bernhard, and A. R. Möller. [1964] [2]p. (AFOSR-64-2014) (AF EOAR-63-7) Unclassified

Presented at Sprtng meeting of the Opt. Soc. of Amer., Washington, D. C., 1964.

Also publtshed tn Jour. Opt. Soc. Amer., v. 54: 581-582, Apr. 1964.

Measurements were made of microwave energy reflected from the front surface of, and transmitted through, models both possessing and lacking the nipple array. When the ratio of microwavelength to center-to-center spacing of the nipples was less than 1.5, the array produced an interference pnenomenon resulting tn zones of increased and decreased transmitted energy. For ratios between 1.5 and 5.0 (ltght wavelengths of 300 mμ to 1.0 μ as translated to corneal dimensions), reflection from the model's nippled surface was reduced and transmission through the model was correspondingly increased. The reduced reflection probably aids camouflage, whereas the augmented transmission of light may increase the probability of seeing during night at threshold by 10% or more over insects not possessing the array. (Contractor's abstract, modified)

1258

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

DISTRIBUTION OF BIOLOGICALLY ACTIVE COMPOUNDS IN THE BODY, by U. S. von Euler. Final rept. Feb. 29, 1964, 5p. (AFOSR-64-0841) (AF EOAR-62-14) AD 438395 Unclassified

The work carried out under this contract has been largely centered around problems concerning the uptake, release and storage of catecholamines tn adrenergic nerves and tn isolated storage granules from nerves and chromaffin cells. Another part of the activity has been devoted to studies of the response of the peripheral vascular system to vasoconstrictor agents under the action of respiratory acidosts. Six papers have been prepared and accepted for publication.

1259

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

TRANSMITTER STORAGE GRANULES OF ADRENERGIC NERVES, by U. S. von Euler. [1963] [14]p. (AFOSR-64-1066) (AF EOAR-62-14) AD 441503 Unclassified

Also published in Actualtties Neurophysiol., v. 5: 37-50, 1963.

Electron mtcroscopy and fluorescence histochemtstry have demonstrated neural transmttter amines in knob-shaped structures in adrenergic nerve endings. Granules wtthin these knobs contain the transmitter in a bound form. When stored at room temperature, they lose the amtnes exponentially, and the rate of loss is enhanced in acid or detergent solutions. Partly depleted granules can take up new transmitter molecules ATP and ADP, but not AMP, prevent depletion and stimulate amine uptake, by a mechanism which is not well known. Adrenaline and noradrenaline compete for binding sites on the granules. Phenoxybenzamine slows amine release, while tyramine enchances it. Reserpine in large concentrations causes a release, but in low concentrations it retards the release of amines without inhibiting spontaneous uptake. It does inhibit the ATP and magnesium dependent uptake. A postulated mechanism of adrenergic neural transmission is presented.

1260

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

THE INFLUENCE OF CHLORPROMAZINE ON THE CATECHOLAMINE EXCRETION OF NORMAL AND COLD ACCLIMATED RATS, by G. E. Johnson. [1964] [8]p. (AFOSR-64-1067) (AF EOAR-62-14) AD 441486 Unclassified

Also published in Acta Physiol. Scand., v. 60: 181-188, 1964.

Chlorpromazine was administered to normal rats placed at 30° and 20°C and to cold acclimated rats exposed to 30° and 2°C. Treatment of the animals at 30° produced no increase in catecholamine excretion. However, rats placed at either 20° or 2° significantly increased their noradrenaline excretion, and to a lesser extent their adrenaline excretion, following chlorpromazine. These increases, also noted in adrenalectomized rats and associated with hypothermia, could be prevented by pretreatment with a ganglionic blocker. It is concluded that the increase in noradrenaline excretion is a result of a temporary hypothermia produced by chlorpromazine and originates from sympathetic nerve endings.

1261

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

THE EFFECT OF COLD EXPOSURE ON THE CATECHOLAMINE EXCRETION OF ADRENALECTOMIZED RATS TREATED WITH RESERPINE, by G. E. Johnson. [1963] [7]p. (AFOSR-64-1068) (AF EOAR-62-14) AD 441485 Unclassified

Also published in Acta Phystol. Scand., v. 59: 438-444, 1963.

Adrenalectomized rats subjected to moderate cold exposure showed a significant tncrease in noradrenaline

excretion in urine. Adrenalectomized rats, treated with reserpine, however, failed to respond with an increase in the noradrenaline excretion during cold stress. A fall in the noradrenaline excretion of the reserpinized animals was usually followed by death. These results suggest that reserpine treatment inhibits the synthesis of noradrenaline in vivo and that the survival of moderately cold stressed adrenalectomized animals is related to the secretion of noradrenaline.

1262

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

UPTAKE OF RADIOACTIVELY LABELED DL-CATECHOLAMINES IN ISOLATED ADRENERGIC NERVE GRANULES WITH AND WITHOUT RESERPINE, by U. S. von Euler, L. Stjarne, and F. Lishajko. [1963] [8]p. (AFOSR-64-1069) (AF EOAR-62-14) AD 441504 Unclassified

Also published in Life Sci., v. 2: 878-885, 1963.

When incubated in vitro the isolated catecholamine storage granules from bovine splenic nerves give off their amines at a rate which is mainly a function of the temperature. By addition of noradrenaline (NA) in about 5×10^{-5} M concentration to the external medium, the amine content of the granules is maintained at a high level. It is not known whether this effect depends on inhibition of the spontaneous release or is due to an exchange reaction, exogenous amines moving into the granules at a rate balancing the flow in the opposite direction of endogenous amines. A high intragranular level of catecholamines mah also be maintained by addition of certain drugs in low concentrations such as reserpine. In the present investigation the mechanisms of these two types of protective effect on the amine content of the nerve granules have been studied using radioactively labeled catecholamines.

1263

Karolinska Inst. [Dept. of Physiology] Stockholm (Sweden).

CATECHOLAMINES AND NUCLEOTIDES IN PHAEOCHROMOCYTOMA, by L. Stjarne, U. S. von Euler, and F. Lishajko. [1964] [10]p. (AFOSR-64-2154) (AF EOAR-62-14) AD 452040 Unclassified

Also published in Biochem. Pharmacol., v. 13: 809-818, 1964.

Isolated catecholamine (CA) storage granules from a phaeochromocytoma were studied in vitro. The tumor granules had a high NA content, while A amounted to only a few percent of the total CA. Most of the amines were particle bound. The storage granules had a lower density and adrenine nucleotide content than bovine adrenal medullary granules. Thus only a minor part of the CA in this tumor could be stored by a mechanism requiring stoichiometric relationship between amines and adenine nucleotides. On incubation in vitro ATP was lost at a slightly higher rate than the CA, leading to an increase in the molar CA/ATP ratio. The ATP lost was quantitatively recovered as AMP in the extragranular medium. ATP-splitting activity occurred to some extent in the particle-free supernatant but was more evident in the high speed sediment.

1264

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

EFFECTS OF RESERPINE, SEGONTIN AND PHENOXYBENZAMINE ON THE CATECHOLAMINES AND ATP OF ISOLATED NERVE AND ADRENOMEDULLARY STORAGE GRANULES, by U. S. von Euler, L. Stjarne, and F. Lishajko. [1964] [6]p. incl. diagrs. refs. (AFOSR-65-0944) (AF EOAR-62-14) AD 617815 Unclassified

Also published in Life Sci., v. 3: 35-40, 1964.

The effects of 3 compounds, reserpine, segontin, and phenoxybenzamine, are compared on the amine and ATP content of the catecholamine storage granules from adrenergic nerve and from adrenal medullary tissues. The inhibition of outflux from the nerve granules caused by reserpine applies selectively to the catecholamines, while the spontaneous loss of ATP is not affected. The effects of Segontin resemble those of reserpine. Phenoxybenzamine added to nerve storage granules maintains a high level of amines and ATP. Adrenal medullary granules incubated with this compound produce an opposite effect. At a somewhat higher concentration, phenoxybenzamine causes a considerable loss of both amines and ATP.

1265

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

UPTAKE OF L- AND D-ISOMERS OF CATECHOLAMINES IN ADRENERGIC NERVE GRANULES, by U. S. von Euler and F. Lishajko. [1964] [6]p. incl. tables, refs. (AFOSR-65-0945) (AF EOAR-62-14) AD 617983 Unclassified

Also published in Acta Physiol. Scand., v. 60: 217-222, 1964.

The spontaneous depletion of endogenous noradrenaline (NA) from bovine splenic nerve granules is diminished or prevented by incubation with either L-NA or D-NA. However, the effect observed following the addition of L-NA is significantly greater than that produced by the D-isomer. No significant difference is observed between the uptake of the 2 isomers of adrenaline (A) in undepleted granules. The enhanced uptake of A or NA in a concentration of 10 μg/ml in the presence of ATP similarly did not differ for the L- and D-isomers of the amine. However, the ATP-dependent uptake at an amine concentration of 1 μg/ml was 2-3 times as high as for L-NA and L-A than for the D-isomers. It is concluded that the ATP-dependent uptake in nerve granules of NA and A at low amine concentrations is to some extent stereospecific, while the amine-uptake at

higher concentrations with and without added ATP is not or only slightly dependent on the steric configuration. (Contractor's abstract)

1266

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

EFFECT OF TYRAMINE, RESERPINE AND COCAINE ON THE NORADRENALINE RELEASE AND UPTAKE OF THE PERFUSED RABBIT KIDNEY, by A. Inouye and I. Tanaka. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-65-1540) (AF EOAR-62-14) AD 623381 Unclassified

Also published in Acta Physiol. Scand., v. 62: 359-363, 1964.

Perfusion of isolated rabbit kidneys for 120-150 min with Tyrode solution containing 0.05% iproniazide caused no change of the normal noradrenaline (NA) content. Addition of NA to the perfusion fluid caused an uptake of NA approximately proportional to the NA concentration. The major part of the NA retained was removed by subsequent perfusion with NA-free Tyrode solution. Perfusion with tyramine 10^{-4} m removed a large part of the renal NA, even in the presence of NA in the perfusion fluid. Reserpine 4×10^{-6} m did not significantly release NA or alter the renal NA content, but diminished the NA uptake from a solution containing NA. Cocaine caused a moderate release of NA and partially prevented the NA uptake while it hardly caused any loss in the renal NA content, suggesting some NA resynthesis. (Contractor's abstract)

1267

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

THE DISTRIBUTION OF NORADRENALINE AND ADRENALINE IN THE FALLOPIAN TUBE OF THE RABBIT, by J. Brundin. [1964] [4]p. incl. diagr. table, refs. (AFOSR-65-1542) (AF EOAR-62-14) AD 624009 Unclassified

Also published in Acta Physiol. Scand., v. 62: 156-159, 1964.

The present study was undertaken in an attempt to explain the functional difference between the isthmic and ampullary regions of the oviduct in the rabbit by a difference in the distribution of their adrenergic nerve supply. The isthmus contains considerable amounts of noradrenaline (NA), while the NA contents of the ampulla and uterus are low. Adrenaline (A) was found in low concentrations in all of the preparations studied. Some implications of the distribution of NA in the different regions are discussed. (Contractor's abstract)

1268

Karolinska Inst. Dept. of Physiology, Stockholm (Sweden).

SOME MORPHOLOGICAL FEATURES OF CATECHOLAMINE STORING NERVE VESICLES, by U. S. von Euler and G. Swanbeck. [1964] [2]p. incl. illus. (AFOSR-65-1302) (AF EOAR-64-31) AD 620829 Unclassified

Also published in Acta Physiol. Scand., v. 62: 487-483, 1964.

Subcellular particles rich in noradrenaline have been obtained from homogenized bovine splenic nerves. After staining with phosphotungstic acid, the existence of granules 0.03-0.1 μ in diam was noted. A characteristic feature is the occurrence of notches, which often were extended to tail-like structures on opposite sides of the granules. Frequently the vesicles occurred in pairs and sometimes even in short chains. This is suggestive of a system similar to granular formation in the Golgi apparatus, which might mean that the granules are arranged in a type of lattice in the axon, and presumably in the terminals.

1269

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

SINGLE UNIT ACTIVITY IN THE RABBIT LATERAL GENICULATE BODY DURING EXPERIMENTAL EPILEPSY, by U. Soderberg and G. B. Arden. 1964, 10p. incl. diagrs. refs. (AFOSR-2908) (AF 61(052)-119) AD 632098 Unclassified

The activity of single cells of the rabbit lateral geniculate body was studied and related to various states of wakefulness and to cortical seizures that developed spontaneously after activation with flickering light, moderate hyperventilation or after the administaation of bemegride. Bemegride increases the firing rate of geniculate cells both in the dark and when the retina is stimulated with flickering light. Bemegride counteracts the depressing effect of sodium pentobarbital. In spontaneously occurring epilepsy in encephale isole animals with acute cortical lesions, and after photic activation in these animals, there is a long-lasting marked inhibition of geniculate activity. This inhibition does not prevent flickering light from influencing cortical activity. The findings are discussed in relation to previous investigations on the relation between specific and nonspecific visual pathways. (Contractor's abstract, modified)

1270

Karolinska Inst. Nobel Inst. for Neurophysiology, Stockholm (Sweden).

RESEARCH ON BRAIN STEM MECHANISMS REGULATING AUTONOMIC ACTIVITIES, by U. Soderberg. Final technical rept. Feb. 5, 1964, 18p. (AFOSR-64-0733) (AF 61(052)119) AD 438640 Unclassified

Some neurophysiological aspects of the regulation of the homeostasis by the central nervous system have been studied and will be described. Attempts have also been made to analyze how such adjustments and how inefficient regulation due to inertial or pathological conditions can influence cerebral activities. Special emphasis has been laid on technical problems. The employment of the neuronally isolated cortex as an index of how the cortical tissue reacts to blood-borne influences is described. Brain-stem activities that are especially involved in autonomic functions and in particular in the arousal phenomenon are discussed.

1271

[Karolinska Inst.] Nobel Inst. for Neurophysiology, Stockholm (Sweden).

NEUROPHYSIOLOGICAL ASPECTS OF HOMEOSTASIS, by U. Soderberg. [1964] [18]p. (AFOSR-64-1170) (AF 61(052)119) AD 442789 Unclassified

Also published in Ann. Rev. Physiol., v. 25: 271-288, 1964.

This report discusses the neurophysiological aspects of the regulation of homeostasis by and within the central nervous system and further, to describe how adjustments and inefficient regulation, due to inertia or pathological conditions, can influence cerebral activities. Homeostasis was taken in its broad sense, which means that behavioral problems were briefly mentioned as well. Since the activities of the subdivisions of the autonomic nervous system are as a rule so closely interrelated attempts at describing each entity separately have only rarely been made.

1272

Keele U. Dept. of Communication, Staffordshire (Gt. Brit.).

NEW METHODS OF ANALYSIS OF ELECTROPHYSIOLOGICAL RESPONSES, by D. M. Mackay, D. A. Jeffreys, and R. R. Glover. June 21, 1963, 1v. incl. diagrs. (AFOSR-5257) (AF EOAR-62-23) AD 416363 Unclassified

This report describes a further year's work on the magnetic-tape averaging system. Effort has been devoted mainly to improving circuitry and developing auxiliary equipment, but a number of experiments on the occipital response to changes in visual pattern are also reported. (Contractor's abstract)

1273

Kent State U. Dept. of Chemistry, Ohio.

A NEW APPROACH TO MEASUREMENT OF DIPOLE MOMENT AND ELECTROLYTES IN PURE ACETIC ACID, by R. T. Myers. Final rept. Apr. 1959-Dec. 1964, 8p. incl. diagr. (AFOSR-65-0366) (AF 49(638)-641) AD 612040 Unclassified

In the method introduced here interpolations, rather than extrapolations, are used, and the value obtained in solution for dipole moment is apparently the same as that in the gas phase, within the experimental error of measurements of the latter. The chief reason for inability to make a definite statement here is the discordant data for dipole moments.

1274

Laval U., Quebec (Canada).

NEUROHUMORAL CONTROL OF THYROTROPIC ACTIVITY, by C. Fortier. Final rept. Oct. 1, 1960-May 31, 1963, 1v. incl. illus. diagrs. tables, refs. (AFOSR-4995) (AF AFOSR-61-15) AD 414858 Unclassified

The results of this investigation indicate that (1) Stress, as exemplified by surgical trauma or faradic stimulation, in addition to stimulating ACTH secretion, simultaneously depresses the synthesis and release of TSH, but has no effect on the removal rate of circulating TSH. (2) Prior adrenalectomy does not influence the TSH response to stress which is therefore not mediated by corticosteroids, or by catecholamines of medullary origin. (3) Thyroidectomy slows down the disappearance rate of circulating TSH, in addition to stimulating TSH secretion. (4) Adrenalectomy depresses both the rate of secretion of TSH and its rate of removal from the circulation. (5) Small and larger doses of triiodothyronine respectively enhance the synthesis and block the release of TSH in the thyroidectomized animal. (Contractor's abstract, in part)

1275

Laval U., Quebec (Canada).

EFFECT OF LOCALIZED DESTRUCTION OF THE VENTRAL HYPOTHALAMUS ON THE ADRENOCORTICOTROPIC RESPONSES TO SURGICAL TRAUMA AND TO HYPOCORTICOIDISM IN THE RAT, by C. Fortier and J. de Groot. [1964] [10p. incl. diagrs. tables, refs. (AFOSR-66-0961) (AF AFOSR-61-15) AD 634490 Unclassified

Also published in Major Problems in Neuroendocrinology; Internat'l. Symposium, Montreal U. (Canada), ed. by E. Bajusz and G. Jasmin. Basel, S. Karger, 1964, p. 220-229.

The adrenal corticosterone response to unilateral adrenalectomy, as well as the 16-day pituitary ACTH response to bilateral adrenalectomy, were suppressed, in the rat, by electrolytic destruction of the bulbous portion of the Median Eminence or of premammillary an and mammillary structures. It is inferred therefore that the hypothalamus plays an essential role in the mediation of the adrenocorticotropic responses to stress and to hypocorticoidism. (Contractor's abstract)

1276

Laval U., Quebec (Canada).

RESIDUAL SYNTHESIS AND RELEASE OF ACTH FOLLOWING ELECTROLYTIC DESTRUCTION OF THE MEDIAN EMINENCE IN THE RAT, by C. Fortier and J. de Groot. [1964] [17]p. incl. illus. diagrs. tables, refs. (AFOSR-66-0965((AF AFOSR-61-15) AD 634454 Unclassified

Also published in Major Problems in Neuroendocrinology; Internat'l. Symposium, Montreal U. (Canada), ed. by E. Bajusz and G. Jasmin. Basel, S. Karger, 1964, p. 203-219.

In order to assess the degree of hypothalamic involvement in the maintenance of basal adrenocorticotropic activity, changes in adenohypophysial ACTH, plasma corticosterone, adrenal corticosterone and ascorbic acid, in vitro corticoidogenesis and corticoidogenic response to ACTH, as well as in pituitary and adrenal weight, were studied, as ordinates of time, over a two month period following electrolytic destruction of the bublus of the Median Eminence in the rat. From a correlation of the pituitary ACTH data with information pertaining to the concentration of the hormone in the blood, it appears that ACTH synthesis, initially depressed following the short burst of secretory activity induced by the surgical procedure, temporarily recovers from this depression, and undergoes thereafter a progressive decline of two-week duration, ascribed as was the depressed rate of release, to the disappearance of CRF and to ischemia. Stabilization, thereupon, of the synchronized rates of synthesis and release is interpreted as evidence that residual corticotrophic activity is compatible with the exclusion of hypothalamic influence presumably achieved by complete destruction of the bulbus of the Median Eminence. (Contractor's abstract)

1277

Laval U., Quebec (Canada).

NEUROHUMORAL CONTROL OF THYROTROPIC ACTIVITY, by C. Fortier. Final progress rept. June 1-Sept. 30, 1963, 4p. (AFOSR-64-0017) (AF AFOSR-62-6) AD 429274 Unclassified

This work has been directed at elucidating some of the problems arising out of our continuing studies on pituitary-thyroid-adrenocortical interactions; initiating a new project on the endocrine basis of adaptation to cold; setting up and adapting techniques for assessing the equilibrium distribution between native and protein-bound plasma corticosterone, and for determining plasma thyroxine.

1278

Laval U., Quebec (Canada).

[ACTH RELEASE AND SYNTHESIS IN THE ACUTELY STRESSED ADRENALECTOMIZED RAT] Syntnese et liberation d'ACTH a la suite d'une agression aigue chez le rat surrenalectomise, by P. Ducommun, S. Ducommun and others. [1964] [2]p. incl. diagr. table, refs. (AFOSR-66-0960) (AF AFOSR-64-511) AD 634555 Unclassified

Also published in Schweiz. Med. Wochenschr., v. 94: 892-893, 1964.

Laparotomy under ether anesthesia in the adrenalectomized female rat resulted in a transient increase in blood ACTH, reaching its peak after 5 min and returning

to normal within 20 min. Contrary to recent findings by Vernikos-Danellis, no increase in pituitary ACTH could be detected in the first 10 postoperative minutes. This militates against the theory of the predominance of ACTH synthesis under the effects of stress. The subsequent fall in pituitary ACTH observed concurrently with the continuing fall in blood ACTH is ascribed to the fact that ACTH synthesis is more markedly inhibited than ACTH release at this later stage of stress response. (Contractor's abstract)

1279

Laval U., Quebec (Canada).

[EFFECTS OF ACTH AND LYSINE-VASOPRESSIN ON CORTICOSTERONE SYNTHESIS AND RELEASE IN THE RAT] Actions de l'ACTH et de la lysine-vasopressine sur la synthese et la liberation de la corticosterone chez le rat, by C. Mialhe-Voloss, B. Koch and others. [1964] [4]p. incl. diagrs. refs. (AFOSR-66-0963) (AF AFOSR-64-511) AD 634566 Unclassified

Also published in Rev. Canad. Biol., v. 23: 469-472, Dec. 1964.

Progressive doses of ACTH and of highly purified lysine-vasopressin were added to rat adrenal glands incubated in vitro for a comparison of their effects on the synthesis and release of corticosterone, through determination of the steroid in the gland and in the incubating fluid. ACTH increased the concentration of corticosterone in the adrenal tissue, as well as in the incubating fluid. The increase was linearly related to the log dose of ACTH over a range of 3 to 48 μ/100 mg. By contrast, lysine-vasopressin had no effect on the adrenal corticosterone concentration. A transient effect on the corticosterone concentration of the medium, recorded after 15 min of incubation at a dose level of 12,800 μ/100 mg, is ascribed to leakage of the steroid, as opposed to altered steroidogenesis. (Contractor's abstract)

1280

Laval U., Quebec (Canada).

EFFECT OF CHRONIC ACTH ADMINISTRATION ON THE ADRENOCORTICOTROPIC RESPONSE TO BILATERAL ADRENALECTOMY IN THE RAT, by P. Ducommun, C. Mialhe-Voloss, and C. Fortier. [1964] [3]p. incl. table, refs. (AFOSR-66-0964) (AF AFOSR-64-511) AD 634567 Unclassified

Also published in Rev. Canad. Biol., v. 23: 443-445, Dec. 1964.

Treatment with large doses of a long-acting ACTH preparation over a period of four weeks following bilateral adrenalectomy in the rat did not significantly alter the rise in pituitary ACTH concentration consequent to adrenalectomy. The weighted mean of four separate assays of an extract of pooled pituitaries from ACTH-treated adrenalectomized animals against a similar extract from adrenalectomized controls was 114.5%, with 95% confidence limits of 96.8 and 135.5. These results do not support the alleged involvement of circulating ACTH in the adjustment of its synthesis or release by the pituitary. (Contractor's abstract)

1281

Laval U., Quebec (Canada).

RELATIVE BINDING OF CORTICOSTERONE BY TRANSCORTIN AND ALBUMIN AS A FUNCTION OF TOTAL PLASMA CORTICOSTERONE CONCENTRATION (Abstract), by F. Labrie, J. P. Raynaud, and C. Fortier. [1964] [1]p. (AFOSR-66-2464) (AF AFOSR-64-511) AD 643140 Unclassified

Also published in Federation Proc., v. 23, Mar.-Apr. 1964.

Following incubation at 37°C of increasing amounts of C^{14}-corticosterone with adrenalectomized rat plasma, distribution of the steroid between native form and transcortin- and albumin-bound moieties was studied as a function of total concentration by concurrent utilization of gel filtration and equilibrium dialysis. Separation of the transcortin-bound fraction was achieved by eluting plasma through Sephadex with phosphate buffer at 37°C. Results were corrected for dilution effect and for dissociation of the transcortin-corticosterone complex inherent to procedure. The native/total protein-bound corticosterone ratio was obtained from equilibrium dialysis of undiluted plasma against 0.9% saline, at 37°C. Assessment of the albumin-bound fraction was derived from the difference between results of the two procedures. (Contractor's abstract, modified)

1282

Laval U., Quebec (Canada).

RELATIVE BINDING OF CORTICOSTERONE BY TRANSCORTIN AND ALBUMIN, AS DETERMINED BY GEL-FILTRATION AND EQUILIBRIUM DIALYSIS (Abstract), by J. P. Raynaud, F. Labrie, and C. Fortier. [1964] [1]p. (AFOSR-66-2465) (AF AFOSR-64-511) AD 643141 Unclassified

Also published in Proc. Canad. Federation Biol. Soc., v. 7: 44, 1964.

Following incubation, at 37°C, of increasing amounts of C^{14} corticosterone with adrenalectomized rat plasma, distribution of the steroid between its native form and its transcortin and albumin-bound moieties was studied as a function of total concentration, by the concurrent utilization of gel-filtration and equilibrium dialysis. Separation of the transcortin-bound fraction was achieved by eluting the plasma through a G 25 coarse Sephadex column with phosphate buffer, at a constant temperature of 37°C. The results were corrected for the dilution effect and for the dissociation of the transcortin-corticosterone complex inherent to the gel-filtration procedure. By concurrently measuring the transcortin-bound and the total protein-bound corticosterone fractions, the adverse effect on binding of

increasing the dilution of the plasma could be quantitated, and an appropriate correction factor derived. (Contractor's abstract, modified)

1283

Laval U., Quebec (Canada).

INFLUENCE OF THYROID ACTIVITY ON CORTICOSTERONE BINDING BY PLASMA PROTEINS (Abstract), by F. Labrie, J. P. Raynaud and others. [1964] [1]p. (AFOSR-66-2469) (AF AFOSR-64-511) AD 643138 Unclassified

Also published in Proc. Canad. Federation Biol. Soc., v. 7: 23, 1964.

Previous studies have suggested that thyroxine could enhance the binding of corticosterone by plasma proteins. To test this hypothesis, rats were sacrificed, with untreated controls, four weeks after thyroidectomy followed or not by daily administration of 20 μg of thyroxine during the last two post-operative weeks; half of the experimental and control animals being exposed, 12.5 minutes prior to killing, to faradic stimulation of 2-minute duration. Adrenal and total plasma corticosterone were determined by a standard fluorometric method. The distribution of corticosterone between its native form and the transcortin and albumin bound moieties was studied. In confirmation of previous results, thyroidectomy and thyroxine administration were respectively found to lower and to increase the basal secretion of corticosterone, as well as the corticoidogenic response to stress. (Contractor's abstract, modified)

1284

Laval U., Quebec (Canada).

PITUITARY-THYROID RESPONSE TO COLD EXPOSURE IN THE RAT (Abstract), by M. Jobin and M. Samel. [1964] [1]p. (AFOSR-66-2470) (AF AFOSR-64-511) AD 644914 Unclassified

Also published in Proc. Canad. Federation Biol. Soc., v. 7: 23, 1964.

Rats were sacrificed following progressively longer periods (15 min to 24 hr) of exposure to moderate cold (13°C) for determination of pituitary and plasma TSH and of plasma thyroxine concentration. The plasma TSH response to cold exposure was characterized by a transient peak within 30 min, and a secondary rise to elevated levels over the remainder of the observation period. No appreciable rise of plasma thyroxine was observed for less than 4 hr of exposure. Elevated values were recorded from then on. No definite response pattern was observed with regard to pituitary TSH. A diurnal variation in plasma thyrotropic activity was suggested in this experiment. This tendency was confirmed in a separate experiment. A third experiment in which the plasma TSH responses to cold of graded intensities (20°, 14°, 8° and 2°C) were compared, revealed a maximum stimulatory effect for temperatures of 8° and 2°C. (Contractor's abstract, modified)

1285

Lehigh U. Center for the Information Sciences, Bethlehem, Pa.

AN EMPIRICAL TESTING PROGRAM FOR MODELS OF INFORMATION STORAGE AND RETRIEVAL SYSTEMS, by D. J. Hillman. Final rept. July 1, 1963-June 30, 1964. Nov. 6, 1964, 10p. (AFOSR-64-2385) (AF AFOSR-64-462) AD 608704 Unclassified

A small scale experimental program was undertaken to compare the efficiency of a retrieval system based on a Boolean model with that of a system based on a negation-free or incomplemented model. The results of the experiment are described.

1286

Lehigh U. Dept. of Mathematics, Bethlehem, Pa.

VECTOR FIELDS AND INFINITESIMAL TRANSFORMATIONS ON RIEMANNIAN MANIFOLDS WITH BOUNDARY, by C.-C. Hsiung. 1963, 36p. incl. refs. (AFOSR-4783) (AF AFOSR-62-206) AD 428685 Unclassified

Also published in Bull. Soc. Math. France, v. 92: 411-434, 1964.

Results of studies made of vector fields or infinitesimal transformations on compact Riemannian manifolds without boundary are extended to Riemannian manifolds with boundary. Fundamental formulas for Lie derivatives are given and the infinitesimal transformations and their generating vector fields are defined in terms of Lie derivatives. Necessary and sufficient conditions for a vector field on a manifold with zero tangential or normal component on a boundary to be a killing vector field are given. Conditions are obtained for the nonexistence of a nonzero conformal killing vector field on a manifold with zero tangential or normal component on the boundary, and necessary and sufficient conditions for a vector field on a manifold with zero tangential or normal component on the boundary to be a conformal killing vector field are obtained. It is shown that if the manifold has constant scalar curvature and admits a certain special infinitesimal nonhomothetic conformal motion leaving the boundary invariant, then the curvature is greater than zero.

1287

Leicester U. Dept. of Biochemistry (Gt. Brit.).

THE METABOLISM OF SIMPLE CARBON COMPOUNDS IN MICRO-ORGANISMS, by H. L. Kornberg. Final technical rept. Oct. 31, 1963, 10p. incl. diagr. refs. (AFOSR-J1454) (AF EOAR-62-77) AD 427528 Unclassified

The main results obtained indicate that: both repression and inhibition of isocitrate lyase may be mediated via phosphopyruvate; β-methyl β-hydroxyaspartate may be cleaved by β-hydroxyaspartate aldolase; glycine utilization by Arthrobacter sp. involves serine and pyruvate, and not glyoxylate or glycerate, as intermediates; tartronic semialdehyde reductase may

be involved in the racemization of D and L glycerate; Cl. kluyveri extracts may catalyze CO_2-fixation dependent on crotonyl-CoA; the utilization of aconate and itaconate proceeds by different metabolic routes, involving distinct and inducible enzymes; the decarboxylation of aspartate by crystalline aspartate 4-carboxy-lyase involves the intermediate formation of a secondary amine between the substrate and an enzyme - pyridoxal 5'-phosphate imine; and Ps. aeruginosa elaborates only one acyl transferase but the kinetics of its production depend on the nature of the inducer.

1288

Leicester U. [Dept. of Biochemistry] (Gt. Brit.).

THE UTILIZATION OF ITACONATE BY PSEUDOMONAS SP, by R. A. Cooper and H. L. Kornberg. [1964] [10]p. (AFOSR-64-1193) (AF EOAR-62-77) AD 442994 Unclassified

Also published in Biochem. Jour., v. 91: 82-91, 1964.

This report describes a route of itaconate catabolism in Pseudomonas B_2aba which is similar to that occurring in liver mitochondria. It was shown that washed suspensions of Pseudomonas B_2aba, grown on itaconate, oxidized itaconate, DL-citramalate and mesaconate, but these substances were not oxidized by succinate-grown cells. Extracts of the itaconate-grown organism catalyzed the formation of pyruvate and acetyl-coenzyme A when incubated with itaconate, adenosine triphosphate, coenzyme A and Mg^{2} ions. The formation of pyruvate and acetylcoenzyme A from DL-citramalate, in the presence of extract and Mg^{2+} ions, necessitated the presence either of succinate, coenzyme A and adenosine triphosphate, or of succinyl-coenzyme A. Both synthetic itaconyl-coenzyme A and enzymically produced citramalyl-coenzyme A yielded pyruvate and acetyl-coenzyme A in equimolar amounts.

1289

Leicester U. Dept. of Biochemistry (Gt. Brit.).

PURIFICATION AND PROPERTIES OF ACYLTRANSFERASES FROM PSEUDOMONAS AERUGINOSA, by M. Kelly and H. L. Kornberg. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-2971) (AF EOAR-62-77) AD 628390 Unclassified

Also published in Biochem. Jour., v. 93: 557-566, 1964.

Two preparations of amidase, of similar final specific activities, were obtained from Pseudomonas aeruginosa 8602/A grown on acetate plus ammonia, and on acetamide, as carbon and nitrogen sources. The purified enzymes catalyzed the transfer of the acyl moieties of a number of aliphatic amides to water (amidase activity) and to hydroxylamine (amide-transferase activity); to a smaller extent they also catalyzed the transfer to hydroxylamine of the acyl moieties of several aliphatic acids (acid-transferase activity). Both enzymes exhibited the same substrate specificity. The ratios of the amidase, amide-transferase and acid-transferase activities exhibited by each enzyme varied in an identical manner with different substrates. Both enzymes exhibited identical kinetic properties. The amidase activity of both enzymes was non-competitively inhibited by urea and by N-methylurea; these inhibitions were reversed by hydroxylamine. Thiourea did not inhibit. The amide-transferase and acid-transferase activities of both enzymes were inhibited by iodoacetate and by p-hydroxymercuribenzoate: the inhibition caused by the latter compound was reversed by cysteine.

1290

Leicester U. [Dept. of Chemistry] (Gt. Brit.).

THE EFFECT OF ADDED ELECTROLYTES ON THE E.S.R. AND OPTICAL ABSORPTION OF METAL-AMMONIA SOLUTIONS, by M. C. R. Symons. June 1964, 31p. (Scientific rept. no. 5) (AFOSR-64-2429) (AF EOAR-62-64) AD 609557 Unclassified

A confined model for the solvated electron is developed by analogy with related systems, and is used to describe the spectral properties of electrons trapped in various media. The nature of the diamagnetic species in metal solutions is discussed in view of the proposed model.

1291

Leicester U. [Dept. of Chemistry] (Gt. Brit.).

THE EFFECT OF ADDED ELECTROLYTES ON THE ELECTRON SPIN RESONANCE AND OPTICAL ABSORPTION OF SOLUTIONS OF THE ALKALI METALS IN LIQUID AMMONIA, by R. Catterall. Final rept. Apr. 1964, 333p. incl. refs. (AFOSR-65-1938, Pt. 2) (AF EOAR-62-64) AD 627234 Unclassified

This is an informative annex to the final report AFOSR-65-1938, Pt. 1. A review of the development of the study of metal solutions is presented. Particular emphasis is placed on the various models proposed to describe the physical properties of these solutions. Electron spin resonance and optical absorption measurements are reviewed in detail.

1292

Leyden U. Lorentz Inst. (Netherlands).

BROWNIAN MOTION IN SYSTEMS OF FINITE SIZE, by I. Oppenheim and P. Mazur. [1964] [13]p. (AFOSR-65-0156) (AF EOAR-62-39) AD 611966 Unclassified

Also published in Physica, v. 30: 1833-1845, 1964.

The solution of the Langevin equation for a Brownian particle in an arbitrary field of force in a finite system, in the presence of walls, is related to the solution of the Langevin equation for an infinite system. Analytic expressions for correlation functions of the momentum in the absence of an external field are obtained. The importance of the order of the $V \to \infty$ and $t \to \infty$ limiting processes is discussed. (Contractor's abstract)

1293

Leyden U. Lorentz Inst. (Netherlands).

ON THE STATISTICAL MECHANICAL THEORY OF BROWNIAN MOTION, by P. Mazur and E. Braun. [1964] [16]p. (AFOSR-65-1083) (AF EOAR-62-99) AD 619645 Unclassified

Also published in Physica, v. 30: 1973-1988, 1964.

It is shown that a heavy particle in a 1-dimensional assembly of harmonic oscillators performs Brownian motion provided that the spectral density $G(\omega^2)$ of eigenvalues ω^2 of the interaction matrix is proportional to ω^{-1} for $\omega \to 0$. The interaction matrix may otherwise be completely arbitrary. A generalization of this result to D-dimensional systems is given. (Contractor's abstract)

1294

Library of Congress. Science and Technology Div., Washington, D. C.

AIR FORCE SCIENTIFIC RESEARCH BIBLIOGRAPHY. VOL. II: 1957-1958, by G. V. Hooker, A. S. Dann and others. 1964, 1103p. incl. illus. refs. (AFOSR-64-0967; AFOSR-700, Vol. II) (ISSA-63-2) AD 446866 Unclassified

This bibliography includes abstracts of all publications supported in whole or in part by the Air Force Office of Scientific Research during the period 1957 through 1958. The Air Force Office of Scientific Research supports fundamental research in the five major scientific disciplines: physics, chemistry, engineering sciences (subsuming mechanics and propulsion), life sciences (both biological and behavioral, but not medical), and mathematics. References, reports, and clues to the existence of reports were found by searching the indexes and report collections of the AFOSR Technical Library, and the Armed Services Technical Information Agency. Reports are posted chronologically and/or alphabetically under contracts, these in turn under laboratories, and these under contractors. The abstracts are coded for future machine searching. A detailed subject index, arranged alphabetically, is provided. Because of the high percentage of mathematical papers included in this volume, a separate mathematical classification is included. In addition to the subject indexes, a contract index, an AFOSR control number index, and a personal author index are provided.

1295

Litton Systems, Inc. Space Sciences Labs., Beverly Hills, Calif.

RESEARCH ON ELECTROMAGNETIC PLASMA ACCELERATION, by A. S. Penfold and R. M. Rosen. Final rept. Dec. 15, 1959-Oct. 31, 1963. June 1964, 494p. incl. illus. diagrs. tables, refs. (Publ. no. 3484) (AFOSR-64-1340) (AF 49(638)759) AD 609482 Unclassified

Included in this report are the following: (a) An experimental investigation of the acceleration of plasma toroids in a pulsed traveling wave device. (b) A theoretical investigation of the behavior of plasma in axially symmetric magnetic fields. (c) A detailed description of a CW polyphase-driven traveling wave accelerator. In addition there are a number of appendices describing various ancillary techniques and apparatuses including polyphase monitoring and control systems, an analog computer for axially-symmetric magnetic fields, and the CW power sources. (Contractor's abstract)

1296

Lockheed Aircraft Corp. [Missiles and Space Div.] Sunnyvale, Calif.

LAMINAR FLAME THEORY AND THE STEADY, LINEAR BURNING OF A MONOPROPELLANT, by W. E. Johnson and W. Nachear. [1963] [35]p. (AFOSR-J476) (AF 49(638)412) AD 408216 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 12: 58-92, 1963.

The principal purposes of this paper are to analyze rigorously the eigenvalue problem, to demonstrate existence and uniqueness of solutions, and to discuss certain aspects of the qualitative behavior of solutions. The formulation of the eigenvalue problem from physical laws, and the subsequent analysis of this problem will be such that no special form for the chemical-reaction-rate law, or chemical source function, need be assumed. In particular, the results will be applicable to the phenomenological mass-action law for a one-step, reversible, chemical reaction involving an arbitrary number of species, in arbitrary initial ratios, and with specific reaction-rate coefficients dependent upon temperature in the form of the Arrhenius laws.

1297

Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.

THE EFFECTS OF PARTICLE SIZE AND NON-STOICHIOMETRIC COMPOSITION ON THE BURNING RATES OF COMPOSITE SOLID PROPELLANTS, by W. Nachbar and G. B. Cline, Jr. [1963] [18]p. incl. diagrs. table. (AF 49(638)412) Unclassified

Published in Combustion and Propulsion; Fifth AGARD Colloq. on High-Temperature Phenomena, Braunschweig (Germany) (Apr. 9-13, 1962), ed. by R. P. Hagerty, A. L. Jaumotte and others. New York, MacMillan Co., 1963, p. 551-568.

Analysis of the steady burning of a composite solid propellant of sandwich construction, which has been proposed previously (see item no. LOC. 01:004, Vol. II) as a mathematical model with which to investigate steady burning, is generalized to include non-stoichiometric proportions of fuel and oxidizer. The theoretical dependence of burning rate upon "particle size" and upon stoichiometry is obtained and is illustrated by calculations with data for 2 composite solid propellants. A

rough qualttative comparison is made of the theoretical predictions with some published experimental data.

1298

[London U.] Imperial Coll. of Sctence and Tech. (Gt. Brit.).

A GENERALIZATION OF FIELD QUANTIZATION AND STATISTICS. II. INTERACTING FIELDS, by S. Kamefucht and J. Strathdee. [1963] [11]p. tncl. table, refs. (AFOSR-J799) (AF EOAR-62-87) AD 413559 Unclassified

Also published in Nuclear Phys., v. 42: 166-176, Apr. 1963.

The generaltzed method of quantization developed tn a previous paper ts extended via suttable modiftcations of the usual commutation relations between different ftelds so as to allow the incorporation of tnteractions. A consequence of the structure of these modified commutation relations is the existence of a supper-selection rule concerning the numbers of particles of each statistical type. By means of thts super-selection rule and of some quantitative consequences of the theory, one is able to establtsh that all of the known elementary particles obey either Fermt-Dirac or Bose-Einstein statistics. (Contractor's abstract)

1299

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

MASSIVE ELECTRODYNAMICS, by G. Feldman and P. T. Matthews. [1963] [6]p. tncl. refs. (AFOSR-J800) (AF EOAR-62-87) AD 413525 Unclassifted

Also published tn Phys. Rev., v. 130: 1633-1638, May 15, 1963.

The relation between gauge invartance, canontcal quantization, and the photon mass is examined. It is found that gauge tnvariance does not require the bare photon mass to be zero. In fact, quantization tn an arbttrary covariant gauge ts only posstble for massive photons. Thts is a generalization of the usual Fermi procedure. A similar generaltzation of the conventional Coulomb gauge quantization leads to a gauge-invariant, but noncovariant, theory of masstve transverse photons.

1300

[London U.] Imperial Coll. of Science and Tech. (Gt. Brtt.).

FEYNMAN RULES FOR REGGE PARTICLES, by T. W. B. Ktbble. [1963] [10]p. (AFOSR-64 0365) (AF EOAR-62-87) AD 434527 Unclassified

Also publtshed tn Phys. Rev., v. 131: 2282-2291, Sept. 1, 1963.

The analogy between Regge poles and poles due to single-particle exchange ts extended to the case of many-particle amplttudes, by considering diagrams with two or more poles. A set of diagrams ts obtatned tn whtch the internal ltnes represent Regge particles. The problem of coupling three particles of arbitrary but physical spin ts treated first, and coupling constants depending on the helicities are defined. The vertex functions which couple three Regge parttcles, and which have a similar symmetry properties, are deftned tn terms of the restdues of Regge poles. The propagator for a Regge particle with trajectory $\alpha(t)$ ts essentially a rotation matrix for spin α, corrrespondigg to a rotation from the tnttial to the final direction of the center-of-mass momentum, divided by $\sin \pi(\alpha - \sigma)$, where σ is a constant whtch replaces the stgnature. The possibility of ustng thts formaltsm to predict the high-energy behavior of production amplttudes is discussed, in particular, for stngle particle production.

1301

[London U.] Imperial Coll. of Sctence and Tech. (Gt. Brit.).

CANONICAL VARIABLES FOR THE INTERACTING GRAVITATIONAL AND DIRAC FIELDS, by T. W. B. Ktbble. [1963] [5]p. (AFOSR-64-0521) (AF EOAR-62-87) AD 433827 Unclassified

Also published in Jour. Math. Phys., v. 4: 1433-1437, Nov. 1963.

The problem of reductng the Lagrangian for the interacting gravitational and dirac fields to canonical form ts discussed, ustng the Vierbein formaltsm. The arbttrary gauge variables corresponding to local Lorentz transformations of the Vterbein are removed by impostng Schwinger's ttme-gauge condition, and a further condition that the spatial part of the Vierbein be symmetrtc. It ts shown that in thts gauge the Lagrangian can be expressed tn a canonical form involving essentially the same gravitational field variables as in the absence of matter, and that the generators of spatial translations and rotations have the expected form.

1302

[London U.] Imperial Coll. of Sctence and Tech. (Gt. Brtt.).

INTERACTION OF INTENSE LASER BEAMS WITH ELECTRONS, by L. S. Brown and T. W. B. Ktbble. [1964] [15]p. tncl. refs. (AFOSR-64-0865) (AF EOAR-62-87) AD 438649 Unclassified

Also published in Phys. Rev., v. 133: A705-A719, Feb. 3, 1964.

The tnteraction of an tntense coherent photon beam with free electron is discussed. The photon beam ts treated as a classtcal external electromagnetic fteld. The discussion ts exact wtthin the approxtmation of neglecting radiative corrections and the restrtction to the case of a plane-wave fteld of arbttrary spectral composition and

polarization properties. The problem of the correct definition of the vacuum current is encountered, and it is shown that a careful procedure is necessary to obtain a covariant result. (Contractor's abstract, modified)

1303

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

DISTRIBUTION OF PIONS IN NUCLEON CLOUDS, by Q. A. M. M. Yahya. [1963] [13]p. (AFOSR-64-1007) (AF EOAR-62-87) AD 440987 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1487-1499, Dec. 16, 1963.

The fluctuation of pions in nucleon clouds is studied using statistical methods. The probability that in an interval of time certain number of pions would reach the physical nucleon cloud and be reabsorbed in the core is obtained in a method analogous to waiting time problem in statistics. The probability that a specified number of cloud states would be formed after some transitions of pions is found explicity by means of generating functions.

1304

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

REGGE-POLE THEORY OF THE PHOTOPRODUCTION OF PIONS, by N. Dombey. [1964] [12]p. (AFOSR-64-1155) (AF EOAR-62-87) AD 442842 Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 1025-1036, Mar. 1, 1964.

In an attempt to apply a Regge-pole treatment to photoproduction it was found that in order to obtain the desired results massive photons have to be introduced into the theory thus allowing effects arising from longitudinal polarization of the photon. A new set of invariant amplitudes for the electroproduction of pions naturally suggest themselves from these considerations.

1305

[London U.] Imperial Coll. of Science and Tech.

INTENSIVE OBSERVABLES IN QUANTUM THEORY, by R. F. Streater. [1964] [10]p. incl. refs. (AFOSR-64-2052) (AF EOAR-62-87) AD 452521 Unclassified

Also published in Jour. Math. Phys., v. 5: 581-590, May 1964.

The notion of strictly intensive observables is introduced in a theory of local observables. It is shown that energy-momentum can never be strictly intensive. This result is used to prove that the algebras of observables is not of Type I for some regions. By analogy with the energy-momentum tensor density for the free field, the definition is weakened. This leads to the introduction of germs of intensive observables. It is proved that the unitary intensive operators form a sheaf F of groups, and the Hermitian intensive operators form a sheaf G of Abelian groups.

1306

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

U-SPIN AND THE WEAK INTERACTION, by P. T. Matthews and A. Salam. [1964] [5]p. incl. diagr. table. (AFOSR-64-2548) (AF EOAR-62-87) AD 453830 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1333-13337, Sept. 1, 1964.

The action of U-spin is applied to the semi-leptonic decays of the baryons. (Contractor's abstract)

1307

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

ON QUASI-FREE POLYLOCAL FIELDS AND FIELDS OF INFINITE SPIN, by R. F. Streater. [1964] [9]p. incl. refs. (AFOSR-65-0116) (AF EOAR-62-87) AD 455796 Unclassified

Also published in Ann. Phys., v. 30: 1-9, Oct. 1964.

A method is presented for constructing polylocal fields, depending on many space-time variables and similar to the generalized free field in 1 variable. A special case of the polylocal field may be said to correspond to a local field of infinite spin. The 1-particle state of such a theory is infinitely degenerate unless the 1-particle unitarity condition holds. In certain cases the existence of localized von Neumann algebras can be proved. The spacelike asymptotic condition in the form suggested by Haag and Ruelle holds, and so the interpretation of the theory in terms of asymptotic states may be expected. (Contractor's abstract, modified)

1308

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

πp PHENOMENOLOGY, (300 ÷ 1300) MEV, by P. Auvil and C. Lovelace. [1964] [47]p. incl. diagrs. tables, refs. (AFOSR-65-0117) (AF EOAR-62-87) AD 455633 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 473-519, July 16, 1964.

Elastic scattering experiments from 300 to 1300 mev

are analyzed by various new or improved techniques. The usual D_{13} and F_{15} assignments for the second and third resonances are supported. The fourth resonance is found to be F_{37}, and the 800 mev π^+p shoulder to be D_{35} inelastic. There are also indications of 4 more inelastic shoulders: in P_{11} (~ 400 mev), S_{11} (~ 600 mev), D_{15} (~ 700 mev) and G_{17} (~ 1200 mev). Both S waves increase steadily with energy, indicating a strong repulsive core. The background at the fourth resonance is strongly spin-dependent, in contradiction to the usual diffraction model. The imaginary parts of the partial amplitudes are obtained quantitatively over much of this region. The most powerful new condition is the requirement that the elasticities of the resonances, as determined from total cross-sections and forward dispersion relations, be compatible with the differential cross-sections there. (Contractor's abstract)

1309

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

RENORMALIZABLE ELECTRODYNAMICS OF SCALAR AND VECTOR MESONS. II, by A. Salam and R. Delbourgo. [1964] [30]p. incl. diagrs. refs. (AFOSR-65-0118) (AF EOAR-62-87) AD 455797 Unclassified

Also published in Phys. Rev., v. 135: B1398-B1427, Sept. 21, 1964.

The gauge technique for solving field theories is applied to scalar and vector electrodynamics. It is shown that for scalar electrodynamics there is no $\lambda\varphi^{*2}\varphi^2$ infinity in the theory, while the conventional subtractions vector electrodynamics is completely finite. The essential ideas of the gauge technique are explained and a preliminary set of rules for finite computation in vector electrodynamics is established. (Contractor's abstract, modified)

1310

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

GAUGE THEORY OF ELEMENTARY INTERACTIONS, by A. Salam and J. C. Ward. [1964] [6]p. incl. table, refs. (AFOSR-65-0809) (AF EOAR-62-87) AD 616059 Unclassified

Also published in Phys. Rev., v. 136: B763-B768, Nov. 9, 1964.

F and D couplings of baryons and mesons are shown to arise naturally with a sample extension of the gauge formalism to a $(SU_3 \times SU_3)_L \times (SU_3 \times SU_3)_R$ group structure. In its general formulation the theory needs parity doublets of (0+) and (0-) ninefolds. It admits of (2 types of F and D coupled) (1+) and (1-) vector and axial-vector meson multiplets, a specially attractive combination of currents which emerges from the formalism being an equal mixture of vector F with axial-vector D [the case of $(SU_3)_L \times (SU_3)_R$]. The theory also admits an approximate (Bronzan-Low) type of quantum number. (Contractor's abstract)

1311

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

SU(6) AND CHARGE FORM FACTORS, by J. M. Charap and P. T. Matthews. [1964] [2]p. (AFOSR-65-0828) (AF EOAR-62-87) AD 616051 Unclassified

Also published in Phys. Ltrs., v. 13: 346-347, Dec. 15, 1964.

This note shows that it is possible to deduce relations between charge form factors using a generalization of U-spin and that the electric charge form factor of the neutron is zero. The SU(6) group, containing the subgroup $SU(3) \otimes SU(2)_U$, is studied and related to baryon magnetic moments. (Contractor's abstract)

1312

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

PRACTICAL THEORY OF THREE-PARTICLE STATES. I. NONRELATIVISTIC, by C. Lovelace. [1964] [25]p. incl. diagr. refs. (AFOSR-65-0462) (AF EOAR-64-46) AD 614493 Unclassified

Also published in Phys. Rev., v. 135: B1225-B1249, Sept. 7, 1964.

A practical theory of 3-particle states is derived in which each of the 2-particle subsystems is assumed to be dominated by a finite number of bound states and resonances. Two sets of equations are then obtained. One expresses processes with 3 final particles in terms unstable-particle scattering; it generalizes and justifies the isobar model. The other is a set of coupled Lippmann-Schwinger equations for the scattering of bound states and unstable particles. The potentials in these scattering equations for composite particles are nonlocal and energy-dependent, and become complex above the 3-particle threshold. They are expressed in terms of the wave functions of the 2-particle bound states and resonances; there are no new arbitrary constants. The solution satisfies 3-particle unitarity. Unstable particles are not approximated by stable ones. The theory applies particularly to "overlapping" final-state interactions. The equations are given in detail for the 3N and $N\pi\pi$ systems in the static limit. In the latter case, the nucleon is treated as an $N\pi$ bound state. (Contractor's abstract, modified)

1313

[London U.] Imperial Coll. of Science and Tech. (Gt. Brit.).

ELECTROMAGNETIC AND WEAK INTERACTIONS, by

A. Salam and J. C. Ward. [1964] [4]p. incl. refs. (AFOSR-65-0825) (AF EOAR-64-46) AD 616050 Unclassified

Also published in Phys. Ltrs., v. 13: 168-171, Nov. 15, 1964.

In this note a synthesis is attempted between electromagnetism and weak interactions. No explanation is offered for the large boson mass value which results from one of the major differences between the two—that electromagnetic coupling strength is vastly different from the weak. Rather a synthesis is sought in terms of a group structure such that the remaining differences—contrasting space-time behavior and contrasting ΔS and ΔI behaviors—appear as aspects of the same fundamental symmetry. Both leptons and hadrons are tested.

1314

London U. [Inst. of Laryngology and Otology] (Gt. Brit.).

THE STUDY OF THE MECHANISM OF TRANSFORMATION OF PHYSICAL ENERGY INTO NERVE ACTIVITY IN THE INTERNAL EAR, by F. C. Ormerod. Final technical rept. Feb. 1963, 7p. (AFOSR-4862) (AF EOAR-62-2) AD 413764 Unclassified

Study of the structure of the cochlea of a number of small mammals revealed, in certain species of bats and of rodents, a number of variations which appear to be related to the somewhat unusual sound frequencies which they are able to detect, and which are not found in the ears of the majority of mammals. Serial sections of larynxes of many species of bats have shown notable modifications—massive intrinsic and extrinsic musculature, large arytenoid cartilages and very slender vocal cords—concerned with production of very high frequency sounds. Further work was done on various aspects of beat-note hypothesis in echolocation. Sonograph analysis of tape recordings of call signals of bats and other animals was made and studied. Suggestion that cavities of skull act as resonant filters was confirmed by constructing models and obtaining identical responses.

1315

London U. [Inst. of Laryngology and Otology] (Gt. Brit.).

EQUIPMENT FOR DETECTING ANIMAL ULTRASOUND, by J. D. Pye and M. Flinn. [1964] [6]p. (AFOSR-64-1168) (AF EOAP-63-30) AD 442787 Unclassified

Also published in Ultrasonics, v. 2: 23-28, Jan.-Mar. 1964.

The study of bioacoustics now includes many instances in which ultrasound is generated but can only be detected by the use of special equipment. In aerial encounters between bats and the insect that form their prey both participants use acoustical mechanisms which operate at 20-150 kc/s. More widespread observations of these phenomena are desirable and this article shows that the basic equipment is neither difficult nor expensive to acquire. Simple microphones and tuned detector/analyzers are described, as well as the more elaborate techniques used for detailed analyses.

1316

London U. Inst. of Laryngology and Otology (Gt. Brit.).

ENERGY TRANSFORMATION WITHIN THE INNER EAR, by D. F. N. Harrison. Final technical rept. July 1964 [6]p. (AFOSR-65-0040) (AF EOAR-63-30) AD 610567 Unclassified

Processing and interpretation of material collected in the West Indies and Great Britain, with a view to correlating structure with function, has been continued. Main emphasis has been placed on cochlea of Chiroptera and Rodentia with analysis of larynges. Sonographic analysis of tape recordings from these species has enabled theories of echolocation to be tested. New apparatus and techniques have been developed for this purpose. (Contractor's abstract)

1317

London U. Inst. of Laryngology and Otology (Gt. Brit.).

SIMPLE ELECTRONIC STROBOSCOPE. USE OF TWO FLASH-TUBES FOR MULTIPLE EXPOSURE PHOTOGRAPHY, by J. D. Pye. [1964] [4]p. incl. illus. diagrs. (AFOSR-65-0310) (AF EOAR-64-47) AD 612519 Unclassified

Also published in Wireless World, v. 70: 339-342, July 1964.

A description is given of the circuitry and operating principles of the stroboscope.

1318

London U. Queen Mary Coll. (Gt. Brit.).

SYNTHESIS OF CITRULLINE AND ARGININE IN CHLORELLA PYRENOIDOSA, by R. G. Hiller. [1964] [6]p. incl. tables, refs. (AFOSR-65-0953) (AF 61(052)-245) AD 617205 Unclassified

Also published in Jour. Exper. Botany, v. 15: 15-20, Feb. 1964.

The distribution of radioactivity in Chlorella during dark $^{14}CO_2$ fixation was investigated either (1) in normal cells with and without added NH_4Cl, or (2) in nitrogen-starved cells supplied with intermediates of the Krebs-Henseleit urea cycle. In the control experiments almost all the activity was present in compounds of or associated with, the tricarboxylic acid cycle. The amino-acids citrulline and arginine became radioactive only in the presence of ammonia or ornithine where initially

they comprised 40 to 60% of the total activity, reactions of the Krebs-Henseleit urea cycle being implicated in their formation. No evidence could be found for a complete urea cycle. Unidentified compounds deriving their radioactivity from the C_6 carbon of citrulline and/or arginine were detected and formed up to 40% of the total $^{14}CO_2$ incorporated after 25 min. (Contractor's abstract)

1319

London U. Queen Mary Coll. (Gt. Brit.).

CARBOXYLATION MECHANISMS IN PHOTOSYNTHESIS, by M. Bermingham and C. P. Whittingham. Final technical rept. Oct. 1, 1962-Sept. 30, 1963. Oct. 1963, 17p. (AFOSR-J1375) (AF EOAR-62-24) AD 429263 Unclassified

The production of glycollate and other compounds from specifically labelled glucose is dependent on the partial pressure of carbon dioxide. The distribution of radioactivity in sucrose and glycollate is altered by INH. The labelling pattern of this glycollate shows little randomization.

1320

London U. Queen Mary Coll. (Gt. Brit.).

THE PHOTOMETABOLISM OF GLUCOSE IN CHLORELLA, by C. P. Whittingham, M. Bermingham, and R. G. Hiller. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0946) (AF EOAR-62-24) AD 617623 Unclassified

Also published in Zeitschr. Naturforsch., v. 18: 701-706, 1963.

Uniformly labeled radioactive glucose was fed to Chlorella cells in the presence of non-radioactive carbon dioxide. The concentration of carbon dioxide was varied and the distribution of radioactivity determined in the light. At low concentrations of carbon dioxide much of the radioactivity appeared in glycollate or derivatives therefrom. By contrast, at higher concentrations of carbon dioxide, most of the radioactivity appeared in sucrose. If the concentration of oxygen was increased above that normally present in air, there was relatively more activity in glycollate. The effect of the addition of isoniazid in these conditions was also investigated. It was concluded that glucose fed to Chlorella exogenously is metabolized in the light in Chlorella via sugar phosphate intermediates of the Calvin cycle. (Contractor's abstract)

1321

London U. Queen Mary Coll. (Gt. Brit.).

THE SYNTHESIS OF AMINO-ACIDS IN CHLORELLA IN LIGHT AND DARK, by R. G. Hiller and C. P. Whittingham. [1964] [8]p. incl. diagrs. tables. (AFOSR-65-0947) (AF EOAR-62-24) AD 617637 Unclassified

Also published in Jour. Exper. Botany, v. 15: 21-28, Feb. 1964.

Experiments with Chlorella show that glycine and serine both become radioactive during photosynthetic incorporation of radioactive carbon dioxide. By contrast, when radioactive glucose is fed to Chlorella in the dark, alanine, glutamate, and aspartate are the major products. These are not produced in significant amount during photosynthesis at low concentrations of carbon dioxide but their formation may be stimulated by the addition of ammonium ions. (Contractor's abstract)

1322

London U. Queen Mary Coll. (Gt. Brit.).

STUDIES WITH FLASH ILLUMINATION ON THE ENHANCEMENT EFFECT IN CHLOROPLASTS, by C. P. Whittingham and P. M. Bishop. [1963] [10]p. incl. diagrs. refs. (AFOSR-65-0948) (AF EOAR-62-24) AD 617810 Unclassified

Also published in NAS-NRC Symposium on Photosynthesis Mechanisms in Green Plants, Publication no. 1145, 1963, p. 371-380.

The effect of light flashes at 4°C on chloroplasts isolated from spinach leaves was investigated, using different oxidant systems. These light flashes consisted of: (1) a single short flash; (2) pre-excitation by a short flash followed by a long flash; (3) monochromatic flash illumination with monochromatic continuous background light; and (4) flash illumination following continuous background illumination.

1323

London U. Queen Mary Coll. (Gt. Brit.).

THE ISONICOTINYL HYDRAZINDE AS A METABOLIC INHIBITOR IN PHOTOSYNTHESIS, by C. P. Whittingham, M. Bermingham and others. [1963] [8]p. incl. diagrs. table. (AFOSR-65-0949) (AF EOAR-62-24) AD 617868 Unclassified

Also published in Colloq. Internationaux Centre National de la Recherche Scientifique, Gif-sur-Yvette et Saclay, Paris (France) (July 23-27, 1962), Paris, CRNS, 1963, p. 571-588.

The photosynthetic production of glycollic acid in Chlorella was shown to be at a maximum at a low concentration of carbon dioxide and at light intensities approaching those required to saturate photosynthesis. Treatment with isonicotinyl hydrazide resulted in a 3-fold stimulation of glycollic acid production. Studies with radioactive carbon dioxide show that glycine and serine were formed together with glycollate. When the radioactive carbon dioxide was replaced by non-radioactive carbon dioxide the compounds of the Calvin cycle lost radioactivity which was accumulated in either glycollate or sucrose suggesting that these were final products of the photosynthetic cycle. At higher concentrations of carbon dioxide sucrose is the main and

predominant product but at low concentration of carbon dioxide a significant fraction of the carbon incorporated forms glycollate, clycine and serine. From the experiments with isonicotinyl hydrazide it would appear that as much as 70% of the carbon incorporated can result in glyoxylate and products therefrom. It is considered that these are derived by cleavage of the compound in the Calvin cycle which is carboxylated to a greater and greater extent the higher the concentration of carbon dioxide. (Contractor's abstract)

1324

[London U.] Queen Mary Coll. (Gt. Brit.).

THE PRODUCTION OF GLYCOLLATE DURING PHOTOSYNTHESIS, by C. P. Whittingham, R. G. Hiller, and M. Bermingham. [1963] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0950) (AF EOAR-62-24) AD 617639 Unclassified

Also published in NAS-NRC Symposium on Photosynthesis Mechanisms in Green Plants, Publication no. 1145, 1963, p. 675-683.

The products of photosynthesis in Chlorella have been investigated over a range of concentrations of CO_2 above and below that in air. At low CO_2 concentrations, a large fraction of CO_2 fixed in photosynthesis is converted to glycolic acid, and to the amino acids glycine and serine. As the CO_2 concentration increases, the production of glycolic acid and glycine decreases and sucrose becomes the major product. Other compounds, e.g., alanine, malic, and aspartic acids, are not markedly affected by changing the CO_2 concentration within the range studied, and represent a relatively small fraction of the total carbon fixed.

1325

[London U. Queen Mary Coll.] (Gt. Brit.)

PHOTOSYNTHETIC MECHANISMS UNDER SUBOPTIMAL CONDITIONS, by C. P. Whittingham. Final scientific rept. Oct. 21, 1964 [18]p. incl. tables. (AFOSR-65-0056) (AF EOAR-64-1) AD 610161 Unclassified

Sucrose produced by photosynthesis in Chlorella was degraded under conditions when glycollate production is significant. Radioactivity was supplied from glucose. No correlation was observed between labelling pattern in sucrose and glycollate production.

1326

London U. King's Coll. (Gt. Brit.).

INFLUENCE OF IONIC SOLUTES UPON RELAXATION TIME, by V. Gold. July 1964, 92p. incl. diagrs. tables, refs. (AFOSR-64-1605) (AF 61(052)458) AD 605723 Unclassified

Spin-lattice relaxation times were measured by the 'direct' nmr method for dilute aqueous solutions of Ni(II) in presence of cyanide, halide, acetone, t-butyl alcohol, trimethyl phosphate, edta and trien, for some of these solutes in the absence of paramagnetic ions. Spin-spin relaxation times were used to measure the influence of hydrogen ions on complex formation between water and acetaldehyde or pyruvic acid. Complex formation between methanol and other solvents through hydrogen-bonding was investigated by measurements of chemical shifts, the influecne of methoxide ions on multiplet collapse, and indicator measurements. (Contractor's abstract, modified)

1327

London U. Coll. (Gt. Brit.).

DECISION-MAKING, by R. J. Audley. [1964] [5]p. incl. diagrs. table, refs. (AFOSR-64-1382) (AF EOAR-62-69) AD 444460 Unclassified

Also published in Brit. Med. Bull., v. 20: 27-31, 1964.

This report contains theories about making rational decisions; Natural decision processes: Decision time, Vicarious trial and error (VTE) behavior, Effort, Confidence; The expanded judgement task and Psychological differences between logically similar decisions.

1328

London U. Coll. (Gt. Brit.).

RESPONSE INSTRUCTIONS AND THE SPEED OF RELATIVE JUDGEMENTS. I. SOME EXPERIMENTS ON BRIGHTNESS DISCRIMINATION, by R. J. Audley and C. P. Wallis. [1964] [15]p. incl. diagrs. tables, refs. (AFOSR-64-1383) (AF EOAR-62-69) AD 444463 Unclassified

Also published in Brit. Jour. Psychol., v. 55: 59-73, 1964.

It is hypothesized that the speed with which a relative judgement is made between two stimuli on any given dimension depends upon the relation between the general position of the stimuli on the dimension and the direction of the required judgement along this. Experiments involving the discrimination of light patches of different luminance are reported which support this hypothesis. They show that subjects are quicker at choosing the brighter than the darker of two relatively intense stimuli but quicker at choosing the darker of two relatively dark stimuli. A provisional explanation of the phenomenon in terms of a response competition theory of choice behavior is offered. Some alternative hypotheses are considered and analogies are made with other psychological phenomena. It is concluded that this is a judgemental phenomenon of some considerable generality. (Contractor's abstract)

1329

London U. Coll. (Gt. Brit.).

RESPONSE INSTRUCTIONS AND THE SPEED OF

RELATIVE JUDGEMENTS. II. PITCH DISCRIMINATION, by C. P. Wallis and R. J. Audley. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0293) (AF EOAR-62-69) AD 611459 Unclassified

Also published in Brit. Jour. Psychol., v. 55: 121-132, 1964.

Subjects were required to make easy pitch discriminations at four frequency levels. In a counter-balanced design, for half their judgements they were required to choose the higher of the pair of tones, and for the other half, the lower. It was found that subjects were quicker at choosing the higher than the lower of two high tones, but quicker at choosing the lower than the higher of two low tones. This 'cross-over' effect was found to be graded across the stimulus levels intermediate in the series, the intersection point being somewhat below the geometric mean of the series of frequencies used. While latencies tended to decrease during the course of an individual session, the cross-over effect was consistently observable in an analysis that controlled for such practice effects. Whether the tone responded to was the first or the second of the pair discriminated was found to be a significant variable. The 'cross-over' phenomenon was only consistently effective when the second tone was chosen. Linking these findings to similar phenomena previously demonstrated in brightness discrimination, theoretical suggestions are advanced which are relevant to all judgemental processes. (Contractor's abstract)

1330

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

[ANATOMICAL LOCALIZATION OF TARGET LEARNING AND MEMORY] Final rept. June 1963-1964, 12p. (AFOSR-64-1442) (AF EOAR-63-2) AD 604472 Unclassified

Work done on the memory system of the octopus is reported. Aspects considered include: analysis of the functions of the pairs of centers concerned with the signals of results; effects of hunger and taste of food; comparison of effects of removing vertical and median superior frontal lobes; electron-microscopy of the lobes; connections with the tactile memory system; the mechanism of poisoning, eating and digestion; effects of large amounts of food on behavior; conduction velocities of nerve fibers of different diameters; effect of lesions in the dorsal basal lobe; function of the peduncle lobe; delayed responses and short term memory; and comparison with other animals.

1331

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE GENERAL AMPLIFICATION FUNCTION OF THE VERTICAL LOBE IN OCTOPUS VULGARIS, by H. Maldonado. [1963] [15]p. (AFOSR-64-1683) (AF EOAR-63-2) AD 448258 Unclassified

Also published in Zeitschr. vergleich. Physiol., v. 47: 215-229, 1963.

The function of the vertical lobe of Octopus was investigated by measurement of the time taken to attack before and after its removal. After operation there was little change in the proportion of attacks but the method allowed the determination of an index showing that the time of attack and the variance of this time were greatly increased after vertical lobe removal. There was no such increase following dummy operations or removal of less than 25% of the lobe. The index did not fall to the level seen at the beginning of positive training. Some of the effects of training therefore survive the operation. It is suggested that what is lacking following removal is an amplification of the output of the optic lobe system constituting the empirical parameter of the command to attack. With re-training after operation the index rises again but seldom reaches its value before operation. The recovery after operation was not correlated with the amount of vertical lobe remaining, but with the initial rate of learning of the animal.

1332

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE POSITIVE LEARNING PROCESS IN OCTOPUS VULGARIS, by H. Maldonado. [1963] [24]p. (AFOSR-64-1684) (AF EOAR-63-2) AD 447593 Unclassified

Also published in Zeitschr. vergleich. Physiol., v. 47: 191-214, 1963.

When an octopus is faced repeatedly with the situation crab-attacked-to-a-bar there are progressive changes in the characteristics of the attacks. The total time to attack decreases and also the variation between times for attacks. The reduction in time is due partly to reduction in the time of construction of the command before the animal emerges from the home. There is also an elimination of the slow initial part of the attacks that is at first present. There is little change in the duration or speed of the final dash by which the prey is captured. The stage of learning reached is a function of the number of occasions of training and not of the number of days in the tank. Days without food distort the learning curve but do not accelerate its progress. The changes in line of attack are thus the expression of a positive learning process and not simply of acclimatization to the new environment.

1333

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE CONTROL OF ATTACK BY OCTOPUS, by H. Maldonado. [1964] [19]p. (AFOSR-64-1685) (AF EOAR-63-2) AD 447595 Unclassified

The attack by an octopus on a crab may be divided into three periods, the first and second time-delays and the final pattern of acceleration. During this final jump there are no periods of constant or nearly constant acceleration or of zero acceleration. The acceleration phase is generally longer than that of deceleration. There was an indispensable minimum period of illumination below which no attack occurred. If the octopus has viewed the crab for a time in excess of the first and

second time-delays before the light is switched off it will make an attack whose final pattern of acceleration does not differ from that of an attack when there is illumination throughout. Since during the final pattern of acceleration the attack is not dependent on continuous estimates of the distance from the goal there must be an internal mechanism that produces a program of forces before the final pattern of accleration begins. During the early stages of learning to attack in a particular situation the sequence of forces is often wrongly programmed and mistaken attacks occur.

1334

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

DELAYED RESPONSES IN OCTOPUS, by P. N. Dilly. [1963] [9]p. (AFOSR-64-1686) (AF EOAR-63-2) AD 447594 Unclassified

Also published in Jour. Exper. Biol., v. 40: 393-401, June 1963.

Octopuses were tested for their ability to perform delayed responses after varying delays and brain lestons. Octopuses delayed for 10 sec were capable of accurate performance without training. In order to make a correct response after 20 or 30 sec delays, some 'learning' is needed. Animals without vertical lobes or without median superior frontal lobes delayed for 30 sec responded correctly. The majority of correct attacks were 'swimming attacks' in which the animal swam through the water without contacting the walls of the tank. Shaking up the animals and disturbing them so that any ortentating contact between the octopus and the door and sides of the tank was destroyed, did not decrease the accuracy of the response. The time taken for the response in these experiments was slightly increased.

1335

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

ELECTRON MICROSCOPY OF OPTIC NERVES AND OPTIC LOBES OF OCTOPUS AND ELEDONE, by P. N. Dilly, E. G. Gray, and J. Z. Young. [1963] [11]p. (AFOSR-64-1687) (AF EOAR-63-2) AD 447596 Unclassified

Also published in Proc. Roy. Soc. (London), v. 158B: 446-456, 1963.

Each optic nerve contains several bundles of axons. The axons have their surface membranes directly apposed and the bundles lie in troughs of the elongated Schwann cells. The axons have pronounced varicosities along their length. The axons enter the optic lobe and run between the granule cells to synapse in the plexiform zone. The granule cells are small neurons. Their cytoplasmic organelles include endoplasmic reticulum, ribosomes, a granular reticulum and of special interest, oval or spherical bodies with a lamellated cortex and granular medulla. The elongated varicose presynaptic bags of the optic axons contain mitochondria in the proximal region, numerous synaptic vesicles and, sometimes, neurofilaments. Below the mitochondrial zone, synaptic contacts are made with small spines invaginated into the bags.

1336

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

PAIRED CENTRES FOR THE CONTROL OF ATTACK BY OCTOPUS, by J. Z. Young. [1964] [24]p. (AFOSR-64-1689) (AF EOAR-63-2) AD 447701 Unclassified

Also published in Proc. Roy. Soc. (London), v. 159B: 565-588, 1964.

The vertical lobe system in Octopus is concerned in the regulation of the tendency to attack. It receives impulses from the optic lobes, from touch and chemoreceptors and from pain receptors. The visual part of the system is organized into lower and upper loops. The lower loop leads from the optic lobes, though two centers and back to the optic lobes. The upper loop also consists of two centers, superposed in parallel above the lower ones. Each of the two loops contains two centers in series and it is suggested that the first center of each pair tends to promote attack and the second to restrain or prevent it. The net effect of two centers of each pair together is to increase the probability of attack, unless pain intervenes.

1337

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

THE VISUAL ATTACK LEARNING SYSTEM IN OCTOPUS VULGARIS, by H. Maldonado. [1963] [19]p. incl. diagrs. refs. (AFOSR-64-1690) (AF EOAR-63-2) AD 447703 Unclassified

Also published in Jour. Theoret. Biol., v. 5: 470-488, 1963.

A model representative of the visual attack learning system in Octopus vulgaris is presented, in which each block stands for a functional unit and the connections between blocks indicate the causal process in terms of flow of information. It is possible to identify some of these blocks with distinct lobes of the octopus brain. The basic assumption of the model is that when an object is shown to the octopus, which is rewarded (or punished) if it catches it, the animal links the reward or punishment not with an 'object' as such but with some outstanding properties of it, encoded by a classifying system. The elements of this 'classifying system' are called the classifying units (C. U. s.). Each C. U. has a discrete scalar output and it is assumed there is a separate C. U. for each set of mutually exclusive properties.

1338

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

STUDIES ON THE RECEPTORS IN THE CEREBRAL VESICLE OF THE ASCIDIAN TADPOLE. 2. THE OCELLUS, by N. Dilly. [1964] [8]p. (AFOSR-64-1704) (AF EOAR-63-2) AD 448278 Unclassified

Also published in Quart. Jour. Micros. Sci., v. 105: 13-20, 1964.

Electron microscope observations of the photoreceptor of the tadpole larva of Ciona intestinalis show the ocellus to consist of about 10 cells. It is made up of 3 parts: a pigment cup, a lens system, and a retina. A single cup-shaped cell filled with membrane-bound pigment granules lies between the lens and the retinal cells. Part of the lens cell is contained within its concavity. The pigment granules are arranged to keep stray light from falling upon the photoreceptor endings. The lens system has 3 lens vesicles arranged in a line along the main axis of the pigment cup cell. The retinal cells lie above the dorsal arm of the pigment cup cell, and have tubular processes that pass through it to end as piles of membranes closely applied to the lens cell. Morphologically the photoreceptor units of the ascidian tadpole closely resemble the visual cells of the vertebrates.

1339

London U. Coll. [Dept. of Anatomy] (Gt. Brit.).

INTERFERENCE IN LEARNING AND LESIONS IN THE VISUAL SYSTEM OF OCTOPUS VULGARIS, by J. R. Parriss. [1963] [13]p. (AFOSR-64-1712) (AF EOAR-63-2) AD 448263 Unclassified

Also published in Behaviour, v. 21: 233-245, 1963.

Two groups of Octopuses, one normal and one with lesions in the optic lobe system, were trained on a discrimination between horizontal and vertical rectangles followed by a discrimination with a square and a diamond. They were then retrained on the original horizontal and vertical discrimination. A further group of normal animals were trained on a discrimination between the square and the diamond followed by a discrimination with the horizontal and vertical rectangles. They were then retrained on the original square and diamond discrimination. Results of the investigation are presented.

1340

London U. Coll. Dept. of Anatomy (Gt. Brit.).

FORCES EXERTED BY OCTOPUS VULGARIS, by N. Dilly, M. Nixon, and A. Packard. [1964] [12]p. incl. diagrs. tables. (AFOSR-65-2840) (AF EOAR-63-2) AD 627552 Unclassified

Also published in Pubbl. Staz. Zool. Napoli, v. 34: 86-97, 1964.

Measurements were made of the maximum pulling forces of octopuses and compared with their body weights. An increase in the maximal pulling force was found to be 2.0 kg/0.10 kg body weight up to 0.50 kg above which the force increased less rapidly with body weight. Two observations were made on the ability of octopuses to push (lift) heavy objects. The forces were found to be approximately half of those in the pulling experiments. Maintained pulls were observed and found to be never more than 50% of the value obtained in maximal pulls by the same animal. Pulls made during swimming were measured in some octopuses and were found to be similar in all of the animals although of wide differences in weight. The arms: body weight ratios were measured and given as a percentage of the total body weight. (Contractor's abstract)

1341

London U. Coll. [Dept. of Chemistry] (Gt. Brit.).

THE REARRANGEMENT OF AROMATIC N-NITROAMINES. PART III. THE ACID-CATALYSED REARRANGEMENT OF N-NITROANILINE, by D. V. Banthorpe, E. D. Hughes, and D. L. H. Williams. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-65-0516) (AF 61(052)66) AD 614215 Unclassified

Also published in Jour. Chem. Soc. (London), Dec. 1964, p. 5349-5361.

Kinetic, product, and tracer studies have been made of the acid-catalyzed rearrangement of isotopically normal and H^2-labelled N-nitro to o- and p-nitroanline over a wide range of acidity. The results are consistent with an intramolecular mechanism involving isomerization to an N-nitrite and migration to the para-position by way of an ortho-linked C-nitrite. Other mechanisms are discussed.

1342

London U. Coll. [Dept. of Physics] (Gt. Brit.).

DETERMINATION OF PION-NUCLEON PARAMETERS AND PHASE SHIFTS BY DISPERSION RELATIONS, by J. Hamilton. Jan. 1963, 120p. (Technical note no. 11) (AFOSR-4744) (AF EOAR-63-3) AD 407610 Unclassified

An account is given of the use of dispersion relations to determine the parameters of low energy pion-nucleon physics (F^2, the s- and p-wave scattering lengths and certain other constants) and the determination of the s- and p-wave phase shifts up to a few hundred mev.

1343

London U. Coll. [Dept. of Physics] (Gt. Brit.).

REMOVAL OF THE DIVERGENCE IN ZERO MOMENTUM TRANSFER DISPERSION RELATIONS, by D. Atkinson. Apr. 30, 1963, 21p. (Technical note no. 12) (AFOSR-4922) (AF EOAR-63-3) AD 414039 Unclassified

A conformal mapptng of the scattering cosine of an elastic scatterng process ts used to remove a divergence caused by crossed channel singularttes. A numertcal application to $\pi N - \pi N$ forward dispersion relations is considered.

1344

London U. Coll. [Dept. of Physics] (Gt. Brtt.).

UNITARITY AND ANALYTICITY IN COMPLEX ENERGY PLANE OF GENERAL SCATTERING AMPLITUDES, by N. S. Kronflt. July 4, 1963, 18p. (Technical note no. 14) (AFOSR-5 86) (AF EOAR-63-3) AD 417149 Unclassifted

Analytic properties of general scatterng amplttudes are considered under the assumption of analyticity tn channel energy plane and ustng unttarity, similar behavior ts done for Feynman amplitudes.

1345

London U. Coll. Dept. of Physics (Gt. Brtt.).

DISPERSION RELATIONS IN HIGH ENERGY PHYSICS, by J. Hamilton. Final rept. Oct. 31, 1964, 4p. tncl. refs. (AFOSR-65-0514) (AF EOAR-63-3) Unclassified

Theoretical studies have been made of the pion-nucleon system, the pton-pion system and the nucleon isovector form factor, by means of the dispersion relation technique. A detailed phase shift analysis of the pton-nucleon scatterng data up to 700 mev pion has been made.

1346

Los Angeles State Coll. [Dept. of Chemtstry] Calif.

CHEMICAL EFFECTS OF ULTRASONIC WAVES, by D. L. Currell, S. Nagy, and G. Wilhetm. Final rept. Sept. 1, 1963, 1v. (AFOSR-J1075) (AF 49(638)471) AD 420052 Unclassifted

The effect of pH and dissolved gases on the ultrasonic reaction of aqueous solutions of phenol and of pyridine to produce acetylene has been investigated. Phenol in alkaline solution and pyridine tn acid solution are essentially unaffected by ultrasontc waves. The rate of production of acetylene ts dependent upon the ratio of specific heats of the dissolved gases. The rate of the ultrasonic cleavage of the pyridine ring was shown to be independent of the surface tension of the reaction solution. The significance of these results is discussed tn terms of possible mechanisms for the chemtcal effect of ultrasonic waves.

1347

Louisiana State U., Baton Rouge.

REPRESENTATIONS OF DERIVATIVES OF ANALYTIC FUNCTIONS BY A MULTI-DIMENSIONAL TYPE OF LA PLACE TRANSFORMS, by P. Porcellt. [1964] [4]p. (AFOSR-65-2180) (AF AFOSR-63-68) AD 627945 Unclassifted

Also publtshed in Proc. Loutsiana Acad. Sci., v. 27: 110-113, Dec. 1964.

The purpose of thts note ts to develop a representation theory for the dertvatives of analytic functions that are the La Place transforms of square summable functions on $(0, \infty)$. The proof of the representation theorem ts presented in the form of two lemmas and tt involves the solvability of certain tnftnite systems of ltnear equations tn the countably tnfinite dimensional Hilbert space. Brtefly, the first lemma shows that the deftnition of the analytic function tmplies one tnfinite system ts solvable and the necessary conditton for thts system to have a solution is also a sufftcient condition for a second tnftnite system to have a solution. The second lemma shows that the solution of the second tnftnite system can be extended to give a representation for the dertvative of the analytic function in question. The tnterest tn representation theorems of the type presented stems from the fact that they are related to problems in approximation theory and to the distribution of zeros of the successive dertvatives of certain types of analytic functions.

1348

Loutsiana State U., Baton Rouge.

INTERPOLATION AND APPROXIMATION WITH RATIONAL FUNCTIONS, by P. Porcellt. [1964] [8]p. (AFOSR-65-2181) (AF AFOSR-63-68) AD 628397 Unclassifted

Also published in Proc. Louisiana Acad. Sci., v. 27: 118-125, Dec. 1964.

Interpolation methods are studied that artse out of the problem of uniformly approximating a continuous function with certatn types of rational functions. Specifically, the author ts interested in learning the nature of approximating an arbitrary continuous function on bounded subsets of a set of real numbers by ltnear forms.

1349

[Louvatn U.] (Belgium).

A CRYOSTAT FOR TEMPERATURES BETWEEN 14 AND 300°K, ADAPTABLE FOR EXPERIMENTS AT HIGH PRESSURE, by A. Van Itterbeek, O. Verbeke and others. [1964] [4]p. incl. diagrs. tables. (AFOSR-64-1240) (AF EOAR-63-40) AD 442799 Unclassifted

Also published in Cryogentcs, Feb. 1964, p. 8-11.

This paper gives a descrtption and design of a regulating system for use tn the temperature range 14-300°K.

1350

Louvain U. Dept. of Applied Mechanics (Belgium).

DESIGNING EQUIVALENT LINKAGES BY SUCCESSIVE ADDITIONS AND SUBTRACTIONS OF REDUNDANT BARS, by F. Buckens. [1963] [6]p. incl. diagrs. (AFOSR-3117) (AF EOAR-62-107) AD 438555 Unclassified

Also published in Ingen. Arch., v. 32: 341-346, 1963.

It is shown that if the trajectory (absolute or relative) described by a point of a linkage can be duplicated by a different linkage (even when the difference is only geometrical), the parallel action of both mechanisms results in a redundant linkage, as far as the number of degrees of freedom is concerned. Admissible changes of the lengths of certain bars, or adequate removal of bars or hinges, while reducing this redundancy may lead to equivalent and sometimes more useful linkages. As an example, this principle may be applied to Hart's four-link inversor, which first duplicated, then simplified, leads either to Peaucellier's six-bar inversor, or to a more general and apparently new six-link inversor which also can be used as a pantograph.

1351

Louvain U. [Dept. of Applied Mechanics] (Belgium).

THE SIGNIFICANCE OF SINGULAR CONFIGURATIONS OF STRUCTURES FROM THE STRENGTH OF MATERIALS POINT OF VIEW, by F. Buckens. [1964] [10]p. incl. diagrs. (AFOSR-65-0618) (AF EOAR-62-107) AD 614541 Unclassified

Also published in Jour. Mecanique, v. 3: 499-508, Dec. 1964.

Simply connected structures, consisting of simple bars connecting multiple hinges, are considered. Furthermore external forces are assumed to act on these hinges. It is shown that when the configurations of the linkages are singular--that is, when there exist parasitic degrees of freedom for small deformations of the structure which do not change the lengths of the bars—the forces appearing in the bars become infinite when certain exceptional conditions are not satisfied by the external loading. (This assumes vanishingly small bar elongations). A necessary condition to avoid infinite forces when the configuration is singular, is the work performed by the external forces on the small parasitic deformation be null. This is also a sufficient condition when the structure is statistically determinate. (Contractor's abstract)

1352

Louvain U. Lab. for Inorganic [and Analytical] Chemistry (Belgium).

REACTION KINETICS IN FLAMES, by A. Van Tiggelen. Final technical rept. Feb. 1963, 30p. incl. diagr. tables, refs. (AFOSR-4594) (AF EOAR-62-65) AD 401390 Unclassified

Flame propagation velocities and temperatures have been measured in propylene-oxygen mixtures at different mixture strengths and varying dilutions with nitrogen. An activation energy of 40 kcal and a mean molecular weight of chain carriers can be derived from these measurements. The reaction mechanism is discussed, it points out the stability of the $C_3H_5\cdot$ radical. A comparative study is made of flames propagating in mixtures of nitrous oxide and CH_4, C_2H_6, C_3H_8, $n\text{-}C_4H_{10}$, $i\text{-}C_4H_{10}$, $C(CH_3)_4$, C_2H_4, C_2H_2, C_3H_6. The overall activation energy of the branching process has been calculated together with the mean molecular weight of the free radicals which are responsible for the propagation of the chain reaction. A reaction mechanism is proposed based on the formation of alkoxy radicals according to $R\cdot + N_2O \rightarrow RO\cdot + N_2$, followed by $RO\cdot + RH \rightarrow ROH + R\cdot$. (Contractor's abstract)

1353

Louvain U. Lab. for Inorganic [and Analytical] Chemistry (Belgium).

KINETICAL STUDY OF HYDROCARBON-NITROUS OXIDE FLAMES, by J. D'Olieslager and A. Van Tiggelen. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-64-1885) (AF EOAR-62-65) AD 449998 Unclassified

Also published in Bull. Soc. Chim. Belg., v. 73: 135-153, 1964.

A comparative kinetical study of flames burning in mixtures of nitrous oxide and different hydrocarbons was made. The mean molecular weight of the chain carriers changes with the nature of the fuel. A probable reaction mechanism requests the formation of alkoxy radicals which decompose more or less easily according to their structure. Concerning the apparent activation energy derived from burning velocities at different degrees of dilution with nitrogen, no systematic change with the nature of the fuel was observed.

1354

Louvain U. Lab. for Inorganic [and Analytical] Chemistry, (Belgium).

CONSIDERATIONS ON THE THEORETICAL EXISTENCE OF FUNDAMENTAL FLAMMABILITY LIMITS IN GASEOUS MIXTURES, by A. Van Tiggelen and J. Burger. [1964] [2]p. (AFOSR-65-1427) (AF EOAR-63-42) AD 622897 Unclassified

Also published in Combustion and Flame, v. 8: 343-344, Dec. 1964.

Flame (chain) propagation theory is employed as the basis for the derivation of a criterion which predicts flammability limits in gaseous mixtures and also the intrinsic condition for non-flammability.

1355

Lovelace Foundation for Medical Education and Research, Albuquerque, N. M.

A STUDY OF THE MECHANICS OF VENTILATION AND OF PULMONARY GAS EXCHANGE IN MAN DURING STRESS, by J. F. Muxworthy, Jr. and E. H. Roorbach. Final rept. June 1963, 66p. (AFOSR-5262) (AF AFOSR-61-35) AD 416534 Unclassified

This study was undertaken to determine the changes in some of the mechanics of breathing due to the stress of certain conditions during surgery on man. The parameters studied were the changes in total, lung, and chest wall compliances under controlled ventilation and depth of anesthesia. The studies include the effects of surgical skin preparation, incision, total surgical stimuli, succinyl-choline, cough, lithotomy, tourniquet and deep hypothermia. A review of the literature is presented and compared to the present study. Two subjects with heart defects were studied while undergoing surgery at deep hypothermia from 10° to 18°C. As the chest was opened only the lung compliance could be measured. The lung compliance rose slightly during cooling, fell during cardiac arrest, and then gradually rose again so that by the time the body temperature was normal, the lung compliance was no lower than at the start of cooling.

1356

Lund U. Depts. of Histology and Zoology (Sweden).

SOME OBSERVATIONS OF ADRENERGIC CONNECTIONS BETWEEN MESENCEPHALON AND CEREBRAL HEMISPHERES, by A. Bertler, B. Falck and others. [1964] [7]p. incl. tables, refs. (AFOSR-65-0308) (AF EOAR-64-5) AD 612319 Unclassified

Also published in Acta Pharmacol. Toxicol., v. 21: 283-289, 1964.

The striatal dopamine in the rabbit brain is localized in axons at least partly originating from the ventral mesencephalon. A corresponding adrenergic pathway has been directly demonstrated in the pigeon brain. A large portion of the NA in the cerebral hemispheres and the diencephalon of the rabbit has been found to be derived from neurons coming from or passing through the mesencephalon. (Contractor's abstract)

1357

Lund U. Depts. of Histology [and Zoology] (Sweden).

ADRENERGIC NERVES TO THE EYE AND ITS ADNEXA IN RABBIT AND GUINEA-PIG, by B. Ehinger. [1964] [21]p. incl. illus. diagr. refs. (AFOSR-65-1296) (AF EOAR-64-5) AD 620600 Unclassified

Also published in Acta Univ. Lund., Section II, no. 20: 3-23, 1964.

The distribution of adrenergic nerves to orbital and ocular structures in rabbits and in guinea-pigs was studied with the sensitive and specific fluorescence method developed by Falck. Considerable species differences were found, especially in the irido-corneal angle, which in rabbits contains few varicose adrenergic fibers (VAF), but in guinea-pigs many. In both species, VAF were found in the cornea, in the dilator and sphincter pupillae as well as in the iris stroma, at the ciliary epithelium, in the ciliary muscle, and in the chorioid. In the chorioid, distribution is densest in those parts that correspond to the areas of the retina that have the highest visual acuity. In rabbits, the vascular nerves in the iris have an unusual distribution throughout the inner part of the perivascular sheath; in some medium-sized vessels, they also reach the intimal layer. An adrenergic innervation of the smooth musculature outside the ocular bulb was found in the tarsal muscle, in the arrectores pilorum, and in that of the tarsal sebaceous glands. No VAF were found around the acini of the lacrimal gland or in the optic nerve. (Contractor's abstract)

1358

Lund U. Depts. of Histology [and Zoology] (Sweden).

NEW ASPECTS OF THE MAMMALIAN PINEAL GLAND. I. FUNCTIONAL SIGNIFICANCE OF FETAL PINEAL GLAND OF RAT. II. MONOAMINE STORES IN MAMMALIAN PINEAL GLAND, by C. Owman. [1964] [40]p. incl. refs. (AFOSR-65-2512) (AF EOAR-64-5) AD 627913 Unclassified

Also published in Acta Physiol. Scand., v. 63, Suppl. 240: 1-40, 1964.

The findings of the secretory activity of the pineal gland prenatally on one hand, and of the monamine stores in the pineal gland postnatally on the other, indicates the possibility of a two-fold functional significance of the pineal gland in one and the same animal during two different phases of life. Similar dual functions have been suggested to occur in the development of the pineal complex in lower vertebrates. Thus, in certain land-living anura the pineal complex is dominated by the frontal organ, probably exerting a photoreceptor function. In adult stages the frontal organ is reduced, while the epiphyseal portion shows up as a well-developed glandular structure. Similarly, the pineal organ of the newt undergoes a characteristic change in cytology, from highly differentiated photoreceptor-like cells during larval stages, into cells with morphologic signs of secretory activity culminating in adult stages. This conversion probably denotes a basic shift in function of the organ. (Contractor's abstract)

1359

Lund U. [Dept. of Pharmacology] (Sweden).

EFFECTS OF ACETYLCHOLINE ON THE MAMMALIAN MOTOR END-PLATE, by S. Thesleff. May 31, 1963, 5p. (AFOSR-5255) (AF EOAR-62-28) AD 416503 Unclassified

The parameters of transmitter release from mammalian motor nerve terminals have been evaluated by

electrophysiological techniques. The amount of transmitter available for immediate release, the rate of transmitter mobilization and synthesis have been calculated from the amplitude of successive series of end-plate potentials.

1360

Lund U. [Dept. of Pharmacology] (Sweden).

RESTORATION OF FUNCTION IN BOTULINUM PARALYSIS BY EXPERIMENTAL NERVE REGENERATION, by S. Thesleff, J. Zelena, and W. W. Hofmann. [1964] [2]p. (AFOSR-64-2160) (AF EOAR-63-12) AD 452275 Unclassified

Also published in Proc. Soc. Exper. Biol. and Med., v. 116: 19-20, 1964.

Results are presented showing that it is possible to restore neuromuscular transmission in botulinum paralyzed rat skeletal muscle by inducing the formation of new motor nerve terminals. The toxin, bound to the original endings, does not interfere with the regeneration following a crush of the motor nerve, and the new terminals can establish effective neuromuscular transmission after a few days. In muscles treated with the toxin alone the paralysis lasts for several weeks.

1361

Lund U. [Dept. of Pharmacology] (Sweden).

INNERVATION OF BOTULINUM POISONED SKELETAL MUSCLES BY ACCESSORY NERVES, by W. W. Hofmann, S. Thesleff, and J. Zelena. [1964] [2]p. (AFOSR-64-2168) (AF EOAR-63-12) AD 452473 Unclassified

Presented at meeting of the Physiological Society, Feb. 21-22, 1964.

Also published in Jour. Physiol. (London), v. 171: 27-28, 1964.

In a series of experiments C. botulinum toxin type A1 was applied locally to the gastrocnemius muscle of adult rats. About 2 weeks later, when the paralysis was maximal, the deep peroneal nerve, which normally supplies the flexor group of the hind limb, was dissected and implanted into the lateral head of the gastrocnemius muscle. For control a similar operation was performed on unpoisoned animals. After 1 month the mechanical response of the gastrocnemius muscle to stimulation of the tibial and peroneal nerves were recorded. All the poisoned muscles responded with strong contractions to stimulation of either of the two nerves. In unpoisoned animals there was no significant response of the gastrocnemius muscle to the stimulation of the implanted nerve.

1362

Lund U. Dept. of Pharmacology (Sweden).

AN ELECTROPHYSIOLOGICAL INVESTIGATION OF NEUROMUSCULAR TRANSMISSION IN MYASTHENIA GRAVIS, by D. Elmqvist, W. W. Hofmann and others. [1964] [18]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1548) (AF EOAR-63-12) AD 623377 Unclassified

Also published in Jour. Physiol., v. 174: 417-434, 1964.

By the use of intracellular electrodes the neuromuscular transmission mechanism was studied in isolated intercostal muscle obtained from patients with myasthenia gravis. With repetitive nerve stimulation at frequencies above 2/sec, only the first few stimuli elicited muscle contractions in most fibers and then subthreshold end-plate potentials (epps), could be recorded. Miniature end-plate potentials (mepps) had a mean amplitude 1/5 of the normal. The calculated size of the quantal components of epps corresponded closely to the mepp amplitude. Other observations made appeared normal, i. e., resting frequency of mepps, quantum content of epps, post-synaptic chemosensitivity with ACh analogs, input resistance, and resting membrane potential. It is tentatively concluded that in myasthenia gravis there is a deficiency in the amount of ACh in the quanta of transmitter released from the motor nerve terminals. (Contractor's abstract, modified)

1363

Lund U. Dept. of Physics (Sweden).

THE SPECTRUM OF VERY HEAVY NUCLEI IN COSMIC RADIATION AND THE PASSAGE THROUGH INTERSTELLAR MATTER, by K. Kristiansson. [1964] [18]p. incl. diagrs. tables, refs. (AFOSR-64-0640) (AF EOAR-62-71) AD 434847 Unclassified

Also published in Arkiv Fysik, v. 25: 513-530, 1964.

With the assumption that iron is the only very heavy element in the cosmic ray source, calculations have been performed of charge spectra of the nuclei in the interval $21 \leq Z \leq 26$ as a function of the amount of interstellar matter traversed and of the mean energy in the collisions between the VH particles and the interstellar nuclei. The comparison with the experimental cosmic ray spectrum shows that the particles have passed through 2-4 g matter at energies below about 500 mev/nucleon. The amount of matter which has been passed at high energy is smaller. This distribution involves some restrictions on the mechanism of acceleration. (Contractor's abstract)

1364

Lund U. Dept. of Physics (Sweden).

THE USE OF THE MEAN BLOB LENGTH METHOD FOR THE IDENTIFICATION OF HEAVY PRIMARIES IN COSMIC RADIATION, by A. Stenman. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-2051) (AF EOAR-62-71) AD 452520 Unclassified

Also published in Arkiv Fysik, v. 27: 267-274, 1964.

The paper describes a study of the blob length method as a means of identifying relativistic heavy primaries in cosmic radiation. The measurements have been restricted to particles with well identified charges $Z \geq 6$. The standard deviation was found to be 1.0 unit of charge in the mean. The experimentally obtained relation between the blob coefficient and the square of the particle charge is given and discussed. The blob coefficient has also been studied as a function of the dip angle. (Contractor's abstract)

1365

Lund U. Dept. of Physics (Sweden).

ROCKET OBSERVATIONS OF SLOW HEAVY PRIMARY NUCLEI AT KRONOGÅRD, SWEDEN, by H. Yagoda, K. Fukui and others. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0461) (AF EOAR-62-71) Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 854-859, Nov. 16, 1964.

Small emulsion blocks recovered from a series of Nike-Cajun rockets launched from Kronogård, Sweden, exhibit the tracks of slow heavy primary nuclei which stop by ionization in the detectors. The charge distribution of these particles, estimated from track width measurements, is consistent with a galactic origin. The kinetic energy of the particles estimated from their range resides between 60 and 570 mev nucleon. This preliminary experiment suggests that important information on the charge and energy spectra can be secured by exposing large areas of emulsion in geophysical sounding rockets.

1366

Lund U. Thermochemistry Lab. (Sweden).

THERMAL STABILITY OF ORGANIC COMPOUNDS, by S. Sunner. Apr. 15, 1964, 17p. incl. diagr. refs. (AFOSR-64-1447) (AF EOAR-62-110) AD 604474 Unclassified

One flow and one static pyrolysis apparatus directly attached to a gas chromatograph through a gas sample valve was built and their performance was studied using the four butanols as test substances. A second static pyrolysis apparatus was developed and was partly assembled. Studies were started on the use of a novel principle for building up a thermal shield for adiabatic calorimetry over a wide temperature range. It is based on the use of microconductors consisting of an inner conductor insulated with magnesia within an outer thin-walled metal tube, 0.25 - 1.00 mm in diameter. The mass of the shield consists almost entirely of the leads. The use of two types of microconductors is presently being investigated—one with platinum wire serving as a resistance thermometer and the second with chromel to be used as a heater. (Contractor's abstract)

1367

Lyon U. [Dept. of Physiology] (France).

NEUROPHYSIOLOGICAL INHIBITORY SYSTEMS ACTIVE DURING SLEEP, by M. Jouvet. Final technical rept. Jan. 1962-July 1964 [28]p. incl. refs. (AFOSR-64-1307) (AF EOAR-62-67) AD 603737 Unclassified

It was concluded that slow sleep and paradoxical phases (P. P.) are qualitatively different states of the nervous system, and that sleep cannot be considered as a unique continuous state. In fact, both ontogeny and philogeny show that two different states may be differentiated. Among the phasic phenomena occurring during P. P., the ponto-geniculo-visual activity (monophasic spikes occurring alone or in clusters) which accompanies the occurrence of rapid eye movements (REM) was investigated: both phenomena are triggered from the pons and the organization REM in different chronic preparations is described. The importance of a colliculo-mesencephalic region for the occurrence of clusters of REM is emphasized, and the dual role of the cortex (visual facilitatory, frontal inhibitory) has been shown. All these results suggest that some complex mechanism integrates rapid eye movements during sleep. The characteristic EMG activity of the extraocular eye muscles during P. P. is also emphasized.

1368

Lyon U. [Dept. of Physiology] (France).

[PHASIC ELECTRICAL ACTIVITY OF THE CORTEX AND OF THE THALAMUS DURING DESYNCHRONIZED SLEEP IN THE CAT] L'activité électrique phasique du cortex et du thalamus au cours du sommeil désynchronisé chez le Chat, by J. A. Hobson. [1964] [5]p. incl. illus. diagr. (AFOSR-65-2252) (AF EOAR-62-67) AD 625342 Unclassified

Also published in Compt. Rend. Seances Soc. Biol., v. 158: 2131-2135, Nov. 16, 1964.

Synchronous phasic spikes were found in the visual system in the thalamus and in the "associative" cortex during the desynchronized phase of sleep.

1369

Lyon U. [Dept. of Physiology] (France).

[STATISTICAL STUDY OF THE SLEEP-WAKING CYCLE IN THE CAT] Etude statistique du cycle veille-sommeils chez le Chat, by F. Delorme, P. Vimont, and D. Jourvet. [1964] [3]p. incl. diagr. tables. (AFOSR-65-2671) (AF EOAR-62-67) AD 629203 Unclassified

Also published in Compt. Rend. Seances Soc. Biol., v. 158: 2128-2130, Nov. 16, 1964.

The cat sleeps 68.5% of the time. Behavioral sleep is divided into 77% "slow" sleep and 23% paradoxical. The average duration of paradoxical sleep is 5 min, 45 ± 80 sec.

1370

Lyon U. [Dept. of Physiology] (France).

[EFFECTS OF RESERPINE, DOPA AND 5 HTP ON THE TWO STATES OF SLEEP] Effets de reserpine, DOPA et 5 HTP sur les deux états de sommeil, by J. Matsumoto and M. Jouvet. [1964] [4]p. incl. diagr. (AFOSR-65-2673) (AF EOAR-62-67) AD 629216
Unclassified

Also published in Compt. Rend. Seances. Soc. Biol., v. 158: 2137-2140, Nov. 16, 1964.

Reserpine in dose 0.5 mg/kg causes a diminution of slow sleep and a total disappearance of paradoxical sleep with a slower return to normal in four days. Reserpine followed by 5 HTP does not affect slow sleep but paradoxical sleep is abolished or reduced for three days. Reserpine followed by DOPA suppressed paradoxical sleep more strongly, with a return to normal the next day. It seems that variations in cerebral catecholamine may effect paradoxical sleep.

1371

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

QUADRUPOLE RELAXATION FOR A SPIN I = 3/2. THE F^{19} N. M. R. SPECTRA OF BF_3 AND ClO_3F, by J. Bacon, R. J. Gillespie, and J. W. Quail. [1963] [7]p. incl. diagrs. refs. (AFOSR-64-0130) (AF AFOSR-62-21) AD 430943 Unclassified

Also published in Canad. Jour. Chem., v. 41: 3063-3069, 1963.

An expression is derived for the broadening of the components of the quartet obtained for the nmr spectrum of nuclei coupled to a nucleus of spin 3/2 undergoing electric quadrupole relaxation. It is shown that the F^{19} spectra of BF_3 and ClO_3F at various temperatures may be satisfactorily interpreted by means of this expression. Activation energies for molecular reorientation of 1.4 kcal/mol for BF_3 and 1.0 kcal/mol for ClO_3F are obtained. (Contractor's abstract)

1372

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

ANTIMONY TETRAFLUORIDE MONOFLUOROSULPHATE: PREPARATION, PROPERTIES, AND STRUCTURE, by R. J. Gillespie and R. A. Rothenbury. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-0576) (AF AFOSR-62-21) AD 434309 Unclassified

Presented at Symposium on Inorganic Fluorine Chemistry, Argonne Nat'l. Lab., Sept. 4-6, 1963.

Also published in Canad. Jour. Chem., v. 42: 416-420, 1964.

When antimony pentafluoride is refluxed with sulfur trioxide, a new compound with the composition $SbF_5 . SO_3$ is formed together with sulfuryl fluoride, disulfuryl fluoride, and small amounts of the higher polysulfuryl fluorides. This compound is a colorless, very viscous liquid. From the chemical analysis, the F^{19} nmr spectrum, and the Raman and infrared spectra of the liquid it was concluded that the compound is antimony tetrafluoride monofluorosulphate $SbF_4(SO_3F)$ and that it is highly polymerized in the liquid state by fluorosulphate bridges that can have either a cis or a trans orientation with respect to each other; the former occurring to a greater extent than the latter. (Contractor's abstract)

1373

McMaster U. [Dept. of Chemistry] Hamilton, Ont. (Canada).

NUCLEAR MAGNETIC RESONANCE STUDIES OF THE PROTONATION OF WEAK BASES IN FLUOROSULPHURIC ACID, by T. Birchall and R. J. Gillespie. [1964] [12]p. (AFOSR-64-0935) (AF AFOSR-62-21) AD 439977 Unclassified

Also published in Canad. Jour. Chem., v. 42: 502-513, 1964.

The proton magnetic resonance spectra of solutions of mesitylene, durene, pentamethylbenzene, hexamethylbenzene, m- and p-xylenes, and anisole have been studied in fluorosulfuric acid and protonation on the ring carbon atom established. Rates of proton exchange have been measured and activation energies calculated for the proton exchange process. Intermolecular exchange with the solvent is suggested as the most probable exchange process in all cases.

1374

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

IODINE CATIONS AND OXYCATIONS. I. SOLUTIONS OF IODIC ACID IN SULFURIC ACID, by R. J. Gillespie and J. B. Senior. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-0936) (AF AFOSR-62-21) AD 439978 Unclassified

Also published in Inorg. Chem., v. 3: 440-444, Mar. 1964.

Solutions of iodic acid in sulfuric acid have been studied by means of cryoscopic and conductometric measurements. No evidence was obtained for the formation of the iodyl cation IO_2^+ or the iodic acidium ion $H_2IO_3^+$, and it appears that iodic acid is converted to solvated and polymerized forms of iodyl hydrogen sulfate, $IO_2 . H_2SO_4$. (Contractor's abstract)

1375

McMaster U. [Dept. of Chemistry] Hamilton, Ont. (Canada).

SULFUR AND SILICON ISOTOPE EFFECTS IN FLUORINE NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY, by R. J. Gillespie and J. W. Quail. [1963] [3]p. (AFOSR-64-0157) (AF AFOSR-64-516) AD 432772 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2555-2557, Nov. 15, 1963.

Satellites due to fluorine on S^{33} have been observed in the F^{19} nmr spectrum of sulfur hexafluoride. Values of the S^{33}-F coupling constant and of the S^{33} isotope effect on the fluorine chemical shift have been obtained from the spectrum. A S^{34} isotope effect has also been observed on the fluorine chemical shift of sulfur hexafluoride and other sulfur-fluorine compounds. Si^{29} isotope effect on the fluorine chemical shift has been observed for silicon tetrafluoride.

1376

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

CATIONS AND OXYCATIONS OF IODINE. II. SOLUTIONS OF IODOSYL SULFATE, IODINE DIOXIDE, AND IODIC ACID-IODINE MIXTURES IN SULFURIC ACID AND DILUTE OLEUM, by R. J. Gillespie and J. B. Senior. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1529) (AF AFOSR-64-516) AD 445956
Unclassified

Also published in Inorg. Chem., v. 3: 972-977, July 1964.

Solutions in sulfuric acid of iodosyl sulfate, iodine dioxide, and mixtures of iodic acid and iodine having the mol ratio $HIO_3/I_2 = 3$ have been studied by means of cryoscopic and conductometric measurements. It is concluded that iodosyl hydrogen sulfate, $IO.HSO_4$, which behaves as a weak electrolyte, is formed in each case. The results of similar measurements on solutions of the same solutes in dilute oleum lead to the conclusion that more sulfated species such as $(HSO_4)_2IO(HSO_4)_2$ and $I(HSO_4)_3$ and related polymers are formed under these conditions. (Contractor's abstract)

1377

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

THE STEREOCHEMISTRY OF FIVE-CO-ORDINATION. PART I. NON-TRANSITION ELEMENTS, by R. J. Gillespie. [1963] [7]p. incl. diagrs. refs. (AFOSR-64-1530) (AF AFOSR-64-516) AD 446403
Unclassified

Also published in Jour. Chem. Soc. (London), Oct. 1963, p. 4672-4678.

The stereochemistry of five-co-ordination in molecules of the non-transition elements is discussed in terms of the theory of valency-shell electron-pair repulsions. It is shown that this theory provides a better explanation for the observed bond lengths and bond angles in both trigonalbipyramidal and square-pyramidal molecules than does the conventional theory of directed valency based on hybrid orbitals. The discussion includes a consideration of molecules with a doubly bonded oxygen atom as one of the ligands, e.g., SOF_4, trigonal-bipyramidal transition states, and pseudorotation in trigonal-bipyramidal molecules. (Contractor's abstract)

1378

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

THE STEREOCHEMISTRY OF FIVE-CO-ORDINATION. PART II. TRANSITION ELEMENTS, by R. J. Gillespie. [1963] [7]p. incl. diagrs. table, refs. (AFOSR-64-1531) (AF AFOSR-64-516) AD 447665 Unclassified

Also published in Jour. Chem. Soc. (London), Oct. 1963, p. 4679-4685.

The stereochemistry of five-co-ordination in molecules of the transition elements is discussed in terms of the theory of valency-shell electron-pair repulsions. For transition elements with d^0 and d^{10} configurations, as for non-transition elements, the trigonal-bipyramidal shape determined by the interactions between the five electron pairs in the valency shell, is preferred. For other less symmetrical d-shell configurations it is necessary to consider the interaction of the valency-shell electron pairs with the d-shell as well as with each other. It is shown that generally this additional interaction results in the square-pyramid's becoming more stable than the trigonal bipyramidal. Examples of both trigonal-bipyramidal and square-pyramidal molecules of the transition metals are described and discussed. (Contractor's abstract)

1379

McMaster U. Dept. ofChemistry, Hamilton, Ont. (Canada).

IODINE OXIDE PENTAFLUORIDE, by R. J. Gillespie and J. W. Quail. [1963] [1]p. incl. diagr. refs. (AFOSR-64-1532) (AF AFOSR-64-516) AD 446138
Unclassified

Also published in Proc. Chem. Soc. (London), Sept. 1963, p. 278.

The reaction of iodine heptafluoride with silica at 100° in a sealed silica tube yielded iodine oxide pentafluoride, IOF_5, a new compound of iodine. The reaction was followed by means of F^{19} nuclear magnetic resonance spectroscopy. The extremely broad iodine heptafluoride resonance was gradually replaced by a broad doublet and quintet on the low-field side of the relatively sharp doublet and quintet due to iodine pentafluoride. A small amount of iodine pentafluoride was present as an impurity in the heptafluoride. This spectrum clearly arises from a new compound containing 4 equivalent F atoms and a fifth non-equivalent F atom. Since the chemical shift of the 2 multiplets is intermediate between those of iodine penta- and hepta-fluoride, the only reasonable compound to which the spectrum can be attributed is iodine oxide pentafluoride.

1380

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

THE ^{19}F N.M.R. SPECTRUM OF IF_7, by R. J. Gillespie and J. W. Quail. [1964] [3]p. incl. diagr. refs. (AFOSR-65-0230) (AF AFOSR-64-516) AD 611453
Unclassified

Also published in Canad. Jour. Chem., v. 42: 2671-2673, 1964.

It is shown that the line shape calculated for the nmr spectrum of a magnetic nucleus attached to a nucleus

of spin 5/2 undergoing quadrupole relaxation agrees well with the observed spectrum of iodine heptafluoride. The iodine-fluorine coupling constant was found to be $J_{IF} \sim 2\,100$ c/s. The apparent magnetic equivalence of the fluorine atoms in IF_7 is discussed. (Contractor's abstract)

1381

McMaster U. Dept. of Chemistry, Hamilton, Ont. (Canada).

SELENIUM ISOTOPE EFFECTS IN FLUORINE NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY, by T. Birchall, S. L. Crossley, and R. J. Gillespie. [1964] [2]p. incl. tables, refs. (AFOSR-65-0385) (AF AFOSR-64-516) AD 611733 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2760-2761, Nov. 1, 1964.

A selenium isotope effect on the fluorine chemical shift has been observed in several selenium-fluorine compounds for all of the naturally occurring selenium isotopes except Se^{74}. Values for some Se^{77}-F^{19} coupling constants are reported. (Contractor's abstract)

1382

McMaster U. Dept. of Metallurgy and Metallurgical Engineering, Hamilton, Ont. (Canada).

OXIDATION OF METALS AND ALLOYS, by W. W. Smeltzer. Final rept. Oct. 1961-Oct. 1963, 1v. incl. illus. diagrs. tables, refs. (AFOSR-J1356) (AF AFOSR-61-108) AD 432718 Unclassified

Basic research was carried out on the oxidation properties of metals and alloys, diffusion and thermodynamic properties of metallic oxides. Measurements were made on the kinetics of oxide film and scale growths. Metallographic, hot stage microscopes and x-ray techniques were employed to examine oxide structures. These studies were augmented by electrochemical measurements and electron microscopy of the metal/oxide composite systems. (Contractor's abstract)

1383

McMaster U. [Dept. of Metallurgy and Metallurgical Engineering] Hamilton, Ont. (Canada).

THE OXIDATION KINETICS OF ZIRCONIUM IN THE TEMPERATURE RANGE 400-600°C, by R. J. Hussey and W. W. Smeltzer. [1964] [5]p. (AFOSR-64-1224) (AF AFOSR-61-108) AD 442802 Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 564-568, May 1964.

The oxidation kinetics of zirconium were determined in the temperature range 400-600°C at subatmospheric pressures for exposure times of 650 hr at 400°C to 160 hr at 600°C by a microbalance technique. From scale thickness measurements, it was shown that at temperatures between 500-600°C the amount of oxygen in the metal varies from 14 to 23% of the total oxygen consumption respectively. Further both the oxidation kinetics and the oxygen distribution between the metal and the oxide were found to be independent of changes of oxygen pressure from 0.25 to 50 cm Hg.

1384

McMaster U. Dept. of Metallurgy and Metallurgical Engineering, Hamilton, Ont. (Canada).

THE PARABOLIC OXIDATION KINETICS OF ALPHA-ZIRCONIUM AT 850°C, by G. R. Wallwork, W. W. Smeltzer, and C. J. Rosa. [1964] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1227) (AF AFOSR-61-108) AD 442817 Unclassified

Also published in Acta Metall., v. 12: 409-415, Apr. 1964.

An investigation is reported on the oxidation properties of alpha-zirconium at 850°C in oxygen for exposures extending to 400 hr. The kinetics were determined by volumetric and gravimetric techniques and may be represented for exposures to approximately 200 hr by a parabolic relationship. Scale thicknesses and oxygen gradients in the metal were determined by metallographic techniques. It is demonstrated that parabolic diffusion relationships derived from an oxide-metal model account for the kinetics of oxidation, scale growth and oxygen solution in the metal. (Contractor's abstract)

1385

McMaster U. [Dept. of Metallurgy and Metallurgical Engineering] Hamilton, Ont. (Canada).

THE DISSOCIATION PRESSURES OF IRON-NICKEL OXIDES, by G. A. Roeder and W. W. Smeltzer. [1964] [5]p. (AFOSR-64-2108) (AF AFOSR-61-108) AD 451720 Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 1074-1078, Sept. 1964.

Electromotive force determinations are reported of solid galvanic cells consisting of a ZrO_2-CaO electrolyte with iron-nickel-oxygen electrodes. To test the design of cells containing embedded electrodes of the reaction metals, dissociation pressures for wustite, magnetite, and nickel oxide were determined and compared with reported values. The standard molar free energy change of the reaction between nickel oxide and wustite and the dissociation pressures of wustite equilibrated with iron-nickel alloys containing nickel to 47.2 a/o were determined at temperatures in the range 800°-1000°C.

1386

McMaster U. [Dept. of Metallurgy and Metallurgical Engineering] Hamilton, Ont. (Canada).

THE MECHANISM OF OXIDATION OF ZIRCONIUM IN

THE TEMPERATURE RANGE 400°-850°C, by R. J. Hussey and W. W. Smeltzer. [1964] [4]p. incl. diagrs. table. (AFOSR-65-0184) (AF AFOSR-64-515) AD 611503 Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 1221-1224, Nov. 1964.

A study of the oxidation mechanism for zirconium in the temperature range 400-850°C, based on examination of the oxide scale growth and oxygen gradients in the metal substrate, is reported. The oxidation kinetics at long times obeyed a parabolic rate equation which was best described in terms of a diffusion model for oxygen diffusion in both the oxide and metal. From the determination of the oxygen gradients, the diffusion constant was evaluated for oxygen diffusion in alpha-zirconium.

1387

McMaster U. Dept. of Physics, Hamilton, Ont. (Canada).

NEUTRON SEPARATION ENERGIES FOR ZIRCONIUM AND THE Zr^{96}-Nb^{96} NAD Nb^{94}-Zr^{94} DECAY ENERGIES, by R. C. Ba ber, R. L. Bishop and others. [1963] [6]p. incl. diagrs. tables. (AFOSR-J650) (AF AFOSR-62-33) AD 413466 Unclassified

Also published in Jour. Phys., v. 41: 696-701, 1963.

Values are reported for the Zr^{92}-Zr^{90}, Zr^{94}-Zr^{92}, and Zr^{96}-Zr^{94} mass differences. These are combined with existing data to compute neutron separation energies for Zr^{94} and Zr^{96}, and the energies available for the Zr^{96}-Nb^{96} and Nb^{94}-Zr^{94} decays. It is pointed out that marked regularities exist among the neutron separation energies for zirconium and tin. (Contractor's abstract)

1388

McMaster U. [Dept. of Physics] Hamilton, Ont. (Canada).

STOPPING CROSS SECTIONS IN CARBON FOR LOW-ENERGY ATOMS WITH Z LESS THAN OR EQUAL TO 12, by J. H. Ormrod and H. E. Duckworth. [1963] [19]p. (AFOSR-J1248) (AF AFOSR-62-33) AD 424322 Unclassified

Also published in Canad. Jour. Phys., v. 41: 1424-1442, 1963.

The electronic stopping cross sections in carbon for atomic projectiles with $Z \leq 12$ have been determined in the energy interval from 10 to 140 kev. In doing so a Monte Carlo calculation was used to subtract from each experimentally observed cross section the contribution which arises from nuclear scattering. The trend of the results thus obtained agrees well with theory. In addition, however, a periodic dependence of S_ϵ on the atomic number of the projectile is observed.

1389

McMaster U. [Dept. of Physics] Hamilton, Ont. (Canada).

SOME NEUTRON SEPARATION ENERGIES FOR ISOTOPES OF Hg, Tl, Pb, AND Bi, by W. McLatchie, R. C. Barber and others. [1964] [11]p. (AFOSR-64-1144) (AF AFOSR-63-159) AD 442829 Unclassified

Also published in Canad. Jour. Phys., v. 42: 926-936, May 1964.

Values derived from mass spectral doublets are reported for isotopic mass differences of the following elements: Hg, Tl, Pb, and Bi. The mass differences are combined with existing reaction and disintegration data to yield single- and double-neutron separation energies for several of the isotopes of the above elements. The resulting neutron separation energy curves for even N are strikingly similar in shape and all exhibit an abrupt change in slope at N = 124. The curves for odd N do not display the same regularity. Currently accepted values for the total decay energies Tl^{204} and Tl^{202}-Hg^{202} are probably too large and too small, respectively, but current values for Pb^{205}-Tl^{205} and Bi^{208}-Pb^{208} are confirmed.

1390

McMaster U. Dept. of Physics, Hamilton, Ont. (Canada).

THE SHAPE OF THE MASS SURFACE IN THE REGION OF 90 NEUTRONS, by H. E. Duckworth, R. C. Barber and others. [1964] [2]p. incl. diagr. table. (AFOSR-67-1757) (AF AFOSR-64-159) Unclassified

Also published in Proc. Internat'l. Cong. Nuclear Phys., Paris (France) (July 2-8, 1964), ed. by P. Gugenberger, v. 2: 557-558, 1964.

A high resolution mass spectrometer was used to determine double-neutron separation energies for many of the stable nuclides with $84 \leq N \leq 98$. These values, together with others that may be calculated from them by use of existing data, are listed and presented graphically.

1391

Madrid U. Dept. of Crystallography (Spain).

[USE OF AN OPTICAL ANALOG IN THE STUDY OF DIFFUSE X-RAY DIFFRACTION IN CRYSTALS] Empleo de analogos opticos en el estudio de la difraccion difusa de rayos X por los cristales, by M. L. Canut, L. M. Valdés, and J. L. Amorós. [1963] [15]p. incl. illus. diagrs. refs. (AFOSR-J1129) (AF EOAR-62-92) AD 421716 Unclassified

By using the analogy between x-ray and light diffraction phenomena, the interpretation of the observed x-rays diffuse scattering arising from crystal imperfections such as thermal or positional disorder can easely be done in terms of Fraunhofer patterns and Q-functions of proper statistical disordered models. Some optical instruments, i.e., optical diffractometer, Q-integrator

and Eller machine were used for the study of the diffuse scattering. It is shown that in the case of anthracene the optical diffraction pattern of a model where rigid body random translational displacements were introduced gives the continuous diffuse regions detected by x-rays and it corresponds to our DFT function. This permits the prediction of the x-rays continuous diffuse scattering regions in molecular crystals, as it is given in the crystal of benzene. (Contractor's abstract, modified)

1392

Madrid U. Dept. of Crystallography (Spain).

[CRYSTAL SURFACES. IV. DISTRIBUTION, GENERATION AND MOVEMENT OF DISLOCATIONS IN PYRITE] Superficies de cristales. IV. Distribución, generación y movimento de dislocaciones en pirita, by J. L. Amorós and M. T. Pascual. [1963] [11]p. incl. illus. diagrs. refs. (AFOSR-J1557) (AF EOAR-62-92) AD 427715 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 61: 39-49, 1963.

Distribution, generation, and movement of dislocations are studied via etch pits in pyrite (FeS_2). The concentration of approximately 2000 dislocations/cm^2 is observed in good crystals. Arrays and forests of dislocations are observed in good and bad crystals respectively. The arrays follows the [100], [210] and [320] directions, which coincide with the PBC vectors previously determined. Movement and generation of dislocations are observed in good crystals under compression and by quenching. Loop nucleation from vacancies and cross gliding screw dislocations mechanism are taken into account to explain the observed facts. Linear and curved cross slipping dislocations are observed, giving rise to characteristic features in the perfect surface of good crystals, that eventually give rise to crack nucleation. (Contractor's abstract)

1393

Madrid U. Dept. of Crystallography (Spain).

[CRYSTAL GROWTH. I. GROWTH VELOCITIES IN CONDITIONS OF COMPETENCE] Crecimiento de cristales. I. Velocidades de crecimento en condiciones de competencia, by J. L. Amorós, E. Martín, and P. Tavira. [1963] [14]p. incl. illus. diagrs. table, refs. (AFOSR-64-0457) (AF EOAR-62-92) AD 435667 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 61: 187-200, 1963.

The growth velocities of different faces of MASD, TGS, and $NaNO_2$ are studied by the method of the drop. The influence of neighbors is determined as a function of growth competence, that causes important changes in the distribution of concentration of the solution causing development of new faces of high indices. These features coincide with a change of the slope of corresponding growth curves. The impurity concentration is extremely important in the growth of $NaNO_2$ single crystals, namely producing hollow crystals by changing the rate of the relative velocities of the equilibrium form of the crystal. (Contractor's abstract)

1394

Madrid U. Dept. of Crystallography (Spain).

[THE THERMAL EXPANSION OF POTASSIUM NITRATE (NITER)] La dilatación térmica del nitro, NO_3K (sal de piedra), by J. L. Amorós, M. Gutiérrez, and M. L. Canut. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-64-2078) (AF EOAR-62-92) AD 452049 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 62: 23-39, 1964.

The thermal expansion of orthorhombic KNO_3 was determined from x-ray Weissenberg photographs in the low temperature range (-170° to 20°C). The three mean section of the thermal expansion ellipsoid and values of the mean expansion coefficients were calculated. Functions giving the temperature dependence of the lattice parameters were obtained. The theory of Hartman was applied to the KNO_3 structure and the most relevant periodic-bond-chains (PBC)-vectors deduced. A general comparison of the thermal expansion of nitrates and carbonates of similar structure is also given.

1395

Madrid U. Dept. of Crystallography (Spain).

[ON THE THERMAL EXPANSION OF THE FERROELECTRIC SODIUM NITRITE] Sobre la dilatación térmica del nitrito dódico ferroeléctrico, by J. L. Amorós, M. Gutiérrez, and M. L. Canut. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-64-2079) (AF EOAR-62-92) AD 452048 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 62: 5-21, 1964.

Thermal behavior of $NaNO_2$ has been studied in the ferroelectric phase (between -180° and 155°C). Thermal expansion has been determined at low temperature and below the transition point. The thermal expansion coefficients have been found and equations giving the variation of the cell parameters with temperature have been determined. The periodic-bond-chain scheme gives qualitative account of the thermal behavior of the crystal. A new function, the temperature difference Fourier synthesis is developed, and it is applied to the study of the changes in the structure with temperature. Evidence is found of a drastic change of the "vibration" ellipsoid of Na^+ and of the presence of NO_2^- groups in a reversal position as the crystal is approaching the transition temperature. The results are discussed in relation to other already known thermal properties of $NaNO_2$. (Contractor's abstract, modified)

1396

Madrid U. of Crystallography (Spain).

[CRYSTAL GROWTH, DISLOCATIONS AND FRACTURE] Crecimiento, dislocaciones y fractura cristalinos, by J. L. Amoros. [1963] [26]p. incl. illus. diagrs. table, refs. (AFOSR-64-2080) (AF EOAR-62-92) AD 451586 Unclassified

Also published in Bol. Acad. Nac. Cien., v. 43: 177-202, 1963.

In this paper the main features of the growth and dislocation production were studied as well as the emergence of dislocations on the surface of a crystal by the etch method. The theory was applied to the interpretation of important surface features observed in pyrite crystals. The morphology of the observed macroscopic layers of growth was interpreted in terms of the periodic bond chain theory. The main mechanism of growth of pyrite crystals has been discovered. Evidence has been found of polygonal spirals in the surface of the crystals. The presence of scattered dislocations as well as clusters of dislocations have been observed. Slip and loop dislocations have been observed and the mechanism explained. The nucleation of microcracks have been studied in relation to the main cleavage plains and applied stress. (Contractor's abstract, modified)

1397

Madrid U. Dept. of Crystallography (Spain).

[ON THE VIBRATIONAL ELASTIC SPECTRUM OF A MOLECULAR CRYSTAL (HEXAMINE) FROM TEMPERATURE DIFFUSE SCATTERING OF X-RAYS] Determinación del espectro elástico vibracional de un cristal molecular, la hexamina, por difracción difusa térmica de rayos X, by A. Carbonell and M. L. Canut. [1964] [14]p. incl. diagrs. tables, refs. (AFOSR-64-2081) (AF EOAR-62-92) AD 452416 Unclassified

Also published in Rev. Cien. Apl., No. 97: 126-139, Mar.-Apr. 1964.

Absolute diffractometric measurements along [100], [110] and [111] in the first Brillouin zones 440, 222 and 800 have been made at room temperature in hexamine by using x-ray Cu monochromatized radiation. A dynamical model has been considered consisting of rigid-body translational molecular motion, i.e., neglecting both librations of the molecules and intramolecular vibrations. Under this assumption, the Born theory of lattice dynamics together with the Laval theory of diffuse scattering has been applied to this primitive (rhombohedral) monomolecular lattice, and the dispersion curves of frequencies and velocities of the three acoustic branches, the seven intermolecular force constants corresponding to interactions between first, second and third neighbors and an approximate elastic vibrational spectrum of hexamine have been obtained. The results are compared with the b. c. c. lattices of α-iron and lithium. (Contractor's abstract, modified)

1398

Madrid U. Dept. of Crystallography (Spain).

[THERMAL EXPANSION AND STACKING DISORDER IN MOLECULAR CRYSTALS. I. 2, 2'-PYRIDIL] Dilatación termica y desorden de apilamiento en cristales moleculares. I. 2, 2'-piridil, by A. Félix, M. L. Canut, and J. L. Amorós. [1964] [11]p. incl. illus. diagrs. (AFOSR-65-0742) (AF EOAR-62-92) AD 615068 Unclassified

Also published in Bol. R. Soc. Esp. Hist. Nat. (G), v. 62: 187-197, 1964.

The thermal expansion quadric of 2, 2'-pyridil has been determined by the Weissenberg method, between -175° and 20°C. The monoclinic crystal shows the maximum (α_{11} = 167.3 x 10^{-6}) and minimum (α_{33} = 12.7 x 10^{-6}) expansion in the plane (010). Although the bond system does not involve other bonds but van der Waals forces, the thermal expansion coefficients are smaller than the expected. 2, 2'-pyridil is formed by curled sheets of molecules formed by chains of molecules along [101]. This causes some possibility of stacking lines along rows of l = 1 (from 011 to 021) and l = 3 (from 013 to 043) which have been detected in Weissenberg and Laue photographs of some single crystals. A two dimensional statistical model where stacking disorder along [001] of the layers of molecules has been introduced gives a Fraunhofer pattern showing general agreement with the x-ray experiments. Both ordered and disordered crystals can be obtained from a solution of the substance in ethanol. (Contractor's abstract)

1399

Madrid U. Dept. of Crystallography (Spain).

[A STUDY OF THE TOPOGRAPHY OF CRYSTALLINE IMPERFECTIONS BY THE PARALLEL BEAM METHOD OF X-RAY DIFFRACTION] Estudio topográfico de las imperfecciones de un cristal por difracción de rayos X; método del haz paralelo, by J. L. Amorós and P. Tavira. [1964] [6]p. incl. illus. diagrs. refs. (AFOSR-65-0743) (AF EOAR-62-92) AD 616061 Unclassified

Also published in Rev. Cien. Apl., No. 98: 217-222, May-June 1964.

The theoretical background of the parallel beam method is discussed. The intensity of the diffracted beam is proportional to $|F(h)|$ or $|F(h)|^2$ according to the dynamical or geometrical theory, respectively. The dynamical theory holds for a perfect crystal and the geometrical theory for a mosaic crystal. If $|F(h)|$ is high for a given crystal plane, the difference between both intensities becomes remarkable and the situation can be used for studying the topography of the perfection of a crystal. A camera following Barth ideas has been built and the experimental results discussed. The new camera allows the observation of the topography of the perfection of a crystal under thermal strain enhancing the potentiality of the method. The camera can also be used in transmission technique where use is made of the anomalous absorption of x-rays by perfect crystals. (Contractor's abstract)

1400

[Madrid U. Dept. of Crystallography (Spain)]

[CROSS-GLIDING OF DISLOCATIONS IN PYRITE SURFACE] Deslizamiento cruzado ("cross-gliding") de dislocaciones en la superficie de la pirita, by J. L. Amorós and M. T. Pascual. [1964] [4]p. incl. illus. (AFOSR-65-1923) (AF EOAR-62-92) AD 626776 Unclassified

Also published in Estudios Geologicos, v. 20: 73-76, Nov. 1964.

Cross-gliding of dislocations was observed in pyrite through slight etching of the free (old) surface. The cross-gliding mechanism is believed to start when the surface is freed of the oxidized bonded coating by the etching technique. Such mechanism gives rise to 2 different phenomena, one of which is related to the annihilation of dislocations of opposite sign. The intrinsic notch brittleness of pyrite crystals is revealed by microcrack nucleation. Micro-cracks are shown also by etching, and the mechanism is associated to the anchoring effect of the oxide coating of the old pyrite surface. (Contractor's abstract)

1401

Maine U. Dept. of Physics, Orono.

INFLUENCE OF AN ELECTRIC FIELD ON THE DIELECTRIC LOSS OF THE LIQUID CRYSTAL P-AZOXYANISOLE, by E. F. Carr. [1963] [5]p. incl. diagrs. refs. (AFOSR-J1558) (AF AFOSR-61-45) AD 427714 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1979-1983, Oct. 15, 1963.

This work involves the alignment of molecules in the anisotropic liquid phase of p-azoxyanisole due to externally applied dc and ac electric fields and walls of the sample holder. Microwave techniques involving dielectric measurements are used to provide a measure of the alignment. Results are discussed which suggest that for very pure samples an alignment should be produced with the long axes of the molecules perpendicular to the externally applied electric field. The alignment with the long axes parallel to the external field which is often observed appears to be due to an extremely small amount of impurity. Results are also discussed which suggest that small amounts of impurity are effective in producing an alignment of the molecules parallel to the walls of the sample holder.

1402

Manitoba U. [Dept. of Mathematics] Winnipeg (Canada).

THE EXPONENTS OF INCIDENCE MATRICES, by A. L. Dulmage and N. S. Mendelsohn. [1964] [10]p. incl. refs. (AFOSR-65-0867) (AF AFOSR-62-235) AD 617626 Unclassified

Also published in Duke Math. Jour., v. 31: 575-584, Dec. 1964.

This note investigates the multiplicative properties of non-negative matrices from a combinatorial point of view. The concepts of reducible, irreducible, and primitive matrices are discussed, and it is proved that if A is an incidence matrix of given design, $A^4 > 0$. The combinatorial description given of the pattern of zeros and nonzeros differs from others in that the concepts of graph theory are used directly. It is based on a consideration of converings of the positive entries of a non-negative matrix by proper mixtures of rows and columns. The connection of a non-negative matrix with a bipartite graph is also shown.

1403

[Marburg U. Inst. for Theoretical Physics (Germany)]

ATTEMPT OF AN AXIOMATIC FOUNDATION OF QUANTUM MECHANICS AND MORE GENERAL PHYSICAL THEORIES, by G. Ludwig. [1964] 46p. (AFOSR-65-0646) (AF 61(052)656) AD 614846 Unclassified

By introducing certain axiomatic assumptions on the production of macroscopic effects by microscopic objects attempts are made to obtain a general basic structure of physical theories. The essential features of the proposition-calculus of quantum mechanics are reproduced through it has not yet been possible to give a complete survey of mathematical realizations which might satisfy the postualtes. (Contractor's abstract)

1404

Marburg U. Inst. for Theoretical Physics (Germany).

REMARKS ON ω-φ AND OCTET-OCTET MIXING, by H. D. Doebner and G. C. Hegerfeldt. [1964] [4]p. (AFOSR-65-0647) (AF 61(052)656) AD 614849 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1724-1727, Sept. 16, 1964.

A discussion is presented of some consequences following the assumption that the SU_3 singlet and octet or the first and second octet are degenerate in the limit of full symmetry with a common mass M_0 leading to 9 or 16 physical particles after mixing. This model allows the number of constants to be lowered by one and gives relations between masses and mixing angles. It turns out that the degenerate ω-φ mixing is in good agreement with experiment; for octet-octet mixing the model leads to predictions of unobserved resonances and is less satisfactory.

1405

Marburg U. Inst. for Theoretical Physics (Germany).

GENERAL QUANTUM FIELD THEORIES AND STRICT

LOCALITY, by K. Kraus. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0651) (AF 61(052)658) AD 615691 Unclassified

Also published in Zeitschr. Phys., v. 161: 1-12, 1964.

A class of general quantum field theories without explicit use of fields A(x) is defined by a set of postulates for the von Neumann algebras $\mathfrak{A}_C$ of local observables. The vacuum state is cyclic with respect to any $\mathfrak{A}_C$, and the Borchers tube theorem is shown to hold. Some $\mathfrak{A}_C$ are factors and not of finite type. A property of local observables called strict locality is formulated and expressed by means of a necessary and sufficient condition for the algebras $\mathfrak{A}_C$. It is proved for finite regions. (Contractor's abstract)

1406

Maremont Corp. Rocket Power, Inc., Pasadena, Calif.

RESEARCH ON CHEMICAL SYNTHESIS WITH MONO-ENERGETIC IONS, by C. Bodai, L. K. Branson and others. Final technical rept. Oct. 1, 1960-Sept. 30, 1964, 13p. incl. diagr. table, refs. (AFOSR-65-1691) (AF 49(636)913) AD 624087 Unclassified

A new technique for the synthesis of chemical compounds was developed. Pure nitrobenzene was synthesized by bombarding the benzene molecule with a beam of NO_2^+ ions under carefully controlled conditions. Ortho, meta and para nitrotoluene were also prepared by the reaction of toluene with NO_2^+ ions. The apparatus used consists of an ion source capable of providing a low-energy (1 ev) high-current (1 ma) beam of selected ionic species; an electrostatic potential control or accelerator for extracting the current from the source and giving accurate ion energies on the order of 1 ev; a reaction vessel in which the ions interact with the target molecules to produce a chemical reaction; and a cold trap to collect the products of reaction. (Contractor's abstract)

1407

Marseille U. (France).

EVOKED VISUAL RESPONSES IN MAN DURING AUDITORY STRESS, by H. J. Gastaut. Final rept. Oct. 30, 1963, 26p. (AFOSR-64-0016) (AF EOAR-62-74) AD 428239 Unclassified

A transcranial study in man of evoked visual responses due to intermittent light stimulation during silence or intense prolonged auditory stimulation is presented. These responses were recorded with conventional EEG as photic driving, or with an apparatus of integration as an average evoked potential. They are increased at the start of sound stimulation and diminished during its continuation. If due account is taken of the corresponding modifications of the fundamental EEG rhythms, one may consider these phenomena as being due to activation with subsequent inhibition of the reticular formation. This would equally explain the psychometric changes, and the lowering of efficiency and of personnel security observed during stress by sound.

1406

Martin-Marietta Corp. Martin Co., Baltimore, Md.

EFFECT OF LOW PRESSURES ON THE MECHANICAL BEHAVIOR OF METALS, by I. R. Kramer and S. E. Podlaseck. Final rept. Oct. 1, 1962-Oct. 1, 1963, 30p. incl. diagrs. table, refs. (AFOSR-J1237) (AF 49(636)-946) AD 424292 Unclassified

Results of a study on the creep, tensile and fatigue behavior of metals at low environmental pressures are presented. Changes in the activation energy for creep of aluminum single crystals were measured as pressure was varied from 10^{-4} to 10^{-7} torr. Effects of vacuum on the tensile properties of single and polycrystalline aluminum are presented. Variations in the tensile properties of 316 stainless steel and 4043 aluminum with pressures in the range 760 to 10^{-6} torr are also presented. Variations in the fatigue life of 1100 aluminum as a function of pressure in the range 760 to 10^{-6} torr are given. (Contractor's abstract)

1409

[Martin-Marietta Corp.] Martin Co., Baltimore, Md.

EFFECT OF VACUUM ON THE MECHANICAL BEHAVIOR OF METALS, by I. R. Kramer, H. Shen, and S. E. Podlaseck. Final scientific rept. Oct. 1, 1963-Oct. 1, 1964, 36p. incl. illus. diagrs. tables, refs. (Rept. no. RR-60) (AFOSR-64-2509) (AF 49(636)946) AD 612022 Unclassified

Effects of vacuum on the various mechanical properties of aluminum have been studied as a function of pressure, strain rate, crystallographic orientation, strain, specimen size and grain size. The results obtained from a series of creep, fatigue and tensile tests indicate that these parameters are intimately related to the magnitude of the effects observed in vacuum. Experimental results obtained in vacuum for the fatigue life, the coefficient of work-hardening, the change in activation energy and the activation volume are presented. The tensile properties of pure α iron have also been studied in vacuum, and the experimental data are presented. A theoretical surface effect model based on the concept of the 'surface debris layer' is proposed to interpret all the phenomena observed in this investigation. (Contractor's abstract)

1410

Martin-Marietta Corp. Martin Co., Baltimore, Md.

EFFECT OF INITIAL IMPERFECTION ON THE STABILITY OF SHALLOW SPHERICAL SHELLS, by G. A. Thurston and F. A. Penning. Final rept. Aug. 31, 1964, 121p. incl. illus. diagrs. tables, refs. (Rept. no. CR-64-28) (AFOSR-64-1627) (AF 49(636)1316) AD 448454 Unclassified

The effect of tnitial tmperfections tn shape cn the elastic buckltng of clamped spherical caps under external pressure was studied. Basing the analysis on tmperfection shapes determined by measurements on the actual test spectmens resulted tn better correlation between theory and experiment for tmperfect sphertcal caps than has been posstble tn the past.

1411

Maryland U. Dept. of Physics and Astronomy, College Park.

SUPERCONDUCTORS WITH PLANE BOUNDARIES, by D. S. Falk. [1963] [55]p. incl. diagrs. refs. (Technical rept. no. 315) (AFOSR-5134) (AF AFOSR-62-46) AD 413475 Unclassified

Also publtshed in Phys. Rev., v. 132: 1576-1590, Nov. 15, 1963.

The Gor'kov equations are solved approximately for various geometries to obtain tnformation about the pair wave function in the vicinity of plane boundaries. The approximation method consists of assumtng a model taken constant withtn the superconductor, and assumtng it to be close to the correct pair wave function. The equations are then solved and a new pair wave function is calculated. The model ts then chosen in a self-consistant manner. The problems considered are the finite and semi-tnftnite superconducting slabs, and semi-tnfinite superconducting and normal metals in contact. The effects of the boundary conditions are discussed. The calculations are performed both at zero temperature and near the critical temperature.

1412

Maryland U. Dept. of Physics and Astronomy, College Park.

LOCALIZED MODE DETECTION BY MEANS OF THE MÖSSBAUER EFFECT, by A. D. Dinhofer. Doctoral thesis, June 1963, 39p. tncl. diagr. refs. (Technical rept. no. 312) (AFOSR-5139) (AF AFOSR-62-46) AD 412526 Unclassified

Also published in Phys. Rev., v. 131: 535-539, July 15, 1963. (AFOSR-64-0437; AD 435651)

The Mössbauer effect in a simple cubic crystal, disordered by light isotopes was studied for the possibility of observing the localtzed mode vibrational spectrum over the background of the continuum.

1413

Maryland U. Dept. of Physics and Astronomy, College Park.

[FUNDAMENTAL INTERACTIONS IN THE SOLID STATE] by R. A. Ferrell and R. D. Myers. Final rept. Sept. 1, 1961-Aug. 31, 1964, 10p. incl. refs. (AFOSR-65-0656) (AF AFOSR-62-46) AD 514136 Unclassifted

This ts a theoretical tnvestigation of fundamental problems tn soltd state physics with emphasis on the treatment of particle correlation artsing in the many-body problem by modern methods of quantum fteld theory. Detailed study of the superconducting state of metals, giving attention to the basic theory of the electron-phonon and phonon-exchange tnteraction, will be undertaken to dertve the correct superconductivity crtterion. In addition, polarization of the degenerate electron gas by a point charge will be computed, exchange corrections tn the dielectric constant of a degenerate electron gas will be determtned, and the existence of localtzed lattice vibrational modes explored.

1414

Maryland U. Dept. of Physics and Astronomy, College Park.

CORRELATION EFFECTS AND THE HELICON DISPERSION RELATION, by R. E. Prange. [1964] [2]p. (AFOSR-65-0740) (AF AFOSR-62-46) AD 615351 Unclassifted

Also publtshed tn Phys. Ltrs., v. 12: 181-162, Oct. 1, 1964.

The model of metals based on the Fröhlich Hamiltonian of the electron-phonon interaction can be descrtbed by a generalized Landau Fermi-ltquid theory. This note constders such a case tn whtch the only possible role of the phonons is in the renormalization of the electronic energies and matrix elements. The heltcon disperston relation is obtatned, and it is shown that there are no tnteraction corrections to the relation.

1415

Maryland U. [Dept. of Physics and Astronomy] College Park.

ON THE GINZBURG-LANDAU EQUATIONS, by R. W. Carroll and A. J. Glick. [1964] [12]p. incl. refs. (AFOSR-66-1344) (AF AFOSR-62-46) AD 641097 Unclassifted

Also published tn Arch. Rational Mech. and Anal., v. 16: 373-384, 1964.

Existence and untqueness theorems for weak solutions of the nonltnear Ginzburg-Landau partial differential equations are proven. The results are based on a contraction mapptng prtnctple and require the parameter K in the equations and the strength of the external magnetic field to be small.

1416

Maryland U. [Dept. of Physics and Astronomy] College Park.

EXPERIMENTAL AND THEORETICAL RESEARCH IN GRAVITATION PHYSICS, by G. Hinds, J. Sinsky and others. Final technical rept. 1963, 17p. (AFOSR-5207) (AF AFOSR-62-143) AD 416608 Unclassified

Research has continued on the generator of dynamical gravitational fields, in the vicinity of 1657 cps. The generator consists of an aluminum cylinder, 8 in. in diam, 60 in. long, suspended in a vacuum chamber. A vacuum tube oscillator drives piezo electric crystals secured to the cylinder, and the cylinder is excited in its lowest compressional mode. A principal objective of the research was accomplished. The cylinder was successfully driven at strain amplitudes as high as 5×10^{-4}. It can be reliably driven at strain amplitudes of 2×10^{-4}. Temperature drift of the cylinder was observed which resulted in a drift of its resonant frequency.

1417

Maryland U. Dept. of Physics and Astronomy, College Park.

RELATIVISTIC PARTICLE DYNAMICS AND THE S MATRIX, by R. Fong and J. Sucher. July 1963, 28p. incl. refs. (Technical rept. no. TR-319) (AFOSR-65-0503) (AF AFOSR-62-361) AD 439077
Unclassified

Also published in Jour. Math. Phys., v. 5: 456-470, Apr. 1964.

Direct-interaction theories are examined from the viewpoint of relativistic scattering theory and the associated concept of "asymptotic covariance". It is pointed out that with any 2-particle Hamiltonian which has no bound states there can be associated a variety of representations of the Lie algebra of the inhomogeneous Lorentz group (IHLG), although the S matrix is in general not covariant. It is shown that the requirement of the asymptotic covariance ensures both the covariance of the S matrix and the existence of a unique representation of the IHLG to be associated with the relativistic 2-particle system. The connection between the Lie algebra, the covariant form of the S matrix, and the uniqueness of K, the generator of pure Lorentz transformations, is thereby clarified. The extension of these considerations to include bound states is made. (Contractor's abstract, in part)

1418

Maryland U. Dept. of Physics and Astronomy, College Park.

THE φ-ω MIXING ANGLE, by Y. S. Kim, S. Oneda, and J. C. Pati. [1964] [4]p. incl. table, refs. (AFOSR-65-0500) (AF AFOSR-64-500) AD 614171
Unclassified

Also published in Phys. Rev., v. 135: B1076-B1079, Aug. 24, 1964.

Under the assumption of vector-meson dominance for $\pi^0 \to 2\gamma$, $\omega \to 3\pi$, and $\varphi \to \rho + \pi$, the φ-ω mixing angles from the observed decay rates for these processes was obtained. These mixing angles are smaller than the Okubo-Sakurai value derived from the Gell-Mann-Okubo mass formula for the vector-meson octet. The lower mixing angles obtained correspond to only a small violation (less than 10%) of the mass-square formula. Further possible checks on these mixing angles, as well as on the hypothesis of φ-ω mixing and the vector-meson dominant model are discussed. (Contractor's abstract)

1419

Maryland U. Dept. of Physics and Astronomy, College Park.

SU(3) SYMMETRY AND THE NONLEPTONIC K-MESON PROCESSES, by S. Oneda, Y. S. Kim, and D. Korff. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-0501) (AF AFOSR-64-500) AD 614172 Unclassified

Also published in Phys. Rev., v. 136: B1064-B1073, Nov. 23, 1964.

Consequence of the SU(3) octet scheme for the nonleptonic weak interactions are studied in some of the nonleptonic K-meson processes. The K_1^0-K_2^0 mass difference and the rates of $K_2^0 \to 2\gamma$ and $K_2^0 \to \pi^+ + \pi^- + \gamma$ decays are discussed. The effect of ω-φ mixing is considered in the $K_2^0 \to 2\gamma$ decay. The possible violation of the $|\Delta I| = \frac{1}{2}$ rule in the $K_2^0 \to 3\pi$ decay is discussed in terms of the η-meson pole contribution. The characteristic features of $K^+ \to \pi^+ + \pi^0 + \gamma$ and $K^+ \to 3\pi$ decays in our model are also discussed. It is inferred that the rate of $K^+ \to \pi^+ + \pi^0 + \gamma$ decay is dominated by the internal bremsstrahlung contribution. A possible effect of a unitary singlet pseudoscalar meson on these problems is also discussed. (Contractor's abstract)

1420

Maryland U. Dept. of Physics and Astronomy, College Park.

THREE-PARTICLE UNITARITY INTEGRAL, by Y. S. Kim. [1964] [5]p. (AFOSR-65-0502) (AF AFOSR-64-500) AD 614173 Unclassified

Also published in Phys. Rev., v. 135: B454-B458, July 27, 1964.

Various forms of the production amplitude are proposed which are convenient for the 3-particle unitarity integral. Both exact and approximate forms are discussed. It is found that in both cases one can separate the final-state configuration from the over-all kinematics by using discrete variables. Form factors with the 3-particle intermediate state are also discussed. (Contractor's abstract)

1421

Maryland U. Dept. of Physics and Astronomy, College Park.

REMARKS ON STRANGENESS NON-CONSERVING WEAK LETPONIC INTERACTIONS, by S. Oneda. [1964] [7]p. incl. refs. (AFOSR-65-0504) (AF AFOSR-64-500) AD 614174 Unclassified

Also published in Nuclear Phys., v. 57: 89-95, Aug./Sept. 1964.

The possibility that both the leptonic currents and the vector K-π resonance, M, couple with the same strangeness changing currents is discussed. The magnitude of renormalized coupling constant and the form factors of $K_{\mu 3}$-decay are discussed. A reasonable consistency with the present experimental situations with regard to the leptonic strangeness changing processes and to the K-π resonances is indicated. (Contractor's abstract)

1422

Maryland U. Dept. of Physics and Astronomy, College Park.

UNITARY SYMMETRY AND NON-LEPTONIC K-DECAYS, by Y. S. Kim and S. Oneda. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-0505) (AF AFOSR-64-500) AD 614175 Unclassified

Also published in Phys. Ltrs., v. 8: 83-85, Jan. 1, 1964.

Current experimental data indicate that the unitary symmetry is a possible higher symmetry which contains in itself the charge independence of strong interactions. Higher symmetry schemes have been attempted also for the weak interaction. For non-leptonic weak processes, the $[\Delta I] = 1/2$ rule is a well accepted isospin selection rule. As the simplest generalization in which the $[\Delta I] = 1/2$ rule is built, it is assumed that the weak non-leptonic interaction Hamiltonian, together with the pseudoscalar and the vector mesons, belongs to the SU(3) octet. Some experimental implications of this assumption in various K-decay processes is discussed.

1423

Maryland U. Dept. of Physics and Astronomy, College Park.

DYNAMICAL MODEL OF THE 1535-MEV Ξ^* HYPERON, by J. C. Pati. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-0506) (AF AFOSR-64-500) AD 614176 Unclassified

Also published in Phys. Rev., v. 134: B387-B396, Apr. 27, 1964.

An attempt is made to understand the dynamical origin of the 1535-mev Ξ^* hyperon. The problem of scattering in the $J = 3/2^+$ state of the $\bar{K}\Lambda$ channel is studied by the N/D method. The influence of all other channels are ignored. The dynamical singularities of the partial-wave amplitude are assumed to arise mainly from the near cut due to the nucleon exchange in the crossed channel, and from the far left-hand cut, i.e., $\infty < S \leq 0$. The contribution of the former is evaluated explicitly in terms of the ΛNK coupling constant and that of the latter, by the method of Balazs, through the introduction of the effective range-pole terms.

1424

Maryland U. Dept. of Physics and Astronomy, College Park.

COUPLING OF INTERNAL AND SPACE-TIME SYMMETRIES, by O. W. Greenberg. [1964] [4]p. (AFOSR-65-0507) (AF AFOSR-64-500) AD 614181 Unclassified

Also published in Phys. Rev., v. 135: B1447-B1450, Sept. 21, 1964.

When Lorentz invariance is ignored, internal symmetries which are violated in a given way, and which are independent of the space-time symmetries, can be rewritten in terms of a larger group which contains the internal group and the time-translation group in a coupled, noncommuting way. This rewriting can be chosen so that the noncommutativity of the time-translation and internal groups splits the mass degeneracy of internal multiplets, i.e., accounts for what was previously called "violation" of the internal group. This procedure is illustrated explicitly for the SU(3) baryon octet with octet symmetry violation. When Lorentz invariance is required, the coupling of internal and space-time symmetries becomes more difficult.

1425

Maryland U. Dept. of Physics and Astronomy, College Park.

CHOICE BETWEEN PRIMARY AND DYNAMICAL $|\Delta T| = 1/2$ RULE IN THE CURRENT-CURRENT PICTURE FOR NONLEPTONIC WEAK DECAYS, by J. C. Pati and S. Oneda. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0826) (AF AFOSR-64-500) AD 616467 Unclassified

Also published in Phys. Rev., v. 136: B1097-B1101, Nov. 23, 1964.

The P-wave intrinsic structure of $K \to 3\pi$ decays is studied in the current-current picture for nonleptonic weak interactions, and it is shown that an accurate measurement of the asymmetry parameters of $K \to 3\pi$ decays could distinguish whether or not the $|\Delta T| = 1/2$ rule is primary or dynamical. In case of the former, as is expected, not only the rates, but also the asymmetry parameters of $K \to 3\pi$ decays should be consistent with a dominant $|\Delta T| = 1/2$ rule, while for the latter, one should expect to observe a large violation of the $|\Delta T| = 1/2$ rule in the asymmetry parameters of $K \to 3\pi$ decays with or without a similar violation in the rates. Some comments are made concerning the general necessity of enhancement of nonleptonic modes regardless of whether the $|\Delta T| = 1/2$ rule is primary or dynamical. (Contractor's abstract)

1426

Maryland U. Dept. of Physics and Astronomy, College Park.

ON A CLASS OF THIRRING MODELS, by C. S. Lam.

[1964] [8]p. incl. refs. (AFOSR-66-0440) (AF AFOSR-64-500) AD 630233 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 637-644, Nov. 1, 1964.

A class of Thirring models self-coupled through a non-covariant current operator is investigated. It is shown that such a coupling will lead to physically meaningful results only at a fixed coupling strength. Furthermore, symmetry-breaking solutions of a kind to be specified in the text are permissible only at this particular coupling strength. The question of Goldstone zero-mass bosons is discussed. (Contractor's abstract)

1427

Maryland U. Dept. of Physics and Astronomy, College Park.

GAUGE PROBLEMS IN CANONICALLY QUANTIZED ELECTRODYNAMICS WITHOUT SUBSIDIARY CONDITIONS, by C. S. Lam. Aug. 1964, 41p. (Technical rept. no. TR-397) (AF AFOSR-64-500) AD 623850 Unclassified

Relations between time ordered functions of quantum electrodynamics quantized in different gauges are discussed.

1428

Maryland U. Dept. of Physics and Astronomy, College Park.

TRANSPORT THEORY FOR ELECTRON-PHONON INTERACTIONS IN METALS, by R. E. Prange. [1964] [15]p. incl. refs. (AFOSR-66-1300) (AF AFOSR-65-735) AD 641096 Unclassified

Also published in Phys. Rev., v. 134: A566-A580, May 4, 1964.

By extending Migdal's approximation for electron-phonon interactions in metals to the nonequilibrium case, it is possible to derive a set of transport equations which are exact to order $(m/M)^{1/2}$. The transport equations may be written in two different forms: In the first form, the electronic distribution function is labeled by a momentum vector; in the second, the labels are excitation energy and the position on the Fermi surface. Despite the width in the spectrum, the momentum space form is identical with the Landau quasiparticle theory. The energy space form is slightly simpler because no wave function renormalization constants appear in the definition of the energies or in the scattering matrix elements. In fact, in the case in which there is space dependence but no time dependence this form of the transport equations looks identical to the weak-coupling Boltzmann equations. This identity is used to prove that to the accuracy of the adiabatic approximation the several transport coefficients are completely unchanged by the many-body effects of the electron phonon interaction. These coefficients, which include the spin diffusivity and the viscosity as well as the ordinary conductivities and all the classical galvano-magnetothermal effects are thus correctly predicted by the standard weak-coupling theory. (Contractor's abstract)

1429

Maryland U. Dept. of Physics and Astronomy, College Park.

SUPERCONDUCTIVITY IN A STRONG SPIN-EXCHANGE FIELD, by P. Fulde and R. A. Ferrell. [1964] [14]p. incl. diagrs. refs. (AFOSR-67-0126) (AF AFOSR-65-735) Unclassified

Also published in Phys. Rev., v. 135: A550-A563, Aug. 3, 1964.

A strong exchange field, such as produced by ferromagnetically aligned impurities in a metal, will tend to polarize the conduction electron spins. If the metal is a superconductor, this will happen only if the spin-exchange field is sufficiently strong compared to the energy gap. When the field is strong enough to break many electron pairs, the self-consistent gap equation is modified and a new type of depaired superconducting ground state occurs. In the idealization of a spatially uniform exchange field ith no scattering, it is found that the depaired state has a spatially dependent complex Gorkov field, corresponding to a nonzero pairing momentum in the BCS model. The presence of the "normal" electrons from the broken pairs reduces the total current to zero, gives the depaired state some spin polarization, and results in almost normal Sommerfeld specific heat and single-electron tunneling characteristics. The nonzero value of the pairing momentum also gives rise to an unusual anisotropic electrodynamic behavior of the superconductor, as well as to a degenerate ground state and low-lying collective excitations, in accordance with Goldstone's theorem. (Contractor's abstract, modified)

1430

Maryland U. [Dept. of Physics and Astronomy] College Park.

CRITICAL CURRENT AND ELECTRON DEPAIRING IN SUPERCONDUCTING FILMS, by P. Fulde and R. A. Ferrell. [1963] [3]p. incl. diagrs. (AFOSR-67-0166) (AF AFOSR-65-735) Unclassified

Also published in Phys. Rev., v. 131: 2457-2459, Sept. 15, 1963.

By varying the magnetic flux enclosed by a cylindrical superconducting film, a supercurrent can be induced to flow in the film. A maximum in the current is reached at a certain value of flux, beyond which the current gradually decreases as a result of the breakup of electron pairs. The self-inductance of the cylinder prevents, however, the experimental study of the depairing situation. This difficulty can be overcome by filling the hollow cylinder with another superconductor whose Meissner effect reduces the flux linkage and the self-inductance of the film. This method of stabilizing the electron depairing should make possible the confirmation of both the following effects of pair breakup:

(a) almost normal tunneling current for voltages less than the gap voltage; (b) anisotropic-electromagnetic surface impedance of the supercurrent-carrying film. (Contractor's abstract)

1431

Maryland U. [Dept. of Physics and Astronomy] College Park.

SELF-FIELD LIMITING OF JOSEPHSON TUNNELING OF SUPERCONDUCTING ELECTRON PAIRS, by R. A. Ferrell and R. E. Prange. [1963] [3]p. incl. diagrs. (AFOSR-67-0170) (AF AFOSR-65-735) Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 479-481, June 1, 1963.

The action of the self-induced magnetic field on the Josephson current carried by pairs of superconducting electrons tunneling through an insulating barrier between two superconductors is considered. The calculation shows that in a barrier whose smallest diameter is greater than a penetration distance λ_J, the Josephson current arises only from a fringe of width λ_J at the barrier edges. For typical junctions λ_J is estimated to be of the order of one half a mm.

1432

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON HARMONIC FUNCTIONS OF FOUR VARIABLES WITH RATIONAL o_4- ASSOCIATES, by R. P. Gilbert. [1963] [18]p. (AFOSR-2252) (AF 49(638)228) AD 419694 Unclassified

Also published in Pacific Jour. Math., v. 13: 79-96, 1963.

The solution of the four dimensional Laplace equation, Operator H is identical to the summation from $\nu = 1$ to 4 of $(H_{x_\nu} x_\nu = 0)$, are investigated by means of the integral operator approach the operator which transforms analytic functions of three complex variables into solutions is used.

1433

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

APPLICATION OF THE TWO-PARTICLE DISTRIBUTION FUNCTION TO ESTIMATE THE COLLISIONAL DAMPING OF PLASMA OSCILLATIONS, by J. M. Burgers. [1963] [9]p. (AFOSR-J1235) (AF 49(638)401) AD 424353 Unclassified

Also published in Phys. Fluids, v. 6: 889-897, July 1963.

An approximate, linearized equation for the pair correlation function, containing a Debye potential instead of the Coulomb potential, is used to derive by direct integration a solution for the pair correlation function for the case of long-wavelength plasma oscillations in a fully ionized gas without a magnetic field. The correlation function is then applied to describe the effect of collisions in a linearized Boltzmann equation for the single-particle distribution function, which again is integrated directly. By substituting the integral of the single-particle function over the velocity space into Poisson's equation for the electric field, a dispersion equation is constructed for the oscillations. From this dispersion equation the damping of the oscillations can be found. The result combines the Landau damping with the collisional damping.

1434

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

DETAILED FLOW-FIELD OBSERVATIONS IN THE TRANSITION PROCESS IN A THICK BOUNDARY LAYER, by E. R. Hama and J. Nutant. [1963] [17]p. incl. illus. diagrs. refs. (AFOSR-J847) (AF 49(638)645) AD 416384 Unclassified

Also published in Proc. 1963 Heat Transfer and Fluid Mechanics Inst., ed. by A. Roshko, B. Sturtevant, and D. R. Bartz. Stanford U. Press, 1963, p. 77-93.

Detailed flow-field observations are made of the transition process in a boundary layer of approx 1 in. thickness in a long running-water channel by the use of the pulsed hydrogen-bubble visualization technique. Following the amplification of the originally two-dimensional wave, the wave warps its front acquiring a longitudinal vorticity component along its swept-back front. The longitudinal vorticity component becomes rapidly concentrated to form a Λ-shaped vortex but with its tip open. This primary Λ vortex creates a strong upward fluid motion along and inside its legs and a high-shear layer is formed. (Contractor's abstract, modified)

1435

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

ON THE GENERATION OF SECONDARY MOTIONS IN THE FIELD OF A VORTEX, by J. R. Weske and T. M. Rankin. Mar. 1963 [25]p. incl. illus. diagrs. refs. (Technical note BN-313) (AFOSR-4666) (AF AFOSR-62-230) AD 410107 Unclassified

Also published in Phys. Fluids, v. 6: 1397-1403, Oct. 1963.

The investigation is concerned with motions in the region of the core of a vortex which exhibit peripheral vorticity. From theoretical reasoning it appears that development of such motions is favored as a zonal maximum of axial vorticity components is produced; e.g. by divergence of the vortex core. Several experiments devised to verify theoretical conclusions furnish evidence

that concentrations of vorticity periodic about the perimeter actually do occur as expected. (Contractor's abstract)

1436

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

UPPER AND LOWER BOUNDS FOR THE APSIDAL ANGLE IN THE THEORY OF THE HEAVY SYMMETRICAL TOP, by J. B. Diaz and F. T. Metcalf. [1964] [17]p. incl. diagrs. (AFOSR-64-2417) (AF AFOSR-62-454) AD 453614 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 214-229, 1964.

If one considers the constrained motion of a particle on the surface of a sphere, solely under the external influence of gravity, this motion may be shown, under certain circumstances, to take place between two horizontal planes cutting the surface. The particle moves periodically from one level to the other and then back again. The position of the particle is given by specifying two quantities, the azimuthal angle and the vertical height. The azimuth is defined to be the angle between the horizontal projection of the position vector and the same projection at some initial time. As the particle moves from the lowest level of motion to the highest, the corresponding increase in the azimuth is called the apsidal angle. A similar situation occurs in the theory of the heavy symmetrical top. A point fixed on the axis of symmetry moves on a sphere and executes a periodic motion between two horizontal planes. Again an apsidal angle may be defined.

1437

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

APPROXIMATION OF DERIVATIVES BY FINITE DIFFERENCE METHODS IN ELLIPTIC BOUNDARY VALUE PROBLEMS, by J. H. Bramble and B. E. Hubbard. [1964] [12]p. incl. refs. (AFOSR-65-0327) (AF AFOSR-62-454) AD 612435 Unclassified

Also published in Contrib. Differential Equations, v. 3: 399-410, 1964.

The problem is considered of approximating the solution of the Dirichlet problem for $Lu \equiv au_{xx} + 2bu_{xy} + cu_{yy} + du_x + eu_y + fu = F$ in a connected region R with smooth boundary C in the (x, y)-plane, where $|b| < a$, c; $f < 0$ and the coefficients and data are smooth. Results are obtained for problems in this class which have solutions with bounded fifth derivatives.

1438

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ON MEAN VALUE THEOREMS FOR STRONGLY CONTINUOUS VECTOR VALUED FUNCTIONS, by J. B. Diaz and R. Vyborny. [1964] [12]p. (AFOSR-64-1734) (AF AFOSR-63-400) AD 447592 Unclassified

Also published in Contrib. Differential Equations, v. 3: 107-118, 1964.

The purpose of this note is to prove two mean value theorems for strongly continuous vector valued functions, which are generalizations of the mean value theorem for strongly continuous and strongly differentiable functions.

1439

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

A MEAN VALUE THEOREM FOR STRONGLY CONTINUOUS VECTOR VALUED FUNCTIONS, by J. B. Diaz and R. Vyborny. [1964] [2]p. (AFOSR-64-1826) (AF AFOSR-63-400) AD 449062 Unclassified

Also published in Czechoslovak Math. Jour., v. 14: 322-323, 1964.

For abstract see item no. 1438, Vol. VII.

1440

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

BERGMAN'S INTEGRAL OPERATOR METHOD IN GENERALIZED AXIALLY SYMMETRIC POTENTIAL THEORY, by R. P. Gilbert. [1964] [15]p. (AFOSR-64-2325) (AF AFOSR-63-400) AD 452321 Unclassified

Also published in Jour. Math. Phys., v. 5: 983-997, July 1964.

This paper contains a study of properties of solutions to the equation of generalized axially symmetric potentials. These potentials play an important role in many aspects of mathematical physics, in particular to an understanding of compressible flow in the transonic region. The ideas that have been basic in this investigation are contained in the integral operator method of Bergman. This method allows one to transplant certain properties of analytic functions to the solutions of linear partial differential equations. Results are obtained concerning singularities, residues, bounds, and growth of entire solutions, which are analogous to those found in classical function theory.

1441

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

VELOCITY MODULATION OF A RELATIVISTIC ELECTRON BEAM, by P. C. T. DeBoer. [1964] [4]p. (AFOSR-65-0923) (AF AFOSR-64-141) AD 613908 Unclassified

Also published in Jour. Appl. Phys., v. 35: 2789-2792, Oct. 1964.

Velocity modulation of a 1-dimensional electron beam is treated relativistically, starting from the collisionless Boltzmann equation and using first-order perturbation theory. A general expression for the perturbation current density j_1 is applied first to a mono-energetic unperturbed beam. Compared to the nonrelativistic case, the magnitude of j_1 is reduced by the factor $(1-u^2/c^2)^{3/4}$, where u is the unperturbed beam velocity and c the velocity of light. The distance between the max of j_1 is increased by the inverse of the same factor. Relativistic effects decrease the efficiency of modulation η, which is defined as the energy carried by the electric field generated by the perturbations, divided by the energy flux in the unperturbed beam. For an unperturbed beam with a rectangular velocity distribution of narrow width w and a fixed mean velocity u_m, the results are independent of w to first order. Expressions for j_1 and η are also found for an unperturbed beam with a rectangular momentum distribution of arbitrary width. (Contractor's abstract, modified)

1442

Maryland U. Inst. for Fluid Dynamics and Applied Mathematics, College Park.

EQUIVALENCE OF CERTAIN INEQUALITIES COMPLEMENTING THOSE OF CAUCHY-SCHWARZ AND HOLDER, by J. B. Diaz, A. J. Goldman, and F. T. Metcalf. [1964] [3]p. incl. refs. (AFOSR-65-0602) (AF AFOSR-64-400) AD 614158 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 68B: 147-149, Oct.-Dec. 1964.

An inequality due to Diaz and Metcalf, which complements the Cauchy-Schwarz inequality, is shown equivalent to a result of Rennie. A more general inequality due to Diaz and Metcalf, which complements that of Holder, is proven equivalent to a previously published generalization of Rennie's inequality. (Contractor's abstract)

1443

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

ON A CLASS OF ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS IN FOUR VARIABLES, by R. P. Gilbert. [1964] [14]p. incl. refs. (AFOSR-65-1021) (AF AFOSR-64-400) AD 618353 Unclassified

Also published in Pacific Jour. Math., v. 14: 1223-1236, 1964.

The elliptic partial differential equation,

$$T_3[\Psi] = \frac{\partial^2 \Psi}{\partial x_\mu \partial x_\mu} + A(r^2)\, x_\mu \frac{\partial \Psi}{\partial x_\mu} + C(r^2)\,\Psi = 0, \ (\mu = 1, 2, 3)$$

has been considered by S. Bergman. This paper investigates the 4 variable analogue of this equation, $T_4[\Psi] = 0$, and shows that many of Bergman's results carry over to this case. In many instances, the methods of several complex variables are needed in order to find the natural generalizations. An integral operator, $B_4[f]$, is used to study the solutions of the above equations. $B_4[f]$ maps analytic functions of 3-complex variables onto harmonic, function-elements of 4 variables.

1444

Maryland U. [Inst. for Fluid Dynamics and Applied Mathematics] College Park.

COMPLEMENTARY INEQUALITIES IV: INEQUALITIES COMPLEMENTARY TO CAUCHY'S INEQUALITY FOR SUMS OF COMPLEX NUMBERS, by J. B. Diaz and F. T. Metcalf. [1964] [38]p. incl. diagr. (AFOSR-66-1232) (AF AFOSR-64-400) AD 641723 Unclassified

Also published in Rend. Circ. Matem. Palermo, Series II, v. 13: 1-38, 1964.

Several inequalities, complementary to Cauchy's inequalities are proved for complex numbers. These provide lower bounds, and are extensions from complementary inequalities for real numbers. Several ring theorems are proved to establish immediate analogs.

1445

Maryland U. Inst. of Molecular Physics, College Park.

STUDIES OF COLOR CENTERS IN ALKALI HALIDES, by W. G. Maisch. Final rept. Sept. 1963, 1v. (AFOSR-J1159) (AF 49(638)627) AD 423984 Unclassified

The peak energy of the F band in the alkali halides studied is very sensitive to changes in the lattice spacing. High pressure measurements indicate that the Ivey equation is fortuitous in that the peak energy is not uniquely determined by the interionic distance of the bulk crystal, but also depends upon the host crystals. Half-widths of the F band above the transition point were greater than below the transition point and the peak optical density decreased. Absorption spectra of the F and M centers in RbF, RbCl, RbBr, and CsI were investigated as a function of pressure. In addition to the F and M band, the No. 3 band and some other unidentified bands were observed under pressures up to 10,000 atm for the absorption spectra of RbCl and RbBr and up to 50,000 atm for the absorption spectra of RbF and CsI.

1446

Massachusetts Inst. of Tech., Cambridge.

NONEQUILIBRIUM IONIZATION DUE TO ELECTRON HEATING: II. EXPERIMENTS, by J. L. Kerrebrock and M. A. Hoffman. [1964] [8]p. incl. diagrs. table, refs. (AFOSR-64-0583) (AF AFOSR-62-308) Unclassified

Presented at AIAA Aerospace Sciences Meeting, New York, Jan. 20-22, 1964.

Also published in AIAA Jour., v. 2: 1080-1087, June 1964.

An experimental study has been conducted of nonequilibrium conductivity of mixtures of argon and potassium. A pure plasma is produced in thermal equilibrium at temperatures up to 2500°K by means of a steady-flow tantalum heat exchanger. Conductivity measurements made with probes between the electrodes indicate that the two-temperature conduction law proposed is valid for electron concentrations above about $10^{13}/cm^3$. At lower electron concentrations, the theory is in error, probably because the electron energy distribution is very non-Maxwellian. (Contractor's abstract, modified)

1447

Massachusetts Inst. of Tech., Cambridge.

NONEQUILIBRIUM IONIZATION DUE TO ELECTRON HEATING: I. THEORY, by J. L. Kerrebrock. [1964] [9]p. (AFOSR-64-2017) (AF AFOSR-62-308) AD 451198 Unclassified

Also published in AIAA Jour., v. 2: 1072-1080, June 1964.

A two-temperature conduction law is proposed which accounts for the variation of the electrical conductivity of a plasma due to joule heating of the electrons. The process of relaxation from an initial condition of thermal equilibrium to the final nonequilibrium condition is treated for a channel flow that represents conditions in an MHD generator. For a mixture of argon and potassium at 1 atm pressure and 2000°K, the relaxation length is about 1 m at a Mach number of unity if the electric field is held constant. The stability of the two-temperature plasma to wavelike disturbances of electron energy and concentration is treated by the classical perturbation technique.

1448

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

RESEARCH ON AEROTHERMOELASTICITY, by J. Dugundji. Final summary rept. June 15, 1963, 12p. incl. refs. (AFOSR-5148) (AF 49(638)219) AD 411292 Unclassified

The general effects of aerodynamic heating on the aeroelastic properties of flight vehicles are investigated. Attention was directed toward coupling mechanisms between aeroelastic and heating effects. Six specific projects were investigated: (1) thermal stress effects in aeroelastic models, (2) vibration and flutter of conical and cylindrical shells, (3) aeroelastic properties of heated, low aspect ratio wings, (4) subsonic flutter of panels on continuous elastic foundations, (5) flutter of orthotropic plates, and (6) local dynamic effects attendant to leading edge melting and ablation.

1449

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

SUPERSONIC FLUTTER OF RECTANGULAR ORTHOTROPIC PANELS WITH ARBITRARY ORIENTATION OF ORTHOTROPICITY, by J. M. Calligeros and J. Dugundji. June 1963, 78p. incl. diagrs. refs. (ASRL technical rept. 74-5) (AFOSR-5328) (AF 49(638)219) AD 421977 Unclassified

An investigation is made of the supersonic flutter of flat, simply supported, rectangular, orthotropic panels, utilizing small deflection thin plate theory and piston theory aerodynamics. Stability boundaries are obtained showing the effects of rotating the panel principal axes with respect to the geometric axes. The role of damping and the effects of panel length-width ratio are also examined. Solutions are obtained using the Principle of Minimum Potential Energy together with a sixteen-mode Rayleigh-Ritz procedure. It is concluded that aligning stiffeners parallel to the air stream direction is not always the preferred orientation. (Contractor's abstract, modified)

1450

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

PLASTIC DEFORMATION AND FAILURE OF SILVER-STEEL FILAMENTARY COMPOSITE MATERIALS, by H. R. Piehler. Nov. 1963, 18p. (ASRL-TR-94-5) (AF 49(638)775) AD 426348 Unclassified

Continuous 7 and 19 filament close-packed silver-steel filamentary composite materials were tested in tension. The early stages of the composite plastic stress strain curves followed a linear mixture rule constructed from the properties of the individual components. The composite elongations at failure, however, were about twice the elongations observed when the filaments were tested alone. The composite ultimate tensile strengths were also above a mixture rule constructed from the ultimate tensile stress of the filaments and the flow stress of the matrix at a strain equal to the elongation at failure of the filaments.

1451

Massachusetts Inst. of Tech. Aeroelastic and Structures Research Lab., Cambridge.

NOTES ON BASIC RESEARCH ON STATIC AND

DYNAMIC NONLINEAR STRUCTURAL PROBLEMS, by T. H. H. Pian, P. T. Hsu and others. Aug. 1963, 28p. (ASRL-TR-109-1) (AFOSR-J1223) (AF AFOSR-62-239) AD 424286 Unclassified

Static and dynamic, nonlinear, large-deflection structural problems have been studied. Both geometrical nonlinearities, due to finite deformations of the structure, and physical nonlinearities due to plasticity, are included in this investigation. The work is presented as 3 separate notes with the following titles: (1) Plane stress yield condition for oblique coordinate systems; (2) Instability of circular rings confined to a rigid boundary; and (3) Numerical solutions for large deflections and rotations of thin elastic-plastic spherical shells and rings.

1452

Massachusetts Inst. of Tech. [Aeroelastic and Structures Research Lab.] Cambridge.

NOTE ON THE INSTABILITY OF CIRCULAR RINGS CONFINED TO A RIGID BOUNDARY, by P. T. Hsu, J. Elkon, and T. H. H. Pian. [1964] [4]p. incl. diagrs. (AFOSR-64-2238) (AF AFOSR-62-239) AD 452406 Unclassified

Also published in Jour. Appl. Mech., Sept. 1964, p. 559-562.

The present problem is concerned with the buckling of a thin ring which is confined to a rigid circular boundary and is subjected to an end-compressive load. The purpose is to extend the study to include the effect of an initial boundary imperfection.

1453

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

RESEARCH ON HEAT TRANSFER CHARACTERISTICS OF DIFFUSION BOUNDARY LAYERS. Final rept. May 1963, 14p. incl. refs. (AFOSR-5142) (AF 49-(638)245) AD 411463 Unclassified

Studies are made on heat transfer characteristics of diffusion boundary layers. Analyses of laminar and turbulent layers undergoing injection at the boundary were studied for the purpose of understanding the effects of compressibility, pressure gradient, mixture properties, and stability. Experimental investigations were conducted to evaluate recovery temperature and heat transfer rates, decay effects downstream of injection regions, ablation, geometries, etc. Methods have been developed for so called nonsimilarity cases and numerical results have been obtained for those with similarity.

1454

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

AN EXPERIMENTAL STUDY OF THERMAL DIFFUSION EFFECTS ON A PARTIALLY POROUS MASS TRANSFER-COOLED HEMISPHERE, by A. F. Gollnick, Jr. [1964] [10]p. incl. illus. diagrs. refs. (AFOSR-64-2233) (AF 49(638)245) AD 452345 Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 7: 699-708, 1964.

A hemispherical model having a porous nose cap of 40° included angle was tested at Mach 3.07. Helium and freon-13 were injected through the cap into the stagnation region, and the variations of adiabatic wall temperature and heat-transfer coefficient with injection rate were measured. Analytical solutions have been obtained for a laminar stagnation point boundary layer and similar free stream conditions. The analysis differs from earlier work in that the effects of thermal diffusion are included. It is predicted that this thermodynamic coupling may lead to stagnation point recovery temperatures considerably different from the zero injection value. (Contractor's abstract, modified)

1455

Massachusetts Inst. of Tech. Aerophysics Lab., Cambridge.

HIGH SPEED VISCOUS AND REACTING FLOWS. Final rept. Apr. 1963-July 1964, 1v. (Rept. no. AL-TR-98; DSR-9195) (AFOSR-64-1616) (AF AFOSR-62-407) AD 605725 Unclassified

The objective of these investigations was to consider several aspects of viscous and large temperature flow fields. Overall topic groups are as follows: (1) the mechanics of fluid injection for thermal protection; (2) the role of thermal diffusion in boundary layer mixtures; (3) the evaluation of thermal diffusion coefficients for turbulent conditions; and (4) the solution of radiation coupled flows.

1456

Massachusetts Inst. of Tech. Center for International Studies, Cambridge.

RADIO BROADCASTING IN COMMUNIST CHINA, by A. P. L. Liu. June 1, 1964, 71p. incl. illus. diagrs. tables, refs. (Rept. no. C/64-8) (AFOSR-67-0953) (AF 49(638)1237) Unclassified

This monograph deals with the rapid growth of a nationwide radio network in Communist China. It follows the two major phases of development closely. The first phase (1949-1955) was the development of a radio monitoring system when radio news was transmitted to the public largely through trained monitors. The second phase (1956-1963) was the development of a wired radio network when loudspeakers were set up in villages all over the country. The development of radio technology

is described, including training of personnel, control of equipment, content of broadcasting, and general listening habits. It is found that because of high illiteracy rates among the people and the controlled nature of broadcasting, the regime uses organized listening extensively with all the functional and dysfunctional consequences thereof.

1457

Massachusetts Inst. of Tech. Center for International Studies, Cambridge.

A GENERAL STUDY OF THE CHANNELS OF COMMUNICATION BETWEEN COMMUNIST CHINA AND THE WESTERN WORLD, by V. V. S. King. May 1, 196[illegible], 94p. incl. tables, refs. (Rept. no. C/64-9) (AFOSR-67-0954) (AF 49(638)1237) Unclassified

This paper is a general survey of all major media about foreign countries existing in Communist China. It first describes the regular mass media (press, periodicals, and radios) and analyzes the content with emphasis on foreign news. Then a special case study is done-the Cuban Missile Crisis-to see how major Chinese newspapers handled the event. It also describes the special agencies in China dealing with foreign trade and cultural exchanges. Statistical information is presented about Chinese delegations sent abroad and foreign delegations coming to China from 1959 to 1964, number of foreign exhibits in Chin from 1958 to 1962, and the number of foreign films shown in China. It is concluded that people in Communist China have a variety of sources of information about the outside world despite official control of information.

1458

Massachusetts Inst. of Tech. Center for International Studies, Cambridge.

SOVIET SOCIOLOGY: 1960-1963, by E. A. Weinberg. Oct. 1964, 110p. incl. tables, refs. (Rept. no. C/64-30) (AFOSR-67-0958) (AF 49(638)1237) Unclassified

As Soviet sociology matures as a discipline, it becomes more receptive to Western scholarship, making increasing use of Western techniques and adapting them to Soviet research theory. According to Soviet scholars in the field, the main problem is a lack of coordination of research and poor communication among the various scholars and institutes engaged in research of a sociological nature. Lack of publishing facilities and inhibitions against experimentation also constitute difficulties, and remedies are suggested for their resolution. An evaluation is given of the state of Soviet sociology. It especially points to the lack of objectivity resulting from political considerations which precludes free choice and open dissent.

1459

Massachusetts Inst. of Tech. Computation Center, Cambridge.

ON THE STABILITY OF RATIONAL APPROXIMATION, by A. A. Goldstein. [1963] [8]p. incl. refs. (AFOSR-64-0718) (AF AFOSR-62-348) AD 436471 Unclassified

Also published in Numerische Math., v. 5: 431-438, 1963.

Let B denote a bounded map from ω to E_n and let $F(x) = \sup \{|[A(\Phi), x]/[B(\Phi), x]) - b(\Phi)|: \Phi \in \omega$ and $[B(\Phi), x] > 0\}$. Let $D_1 = \{x \in E_n: [B(\Phi), x] > 0$ all $\Phi \in \omega\}$. Again in this setting it is known that F does not necessarily achieve a minimum on D_1. The idea of the present paper is to enlarge the domain D_1 to D as follows. Add those points to D_1 where numerator and denominator vanish simultaneously for some $\Phi \in \omega$. Then under mild hypotheses, algebraic in nature, F achieves a minimum on D at, say, y. As an application of this result the theorem of Achieser is deduced.

1460

Massachusetts Inst. of Tech. [Computation Center] Cambridge.

FUEL OPTIMIZATION IN ORBITAL RENDEZVOUS, by A. A. Goldstein, A. H. Greene, and A. T. Johnson. [1964] [22]p. incl. diagrs. refs. (AFOSR-64-1817) (AF AFOSR-62-348) AD 449070 Unclassified

Presented at AIAA Guidance and Control Conf., Cambridge, Mass., Aug. 12-14, 1963.

Also published in Guidance and Control, ed. by R. C. Langford and C. J. Mundo. New York, Academic Press, v. 2: 823-844, 1964.

This paper reports results of numerical investigations of certain thrust functions and the fuel expenditure they induce in the terminal phase of orbital rendezvous. Several criteria of optimality have been considered, and corresponding computer programs for each of these have been developed to calculate optimal controls. Numerical examples of controls thought to be optimal or nearly so, are exhibited. (Contractor's abstract)

1461

[Massachusetts Inst. of Tech. Computation Center, Cambridge]

CONVEX PROGRAMMING IN HILBERT SPACE, by A. A. Goldstein. [1964] [2]p. (AFOSR-64-2424) (AF AFOSR-62-348) AD 453531 Unclassified

Also published in Bull. Amer. Math. Soc., v. 70: 709-710, Sept. 1964.

This note gives a construction for minimizing certain

twice-differentiable functions on a closed convex subset C, of a Hilbert Space, H. The algorithm assumes one can constructively "project" points onto convex sets. In certain instances, say on spheres, linear varieties, and orthants, the method can be effective for applications to control theory.

1462

Massachusetts Inst. of Tech. Computation Center, Cambridge.

DUALITY THEOREMS FOR CONVEX FUNCTIONS, by R. T. Rockafellar. [1964] [4]p. (AFOSR-64-2552) (AF AFOSR-62-348) AD 454021 Unclassified

Also published in Bull. Amer. Math. Soc., v. 70: 189-192, Jan. 1964.

The purpose of this note is to announce the following general fact: Let F and G be finite-dimensional partially-ordered real vector spaces in which the non-negative cones P(F) and P(G) are polyhedral. Let A be a linear transformation from F to G. Let f be a proper convex function on F and let g be a proper concave function on G. If there exists at least one $x \in ri$ (dom f) such that $x \geq 0$ and $Ax \geq y$ for some $y \in ri$ (dom g), then

$$\inf \{f(x) - g(y) \mid x \geq 0,\ Ax \geq y\} = \max \{g^*(y^*) - f^*(x^*) \mid y^* \geq 0,\ A^*y^* \leq x^*\},$$

where A^* is the adjoint of A.

1463

Massachusetts Inst. of Tech. [Computation Center] Cambridge.

BEST APPROXIMATION WITH RESPECT TO NEARBY NORMS, by B. R. Kripke. [1964] [3]p. (AFOSR-65-0324) (AF AFOSR-62-348) AD 612222 Unclassified

Also published in Numerische Math., v. 6: 103-105, 1964.

The following theorem is established. Let V be a vector space of finite dimension, W a subspace of V, $f \in V$. Let ρ_k, $k = 1, 2, \ldots$, be seminorms on V such that for each $v \in V$, $\lim_{k \to \infty} \rho_k(v) = \rho(v)$, where ρ is a norm. Let $\rho_k \in W$ be the best ρ_k-best approximation to f. Then (1) every subsequence of $\{\rho_k\}$ has a ρ-convergent subsequence; (2) $\rho(f - \rho_k) \to \inf \{\rho(f - w) \mid w \in W\}$; (3) every ρ-cluster point of $\{\rho_k\}$ is a ρ-best approximation to f; and (4) if f has a unique ρ-best approximation ρ out of W, then $\rho(\rho - \rho_k) \to 0$.

1464

[Massachusetts Inst. of Tech. Computation Center, Cambridge]

A NECESSARY CONDITION FOR THE EXISTENCE OF BEST APPROXIMATIONS, by B. R. Kripke and R. T. Rockafellar. [1964] [2]p. (AFOSR-65-1005) (AF AFOSR-62-348) AD 618620 Unclassified

Also published in Jour. Math. and Mech., v. 13: 1037-1038, Nov. 1964.

This note proves the following theorem: Let B be a Banach space and X a bounded subset of B. In order that for each bounded real-valued function F on X there exist a continuous linear functional $\phi \in B^*$ such that $\Delta(\phi) = \sup \{|F(x) - \phi(x)| : x \in X\} = \inf \{\Delta(\psi) : \psi \in B^*\}$, it is necessary that 0 be in the interior of the closed, balanced, convex hull K of X relative to its linear span [K]. It was formerly proved that this condition is also sufficient to insure the existence of best approximations even when X is not bound. This paper shows that when the condition fails, there is a linear function F on [K] such that the restriction of F to X is continuous, and F can be uniformly approximated on X within any desired degree of accuracy by functionals in B^*, but the restriction of F to X is not equal to the restriction to X of any function.

1465

Massachusetts Inst. of Tech. [Computation Center] Cambridge.

NUMERICAL SOLUTION OF MULTI-GROUP EQUATIONS, by K. F. Hansen and D. R. Edwards. [1963] [2]p. (AFOSR-64-2129) (AF AFOSR-63-341) AD 452028 Unclassified

Also published in Trans. Amer. Nuclear Soc., June 1963, p. 10-11.

This paper presents a new method for numerically solving the multi-group equations. The method was first presented in connection with the Helmholtz equation. The current report represents a generalization and extension of the original work.

1466

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

THE FLUTTER OF MULTI-BAY PANELS AT HIGH SUPERSONIC SPEEDS, by E. Dowell. Aug. 1963, 110p. incl. diagrs. refs. (ASRL-TR-112-1) (AFOSR-5327) (AF AFOSR-62-363) AD 423929 Unclassified

Presented at AIAA Aerospace Sciences Meeting, New York, Jan. 20-22, 1964.

Also published in AIAA Jour., v. 2: 1805-1814, Oct. 1964. (AFOSR-64-2474; AD 609812)

The flutter of 2-dimensional panels of finite and infinite length on multiple simple supports in the streamwise direction was investigated theoretically under the assumptions that the system is adequately described by classical small deflection plate theory and

quasi-steady, supersonic aerodynamic theory. No further physical and/or mathematical approximations are made and a solution is effected by the method employed by Hedgepeth, Houbolt, and Movchan for the one bay (2 supports) configuration. (Contractor's abstract, modified)

1467

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

THE FLUTTER OF VERY LOW ASPECT RATIO PANELS, by E. H. Dowell. July 1964, 93p. incl. diagrs. refs. (ASRL-TR-112-2) (AFOSR-64-1723) (AF AFOSR-62-363) AD 608702 Unclassified

The aeroelastic stability of an infinitely long panel of finite width with the upper surface exposed to an inviscid flow is examined. The panel behavior is accounted for by small deflection plate theory while the aerodynamic forces acting on the panel are described by the classical linearized, potential theory. The panel is assumed to be simply-supported along the side edges, although other edge conditions may be considered in a similar manner. It is shown that the critical wavelength is approximately twice the panel width and thus the present results should be valid approximations for a panel of finite length whose length is much greater than its width. Rather extensive numerical results were obtained for flutter velocity.

1468

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

MOLECULAR BEAM-SURFACE INTERACTIONS. Final rept. 1964, 18p. (AFOSR-64-1661) (AF AFOSR-63-131) AD 606078 Unclassified

The purpose of the work was to study the detailed behavior of gas molecules at a solid boundary in order to gain understanding of gas-solid collision phenomena. Experimentally, the scheme involves analysis of the velocity distribution of a beam of molecules incident on a solid surface and analysis of velocity and spatial distribution of the molecules after surface collision. The experimental work has thus far been directed towards the development of: (1) a molecular velocity spectrometer, (2) a vacuum apparatus, and (3) a signal detection and discrimination system. The report includes primarily a description of these components.

1469

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

EXPERIMENTS ON CYLINDER DRAG, SPHERE DRAG, AND STABILITY IN RECTILINEAR COUETTE FLOW, by D. L. Kohlman. Mar. 1963, 145p. incl. illus. diagrs. tables, refs. (Fluid Dynamics Research Lab. rept. no. 63-1) (AFOSR-4717) (AF AFOSR-62-187 and AF AFOSR-63-156) AD 400562 Unclassified

The purpose of this study was to develop an apparatus for investigation of phenomena in rectilinear Couette flow, and to conduct experiments in several such areas. It was divided into 4 main parts: (1) Design and development of the shear flow tank and related experimental apparatus; (2) Study of circular cylinder drag in Couette flow at low Reynolds number; (3) Study of sphere drag in Couette flow at low Reynolds number; and (4) Study of instability of rectilinear Couette flow. (Contractor's abstract, modified)

1470

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

PARAMETRIC AMPLIFICATION OF SURFACE AND INTERNAL WAVES, by R. E. Kelly. Final scientific rept. June 1964, 113p. incl. illus. diagrs. refs. (Fluid Dynamics Research Lab. rept. no. 64-3) (AFOSR-64-1662) (AF AFOSR-63-156) AD 605728 Unclassified

The report concerns the possible signification of waves in fluids due to fluctuations with time of some parameter which defines in part the natural frequencies of the system. First, the fluid is taken to be within a container which oscillates in the vertical direction so that the gravitational acceleration, relative to the container, varies with time. Both surface waves, in the case of an interface, and internal waves, in the case of continuous variation of density, are considered. Secondly, two fluids of different densities are taken to flow parallel to each other in an oscillatory manner and with different mean values of velocity. (Contractor's abstract, modified)

1471

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

STUDIES ON THE INSTABILITY OF CIRCULAR RINGS, by Y. Elkon. June 1964, 52p. incl. diagrs. (ASRL-TR-119-1) (AFOSR-64-1843) (AF AFOSR-63-347) AD 609503 Unclassified

The critical loads associated with the instability phenomenon of elastic-perfectly plastic circular rings, which are confined to a rigid boundary and subjected to end circumferential compressive loads, are determined. Finite-deflection nonlinear theory is employed and two types of imperfections are included in the model; (a) boundary imperfection; (b) an imperfection in the shape of the ring in its initially stress-free state. (Contractor's abstract, modified)

1472

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

DERIVATION OF ELEMENT STIFFNESS MATRICES

BY ASSUMED STRESS DISTRIBUTIONS, by T. H. H. Pian. [1964] [4]p. incl. diagr. (AFOSR-64-2242) (AF AFOSR-63-347) AD 452301 Unclassified

Also published in AIAA Jour., v. 2: 1333-1336, July 1964.

This paper presents an alternative derivation of the element stiffness matrices. In this method, instead of a required continuous displacement function over the element, it is necessary only to write down the boundary displacements that will guarantee a complete displacement compatibility. The derivation is based on the principle of minimum complementary energy. The present proposed method is apparently different from the variational methods suggested by Melosh and by Best.

1473

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

LARGE ELASTIC, PLASTIC, AND CREEP DEFLECTIONS OF CURVED BEAMS AND AXISYMMETRIC SHELLS, by J. A. Stricklin, P.-T. Hsu, and T. H. H. Pian. [1964] [8]p. incl. diagrs. refs. (AFOSR-64-2243) (AF AFOSR-63-347) AD 452302 Unclassified

Presented at AIAA Aerospace Sciences Meeting, New York, Jan. 20-22, 1964.

Also published in AIAA Jour., v. 2: 1613-1620, Sept. 1964.

A numerical method is presented for analyzing large deflections of curved beams and large axisymmetric deflections of shells of revolution. The governing equations that are in finite-difference form are solved by a Newton-Raphson iteration procedure. The plastic stress-strain relations are determined by assuming three independent slip planes that are the planes of maximum shear stresses. The stress-strain relation along each slip plane is assumed to be linearly strain hardening. This plasticity model gives piecewise linear plasticity relations with determinate coefficients. The method is applied to several problems including low arches, circular rings, shallow and deep spherical shells under elastic-plastic deformations, and a shallow arch under creep deformation. (Contractor's abstract, modified)

1474

Massachusetts Inst. of Tech. [Dept. of Aeronautics and Astronautics] Cambridge.

THE CALCULATION OF TWO- AND THREE-DIMENSIONAL INVISCID UNSTEADY FLOWS BY THE METHOD OF CHARACTERISTICS, by H. Sauerwein. Final scientific rept. June 1964, 190p. incl. diagrs. tables, refs. (Fluid Dynamics Research Lab. rept. no. 64-4) (AFOSR-64-1055) (AF AFOSR-64-156) AD 605324 Unclassified

The problem of the numerical solution by the method of characteristics of the 2- and 3-dimensional flow of an inviscid nonequilibrium gas is formulated. For unsteady flows, the method is limited to the solution of hypersonic or other flows which have short transient times. The specific details of the finite difference network and the associated finite difference equations are presented. It was found that numerical instability was possible with certain previously proposed networks. An existing stability criterion was found to apply to the multi-dimensional method of characteristics and the criterion was used to synthesize a stable finite difference network. High speed digital computer programs are presented which perform the numerical calculation. Four example cases of the flow about a circular cylinder with its axis perpendicular to a Mach five free stream are presented. (Contractor's abstract, modified)

1475

Massachusetts Inst. of Tech. [Dept. of Chemistry] Cambridge.

CONCERNING THE MECHANISM OF THE REACTION OF PHENYL(TRIHALOMETHYL)MERCURIALS WITH OLEFINS, by D. Seyferth and J. M. Burlitch. [1964] [2]p. (AFOSR-64-1802) (AF AFOSR-64-502) AD 449087 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2730-2731, July 5, 1964.

Studies of the stereochemistry of the haloformbutoxide-olefin reaction and of the relative reactivities of olefins toward this reagent system led to the conclusion that the reaction of a free, electrophilic dihalocarbene with the olefin was involved. Qualitative studies of relative reactivities of olefins toward sodium trichloroacetate in 1,2-dimethoxyethane suggested that there was also a reaction between a free carbene and an olefin taking place.

1476

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

NON-RADIAL OSCILLATIONS AND CONVECTIVE INSTABILITY OF GASEOUS MASSES, by S. Chandrasekhar and N. R. Lebovitz. [1963] [15]p. incl. table, refs. (AFOSR-4609) (AF 49(638)42) AD 611734 Unclassified

Also published in Astrophys. Jour., v. 138: 185-199, July 1, 1963.

Modes of non-radial oscillation of gaseous masses belonging to spherical harmonics of orders l = 1 and 3 are considered on the basis of the first- and the third-order virial equations. For an assumed Lagrangian displacement the theory predicts the occurrence of modes of oscillation of 2 different types: modes (belonging to l = 3) which are analogous to the Kelvin modes of an incompressible sphere and modes (belonging to l - 1) which are analogous to those discovered by Pekeris for a homogeneous compressible sphere and which exhibit its convective instability. The theory is applied to the

polytropic gas spheres, and it is shown that they are convectively unstable.(for the modes belonging to l = 1) if the ratio of the specific heats γ is less than a certain critical value. The extent of this agreement is a measure of the accuracy of the method based on the virial equations and the assumed form of the Lagrangian displacement. (Contractor's abstract, modified)

1477

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

THE EQUILIBRIUM AND THE STABILITY OF THE JEANS SPHEROIDS, by S. Chandrasekhar and N. R. Lebovitz. [1963] [13]p. incl. diagrs. tables, refs. (AFOSR-4610) (AF 49(638)42) AD 611735 Unclassified

Also published in Astrophys. Jour., v. 137: 1172-1184, May 15, 1963.

The equilibrium and the stability of homogeneous masses distorted by the tidal effects of a secondary (of mass M′ at a distance R) are re-examined on the basis of the second-order virial equations. In agreement with known results, it is shown that, under circumstances when the figure of equilibrium is a prolate spheroid, there is a maximum value of μ (= GM'/R^3) which is compatible with equilibrium. The problem of the small oscillations of these Jeans spheroids is next considered. The characteristic frequencies of oscillation belonging to the second harmonics are determined both in case the mass is considered incompressible and in case it is considered compressible and subject to the gas laws governing adiabatic changes. (Contractor's abstract)

1478

Massachusetts Inst. of Tech. [Dept. of Mathematics, Cambridge.]

ON THE OSCILLATIONS OF THE MACLAURIN SPHEROID BELONGING TO THE THIRD HARMONICS, by S. Chandrasekhar and N. R. Lebovitz. [1963] [10]p. incl. diagrs. tables. (AFOSR-4611) (AF 49(638)42) AD 614155 Unclassified

Also published in Astrophys. Jour., v. 137: 1162-1171, May 15, 1963.

The characteristic frequencies of oscillation of the Maclaurin spheroid belonging to the third harmonics are found. Two further points of neutral stability, beyond the first at eccentricity e = 0.81267, are isolated. They occur at e = 0.89926 and e = 0.96937; it is the second of these that is the analogue of the point of bifurcation along the Jacobian sequence. (Contractor's abstract)

1479

Massachusetts Inst. of Tech. [Dept. of Mathematics, Cambridge]

ON THE STABILITY OF THE JACOBI ELLIPSOIDS, by S. Chandrasekhar and N. R. Lebovitz. [1963] [20]p. incl. diagrs. tables. (AFOSR-4612) (AF 49(638)42) AD 614156 Unclassified

Also published in Astrophys. Jour., v. 137: 1142-1161, May 15, 1963.

The problem of the small oscillations of the Jacobi ellipsoids is solved, and all the characteristic frequencies belonging to the second and the third harmonics are found. In particular, the variation, along the Jacobian sequence, of the characteristic frequency with respect to which the Jacobi ellipsoid becomes unstable is exhibited. (Contractor's abstract)

1480

[Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge]

A CLASSIFICATION THEOREM FOR FIBRE SPACES, by J. Stasheff. [1963] [8]p. incl. diagrs. (AFOSR-65-0078) (AF 49(638)42) AD 455619 Unclassified

Also published in Topology, v. 2: 239-246, 1963.

Let [X, Y] denote the set of homotopy classes of maps of X into Y, and LF(X) denote the set of fiber homotopy equivalence classes of Hurewicz fibrings p: E → X with fibers of the homotopy type of F. The following classification theorem is proved: If F is a finite CW-complex, there is a space B_H such that [, B_H] and LF( ) are naturally equivalent as functors from the category of CW-complexes and homotopy classes of maps to the category of sets and functions.

1481

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

SECTIONAL CURVATURES AND CHARACTERISTICS CLASSES, by J. A. Thorpe. [1964] [15]p. (AFOSR-65-0345) (AF 49(638)42) AD 612236 Unclassified

Also published in Ann. Math., v. 80: 429-443, Nov. 1964.

The relationship between the curvature properties of a Riemannian manifold X and the global topological and differential invariants of X is considered. The concept of pth sectional curvature is defined and examples presented.

1482

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

A STRING PROBLEM, by H. P. Greenspan. [1963] [10]p. (AFOSR-J1020) (AF 49(638)708) AD 419708 Unclassified

Also published tn Jour. Math. Anal. and Appl., v. 6: 339-348, June 1963.

The forced oscillatory motion of a string of variable length ts considered. The prtmary aim is to examine the response of this simple system to an excitation which would produce resonance under slightly different conditions (e.g., for a string of definite fixed length). Interest in this problem derives from the fact that it may be related to more complicated phenomena occurring tn hydrodynamic stability theory.

1483

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

RESEARCH IN FLUID DYNAMICS, by H. P. Greenspan. Final rept. Sept. 16, 1960-Sept. 15, 1963, 3p. incl. refs. (AFOSR-J1350) (AF 49(638)708) AD 6[illegible]9207 Unclassified

Research was conducted in the areas of wave propagation and shock dynamics, magnetohydrodynamics, hydrodynamic stability, oceanic circulation, and dynamics of rotating fluids. Publications resulting from this research are listed.

1484

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

A NOTE CONCERNING TOPOGRAPHY AND INERTIAL CURRENTS, by H. P. Greenspan. [1963] [8]p. incl. diagr. (AFOSR-64-0713) (AF 49(638)708) AD 436512 Unclassified

Also published in Jour. Marine Research, v. 21: 147-154, Sept. 15, 1963.

A simple steady dynamical model of inertial currents incorporating the effects of bottom topography is studied. The results of this analysis and those of preceding investigations indicate that topography may exert considerable influence on the structure of the Gulf Stream, on its separation point from the coastline, and on iis subsequent meander pattern. (Contractor's abstract)

1485

Massachusetts Inst. of Tech. Dept. of Mathematics, Cambridge.

ON A TIME-DEPENDENT MOTION OF A ROTATING FLUID, by H. P. Greenspan and L. N. Howard. [1963] [20]p. incl. diagrs. table. (AFOSR-64-0728) (AF 49-(638)708) AD 437326; AD 439720 Unclassified

Also published in Jour. Fluid Mech., v. 17: 385-404, 1963.

The manner is considered in which the state of rigid rotation of a contained viscous fluid is estabitshed. It ts found that the motion consists of 3 distinct phases, namely, the development of the Ekman layer, the inviscid fluid spin-up, and the viscous decay of residual oscillations. Boundary-layer theory is used to study the phenomenon in the case of general axially symmetric container configuration and explicit formulas are deduced which exhibit the effect of geometry in sptn-up. The special case of cylindrical side walls is also investigated by this method. The results of very simple experiments confirm the theoretical predictions. (Contractor's abstract, modified)

1486

Massachusetts Inst. of Tech. [Dept. of Mathematics] Cambridge.

EXPLICIT FORMAL CONSTRUCTION OF NONLINEAR QUANTUM FIELDS, by I. E. Segal. [1964] [14]p. incl. refs. (AFOSR-64-2511) (AF AFOSR-63-342) AD 454018 Unclassified

Also published tn Jour. Math. Phys., v. 5: 269-282, Feb. 1964.

It is shown that there can be associated with any given nonlinear relativistic partial differential equation an operator field satisfying the canonical commutation relations, transforming appropriately under the action of the Lorentz group, and propagated in accordance with the given differential equation. This quantization procedure is unique, apart from the scale of the commutators. The treatment is intuitive, but is capable of rigorization in terms of the mathematical theory of analysis in function space (functional integration). (Contractor's abstract, modified)

1487

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

PERTURBATION TECHNIQUES FOR RANDOM VIBRATION OF NONLINEAR SYSTEMS, by S. H. Crandall. [1963] [6]p. (AFOSR-64-0118) (AF 49(638)564) AD 430670; AD 434631 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1700 1700-1705, Nov. 1963.

The random response of vibratory systems that are only slightly nonlinear may be conveniently obtained by applying the classical perturbation method. The present paper describes and illustrates the procedure. Oscillators with nonlinearity in the stiffness elements are treated first because more-complete results can be obtained when the damping remains linear. Then, systems

with more-general nonlinearities are examined. The techniques are illustrated by applications to simple one- and two-degree-of-freedom, nonlinear, vibratory systems.

1488

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

ZERO CROSSINGS, PEAKS AND OTHER STATISTICAL MEASURES OF RANDOM RESPONSES, by S. H. Crandall. [1963] [7]p. (AFOSR-64-0164) (AF 49(638)-564) AD 432558; AD 434632 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1693-1699, Nov. 1963.

Several statistical properties of a stationary random process that are of interest in random vibration applications are reviewed. In the first three sections, the zero crossings, threshold crossings, distribution of peaks, and a simple model of fatigue damage are obtained directly from calculations. In the fourth and fifth sections, it is alternatively assumed that x(t) is the response of a particular nonlinear oscillator to random excitation. It is shown that certain statistical results can be obtained by utilizing the oscillator properties.

1489

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

LAMINAR BOUNDARY - LAYER WEDGE FLOWS WITH EVAPORATION AND COMBUSTION, by T.-N. Chen and T.-T. Toong. [1964] [22]p. incl. diagrs. refs. (AFOSR-64-0148) (AF 49(638)629) Unclassified

Presented at AIAA Heterogeneous Combustion Conf., Palm Beach, Fla., Dec. 11-13, 1963.

Also published in Prog. Astronaut. and Aeronaut., v. 15: 643-664, 1964.

A steady, laminar, boundary-layer flow of an oxidizer over a 2-dimensional wedge (covered with fuel) involving evaporation (or sublimation) and combustion is studied for the case where chemical reaction is assumed to occur in an infinitesimally thin flame. Results presented include the effects of the Prandtl number, wedge parameter, and heat ratio on the profiles of the velocity, temperature, and composition in the boundary layer, the boundary-layer and displacement thickness, the flame position, the skin friction, and the rates of evaporation and combustion. Also included is a comparison of the boundary-layer characteristics with and without combustion. (Contractor's abstract, modified)

1490

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

THE SPECTRUM OF RANDOM VIBRATION OF A NONLINEAR OSCILLATOR, by S. H. Crandall. June 1964 [25]p. incl. refs. (AFOSR-64-1057) (AF 49(638)-1314) AD 604047 Unclassified

Presented at Eleventh Internat'l. Cong. of Applied Mechanics, Munich (Germany), Aug. 30-Sept. 5, 1964.

When a linear vibratory system is excited by a stationary random process, the most useful statistical description of the response is given by either the autocorrelation function or the spectral density. The exact calculation of these statistics for a nonlinear oscillator remains an unsolved problem although a general approach has been outlined. This paper describes three approximate procedures which apply to systems which are only slightly nonlinear. The procedures are perturbation, equivalent linearization, and a new heuristic method based on simply averaging the deterministic properties of the nonlinear system. It is shown that for vibratory systems with small stiffness nonlinearities all three procedures give autocorrelations (and spectra) which are identical to first order in the nonlinearity parameter. (Contractor's abstract)

1491

Massachusetts Inst. of Tech. Dept. of Mechanical Engineering, Cambridge.

STAGNATION POINT HEATING IN IONIZED MONATOMIC GASES, by J. P. Reilly. June 1963 [26]p. incl. diagrs. refs. (Publication no. 641) (AFOSR-5442) (AF AFOSR-62-329) AD 430031 Unclassified

This paper reports on measurements made of the heat transfer to the stagnation point of a cylinder in partially ionized monatomic gases, and assesses the effect of free electrons on the total gas thermal conductivity. Comparison of the experimental data is made with 2 real-gas estimates, the first including the effects of ionization only on the thermodynamic properties involved, and a second including the effects of ionization on both the thermodynamic and transport properties. The experimental results are in substantial agreement with the latter prediction where equilibrium is attained, and confirms the prediction of an increased gas thermal conductivity due to the presence of free electrons. (Contractor's abstract, modified)

1492

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineering] Cambridge.

NONLINEAR VIBRATIONS: A COMPARATIVE STUDY WITH APPLICATIONS TO CENTRIFUGAL PENDULUM VIBRATION ABSORBERS, by D. E. Newland. Doctoral thesis, May 1963, 1v. (AFOSR-5224) (AF AFOSR-63-154) AD 415914 Unclassified

This thests is in 2 parts. Part 1 is a comparative study of methods for the analysts of nonltnear vibrations. It ts prtmarily concerned with forced vibrations, and ts restrtcted to lumped parameter systems (systems with a ftntte number of degrees-of-freedom). Part 2 ts the appltcation of the most suitable of these methods to problems occurrtng tn the destgn of centrifugal pendulum vibration absorbers.

1493

Massachusetts Inst. of Tech. [Dept. of Mechanical Engineertng] Cambrtdge.

[THE JUMP PHENOMENON OF THE ABSORBED VIBRATIONS OF A NONLINEAR CENTRIFUGAL PENDULUM WITH LARGE ANGLES OF DISPLACEMENT] Il fenomeno del salto non ltneare nel funzionamento degli assorbitori di vibrazioni a pendolo centrifugo ad angoli grandi, by J. P. Dan Hartog. [1964] [11]p. tncl. illus. diagrs. (AFOSR-65-0328) (AF AFOSR-63-154) AD 611956 Unclassified

Also publtshed tn Scuola tn Azione, No. 14: 30-40, 1963-1964.

The torsion vibrations in the alternating combustion engine are studied with the purpose of clarifying the regulatory action and behavior of a nonlinear centrifugal-pendulum-vibration absorber. The oscillation angle of the pendulum exceeded 80° as a result of the nonlinear oscillation. The bastc governtng equations are reduced to a nonltnear equation.

1494

Massachusetts Inst. of Tech. [Dept. of Mecnanical Engineertng] Cambrtdge.

APPROXIMATE ANALYTICAL SOLUTION OF SIMILARITY BOUNDARY LAYER EQUATIONS WITH VARIABLE FLUID PROPERTIES, by N. H. Kemp. Sept. 1964, 72p. (Fluid Mechanics Lab. publ. no. 64-6) (AFOSR-64-1934) (AF AFOSR-63-353) AD 606870 Unclassifted

An approximate method of the integral type ts developed for computing heat transfer and shear stress tn stmilartty boundary-layer problems of single flutds with variable fluid properties. It ts applied to flat-plate, stagnation-point, and shock-tube end-wall geometrtes. Simple analytical formulas are developed tnvolving tntegrals over the fluid properties. It ts shown that a simple relation exists between the heat transfer tn the stagnation-potnt and end-wall cases, enabltng bounds on the stagnation-potnt heat transfer rate to be found from calculations for the stmple end-wall geometry.

1495

Massachusetts Inst. of Tech. Dept. of Mechantcal Engineertng, Cambridge.

ENTRY HEAT TRANSFER AT SUPER-ORBITAL SPEEDS, by J. A. Fay. Aug. 1964 [31]p. tncl. diagrs. refs. (Fluid Mechantcs Lab. publ. no. 64-7) (AFOSR-64-1935) (AF AFOSR-63-353) AD 606869 Unclassified

In thts paper estimates are given of the expected relative magnttudes of modes of heat transfer at the stagnation point of a blunt body for flight velocities above 20 km/sec and for altitudes at whtch continuum flow exists, so that the princtpal mode of heat transfer may be determtned. With respect to the convective heat transfer, the detatled theories appltcable tn the velocity range of 10 to 20 km/sec are reviewed and the state of knowledge of the transport properties ts discussed. Radiation heating due to continuum and ltne radiation ts estimated from existing calculations tn order to determtne the flight conditions for which the shock layer becomes opaque and body stze for whtch radiation exceeds the convectlve heating. The problem of shock wave formation and tonization relaxation ts also discussed. (Contractor's abstract, modified)

1496

Massachusetts Inst. of Tech. [Dept. of Phystcs] Cambrtdge.

THE CONCEPTUAL STRUCTURE OF PHYSICS, by L. Tisza. [1963] [35]p. (Technical rept. no. 409) (AFOSR-2577) (AF 49(638)95) AD 401297; AD 408476 Unclassified

Also publtshed tn Rev. Modern Phys., v. 35: 151-185, Jan. 1963.

This paper describes a new technique of logical analysts that is to brtng about a more harmontous relation between conceptual thinking and formal developments. However, this ts to be achieved withtn a program the scope of which ts much more modest and manageable than the one htnted at by Einstein. It ts proposed to sort out and tmprove the logical structure of the existtng empirtcally verified theortes. The establtshment of a new foundation ts the expected outcome rather than the prerequisite of this procedure.

1497

Massachusetts Inst. of Tech. Dept. of Physics, Cambrtdge.

THE STATISTICAL THERMODYNAMICS OF EQUILIBRIUM, by L. Tisza and P. M. Quay. Oct. 15, 1963 [43]p. incl. refs. (Technical rept. no. 414) (AFOSR-64-0268) (AF 49(638)95) AD 428952; AD 431084 Unclassifted

Also published tn Ann. Phys., v. 25: 48-90, Oct. 1963.

A stattstical thermodynamtcs ts developed tn terms of extensive variables (additive invartants) distrtbuted over a cellular division in space. In general, thts distribution is governed by randomness and correlations. The present theory, however, deals explttctly only with randomness, although correlations are tmpltctt tn the

so-called fixed variables of the system. Because of this restriction, the theory is valid only for the fluctuations of coupled systems that have reached their equilibrium. A set of postulates is advanced, the essence of which is the requirement that distribution functions (d.f.) exist for two basic coupling situations. (Contractor's abstract, modified)

1498

Massachusetts Inst. of Tech. [Electronics Systems Lab.] Cambridge.

[A SAMPLE DATA MODEL FOR EYE TRACKING MOTION] Ein Abtastmodell fur augenfolgebewegungen, by L. R. Young and L. Stark. [1963] [4]p. (AFOSR-64-0541) (AF 49(638)1130) AD 436164 Unclassified

Also published in Regelungstechnik, v. 4: 148-151, Jan. 1, 1963.

The biological control system which directs our eyes to an object of interest, and enables them to follow a moving target, was investigated from a servomechanisms point of view. Envidence from deterministic transient movements and the frequency response led to a sampled data model for the system, with a sampling period corresponding to the psychological refractory period of 0.2 second. In addition to describing normal tracking, the model predicts the observed changes in transient and frequency characteristics and the limits of stability as the effective visual feedback is varied.

1499

Massachusetts Inst. of Tech. Electronics Systems Lab., Cambridge.

VARIABLE FEEDBACK EXPERIMENTS TESTING A SAMPLED DATA MODEL FOR EYE TRACKING MOVEMENTS, by L. R. Young and L. Stark. [1963] [14]p. (AFOSR-64-0549) (AF 49(638)1130) AD 436156 Unclassified

Also published in IEEE Trans. Human Factors Electron., v. HFE-4: 38-51, Sept. 1963.

A sampled data model is presented to describe the action of the control system for directing human gaze at a moving target. The plausibility of the model is supported by its successful prediction of experimental tracking characteristics under variable effective visual feedback. The feedback is altered by addition of an external signal from measured eye position to target position, and its effects on the frequency and transient responses of the model and the experimental records are compared.

1500

Massachusetts Inst. of Tech. [Fluid Dynamics Research Group] Cambridge.

MAGNETOHYDRODYNAMIC SHOCK WAVES, by J. E. Anderson. 1963, 226p. (AFOSR-5317) (AF AFOSR-62-84) AD 425591 Unclassified

A study was made of the existence, uniqueness, and qualitative properties of steady-state magnetohydrodynamic shock waves and their stability with respect to breakup as a result of small-flow disturbances. As some knowledge of magnetohydrodynamic shock waves is assumed in the reader, the conservation (Rankine-Hugoniot) relations for these shock waves are discussed only in enough detail to provide background needed for the primary topic.

1501

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

[COHERENT LIGHT AND RADIO OPTICS] Final rept. Feb. 1962-June 1963, 7p. incl. refs. (AFOSR-J1342) (AF AFOSR-62-317) AD 428961 Unclassified

The research performed under this contract has dealt with the fluorescence and absorption of rare earth ionic and transition metal ionic solids of importance in optical masers and analyses of temporal, spatial and spectral properties in coherent emission from solids. Attempts have been made to use coherent light in new experiments in physics. These include the observations of nonlinear response in massive dielectrics, and on photo emissive surfaces with the object of detecting beat frequencies in the submillimeter spectral range.

1502

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

TEMPERATURE AND RISE-TIME DEPENDENCE OF THE ELECTRIC STRENGTH OF ALKALI HALIDE CRYSTALS, by F. W. Kaseta. Mar. 1963, 39p. incl. diagrs. tables, refs. (Technical rept. no. 177) (AFOSR-4689) (Nonr-184110) AD 403657 Unclassified

Techniques were developed to extend d-c and impulse breakdown measurements to liquid-helium temperature. The breakdown strength of KCl was measured from 4.2° to 425°K with d-c voltages and 1- and 10-μsec rise-time pulses. The breakdown strength was lower for d-c voltages than for pulses over the entire temperature range. Changing the pulse rise time from 1 to 10 μsec had little effect on electric strength. No thickness dependence was observed. The electric strength of a mixed crystal (75% KCl - 25% RbCl) was measured from 77° to 375°K. (Contractor's abstract, modified)

1503

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

PIEZOELECTRIC COUPLING BETWEEN ULTRASONIC WAVES AND FREE ELECTRONS IN CADMIUM

SULFIDE, by K. W. Nill. July 1963, 20p. incl. illus. diagrs. refs. (Technical rept. no. 181) (AFOSR-64-0629) (Nonr-184110) AD 414853 Unclassified

In some semiconductors, there is strong coupling between lattice waves and free electrons due to the piezoelectric effect. This coupling provides an energy-exchange mechanism from the electron system to the lattice system. This transfer is experimentally observed here as the amplification of an ultrasonic wave and as an acoustoelectric current resulting from the wave-electron drag. Experimental results are presented which support an acoustoelectric-effect explanation of a kink in the current-voltage characteristics of piezoelectric semiconductors. (Contractor's abstract)

1504

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

FREQUENCY AND TEMPERATURE RESPONSE OF THE POLARIZATION OF BARIUM TITANATE, by J. M. Ballantyne. Mar. 1964, 34p. incl. illus. diagrs. tables, refs. (Technical rept. no. 188) (AFOSR-64-0908) (Nonr-184110) Unclassified

The frequency and temperature response of the polarization of $BaTiO_3$ from 0 to 1000 cm^{-1} and between 24° and 200°C has been determined by transmission and reflectivity measurements. The infrared transmission of thin single-crystal $BaTiO_3$ has been recorded from 250 to 4000 cm^{-1}. The reflectivity of single-domain $BaTiO_3$ has been measured continuously from 10 to 4000 cm^{-1}, and at points of 0, 77, 5, and 10 cm^{-1}. Reflectivity analysis indicates that the dispersion of the polarization in stngle-domain $BaTiO_3$ from 1 to 1000 cm^{-1} consists of 3 resonances, at 12, 182, and 491 cm^{-1}. The 12-cm^{-1} resonance is responsible for the ferroelectric state and exhibits an unusual dispersion characteristic, being broad and possessing an extended high-frequency tail. The integrated intensity of the 12-cm^{-1} resonance is very large and above the Curie point decreases rapidly with increasing temperature. (Contractor's abstract, modified)

1505

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

FLUORESCENCE OF TRANSITION METAL IONS IN CRYSTALS, by B. Di Bartolo. June 1964, 67p. incl. illus. diagrs. tables, refs. (Technical rept. no. 190) (AFOSR-64-1368) (Nonr-184110) AD 603459 Unclassified

Experiments were made to evaluate the temperature dependence of linewidth, lineshift, and lifetime of the peaked fluorescence presented by Cr^{3+} and V^{2+} impurities in Al_2O_3 and MgO. The vibrontc spectrum associated with the $^2E \rightarrow {}^4A_2$ fluorescence transition at 8700A of V^{2+} in MgO has been tnvesttgated as a function of temperature. The fluorescence lifetime of the ^2E level, whtch is 50 msec and nearly temperature-independent at 77°K, decreases rapidly above 200°K to ~0.03 msec at 300°K. (Contractor's abstract, modified)

1506

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

BREAKDOWN STRENGTH OF ALKALI HALIDES AS FUNCTION OF TEMPERATURE AND DISLOCATION DENSITY, by R. Nevald. Oct. 1964, 22p. (Technical rept. no. 193) (Nonr-184110) AD 608827 Unclassified

The d-c breakdown strength of NaCl, RbBr, and KI single crystals was measured from 4.2° to 400°K. The characteristics consist of a slow rtse at low temperatures followed by a steep decrease tn the high-temperature region. The electric strength of NaCl crystals was measured as function of temperature for four different dislocation densities. For higl. dislocation densities, the rising section of the characteristic flattens, the falling section steepends, and the maximum shifts to lower temperatures. These trends conform with previous findings on the effect of addition agents and the transition from crystal to glass.

1507

Massachusetts Inst. of Tech. Lab. for Insulation Research, Cambridge.

ELECTRONIC BAND STRUCTURE OF TiC, TiN, AND TiO, by V. Ern and A. C. Switendick. Oct. 1964, 28p. (Technical rept. no. 192) (Nonr-184110) AD 608826 Unclassified

The band structure of metallic face-centered cubic TiC, TiN, and TiO has been obtained by the augmented plane wave (APW) method at the equivalent of 256 points in the Brillouin zone and for an energy range appropriate to cover the nonmetal 2s and 2p and the titanium 3d and 4s states. A density of states, the Fermi energy, and contours of constant energy were obtained for the 3 compounds. A charge distribution in the APW scheme was derived from the equivalent of 32 points tn the zone, and the admixture of the bands was analyzed. The results are conststent with the available experimental data.

1508

Massachusetts Inst. of Tech. [Lab. for Nuclear Science] Cambridge.

EXTENSIVE AIR SHOWERS AT 5200 METRES ABOVE SEA LEVEL AND SEARCH FOR HIGH ENERGY PRIMARY GAMMA RAYS, by G. Clark, I. Escobar and others. 1964, 60p. (AFOSR-64-1757) (AF 49(638)922) AD 442210 Unclassified

Also publtshed in Pontifictae Academia Scientiarum Scripta Varia, v. 25: 29-60, 1963.

Part I of the report describes the chief characteris'tcs

of EAS observed at 5200 m above sea level. The main results of this study are: (1) the observed showers having sizes in the range approximately 105 to 106 are near their maximum development; (2) the fluctuations in the number of muons in the observed showers is only one third of that observed at sea level; and (3) the lateral distribution of the observed showers, follows N.K.G. function with best 's' value slightly less than unity. Part II of the report mainly outlines the approach for the search for high energy primary gamma rays.

1509

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE GENERATION OF HIGH MAGNETIC FIELDS, by D. B. Montgomery. [1963] [36]p. incl. diagrs. tables, refs. (AFOSR-J1116) (AF 19(604)7344) AD 420517 Unclassified

Also published in Rept. Prog. Phys., v. 26: 69-104, 1963.

The generation of high magnetic fields by means of water-cooled magnets, iron magnets, pulsed magnets, cryogenic magnets and superconducting magnets is discussed. Relationships between currents, fields, power, magnetic stresses, cooling requirements and field homogeneity are presented in detail. Fabrication techniques, power supplies and specific magnet constructions are discussed. Reference is made to nearly 100 papers giving more detail on specific subjects. (Contractor's abstract)

1510

[Massachusetts Inst. of Tech. National Magnet Lab., Cambridge]

ELECTRONIC POLARIZABILITIES AND STERNHEIMER SHIELDING FACTORS, by R. E. Watson and A. J. Freeman. [1963] [6]p. (AFOSR-J1118) (AF 19(604)-7344) AD 421050 Unclassified

Also published in Phys. Rev., v. 131: 250-255, July 1, 1963.

A new method is developed for determining the distortions (polarizabilities) induced in electronic distributions by valence electrons and/or crystalline fields and their effect (expressed as Sternheimer shielding factors) on magnetic and electric hyperfine interactions. It is shown that the 'angular' excitations are gotten by relaxing the usual restriction that the spatial part of the one-electrons of the same shell but differing in magnetic quantum number have the same radial function yields the 'radial' excitations. Calculations are reported for several spherical ions (Cl and Cu) in an external field, but the scheme is also applicable to the problem of induced electric quadrupole (and magnetic dipole and higher multipole) distortions of an ion by its own aspherical charge distribution.

1511

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE NATIONAL MAGNET LABORATORY AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, by F. Bitter. [1963] [7]p. (AFOSR-J1595) (AF 19(604)-7344) AD 427635 Unclassified

Also published in Birt. Jour. Appl. Phys., v. 14: 759-765, Nov. 1963.

This paper reviews magnetic fields available in pulsed coils and continuous operation, using normal conductors. The new laboratory in operation at the Massachusetts Institute of Technology is described. This involves primarily four generators designed to produce 10,000A continuously, and current pulses up to 40,000A each for times diminishing to a few seconds, and at voltages of 200-250 v. The power and corresponding cooling water can be made available at 10 locations by remote control. The generators may be operated independently and simultaneously or in any series or parallel combination desired.

1512

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH-PRESSURE TRANSITIONS IN A(III)B(VI) COMPOUNDS: INDIUM TELLURIDE, by M. D. Banus, R. E. Hanneman and others. [1963] [2]p. (AFOSR-J1591) (AF 19(604)7344) AD 427628 Unclassified

Also published in Science, v. 142: 662-663, Nov. 8, 1963.

Metallic InTe(II) has a NaCl structure with AO = 6.154A and becomes superconducting below 3.5°K. These results are substantially different from those previously reported. The pressure temperature diagram to 850°C and 50 kb is presented.

1513

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ANTISHIELDING OF MAGNETIC AND ELECTRIC HYPERFINE INTERACTIONS IN OPEN SHELL IONS, by A. J. Freeman and R. E. Watson. [1963] [8]p. (AFOSR-64-0428) (AF 19(604)7344) AD 434317 Unclassified

Also published in Phys. Rev., v. 131: 2566-2573, Sept. 15, 1963.

Previously a method was presented for determining the contribution of closed atomic shells to magnetic and electric hyperfine interactions. This method is discussed and applied to the study of the antishielding of both magnetic dipole and electric quadrupole interactions associated with the aspherical valence electrons of atoms and ions. In addition to closed shell

antishielding, it is shown that there are repercussions within the open shell which are significant for hyperfine interactions. Results of specific computations for the free Fe^{2+} ion and the Cl atom are given, and comparisons are made with earlier perturbation theory results.

1514

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SEARCH FOR FERROMAGNETICALLY TRAPPED MAGNETIC MONOPOLES OF COSMIC-RAY ORIGIN, by E. Goto and H. Henry. [1963] [10]p. (AFOSR-64-0468) (AF 19(604)7344) AD 435657 Unclassified

Also published in Phys. Rev., v. 132: 387-396, Oct. 1, 1963.

Magnetic monopoles, if they exist, should be trapped and accumulated in ferromagnetic outcrop on the earth's surface and from fragments of a stony-iron meteorite. In the nuclear emulsions used for detection, no tracks were found satisfying our geometric criteria and having an energy-loss rate compatible with the theoretical expectation for monopoles. The area-time product of the magnetite cosmic-ray exposure is estimated to be about 10^{13} cm^2 sec. From the negative results, upper-limit monopole production cross sections in the atmosphere are estimated as a function of assumed monopole mass.

1515

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETIC-FIELD DEPENDENCE OF FREE-CARRIER ABSORPTION IN SEMICONDUCTORS, by J. K. Furdyna and M. E. Brodwin. [1963] [8]p. incl. diagrs. table, refs. (AFOSR-64-0469) (AF 19(604)-7344) AD 435655 Unclassified

Also published in Phys. Rev., v. 132: 97-104, Oct. 1, 1963.

A plane-wave semiclassical analysis of the amplitude of an electromagnetic wave transmitted through a semiconductor in the presence of a magnetic field is discussed and some theoretical predictions are compared with experimental measurements. The Faraday and the Voigt configurations, longitudinal and transverse, respectively, are specifically considered. The theoretical results, obtained formally in terms of the high frequency conductivity tensor, are applied to the isotropic, one-carrier semiconductor model. The general expression, covering all ranges of frequency and magnetic field within the extent of validity of the model, is derived and reduced to simple forms applicable to specific experimental situations. (Contractor's abstract, modified)

1516

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SHIELDING AND DISTORTION OF RARE-EARTH CRYSTAL FIELD SPECTRA, by R. W. Watson and A. J. Freeman. [1964] [14]p. (AFOSR-64-1253) (AF 19(604)7344) AD 442815 Unclassified

Also published in Phys. Rev., v. 133: A1571-A1584, Mar. 16, 1964.

The contributions of the closed atomic shells to electrostatic interaction are examined and are found to be significant in several respects: (1) the magnitude of the crystal-field splittings are reduced from the values obtained by considering just the 4F shell alone; and (2) the result that the ordering and relative spacing of the crystal-field levels are not necessarily those implied by the 4F crystal-field matrix elements alone. It is shown that in some cases the distortion of the ion's charge distribution produces severe deviations from the crystal-field level scheme predicted by VC directly. Also investigated is the role played by the crystal field in producing by means of the distortion of the closed and 4F shells, and the interaction of these distortions with the open 4F shell, contributions to the magnetic (and electric) hyperfine interactions.

1517

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SUPERCONDUCTING MAGNETS, by D. B. Montgomery. [1964] [11]p. incl. illus. diagrs. table, refs. (AFOSR-64-1738) (AF 19(604)7344) AD 448284 Unclassified

Also published in IEEE Spectrum, v. 1: 103-113, Feb. 1964.

The contents of this report are: Wire characteristics; Degradation effect; Solenoid design; Coil protection; Mechanical stresses; Dewar vessels; and Power supplies.

1518

Massachusetts Inst. of Tech. [National Magnet Lab.] Cambridge.

MAGNETIC TRANSLATION GROUP. II. IRREDUCIBLE REPRESENTATIONS, by J. Zak. [1964] [5]p. (AFOSR-64-1739) (AF 19(604)7844) AD 448282 Unclassified

Also published in Phys. Rev., v. 134: A1607-A1611, June 15, 1964.

The physical irreducible representations of the magnetic translation group (M. T. G.) defined previously have been found. From these a set of solutions of Schrodinger's equation for a Bloch electron in a magnetic field has been constructed. In general the M. T. G. is non-Abelian. However, when the magnetic flux through

areas enclosed by any vectors of the Bravais lattice become multiples of an elementary 'fluxon' hc/e, the M. T. G. becomes isomorphic to the usual translation group.

1519

Massachusetts Inst. of Tech. [National Magnetic Lab.] Cambridge.

MAGNETIC TRANSLATION GROUP, by J. Zak. [1964] [5]p. (AFOSR-64-1740) (AF 19(604)7344) AD 448287 Unclassified

Also published in Phys. Rev., v. 134: A1602-A1606, June 15, 1964.

A group-theoretical approach to the problem of a Bloch electron in a magnetic field is given. A magnetic translation group is defined and its properties, in particular its connection with the usual translation group, are established.

1520

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

COVALENCY IN CRYSTAL FIELD THEORY: $KNiF_3$, by R. E. Watson and A. J. Freeman. [1964] [21]p. (AFOSR-64-2076) (AF 19(604)7344) AD 451356 Unclassified

Also published in Phys. Rev., v. 134: A1526-A1546, June 15, 1964.

The theory of covalency in crystal field phenomena is examined, using, as example, the Ni-F6 complex in $KNiF_3$. The Hund-Mulliken-Van Vleck molecular orbital-linear combination of atomic orbitals treatment is followed. The role of the antibonding and bonding electrons in the complex is discussed from a multi-electron point of view. The exact self-consistent one-electron Hamiltonian is discussed in some detail. Emphasis is placed on elucidating the source and nature of the covalent effects appropriate to the various physical phenomena. It was found that it is the covalent mixing of those bonding electrons having no antibonding partners which contribute to all experimental observables.

1521

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

BULK ABSORPTION OF RADIATION IN SUPERCONDUCTORS, by E. E. H. Shin. [1964] [7]p. (AFOSR-64-2089) (AF 19(604)7344) AD 451349 Unclassified

Also published in Phys. Rev., v. 135: A299-A305, July 20, 1964.

Perturbation theory is applied to calculate the spectral shape of the bulk absorption of radiation in a superconductor. The second-order processes involving one photon and one phonon are considered. The resulting spectrum exhibits a spike near the frequency corresponding to the energy gap. This is attributed to the large values of the BCS density of states at the gap edges.

1522

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

CALCULATION OF MAGNETIC HYPERFINE CONSTANT OF P^{31}, by N. Bessis, H. Lefebvre-Brion and others. [1964] [3]p. (AFOSR-64-2090) (AF 19(604)7344) AD 451721 Unclassified

Also published in Phys. Rev., v. 135: A588-A590, Aug. 3, 1964.

The results of different kinds of calculations, which use the concept of spin polarization, all predict a negative sing of the magnetic hyperfine constant of the 4s ground state of P^{31} in contradiction with the sign deduced by Lambert and Pipkin from an optical pumping experiment. This result means that either an error in experimental sign has been made or that the first serious breakdown of the exchange polarization model has been found.

1523

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SATURATION MAGNETORESISTANCE AND IMPURITY SCATTERING ANISOTROPY IN n-TYPE SILICON, by L. J. Neuringer and D. Long. [1964] [6]p. (AFOSR-64-2093) (AF 19(604)7344) AD 451353 Unclassified

Also published in Phys. Rev., v. 135: A788-A793, Aug. 3, 1964.

In the classical strong-field region the magnetoresistance of semiconductors is expected to saturate. If one investigates the dependence of the saturation magnetoresistance upon the strength of ionized-impurity scattering, quantitative conclusions may be drawn concerning the anisotropy of the relaxation time for such scattering. The strong-field longitudinal magnetoresistance and carrier mobility of phosphorus-doped silicon have been studied in dc magnetic fields to 90 kg at 78°K.

1524

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ELECTRON SPIN RESONANCE STUDIES WITH SUPERCONDUCTING MAGNETS: THE SPECTRUM OF Dy^{3+} AND Sm^{3+} IN CaF_2, by W. Low. [1964] [4]p. (AFOSR-64-2345) (AF 19(604)7344) AD 451932 Unclassified

Also published in Phys. Rev., v. 134: A1479-A1482, June 15, 1964.

An electron spin resonance spectrometer has been constructed using strong magnetic fields up to 46,000 G generated by a superconducting magnet. It is being used for the measurement of the magnetic properties of transition elements in ionic crystals such as (1) small g factors, (2) energy level sparations up to 1/20 cm, (3) isotropic and anisotropic exchange terms in spectra pairs of paramagnetic ions, (4) spin-lattice relaxation times at high magnetic fields.

1525

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

QUADRUPOLE ANTISHIELDING FACTORS FOR RARE-EARTH AND SOME OTHER HEAVY IONS, by R. E. Watson and A. J. Freeman. [1964] [4]p. (AFOSR-64-2449) (AF 19(604)7344) AD 453807 Unclassified

Also published in Phys. Rev., v. 135: A1209-A1212, Aug. 31, 1964.

Sternheimer quadrupole antishielding factors are reported for several rare-earth ions and for several ions isoelectronic with I^- and Br^-. Radial excitations were obtained using the self-consistent-field unrestricted Hartree-Fock method described previously. Comparisons with perturbation-theory estimates of Sternheimer are presented.

1526

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE OPERATION OF OPTICAL MASERS IN UNIFORM MAGNETIC FIELDS, by W. A. Runciman. [1964] [4]p. (AFOSR-64-2521) (AF 19(604)7344) AD 453808 Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), v. 1: 673-676, 1964.

Optical masers usually emit light of a single frequency with a narrow line width. If an optical maser is operated in a homogeneous magnetic field, we might find the following advantages. The emission frequency might be tuned by an amount up to the half-width of the Zeeman pattern normally associated with the transition. It is also possible that two or more frequencies be simultaneously emitted allowing the formation of variable sum and difference frequencies when the light is incident on a non-linear dielectric. Finally, it may be possible to reduce the operating threshold. Preliminary results are now reported on a solid state and a gaseous optical maser to test these ideas.

1527

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SPIN EFFECTS ON THE LONG-WAVELENGTH OSCILLATIONS OF A QUANTUM PLASMA IN A MAGNETIC FIELD, by N. J. Horing. [1964] [6]p. (AFOSR-65-0165) (AF 19(604)7344) AD 611519 Unclassified

Also published in Phys. Rev., v. 136: A494-A499, Oct. 19, 1964.

The results of earlier work on the quantum theory of electron-gas plasma oscillations in a magnetic field are extended to take account of the difference in masses associated with the orbital and spin parts of the individual electronic motions in the presence of a lattice, and allowance is made for an anomalous electronic g factor. Tractable expressions for the complete plasmon dispersion relation and damping constant (at arbitrary temperature and arbitrary magnetic field strength), which are obtained using a Green's function formulation of the random-phase approximation, are reported. The low-wave-number (p) approximation of the dispersion relation is investigated in detail.

1528

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

GROUP-THEORETICAL CONSIDERATION OF LANDAU LEVEL BROADENING IN CRYSTALS, by J. Zak. [1964] [5]p. (AFOSR-65-0166) (AF 19(604)7344) AD 611518 Unclassified

Also published in Phys. Rev., v. 136: A776-A780, Nov. 2, 1964.

A group-theoretical classification of the energy levels for a Bloch electron in a magnetic field is given. The fact is used that the magnetic translation group is a subgroup of the symmetry group for a free electron in a magnetic field, and it is shown that the broadening of the Landau levels in crystals is a general feature that follows from symmetry considerations. An explicit formula for the broadening in the case of cubic symmetry is derived.

1529

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

SIGN OF THE MAGNETIC HYPERFINE FIELD IN DILUTE IRON ALLOYS USING THE MOSSBAUER EFFECT, by N. Blum and L. Grodzins. [1964] [5]p. (AFOSR-65-0167) (AF 19(604)7344) AD 611520 Unclassified

Also published in Phys. Rev., v. 136: A133-A137, Oct. 5, 1964.

The sign of the hyperfine field in several dilute iron alloys has been determined. The technique makes use

of the Mossbauer effect, which is used to establish the helicity of gamma rays emitted and absorbed in a longitudinal magnetic field. Experiments were performed which show that the field induced at the iron nucleus by the application of an external magnetic field H_O is negative, i.e., opposite to H_O in Mossbauer sources of Co^{57} in Cu and Au and in absorbers of Mo and Rh containing about 1% Fe^{57}. The spontaneous field H_{int} observed in a 1/2% Fe^{57}-in-Cu alloy below 50°K is positive.

1530

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ONE-DIMENSIONAL EQUATION FOR A TWO-DIMENSIONAL BLOCH ELECTRON IN A MAGNETIC FIELD, by J. Zak. [1964] [3]p. (AFOSR-65-0731) (AF 19-(604)7344) AD 614862 Unclassified

Also published in Phys. Rev., v. 136: A1647-A1649, Dec. 14, 1964.

Because of its relation to quantum effects in solids, it is of interest to study the behavior of a Bloch electron in the plane perpendicular to an external magnetic field. The dynamics of an electron in a two-dimensional periodic potential and a constant magnetic field perpendicular to the plane of motion is disucssed. Using symmetry-adapted functions an exact one-dimensional Schroedinger equation for this two-dimensional Bloch electron in a magnetic field has been derived. By contrast to other methods, since no approximations were introduced in the derivation, this one-dimensional equation contains all the information for describing the dynamics of the problem.

1531

Massachusetis Inst. of Tech. National Magnet Lab., Cambridge.

ULTRASONIC AND THERMAL BEHAVIOR OF Nb-25% Zr IN STRONG MAGNETIC FIELDS, by L. J. Neuringer and Y. Shapira. [1964] [3]p. incl. diagrs. table. (AFOSR-65-0732) (AF 19(604)7344) AD 614851 Unclassified

Also published in Solid State Commun., v. 2: 349-351, 1964.

In this note it is reported that (1) a distinct attenuation edge, as a function of magnetic field intensity, exists for ultrasonic shear waves propagated along the direction of the field in a Nb-25% Zr alloy below its transition temperature, T_c; (2) this edge can be traversed in a reversible manner as a function of the applied magnetic field and is absent at 77°K; (3) the magnetic field at which the attenuation edge occurs at 4.2°K agrees to within 2 kgauss with H_{c2}, the upper critical field, as determined by magnetization measurements on the same sample, and is also in agreement with the transition field obtained from resistance measurements on samples of similar composition; (4) heating spikes and ultrasonic attenuation bursts (in one to one correspondence) have been observed as a function of magnetic field for $H < H_{c2}$ at 2° and 4.2°K.

1532

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

UMKLAPP CONTRIBUTION TO BULK ABSORPTION IN SUPERCONDUCTORS, by E. E. H. Shin. [1964] [4]p. incl. diagr. refs. (AFOSR-65-0735) (AF 19-(604)7344) AD 616044 Unclassified

Also published in Phys. Rev., v. 136: A889-A892, Nov. 16, 1964.

The second-order umklapp contribution to the bulk absorption of radiation is calculated for superconductors at very low temperatures and is compared with the previously calculated normal phonon contributions. The umklapp absorption spectrum exhibits a sharp peak at the frequency ω_g representing the superconducting energy gap. For Pb, it is not only larger than the normal phonon absorption by many orders of magnitude but is also comparable with the skin absorption. It can also exhibit anisotropy in a single crystal through the polarization factor $(\hat{e} \cdot g)^2$ (where $\hat{e}$ is a unit vector in the direction of polarization of the incident radiation and g = reciprocal lattice vector), which appears in the expression for the umklapp absorption rate. (Contractor's abstract)

1533

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

INFLUENCE OF LANDAU LEVEL BROADENING ON THE DE HAAS-VAN ALPHEN EFFECT, by S. J. Williamson, S. Foner, and R. A. Smith. [1964] [3]p. (AFOSR-65-0736) (AF 19(604)7344) Unclassified

Also published in Phys. Rev., v. 136: A1065-A1067, Nov. 16, 1964.

Dingle's treatment of the influence of Landau level broadening on the de Haas-van Alphen effect is extended by the method of Lifshitz and Kosevich to include a Fermi surface of arbitrary shape. It is shown that a momentum-dependent or energy-dependent linewidth can influence the period, phase, and amplitude of the magnetization oscillations, although crude estimates indicate that in many cases the effects would be quite small. (Contractor's abstract)

1534

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ANTIFERROMAGNETIC RESONANCE IN SYSTEMS WITH DZYALOSHINSKY-MORIYA COUPLING; ORIENTATION DEPENDENCE IN αFe_2O_3, by S. J. Williamson

and S. Foner. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-0737) (AF 19(604)7344) AD 616173 Unclassified

Also published in Phys. Rev., v. 136: A1102-A1106, Nov. 16, 1964.

Resonance conditions for an antiferromagnet whose sublattice magnetization vectors are canted by the Dzyaloshinsky-Moriya interaction are generalized to include an arbitrary angle θ between the applied magnetic field and the hard direction of magnetization, and the resulting normal modes are discussed. A correction term to the low-frequency resonance expressions derived by Pincus may be appreciable at higher magnetic fields and small θ. For suitable parameters, this term permits the measurement of all pertinent effective fields by resonance experiments. It is furthermore shown that demagnetization effects are negligible. Microwave resonance experiments as a function of field to 60 kgauss angle and frequency 12 to 35 gauss cps on synthetic single crystals of σ Fe_2O_3 failed to reveal a departure from the Pincus relation, thus leading to the conclusion that $H_A/H_E < 10^{-2}$. (Contractor's abstract)

1535

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

MAGNETS FOR FIELDS ABOVE 100 KILOGAUSS, by D. B. Montgomery. [1964] [2]p. incl. diagrs. (AFOSR-65-1173) (AF 19(604)7344) AD 621654 Unclassified

Presented at Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 4-6, 1964.

Also published inNEREM Record, 1964.

Methods of generating high magnetic fields beyond those obtainable with laboratory-type iron magnets are discussed. The only practical methods other than high-field superconductors, use copper magnets, water-cooled for continuous duty, and uncooled or pre-cooled for pulse duty. For water-cooled magnets, the cooling process and the strong forces of the high water velocities c nstitute the principal design problems.

1536

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

INTENSE MAGNETIC FIELDS FOR RESEARCH, by A. J. Freeman. [1964] [2]p. (AFOSR-65-1174) (AF 19(604)7344) AD 621302 Unclassified

Presented at Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 4-6, 1964.

Also published in NEREM Record, 1964.

A review is presented of the developments in and importance of intense magnetic field research. Intense magnetic fields are considered to be those above 30,000 gauss and are produced by air core magnets up to 160,000 gauss on a continuous basis. In basic research, magnetic fields are valuable in revealing the structure of specific materials and the general physical laws governing all matter. Intense magnetic fields reveal a considerable amount of data that could not be obtained at all or that would be much less effective with weaker fields.

1537

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

THE DETERMINATION OF FORCED-CONVECTION SURFACE-BOILING HEAT TRANSFER, by A. E. Bergles and W. M. Rohsenow. [1963] [8]p. incl. diagrs. refs. (AFOSR-65-1439) (AF 19(604)7344) AD 627484 Unclassified

Presented at ASME-AIChE Heat Transfer Conf. and Exhibit, Boston, Mass., Aug. 11-14, 1963. (Paper No. 63-HT-22)

The characteristics of the boiling curve for forced convection surface boiling are examined in detail. In the region of low wall superheat, the heat transfer can be predicted by available correlations for forced convection. An analysis is presented for the inception of first significant boiling. Experimental results are in good agreement with analytical predictions. Pool-boiling data were taken under saturated and subcooled conditions for surfaces similar to those used in forced-convection surface boiling. These data indicate that the curves for forced-convection surface boiling cannot be based on data for saturated pool boiling but must rather be based on actual forced-convection data. (Contractor's abstract)

1538

Massachusetts Inst. of Tech. National Magnet Lab., Cambrdige.

STRONG-FIELD GALVANOMAGNETIC EFFECTS IN n-TYPE GERMANIUM, by L. J. Neuringer. [1965] [7]p. incl. diagrs. table. refs. (AFOSR-65-1763) (AF 19(604)7344) AD 625757 Unclassified

Also published in Proc. Seventh Internat'l. Conf. on Semiconductor Phys., Paris (France) (July 19-24, 1964), p. 379-385.

A quantitative analysis is made of the dependence of the longitudinal saturation magnetoresistance upon the strength of the impurity scattering in n-type germanium at 77°K. Measurements of the longitudinal magnetoresistance and Hall coefficient are performed as a function of magnetic field to 130 kg, and the conductivity mobility is determined by the mixed lattice and impurity scattering. The classical strong-field theory of Herring and Vogt and the Born approx are found to be in agreement with experimental results. The overall relaxation time anisotropy is found to be greater than unity for all samples studied and is 1.23 in the case of pure lattice scattering. The conductivity mobility for pure lattice scattering is given a value of 4.1×10^4 $cm^2/V\text{-sec}$.

1539

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

TWO PHASE FLOW IN CAPILLARY TUBES, by M. Suo and P. Griffith. Mar. 1963, 77p. incl. diagrs. refs. (Technical rept. no. 8581-24) (AF 19(604)7344) AD 402012 Unclassified

The flow of two phases, gas and liquid, has been studied in horizontal tubes of capillary diameter. The flow has been primarily studied in the regime where the gas flows as long bubbles separated from the wall of the tube by a liquid film and from each other by slugs of liquid. In this regime, the pressure drop, density and the thickness of the liquid film around a bubble have been correlated. The conditions under which the long bubble flow can exist and under which the correlations are valid have been determined. Of special interest is that the correlations should be valid in a zero-gravity field.

1540

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

BAND STRUCTURE AND MAGNETISM OF GADOLINIUM METAL, by J. O. Dimmock and A. J. Freeman. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-0605) (AF 49(638)1468) AD 614557 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 750-752, Dec. 21, 1964.

Some results of a nonrelativistic augmented plane wave calculation of the electronic energy bands in gadolinium metal are reported. The calculated conduction bands differ markedly from those of the free-electron model, and instead closely resemble those of the transition metals. This is due to the fact that bands originating from atomic 5d and 6s states overlap and are strongly mixed. The bands near the Fermi surface are of mixed s-d character and yield a density of states about 3 times that given in the free-electron model.

1541

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

ALFVÉN-WAVE PROPAGATION IN PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE, by M. Surma, J. K. Furdyna, and H. C. Praddaude. [1964] [3]p. incl. diagrs. (AFOSR-65-0606) (AF 49(638)1468) AD 615364 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 710-712, Dec. 14, 1964.

Alfvén-wave propagation has recently been observed in bismuth and antimony. An investigation was made of the phenomenon in pyrolytic graphite (PG), which afforded the possibility of investigating the unique behavior of Alfvén waves in an almost 2-dimensional plasma. The experiments were carried out at 4.2°K with a 35-Gc/sec absorption cavity spectrometer. The results are in good agreement with the anisotropy of the Fermi surface of graphite. The carrier density, estimated on the basis of these measurements using Shubnikov-de Haas effective masses for the basal plane, is $3.3 \times 10^{24}/m^3$ for each carrier. In the low-field region, cyclotron resonance was observed in both PG and single-crystal graphite.

1542

Massachusetts Inst. of Tech. National Magnet Lab., Cambridge.

HIGH FIELD MAGNETIC MOMENT AND ANTIFERROMAGNETIC RESONANCE MEASUREMENTS IN α-Fe_2O_3, CoF_2, FeF_2 AND $(MnF_2)_{1-x}(ZnF_2)_x$, by S. Foner. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-1981) (AF 49(638)1468) AD 626329 Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism Nottingham (Gt. Brit.) (Sept. 7-11, 1964), 1964, p. 438-442.

Pulsed field measurements of the spin-flop transition in natural single crystal α-Fe_2O_3 are presented for T = 4.2 to 250°K, and brief comments are made on related antiferromagnetic resonance experiments. The value of $H_c = 65 \pm 3$ kgauss for α-Fe_2O_3 for low temperatures leads to an anisotropy field which is about 1/50 of the dipolar anisotropy and is much smaller than previously estimated. It is suggested that high field reversal of memory in polycrystalline α-Fe_2O_3 reflects the spin-flop phenomenon. Free energy contributions of spontaneous moments to the critical field are discussed. Results of magnetic susceptibility, antiferromagnetic resonance and spin-flop in two compositions of (MnF $(MnF_2)_{1-x}(ZnF_2)_x$ are also briefly presented. (Contractor's abstract, modified)

1543

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OPTIMUM NOISE PERFORMANCE OF MULTITERMINAL AMPLIFIERS, by W. D. Rummler. Feb. 1, 1964, 124p. incl. diagrs. refs. (Technical rept. no. 417) (AFOSR-64-0700) (DA 36-039-AMC-03200(E)) Unclassified

A measure is determined of the optimum noise performance of a linear multiterminal-pair amplifier; this optimum performance is achieved with a multiterminal-pair source in a narrow band of frequencies Δf at a single-output terminal pair. The optimum noise performance of such a system is defined as the maximum signal-to-noise ratio achievable at large exchangeable signal power. It is shown that this is a meaningful criterion for any system that is to deliver ultimately an amount of signal power considerably greater than $kT_o\Delta f$, the noise power available from a resistor at a temperature T_o. The techniques described can be

used to determine the maximum signal-to-noise ratio achievable at any value of exchangeable (or available signal power. The results are presented in a plot with noise-to-signal ratio and the reciprocal of exchangeable signal power as coordinates—the noise-performance plane. The noise figure, exchangeable-power gain, and noise measure are given a geometrical interpretation in this plane. (Contractor's abstract, modified)

1544

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A STUDY OF THE PERFORMANCE OF LINEAR AND NONLINEAR FILTERS, by V. R. Algazi. June 22, 1964, 104p. incl. diagrs. refs. (Technical rept. no. 420) (DA 36-039-AMC-03200(E)) AD 601875 Unclassified

A measure of the performance of filters is proposed which compares the filter under study to an optimum attenuator acting on the same input. The noise level (noise-to-message power ratio) is emphasized as an independent parameter important to the behavior and the performance of both linear and nonlinear filters. For optimum and nonoptimum linear filters, the effect of the noise level on the performance is the specific object of study. For nonlinear no-memory filters after considering the determination of the optimum filter for mean-square and non mean-square criteria, the characteristics of the message and the noise are investigated for which the optimum mean-square filter reduces to an attenuator. (Contractor's abstract, modified)

1545

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTROMAGNETIC INDUCTION ON AN EXPANDING CONDUCTING SPHERE, by L. C. Bahiana. May 30, 1964, 71p. incl. diagrs. refs. (Technical rept. no. 421) (AFOSR-64-1363) (DA 36-039-AMC-03200(E)) AD 602435 Unclassified

The major part of the work reported here is concerned with the case of a perfectly conducting expanding sphere. This problem is solved rigorously with the help of an integral equation relating the current density to the magnetic vector potential. The fields are determined in integral form for any arbitrary velocity of expansion, and calculated explicitly for the particular case of constant velocity of expansion. The physical interpretation of these solutions is discussed. The electromagnetic force acting on the sphere is found, and the energy-power balance at the surface of the sphere is investigated with the help of Poynting's theorem. The case of the expanding sphere with finite conductivity is formulated, but exact solutions are not given. A rough calculation of the expected electric field 1000 km from a typical nuclear explosion shows that the field is measurable, and its value is of the same order of magnitude as that predicted by another proposed theory.

1546

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CODING COLOR PICTURES, by U. F. Gronemann. June 17, 1964, 41p. incl. illus. diagrs. tables, refs. (Technical rept. no. 422) (AFOSR-64-1364) (DA 36-039-AMC-03200(E)) Unclassified

A computer-simulation study of efficient coding for color pictures has been undertaken. Two typical color transparencies were resolved into 3 primaries, sampled in a square array and recorded digitally on magnetic tape. The computer program transformed these data into luminance and chrominance quantities, performed certain parameter modifications, reconverted them into primary-color quantities and wrote them on an output tape. The output tape was played back through the recorder-reproducer to produce images of the coded pictures on the face of the cathode-ray tube, which were photographed through appropriate filters on color film. The resultant transparencies were later viewed and compared by a number of observers. Two major conclusions were drawn: (1) A normal monochromatic picture can be converted into a full color picture of the same apparent sharpness by transmitting additonally only a fraction of a bit per sample; and (2) Inclusion of color may result in an over-all lower transmission rate requirement than would the same picture coded monochromatically. For some purposes, such as recognizing objects, this reduction can be substantial. (Contractor's abstract, modified)

1547

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MODEL FOR FIRING PATTERNS OF AUDITORY NERVE FIBERS, by T. F. Weiss. Mar. 2, 1964, 93p. incl. diagrs. table refs. (Technical rept. no. 418) (AFOSR-64-1367) (DA 36-039-AMC-03200(E)) Unclassified

Recent electrophysiological data obtained from auditory nerve fibers of cats have made possible the formulation of a model of the peripheral auditory system. This model relates the all-or-none activity of these fibers to acoustic stimuli. The constituents of the model are intended to represent the major functional constituents of the peripheral system. These constituents are: (1) a linear mechanical system intended to represent the outer, middle, and the mechanical part of the inner ear; (2) a transducer intended to represent the action of the sensory cells; and (3) a model neuron intended to represent the nerve excitation process. A general-purpose digital computer has been used to determine the response of the model to a variety of acoustic stimuli. These results have been compared with data obtained from auditory nerve fibers. (Contractor's abstract)

1548

Massachusetts Inst. of Tech. Researc . of Electronics, Cambridge.

NOTE ON SHORT TERM STORAGE OF INFORMATION IN VISION, by M. Eden. [1964] [2]p. (AFOSR-64-1574) (DA 36-039-AMC-03200(E)) AD 444392 Unclassified

Also published in Perceptual and Motor Skills, v. 19: 93-94, 1964.

A reevaluation of the short term memory experiments of Averbach and Sperling furnishes evidence that the memory read-out is linear. (Contractor's abstract)

1549

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EXPERIMENTS ON COMPUTER RECOGNITION OF CONNECTED HANDWRITTEN WORDS, by P. Mermelstein and M. Eden. [1964] [16]p. incl. diagrs. table. (AFOSR-64-1575) (DA 36-039-AMC-03200(E)) AD 444394 Unclassified

Also published in Inform. and Control, v. 7: 255-270, June 1964.

An operational system is presented for the recognition of handwritten words when written on line on a special transducer. The system represents a new approach to handwriting recognition, that of searching for the invariants of the patterns of consideration of the intrinsic movements that execute the handwriting. Experiments carried out by computer simulation of the recognition system reveal that the system is capable of recognizing well-informed, legible handwritten words with a reliability that depends on the correspondence between the script of the test samples and that of the ensemble on which the machine's representation of handwriting is based. (Contractor's abstract, modified)

1550

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RESPONSES OF SINGLE UNITS IN THE AUDITORY CORTEX, by G. L. Gerstein and N. Y.-S. Kiang. [1964] [18]p. incl. diagrs. refs. (AFOSR-64-1576) (DA 36-039-AMC-03200(E)) AD 444393 Unclassified

Also published in Exper. Neurol., v. 10: 1-18, July 1964.

The temporal firing patterns of units in the auditory cortex were studied as a function of stimulus parameters. Different units exhibit a wide variety of response patterns for the same stimulus. A particular unit may exhibit different response patterns to different stimuli. (Contractor's abstract, modified)

1551

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TRAVELING DENSITY VARIATIONS IN PARTIALLY IONIZED GASES, by R. S. Cooper. Sept. 2, 1964, 79p. incl. diagrs. tables, refs. (Technical rept. no. 424) (AFOSR-64-1910) (DA 36-039-AMC-03200(E)) AD 606220 Unclassified

The report deals with the problem of the propagation of macroscopic waves of ionization within the positive column of glow discharge tubes. In the literature of this field these waves have been called 'moving striations' because of the visible radiation emanating from the traveling pulse. Both experimental and theoretical analyses of this phenomenon were made. The principal experimental result of this work is the establishment of a linear regime of operation for the observed traveling waves and the artificial excitation of them. The principal theoretical result is the derivation and the analysis of a linear theory that is applicable to the experimental regime of operation. (Contractor's abstract)

1552

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INFRARED STUDIES OF PEROVSKIT TITANATES, by C. H. Perry, B. N. Khanna, and G. Rupprecht. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-2140) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Phys. Rev., v. 135: A408-A412, July 20, 1964.

The infrared reflection and transmission spectra of $CaTiO_3$, $SrTiO_3$, and $PbTiO_3$ have been measured from 4000 to 30 cm^{-1} at room temperature. The reflection data obtained from transmission spectra. Three infrared active vibrations were observed for cubic $SrTiO_3$ as required by group theory. However, in the case of $CaTiO_3$ and $PbTiO_3$, which crystallize bands were found which had not been observed previously. These distortions from ideal cubic symmetry would split degenerate modes to possibly give additional frequencies. The results are compared with those of other workers. (Contractor's abstract, modified)

1553

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MAGNETOHYDRODYNAMIC POWER GENERATION—A STATUS REPORT, by W. D. Jackson. [1964] [6]p. incl. diagrs. table, refs. (AFOSR-64-2141) (DA 36-039-AMC-03200(E)) AD 447457 Unclassified

Also published in Jour. Electron. Power, v. 10: 258-263, Aug. 1964.

This report gives the historic and theoretical background to the development of m.h.d. power generation and surveys promising recent applications such as topping devices and space-vehicle power systems.

1554

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EVOKED RESPONSES FROM THE AUDITORY CORTEX, by D. C. Teas and N. Y.-S. Kiang. [1964] [29]p. incl. diagrs. refs. (AFOSR-64-2142) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Exper. Neurol., v. 10: 91-119, Aug. 1964.

Evoked responses were recorded from the auditory cortex of unanesthetized cats. With clicks of moderate intensity, the waveforms of the responses were highly repeatable among awake cats. Introduction of certain variables such as localized injury to cortex, anesthesia, or sleep resulted in more or less characteristic changes in the waveform of the evoked responses. In particular, the later components of the responses seemed to be more sensitive to changes in the state of the animal, while the early components seemed to be abolished by local injury to the cortex. The evoked responses and particularly the later components did not always behave in a reliably repeatable fashion as click intensity or click rate was changed. When broad-band background noise was introduced, the click evoked responses always showed a characteristic decrease in the earliest component. These results are interpreted in terms of multiple projection pathways to cortex with possible functional significance. (Contractor's abstract, modified)

1555

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A PRELIMINARY EXPERIMENT ON THE PERCEPTUAL BASIS FOR MUSICAL INSTRUMENT FAMILIES, by M. Clark, Jr., P. Robertson, and D. Luce. [1964] [5]p. incl. diagrs. tables. (AFOSR-64-2144) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Jour. Audio Eng. Soc., v. 12, July 1964.

Experimental evidence is presented for the evidence of perceptual families of instruments. This evidence is the result of confusions in identifying the instruments that produced tones when these tones were played back at speeds higher than that at which they were recorded. The string family consists of violins, violas, cellos, and double basses. The brass family consists of trumpets, trombones, tubas, and French horns. The double reed family consists of oboes, English horns, and bassoons, with the bassoons only very weakly linked to the other members of the family. The families are listed in order of decreasing tightness. Very tight subfamilies are formed of the following pairs: violin-viola, cello-double bass, oboe-English horn, trumpet-trombone. (Contractor's abstract)

1556

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SUPERPOSITION IN A CLASS OF NONLINEAR SYSTEMS, by A. V. Oppenheim. [1964] [7]p. incl. diagrs. (AFOSR-64-2146) (DA 36-039-AMC-03200(E)) AD 448383 Unclassified

Also published in IEEE Internat'l. Conv. Rec., Part 1: 171-177, 1964.

The ease of analysis and characterization of linear systems stems primarily from the fact that they satisfy the principle of superposition. A generalization of the principle of superposition is presented and the class of nonlinear systems that satisfy this generalized principle is discussed. A canonical representation for systems in this class is derived, which consists of a cascade of 3 systems, the first and last of which are dependent upon a general property of the system inputs and outputs, respectively. The second system in the canonical representation is a linear system. Applications of the theory are considered for a class of nonlinear feedback systems. (Contractor's abstract)

1557

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE OPTIMUM QUANTIZATION OF STATIONARY SIGNALS, by J. D. Bruce. [1964] [7]p. incl. diagrs. table. (AFOSR-64-2147) (DA 36-039-AMC-03200(E)) Unclassified

Also published in IEEE Internat'l. Conv. Rec., Part 1: 118-124, 1964.

The exact expression for the quantization error as a function of the parameters that define the quantizer, the error-weighting function, and the amplitude probability density of the quantizer-input signal is presented. An algorithm is developed that permits the determination specific values of the quantizer parameters that define the optimum quantizer. This algorithm, which is based on a modified form of dynamic programming, is valid for both convex and nonconvex error-weighting functions. Examples of optimum quantizers designed with this algorithm for a representative speech sample are presented. The performance of these quantizers is compared with that of the uniform quantizer. (Contractor's abstract)

1553

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THEORY OF RADIATION EMISSION AND ABSORPTION

IN PLASMA, by T. H. Dupree. [1964] [18]p. incl. table. (AFOSR-64-2148) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Phys. Fluids, v. 7: 923-940, July 1964.

Starting with the basic plasma kinetic equations correct to second order in the plasma parameter, general formulas for cyclotron and bremsstrahlung emission and absorption are derived. The theory provides a rigorous description of the interaction of plasma and radiation. At equilibrium, Kirchhoff's law is recovered and the theory reduces to previously derived results. (Contractor's abstract)

1559

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A MULTIUSER COMPUTATION FACILITY FOR EDUCATION AND RESEARCH, by J. B. Dennis. [1964] [9]p. incl. diagrs. (AFOSR-64-2282) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Commun. Assoc. Computing Mach., v. 7: 521-529, Sept. 1964.

Implementation is described for a small-scale multiuser computer system that permits several users to work independently with the machine, and to obtain satisfactory response using typewriter communication.

1560

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOTE ON RECURRENT CODES, by E. R. Berlekamp. [1964] [2]p. (AFOSR-64-2283) (DA 36-039-AMC-03200(E)) AD 450890 Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-10, July 1964.

Wyner and Ash have given bounds on the minimum guard space necessary to correct all bursts of a specified maximum length with a recurrent code. Following the methods of a previous paper, this communication gives an explicit construction for achieving their lower bound for recurrent codes designed to correct error bursts of a known phase.

1561

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STATISTICAL THEORY OF SPIN-SPIN INTERACTIONS IN SOLIDS, by W. J. C. Grant and M. W. P. Strandberg. [1964] [12]p. incl. refs. (AFOSR-64-2284) (DA 36-039-AMC-03200(E) and DA 36-039-sc-87376) AD 450889 Unclassified

Also published in Phys. Rev., v. 135: A715-A726, Aug. 3. 1964.

A theoretical theory of spin interactions is presented which takes its starting point from pair transitions rather than single-particle transitions. The approach through straightforward perturbation theory applied to pairs, and the approach through the time development of the pair-transition operator $S_x(t)$ are shown to be equivalent. The averaging over possible pair configurations is performed by means of a weight function which allows inclusion of the details of the lattice structure and of departures from random spin distribution. Concentration dependence and temperature dependence appear naturally in the formalism. The formalism is not intrinsically restricted to a particular type of spin interaction. The existence of asymmetry in certain line shapes is indicated. The theory is applied to magnetic dipole interaction and exchange. (Contractor's abstract, modified)

1562

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LINE SHAPES OF PARAMAGNETIC RESONANCES OF CHROMIUM IN RUBY, by W. J. C. Grant and M. W. P. Strandberg. [1964] [13]p. incl. diagrs. tables, refs. (AFOSR-64-2285) (DA 36-039-AMC-03200(E) and DA 36-039-sc-87376) AD 450887 Unclassified

Also published in Phys. Rev., v. 135: A727-A739, Aug. 3, 1964.

Using the formalism of the preceding paper, detailed numerical calculations are performed for the line shapes of paramagnetic resonances of chromium in ruby. It is found that (1) the dipolar line departs only slightly from the Lorentzian at the highest attainable concentrations, (2) the line is predominantly nondipolar at low concentrations, (3) no inference is possible from moments as to the magnitude or parametric behavior of intensities and half-widths, (4) neither exchange nor clustering of impurities affect the line shape at low concentrations, and (5) exchange cannot narrow the $(\frac{1}{2}, -\frac{1}{2})$ transition. Various explanations for the observed residual width at vanishing concentrations are discussed in the light of these findings. (Contractor's abstract)

1563

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

LOCAL, SEGMENTAL AND SUPRASPINAL INTERACTION WITH A DORSOLATERAL SPINAL CUTANEOUS AFFERENT SYSTEM, by A. Taub. [1964] [18]p. incl. illus. diagrs. refs. (AFOSR-64-2288) (AF AFOSR-64-591 and DA 36-039-AMC-03200(E)) AD 450891 Unclassified

Also published in Exper. Neurol., v. 10: 357-374, Oct. 1964.

This report deals with the spinocervical tract and with the effects of the electrical stimulation of cerebellar nuclear and brain-stem structures upon the receptive field response characteristics of its single units. Its primary purpose is to describe the constriction of the cutaneous light tactile excitatory receptive field obtained by such stimulation and to demonstrate a possible underlying presynaptic mechanism. In addition, a novel form of afferent inhibition by mechanical and thermal stimulation is described, and some intersegmental inhibition patters are discussed.

1564

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EXCITATION OF ION OSCILLATIONS IN BEAM-PLASMA SYSTEMS, by M. T. Vlaardingerbroek. Sept. 18, 1964, 31p. incl. diagrs. refs. (Technical rept. no. 426) (AFOSR-64-2289) (DA 36-039-AMC-03200(E)) AD 607269 Unclassified

This report suggests possible ways for further theoretical study of the interaction of an electron beam and the ions in a hot-electron plasma. Equations are obtained for beam-plasma interaction in a filled cylindrical waveguide in which the thermal velocity distribution is longitudinal but otherwise arbitrary. An approximation is described based on these equations by using only one transverse wave number. Beam- (hot-electron) plasma interaction is calculated including a transverse random velocity distribution. The theory of a filamentary beam and a plasma-filled waveguide are combined, using the coupling-of-modes theory, for the description of some of the weak interactions between a thin beam and a finite plasma. (Contractor's abstract, modified)

1565

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RADIO OBSERVATIONS OF VENUS AND THE INTERPRETATIONS, by A. H. Barrett and D. H. Staelin. [1964] [27]p. incl. diagrs. tables, refs. (AFOSR-64-2356) (DA 36-039-AMC-03200(E)) AD 451341 Unclassified

Also published in Space Sci. Rev., v. 3: 109-135, 1964.

The radio observations of Venus are reviewed and compared with theoretical microwave spectra computed for a variety of models of the Venusian environment. The models considered are (a) a CO_2-N_2 atmosphere, (b) an atmosphere of dust (the aeolosphere model), and (c) a cloud model with various loss mechanisms in the cloud. The effect of polarization on the surface emissivity has been included in all the computations. It is shown how the radio observations place limits upon the acceptable models. It is shown how some models place severe restrictions on radar observations at short centimeter wavelengths, thereby emphasizing the importance of such experiments. (Contractor's abstract)

1566

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ORBIT STABILITY IN A HELICALLY PERTURBED MAGNETIC FIELD, by L. M. Lidsky. [1964] [5]p. incl. diagrs. (AFOSR-64-2357) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Phys. Fluids, v. 7: 1484-1488, Sept. 1964.

The stability of particle orbits in resonant helices ("corkscrews") is investigated for axial acceleration and deceleration of the injected particles. It is shown that deviations from the unperturbed orbit lead to growing oscillations about that orbit for a decelerating corkscrew. The growth rate is small in devices suitable for injection into mirror fields. The numerical results are in agreement with experimental observations of injection parameters and output properties. Deviations from the equilibrium orbit in an accelerating corkscrew lead to damped oscillations. (Contractor's abstract)

1567

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DEVELOPMENT OF A LARGE-VOLUME SUPERCONDUCTING SOLENOID, by L. J. Donadieu. Oct. 16, 1964, 131p. incl. illus. diagrs. tables, refs. (Technical rept. no. 427) (AFOSR-64-2455) (DA 36-039-AMC-03200(E)) AD 608445 Unclassified

Problems encountered in the development of large-volume superconducting solenoids have been investigated in the light of the experience induced by the realization of a particular prototype (8.0 in. in diam., 4 ft long, 20 kilogauss at room temperature). The current-field characteristics of some useful superconducting materials (Nb, Mo-Re, Nb-Zr) have been measured; the results are discussed in terms of recent theories of superconductors. The spurious loss of the resistanceless state of a superconducting solenoid, which is particularly dangerous for large-volume devices, was thoroughly investigated. Results of calculations for the prototype solenoid are presented. The design of the prototype solenoid, is thoroughly detailed. The most important topics covered: field calculation for multicoil solenoids; magnetic stresses and magnetic energy; quenching process for multicoil solenoids; steady-state heat transfer caused by residual gas, thermal radiation and conduction; and transient heat transfer. (Contractor's abstract, modified)

1568

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RELAXATION SPECTRA OF RIBONUCLEASE. I. THE INTERACTION OF RIBONUCLEASE WITH CYTIDINE

3'-PHOSPHATE, by R. E. Cathou and G. G. Hammes. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-64-2456) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3240-3245, Aug. 20, 1964.

Kinetic studies of the interaction of bovine pancreatic ribonuclease with cytidine 3'-phosphate have been made at high enzyme concentrations (> 10^{-5} M) using the temperature jump method. Two different relaxation processes with characteristic relaxation times ranging from about 1 msec to less than 20 μ sec have been observed. One process is concentration dependent and is observed at all pH's in the range studied (pH 5.0-7.5). This effect is due to the formation of the enzyme—substrate complex; the rate constants for both complex association and dissociation were determined and interpreted in terms of elementary mechanistic steps involving an enzyme group with a pK of 6.7 in the free enzyme. The other relaxation process is observed only when the enzyme is essentially all in the form of the enzyme-cytidine 31-phosphate complex. The relaxation time is concentration independent, suggesting an intramolecular process. (Contractor's abstract, modified)

1569

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EVOKED RESPONSES IN RELATION TO VISUAL PERCEPTION AND OCULOMOTOR REACTION TIMES IN MAN, by J. S. Barlow. [1964] [36]p. incl. illus. diagrs. tables, refs. (AFOSR-64-2458) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Ann. New York Acad. Sci., v. 112: 432-467, May 8, 1964.

Results are described and discussed from experiments in which responses evoked by visual stimuli are studied in relation to oculomotor reaction times, and in relation to some of the phenomena associated with visual perception.

1570

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A NOTE ON ASYMMETRY IN PHRASE STRUCTURE GRAMMARS, by G. H. Matthews. [1964] [6]p. (AFOSR-64-2459) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Inform. and Control, v. 7: 360-365, Sept. 1964.

The author (1963) defined several classes of grammars and determined their generative power. These grammars are defined partially by the form of their rules and partially by the form of the derivations of the sentences they generate. That paper shows that one-way grammars and one-way discontinuous grammars are equivalent to context-free grammars as defined by Chomsky (1959). This paper shows that the restrictions on the form of the rules are not essential; any unrestricted rewriting system generates a context-free language if its derivations are confined to one-way derivations as defined by Matthews (1963).

1571

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TRANSISTOR BECOMES SENSOR IN TEMPERATURE REGULATOR, by S. Greenblatt. [1964] [1]p. incl. diagr. (AFOSR-64-2460) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Electronics, v. 37, Nov. 2, 1964.

A simple temperature-control circuit was constructed by taking advantage of the predictable variation of transistor parameters with temperature. The construction is detailed and a schematic diagrm is included.

1572

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PRESYNAPTIC HYPERPOLARIZATION: A ROLE FOR FINE AFFERENT FIBRES, by L. M. Mendell and P. D. Wall. [1964] [21]p. incl. illus. diagrs. refs. (AFOSR-65-0020) (DA 36-039-AMC-03200) AD 452860 Unclassified

Also published in Jour. Physiol., v. 172: 274-294, 1964.

This paper provides evidence that the presynaptic control mechanism is in continuous operation and that arriving nerve impulses may either increase of decrease the membrane potential of neighboring fibers and, therefore, may either facilitate or inhibit presynaptically. Experiments are described in spinal cats which show that the steady arrival of cutaneous impulses at the cord results in a steady depolarization of passive afferent terminals. By the use of a method for preferential blocking of large fibers by anodal polarization, it is shown that impulses in fine fibers produce a hyperpolarization of the terminals of large fibers. This effect is blocked by barbiturate. If terminals are held steadily depolarized, the arrival of impulses in A fibers hyperpolarizes the terminals of passive neighbors. Positive dorsal root potentials are associated with hyperpolarization of the terminals of large diameter cutaneous fibers. C fiber volleys hyperpolarize the terminals of cutaneous A fibers and facilitate the reflex evoked by the A fibers.

1573

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOTE ON BINAURAL MASKING-LEVEL DIFFERENCES AS A FUNCTION OF THE INTERAURAL CORRELATION

OF THE MASKING NOISE, by N. I. Durlach. [1964] [5]p. incl. diagr. refs. (AFOSR-65-0021) (DA 36-039-AMC-03200(E)) AD 452859 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 1613-1617, Sept. 1964.

A quantitative 'black-box' model is constructed for interpreting data that describe the dependence of binaural masked thresholds on the proportion of common noise in the masking signals. This model is a natural adjunct to the equalization-and-cancellation model, discussed in previous papers. (Contractor's abstract)

1574

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALYSIS OF ELECTRON BEAM-PLASMA SYSTEMS, by P. E. Serafim. July 31, 1964, 96p. incl. diagrs. table, refs. (Technical rept. no. 423) (AFOSR-65-0022) (DA 36-039-AMC-03200(E)) AD 609023 Unclassified

The interaction between an electron beam and a plasma in metallic waveguides and in the presence of an external longitudinal magnetostatic field is analyzed. Plasma ions and electrons are considered. The treatment is valid for slow and fast waves and for relativistic beam velocities. In the first part an exact analysis is made of the beam-plasma waveguide based on the linearized Maxwell equations and the Lorentz force equation. The "operator" dielectric tensor description of the beam-plasma medium is introduced. The properties of this tensor are examined and the boundary conditions are formulated in terms of the elements of this tensor. In the second part, a solution of the plasma waveguide problem by a coupling-of-modes theory is given. The results are specialzied for plasma waveguides, and the case of a completely filled circular plasma waveguide is examined in detail. (Contractor's abstract, modified)

1575

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETERMINATION OF NEUTRAL GAS TEMPERATURE IN A PLASMA COLUMN FROM SOUND VELOCITY MEASUREMENTS, by K. W. Gentle and U. Ingard. [1964] [2]p. incl. diagrs. (AFOSR-65-0025) (DA 36-039-AMC-03200(E)) AD 452454; AD 453584 Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 105-106, Sept. 1, 1964.

The temperature of the neutral gas component in a glow discharge plays a significant role in experiments involving the influence of gas flow on the properties of the discharge. An ordinary Langmuir probe, properly biased, is a simple means for the detection of sound in a discharge. The sound speed is obtained directly from the measured travel time of a sound pulse between two such probes inserted in a plasma column. In this experiment the acoustic signal is produced in the neutral gas, 40 cm from the plasma column, by a spark sound source. As has frequently been noted, the wave produced by a spark of this type travels with the small-signal sound velocity outside a small region about the source.

1576

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

POLARIZATION EFFECTS ON MAGNETIC RESONANCES IN FERROELECTRIC POTASSIUM TANTALATE, by S. H. Wemple. Dec. 31, 1964, 83p. incl. illus. diagrs. tables, refs. (Technical rept. no. 425) (AFOSR-65-0254) (DA 36-039-AMC-03200(E)) AD 609911 Unclassified

Electric field effects on electron paramagnetic resonances (EPR) associated with Fe^{3+} impurity ions in the perovskite ferroelectric $KTaO_3$ are presented. A large effect ($D = 30 \times 10^{-4}$ cm^{-1} for E = 14 kv/cm) was predicted and observed at 4.2°K. The effect is several orders of magnitude larger in $KTaO_3$ than has been reported for other centrosymmetric lattices. The EPR angular dependence data for the Fe^{3+} ion in a cubic environment are interpreted in terms of appropriate spin Hamiltonian parameters. The result is $|a| = (345 \pm 10) \times 10^{-4}$ cm^{-1} and $g = 1.09 \pm 0.01$. The EPR spectra for Fe^{3+} ions having a neighboring oxygen vacancy, and for Fe^{5+}, Mn, and Cr are also reported. A method for growing fairly large (~1 cm^3) and good quality single crystals of $KTaO_3$ is described. (Contractor's abstract, modified)

1577

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELECTRON-STREAM INTERACTION WITH PLASMAS, by R. J. Briggs. Cambridge, M.I.T. Press, 1964, 187p. incl. diagrs. refs. (Special technical rept. no. 10) (AFOSR-65-0255) (DA 36-039-AMC-03200(E)) AD 454587 Unclassified

This study considers the instabilities that result when an electron beam is injected into a plasma. A number of different models of the system are considered, and all instabilities are classified according to whether they are convective instabilities (amplifying waves) or non-convective (absolute) instabilities. The study also analyzes the instabilities in unbounded beam-plasma systems and in systems of finite extent transverse to the electron stream and gives a detailed consideration of the possibility of a strong interaction with the ions in a hot-plasma. In addition, a mathematical criteria is presented for identifying absolute instabilities and amplifying waves. These criteria are based only on an analysis of the dispersion equation of the system and are not restricted to beam-plasma systems.

1578

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RESPONSES TO ACOUSTIC STIMULI FROM SINGLE UNITS IN THE EIGHTH NERVE OF THE GREEN FROG, by M. B. Sachs. [1964] [3]p. incl. diagrs. (AFOSR-65-0267) (DA 36-039-AMC-03200(E)) AD [illegible]011
Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 1956-1958, Oct. 1964.

Single-unit activity was recorded from the eighth nerve of the green frog. All units are frequency-selective. Units most sensitive to tone bursts of frequencies below 450 cps show little or no spontaneous activity; their responses to tone bursts can be inhibited by tones of frequency above 500 cps. Many of these low-frequency units are sensitive to vibration and their responses to vibration can also be inhibited. Units with most sensitive frequencies above 650 cps are spontaneous and cannot be inhibited. Ten units displaying very different response patterns are also discussed. (Contractor's abstract, modified)

1579

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE DETECTION OF THE OH AND OTHER MOLECULAR LINES IN THE RADIO SPECTRUM OF THE INTERSTELLAR MEDIUM, by A. H. Barrett. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-0268) (DA 36-039-AMC-03200(E)) AD 454004
Unclassified

Also published in IEEE Trans. on Military Electron., v. MIL-8: 156-165, July-Oct. 1964.

The nature of Λ-doublet levels are reviewed in an attempt to clarify the origin of the OH lines. The results of the OH observations are presented and the distinction between absorption and emission experiments is discussed in terms of the importance for the OH lines. The frequencies of the astrophysically important OH transitions in various molecular states and isotopic species are given and their detection possibilities are briefly discussed. Radio molecular lines of SH, SiH, CH, CN, and NH are also discussed. (Contractor's abstract, modified)

1580

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SPECTRUM AND RELATIVE INTENSITIES OF INTERSTELLAR OH LINES, by A. H. Barrett and A. E. E. Rogers. [1964] [2]p. incl. table, refs. (AFOSR-65-0269) (DA 36-039-AMC-03200(E)) AD 454012
Unclassified

Also published in Nature, v. 204: 62-63, Oct. 3, 1964.

The frequencies, theoretical relative intensities and transition probabilities of 14 microwave lines of various energy levels and isotopic species of OH are listed. The relation of present observational data to some of these parameters is briefly discussed.

1581

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EFFECT OF GAS FLOW ON THE PROPERTIES OF A PLASMA COLUMN, by K. W. Gentle, U. Ingard, and G. Bekefi. [1964] [2]p. incl. diagrs. (AFOSR-65-0270) (DA 36-039-AMC-03200(E)) AD 454010
Unclassified

Also published in Nature, v. 203: 1369-1370, Sept. 26, 1964.

This communication describes some effects of gas flow on the properties of a weakly ionized d.c. discharge in argon at pressures of 2-30 mm mercury, with discharge currents of 15-200 m. amp, and gas flow velocities ranging from zero to 1.5×10^4 cm/sec, corresponding to a Mach number approximately 0.5.

1582

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ALTERNATION OF RULES IN CHILDREN'S GRAMMAR, by P. Menyuk. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-65-0360) (DA 36-039-AMC-03200(E))
Unclassified

Also published in Jour. Verbal Learning and Verbal Behav., v. 3: 480-488, Dec. 1964.

The use of alternate restricted rules which do not produce completely well-formed structures) found in children's grammar are analyzed in an attempt to present an adequate description of increasing complexity in grammar as children mature. Language samples were obtained from 159 children ranging in age from 2 yr, 10 mos to 7 yr, 1 mo. Each child's language sample was analyzed by means of a generative model of grammar. The data indicate that increasing complexity is not simply related to the acquisition and increased usage of more complex sentence types. Increasing complexity is also dependent on children's improved ability to proceed from the application of the most general rule in the formulation of a syntactic structure to the increasingly differentiating rules, and then to the complete ordered set needed for a particular structure. (Contractor's abstract, modified)

1583

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DISTRIBUTED SOLUTION OF NETWORK

PROGRAMMING PROBLEMS, by J. B. Dennis. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0361) (DA 36-039-AMC-03200(E)) Unclassified

Also published in IEEE Trans. Commun. Systems, v. CS-12: 176-184, June 1964.

A method is presented for the solution of network programming problems through the iterative execution of the same algorithm for each station of the network. At a given station, the algorithm requires data only from adjacent stations of the network. The theory of the method is developed through the use of electrical models of network programming problems. The techniques should be useful for the communications message-routing problem and similar cases in which the disadvantages of relying on a computation performed at a maser station must be avoided.

1584

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PSEUDORANDOM SCANNING, by T. S. Huang. [1964] [3]p. incl. diagrs. (AFOSR-65-0362) (DA 36-039-AMC-03200(E)) AD 611718 Unclassified

Also published in IEEE Trans. Commun. Technol., v. COM-12: 105-107, Sept. 1964.

The use of pseudorandom scanning is considered in the transmission of still picture through a 1-dimensional channel. It is shown that: (1) if the channel contains noise of a burst nature then pseudorandom scanning should give a better picture; and (2) in a low-pass channel pseudorandom scanning will add substantial noise to the picture even if the channel bandwidth is reasonably wide.

1585

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

TRANSFORMATION OF SMALL-SIGNAL ENERGY AND MOMENTUM OF WAVES, by R. J. Briggs. [1964] [5]p. incl. diagrs. (AFOSR-65-0363) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Jour. Appl. Phys., v. 35: 3268-3272, Nov. 1964.

The transformation of the small-signal energy and momentum of a wave between two inertial reference frames as first given by Sturrock are derived by using simple perturbation theory and the appropriate transformations of length, time, current, and electromagnetic fields. The approach allows a straightforward generalization to the case of relativistic linear transformations to nonrelativistic transformations between two reference frames that rotate with respect to each other. These rotating and linear transformations allow one to make very general statements about the frequency and wave numbers for which negative-energy waves are obtained in a rotating and translating medium, as, for example, an electron beam in Brillouin flow. (Contractor's abstract)

1586

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DIAGNOSTIC EXPERIMENTS IN A MAGNETICALLY DRIVEN SHOCK TUBE, by J. B. Heywood. Dec. 31, 1964, 57p. incl. illus. diagrs. tables, refs. (Technical rept. no. 428; Fluid Mechanics Lab. publ. no. 65-1) (AFOSR-65-0544) (DA 36-039-AMC-03200(E)) AD 610583 Unclassified

This report describes the results obtained from a series of experiments in hydrogen in a magnetic annular shock tube with an applied axial magnetic field. Measurements of the front speed were made over as wide a range of initial gas pressure, initial drive bank voltage, and axial magnetic field as possible. These results are compared with the predicted speeds obtained from the Kemp and Petschek solutions and the snowplow model, and reasonable agreement is obtained. Measurements were also made on the front properties with magnetic and electric field probes inside the annulus, and with phototubes. It was found that a substantial fraction of the drive current always flows in the front and no shock wave preceding the current sheet was observed. (Contractor's abstract, modified)

1587

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERTURBATION OF A PLASMA BY A PROBE, by J. F. Waymouth. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0545) (DA 36-039-AMC-03200(E)) AD 611641 Unclassified

Also published in Phys. Fluids, v. 7: 1843-1854, Nov. 1964.

The theory of the electrostatic probe immersed in a plasma is discussed under the assumptions that particle mean free paths are comparable with or smaller than probe radius. The range of validity of the results is for $\lambda_c/r_p < 10$, $r_p/100\lambda_D > 1$, $\lambda_c/\lambda_D > 10$, where r_p is probe radius, λ_c is particle mean free path, and λ_D is the Debye length. In the limit of λ_c/r_p approaching infinity, the results converge toward the Langmuir result for the same probe. The probe-current vs voltage characteristic obtained when mean free paths are short is distorted because the degree of perturbation of plasma density and potential vary with probe voltage. An unexpected result is that the shape of the probe characteristic in the vicinity of the "knee" is sensitive to ion temperature, and may possibly be used to determine the ion temperature. (Contractor's abstract)

1588

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

MEASUREMENT OF CORRELATION FUNCTIONS, by M. Schetzen. [1964] [5]p. incl. diagrs. (AFOSR-65-0546) (DA 36-309-AMC-03200(E)) AD 611947 Unclassified

Also published in Proc. IEEE (London), v. 111: 2100-2104, Dec. 1964.

A practical and relatively simple method of measuring correlation functions is presented. The method, which is applicable to all orders of correlation functions, is based upon orthogonal expansions. The application of this method to the experimental determination of a 2nd-order cross correlation function is discussed in detail and some experimental results are presented. (Contractor's abstract)

1589

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NATURE OF SPONTANEOUS OSCILLATIONS IN A CESIUM DIODE ENERGY CONVERTER, by W. T. Norris. [1964] [9]p. incl. diagrs. (AFOSR-65-0547) (DA 36-039-AMC-03200(E)) AD 611640 Unclassified

Also published in Jour. Appl. Phys., v. 35: 3260-3268, Nov. 1964.

In an attempt to understand the nature of the oscillations that are observed in plasma diodes the usual collision-free model is examined. The equations describing the model are simplified by neglecting the time-dependent term in the Boltzmann equation for the electrons. A criterion is introduced of stability which allows the prediction of a possible instability in the steady-state condition which arises because the electrons can redistribute their charge more rapidly than the ions. The simplified equations and the criterion together lead to a good qualitative and a partial quantitative understanding of a particular case. (Contractor's abstract, modified)

1590

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

EMITTER MATERIALS FOR HIGH TEMPERATURE ENERGY CONVERSION, by W. B. Nottingham. [1964] [15]p. incl. diagrs. tables, refs. (AFOSR-65-0610) (DA 36-039-AMC-03200(E)) AD 451360; AD 452625 Unclassified

Presented at Proc. Eighteenth Annual Power Sources Conf., May 19-21, 1964.

Also published in High Temp. Technol., 1964, p. 389-403.

This report presents a number of pertinent points relative to the properties of materials, and specifically of emission materials needed for the efficient operation of a thermionic energy converter. Rasor (Proc. IEEE, v. 51: 733, 1963) has made an analysis that shows that rhenium and tungsten are the most favorable emitter materials, and molybdenum and tantalum are possible for emitter use. This paper gives major attention to the properties of rhenium and tungsten.

1591

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A KINETIC INVESTIGATION OF THE INTERACTION OF ADENOSINE-5'-TRIPHOSPHATE WITH DIVALENT METAL IONS, by G. C. Hammes and S. A. Levison. [1964] [3]p. incl. diagrs. table, refs. (AFOSR-65-0612) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Biochem., v. 3: 1504-1506, Oct. 1964.

Rate constants for the formation and dissociation of Ni(II) and Co(II) complexes of ATP have been determined utilizing the temperature-jump method; lower bounds of the rate constants for the corresponding Mn(II) complex have also been determined. The values of the formation rate constant at 25° in 0.1M KNO_3 for Ni(II), Co(II), and Mn(II) are 4.1×10^6, 9.2×10^7, and $> 10^9 M^{-1}$ sec^{-1}, respectively, while those for the dissociation rate constant are 38, 2.0×10^3, and $> 10^4$ sec^{-1}. Experimental values of the formation rate constant for these ions plus those for Ca(II) and Mg(II) are in reasonable agreement with calculated values based on a previously proposed mechanism involving water dissociation from the inner hydration shell of the metal ion as the rate-determining step in complex formation. The implications of these results for the understanding of metal ion specificity in biological systems are discussed. (Contractor's abstract)

1592

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A SYSTEM FOR AUTOMATIC RECOGNITION OF HANDWRITTEN WORDS, by P. Mermelstein and M. Eyden. [1964] [10]p. incl. illus. table. (AFOSR-65-0903) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Proc. Fall Joint Computer Conf., San Francisco, Calif., Oct. 27-29, 1964, p. 333-342.

Experimental results are reported for the recognition of 254 word samples under various conditions of machine learning. The test samples were generated by 4 writers from a vocabulary of 32 words in which each letter of the alphabet occurred at least twice. A dictionary of the 10,000 most frequently used English words was used to limit the recognition results to words of the language. Experiments carried out by general purpose computer simulation of the recognition system reveal that the system is capable of recognizing well-formed, legible

handwritten words with a reliability that depends on the correspondence between the script of the writing sample and that of the ensemble on which the machine's representation of handwriting is based. The resulting recognition rates are found to be significantly better than those previously reported.

1593

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MINIMUM DETECTABLE CHANGE IN INTERAURAL TIME OR INTENSITY DIFFERENCE FOR BRIEF IMPULSIVE STIMULI, by J. L. Hall, II. [1964] [3]p. incl. diagrs. (AFOSR-65-1148) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 2411-2413, Dec. 1964.

Experimental results are presented for an investigation of the just-noticeable change in interaural time difference and interaural intensity difference as a function of over-all intensity. Three subjects were studied in a dark, sound proofed room with stimuli produced by dichotic clicks, the click to one ear leading by $\Delta\tau/2$ μ sec or more intense by $\Delta I/2$ dB. The results are presented with no attempt at physiological interpretation. (Contractor's abstract)

1594

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE OPERATION OF OPTICAL MASERS IN UNIFORM MAGNETIC FIELDS, by W. A. Runciman. [1964] [4]p. incl. diagrs. (AFOSR-65-1391) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 1: 673-676, 1964.

A ruby optical maser and a helium-neon gas maser were examined in a homogeneous magnetic field. Observation of the ruby maser at various angles indicated that in all cases the Zeeman components of lowest energy are strongest. It was found possible to tune the frequency by 7 cm^{-1} using a magnetic field of 49 kilogauss and to operate the ruby maser at two frequencies separated by 5 cm^{-1}. Similar experiments with helium-neon gas masers exhibited quenching effects in the mode pattern at 3-6 kilogauss.

1595

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THEORY, PRODUCTION AND USE OF OPTICAL GRATINGS FOR HIGH-RESOLUTION SPECTROSCOPY, by G. W. Stroke. [1964] [17]p. incl. illus. diagrs. refs. (AFOSR-65-1392) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 2: 1221-1237, 1964.

Using the interferometric servo-control system, optical gratings have been ruled for spectral resolutions in the 1 million resolving power range. The simplified interferometric control system for the Jewell-Ash ruling engine is described. A short resumé is first given of the theory of the diffraction of light by gratings. The control system for the Jewell-Ash engine is then considered, and finally the application of such gratings to high-resolution spectroscopy is discussed.

1596

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

NONLINEAR EFFECTS IN SOLID STATE PLASMAS, by B. Lax, A. L. McWhorter, and J. G. Marvroides. [1964] [6]p. incl. refs. (AFOSR-65-1394) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb 11-15, 1963), New York, Columbia U. Press, v. 2: 1521-1526, 1964.

Nonlinear phenomena in plasmas can be induced by intense optical fields to produce frequency doubling and mixing. It is shown theoretically that a variety of schemes are available for observing the phenomena on the surface or in the bulk materials containing electron plasmas. The bulk phenomena can be utilized to develop parametric devices which should permit the realization of amplifiers and oscillators as sources in the far infrared region of the spectrum.

1597

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

THE RAMAN MASER, by H. J. Zeiger and P. E. Tannenwald. [1964] [3]p. (AFOSR-65-1395) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Quantum Electronics; Proc. Third Internat'l. Cong., Paris (France) (Feb. 11-15, 1963), New York, Columbia U. Press, v. 2: 1589-1596, 1964.

In this investigation, it is shown that the emission of coherent Raman radiation is particularly favorable because it does not depend on achieving population inversion of energy levels. The Raman scattering from a crystal with ionic energy levels is calculated, and it is shown how the theory can be extended to the case of scattering from vibrational levels of a solid or liquid. The requirements for satisfying the oscillation condition are considered, based on estimates of available laser sources, laser and Raman cavity Q's, and matrix elements.

1598

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NUCLEAR MOMENTS AND ISOTOPE AND ISOMER SHIFTS OF NEUTRON-DEFICIENT MERCURY ISOTOPES 195, 195^m, 194, 193, 193^m AND 192, by W. J. Tomlinson, III and H. H. Stroke. [1964] [20]p. incl. diagrs. tables, refs. (AFOSR-65-1469) (DA 36-039-AMC-03200(E)) Unclassified

Also published in Nuclear Phys., v. 60: 614-633, 1964.

Nuclear spins I, magnetic-dipole μ and electro-quadrupole Q moments, and optical spectroscopic isotope and isomer shifts (IS) were obtained for the neutron-deficient mercury isotopes and isomers with mass numbers from 192 to 195. The isotopes were produced by p, yn reactions on Au^{197}. Approximately 0.01 μg of Hg was transferred into the rf-excited electrodeless light sources. A well-blazed plane diffraction grating, 25 cm wide, was used in the multiple wavelength monochromator of 11 m focal length for these high-resolution optical hfs measurements. The isotope- and isomer-shift results, which led to a hypothesis of the cause of odd-even staggering in isotope shift are discussed. (Contractor's abstract, modified)

1599

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DIGITAL COMMUNICATION OVER FIXED TIME-CONTINUOUS CHANNELS WITH MEMORY—WITH SPECIAL APPLICATION TO TELEPHONE CHANNELS, by J. L. Holsinger. Oct. 20, 1964, 117p. incl. diagrs. refs. (Technical rept. no. 430) (Lincoln Lab. technical rept. no. 366) (AFOSR-65-1470) (DA 36-039-AMC-03200(E)) Unclassified

This report studies the performance of the best possible method for digital communication over fixed time-continuous channels with memory, i.e., channels with intersymbol interference and/or colored noise. The channel model assumed is a linear, time-invariant filter followed by additive, colored Gaussian noise. Two questions are considered: (1) given a set of signals, what is the probability of error? and (2) how should these signals be selected to minimize the probability of error? It is shown that answers to these questions are possible when a suitable vector space representation is used, and the basis functions required for this representation are presented. Using this representation and the random coding technique, a bound on the probability of error for a random ensemble of signals is determined and the structure of the ensemble of signals yielding a minimum error bound is derived. The inter-relation of coding and modulation in this analysis is discussed and conclusions shown. (Contractor's abstract, modified)

1600

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SEQUENTIAL MEASUREMENT OF MULTIDIMENSIONAL TRANSDUCERS, by J. R. Sklar. Oct. 29, 1964, 85p. incl. diagrs. tables, refs. (Technical rept. no. 431) (Lincoln Lab. technical rept. 360) (AFOSR-65-2272) (DA 36-039-AMC-03200(E)) Unclassified

This report analyzes a sequential algorithm suggested by R. M. Fano and describes its application to measurement problems. From the analysis, bounds to the average number of computations needed to estimate one parameter are obtained. A bound is also derived for the probability of estimating at least one parameter of a set incorrectly. This difficulty determines a limit to the precision obtainable with the sequential method. A series of simulation experiments was performed to test the hypotheses and, although the theoretical and simulated measurement problems were not identical, the theoretical and experimental results agree, at least qualitatively. (Contractor's abstract, modified)

1601

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

FREQUENCY-IMPULSE MODULATION AS A MEANS OF ATTAINING ACCURACY IN CESIUM ATOMIC CLOCKS, by R. S. Badessa, V. J. Bates, and C. L. Searle. [1964] [6]p. incl. diagrs. table. (AFOSR-65-2443) (DA 36-039-AMC-03200(E)) Unclassified

Also published in IEEE Trans. on Instr. and Meas., v. IM-13: 175-180, Dec. 1964.

An electronic system has been developed which corrects for cavity-detuning errors in cesium atomic-beam frequency standards. The RF signal applied to the beam tube is square-wave phase modulated, i.e., frequency-impulse modulated. The transient response of the beam tube to these phase steps is used as a control signal. When the positive and negative transients are both equal in area and identical in shape, it will be shown that the applied RF signal must be exactly at cesium frequency (for the given magnetic field) and the RF cavities must be exactly in tune. Two feedback loops are needed; one for correcting the crystal oscillator, the other for adjusting the relative phase of the RF cavities. With cavity detuning error greatly reduced by this system, the remaining source of inaccuracy is the uncertainty of the magnetic field in the drift region of the beam tube. An experiment is described which may permit setting a given cesium-beam standard to a frequency that differs by a precisely known amount from the zero-field cesium-resonance frequency. (Contractor's abstract)

1602

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ANALOG COMMUNICATION OVER RANDOMLY-TIME-

VARYING CHANNELS, by H. L. Van Trees. 1964, 25p. incl. diagrs. refs. (AFOSR-68-1808) (DA 36-039-AMC-03200(E)) AD 451891 Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-12: 51-63, Jan. 1968.

The problem of analog communication over a randomly-time-varying channel is discussed.

1603

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CONSTRUCTION OF TIME-LIMITED FUNCTIONS WITH SPECIFIED AUTOCORRELATION FUNCTIONS, by E. M. Hofstetter. [1964] [8]p. (DA 38-039-AMC-03200(E)) AD 442967 Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-10: 119-126, Apr. 1964.

A necessary and sufficient condition is derived for a function to be the autocorrelation function of a time-limited function of specified length. A constructive procedure for determining all possible time-limited functions having the same autocorrelation function as a given time-limited function is presented. The procedure consists of passing the given time function through one out of a collection of specially tailored all-pass filters. The class of functions so generated may be either finite or infinite depending on the original time function. Specific examples of the construction procedure are given.

1604

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DERIVATION OF SPIN HAMILTONIANS BY TENSOR DECOMPOSITION, by W. J. C. Grant and M. W. P. Strandberg. [1984] [5]p. (DA 36-039-AMC-03200(E)) AD 442968 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 635-639, 1964.

The spin Hamiltonian of a paramagnetic system is derived from the decomposition of spherical tensors having appropriate symmetry properties. Although no explicit use of group theory is involved, the Hamiltonian obtained is similar to that derived from purely group theoretical methods.

1605

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

OBSERVATIONS OF THE AEROSOL LAYER AT 20 KM BY OPTICAL RADAR, by G. Flocco and G. Grams. [1964] [2]p. [DA 38-039-AMC-03200(E)) AD 442972 Unclassified

Also published in Jour. Atmos. Sci., v. 21: 323-324, May 1964.

The existence of an aerosol layer at an altitude of about 20 km has been well established by optical techniques and by direct sampling from balloons and aircraft. Preliminary results from observation of this layer with an optical radar are reported.

1606

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SYNTACTIC RULES USED BY CHILDREN FROM PRESCHOOL THROUGH FIRST GRADE, by P. Menyuk. [1964] [14]p. (DA 38-039-AMC-03200(E)) AD 442948 Unclassified

Also published in Child. Develop., v. 35: 533-548, 1964.

A transformational model of syntactic structures was used to describe children's grammar from under 3 years of age to over 7 years as a self-contained system and to indicate developmental trends. An almost steady rise in the percentages of children using transformations as an increasingly older population was observed. The youngest children excluded rules at the phase structure and transformational levels of the grammar and alternated more restricted and nonrestricted rules at all three levels of the grammar. The addition of these excluded rules and a change in the number and nature of the restricted forms used seem to be developmental trends.

1607

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SOME MEMORY ASPECTS OF FINITE AUTOMATA, by C. L. Liu. May 31, 1963, 71p. incl. diagrs. tables. (Technical rept. no. 411) (AFOSR-5001) (DA 36-039-sc-78108) AD 409580 Unclassified

The most important characteristic of a finite automaton is that it has a memory. By this we mean that the behavior of an automaton is dependent upon its past history. In this report several special cases are studied in which the unique determination of the behavior of an automaton is possible, even when a portion of its past history is unknown.

1608

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A DIGITAL SPECTRAL ANALYSIS TECHNIQUE AND ITS APPLICATION TO RADIO ASTRONOMY, by S. Weinreb. Doctoral thesis, Aug. 30, 1963, 119p. incl. illus. diagrs. tables, refs. (Technical rept. no. 412) (AFOSR-5483) (DA 36-039-sc-78108) AD 418413 Unclassified

An efficient, digital technique for the measurement of the autocorrelation function and power spectrum of Gaussian random signals is described. This report presents an indirect method of computing the autocorrelation function of a signal having Gaussian statistics which greatly reduces the amount of digital processing that is required. A review of the measurement of power spectra through the autocorrelation function method is given. The one-bit technique of computing the autocorrelation function is presented; in particular, the mean and variance of the resulting spectral estimate have been investigated. These results are then applied to the problem of the measurement of spectral lines in radio astronomy. A complete radio-astronomy system is described. (Contractor's abstract, modified)

1609

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

AN ANALYSIS AND SYNTHESIS PROCEDURE FOR FEEDBACK FM SYSTEMS, by A. Wojnar. Sept. 30, 1963, 49p. incl. diagrs. tables, refs. (Technical rept. no. 415) (AFOSR-5484) (DA 36-039-sc-78108) Unclassified

An investigation of frequency-compressive feedback FM systems has been made, with emphasis placed on threshold behavior. In Part A, following a survey of the existing noise analysis of FM systems, use is made of a recent evaluation of the impulsive noise component which is due to Rice. It is shown that this excess-noise component predominates in the threshold region of most conventional FM systems. In Part B, two possible mechanisms causing noise threshold in a feedback FM system are examined. It is shown that the feedback threshold results in an abrupt breakdown of system performance, and therefore should not be approached too closely. Some modified formulas for feedback FM system performance at threshold are proposed; new bounds on the performance of the systems with optimum feedback filters are derived. Experimental results with certain feedback FM configurations are reported. (Contractor's abstract, modified)

1610

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

INVESTIGATION OF ELECTRON-BEAM INTERACTION WITH A BEAM-GENERATED PLASMA, by W. D. Getty. Jan. 19, 1933, 110p. incl. illus. diagrs. tables, refs. (Technical rept. no. 407) (AFOSR-5485) (DA 36-039-sc-78108) AD 298698 Unclassified

This report is concerned with the study of the beam-plasma interaction and the consideration of it as a possible mechanism for the heating of plasma electrons. A strong interaction between the electron beam and a weakly ionized gas is produced by a moderately high-perveance electron gun operating at peak pulse voltages up to 10 kv. After a time delay that is required for the production of plasma by beam ionization, self-excited uhf oscillations are observed. These oscillations are accompanied by several phenomena such as: scattering of the electron beam across the axial magnetic field by oscillatory, electric-field forces; generation of an intense pulse of visible light which occurs simultaneously with the beam scattering; and excitation of electrons to energies above 100 ev. An approximate small-signal theory of wave propagation in a cylindrical beam-plasma system is applied in the interpretation of certain properties of the plasma oscillations. It is concluded that, in a beam-generated plasma system, the oscillations start at a frequency that is determined by the magnetic field, and they become sufficiently intense to impart a significant oscillatory energy to the plasma electrons. (Contractor's abstract, modified)

1611

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CODING AND DECODING FOR TIME-DISCRETE AMPLITUDE-CONTINUOUS MEMORYLESS CHANNELS, by J. Ziv. Jan. 31, 1963, 101p. incl. diagrs. tables, refs. (Technical rept. no. 399) (AFOSR-5486) (DA 36-039-sc-78108) AD 299016 Unclassified

This report can be summarized under 3 main headings: (1) Signal space structure—A scheme for constructing a discrete signal space, for which sequential encoding-decoding methods are possible for the general continuous memoryless channel, is described. The effects of these signal-space constraints on the average probability of error, for different signal-power constraints, are also discussed. (2) Decoding schemes—The application of sequential decoding to the continuous asymmetric channel is discussed. A new decoding scheme for convolutional codes, called successive decoding, is introduced. The corresponding probabilities of error of the 2 decoding schemes are also discussed. and (3) Quantization at the receiver—Its effects on probability of error and receiver complexity are considered. (Contractor's abstract, modified)

1612

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THRESHOLD DECODING, by J. L. Massey. Apr. 5, 1963, 123p. incl. diagrs. tables, refs. (Technical rept. no. 410) (AFOSR-5487) (DA 36-039-sc-78108) AD 407946 Unclassified

Two procedures for decoding linear systematic codes, majority decoding and a posteriori probability decoding, are formulated. The essential feature of both methods is a linear transformation of the parity-check equations of the code into "orthogonal parity checks." The decoding decisions are then made on the basis of the values assumed by these orthogonal parity checks. For binary codes, the principal component required in the circuitry for instrumenting these decoding rules is an ordinary threshold logical element. For this reason, these decoding rules are referred to as for ms of

"threshold decoding." It is shown that threshold decoding can be applied effectively to convolutional codes up to approximately 100 transmitted bits in length over an interesting range of rates. Very simple decoding circuits are presented for such codes. It is also shown that threshold decoding is applicable to certain low-rate block codes, and that a generalization of the method is applicable to several other classes of block codes. (Contractor's abstract, modified)

1613

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

[GENERAL NOTIONS CONCERNING THE MACROSCOPIC THEORY OF WAVES IN PLASMAS] Notions generales sur la theorie macroscopique des ondes dans les plasmas, by W. P. Allis and J. L. Delcroix. [1963] [38]p. incl. diagrs. tables, refs. (AFOSR-5501) (DA 36-039-sc-78108) AD 447416 Unclassified

The propagation of monochromatic plane waves in an indefinite plasma is treated in the hydrodynamic theory of two fluids. Plasmas with isotropic pressure and waves obeying exact adiabaticity are considered.

1614

[Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge]

MEASUREMENTS OF THE SUN, MOON, VENUS, AND TAU A AT 1.18 CM WAVELENGTH, by D. H. Staelin, A. H. Barrett, and B. R. Kusse. [1963] [1]p. (AFOSR-J977) (DA 36-039-sc-78108) Unclassified

Also published in Astronom. Jour., v. 88: No. 1310, June 1963.

During December 1962 observations were made of the sun, moon, Venus, and Tau A at 1.18-cm wavelength (f = 25.5 Gc/sec). A 8.0 min beamwidth was obtained using the 28-ft-diameter paraboloid reflector at Lincoln Laboratory, MIT. The radiometer was a Dicke-type superheterodyne with a bandwidth of 8 Mc/sec and a sensitivity of 2.5°K with a 5-sec integration time. Data from these observations are given.

1615

Massachusetts Inst. of Tech. Research Lab. of Electronics. Cambridge.

A CIRCULARLY POLARIZED MASER OSCILLATOR, by T. Ogawa. [1963] [6]p. incl. illus. diagrs. refs. (AFOSR-J990) (DA 36-039-sc-78108) Unclassified

Also published in Jour. Appl. Phys., v. 34: 484-488, Mar. 1963.

The frequency stability of a circularly polarized solid-state paramagnetic maser oscillator has been observed with the objective of obtaining the information needed to construct a frequency standard with a broad microwave spectral line. The beat frequency between two such masers by using ruby can be made almost free from the variation of the static magnetic field and of the angle between the crystalline axes and the static magnetic field. The stability of the 1.5-mc beat frequency is approximately 10^{-6} for short time intervals, and is approximately 10^{-5} for long time intervals. The effect of reflections from the load on frequency is considerably reduced by the unidirectional structure used here, as compared with that to be expected with a reflection type of maser. (Contractor's abstract, modified)

1616

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

PERTURBATION OF VOWEL ARTICULATIONS BY CONSONANTAL CONTEXT: AN ACOUSTICAL STUDY, by K. N. Stevens and A. S. House. [1963] [18]p. incl. diagrs. tables, refs. (AFOSR-J1000) (DA 38-039-sc-78108) Unclassified

Also published in Jour. Speech and Hearing Research, v. 6: 111-128, June 1963.

Measurements of the formant frequencies and bandwidths of 8 common vowels of American English are described. The speech materials were provided by 3 adult male talkers and the measurements were performed using a spectrum-matching procedure implemented on a general-purpose digital computer. The differences between the present data and measurements in the literature, and the systematic differences in formant data from one talker to another are discussed and explicated in terms of an acoustical theory of speech production and certain postulated dynamic properties of the articulatory mechanism.

1617

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ODOR SPECIFICITIES OF THE FROG'S OLFACTORY RECEPTORS, by R. C. Gesteland, J. Y. Lettvin, and others. [1963] [16]p. incl. diagrs. table. (AFOSR-J1007) (DA 38-039-sc-78108) Unclassified

Also published in Proc. First Internat'l. Symposium on Olfaction and Taste; Oxford, Pergamon Press, 1963, p. 19-34.

This report may be summarized as follows: (1) A new recording technique that allows the action potentials of single primary olfactory receptors in the frog to be recorded extracellularly is described; (2) The general response patterns of the olfactory receptors are described and correlated with the observations on the slow potentials of the mucosa; (3) Some of the odor-specific properties of the receptors are described; and (4) Possible receptor mechanisms are discussed in the light of the new data on odor-specific responses.

1618

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

SIMPLIFIED ANALYSIS OF THE RIJKE PHENOMENON, by G. C. Maling, Jr. [1963] [2]p. incl. diagr. (AFOSR-J1120) (DA 38-039-sc-78108) AD 417807 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1058-1060, July 1963.

The wave equation including source terms that arise because of introduction of heat into a medium has been used as the starting point for a small-signal analysis of the Rijke phenomenon. The dependence of the onset of oscillation on mean flow velocity through the tube has been found for 3 different values of heater power. The results of the analysis compare favorably with experimental results when the cutoff occurs at high flow velocities. At lower flow velocities, the analysis is not satisfactory because of an instability in the mean flow. (Contractor's abstract)

1619

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

HYPERFINE STRUCTURE, ISOTOPE, AND ISOMER SHIFTS IN Hg^{193m}, Hg^{194}, Hg^{195m}, AND Hg^{195}— COMMENTS ON THE PAPER OF KLEIMAN AND DAVIS, by W. J. Tomlinson, III and H. H. Stroke. [1963] [3]p. incl. illus. diagr. tables. (AFOSR-J1121) (DA 36-039-sc-78108) AD 415792 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 828-830, July 1963.

An analysis has been made of the discrepancies between the hfs and isotope shift results for Hg^{194}, Hg^{195}, and Hg^{195m} of Kleiman and Davis and the data obtained particularly in view of the importance of these results for interpretation of the odd-even staggering effect in isotope shift. The hfs results have been confirmed by the more precise level-crossing experiments. Errors in the work of Kleiman and Davis have been attributed, in part, to the presence of Hg^{197} and Hg^{197m} in their sources. Experimental results are shown for the Hg^{194} isotope shift. It was found that $Hg^{194}-Hg^{198}$ isotope shift = 0.146 ± 0.010 cm^{-1}, and a preliminary value $Hg^{193m}-Hg^{195m}$ shift = 0.150 cm^{-1}. These results lend further support to the hypothesis on the causes of odd-even staggering in isotope shift. (Contractor's abstract, modified)

1620

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STARK EFFECT AND HYPERFINE STRUCTURE OF HYDROGEN FLUORIDE, by R. Weiss. [1963] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-J1122) (DA 36-039-sc-78108) AD 415790 Unclassified

Also published in Phys. Rev., v. 131: 659-665, July 15, 1963.

The nuclear hyperfine structure constants and the electric dipole moment of hydrogen fluoride, H^1F^{19}, in the ground-vibrational and first excited rotation state have been measured in a molecular beam electric resonance experiment. A digitally computed solution of the Stark effect with magnetic hyperfine structure was necessary to interpret the data. The theory and experiment are in good agreement over the range of electric-field strengths used in the experiment. The hfs constants are in excellent agreement with the averaged absolute values of these constants as measured in a molecular beam magnetic resonance experiment. The agreement has significance because of discrepancies between the results from the two resonance methods, for some other molecules, in previous experiments. (Contractor's abstract, modified)

1621

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A HEURISTIC DISCUSSION OF PROBABILISTIC DECODING, by R. M. Fano. [1963] [11]p. incl. diagrs. refs. (AFOSR-J1124) (DA 36-039-sc-78108) Unclassified

Also published in IEEE Trans. Inform. Theory, v. IT-9: 64-74, Apr. 1963.

The purpose of this paper is to present a heuristic discussion of the probabilistic decoding of digital messages after transmission through a randomly disturbed channel. The adjective "probabilistic" is used to distinguish the decoding procedures discussed here from algebraic procedures based on special structural properties of the set of code words employed for transmission. In order to discuss probabilistic decoding in its proper frame of reference, the more general problem of transmitting digital information through randomly disturbed channels is outlined and some of the key concepts and results pertaining to it are briefly reviewed.

1622

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ON THE EFFECT OF ATMOSPHERIC TURBULENCE ON SOUND PROPAGATED OVER GROUND, by U. Ingard and G. C. Maling, Jr. [1963] [3]p. incl. diagrs. refs. (AFOSR-J1393) (DA 36-039-sc-78108) Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 1056-1058, July 1963.

The sound field above a plane boundary has been calculated by assuming that both the direct and reflected

waves fluctuate in amplitude and phase. The pressure field is described in terms of a time-dependent mean-square pressure ($\overline{p^2}$) whose statistical properties are studied. The mean and variance of ($\overline{p^2}$) have been calculated by assuming that the turbulent fluctuations are normally distributed. The results are compared with some experimental data obtained outdoors over a large rigid boundary. Most of the experimental data have been found to be in good agreement with the calculations. (Contractor's abstract)

1623

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

$^3S_1$ HYPERFINE-STRUCTURE SEPARATIONS AND ISOTOPE SHIFTS OF RADIOACTIVE Cd^{107}, Cd^{109}, AND OF STABLE Cd ISOTOPES, by R. J. Hull and H. H. Stroke. [1963] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-J1545) (DA 36-039-sc-78108) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 53: 1147-1152, Oct. 1963.

High-resolution spectra of radioactive Cd^{107} and of Cd^{111} and Cd^{113} were obtained in the wavelengths λ = 3261, 4678, 4300, and 5085 A. The Cd^{109}-Cd^{113} isotope shift was found in the 3261-A resonance line, 0.033 ± 0.005 cm^{-1}, with the sign of the volume-dependent isotope shift and hfs separation in the 5s6s $^3S_1$ state, $\Delta\nu(Cd^{113}) = -0.407 \pm 0.005$ cm^{-1}. The three 5s6s to 5s5p ^3P lines display isotope shifts that are smaller than the precision of the experiment. A factors of Cd^{107}, Cd^{109}, and Cd^{111} are obtained from the spectroscopic and the published resonance and level-crossing data. The isotope shift is studied in combination with previous results in the light of possible nuclear polarizability effects. (Contractor's abstract, modified)

1624

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STAGES IN THE EDUCATION OF A PHYSICIST: AN ATTEMPTED SOLUTION OF A PEDAGOGICAL PROBLEM, by D. H. Douglass, Jr. and M. W. P. Strandberg. [1963] [6]p. incl. table. (AFOSR-J1546) (DA 36-039-sc-78108) Unclassified

Also published in Amer. Jour. Phys., v. 31: 707-712, Sept. 1963.

The stages in the development of a professional physicist are considered. One of the weak points of this process, the transition from the student stage to research apprenticeship, is considered in some detail. A teaching experiment that has been performed at MIT and was designed to bridge this gap is discussed. The results of this experiment lead to the proposal of this procedure as a partial solution to this particular problem. (Contractor's abstract)

1625

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CENTRAL FACTORS IN AUDITORY FREQUENCY SELECTIVITY, by J. A. Swets. [1963] [12]p. incl. table, refs. (AFOSR-64-0309) (DA 36-039-sc-78108) Unclassified

Also published in Psychol. Bull., v. 60: 429-440, Sept. 1963.

Evidence for involvement of cognitive factors makes it seem clear that the number, the frequency locations, and the widths of the critical bands which are operative in a given auditory task reflect to a substantial extent the strategy of listening that is adopted by O for that particular task. Central modulation of sensory information is extensive enough to make unlikely the discovery, through psychophysical methods, of a unitary peripheral process that remains stable despite changes in O's task, his information, and his aims. The value of a psychophysical approach to peripheral sensory mechanisms depends upon the ability to specify, and then on the ability to isolate, the central contribution to O's response. (Contractor's abstract)

1626

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

MONOGENIC NORMAL SYSTEMS ARE UNIVERSAL, by M. A. Arbib. [1963] [6]p. incl. diagrs. (AFOSR-64-0310) (DA 36-039-sc-78108) Unclassified

Also published in Jour. Australian Math. Soc., v. 3: 301-306, 1963.

In 1943, Post conjectured that "monogenic normal systems are universal", and in 1961 Minsky proved a stronger result "tag' systems are universal" which implied the proof of Post's conjecture. The author had independently obtained a simple direct proof of Post's conjecture. The purpose of this note, then, is to present an exposition of Post's conjecture, and to show the full simplicity of its direct verification. (Contractor's abstract)

1627

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE MECHANISM OF ENZYMATIC TRANSAMINATION, by G. G. Hammes and P. Fasella. [1963] [11]p. incl. diagrs. table, refs. (AFOSR-64-0315) (DA 36-039-sc-78108) Unclassified

Also published in Proc. of Symposium on Chem. and Biol. Aspects of Pyridoxal Catalysis; Rome (Italy) (1962). Oxford, Pergamon Press, 1963, p. 185-195.

The mechanism of enzymatic transamination has been investigated using purified glutamic-aspartic transaminase as a particular example. Both the kinetic and equilibrium properties of the enzyme-substrate systems were investigated at high enzyme concentrations ($> 10^{-3}$M). The kinetic studies were carried out over a time range from 5 μsec to 1 sec. At pH 8.0, the minimal mechanism consistent with all of the data as is as follows: $E_L + As = X_1 = X_2 = E_M + Oa$, $E_M + Kg = Y_2 = Y_1 = E_L + Gm$. A study of the interaction of hydroxylamine with enzyme revealed that the equilibrium constant for Schiff base formation is more favorable for the combination of hydroxylamine with the enzyme at low pH's, although the enzyme is catalytically inactive at these same pH's. A quantitative study of the interaction of keto acids with the pyridoxal form of the enzyme indicated that the rate constant characterizing the formation of E_LKA and E_LKAH^+ complexes is essentially diffusion controlled ($> 5 \times 10^8$ $M^{-1}sec^{-1}$). Possible roles of the protein molecule in the catalytic process are also discussed. (Contractor's abstract, modified)

1628

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DESIGN AND CONSTRUCTION OF HIGH MAGNETIC FIELD TRAVELING WAVE LINES, by L. M. Lidsky and D. J. Rose. [1963] [5]p. incl. illus. diagrs. tables. (AFOSR-64-0323) (DA 36-039-sc-78108) Unclassified

Also published in Rev. Sci. Instr., v. 34: 1223-1227, Nov. 1963.

A pulsed, capacitively loaded helical line capable of generating 5000-G pulses is described. The line velocity is 15 cm/μsec. Titanate ceramics are used as the dielectric elements. The analysis and design take into account the often overlooked effect of inductive coupling between line elements. A formalism suitable for numerical computation of complicated systems is illustrated. The design can be extended to give a variable velocity 9-kG line. (Contractor's abstract)

1629

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

REALIZABILITY OF INDUCTIVE LOGIC, by M. C. Goodall. [1963] [6]p. incl. diagrs. refs. (AFOSR-64-0327) (DA 36-039-sc-78108) Unclassified

Also published in IEEE Trans. Military Electron., v. MIL-7: 168-173, Apr.-July 1963.

The basic model is a two-way communication system in which observer O transmits axioms A, interprets received message S* by rules R of a Post normal logic. O's strategy is to generate (applying R to A) derivations S that minimize d(S, S*), subject among other things, to R being Turing universal. This implies that (A, R:S*) are analogs of complementary observables and interaction potential in quantum mechanics. The model shows, in contrast to the quantum analog, the characteristic openness of induction: namely, S* is not an analytic potential determining probability Pr(R) uniquely, so that restrictions, such as those given, are necessary on the superabundance of R, which, if not arbitrary, must depend on realizability of higher level generalizations. Thus we have here a first stage in a quantitative transformation theory of language. (Contractor's abstract, modified)

1630

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

kTH-ORDER FINITE AUTOMATON, by C. L. Liu. [1963] [6]p. incl. diagrs. tables. (AFOSR-64-0332) (DA 36-039-sc-78108) Unclassified

Also published in IEEE Trans. Electron. Comput., v. EC-12: 470-475, Oct. 1963.

A kth-order finite automaton is an automaton whose next state is a function of its most recent k states as well as its present input. A procedure to test whether a given ordinary automaton is equivalent to some kth-order automaton is suggested. (Contractor's abstract)

1631

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETECTION OF SCATTERING LAYERS IN THE UPPER ATMOSPHERE 960-140 km) BY OPTICAL RADAR, by G. Flocco and L. D. Smullin. [1963] [2]p. incl. diagrs. table. (AFOSR-64-0333) (DA 36-039-sc-78108) Unclassified

Also published in Nature, v. 199: 1275-1276, Sept. 28, 1963.

This communication reports observations made by us of optical echoes from atmospheric constituents (presumably dust) at heights of 60-140 km. They were detected with an optical radar. The techniques utilized are a development of those previously reported. The results obtained from these observations are given.

1632

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

THE INTERACTION OF GLUTAMIC-ASPARTATE TRANSAMINASE WITH PSEUDO SUBSTRATES, by

G. G. Hammes and P. Fasella. [1963] [4]p. incl. diagrs. tables, refs. (AFOSR-64-0337) (DA 36-039-sc-78108) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 3929-3932, Dec. 20, 1963.

Equilibrium and kinetic studies have been made of the interaction of the aldehydic form of glutamic-aspartate transaminase with hydrogen ion, hydroxylamine, ketoglutarate, and oxalacetate. Spectrophotometric methods and the temperature jump technique were primarily employed. A pK of 6.25 was measured for the transformation of the enzyme between a yellow and colorless form. Hydroxylamine forms a complex, presumably an oxime, with both forms of the enzyme, the binding constant for the interaction with the protonated enzyme being much larger. The rate constants for this process are similar to those of the enzyme-substrate reactions. The keto acids, ketoglutarate and oxalacetate, also form complexes with both forms of the enzyme. Again the protonated enzyme interacts much more strongly with the pseudo substrates. The formation of these keto acid complexes is essentially diffusion controlled. The relevance of these findings to the enzymatic mechanism is discussed. (Contractor's abstract, modified)

1633

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

ELASTIC CONSTANTS OF AMMONIUM CHLORIDE NEAR THE LAMBDA POINT, by C. W. Garland and J. S. Jones. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-64-0338) (DA 36-039-sc-78108) Unclassified

Also published in Chem. Phys., v. 39: 2874-2880, Dec. 1, 1963.

The adiabatic elastic constants of single-crystal ammonium chloride have been measured as functions of sound frequency from 5 to 55 mc/sec, and as functions of temperature from ~150° to 300°K by an ultrasonic pulse technique. The values of the constants at 300°K are $c_{11} = 3.70$, $c_{44} = 0.86$, $(c_{11}-c_{12})/2 = 1.41$ in units of 10^{11} dyn/cm^2. Special emphasis was given to the region around 243°K, the critical temperature for the order-disorder transition. The results are discussed in terms of the phenomenological thermodynamic theory of Pippard. (Contractor's abstract)

1634

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

KINETIC THEORY OF PLASMA AND THE ELECTROMAGNETIC FIELD, by T. H. Dupree. [1963] [16]p. incl. refs. (AFOSR-64-0339) (DA 36-039-sc-78108) Unclassified

Also published in Phys. Fluids, v. 6: 1714-1729, Dec. 1963.

An exact kinetic equation for plasma and the electromagnetic field is derived. This equation describes the fluctuations of the fields and particle distributions. The solution is obtained by expanding in a parameter which characterizes the amplitude of these fluctuations. A systematic procedure is given for generating the solution to arbitrary order in the expansion. Some typical applications of the theory are presented. These include calculations of a collision integral, incoherent scattering, and bremsstrahlung emission and absorption. (Contractor's abstract)

1635

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RADIO OBSERVATIONS OF OH IN THE INTERSTELLAR MEDIUM, by S. Weinreb, A. H. Barrett and others. [1963] [3]p. incl. diagr. tables, refs. (AFOSR-64-0340) (DA 36-039-sc-78108) Unclassified

Also published in Nature, v. 200: 829-831, Nov. 30, 1963.

This article reports the detection of 18-cm absorption lines of the hydroxyl (OH) radical in the radio absorption spectrum of Cassiopela A, thereby providing positive evidence for the existence of OH in the interstellar medium. The evidence may be summarized as follows: (1) Lines at both 1,667 mc/sec and 1,665 mc/sec have been detected with frequencies and intensity ratios that are in good agreement with the expected values; (2) The OH absorption spectra at both frequencies show general agreement with the H absorption spectra; (3) The absorption lines disappear when the antenna is positioned off Cassiopela A by one degree in both azimuth and elevation; and (4) The lines shifted 20 kc/sec between October 17 and October 29; this is the shift expected from the orbital velocity of the Earth during this time-interval.

1636

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

BINAURAL INTERACTION IN THE ACCESSORY SUPERIOR OLIVARY NUCLEUS OF THE CAT - AN ELECTROPHYSIOLOGICAL STUDY OF SINGLE NEURONS, by J. L. Hall. Doctoral thesis, Jan. 22, 1964, 88p. (Technical rept. no. 416) (DA 36-039-sc-78108) AD 430953 Unclassified

In an effort to understand the neural encoding of binaurally presented stimuli, clicks were presented through earphones to the 2 ears of Dial-anesthetized cats. The electrical response activity of single nerve cells in the accessory nucleus of the superior olive was studied. Stimulus parameters investigated include interaural time difference, interaural intensity difference, and average intensity. Attention was focused on cells that were excited by stimulation of the contralateral ear and inhibited by stimulation of the ipsilateral ear.

1637

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

CODING FOR PRACTICAL COMMUNICATIONS SYSTEMS, by P. Elias. [1963] [23]p. (DA 36-039-sc-78108) AD 444273 Unclassified

Also published in Radio Waves and Circuits, New York, Elsevier Publishing Co., 1963, p. 125-147.

A discussion of the application of error-correcting codes to practical communications systems leads to the following conclusions: (1) Coding and decoding equipment to implement known schemes is feasible, and (2) Decoding error probability is independent of the statistical characteristics of the source of data, which need not be known. For a scatter link with time-varying path loss, 3 channels are considered. Their average capacities can be measured and the measurement need not be precise; known codes and decoding procedures can be used in all 3 channels, and a code of given rate becomes more reliable and easier to decode as channel capacity increases. Coding may be used in these time-varying channels to give the same reliability as in channels with independent errors, with substantially the same equipment complexity, at a moderate cost in additional delay.

1638

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

DETERMINATION OF THE FINAL STATE OF AN AUTOMATON WHOSE INITIAL STATE IS UNKNOWN, by C. L. Liu. [1963] [4]p. (DA 36-039-sc-78108) AD 439713 Unclassified

Also published in IEEE Trans. Electron. Comput., v. EC-12: Dec. 1963.

Methods are developed to illustrate whether or not it is possible to determine the final state of a finite automaton when (1) the initial state of the automaton is unknown and the input sequence and its corresponding output sequence are given and (2) both the initial state and the input sequence are unknown and only the output sequence is given.

1639

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

NOTE ON BINAURAL MASKING-LEVEL DIFFERENCES AT HIGH FREQUENCIES, by N. I. Durlach. [1964] [6]p. (DA 36-039-sc-78108) AD 440490 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 576-581, Mar. 1964.

A quantitative black-out model is developed for use in interpreting certain data on binaural masking-level differences at high frequencies. The basic idea of this model is that these differences are the result of variations in the extent to which the envelopes of the signals presented to the two ears of the listener are unequal.

1640

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

A PERTURBATION SOLUTION OF THE EQUATION OF MOTION FOR THE DENSITY MATRIX, by H. C. Praddaude. [1962] [13]p. (DA 36-039-sc-78108) Unclassified

Published in Ann. Phys., v. 22: 210-222, May 1963.

A solution of the Laplace transform of the equation of motion for the density matrix is obtained in terms of a resolventlike operator. A suitable expansion of the resolvent in terms of irreducible matrix elements is obtained and as an application of the formalism, the emission of radiation from a 2-level system is treated in the lowest order of present perturbation theory.

1641

Massachusetts Inst. of Tech. [Research Lab. of Electronics] Cambridge.

SIMULTANEOUS STUDIES OF FIRING PATTERNS IN SEVERAL NEURONS, by G. L. Gerstein and W. A. Clark. [1964] [3]p. (DA 36-039-sc-78108) AD 440492 Unclassified

Also published in Science, v. 143: 1325-1327, Mar. 20, 1964.

A tungsten microelectrode with several small holes burnt in the vinyl insulation enables the action potentials from several adjacent neurons to be observed simultaneously. A digital computer is used to separate the contributions of each neuron by examining and classifying the waveforms of the action potentials. These methods allow studies to be made of interactions between neurons that lie close together.

1642

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

WAVES IN ANISOTROPIC PLASMAS, by W. P. Allis, S. J. Buchsbaum, and A. Bers. 1963, 280p. incl. diagrs. tables, refs. (DA 36-039-sc-78108) AD 400916 Unclassified

This report discusses Free waves: General properties of waves in anisotropic media, Particle displacements in the electric field, Phase velocity surfaces, Polarization, Transport theory, and Boltzmann theory. and (2) Energy-power theorems and guided waves: Conservation principles for temperature plasmas, Field analysis of plasma waveguides, and Boundary-value problems

and approximate techniques. Also discussed are Evaluation of integrals for the conductivity, and Expansions of the dielectric tensor for low temperatures.

1643

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

RESEARCH ON PARAMAGNETIC RESONANCES, by M. W. P. Strandberg and R. L. Kyhl. Final rept. Jan. 15, 1963, 27p. (DA 36-039-sc-67376) AD 401469 Unclassified

Research in the field of paramagnetism and metal physics is reviewed. Topics include paramagnetic spin-lattice relaxation, paramagnetic resonance line shapes, masers, lasers, ferroelectric crystals, thin-film superconductivity, microwave surface impedance of superconductors, and studies using coherent phonons.

1644

Massachusetts Inst. of Tech. Research Lab. of Electronics, Cambridge.

STUDIES OF SENSORY PATHWAYS, by P. D. Wall. Final scientific rept. Nov. 1, 1963-Oct. 31, 1964. Nov. 30, 1964, 3p. (AFOSR-65-0153) (AF AFOSR-64-591) AD 610826 Unclassified

Summaries of two phases of the research underway are presented. In the first, problems are discussed relative to devising a computer program which will satisfy the essential requirement of a biological model. In the second, a behavioral, anatomical, and electrophysiological investigation to determine the structural and functional properties of the dorsolateral spinal cutaneous afferent system in the cat is described.

1645

Massachusetts Mental Health Center, Boston.

NORMS ON THE HARVARD GROUP SCALE OF HYPNOTIC SUSCEPTIBILITY FORM A, by R. E. Shor and E. C. Orne. [1963] [9]p. (AFOSR-J329) (AF 49(636)-726) AD 408012 Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 11: 39-47, 1963.

Norms are presented on an adaptation for group administration with self-report scoring of Weitzenhoffer and Hilgard's Stanford Hypnotic Susceptibility Scale, Form A. Comparisons are made between a sample of 132 undergraduates given the new-group administered version and four reference samples including the original Stanford U normative group. Findings indicate that the group-administered version yields norms congruent with the individually-administered original. Diagnostic evaluations of hypnotic depth after one or more additional hypnotic training sessions tentatively indicate that the adapted scale is an effective predictor of subsequent hypnotic depth.

1646

Massachusetts Mental Health Center, Boston.

THE CONTRIBUTION OF NONDEPRIVATION FACTORS IN THE PRODUCTION OF SENSORY DEPRIVATION EFFECTS: THE PSYCHOLOGY OF THE PANIC BUTTON, by M. T. Orne and D. E. Scheibe. [1964] [10]p. (AFOSR-64-0826) (AF 49(636)726) AD 436384 Unclassified

Also published in Jour. Abnorm. and Social Psychol., v. 68: 3-12, 1964.

From the premise that both social cue factors, or demand characteristics, and sensory deprivation operations combine in producing commonly observed effects of sensory deprivation, an experiment is reported which tests the hypothesis that sensory deprivation effects can be produced by manipulating demand characteristics while holding the effect of the physical environment constant.

1647

Massachusetts Mental Health Center, Boston.

AN EXPERIMENTAL COMPARISON OF HYPNOTIC DEPTH MEASURED BY SELF-RATINGS AND BY AN OBJECTIVE SCALE, by D. N. O'Connell. [1964] [13]p. (AFOSR-64-0631) (AF AFOSR-63-86) AD 436366 Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 12: 34-46, 1964.

The behavioral items of an individually-administered test of hypnotic susceptibility were scored by the subjects themselves and by observers. Susceptibility scores derived from these self-ratings and observer-ratings were in excellent agreement and did not differ significantly in distribution. Marked item scoring biases were found as a function of hypnotizability: poor hypnotic subjects tending to underevaluate their performance and good ones to overevaluate it. Moderate correlations were found between magnitude estimates made by subjects of their subjective hypnotic depth and both observer-ratings and self-rating susceptibility scores.

1646

[Massachusetts Mental Health Center, Boston]

PSYCHOLOGICAL CORRELATES OF PLATEAU HYPNOTIZABILITY IN A SPECIAL VOLUNTEER SAMPLE, by R. E. Shor, M. T. Orne, and D. N. O'Connell. Sept. 1964, 116p. (AFOSR-64-2499) (AF AFOSR-63-66) AD 609713 Unclassified

A number of specific hypotheses about correlates of hypnotizability were tested. Findings confirmed the hypotheses that hypnotizability could be predicted from general propensity for unusual subjective hypnotic-like experiences, from attitudes and motivational factors specifically relating to hypnosis, and from postural

sway, heat illusion, and vividness of mental imagery. In addition, with few exceptions the hypothesis was supported that there would be only negligible relationships between hypnotizability and measures of personality.

1649

[Massachusetts Mental Health Center, Boston]

[INVESTIGATION OF THE NATURE AND USES OF HYNOSIS AS A CONTROL TECHNIQUE]. Final rept. Dec. 1964 [8]p. incl. refs. (AFOSR-64-2519) (AF AFOSR-63-88) Unclassified

The studies conducted under this contract were concerned with the nature of the hypnotic phenomenon. They included investigations of psychophysiological responses during hypnosis, the development of techniques to facilitate such an approach, the investigation of changes which can be brought about by hypnosis with special emphasis on social control and antisocial behavior and, finally, a major effort to study the psychological and psychophysiological correlates of hypnotizability. In the process of the latter studies the Harvard Group Scale of Hypnotic Susceptibility was developed.

1650

Massachusetts Mental Health Center, Boston.

A NOTE ON SHOCK TOLERANCES OF REAL AND SIMULATING HYPNOTIC SUBJECTS, by R. E. Shor. [1964] [5]p. (AFOSR-65-0073) (AF AFOSR-63-88) AD 455660 Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 12: 258-262, 1964.

Prior to the induction of hypnosis, subjects who later in an experiment were actually to be hypnotized selected lower criterion electric shock levels than did subjects who later were only to simulate hypnosis. This is the first quantified objective difference found to date between the behavior of reals and simulators.

1651

Massachusetts Mental Health Center, Boston.

A NOTE ON THE OCCURRENCE OF HYPNOSIS WITHOUT CONSCIOUS INTENT, by M. T. Orne. [1964] [6]p. (AFOSR-65-0074) (AF AFOSR-63-88) AD 455677 Unclassified

Also published in Internat'l. Jour. Clin. and Exper. Hypnosis, v. 12: 75-80, 1964.

Anecdotal data reporting the occurrence of hypnosis in the absence of the hypnotist and without apparent conscious intent on the part of the subject are discussed. It is felt that this phenomenon has considerable implications for an understanding of the hypnotic process. An authenticated autobiographical report of such an event is introduced.

1652

Massachusetts U. [Dept. of Psychology] Amherst.

NOISE AND HUMAN PERFORMANCE, A PSYCHOPHYSIOLOGICAL APPROACH, by W. H. Teichner, E. Arees, and R. Reilly. [1963] [15]p. incl. diagrs. refs. (AFOSR-J528) (AF AFOSR-62-202) AD 407867 Unclassified

Also published in Ergonomics, v. 6: 83-97, Jan. 1963.

A theoretical approach is developed for the study of the effects of noise on human performance which takes into account the psychological factors of distraction and habituation and the physiological factors of auditory adaptation and bodily arousal. Two experiments designed to test theoretical predictions suggested that the approach is reasonable. Distraction studied in terms of changes in ambient noise levels was found to be a function of the amount of change. When adaptation of the ear is controlled by use of on-off sound sequences, ignoring distraction, performance is directly related to the on-off ratio early in exposure and inversely related to the ratio later in exposure. At all sound ratios performance in noise is better than in quiet. When distraction is taken into account, these results are influenced by the differences in rate and amount of adaptation of loudness and rate of habituation to distraction so that at any given time performance may seem to be decreased, increased or unaffected. (Contractor's abstract)

1653

Massachusetts U. [Dept. of Psychology] Amherst.

THE EFFECTS OF ENVIRONMENTAL TEMPERATURE AND ALERTING STIMULI ON PROLONGED SEARCH, by E. A. Arees. June 1963, 29p. (Rept. no. TN-2) (AFOSR-5349) (AF AFOSR-63-404) AD 466160 Unclassified

The purpose of this investigation was to evaluate the effects of air temperature and alerting signals on target detection in a prolonged search task and to evaluate the results in terms of their relations to the physiological thermal gradient. Twenty-four subjects were exposed to air temperatures of 55°, 75° and 105°F at 40% relative humidity under various presentation patterns of a 1-min alerting signal. The results suggest the following conclusions for the conditions involved: (1) Target detection correlates with the physiological thermal gradient for individual subjects. Best individual performance occurs at different air temperatures for different individuals. (2) Target detection appears to be independent of the physiological thermal gradient and of air temperature when averaged over all subjects (3) Alerting stimuli of the sort used have no effect on either target detection or the thermal gradient.

1654

Materials Research Corp., Orangeburg, N. Y.

A STUDY OF SCIENTIFIC RESEARCH MATERIALS,

by G. Murray, A. Johnson and others. Quarterly technical rept. no. 3, Oct. 1, 1963-Jan. 1, 1964. Feb. 12, 1964, 80p. (Rept. no. 452) (AF 49(638)1241) AD 432874 Unclassified

Effort was directed toward (1) a further study of the parameters pertinent to the electron beam zone refinement or refractory metals, (2) a feasibility determination of a plasma heat source for zone refinement, (3) preparation of intermetallic compounds, and (4) initiation of a program in the flux methods of a nonmetallic crystal growth.

1655

Matrix Corp., Arlington, Va.

THE WIT AND HIS GROUP, by J. D. Goodchilds and E. E. Smith. [1964] [9]p. incl. tables, refs. (AFOSR-1983) (AF 49(638)1000) AD 438550 Unclassified

Also published in Human Relations, v. 17: 23-31, 1964.

Two studies of six-person groups of adult male subjects were conducted to examine some personality correlates and possible effects upon the group of naturally occurring witty behavior. The major findings were as follows: (1) All wits were high participants and conformed less to group opinions; (2) Deliberate wits expressed a positive self-image on a variety of measures; (3) Groups containing deliberate wits evaluated the group experience favorably; and (4) Groups containing deliberate wits did better on a problem-solving task than did other groups. (Contractor's abstract)

1656

Maudsley Hospital, London (Gt. Brit.).

THE EFFECT OF INTRAPITUITARY INFUSION OF MEDIAN EMINENCE AND OTHER BRAIN EXTRACTS ON ANTERIOR PITUITARY GONADOTROPHIC SECRETION, by H. J. Campbell, G. Feuer, and G. W. Harris. [1964] [15]p. incl. illus. tables, refs. (AFOSR-65-0036) (AF 61(514)953) AD 454836 Unclassified

Also published in Jour. Physiol. (London), v. 170: 474-486, 1964.

Infusions of extracts of the median eminence of the tuber cinereum, obtained from the brains of rabbits, cattle and monkeys, into the anterior pituitary gland of isolated female rabbits was found to excite secretion of gonadotrophic hormone (presumably LH) as shown by consequent ovulation in 55 out of 90 cases. Similar infusions into the pituitary gland of control brain extracts and other naturally occurring substances resulted in ovulation in only 6 out of 95 cases. Intravenous infusions of median-eminence extracts was found to evoke ovulation in 6 out of 23 rabbits. The conclusions is drawn that the median eminence contains some substance which excites the secretion of LH from the anterior pituitary gland of rabbits. It seems likely that the release of this substance into the hypophysial portal vessels forms part of the neurohumoral mechanism controlling LH secretion.

1657

Maudsley Hospital, London (Gt. Brit.).

VASOPRESSIN AND THYROID FUNCTION IN THE RABBIT, by J. Garcia, G. W. Harris, and W. J. Schindler. [1964] [29]p. incl. diagrs. refs. (AFOSR-65-0037) (AF 61(514)953) AD 454837 Unclassified

Also published in Jour. Physiol, (London), v. 170: 487-515, 1964.

A method is described for measuring changes in thyroid activity in conscious unrestrained rabbits, based on the acute release of I^{131} labelled compounds from the thyroid gland, as determined by measurements of blood radioactivity. With this method straight-line log. dose-response curves have been obtained to TSH given by intravenous infusion in doses between 10 and 1000 m-u. The action of synthetic and highly purified preparations of vasopressin on thyroid function in the rabbit have been studied. An increased thyroid activity is stimulated by 2 hr infusions of vasopressin at rates of 1.4-22.4 m-u/min. It has been shown that vasopressin does not act as a hypothalamic neurohumour increasing the discharge of pituitary TSH; nor does it act to release TSH from peripheral binding sites or to potentiate the action of circulating TSH.

1658

Maudsley Hospital, London (Gt. Brit.).

VASOPRESSIN AND THYROID FUNCTION IN THE RAT: THE EFFECT OF OESTROGENS, by G. W. Harris, S. Levine, and W. J. Schindler. [1964] [8]p. incl. diagr. tables, refs. (AFOSR-65-0038) (AF 61(514)953) AD 454710 Unclassified

Also published in Jour. Physiol. (London), v. 170: 516-523, 1964.

The thyroid response of normal male and female rats to injection of vasopressin has been studied by methods involving the uptake of I^{131} by the thyroid, and the acute release of radio-iodinated compounds from the gland. No sign of increased thyroid activity was observed to follow administration of vasopressin to normal rats. Rats given three spaced injections of oestradiol benzoate over the preceeding 9 days showed an increased thyroidal activity, as assessed by the acute release method, following injection of vasopressin but not of oxytocin. (Contractor's abstract)

1659

Maudsley Hospital, London (Gt. Brit.).

CHEMICAL FACTORS IN THE EXCITATION OF

CEREBRAL TISSUES, hy H. McIlwain. Final technical rept. May 1963, 16p. (AFOSR-4[illegible]57) (AF EOAR-62-4) AD 413762 Unclassified

Mammalian cerebral tissues, electrically stimulated during incubation in isolation, showed a number of coordinated metabolic and electrical changes. Their respiratory rates increased in fashions which were quantitatively related to the duration, frequency, and potential of the stimulating pulses applied. Corresponding increase in movements of Na and K took place. Membrane potentials in cellular elements of the tissue diminished on stimulation and subsequently recovered; the time-course of diminution and recovery was directly connected with the concomitant ion movement. Chlorpromazine, phenobarhitone and cocaine in concentrations involved in their actions as drugs, and also clupeine, affected both ion movements and membrane potentials of the stimulated tissue. They did so in fashions which were characteristic of the added substance.

1660

Maudsley Hospital, London (Gt. Brit.).

SUBSTRATES AND THE POTASSIUM AND SODIUM LEVELS IN GUINEA PIG: CEREBRAL CORTEX SLICES IN VITRO: EFFECTS OF APPLICATION OF ELECTRICAL PULSES OF INHIBITORS AND OF ANOXIA, hy P. Joanny and H. H. Hillman. [1963] [10]p. incl. diagrs. tahles, refs. (AFOSR-J1315) (AF EOAR-63-1) AD 423995 Unclassified

Also puhlished in Jour. Neurochem., v. 10: 655-664, 1963.

In the presence of group (I) substrates, 10 mM-glucose and 20 mM-lactate, the maximum in vitro K and Na gradients are found. With group (II) substrates, 10 mM-L-glutamate 10 mM-glucose mixture, 20 mM-pyruvate, 20 mM-fructose, 10 mM-L-glutamate (alone) and 20 mM-oxaloacetate, near-maximal non-inulin K concentrations were found, hut higher Na (increasing in that order). Group (III) suhstrates, 20 mM-succinate and 20 mM-fumarate, gave no higher K and slightly higher Na than were found in the ahsence of substrate. Electrical stimulation for 10 min in the presence of all suhstrates tested and in the absence of added substrate, and after 3 hr, always caused a fall of K and rise of Na in the direction of their electro-chemical gradients. (Contractor's ahstract)

1661

Maudsley Hospital, London (Gt. Brit.).

CHEMICAL FACTORS IN CEREBRAL EXCITATION, by H. McIlwain. Final technical rept. May 8, 1964, 14p. (AFOSR-64-1275) (AF EOAR-63-1) AD 602790 Unclassified

Membrane potentials recorded intracellularly from slices of cerebral cortex gave a mean value of 59 ± 10 mV (S. D.). Potentials were more stahle in media containing 2.6 mM calcium than in media with 0.75 mM calcium. Small amounts of KCl were applied to the tissue surface, and calculated to give hy diffusion concentrations of K up to 100 mM near the cells under observation. The KCl diminished the potentials, which subsequently recovered. Similar results were obtained hy additions of sodium glutamate. Analysis of the tissue for Na, K, Cl and inulin showed that considerahle gradients existed for these ions between tissue and incubation fluid; the gradients were compared with the observed membrane potentials.

1662

Maudsley Hospital, London (Gt. Brit.).

POLYBASIC AND POLYACIDIC SUBSTANCES OR AGGREGATES AND THE EXCITABILITY OF CEREBRAL TISSUES, ELECTRICALLY STIMULATED IN VITRO, hy H. McIlwain. [1964] [7]p. incl. diagrs. tahles, refs. (AFOSR-64-1703) (AF EOAR-63-1) AD 448260 Unclassified

Also published in Biochem. Jour., v. 90: 442-448, 1964.

Cerebral-cortical tissues lost their normal excitahility on incubation in protamine-containing media, rinsing and examination in a second medium similar to the first hut without protamine. Excitahility could be restored hy adding ganglioside preparations to the second medium. Phosphatidylserine and sulphatide preparations also restored excitahility, hut were required in greater concentrations than were the gangliosides. Chondroitin sulphates, suramin and polyglutamic acids (descending order of activity) also restored excitahility. The effective agents complied with the following general description: they were polyacidic or existed in aqueous solution as polyacidic aggregates, and were required in quantities equivalent to or greater than the basic groups added to the tissue hy the protamine with which it had heen incubated. (Contractor's abstract, modified)

1663

Maudsley Hospital, London (Gt. Brit.).

ACTIONS OF HALOPERIDOL, MEPERIDINE, AND RELATED COMPOUNDS ON THE EXCITABILITY AND ION CONTENT OF ISOLATED CEREBRAL TISSUE, by H. McIlwain. [1964] [7]p. (AFOSR-64-1711) (AF EOAR-63-1) AD 447704 Unclassified

Also puhlished in Biochem. Pharmacol., v. 13: 523-529, 1964.

Haloperidol, two other gamma-animobutyrophenones structurally related to it, meperidine and chlorpromazine were compared in their actions on isolated tissues from guinea pig cerebral cortex. Under ordinary metaholic conditions, the compounds were without effect on the respiration and on the sodium and potassium content of the tissues, and also on their chloride content and glycolysis in the instances examined. Response of the tissues to electrical stimulation was however, highly sensitive to the compounds, all of which inhibited respiratory response at a concentration of 10 mM. At higher concentrations, haloperidol increased the

sodium content of the stimulated tissue. Chlorpromazine also acted in this fashion, but the two other gamma-aminobutyrophenones and meperidine, did not do so.

1664

Max-Planck-Inst. für Biologie, Tubingen (Germany).

PROCESSING OF INFORMATION AND CONTROL PROCESSES IN BIOLOGICAL ORGANISMS, by W. E. Reichardt. Final rept. Mar. 31, 1964, 11p. (AFOSR-64-1064) (AF 61(052)232) AD 441482 Unclassified

This final report, written in summary form includes: (1) Processing of optical information in the compound eye of the horseshoe crab Limulus, (2) Analysis of optomotor responses in insects, (3) The influence of sinusoidally changing brightness densities onto the mean pupil diameter of the human eye and the subjective light intensity, (4) Quantitative relations between light stimulus and contraction of the musculus sphincter pupillae of the toad Discoglossus pictus, and (5) Relations between stimulus input and excitation output in mechanoreceptors.

1665

Max-Planck-[Inst. für Strömungsforschung, Göttingen] (Germany).

RADIOSONDE MEASURES AFTER-EFFECTS OF SOLAR EVENTS, by E. Waibel. [1963] [5]p. incl. diagrs. (AFOSR-64-0117) (AF EOAR-63-56) AD 430669 Unclassified

Also published in Electronics, Apr. 19, 1963.

A balloon-borne radiosonde was developed to explore phenomena initiated by solar events and accompanied by x-rays and particle radiation in the auroral zone. The system distinguishes between photons and charged particles, which is required because both kinds of radiation may occur after strong solar flares. The equipment, which has operated successfully in several flights over the polar ragions of Europe, uses both a scintillation counter and a counter telescope. Because of this combination, the radiosonde can be readily modified for a wide variety of radiation measurements in the upper atmosphere. The system is also easily adjusted and requires little time to make it ready for flight. Design of the radiosonde was influenced by the conditions under which it would operate.

1666

Max-Planck-Inst. für Strömungsforschung, Göttingen (Germany).

RECENT EXPERIMENTAL INVESTIGATIONS ON THE SCATTERING OF SOUND BY TURBULENCE, by D. W. Schmidt. Apr. 1963, 23p. incl. illus. diagrs. (AGARD rept. no. 461) (AFOSR-64-1279) (AF EOAR-63-56) AD 443152 Unclassified

Presented at AGARD specialists' meeting on Mechanism of Noise Generation in Turbulent Flow, Training Center for Experimental Aerodynamics, Rhode-Saint Genèse (Belgium), Apr. 1-5, 1963.

Experimental investigations of the scattering of sound by turbulence were performed in a wind tunnel. Recent theoretical predictions concerning the sound attenuation are well confirmed and partly extended by the measurements. In the range of the parameters which is of interest for practical applications the most important results obtained are the proportionality of the sound attenuation to the square of the sound frequency and to the square of the turbulent Mach number. A formula is derived from which the turbulent attenuation of directed sound (such as aircraft noise in the free atmosphere) can be calculated. A method for measuring large phase variations is described in preliminary form; it will be used to investigate the influence of turbulent scattering on the phase angle of the sound waves. (Contractor's abstract)

1667

Max-Planck-Inst. für Zellchemie, Munich (Germany).

THE BIOSYNTHESIS OF RUBBER, by J. Berndt. Final technical rept. Nov. 30, 1963, 23p. (AFOSR-64-1136) (AF EOAR-63-35) AD 601729 Unclassified

Isopentenyl pyrophosphate is incorporated into rubber by latex (from Hevea brasiliensis) in the presence of Mg ions. By removal of the isopentenylpyrophosphate isomerase from latex it was shown, that dimethylallyl pyrophosphate is necessary as a primer for the rubber biosynthesis. Hence, the formation of the rubber molecule is a de novo synthesis. The polymerase is Mg dependent and is inhibited by SH-poisons, as could be shown with latex freed from isopentenyl-pyrophosphate isomerase.

1668

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

ON THE TWO-STATE MECHANISM FOR HOMOGENEOUS IONIC POLYMERIZATION, by B. D. Coleman and T. G. Fox. [1964] [16]p. (AFOSR-64-1546) (AF 49(638)541) AD 446126 Unclassified

Also published in Jour. Polymer Scl., Part C, 1964, p. 345-360.

To explain the occasional occurrence of "stereoblock" structures in homogeneous anionic polymerization of alpha-olefins it was recently proposed that in these polymerizations the reactive end of a growing polymer can have several, say N, states (1), (2),..., (N) which are in dynamic equilibrium and that each such state is capable of adding monomer with its own rate and stereospecificity. It appears that for the present it is expedient to take advantage of the reduction in the number of free parameters which results when N = 2, and to consider in detail the consequences of a two-state mechanism. Here are summarized those theoretical results

on the two-state model which appear to be accessible to experimentation. The emphasis is on the diastereosequence and molecular weight distributions.

1669

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

MONOTONICITY ON CURVES IN LIEU OF THE C-N INEQUALITIES FOR FINITE ELASTICITY, by L. E. Bragg. [1964] [12]p. (AFOSR-65-0327) (AF 49(636)-541) AD 612239 Unclassified

Also published in Arch. Rational Mech. Anal., v. 17: 327-338, 1964.

It is shown that GCN inequality for the strain energy function is equivalent to the monotonicity of some scalar-valued functions defined over curves in the 6-dimensional space of symmetric tensors. The theory of these curves is developed. (Math. Rev. abstract)

1670

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THERMODYNAMICS OF MATERIALS WITH MEMORY, by B. D. Coleman. [1964] [46]p. incl. refs. (AFOSR-65-0368) (AF 49(638)541) AD 616039 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 17: 1-46, 1964.

This paper attempts to lay the foundations of a thermodynamic theory of simple materials; i.e., materials for which the stress at time t is determined by the history of the strain. The theory is developed from basic equations for the stress, heat flux, specific internal energy, and specific entropy determined by the deformation gradient, past temperature, and temperature gradient at time t. The concepts are macroscopic, the physical principles being those of continuum physics: balance of momentum, balance of energy, equipresence, fading memory, material objectivity, and the Clausium-Duhem inequality.

1671

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

[INFRARED SPECTRA OF SOLIDS]. Final rept. July 31, 1963, 1v. (AFOSR-J1189) (AF 49(636)542) AD 439339 Unclassified

Studies have been made of: (1) Motion of molecules as a whole in condensed phases; (2) Natural lines or band widths of vibrational transitions in the solid state; and (3) Orientation-dependent intermolecular forces. Studies also included: Site splittings and Davydov splittings. Other research reported includes: IR studies of free radicals and flash excitation.

1672

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

NUCLEAR MAGNETIC RESONANCE, by A. A. Bothner-By, C. Naar-Colin and others. Summary rept. [1963] 10p. (AFOSR-4709) (AF 49(636)960) AD 615666 Unclassified

A summary is given of work on: (1) the nuclear magnetic resonance spectra of olefinic compounds; (2) rotational isomerism in 2,3-disubstituted butanes; and (3) methods of analyzing nuclear magnetic resonance spectra.

1673

[Mellon Inst. Dept. of Chemistry, Pittsburgh, Pa.]

INELASTIC SCATTERING OF 390-V ELECTRONS BY HELIUM, HYDROGEN, METHANE, ETHANE, CYCLOHEXANE, ETHYLENE, AND WATER, by E. N. Lassettre and S. A. Francis. [1964] [10]p. (AFOSR-64-1914) (AF AFOSR-63-61) AD 452257 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1208-1217, Mar. 1, 1964.

Electron impact spectra obtained by the inelastic scattering of 390-v electrons from helium, hydrogen, methane, ethane, cyclohexane, ethylene, and water are given. It is shown experimentally that, at small scattering angles and a fixed velocity-analyzer setting, the scattered current as a function of pressure contains a maximum. The theory of this effect is discussed.

1674

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

COLLISION CROSS SECTIONS FOR OXYGEN IN THE EXCITATION ENERGY RANGE 10 TO 60 V, by S. M. Silverman and E. N. Lassettre. [1964] [11]p. (AFOSR-64-1964) (AF AFOSR-63-61) AD 452497 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2922-2932, May 15, 1964.

Inelastic, electronic, collision cross section for the scattering of electrons of approximately 500-v kinetic energy have been determined over the excitation energy range 10 to 60 v. Generalized oscillator strengths are calculated from the results and used to test the oscillator sum rule. Extrapolated oscillator strengths are compared with those calculated from ultraviolet absorption coefficients.

1675

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

THEORETICAL CALCULATION OF ELECTRON

COLLISION CROSS SECTIONS FOR THE $1\,^1S \rightarrow 2\,^1P$ TRANSITION IN HELIUM, by E. N. Lassettre and E. A. Jones. [1964] [4]p. (AFOSR-64-2291) (AF AFOSR-63-61) AD 452691 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1218-1221, Mar. 1, 1964.

Using the Born approximation, collision cross sections for a transition in helium have been calculated. The wavefunctions employed are those used by J. A. Wheeler in the calculation of oscillator strengths.

1676

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

DETERMINATION OF GENERALIZED OSCILLATOR STRENGTHS FOR MOLECULAR HYDROGEN BY ELECTRON IMPACT, by E. N. Lassettre and E. A. Jones. [1964] [10]p. (AFOSR-64-2292) (AF AFOSR-63-61) AD 452690 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1222-1231, Mar. 1, 1964.

Inelastic electron collision cross sections at small scattering angles are determined for molecular hydrogen using electrons whose initial kinetic energies range from 324 to 461 v. Oscillator strengths have been calculated from the data and compared with values determined from ultraviolet absorption data by other investigators. The oscillator sum has been calculated and compared with theory and calculated refractive indices compared with experiment.

1677

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

NEW TYPES OF ORGANOSULFUR DERIVATIVES OF METAL CARBONYLS, by R. B. King and M. B. Bisnette. [1964] [2]p. (AFOSR-64-1535) (AF AFOSR-64-580) AD 446352 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 1267-1268, 1964.

This communication describes a new and entirely different synthesis of new types of organosulfur derivatives of metal carbonyls with metal-sulfur bonds. These new compounds have been obtained by thermal or photochemical decarbonylation of compounds of general formula $CH_3S(CH_2)_nM(CO)_x(C_5H_5)_y$ (n = 1, 2, or 3; M = Fe (x = 2, y = 1), Mo (x = 3, y = 1), or Mn (x = 5, y = 0)) without metal-sulfur bonds. These sulfur-containing transition metal alkyl derivatives, none of which has been previously reported, may in turn be obtained from metal carbonyl anions and the chloroalkyl methyl sulfides $CH_3S(CH_2)_nCl$.

1678

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

CYCLOPENTADIENYLCOBALT CARBONYL DIIODIDE, by R. B. King. [1964] [1]p. (AFOSR-65-0540) (AF AFOSR-64-580) AD 614540 Unclassified

Also published in Zeitschr. Naturforsch., v. 19: 1160, 1964.

Monomeric cyclopentadienylcobalt dicarbonyl, $C_5H_5Co(CO)_2$, reacts readily with iodine in diethyl ether solution at room temperature evolving CO and precipitating black crystalline cyclopentadienylcobalt carbonyl diiodide, $C_5H_5CoCOI_2$. This reaction is entirely analogous to the reaction of $Fe(CO)_5$ with iodine to give $Fe(CO)_4I_2$. The compound $C_5H_5CoCOI_2$ is also closely related to the perfluoroalkyl derivatives $C_5H_5CoCOR_fI$.

1679

Mellon Inst. [Dept. of Chemistry] Pittsburgh, Pa.

AN ARYLAZO DERIVATIVE OF MOLYBDENUM, by R. B. King and M. B. Bisnette. [1964] [1]p. incl. refs. (AFOSR-65-0614) (AF AFOSR-64-580) AD 615355 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5694, 1964.

Reactions between aryldiozonium salts and many anions are useful both for the preparation of substituted aromatic compounds and for the preparation of arylazo compounds often useful as dyes. In attempts to prepare interesting aryl or arylazo complexes of various transition metals, investigations have been made of reactions between various aryldiozonium salts and various metal carbonyl anions. By this synthetic technique the first compound with an arylazo group, RN = N, directly bonded to a transition metal has been prepared.

1680

Melpar, Inc., Falls Church, Va.

RESEARCH ON THE ROLE OF LIPID PHASE TRANSITIONS IN BIOLOGICAL MEMBRANES, by I. Blei. Final rept. Sept. 1963, 27p. (AFOSR-J1175) (AF 49-(638)1176) AD 422943 Unclassified

A hypothesis of biological differentiation of sodium and potassium through lipid phase transitions in the bimolecular leaflets of biological membranes has been probed using lecithin micelles, which may be considered ordered, the temperature coefficient of the solubilizing power of lecithin for a sodium dye salt is negative and that for the potassium salt of the same dye, is positive. These results indicate that order-disorder transitions within biological systems may provide the physical basis for changes in ionic mobility in biological membranes.

1681

Miami U. Dept. of Chemistry, Coral Gables, Fla.

CYCLOPENTANE CONFORMATIONS: SOLVOLYSIS OF 3-SUBSTITUTED TOSYLATES, by I. Lillien and K. Khaleeluddin. [1964] [2]p. incl. table. (AFOSR-64-2203) (AF AFOSR-63-123) AD 452379 Unclassified

Also published in Chem. and Indus. (London), June 1964, p. 1028-1029.

The solvolytic behavior of 3-methyl-, and cis- and trans-3-butylcyclopentyl tosylates was compared with cyclopentyl tosylate itself, and almost negligibly small kinetic differences were found.

1682

Miami U. [Dept. of Mathematics] Coral Gables, Fla.

KLEENE QUOTIENT THEOREMS, by J. D. McKnight, Jr. [1964] [10]p. (AFOSR-65-1165) (AF 49(638)1215) AD 623068 Unclassified

Also published in Pacific Jour. Math., v. 14: 1343-1352, 1964.

Generalizations are presented of the Kleene quotient theorem and the Converse theorems dealing with the properties of semigroups. The Kleene quotient theorem is generalized by removing the restriction that the semigroup be free. It then states that every element of a finite quotient of a finitely generated semigroup is a regular subset of the semigroup. The Converse theorems are altered by removing the restriction that the free semigroup be finitely generated. A new method of proof of the theorems is presented which is thought to be more transparent than the method of Kleene. In this method, transformation semigroups are avoided in the proofs of the Converse theorems by introducing a class of refinements of quotients. From this method, a finite automation is defined.

1683

Miami U. Dept. of Physics, Coral Gables, Fla.

NEW SYMMETRY GROUP FOR ELEMENTARY PARTICLES. I. GENERALIZATION OF LORENTZ GROUP VIA ELECTRODYNAMICS, by B. Kursunoglu. [1964] [8]p. incl. refs. (AF 49(638)1260) AD 450512 Unclassified

Also published in Phys. Rev., v. 135: B761-B768, Aug. 10, 1964.

By using the definition of the photon angular momentum a connection between the Lorentz group and the unitary symmetry group of the strong interaction is established. The new group (to be called ILU_4 is a twenty-parameter group containing SU_3 and the inhomogeneous Lorentz group as its subgroups. The spacetime and internal symmetries of dynamical systems may be described by a single symmetry group. The new symmetry group imparts a unitary content to every Lorentz frame of reference. (Contractor's abstract)

1684

Miami U. Dept. of Physics, Coral Gables, Fla.

BIVARIATE DISTRIBUTION FUNCTION FOR A PLASMA IN A MAGNETIC FIELD, by R. F. Polcyn. [1964] [2]p. (AFOSR-65-0096) (AF 49(638)1260) AD 455934 Unclassified

Also published in Phys. Fluids, v. 7: 1719-1720, Oct. 1964.

The position-velocity distribution function for Brownian motion in a magnetized plasma is derived. From this derivation are deduced diffusion coefficients and the Fokker-Planck equation.

1685

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

FIELD EMISSION IN A MAGNETIC FIELD, by F. J. Blatt. [1963] 15p. incl. diagrs. refs. (AFOSR-4759) (AF 49(638)70) AD 409244; AD 409317 Unclassified

Also published in Phys. Rev., v. 131: 166-169, July 1, 1963.

An expression for the field-emission current in a longitudinal magnetic field is derived in the zero-temperature limit. Two cases are considered, corresponding to constant Fermi energy (A) and constant electron density (B). In both cases the calculated current density contains an oscillatory contribution periodic in 1/H, as well as a term which decreases as the square of the magnetic field. In case B, however, an oscillatory contribution appears that is absent in case A. Since the two oscillatory terms in case B differ in phase and their amplitudes depend on different powers of H, it should be possible to distinguish between cases A and B. The current-decrease quadratic in H has its origin in the steady diamagnetism of the electron gas. Using accepted values of effective mass, Fermi energy, and work function, it was found that for bismuth the predicted variations of the emission current with magnetic field should be readily observable.

1686

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

PARAMAGNETIC RELAXATION AT VERY LOW TEMPERATURES. Final rept. 1963, 6p. (AFOSR-4455) (AF 49(638)613) AD 295892 Unclassified

Paramagnetic relaxation was examined in the following situations: (1) nuclear relaxation as a function of paramagnetic centers; (2) antiferromagnetic relaxation examined by a probe nucleus or antiferromagnetic center;

(3) second sound generation by relaxation energy; (4) paramagnetic relaxation in color centers and centers produced by irradiation; and (5) paramagnetic relaxation at low fields and low frequencies.

1687

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

LATTICE-VIBRATION EIGENVECTORS AND APPLICATIONS THEREOF FOR NaCl AND KCl, by S. S. Jaswal and D. J. Montgomery. [1964] [5]p. (AFOSR-64-2522) (AF AFOSR-62-37) AD 453616 Unclassified

Also published in Phys. Rev., v. 135: A1257-A1261, Aug. 31, 1964.

Eigenvectors and eigenvalues for vibrations of the rocksalt lattice were computed in the harmonic approximation on the rigid-ion model and on a deformation-dipole model. The eigenvectors, furthermore, provide a basis for perturbation treatment. The frequencies of the local modes, and the corresponding amplitudes for impurity-atom vibrations, that result from point mass defects in NaCl and KCl, were also computed.

1688

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

INFRARED DISPERSION FREQUENCIES FOR ALKALI HALIDES, by C. M. Randall, R. M. Fuller and D. J. Montgomery. [1964] [3]p. (AFOSR-64-2539) (AF AFOSR-62-37) AD 454019 Unclassified

Also published in Solid State Commun., v. 2: 273-275, 1964.

Analysis of the photon-phonon interaction, among other phenomena requires knowledge of the optical behavior of crystals. The alkali halides, because of their simple properties, have been the subject of much recent work in lattice vibrations and in dispersion relations. One of the most important optical parameters for such studies, the infrared dispersion frequency ω_0, is most directly evaluated by observing the infrared absorption spectrum of thin films. Techniques were developed for the production and analysis of such spectra.

1689

Michigan State U. Dept. of Physics [and Astronomy] East Lansing.

A PROTON RESONANCE STUDY OF THE MAGNETIC STRUCTURE OF ANTIFERROMAGNETIC $CoCl_2 \cdot 6H_2O$, $CoBr_2 \cdot 6H_2O$, $NiCl_2 \cdot 6H_2O$, AND $NiBr_2 \cdot 6H_2O$, by R. D. Spence, P. Middents and others. [1964] [2]p. incl. diagr. tables. (AFOSR-64-1763) (AF AFOSR-63-430) AD 449053 Unclassified

Also published in Jour. Appl. Phys., v. 35: 654-855, Mar. 1964.

Studies of the antiferromagnetic states of $CoCl_2 \cdot 6H_2O$, $CoBr_2 \cdot 6H_2O$, $NiCl_2 \cdot 6H_2O$, and $NiBr_2 \cdot 6H_2O$ by proton resonance show that their magnetic space group must be either $P_c 2_1/a$ or $C_c 2/c$. The magnitudes of the local fields indicate that the Co salts belong to the former group and the Ni salts to the latter. (Contractor's abstract)

1690

Michigan State U. [Dept. of Physics and Astronomy] East Lansing.

PROTON RESONANCE STUDY OF ANTIFERROMAGNETIC $FeCl_2 \cdot 4H_2O$, by R. D. Spence, R. Au, and P. A. Van Dalen. [1964] [5]p. (AFOSR-65-0162) (AF AFOSR-63-430) AD 611477 Unclassified

Also published in Physica, v. 30: 1612-1616, 1964.

The proton resonance spectrum of $FeCl_2 \cdot 4H_2O$ has been examined in the temperature range 4.2K to 0.35K. Data obtained showed: (1) 4.2-1.1K-lines characteristic of the paramagnetic state; (2) 1.1-0.7K-no lines; and (3) 0.7-0.35K-lines characteristic of the antiferromagnetic state. Using the observed local fields and symmetry arguments a structure for the antiferromagnetic spin arrangement is proposed.

1691

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

OPTICAL ANALYSIS TECHNIQUES APPLIED TO SEISMIC DATA, by P. L. Jackson. Semiannual technical summary rept. no. 5, June 15-Dec. 15, 1963. Jan. 1964, 10p. (AF 49(636)1076) AD 427360 Unclassified

The following tasks were performed: (1) Acquiring and using a scanning microphotometer for measurement and control of recordings and calibrations on variable-density film; (2) Improvement in the conversion, calibration, and measurement of seismograms from magnetic tape to variable-density film; (3) An extensive group of seismograms has been converted and is being frequency analyzed; (4) A laser has been introduced as a light source into the optical system; and (5) Arrangements have been made to obtain a commercial variable-density recorder for evaluation.

1692

Michigan U. [Acoustics and Seismics Lab.] Ann Arbor.

TIME-FREQUENCY SIGNATURES THROUGH OPTICAL DIFFRACTION SCANNING, by P. L. Jackson. Sept. 1963, 21p. (Rept. no. 4596 17R) (AF 49(636)1076) AD 419191 Unclassified

An optical scanning method has been developed to present frequency content as it occurs and changes throughout a variable-density seismogram. Energy distributions are shown in both frequency and time. A two-dimensional pattern is presented which can be visually evaluated, and is suitable for numerical measurement. It also describes a similar scanning method by which seismic wave dispersions can be revealed and measured.

1693

Michigan U. Acoustics and Seismics Lab., Ann Arbor.

INVESTIGATION OF AUDITORY DISCRIMINATION OF SEISMIC SIGNALS FROM EARTHQUAKES AND EXPLOSIONS, by G. E. Frantti and L. A. Levereault. Final rept. Apr. 1964, 39p. (Rept. no. 4595 14F; Rept. no. 5178 27T) (AF 49(638)1079) AD 437784 Unclassified

Magnetic tape recordings of short-period seismic signals from approximately 200 earthquakes and explosions were time-compressed by a factor of up to 512 to shift seismic frequencies to the audible range. Auditory experiments were conducted to determine the ability of the human auditory system to distinguish between seismic signals from earthquakes and explosions. The results of the experiments suggest that a trained listener can identify approximately two thirds of the seismic sounds presented.

1694

Michigan U. [Dept. of Chemical and Metallurgical Engineering] Ann Arbor.

SINTERING OF METAL OXIDES, by G. Parravano. Final rept. Oct. 1963, 28p. (AF 49(638)493) AD 602529 Unclassified

The research program had the following major objectives: (1) To determine the transport mechanisms which control the sintering of a representative group of metal oxides; (2) To relate the observed sintering mechanisms to fundamental properties of the solids (vapor pressure, diffusion coefficients, deviations from stoichiometric composition); (3) To investigate the role of whisker growth in metal oxides on their sintering behavior, and (4) To assess the influence of surface effects on sintering in oxide compounds.

1695

Michigan U. Dept. of Chemical and Metallurgical Engineering, Ann Arbor.

POLYMERIZATION OF STYRENE WITH $TiCl_3$-$Al(C_2H_5)_3$ AND VCl_3-$Al(C_2H_5)_3$ CATALYSTS, by F. D. Otto and G. Parravano. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-67-2643) (AF 49(638)606) Unclassified

Also published in Jour. Polymer Sci., Part A, v. 2: 5131-5147, 1964.

The polymerization of styrene was studied in benzene solution with two catalyst systems: $TiCl_3$-$Al(C_2H_5)_3$ and VCl_3-$Al(C_2H_5)_3$. The rate of polymerization with VCl_3 as catalyst component was generally faster than the rate obtained with $TiCl_3$. A reaction scheme has been postulated to account for the influence of monomer and catalyst on the steady state rate. The model suggests that $TiCl_3$ activation consists of surface alkylation and removal of Cl^- ions by reaction with $Al(C_2H_5)_3$. Monomer adsorption occurs on vacant sites, neighboring alkylated surface sites, in competition with the adsorption of metal alkyl. Vacant and alkylated sites partake in the first coordination sphere of Ti^{+3} ions in $TiCl_3$. Polymerization follows by monomer insertion into the Ti—C bond at the alkylated site.

1696

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

EXPERIMENTAL STUDY OF "TONE DEAFNESS", by W. P. Tanner, Jr. and C. L. Rivette. [1964] [3]p. incl. tables. (AFOSR-2035) (AF 49(638)369) AD 453793 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 1465-1467, Aug. 1964.

In a series of experiments designed to compare the efficiency of human observers in amplitude-discrimination tasks to their efficiency in frequency-discrimination tasks, the behavior of one of the 4 observers suggested that he was completely insensitive to frequency differences. The procedure of the experiments was then diverted to conduct an experimental case-study comparing the tone-deaf observer to 3 observers with normal frequency discrimination under a variety of experimental conditions. In amplitude-discrimination experiments in which he is detecting pulses of sine waves, he compares favorably. He far surpasses the other 3 observers when the signal is a sample of white Gaussian noise. (Contractor's abstract, modified)

1697

Michigan U. Dept. of Electrical Engineering, Ann Arbor.

[INVESTIGATION IN THE THEORY OF SPHEROIDAL AND MATHIEU FUNCTIONS], by F. B. Sleator. Final rept. June 1964, 10p. (AFOSR-64-1274) (AF AFOSR-63-289) AD 602787 Unclassified

The objective of this investigation was to develop and exploit new relations between the spheroidal functions and other better known functions which might reduce the labor and complication involved in obtaining new numerical values of the spheroidal functions and thus facilitate the quantitative solutions of new spheroidal diffraction problems or the extension of existing solutions into ranges not previously covered. Although the present

forms should give values sufficiently accurate for practical applications, it is clear that they are more suitable for filling in gaps in existing tables as the need arises than for large-scale production of new ones.

1698

Michigan U. [Dept. of Electrical Engineering] Ann Arbor.

MONOTONE REDUCTION ALGORITHMS, by R. F. Arnold and D. L. Richards. [1964] [2]p. (AFOSR-65-0583) (AF AFOSR-64-367) AD 619281 Unclassified

Also published in Internat'l. Conf. on Microwaves Circuit Theory, and Information Theory, Tokyo (Japan) (Sept. 1964). Tokyo, Inst. of Electrical Communication Engineers of Japan, Summaries of Papers, Part 3, 1964, p. 175-176.

A summary is given of a paper which considers a class of algorithms which are appropriate for a two-sided congruence relation on words. The main body of the paper is devoted to showing that a finite rank ordered work problem always has a unique best monotone reduction algorithm, and that this core algorithm is the unique result of self-applying an arbitrary reduction algorithm.

1699

Michigan U. [Dept. of Mathematics] Ann Arbor.

KOSIŃSKI'S r-SPACES AND HOMOLOGY MANIFOLDS, by C. N. Lee. [1963] [5]p. (AFOSR-4281) (AF 49-(638)774) AD 424231 Unclassified

Also published in Michigan Math. Jour., v. 10: 289-293, 1963.

The purpose of the present paper is to show that a connected r-space is a (locally orientable) singular homology manifold over an arbitrary coefficient field. This may be considered as an explanation of the fact that r-spaces resemble topological manifolds. It is further shown that a connected HLC r-space is a (locally orientable) singular homology manifold over any principal ideal domain K, and hence a Cech cohomology manifold over K.

1700

Michigan U. [Dept. of Mathematics] Ann Arbor.

INTEGRAL REPRESENTATIONS OF AXIALLY SYMMETRIC POTENTIAL FUNCTIONS, by A. E. Heins and R. C. MacCamy. [1963] [13]p. (AFOSR-J1211) (AF AFOSR-62-341) AD 424270 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 13: 373-385, 1963.

Solutions are given for elliptic partial differential equations in 3 variables when there is an axis of symmetry. A uniqueness theorem is proved which illustrates connection between elliptic partial differential equations with analytic coefficients and hyperbolic partial differential equations. This suggests an existence theorem which is proved by obtaining an analog of the Lapiace integral by constructing a convergent successive approximation procedure. The connection between the regularity of the solution and the analyticity of the boundary data at r = 0 is also discussed.

1701

Michigan U. [Dept. of Mathematics] Ann Arbor.

ON DIFFRACTION BY A HALF-PLANE, by A. E. Heins. [1964] [8]p. (AFOSR-64-2423) (AF AFOSR-62-341) AD 454962 Unclassified

Also published in Jour. Math. Pures et Appl., v. 43: 59-66, 1964.

The mathematical theory of diffraction, as it pertains to the half-plane, has been an object of much investigation. Various mathematical methods have been employed to discuss three cases of interest; that is, plane wave excitation, cylindrical wave excitation (the line source) and spherical wave excitation (the point source). This paper discusses yet another method which brings the problem within the realm of the classical theory of functions of a complex variable and some properties of the Fourier transform theorem.

1702

Michigan U. Dept. of Mathematics, Ann Arbor.

NON-EQUILIBRIUM HYDRODYNAMICS OF A CHEMICALLY REACTING FLUID, by C. Yuan. Progress rept. Sept. 1963, 33p. incl. refs. (AFOSR-5514) (AF AFOSR-63-20) Unclassified

Two topics are studied: (I) the thermodynamics (and hence the energy relations) for a chemically reacting fluid with heat of reaction effects; and (II) the upper and lower limiting speeds of "linearly perturbed motions" in the fluid. The first of the above leads to the study of two types of relations: (1) the usual extent of reaction equation; (2) linear phenomenological equations for the heat flux and rate of reaction in terms of the affinity and temperature. For the limit speeds, the following results are obtained: (a) in the low frequency case, the limit speed coincides with that of Broer, Stupochenko-Stakhanov and is independent of heat of reaction; and (b) in the high frequency case, the limit speed is independent of the chemical reaction. (Contractor's abstract, modified)

1703

Michigan U. [Dept. of Mathematics] Ann Arbor.

THE CAUCHY PROBLEM AND ENTROPY IN CHARGED COMPRESSIBLE RELATIVISTIC SELF-INDUCTIVE FLUIDS, by N. Coburn. [1963] [18]p. incl. refs. (AFOSR-64-0971) (AF AFOSR-63-20) AD 440143 Unclassified

Also published in Relativistic Fluid Mechanics and Magnetohydrodynamics, New York, Academic Press, 1963, p. 43-60.

The paper is divided into 2 parts. In Part I, the Cauchy problem for 3 hyperbolic systems of partial differential equations is studied. In Part II, the study is limited to the determinations of the modifications in the basic Cauchy equations of the noninductive case for the case when self-induction is present. The self-induction terms are defined and enter into the Maxwell equations. Since these terms also enter into the entropy relation, it is determined how these terms effect the entropy relation, and then how these terms effect the basic Cauchy equations.

1704

Michigan U. [Dept. of Mathematics] Ann Arbor.

ALMOST ACYCLIC MAPS OF MANIFOLDS, by K. W. Kwun and F. Raymond. [1964] [13]p. (AFOSR-66-2027) (AF AFOSR-63-373) AD 642985 Unclassified

Also published in Amer. Jour. Math., v. 86: 638-650, July 1964.

A map is called proper if the inverse image of each compact set is compact. A proper map is said to be acyclic over a coefficient domain L if each point inverse is cohomologically trivial over L. A map $f: (X, A) \to (Y, B)$ is admissible if (1) f is proper, (2) (X, A), (Y, B) are locally compact Hausdorff closed pairs and (3) $f(A) = B$ and $f(X-A) = Y-B$. This paper deals with the following question: Suppose $f: (X, A) \to (Y, B)$ is an admissible map such that $f|X-A$ is acyclic. Under what conditions is f acyclic? Also, the paper studies the cohomology of the set A when $f: (X, A) \to (Y, B)$ is an admissible map between manifolds. The main theorems state what conditions on f, A, B, X, Y are necessary so that f is acyclic.

1705

Michigan U. [Engineering Psychology Group] Ann Arbor.

RESEARCH ON DECISION PROCESSES, by W. Edwards. Final rept. Dec. 1, 1961-Mar. 29, 1963. June 1963, 17p. (Rept. no. 4902 5F) (AFOSR-5047) (AF AFOSR-62-182) AD 415158 Unclassified

The statement of research work read in part as follows: (a) Probability feedback in sequential decision making will be studied by determining courses of action whose probabilities of success will be well-defined functions of the subject's previous choices. (b) Probability tracking will be studied by determining courses of action whose probabilities of success vary according to some well-defined function of the number of elapsed trials. (c) The psychophysics of probability will be studied by determining the psychophysical properties, in particular the size of just noticeable difference, of sequential and simultaneous displays of probabilities. (d) Theoretical work on general decision making will be done including updating of existing literature surveys.

1706

Michigan U. Engineering Psychology [Group] Ann Arbor.

RESEARCH ON DECISION PROCESSES, by W. Edwards. Final rept. Apr. 1, 1963-Mar. 31, 1964. July 1964 [15]p. incl. table, refs. (Rept. no. 5569-1-F) (AF AFOSR-63-192) AD 604488 Unclassified

The report consists of an annotated reference list concerning articles and speeches published, in press, or still in preparation on decision making. In the case of published articles, the annotation is the published summary or abstract of the article, with the addition of a few comments indicating its status in the research program. All articles and speeches resulting from the whole four-year research program are included; an attempt is made to identify the sources of support of each.

1707

Michigan U. [Engineering Psychology Group] Ann Arbor.

BASES FOR PREFERENCES AMONG THREE-OUTCOME BETS, by S. Lichenstein. May 1964, 22p. (AF AFOSR-63-192) AD 600139 Unclassified

This experiment compared the moment functions of a bet as predictors of choices among bets with the subjectively expected utility (SEU) maximization model. Bet parameters of Expected Value (EV), Variance (V), Skewness (Sk), and probabilities were independently varied in 182 3-outcome bets. Each of 12 Ss bid on each bet and played some bets for real money. Ss preferred high EV and low V, but had no preferences within Sk or probability levels. Sets of bets existed which were equal in all parameters; within such sets, Ss preferred bets with the largest least likely amount. The moment-function approach was rejected; the SEU model was not. A lexicographic ordering of variables was suggested.

1708

Michigan U. Inst. of Science and Tech., Ann Arbor.

ANALOG COMPUTATION OF TIME-VARYING POWER SPECTRA OF SEISMIC WAVES, by V. L. Larrowe and R. E. Crabtree. Apr. 1963, 62p. (Rept. no. 5178 8T; Rept. no. 3708 15T) (AFOSR-4696) (AF 49(638)911 and AF 49(638)1170) AD 403084 Unclassified

An analog computing technique for measuring time-varying power spectra of seismic signals was developed. The signal to be analyzed is recorded on a magnetic-tape loop so that it may be played back repeatedly, and the analog computing equipment, connected to the output of the tape-playback apparatus, measures as a function of time the power level at a different specific frequency for each passage of the tape. The concept of a time-varying spectrum is developed and the theory of the analysis method used is derived.

1709

Michigan U. Inst. of Science and Tech., Ann Arbor.

DIFFERENTIATION OF EARTHQUAKES AND UNDERGROUND NUCLEAR EXPLOSIONS ON THE BASIS OF AMPLITUDE CHARACTERISTICS, by D. E. Willis, J. DeNoyer, and J. T. Wilson. [1963] [9]p. incl. illus. diagrs. (AFOSR-5352) (AF 49(636)1170) Unclassified

Also published in Bull. Seismol. Soc., v. 53: 979-987, Oct. 1963.

The particle velocity ratios of the maximum shear-surface waves to maximum compressional waves were determined for a large number of earthquakes recorded over a wide geographic range. These results are compared with similar types of data for underground nuclear detonations recorded in the United States. It was found that this technique could be used as a diagnostic aid in distinguishing between these two types of sources at distances less than 1000 km. (Contractor's abstract)

1710

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

ENERGY SPECTRA FOR UNDERGROUND EXPLOSIONS AND EARTHQUAKES, by G. E. Frantti. [1963] [9]p. incl. diagrs. tables. (AFOSR-5353) (AF 49(638)-911 and AF 49(638)1170) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 997-1005, Oct. 1963.

Energy density for the entire seismogram is examined as a function of frequency for underground explosions and earthquakes. Anomalous differences in the spectra appear to correlate with the time duration of the source. Ratios of aftershock to earthquake energy show a relatively flat frequency dependence. In contrast, corresponding ratios for nuclear shot-collapse events change rapidly with increasing frequency. Analysis of these data suggests that measurements of total seismogram energy might be usefully applied in the seismic source discrimination problem. (Contractor's abstract)

1711

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

SPECTRAL ENERGY DENSITY FOR QUARRY EXPLOSIONS, by G. E. Frantti. [1963] [8]p. incl. diagrs. (AFOSR-5357) (AF 49(636)911 and AF 49(636)1170) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 989-996, Oct. 1963.

Several explosions of varying time duration have been recorded at 156 km along a constant propagation path from a central Michigan limestone quarry. Energy density for body waves and surface waves is examined as a function of frequency and observed to peak between 1 and 10 cps. A correlation between spectral amplitudes and source duration time is revealed and is emphasized at shot durations which approximate the dominant period of seismic waves. A study of the data suggests that seismic energy levels may be controlled, in part, by regulating the time duration of delayed quarry blasts. This parameter (total duration time) has been generally neglected in published studies involving commercial blasts. (Contractor's abstract)

1712

Michigan U. Inst. of Science and Tech., Ann Arbor.

AN EXPERIMENTAL STUDY OF SOURCE MOTION SYNTHESIS FROM FIRST ARRIVALS, by H. N. Pollack. [1963] [9]p. incl. diagrs. refs. (AFOSR-5472) (AF 49(638)1078 and AF 49(636)1170) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 955-963, Oct. 1963.

The motion near a seismic source is synthesized from experimentally obtained seismograms of non-dispersed body waves. The body waves were emitted from an explosive source submerged in a lake with a frozen surface. The seismograms were recorded at several distances. These results indicate that over the short propagation distances, the observed waveforms and their associated spectra retain characteristics of the source function. The records also yield some information regarding the nature and structure of the elastic medium about the source. (Contractor's abstract, modified)

1713

Michigan U. Inst. of Science and Tech., Ann Arbor.

SHORT PERIOD SPECTRAL MEASUREMENTS OF SEISMIC WAVES IN THE NORTHEASTERN U.S.A., by D. E. Willis. [1964] [13]p. incl. illus. diagr. (AFOSR-65-2911) (AF 49(636)1170) AD 448923 Unclassified

Also published in Earthquake Notes, v. 35: 1-13, Mar.-June 1964.

An investigation of the high-frequency energy content of seismic waves propagated out to distances of several 100 km. is reported for the northeastern portion of the United States. Recordings were obtained on magnetic tape using broadband equipment for earthquake and high-explosive sources. Significant amounts of high-frequency seismic energy in the range from 10-20 cps were found in both type sources. Similar type measurements made in southwestern areas of the United States show little evidence of this high-frequency energy. (Contractor's abstract)

1714

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

METHODS OF SPECTRAL ANALYSIS OF SEISMIC

DATA, by I. K. McIvor. [1964] [20]p. (AFOSR-65-2912) (AF 49(638)1170) AD 453601 Unclassifled

Also published in Bull. Seismol. Soc. Amer., v. 54: 1213-1232, Aug. 1964.

Three different methods of spectral analysis are compared on the basis of a common interpretation in terms of time-varying Fourier analysis. The spectra obtained by these methods for a particular seismic event are given and differences in the results are resolved.

1715

Michigan U. Inst. of Science and Tech., Ann Arbor.

ELASTIC AND ACOUSTIC WAVES RADIATED FROM CYLINDRICAL MEDIA ABOUT A POINT SOURCE, by W. C. Meecham and J. M. DeNoyer. Nov. 1963, 21p. (Rept. no. 3649 23T; Rept. no. 5178 14T) (AF 49(638)-1170) AD 423016 Unclassified

The theory for 3 related but different problems is considered. These problems involve finding the radiation pattern from simple harmonic sources in various types of media geometries which can be represented by cylindrical surfaces. The first problem is a consideration of a point source on the axis of an elastic circular cylinder which is completely surrounded by an infinite elastic medium of different properties. The second and third problems are acoustic or two-fluid problems. A free surface has been introduced in both these examples.

1716

Michigan U. [Inst. of Science and Tech.] Ann Arbor.

HIGH FREQUENCY MICROEARTHQUAKES RECORDED AT QUETTA, PAKISTAN, by J. [M.] DeNoyer. [1964] [7]p. (AF 49(638)1170) AD 612437 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 2133-2139, Dec. 1964.

Numerous high frequency microearthquakes were recorded on a special portable magnetic tape recorded at Quetta, Pakistan, during the summer of 1962. These microearthquakes have maximum particle velocities between 30 and 50 cps. Many of the foci appear to be almost directly under the recording station. The focal distance for the nearest of these earthquakes appears to be less than 1 km. The source for these earthquakes may result from 'bedding plane slippage' as strain accumulates in sediments adjacent to a high angle fault.

1717

Michigan U. [Research Center for Group Dynamics] Ann Arbor.

PERCEPTION, DRIVE AND BEHAVIOR THEORY, by R. B. Zajonc and D. D. Dorfman. [1964] [24]p. (AFOSR-64-2255) (AF 49(638)367) AD 452343 Unclassified

Also published in Psychol. Bull., v. 62: 267-290, July 1964.

The role of perceptual variables in Behavior Theory was examined in terms of their implications for stimulus-intensity generalization and discrimination learning. Examination of the so-called sensory-interaction effects seriously questioned the validity of the afferent stimulus-interaction postulate. Results of experiments on stimulus-intensity generalization and discrimination learning were found to conflict with the predictions derived from Behavior Theory, supporting the view based on sensory-interaction effects.

1718

Michigan U. Research Center for Group Dynamics, Ann Arbor.

RELATIONSHIP BETWEEN WORD FREQUENCY AND RECOGNITION: PERCEPTUAL PROCESS OF RESPONSE BIAS? by R. B. Zajonc and B. Nieuwenhuyse. [1964] [10]p. incl. diagrs. table. (AFOSR-65-0712) (AF AFOSR-63-21) AD 616821 Unclassifled

Also published in Jour. Exper. Psychol., v. 67: 276-285, Mar. 1964.

Functions relating word frequency to recognition threshold and to pseudo-recognition threshold were compared for 24 Dutch Ss. Luminance thresholds were obtained to 10 Turkish words previously shown with frequencies of 1, 2, 5, 10, and 25. Pseudo-recognition thresholds were obtained in the absence of stimuli for the same words and the same Ss. Drive was manipulated to determine whether it interacts with frequency, taking this interaction as an indication of response bias. The comparison of the frequency-threshold functions, the absence of a drive-frequency interaction, and the decreasing dependence of response emission on prior training with increasing stimulus information, demonstrated that response bias plays a negligible role in the frequency-recognition relationship when stimuli are present and when a stringent recognition criterion is employed. (Contractor's abstract)

1719

Microwave Electronics Corp., Palo Alto, Calif.

PROPAGATION, DISPERSION, AND ATTENUATION OF BACKWARD-TRAVELING MAGNETOSTATIC WAVES IN YIG, by F. A. Olson and J. R. Yaeger. [1964] [3]p. incl. diagrs. (AFOSR-65-0898) (AF 49-(638)1330) AD 617452 Unclassifled

Also published in Appl. Phys. Ltrs., v. 5: 33-35, July 15, 1964.

The propagation of long-wavelength spin waves were observed in single-crystal rods of yttrium iron garnet (YIG). These magnetostatic waves were propagated along the axis of YIG rods, ~0.1 cm^2 cross section area, 0.8 to 1.6 cm length, and of variant crystal types. There was no significant variation in results between the varieties of crystals tested. The dispersion

characteristics of the waves are determined, and from attenuation measurements relaxation times are estimated at a number of microwave frequencies. The propagation velocity and propagation attenuation are also discussed. The fit of the data further substantiates that the transmission through the YIG sample is due to magnetostatic waves which propagate as highly dispersive backward waves.

1720

Midwest Research Inst., Kansas City, Mo.

RESEARCH ON PANEL FLUTTER OF CYLINDRICAL SHELLS, by R. O. Stearman. Final rept. Jan. 1964, 96p. (AFOSR-64-0074) (AF 49(636)1169) AD 430829; AD 430991 Unclassified

A theoretical study was made on the panel flutter characteristics of a ring and longeron stiffened circular cylindrical shell at high supersonic Mach number. This study is an extension of an earlier program and uses the cyclic reduction procedure developed there to simplify the flutter analysis. This actual reduction procedure is included for completeness. An improved modal analysis was employed in this study which leads to an increased understanding of the flutter behavior of such complex structures at the high supersonic Mach numbers. A method for extending the above analysis to the lower supersonic Mach numbers is also discussed.

1721

Midwest Research Inst., Kansas City, Mo.

FLUTTER OF A RING OF PANELS, by R. Stearman. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1679) (AF 49(638)1169) AD 450312 Unclassified

Also published in AIAA Jour., v. 2: 1441-1448, Aug. 1964.

A theoretical investigation has been made of the flutter characteristics of a ring and longeron-stiffened cylindrical shell whose outer surface is exposed to a supersonic flow parallel to its axis. It is shown that the flutter analysis of this configuration can be reduced to the analysis of an equivalent single panel using the circulant matrix idea. An approximate flutter solution is obtained for this configuration in the limit when the number of panels become large, and the unsteady aerodynamic pressures may be computed from simple linear piston theory. (Contractor's abstract, modified)

1722

Midwest Research Inst., Kansas City, Mo.

RESEARCH ON PANEL FLUTTER, by R. O. Stearman. Final technical rept. Dec. 1964, 36p. incl. illus. diagrs. tables, refs. (AFOSR-65-0247) (AF 49(638)-1324) AD 614801 Unclassified

During this past year the theoretical approach to the thin shell panel flutter studies at Midwest Research Institute was extended to include an experimental program. The basic objective of this program is concerned with the influence of an external flow field on the stability characteristics of thin cylindrical shells. The significant accomplishments attained during the year's research effort include the design and fabrication of a cylindrical shell flutter model, its supporting instrumentation, and a thin shell electro-forming facility for fabricating the flutter shells. These combined accomplishments will permit a first correlation of experimental shell stability studies at the lower supersonic Mach numbers.

1723

Milan U. (Italy).

[OXYGEN AND HYDROGEN PEROXIDE ELECTROCHEMICAL PROCESSES ON CHROMIUM ELECTRODES] Processi elettrochimici dell'ossigeno e dell'acqua ossigenata su elettrodi di cromo, by T. Mussini. [1963] [5]p. incl. diagrs. refs. (AFOSR-64-1611) (AF 61-(052)260) AD 449084 Unclassified

Also published in Chim. e Indus. (Milan), v. 45: 679-683, June 1963.

The cathodic progress of oxygen as well as the cathodic and anodic processes of hydrogen peroxide on chromium electrodes have been studied, and the singular behavior of chromium with regards to the aforementioned processes has been brought into evidence. On the basis of the polarization curves experimentally obtained, the mechanism of the oxygen cathodic reduction on chromium has been outlined; moreover the mechanism has been studied of the cathodic inhibition by chromates in the oxygen reduction process, also relating this mechanism to the one of oxygen cathodic reduction on chromium.

1724

Milan U. Inst. of General Chemistry (Italy).

HYDRIDO AND CARBONILHYDRIDO IRIDIUM COMPOUNDS, by L. Malatesta, M. Angoletta, and G. Caglio. [1964] [3]p. incl. diagrs. refs. (AFOSR-64-2200) (AF EOAR-64-9) AD 453616 Unclassified

Also published in Proc. Eighth Internat'l. Conf. on Coordinating of Chemistry, Vienna (Austria) (Sept. 7-11, 1964), 1964, p. 210-212.

Using as ligand triphenylphosphine (=L) IrH_3L_2 the unsaturated hydride IrH_3L_2 was prepared, as well as the hydridocarbonyi (triphenylphosphine) iridium compounds $IrHCOL_2$ and IrH_3COL_2, and the related organometallic derivative $Ir(COOR)(CO)_2L_2$.

1725

Milan U. Inst. of General Chemistry (Italy).

HYDRIDO-COMPLEXES OF TRANSITION METALS. PART I. HYDRIDO-COMPLEXES OF RHODIUM(I),

COBALT(I), AND COBALT(III), by A. Sacco and R. Ugo. [1964] [5]p. incl. diagr. table, refs. (AFOSR-65-0237) (AF EOAR-64-9) AD 611362 Unclassified

Also published in Jour. Chem. Soc. (London), Sept. 1964, p. 3274-3278.

The preparation and properties are described of complex-salts of rhodium. From these compounds, a very stable hydrido-complex of rhodium has been prepared by reduction with lithium aluminum hydride or sodium borohydride. The product of the reaction between $[CoBr_2[C_2H_4(PPh_2)_2]_2]$ and sodium borohydride is shown to be a hydrido-complex of cobalt. The formula of this complex is supported by the diamagnetism of the compound, by its reaction with carbon tetrachloride to give chloroform. On the ground of their dipole moments and of their isomorphism with $[Ni[C_2H_4(PPh_2)_2]_2]$, a non-orthogonal structure for these hydrido-complexes of rhodium and cobalt is suggested. (Contractor's abstract, modified)

1726

Milan U. Inst. of General Chemistry (Italy).

BASIC BEHAVIOUR OF SOME PLATINUM (O) DERIVATIVES, by F. Cariati, R. Ugo, and F. Bonati. [1964] [2]p. incl. table. (AFOSR-65-0236) (AF EOAR-64-9) AD 611383 Unclassified

Also published in Chem. and Indus. (London), 1964, p. 1714-1715.

Zerovalent Pt derivatives of PtL_3 general formula ($L = PPh_3$ or $AsPh_3$)[3] have been found to have basic behavior analogous to the reaction of some transition metal complexes, such as the reversible reactions of $[\pi\text{-}C_5H_5)_2ReH]$[1] or $[Fe(CO)_3(PPh_3)_2]$[2] with acids to give hydrides.

1727

Milan U. Inst. of General Chemistry (Italy).

[NEW TRIPHENYLPHOSPHINE HYDRIDES OF RHENIUM] Nuovi idruri trifenilfosfinice di renio, by L. Malatesta, M. Freni, and V. Valenti. [1964] [9]p. incl. diagrs. tables. (AFOSR-65-0611) (AF EOAR-64-9) AD 614207 Unclassified

Also published in Gazz. Chim. Ital., v. 94: 1276-1286, 1964.

The preparation and the properties of the rhenium, triphenylphosphinehydrides ReH_5L_2 and ReH_5L_3 [$L = (PC_6H_5)_3$], are described. They are obtained by the reactions that allowed us to isolate the hydrides ReH_3L_2, $ReH_3L_2 \cdot 2C_2H_5OH$ and ReH_3L_4 previously prepared in these laboratories. They are crystalline, non-electrolyte diamagnetic substances and the infrared and nuclear magnetic resonance spectra those expected on account of their hydridic structure.

1726

Milan U. Inst. of Physics (Italy).

THERMOLUMINESCENCE IN PLASTICALLY DEFORMED KBr, by R. Fieschi, R. Oggioni, and G. Spinolo. [1963] [7]p. incl. diagrs. refs. (AFOSR-J1141) (AF EOAR-63-27) AD 421723 Unclassified

Also published in Phys. Stat. Solidi, v. 3: 1207-1213, 1963.

The thermoluminescence of plastically deformed KBr crystals is measured in the temperature range 60-350°K for differing amounts of deformation. It is found that the glow peaks characteristic of undeformed crystals are greatly enhanced but that no new glow peaks appear. The effect of annealing at different temperatures, before x-ray excitation shows that the enhanced emission is not due to direct trapping of carriers by dislocations. The study of changes in the absorption spectra indicates that there is no correlation between coloration and enhanced emission of different deformed samples. (Contractor's abstract)

1729

Milan U. Inst. of Physics (Italy).

THERMOLUMINESCENCE INDUCED BY PLASTIC DEFORMATION IN ALKALI HALIDES, by E. Panizza. [1964] [2]p. incl. diagrs. table, refs. (AFOSR-64-1995) (AF EOAR-63-27) AD 452509 Unclassified

Also published in Phys. Ltrs., v. 10: 37-36, May 15, 1964.

It is well known that light and electrons are emitted by alkali halide single-crystals during plastic deformation. It seems that color centers and in general x-ray charged traps are ionized by interaction with dislocations moving through the sample during plastic deformation. The primary purpose of our research has been to study this interaction by also taking into account the radiationless capture of carriers freed from the x-ray charged traps, by deformation.

1730

Milan U. [Inst. of Physics] (Italy).

SURFACES AND DISLOCATIONS IN ALKALI HALIDES, by R. Fieschi. Final rept. Oct. 1, 1962-Sept. 30, 1964. Nov. 30, 1964, 59p. incl. diagrs. tables, refs. (AFOSR-65-0365) (AF EOAR-63-27) AD 611762 Unclassified

This research dealt mainly with the influence of plastic deformation on the thermoluminescence (TL) of alkali halide single crystals; the work was expanded to include the study of TL in undeformed crystals in order to clarify the nature of the various traps. The influence of plastic deformation on dipolar complexes (Sr^{++} +) in doped samples was studied by means of

ionic thermoconductivity, a method recently conceived. Some work was done also on the absorption edge and on the manganese ESR in deformed samples.

1731

Milan U. Inst. of Physics (Italy).

[IONIC SURFACE RELAXATION IN POWDERS OF ALKALI HALIDES] Rilassamenti ionici superficiali in polveri di alogenuri alcalini, by C. Bucci. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-65-1784) (AF EOAR-63-27) AD 626353 Unclassified

Also published in Proc. Sixty-fifth Annual Meeting of the AEI (Palermo), No. 67: 1-5, 1964.

An experimental investigation of the dielectric surface relaxation in the alkali halides is presented. A study is made of powdered KCl, both pure and contaminated with $SrCl_2$, ionized with the aid of thermocurrents in the temperature range between LNT and 250°C. The thermocurrent bands at 210°K were attributed to Maxwell Wagner relaxation. In particular, from the 210°K band one deduces an activation energy of 0.35 ev and a frequency factor of 10^8; these values may correspond to free surface motion. The activation energy values and the frequency factor for the 460°K band are in agreement with the typical value of free motion in larger volumes.

1732

Minnesota U., Minneapolis.

INVESTIGATION OF MAGNETIC RESONANCE IN STRONGLY COUPLED DIPOLE SYSTEMS, by A. H. Morrish. Final rept. June 16, 1960-June 15, 1963. July 1963, 47p. incl. diagrs. tables, refs. (AFOSR-J1112) (AF 49(636)603) AD 416424; AD 421126 Unclassified

The first part of this report is a summary of the accomplishments made during the course of this entire contract. The last part of the report describes in some detail those parts of the research not yet published. This latter material is discussed under the following four headings: (1) Initial permeability of polycrystalline garnets; (2) The influence of thin-film boundary conditions on spin-wave spectra; (3) Studies of large single crystal garnets; and (4) Resonance in single crystal garnets.

1733

Minnesota U., Minneapolis.

NATURAL SPECTRUM OF POLYCRYSTALLINE YIG AS A FUNCTION OF DENSITY, by J. D. Holm and A. H. Morrish. [1964] [2]p. (AFOSR-64-1246) (AF 49(636)803) AD 442800 Unclassified

Also published in Jour. Appl. Phys., v. 35: 894-695, Mar. 1964.

The initial permeability of polycrystalline yttrium iron garnet has been measured as a function of density at frequencies from 5 kc/sec to 7.5 gc/sec. The samples were prepared by grinding very pure single crystals into a powder and then pressing and sintering. The samples of highest density have 2 absorption peaks that occur at approximately 1 mc/sec and 200 mc/sec. This is in very good agreement with observations on polycrystalline samples prepared with coprecipated powders but not with those prepared with raw oxides. The separation between the 2 absorption peaks decreases as the sample density decreases, until ultimately only one peak is observed in a sample with 72% density. The results are interpreted in terms of the changing sample porosity.

1734

Minnesota U., Minneapolis.

MECHANISM OF SPIN-WAVE PINNING IN SOME FERROMAGNETIC FILMS, by C. W. Searle and A. H. Morrish. [1963] [2]p. (AFOSR-64-1247) (AF 49(636)-603) AD 442797 Unclassified

Also published in Phys. Ltrs., v. 7: 229-230, Dec. 1, 1963.

An experimental study of the influence that the boundary conditions of thin ferromagnetic films have on spin-wave spectra has been made.

1735

Minnesota U., Minneapolis.

ALTERATIONS OF BRAIN BIOCHEMISTRY AND DEVELOPMENT OF BEHAVIOR, by F. E. Shideman. [1964] [9]p. incl. tables. (AFOSR-64-1276) (AF AFOSR-63-204) AD 602765 Unclassified

These studies were undertaken to provide a basis for future experiments in which the catecholamine and/or serotonin of the brain would be altered at various stages of embryonic and neonatal development and the influence of such changes on subsequent development of certain types of behavior determined. Infant rats were killed at different times after birth. There appear to be two periods in the young developing rat at which rather abrupt increases in total catecholamine concentration occur. The first of these is at some time between 1 1/2 and 4 days after birth and the second when the animal is 24 to 26 days of age. At the latter time, concentrations of brain serotonin are more than twice those found in the newly born animal.

1736

Minnesota U. Dept. of Aeronautics and Engineering Mechanics, Minneapolis.

THE EFFECT OF HIGH-FREQUENCY SUPPORT

OSCILLATION ON THE MOTION OF A SPHERICAL PENDULUM, by G. W. Hemp and P. R. Sethna. [1964] [4]p. incl. diagrs. refs. (AFOSR-64-2315) (AF AFOSR-62-275) AD 452303 Unclassified

Also published in Jour. Appl. Mech., June 1964, p. 351-354.

This investigation studies the problem of a spherical pendulum with a vertically oscillating point of suspension. The study will be made for arbitrary angular displacements of the pendulum, but certain assumptions will be made with regard to the amplitude and frequency of the support motion.

1737

Minnesota U. [Dept. of Electrical Engineering] Minneapolis.

WAVEGUIDE PERTURBATION TECHNIQUES IN MICROWAVE SEMICONDUCTOR DIAGNOSTICS, by K. S. Champlin and D. B. Armstrong. [1963] [5]p. (AFOSR-J1113) (AF 49(638)747) AD 422966 Unclassified

Also published in IEEE Trans. Microwave Theory and Tech., v. MTT-11: 73-77, Jan. 1963.

In studying detailed scattering mechanisms, a microwave transport experiment contains potentially more information than an analogous dc experiment. This paper discusses perturbation techniques which are useful in determining the microwave conductivity and low-field Hall effect of a bulk semiconductor contained in a waveguide from measurement of the properties of the transmitted wave.

1738

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

CHARGE CARRIER INERTIA IN SEMICONDUCTORS, by K. S. Champlin and D. B. Armstrong. [1964] [9]p. incl. diagrs. refs. (AFOSR-64-1746) (AF 49-(638)747 and AF AFOSR-64-606) AD 448293 Unclassified

Also published in Proc. IEEE, v. 52: 677-685, June 1964.

The conduction process in semiconductors exhibits effects associated with inertia of the carriers when the observation frequency is comparable to the reciprocal of the relaxation time for randomization of momenta. This paper derives equivalent circuits which illustrate inertial effects and discusses their temperature dependence. A highly accurate reflection bridge technique for measuring microwave conductivity and permittivity is then described. Finally, measurements of conductivity and permittivity of n-type silicon and p-type germanium at 24 Gc and at temperatures between 77° and 300°K are presented and compared with theory. At 77°, the inertial effects are found to be largest for the p-type germanium and cause the microwave conductivity to be less than the dc conductivity by a factor of 1/2.

1739

Minnesota U. [Dept. of Electrical Engineering] Minneapolis.

THE MOBILITY AND RECOMBINATION OF POSITIVE RARE GAS IONS, by V. R. Mittelstadt, J. M. Madison, and R. J. Oskam. Final rept. Jan. 1963, 49p. (AFOSR-4839) (AF AFOSR-62-103) AD 415615 Unclassified

This report describes briefly (1) a microwave system for measuring the electron density in decaying plasmas over t density range of about five thousand, (2) an experimental tube for measuring the value of the mobility of positive ions by means of the transit-time method, and (3) the results obtained during the period of the contract. The studies were confined to the rare gas ions and excellent agreement was found between the value of the mobility of atomic and molecular ions as determined from ambipolar diffusion coefficient measurements and those found by means of the ion transit-time method. The influence of the presence of negative ions on the ambipolar diffusion coefficient of electrons was demonstrated.

1740

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

ION MOBILITIES IN HELIUM, NEON, AND ARGON, by H. J. Oskam and V. R. Mittelstadt. [1963] [10]p. incl. diagrs. refs. (AFOSR-64-0810) (AF AFOSR-62-103) AD 438376 Unclassified

Also published in Phys. Rev., v. 132: 1435-1444, Nov. 15, 1963.

Measurements of the electron density as a function of time during the decay period of pulsed plasmas produced in helium, neon, and argon are reported. The values of the mobilities of positive ions in their parent gas, calculated from the rate of electron loss by ambipolar diffusion are compared with those measured with the ion-transit-time methods. The dependence on gas pressure of the efficiency of the cataphoretic segregation of neon impurity atoms in helium is demonstrated and explained. (Contractor's abstract)

1741

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

MICROWAVE TECHNIQUES IN THE STUDY OF SEMICONDUCTORS, by K. S. Champlin and J. N. Bhar. [1964] [1]p. (AFOSR-65-0187) (AF AFOSR-64-606) AD 456559 Unclassified

Also published in Proc. IEEE, v. 52: Oct. 1964.

Bhar comments on the issue—taken by K. S. Champlin with 3 points raised in an earlier paper by Bhar (Proc. IEEE, v. 51: 1623-1631, Nov. 1963) concerning microwave conductivity and permittivity of semiconductors. These concern: (1) whether or not the relaxation time is velocity dependent; (2) a factor of 5 discrepancy in an early work by Benedict and Shockley (Phys. Rev., v. 89: 1152-1153, Mar. 1953); and (3) comparison of conductivities at microwaves and d.c.

1742

Minnesota U. Dept. of Electrical Engineering, Minneapolis.

COMMENT ON "MICROWAVE MEASUREMENT OF CONDUCTIVITY AND DIELECTRIC CONSTANT OF SEMICONDUCTORS," by K. S. Champlin and B. R. Nag. [1964] [2]p. incl. diagr. (AFOSR-65-0188) (AF AFOSR-64-606) AD 456560 Unclassified

Also published in Proc. IEEE, v. 52: 1061-1062, Sept. 1964.

Theoretical sources of error are indicated in the expressions for determining the conductivity and dielectric constant of a thin semiconductor sample placed in the center of a rectangular waveguide. On checking experimental results, however, no error was found. Therefore, the accuracy of the method should be judged by using samples of different conductivities and dimensions, and calculating the actual contribution of all sources of error to the semiconductor parameters.

1743

Minnesota U. [Dept. of Mathematics] Minneapolis.

[A SYSTEM OF AXIOMS FOR EUCLIDEAN GEOMETRY] Ein Axiomensystem für die euklidische Geometrie, by H. Guggenheimer. [1964] [6]p. (AFOSR-65-1036) (AF AFOSR-62-93) AD 619760 Unclassified

Also published in Elemente Math., v. 19: 126-131, 1964.

A system of axioms is presented for Euclidean geometry. The axioms essentially state that there are no colinear points, that the plane is complete, and that the Pythagorean theorem is valid. The advantage of the system is that the fundamental relations contain only even powers of lengths, but that nevertheless directed line segments can be established in a natural way.

1744

Minnesota U. [Dept. of Mathematics] Minneapolis.

A NOTE ON THE MAP $H^1(X, G_\omega) \to H^1(X, G_c)$ FOR CERTAIN COMPLEX MANIFOLDS, by H. Rohrl. [1963] [6]p. (AFOSR-J1586) (AF AFOSR-62-106) AD 427595 Unclassified

Also published in Topology, v. 2: 247-252, 1963.

For X, a holomorphically complete complex space, the canonical map A is a bijective. However, for complex spaces other than holomorphically complete ones information concerning the map A is scarce. It suggests itself to investigate this map for projective algebraic manifolds. Obviously A is surjective for X the Riemannian sphere and G the general linear group but A fails to be injective in this case. Surjectivity of A for x any compact Riemann surface and G any connected complex Lie group is proved. More generally it is shown that, given the holomorphic family of compact Riemann surfaces, the family of topological fiber bundles (with structure group a connected complex Lie group and fiber a complex space) is over a sufficiently small neighborhood U of each point of M topologically isomorphic to a holomorphic family of holomorphic fiber bundles.

1745

Minnesota U. [Dept. of Mathematics] Minneapolis.

[FUNCTIONAL ANALYSIS AND STOCHASTIC PROCESSES], by R. H. Cameron, G. E. Baxter and others. Final status rept. June 1, 1962-June 1, 1963, 5p. (AFOSR-5277) (AF AFOSR-62-252) AD 417491 Unclassified

A number of problems in Functional Analysis, Integration in Function Space, Stochastic Processes and related areas have been studied and several papers have been written.

1746

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON FUNCTIONS THAT COMMUTE WITH FULL FUNCTIONS, by G. Baxter and J. T. Joichi. [1964] [7]p. (AFOSR-64-1624) (AF AFOSR-62-252) AD 446880 Unclassified

Also published in Nieuw Archief voor Wiskunde, v. 12: 12-18, 1964.

Definition. A function f is a hat function if for some integer is greater than or equal to 1, f alternately takes on the values 0 and 1 at the points i/n, $i = 0, 1, \ldots, n$, ($f(0) = 0$ or 1) and is linear in between. It is shown that any function g which commutes with a hat function f with n greater than or equal to 2, is either a constant or a hat function. It is shown that any function g which is nowhere constant and has only a finite number of maxima and minima and commutes with a full function f with n greater than or equal to 2 branches is necessarily itself a full function.

1747

Minnesota U. [Dept.] of Mathematics, Minneapolis.

THE BEHAVIOR OF INCREASING STABLE PROCESSES FOR BOTH SMALL AND LARGE TIMES, by B. Fristedt. [1964] [8]p. (AFOSR-65-2642) (AF AFOSR-62-252) AD 627770 Unclassified

Also published in Jour. Math. and Mech., v. 13: 849-856, Sept. 1964.

This paper is concerned with the sample functions of increasing stable processes having no deterministic linear component.

1748

Minnesota U. [Dept. of Mathematics] Minneapolis.

SUPER-SOLUTIONS FOR QUASI-LINEAR ELLIPTIC EQUATIONS, by H. Jenkins. [1963] [9]p. (AFOSR-64-2324) (AF AFOSR-63-372) AD 452305 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 402-410, 1963.

This paper gives a geometric characterization of super-solutions in terms of the function E. This characterization is then applied to construct explicit families of super-solutions, which are in turn used to deduce theorems about the behavior of solutions.

1749

Minnesota U. [Dept. of Mathematics] Minneapolis.

RATIO LIMIT THEOREMS FOR MARKOV CHAINS, by J. F. C. Kingman and S. Orey. [1964] [4]p. (AFOSR-65-0868) (AF AFOSR-63-380) AD 617586 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 907-910, Dec. 1964.

This note considers Markov chains with stationary transition probabilities and state space S = 0, 1, 2, . . . , in both discrete and continuous time. When (1)

$$\lim_{n\to\infty} \frac{P_{ij}^{(n+m)}}{P_{kh}^{(n)}} = \frac{\pi_j}{\pi_h}, \quad m = 0, \pm 1, \pm 2, \ldots, \; i, j, k, h$$

S, it is said that the strong ratio limit property S (SRLP) holds. In the continuous time case (1) is replaced by (2)

$$\lim_{t\to\infty} \frac{P_{ij}^{(t+\Delta)}}{P_{kh}^{(t)}} = \frac{\pi_j}{\pi_h}, \quad -\infty < \Delta < \infty, \; i, j, k, h \; S.$$

It is shown that if the probability of returning to i by time N is greater than ϵ, where N and ϵ are positive numbers independent of i, SRLP holds. The condition can be taken as a weak form of spatial homogeneity. Since (1) and (2) may not hold, substitutes for SRLP are further discussed.

1750

Minnesota U. [Dept. of Mathematics] Minneapolis.

CONSTRUCTION OF A MARKOV PROCESS FROM HITTING PROBABILITIES, by F. Knight and S. Orey. [1964] [17]p. (AFOSR-65-0869) (AF AFOSR-63-380) AD 617625 Unclassified

Also published in Jour. Math. and Mech., v. 13: 857-873, Sept. 1964.

In this note it is shown that there exists a Markov process with stationary transition probabilities having the $H_A(x, .)$ as hitting probabilities and such that a function $g(x)$ is the expected lifetime of the process when started at x. Argumentation leads to a final theorem containing the expected lifetime, the hitting probabilities, and the transition probabilities of the Markov process X_x^∞.

1751

Minnesota U. [Dept. of Mathematics] Minneapolis.

EIGENVALUES OF NON-NEGATIVE MATRICES, by W. E. Pruitt. [1964] [4]p. (AFOSR-65-0870) (AF AFOSR-63-380) AD 617587 Unclassified

Also published in Ann. Math. Stat., v. 35: 1797-1800, Dec. 1964.

If P = (pij), i, j, = 0, 1, 2, . . . , is a matrix with non-negative entries, it is said to be irreducible if for every pair i, j, there is a finite sequence of integers $k_1, k_2, \ldots, k_n$ such that $p_{ik_1} p_{k_1k_2} \cdots p_{k_nj} > 0$. This note considers such an irreducible matrix as an operator acting on column vectors having non-negative entries. A necessary and sufficient condition for there to be a solution of $px = \lambda x$ is obtained. P is transformed into a substochastic matrix to which the Harris-Veech theorem is applied, which gives a necessary and sufficient condition for the existence of a stationary measure for a transient Markov chain. R-recurrent and recurrent matrices are investigated and related in the stochastic case to the given eigenvalue problem.

1752

Minnesota U. Dept. of Mathematics, Minneapolis.

ON THE LIMIT BEHAVIOUR OF EXTREME ORDER STATISTICS, by O. Barndorff-Nielsen. Mar. 6, 1963, 22p. incl. refs. (AFOSR-5525) (AF AFOSR-63-381) Unclassified

This paper is concerned with some recent developments in the theory of limit behavior of extreme order statistics. Section 1 introduces notations and definitions and states a few elementary facts concerning the distributions of the set of order statistics corresponding to a set of independent, identically distributed random variables. Section 2 deals with limit distributions, while sections 3 and 4 deal with stability in probability

and stability almost surely. Section 5 turns to the dependence case, summarizing some recent results. Section 4 contains a proof of the sufficiency of a simple condition for stability almost surely of the maximal order statistic.

1753

[Minnesota U. Dept. of Mathematics, Minneapolis]

SUBFIELDS AND LOSS OF INFORMATION, by O. Barndorff-Nielsen. [1964] [11]p. (AFOSR-64-2279) (AF AFOSR-63-381) AD 452373 Unclassified

Also published in Zeitschr. Wahrscheinlichkeitstheorie, v. 2: 369-379, 1964.

This paper is a study of a minimax-type measure of the loss of information occurring from observing only a sub-field of the sigma field describing a given experiment. In order not to obscure the ideas behind the definition and basic properties of the loss measure by technical difficulties of a mathematical nature, the simple framework of finite-atomic sigma fields was chosen for discussion. Generalizations and further results will be given in a subsequent paper.

1754

Minnesota U. [Dept. of Mathematics] Minneapolis.

ASYMPTOTIC BEHAVIOR OF SUCCESSIVE ITERATES OF CONTINUOUS FUNCTIONS UNDER A MARKOV OPERATOR, by B. Jamison. [1964] [12]p. incl. refs. (AFOSR-65-2624) (AF AFOSR-63-381) AD 628438 Unclassified

Also published in Jour. Math. Anal. and Appl., v. 9: 203-214, Oct. 1964.

Let $P(x, E)$ be a transition probability operator on a compact metric state space S. This paper studies the asymptotic behavior of the sequences $[\int f(y)P^n(\cdot, dy)]$ for continuous functions f on S. In section 2, it is shown that if $P(x, E)$ is "uniformly stable in mean" then the Cesaro averages of the sequences in question converge uniformly to constants if and only if there are not two disjoint invold topologically and stochastically closed subsets in S. In Section 3, a stronger condition is imposed on called "uniform stability", and several conditions are given necessary and sufficient for the uniform convergence of the sequences themselves to constants. In Section 4, two applications are given.

1755

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON A CLASS OF COMMUTING FUNCTIONS, by G. Baxter and J. T. Jolchi. [1964] [11]p. incl. diagrs. (AFOSR-65-2631) (AF AFOSR-63-381) AD 627980 Unclassified

Also published in Nieuw Archief voor Wiskunde, v. 12: 126-135, 1964.

Let X be the unit interval (0, 1) and let F and G be a pair of functions mapping X continuously into itself, and which commute under composition, that is, $F(G(x)) = G(F(x))$. It has been conjectured that under these circumstances the functions F and G must have a common fixed point. This conjecture has only been verified in some very special cases. It appears to us that among the primary difficulties encountered in attempting to verify the conjecture in more general cases is the lack of a plentiful supply of examples to investigate. This paper introduces a method by which a variety of such pairs of functions may be constructed.

1756

Minnesota U. [Dept. of Mathematics] Minneapolis.

ON PERMUTATIONS INDUCED BY COMMUTING FUNCTIONS, AND AN EMBEDDING QUESTION, by G. Baxter and J. T. Jolchi. [1963] [11]p. (AFOSR-65-2632) (AF AFOSR-63-381) AD 627979 Unclassified

Also published in Math. Scand., v. 13: 140-150, 1963.

Let $f \equiv f(x)$ and $g \equiv g(x)$ be two continuous and commuting functions (under substitution) each mapping the closed interval $[a, b]$ into itself. Isbell has conjectured that f and g must have a common fixed point, or equivalently, that f and the composite function $h = fg \equiv f(g(x))$ must have a common fixed point. Except in special cases the conjecture has not been verified. This paper suggests one method for attacking the Isbell conjecture by trying to embed the commuting functions in a semigroup and thereby proving the existence of the common fixed point.

1757

[Minnesota U. Dept. of Mathematics, Minneapolis]

REMARKS ON THE EXTREME EIGENVALUES OF TOEPLITZ FORMS ASSOCIATED WITH ORTHOGONAL POLYNOMIALS, by S. V. Parter. Aug. 1964, 32p. (Rept. no. MRC-TSR-498) (AF AFOSR-63-381) Unclassified

The extreme eigenvalues of the truncated Toeplitz matrices associated with certain orthogonal polynomials were studied. In particular, certain comparison theorems enable one to extend the results of Hirschman for the classical orthogonal polynomials.

1758

Minnesota U. Heat Transfer Lab., Minneapolis.

EMISSIVITY MEASUREMENT OF POROUS MATERIALS, by O. E. Tewfik and Y.-W. Yang. [1963] [2]p. incl. diagrs. (AFOSR-3677) (AF 49(638)558) AD 430658 Unclassified

Also published in Jour. Heat Transfer, Feb. 1963, p. 79-80.

The pres ote describes a method by which the total hemispherical emissivity of a porous material is readily measured without the use of a radiometer or special sample preparation.

1759

Minnesota U. Heat Transfer Lab., Minneapolis.

ONE-DIMENSIONAL MASS AND HEAT TRANSFER AND THEIR COUPLING, by O. E. Tewfik. [1964] [13]p. incl. diagrs. (AFOSR-64-1878) (AF 49(638)558) AD 449983 Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 7: 409-421, 1964.

Consideration is given to the steady-state transfer of mass and heat from a porous wall to a non-dissipative binary system or air-hydrogen in one case, and air-carbon dioxide in another. Hydrogen or helium is injected at a uniform rate through the porous wall into the system. According to the thermodynamics of irreversible processes, the fluxes of heat and mass are coupled. The effects of such coupling are shown to be small on the concentration field, appreciable on the temperature field and heat flux under certain conditions, and negligible on the heat-transfer coefficient when defined in terms of an adiabatic wall temperature. In general, the magnitude of the effects are much more pronounced for hydrogen injection than for carbon dioxide injection. (Contractor's abstract, modified.

1760

Minnesota U. Heat Transfer Lab., Minneapolis.

DIFFUSION-THERMO EFFECTS IN STAGNATION-POINT FLOW OF AIR WITH INJECTION OF GASES OF VARIOUS MOLECULAR WEIGHTS INTO THE BOUNDARY LAYER, by E. M. Sparrow, W. J. Minkowycz, and E. R. G. Eckert. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1023) (AF AFOSR-64-17) AD 440961 Unclassified

Also published in AIAA Jour., v. 2: 652-659, Apr. 1964.

This paper is concerned with the effect of diffusion thermo on the heat transfer, mass transfer, and flow in a boundary layer into which various foreign gases are injected. Air is the mainstream gas. Particular consideration is given to the question of how the magnitude of the diffusion-thermo effect is related to the molecular weight of the injected gas. Correspondingly the analysis includes injection of hydrogen, helium, argon, carbon dioxide, and xenon; the selection of these was also influenced by the availability of transport and thermodynamic properties. The study is carried out for plane and axisymmetric stagnation flow in forced convection and for plane stagnation flow in free convection. (Contractor's abstract, modified)

1761

Minnesota U. Heat Transfer Lab., Minneapolis.

RECENT STUDIES RELATING TO MASS TRANSFER COOLING, by E. M. Sparrow. [1964] [18]p. (AFOSR-64-1681) (AF AFOSR-64-17) AD 449995 Unclassified

Also published in Proc. Heat Transfer and Fluid Mechanics Inst., ed. by W. F. Giedt and S. Levy, Stanford U. Press, 1964, p. 1-18.

This paper is concerned with the effects of thermal diffusion and diffusion thermo on the heat transfer, mass transfer, and flow in a boundary layer into which various foreign gases are injected. Air is the main stream gas. One effect of diffusion thermo is to create an adiabatic wall temperature which differs from the main stream temperature Te. Under nonadiabatic conditions, the rate of heat transfer from (or to) the surface can be substantially altered by the diffusion-thermo effect when the ratio of wall to stream temperature is not greatly different from unity. Specific consideration is given to the heat transfer results for plane stagnation flow in forced convection and for the stagnation region of a horizontal cylinder in free convection.

1762

Minnesota U. Heat Transfer Lab., Minneapolis.

THE EFFECT OF DIFFUSION THERMO AND THERMAL DIFFUSION FOR HELIUM INJECTION INTO PLANE AND AXISYMMETRIC STAGNATION FLOW OF AIR, by E. M. Sparrow, W. J. Minkowycz and others. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-2247) (AF AFOSR-64-17) AD 452526 Unclassified

Presented at ASME-AIChe Heat Transfer Conference and Exhibit, Boston, Mass., Aug. 11-14, 1963.

Also published in Jour. Heat Transfer, Aug. 1964.

An analysis has been carried out with the aim of clarifying the effects of diffusion thermo and thermal diffusion on heat transfer, flow, and mass transfer for the helium-air boundary layer in stagnation flow. To provide information applicable to both laboratory-type situations and aerospace applications, results have been obtained over the range of free-stream temperatures from 500° to 5000°R. For ratios of wall-to-stream temperature (Tw/Te) which differ only moderately from unity, it is found that the aforementioned diffusional transport has a decisive effect on heat transfer. Further, the diffusion thermo is far more important than the thermal diffusion. (Contractor's abstract, modified)

1763

Minnesota U. Inst. of Tech., Minneapolis.

VARIATIONAL PROBLEMS OF MINIMAL SURFACE

TYPE. 1, by H. Jenkins and J. Serrin. [1963] [26]p. (AFOSR-J1024) (AF AFOSR-62-101) AD 419669 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 12: 185-214, 1963.

The solutions of a variational problem of minimal surface type are known to share certain properties with non-parametric minimal surfaces; for example, they cannot have isolated singularities. Moreover, as is the case with the classical minimal surface equation, there can exist no non-linear entire solutions of a problem of minimal surface type. There are established a number of further properties of solutions of variational problems of minimal surface type. The results are new, even in the classical minimal surface case, and contrast sharply, as do the properties above, with analogous results for solutions of uniformly elliptic equations.

1764

Minnesota U. Inst. of Tech., Minneapolis.

[PROBLEMS IN HYDRODYNAMICS AND PARTIAL DIFFERENTIAL EQUATIONS]. Final technical rept. June 1, 1962-May 31, 1963, 4p. (AFOSR-J1443) (AF AFOSR-62-101) Unclassified

The contents of this report are: (1) Variational calculus, (2) Linear and non-linear partial differential equations, and (3) Navier-Stokes equations.

1765

Minnesota U. School of Chemistry, Minneapolis.

EFFECT OF HETEROCONJUGATION ON ACID-BASE CONDUCTOMETRIC TITRATION CURVES OF 3, 5-DINITROBENZOIC ACID IN ACETONITRILE, by I. M. Kolthoff and M. K. Chantooni, Jr. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-J1097) (AF 49(636)519) AD 420660 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2195-2201, Aug. 5, 1963.

Heteroconjugation is defined as the conjugation of an anion A^- with a hydrogen bond donor HR: $A^- + nHR \rightleftharpoons A(HR)_n^-$. In a solvent which is a non-hydrogen bonder and has a dielectric constant of 40 or less, like acetonitrile, the degree of dissociation of a salt BH^+A^- is greatly increased by addition of HR. As a result of heteroconjugation the maximum in conductance between 50 and 100% neutralization in the conductometric titration with an amine of an incompletely dissociated acid HA, which has no intramolecular hydrogen bonds, can be eliminated in the presence of HR. Conductometric titration curves in acetonitrile of sulfuric acid with pyridine in the presence of various concentrations of resorcinol and of 3, 5-dinitrobenzoic acid with triethylamine in the presence of resorcinol or p-bromophenol illustrate this effect of heteroconjugation. The calculated conductances on the titration curves of 3, 5-dinitrobenzoic acid with triethylamine in the presence of various concentrations of resorcinol were found to be in satisfactory agreement with the experimental data. Infrared spectra of solutions in acetonitrile of tetraethylammonium 3, 5-dinitrobenzoate in the presence of varying concentrations of resorcinol or p-bromophenol substantiate the conclusion that heteroconjugation occurs by hydrogen bonding. Structures for the various heteroconjugates are postulated. (Contractor's abstract, modified)

1766

Minnesota U. School of Chemistry, Minneapolis.

THE REACTION OF VINYLMERCURIC IODIDE WITH NONHALOGEN ACID, by M. M. Kreevey and R. A. Kretchmer. [1964] [6]p. (AFOSR-64-1412) (AF 49-(638)711) AD 445074 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2435-2440, 1964.

The rate-determining step in the cleavage of vinylmercuric iodide to ethylene and HgI^+ is the transfer of a proton from a hydronium ion to carbon. The rate is first order in substrate and roughly proportional to the acid concentration up to about 4 M perchloric or sulfuric acid. The solvent isotope effect is 2.96 ± 0.10 at 25°C in dilute perchloric acid. In 2.5 M sulfuric acid, it is 2.2 ± 0.2. The enthalpy and entropy of activation are 17.6 ± 0.4 kcal/mole and -16.5 ± 1.3 cal/mole/deg, respectively. These results require that proton transfer be rate determining and suggest a transition state somewhat more highly solvated than the starting state. It is further suggested that desolvation of the hydronium ion lags seriously behind the actual proton transfer.

1767

Minnesota U. [School] of Chemistry, Minneapolis.

STATISTICAL MECHANICS OF CROSS-LINKED POLYMERS: FORMATION OF THE INFINITE NETWORK, by H. Brodowsky and S. Prager. [1963] [5]p. incl. diagr. (AFOSR-4664) (AF 49(636)720) AD 408365 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1103-1107, Aug. 15, 1963.

It is shown that crosslinks of infinite functionality in equilibrium with a solution of bifunctional monomer behave as particles interacting with a Debye-Huckel type of potential. Applying the Debye-Huckel theory to a fluid consisting of such particles leads to a condensation phenomenon which corresponds to gel formation.

1768

Minnesota U. [School of Chemistry] Minneapolis.

EFFECTIVE DIFFUSION COEFFICIENT IN POROUS

MEDIA, by H. L. Weissberg. [1963] [4]p. incl. diagr. (AFOSR-4684) (AF 49(638)720) AD 410160 Unclassified

Also published in Jour. Appl. Phys., v. 34: 2636-2639, Sept. 1963.

Recent calculations by Prager of upper bounds for the effective diffusion coefficient (or conductivity) in porous media, in terms of certain statistical parameters of the random geometry, are reformulated so as to apply specifically to a bed of spherical particles. The calculations are simplified by considering an idealized bed in which centers are randomly situated without restricting the spheres to nonoverlapping locations. The result, applicable to randomly overlapping spheres of either uniform or nonuniform sizes, gives the upper bound for the effective diffusion coefficient as $\Phi D_0/[1-1/2 \ln\Phi]$, where D_0 is the actual diffusion coefficient in a fluid which fills the void regions of the bed and Φ is the void fraction. This result is compared with experimental results of various investigators. (Contractor's abstract, modified)

1769

Minnesota U. [School] of Chemistry, Minneapolis.

BROWNIAN MOTION IN MANY-PARTICLE SYSTEMS. I. FORCED INTERDIFFUSION OF TWO SPECIES, by G. W. Woodbury, Jr., and S. Praeger. [1964] [5]p. incl. refs. (AFOSR-64-1948) (AF 49(638)720) AD 450514 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3417-3421, Sept. 5, 1964.

This paper discusses a system consisting of two species, alpha and beta whose molecules are subjected to opposing external forces A(a) and A(b), causing a to move relative to b with a mean velocity u. On the assumption that each molecule is undergoing a Brownian motion biased by the external forces and its interactions with other molecules, it is possible to derive a rigorously valid upper bound on the magnitude of u, a bound which can be expressed in terms of equilibrium two- and three-particle distribution functions. Explicit calculations are given for the case where the alpha-species is present at very low concentrations and the beta-molecules do not interact with one another. (Contractor's abstract)

1770

Minnesota U. School of Chemistry, Minneapolis.

PERTURBATION THEORY AND THE HELLMANN-FEYNMAN THEOREM, by R. Yaris. [1963] [5]p. (AFOSR-J1489) (AF 49(638)940) AD 427945 Unclassified

Also published in Jour. Chem. Phys., v. 39: 863-867, Aug. 15, 1963.

By using the Hellmann-Feynman theorem in conjunction with an operator formulation of perturbation theory it is shown that, while for a general Hamiltonian an energy derivative is determined only to order n by an nth-order wave-function (Salem and Wilson), for a restricted class of systems it is determined to order n+1, and by restricting the class somewhat further one can obtain energy derivatives to order 2n+1. The example of the force between two atoms interacting through dispersion type forces is briefly discussed.

1771

Minnesota U. [School of Chemistry] Minneapolis.

TIME-DEPENDENT PERTURBATION-VARIATION METHOD, by R. Yaris. [1963] [4]p. (AFOSR-64-0221) (AF 49(638)940) AD 432510 Unclassified

Also published in Jour. Chem. Phys., v. 39: 2474-2477, Nov. 1963.

Through the use of the time-ordered perturbation expansion, an operator equation for the time-dependent perturbation problem, of the same form as occurs in the time-independent problem, is generated. Thus, a variational method can be used to study the time-dependent case as well as the time-independent case. This variational method is used to recover the Dirac expansion as an example of a solution in series form, and it is also used to develop a simple (approximate) analytic solution as an example of a solution in closed form.

1772

Minnesota U. [School of Chemistry] Minneapolis.

RESOLVENT OPERATOR FORMULATION OF STATIONARY STATE PERTURBATION THEORY, by R. Yaris. [1964] [7]p. (AFOSR-64-1466) (AF 49(638)940) AD 445021 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1891-1897, Apr. 1, 1964.

By starting with an exact operator equation and using different methods of expanding the resolvent operator, the Schrodinger, Wigner-Brillouin, similarity transformation, gauge transformation, and first-order perturbation iteration method, perturbation expansions are generated in a rigorous and straightforward manner. It is also shown how additional perturbation and perturbation iteration methods can be generated.

1773

Minnesota U. School of Chemistry, Minneapolis.

COMMENTS ON THE RESONANCE FLUORESCENCE IN GASES, by C. A. Mead and H. F. Hameka. [1964] [1]p. (AFOSR-65-0371) (AF 49(638)940) AD 611921 Unclassified

Also published in Jour. Chem. Phys., v. 40: 606, Jan. 15, 1964.

A new theoretical description of resonance fluorescence has been developed and applied to dilute gases and molecular crystals. It was shown that all properties of resonance fluorescence can be derived from a matrix, which was called the damping matrix. The purpose of the report is to make two comments on the treatment of dilute gases.

1774

Minnesota U. [School] of Chemistry, Minneapolis.

POINT DEFECTS IN MAGNESIUM OXIDE, by J. E. Wertz, G. S. Saville and others. [1963] [20]p. incl. diagrs. (AFOSR-5519) (AF AFOSR-62-54) Unclassified

Electron spin resonance has provided a means of detecting numerous defect centers as well as of constructing models for them. A model involving next-nearest-neighbor vacancy association has been proposed for a titanium center. A center resulting from heating MgO in hydrogen has been detected by its strong doublet absorption at 3300 cm^{-1}. Using the ESR spectrum of F-centers to monitor their concentration through a series of bleaching experiments, it has been possible to assign the 5 ev optical absorption band to F-centers. Marked resemblances of neutron-irradiated MgO spectra with recent alkali halide F-aggregate spectra are noted and discussed in relation to lattice vibration frequencies. (Contractor's abstract)

1775

Minnesota U. School of Chemistry, Minneapolis.

POLAROGRAPHY IN ACETONITRILE OF TITANIUM TETRACHLORIDE AND TETRAIODIDE IN VARIOUS SUPPORTING ELECTROLYTES, by I. M. Kolthoff and F. G. Thomas. [1964] [10]p. incl. diagrs. tables, refs. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-64-2202) (AF AFOSR-63-26) AD 452399 Unclassified

Also published in Jour. Electrochem. Soc., v. 111: 1065-1074, Sept. 1964.

Current-potential curves of titanium tetrachloride in acetonitrile (AN) with tetraethylammonium perchlorate as supporting electrolyte have been determined at the dropping mercury electrode. The effect of chloride, bromide, iodide, and thiocyanate ions has been investigated. In general, only two well defined reduction waves were obtained. With tetraethylammonium chloride as supporting electrolyte, three reduction waves corresponding to the reduction of Ti(IV) to Ti(III), Ti(II), and Ti(0), were observed. Titanium tetraiodide in AN with tetraethylammonium perchlorate as supporting electrolyte gives a single reduction wave at the dropping mercury electrode corresponding to the reduction of Ti(IV) to Ti(0). (Contractor's abstract, modified)

1776

Minnesota U. School of Chemistry, Minneapolis.

REVIEW OF FUNDAMENTALS OF POLAROGRAPHY IN INERT ORGANIC SOLVENTS, by I. M. Kolthoff. [1964] [15]p. incl. tables, refs. (AFOSR-65-1652) (AF AFOSR-63-26) AD 624330 Unclassified

Presented at Third Internat'l. Cong. of Polarography.

Also published in Jour. Polarog. Soc., v. 10: 22-36, 1964.

The fundamental aspects of polarography in non-aqueous media are reviewed with special emphasis on inert, non-protonating solvents. The interrelationship between the potential scales in different solvents is considered, in terms of the Pleskov and Strehlow conventions. The polarography of cationic and anionic species in acetonitrile is discussed in detail. Protonation reactions in non-aqueous solvents is also considered in terms of the acid-base characteristics of each system. Finally, a detailed description is given of the polarography of titanium halides in acetonitrile. (Contractor's abstract)

1777

Minnesota U. [School of Chemistry] Minneapolis.

NUCLEAR MAGNETISM, by J. E. Wertz. [1964] [14]p. incl. refs. (AFOSR-65-1761) (AF AFOSR-63-200) AD 625546 Unclassified

Also published in Magnetic Materials Digest, ed. by A. H. Morrish, R. J. Prosen, and S. M. Rubens. Philadelphia, M. W. Lads Publishing Co., 1964, p. 241-254.

A review is presented of recent research on the effects of interactions of nuclei with non-zero spin on magnetic systems. Subjects covered include nuclear magnetic resonance, nuclear spin-spin interactions, nuclear specific heats, hyperfine interaction measurements and quadrupole effects, and hyperfine interaction measurements on rare earth compounds.

1778

Minnesota U. [School] of Chemistry, Minneapolis.

POINT DEFECTS IN MAGNESIUM OXIDE, by J. E. Wertz, G. S. Saville and others. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-1762) (AF AFOSR-63-200) AD 625550 Unclassified

Also published in Proc. Brit. Ceram. Soc., July 1964, 59-70.

Electron spin resonance provides a means of detecting numerous defect centers as well as a means of constructing models for them. A model involving next-nearest-neighbor vacancy association is proposed for a titanium center. A center resulting from heating MgO in hydrogen has been detected by its strong doublet absorption at 3300 cm^{-1}. Using the esr spectrum of F

centers to monitor their concentration through a series of bleaching experiments, it has been possible to assign the 5 ev optical absorption band to F centers. Marked resemblances of neutron-irradiated MgO spectra with recent alkali halide F aggregate spectra are noted and discussed in relation to lattice vibration frequencies. (Contractor's abstract, modified)

1779

Mississippi U. Dept. of Chemistry, University.

DETERMINATION OF SPECTROSCOPIC AND THERMODYNAMIC CONSTANTS FOR A SYSTEM OF 1:1 AND 2:1 COMPLEX EQUILIBRIUM REACTIONS, by N. B. Jurinski. [1964] [7]p. (AFOSR-4954) (AF AFOSR-62-19) AD 413760 Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 74-81, 1964.

A method of determining the formation constants and the molar absorbancy indices of several complex systems is described. It is shown that observed variations in the apparent formation constant with wavelength or concentration (based on the assumption of only 1:1 interactions) may be attributable to consecutive or simultaneous formation of higher order complexes. (Contractor's abstract)

1780

Mississippi U. Dept. of Chemistry, University.

A QUANTITATIVE SPECTROPHOTOMETRIC STUDY OF INTERACTIONS BETWEEN IODINE AND ARYL METHYL SULFIDES IN CARBON TETRACHLORIDE, by V. Ramakrishnan and P. A. D. de Maine. [1963] 19p. incl. tables, refs. (AFOSR-4955) (AF AFOSR-62-19) AD 413759 Unclassified

Mixtures of aryl methyl sulfides and iodine in carbon tetrachloride have two charge-transfer absorption bands with maxima located near 3050 A and between 3380 and 3525 A, respectively. Computer analysis of spectrophotometric data for these systems at 20° and 45°C has shown that (1) data collected between 3300 and 3600 A are consistent with the simultaneous reversible formation of two isomeric 1:1 complexes between the sulfide and iodine, and (2) data between 2900 and 3100 A (the region where the sulfides absorb) cannot be explained by the simultaneous reversible formation of two isomeric 1:1 complexes. Thermodynamic and spectroscopic constants for the iodine complexes with thioanisole and with o-, m-, and p-tolyl methyl sulfides in carbon tetrachloride are given. Contact charge-transfer and charge-transfer theories are considered. (Contractor's abstract)

1781

Mississippi U. Dept. of Chemistry, University.

TEMPERATURE CONTROL ATTACHMENTS FOR VARIABLE AND FIXED PATH LENGTH INFRARED CELLS, by M. S. Smith and P. A. D. de Maine. [1963] [3]p. incl. diagr. (AFOSR-J282) (AF AFOSR-62-19) AD 400877 Unclassified

Also published in Canad. Jour. Chem., v. 41: 812-814, 1963.

Quantitative studies of the temperature dependence of infrared spectra for liquids have been frustrated by the difficulties in designing adequate devices for controlling the liquid temperature in the cells. This paper describes an inexpensive attachment for controlling the sample temperature in ordinary infrared cells.

1782

Mississippi U. [Dept. of Chemistry] University.

THE INTERACTION OF IODINE WITH ARYL METHYL SULFIDES, by V. Ramakrishnan. [1963] [4]p. (AFOSR-64-0131) (AF AFOSR-62-19) AD 431077 Unclassified

Also published in Jour. Molec. Spectros., v. 11: 253-256, Oct. 1963.

Electronic spectral data for mixtures of iodine and aryl methyl sulfides in CCl_4 are reported. The mixtures exhibit two bands in the 290-360 mμ region, and under certain conditions a third band in the visible region. The two ultraviolet bands are attributed to the charge-transfer transition involving the two e1g non-degenerate orbitals into which the e1g orbital of benzene splits in unsymmetrically substituted benzenes. The intense color change which accompanies increased donor concentrations is explained by postulating the formation of an iodosulfonium ion.

1783

Mississippi U. [Dept. of Chemistry] University.

SPECTROPHOTOMETRIC AND NON-SPECTROPHOTOMETRIC STUDIES OF SOLUTIONS, by P. A. D. de Maine. Summary rept. 1964, 8p. (AFOSR-64-1109) (AF AFOSR-62-19) AD 601692 Unclassified

Summaries are given of researches in the following areas: cryoscopic studies; theoretical projects; spectral studies of systems containing phosphonitrilic chlorides; complex formation between aromatic hydrocarbons and some nitro compounds solvent effects on charge-transfer complexes between 1,3,5-trinitrobenzene and aromatic hydrocarbons in different solvents; spectrophotometric study of interactions between iodine and aryl methyl sulfides in carbon tetrachloride; infrared spectral studies of complex formation; molecular interactions studied by means of precision dielectric constant measurements; conductance and viscosity studies of rare earth chlorides; and computer methods.

1784

Mississippi U. Dept. of Chemistry, University.

ULTRAVIOLET ABSORPTION SPECTRA OF

1, 3, 5-TRINITROBENZENE IN CARBON TETRACHLORIDE, n-HEXANE, n-HEPTANE, CYCLOHEXANE, OR CHLOROFORM, by C. C. Thompson, Jr. and P. A. D. de Maine. [1964] [14]p. incl. tables. (AFOSR-64-2184) (AF AFOSR-62-19) AD 452304
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 123-136, 1964.

Absorptivities of 1, 3, 5-trinitrobenzene dissolved in five inert solvents (CCl_4, n-hexane, n-heptane, cyclohexane, or $CHCl_3$) were calculated from spectrophotometric data collected at 50 A intervals between 2650 and 4300 A at 20° and 45°C. Deviations from Beer's Law and temperature effects are discussed in terms of interactions between two forms of the trinitrobenzene molecule. At wavelengths below 3900 A, variations in the trinitrobenzene absorptivity with solvent are observed. (Contractor's abstract)

1785

Mississippi U. Dept. of Chemistry, University.

CHARGE-TRANSFER COMPLEX FORMATION BETWEEN IODINE AND ARYL METHYL SULFIDES IN CARBON TETRACHLORIDE, by V. Ramakrishnan and P. A. D. de Maine. [1964] [14]p. incl. tables, refs. (AFOSR-64-2185) (AF AFOSR-62-19) AD 451922
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 82-95, 1964.

For abstract see AFOSR-4955; Item no. 1780, Vol. 7.

1786

Mississippi U. Dept. of Chemistry, University.

CHARGE-TRANSFER COMPLEXES OF 1, 3, 5-TRINITROBENZENE WITH HEXAMETHYLBENZENE, PENTAMETHYLBENZENE, DURENE, MESITYLENE, OR BENZENE, by C. C. Thompson, Jr. and P. A. D. de Maine. [1964] [22]p. incl. tables, refs. (AFOSR-64-2186) (AF AFOSR-62-19) AD 452031
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 137-158, 1964.

Here are reported formation constants and absorptivities of 1:1 complexes of 1, 3, 5-trinitrobenzene with hexamethylbenzene, pentamethylbenzene, durene, mesitylene or benzene dissolved in five inert solvents (CCl_4, hexane, heptane, cyclohexane or $CHCl_3$).

Ultraviolet absorption data for these systems were collected at 12 or 13 wavelengths between 2750 and 4200 A at 20° and 45°C. All data were processed with an IBM 1620-60K digital computer using recently developed computer programs. Variations in the formation constants with wavelength have been attributed to simultaneous 1:1 and higher order reactions.

1787

Mississippi U. [Dept. of Chemistry] University.

COMPLEX FORMATION BETWEEN AROMATIC HYDROCARBONS AND SOME NITRO COMPOUNDS, by N. B. Jurinski and P. A. D. de Maine. [1964] [27]p. incl. tables, refs. (AFOSR-64-2187) (AF AFOSR-62-19) AD 452032
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 96-122, 1964.

Analysis of ultraviolet spectral data for 1:1 complex formation has yielded values of the association constants, molar absorptivities of the complexes, and the maximum permitted errors in these quantities, through use of a new computer method. Values are listed at 20° and 45°C. over the wavelength range 300-400 mμ for various nitrobenzene acceptors with a series of methyl benzene donors. (Contractor's abstract)

1788

Mississippi U. Dept. of Chemistry, University.

CRYOSCOPIC EVIDENCE OF COMPLEX FORMATION WITH $(PNCl_2)_3$ AND $(PNCl_2)_4$, by P. A. D. de Maine and R. D. Srivastava. [1964] [7]p. incl. tables, refs. (AFOSR-64-2188) (AF AFOSR-62-19) AD 452033
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 67-73, 1964.

Suppression constants are reported for $(PNCl_2)_3$, $(PNCl_2)_4$ and naphthalene in cyclohexane; and for chloranil and naphthalene in p-dioxane. Formation constants (in mole fraction units) calculated from cryoscopic data for the 1:1 complexes, naphthalene-$(PNCl_2)_3$ and naphthalene-$(PNCl_2)_4$ are 2.38 (± 0.60) and 1.75 (± 0.25), respectively near 5°C. For the naphthalene-chloranil complex in p-dioxane, the formation constant (mole fraction units) is 5.2 (± 0.65) near 8°C. (Contractor's abstract)

1789

Mississippi U. Dept. of Chemistry, University.

IODINE COMPLEXES IN INERT SOLVENTS. XVI. QUANTITATIVE CRYOSCOPIC AND SPECTROPHOTOMETRIC STUDIES OF SOME IODINE CHARGE-TRANSFER COMPLEXES, by R. D. Srivastava and P. A. D. de Maine. [1964] [16]p. incl. tables, refs. (AFOSR-64-2189) (AF AFOSR-62-19) AD 452030
Unclassified

Also published in Jour. Mississippi Acad. Sci., v. 10: 51-66, 1964.

Cryoscopic and spectrophotometric studies of the naphthalene-iodine and diethyl ether-iodine one:one

charge-transfer complexes in bromoform and in ethylene bromide are reported. The results indicate that (1) weak charge-transfer complexes are formed because of specific interactions between individual donor and iodine molecules; (2) spectrophotometric methods can be used to determine thermodynamic constants for weak complexes; and (3) the inert solvent used determines the magnitude of the formation constant, but does not affect the heat of formation of the complex. (Contractor's abstract)

1790

Mississippi U. [Dept. of Chemistry] University.

CHARGE-TRANSFER COMPLEXES IN SOLUTION. I. SPECTROPHOTOMETRIC STUDIES OF AROMATIC HYDROCARBON-AROMATIC NITRO COMPOUNDS DISSOLVED IN CARBON TETRACHLORIDE, by N. B. Jurinski and P. A. D. de Maine. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-2210) (AF AFOSR-62-19) AD 452476 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3217-3222, Aug. 20, 1964.

This paper reports on an ultraviolet absorption spectral study of the charge-transfer complexes formed between certain methylbenzenes and selected aromatic nitro compounds in carbon tetrachloride at 20° and 45°C. Toluene, m-xylene, mesitylene, durene, pentamethylbenzene, and hexamethylbenzene were the donors used. Acceptors were nitrobenzene, m-dinitrobenzene, p-dimitrobenzene, sym-trinitrobenzene, and sym-trinitrotoluene. The new computer method designed to eliminate ambiguities from the literature was used to process all experimental information. For a given donor, the absorptivity of the complex (ac) increases as the strength of the acceptor is increased by increasing the number of nitro groups. (Contractor's abstract, modified)

1791

Missouri U. [Dept. of Mathematics] Columbia.

COMPLETELY WELL-POSED PROBLEMS FOR NONLINEAR DIFFERENTIAL EQUATIONS, by M. D. George. [1964] [5]p. (AFOSR-3878) (AF AFOSR-62-97) AD 440974 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 96-100, Feb. 1964.

A study is made of the effect on a completely well-posed problem of a nonlinear perturbation of the operator L. It is shown that under certain conditions a completely well-posed porblem for a differential operator L remains completely well-posed for L + A, where A is a nonlinear transformation in X. Combining this result with certain functional analysis conditions guaranteeing the existence of completely well-posed problems for perturbed differential operators can be derived. One such result is given for the case $X = L^2$.

1792

Missouri U. [Dept. of Mathematics] Columbia.

PERIODICITY AND BOUNDEDNESS OF SOLUTIONS OF GENERALIZED DIFFERENTIAL EQUATIONS OF GROWTH, by W. R. Utz and P. E. Waltman. [1963] [24]p. incl. refs. (AFOSR-J749) (AF AFOSR-62-207) AD 413643 Unclassified

Also published in Bull. Math. Biophys., v. 25: 75-93, 1963.

Sufficient conditions are given for the existence of periodic solutions of differential equations having as special cases the equations used to describe the competition between two species. Conditions implying the boundedness of solutions are also given. Integrable classes are provided and a particular example is examined in detail. (Contractor's abstract)

1793

Montana State U. Communication Research Lab., Missoula.

AN EXPERIMENTAL TECHNIQUE FOR THE STUDY OF HUMAN COMMUNICATION, by F. L. Brissey. Sept. 1964, 73p. incl. illus. tables, refs. (AFOSR-64-2409) (AF AFOSR-62-214) AD 609946 Unclassified

Results are reported of empirical studies of conditions assumed to influence the effectiveness of communication systems.

1794

Montreal U. Inst. of Experimental Medicine and Surgery (Canada).

THE DOCUMENTATION SERVICE OF THE INSTITUTE OF EXPERIMENTAL MEDICINE AND SURGERY OF THE UNIVERSITY OF MONTREAL, by G. Ember and G. Gabbiani. [1963] [4]p. (AFOSR-64-0683) (AF AFOSR-62-356) AD 436517 Unclassified

Also published in Bull. A. I. D., 1963, p. 19-22.

The system (SSS) of evaluating, storing and retrieving medical information at the Institute of Experimental Medicine and Surgery of the University of Montreal is described.

1795

Naples U. [Inst. of Aerodynamics] (Italy).

GENERALIZED VELOCITY POTENTIAL EQUATION FOR PLURI-REACTING MIXTURES, by L. G. Napolitano. Aug. 1963, 52p. (IA rept. no. 103) (AFOSR-64-0885) (AF 61(052)327) AD 600098 Unclassified

The paper is concerned with the derivation and discussion of the velocity potential equation for steady linearized motions of gas mixtures in which any number k of independent reactions take place. In a first part a number of thermodynamic notions, of interest in the subsequent development of the analysis, are briefly recalled. The second part deals with the derivation of the generalized potential equation and with the analysis of its essential features. In a last part the limiting forms assumed by the potential equation when a number of reactions can be considered either frozen or in equilibrium are derived and discussed. Explicit expressions of the potential equation and of all other pertinent quantities for indicative cases of plane motions are listed in an appendix.

1796

Naples U. Inst. of Aerodynamics (Italy).

RESEARCH ON SUPERSONIC FLOW AROUND THREE DIMENSIONAL POINTED BODIES, by L. G. Napolitano. Final rept. Dec. 1964, 75p. incl. refs. (IA rept. no. 121) (AFOSR-65-1710) (AF 61(052)327) AD 625870 Unclassified

A review of research on non-equilibrium flows is presented. The work is divided into two parts, containing published and unpublished research, respectively. Part I deals with the thermodynamics and dynamics of multireacting mixtures. By starting from basic postulates, a self-consistent and complete thermodynamic theory is formulated. The study of the dynamics is mostly limited to the linearized approximation and falls within two categories: (a) formulation of basic equations and analysis of their overall properties; and (b) the solutions of typically representative flow fields. Part II deals with the derivation and discussion of the potential equation for linearized steady motion of a multireacting mixture within the volume-viscosity analogy. Also, the notion of thermodynamic characteristic speeds introduced in Part I is generalized, and a more exhaustive study of its properties is made.

1797

Naples U. Inst. of Theoretical Physics (Italy).

INEQUIVALENT REPRESENTATIONS AND SUPERCONDUCTIVITY, by L. Laplae and H. Umezawa. [1964] [25]p. incl. diagr. (AFOSR-65-0744) (AF EOAR-62-104) AD 615693 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 372-396, July 16, 1964.

The problem of superconductivity is considered from the viewpoint of the theory of the inequivalent representations for the quantized field. This theory naturally leads to the conclusion that the ground state is not an eigenstate of the number of electrons. This conclusion is independent of the assumption of the pair effects, although the final results given are the same as those of the B. C. S. theory. It is shown that the quantization of the magnetic flux can also be explained by the viewpoint presented. The method of the computation for higher-order effects is also briefly discussed.

1798

Naples U. Inst. of Theoretical Physics (Italy).

OBSERVATIONS ON SPIKE SEQUENCES FROM SPONTANEOUSLY ACTIVE PURKINJE CELLS IN THE FROG, by V. Braitenberg. Final scientific rept. Nov. 20, 1964 [35]p. incl. diagrs. table, refs. (AFOSR-65-1488) (AF EOAR-63-89) AD 623799 Unclassified

A microelectrode whose tip is inserted in some portion of the nervous system in the vicinity of a neural cell body, which is either spontaneously active, or active under some stimulation, will record a sequence of pulses of fairly uniform shape and amplitude (spikes), separated by time intervals which in general vary in an apparently haphazard way. If the activity so recorded is interpreted as a message transmitted from neuron to neuron, at least 3 different analogies with types of messages as they occur in familiar physical situations may be proposed. More than one of these principles may be active conjointly, or different types of messages may be produced at different times by the same neuron.

1799

National Bureau of Standards, Washington, D. C.

HEAT OF COMBUSTION AND HEAT OF FORMATION OF ALUMINUM CARBIDE, by R. C. King and G. T. Armstrong. [1964] [8]p. incl. diagr. tables, refs. (AFOSR-66-0353) (ISSA 65-8) Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 68A: 661-668, Nov-Dec. 1964.

The heat of combustion of aluminum carbide (Al_4C_3) in oxygen was measured by means of bomb calorimetry. The solid product of the combustion consisted of alpha aluminum oxide and another crystalline form of alumina, which was characterized as delta alumina. The heats of combustion were corrected for the formation of the delta aluminum oxide. The results when combined with the heats of formation of alpha aluminum oxide and carbon dioxide, yielded -49.7 kcal mole^{-1} for the standard heat of formation of aluminum carbide at 298.15°K with an estimated overall uncertainty of ± 1.2 kcal mole^{-1}.

1800

National Engineering Science Co., Pasadena, Calif.

LAMB'S PROBLEM FOR AN INHOMOGENEOUS MEDIUM WITH CONSTANT VELOCITIES OF PROPAGATION, by T. Karlsson and J. F. Hook. [1963] [16]p. incl. diagrs. tables, refs. (AFOSR-5354) (AF 49(638)-1082) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 53: 1007-1022, Oct. 1963.

A recently introduced method of separation of the vector wave equation of elasticity for certain types of inhomogeneous, elastic media is employed to study the two-dimensional problem of an inhomogeneous, isotropic, half-space whose elastic parameters and density vary as the square of the depth, leaving the velocities of propagation of P and S waves constant. The Rayleigh wave dispersion curve for this medium is examined. It is found that the medium yields a single Rayleigh mode with Rayleigh wave phase velocity varying between the shear velocity and the Rayleigh wave velocity of a homogeneous medium of the same Poisson's ratio. The disturbance generated by an impulsive surface line load is considered. An exact solution to this problem is obtained and numerical results for the displacements are presented and compared to the solutions for the corresponding homogeneous medium. The displacements vary inversely with depth and the relative effects of the inhomogeneity as compared to the homogeneous medium increase with distance from the source. The displacements at times before and behind the Rayleigh wave have similar, i.e. approximately sinusoidal, variation with distance from the source. (Contractor's abstract)

1801

National Research Corp., Cambridge, Mass.

THE INFLUENCE OF SURFACE PHENOMENA ON THE MECHANICAL PROPERTIES OF STRUCTURAL MATERIALS (FATIGUE OF ALUMINUM IN VACUUM), by J. L. Ham. Final rept. Jan. 1, 1961-Jan. 1, 1963. Aug. 1963, 71p. (AFOSR-4860) (AF 49(638)1005) AD 413671 Unclassified

Techniques were developed for evaluating the fatigue life of metals by reverse bending in controlled gaseous environments including high vacuum, and bombardment. These techniques were applied to electropolished specimens of commercially pure, half hard rolled aluminum sheet. The fatigue life of aluminum in reverse bending at 125 to 140 cps was found to be about seven times longer in vacuum than in wet air and about four times longer in vacuum than in dry air. The cyclic strain causes more surface roughening in vacuum than in air. A hypothesis based on adsorption equilibrium and immunization to cracking by work hardening is proposed to explain the step change in life with pressure. The effectiveness of bombardment is ascribed to prevention of crack contamination by migration of mobile surface gas films.

1802

[Naturalia et Biologia, Paris (France)]

ELECTROPHYSIOLOGIC STUDIES OF THE BASAL GANGLIA AND STRIOPALLIDAL INHIBITION OF NONSPECIFIC AFFERENT ACTIVITY, by G. M. Krauthamer and D. Albe-Fessard. Jan. 20, 1964, 24p. incl. illus. refs. (AFOSR-65-2832) (AF EOAR-63-13) AD 629093 Unclassified

Also published in Neuropsychologia, v. 2: 73-83, 1964.

Anatomical and behavioral data are summarized to show that the function of the basal ganglia extends beyond a simple control of motor activity. A summary is given of the neurophysiological data showing that: (a) The basal ganglia are integrative centers (structures with convergence properties, receiving messages from peripheral sense organs as well as the cortex; and (b) Stimulation of these nuclei (described in the literature) leads to effects outside the efferent motor pathways. In cats anesthetized with chloralose, the stimulation of certain zones in the basal ganglia inhibits the evoked nonspecific sensory activity at different levels (bulb, thalamus, cortex) but leaves intact primary sensory activity. An attempt is made to understand certain experimental and clinical observations in term of the possible role that the described inhibition might play in the normal subject.

1803

Nevada U. Mackay School of Mines, Reno.

STUDY OF SEISMICITY, MECHANICS OF FAULTING AND CRUSTAL STRUCTURE WITHIN THE BASIN AND RANGE AND ADJOINING PROVINCES, WITH EMPHASIS ON SEISMIC INFORMATION PROVIDED BY NUCLEAR EXPLOSIONS, by D. B. Slemmons, A. Ryall, and J. I. Gimlett. Final rept. Mar. 1, 1962-Apr. 30, 1964, 5p. (AF AFOSR-62-285) AD 442554 Unclassified

Two new seismographic installations near Tonopah and Golconda, and additional instruments at the Reno seismographic station have greatly improved the University's capability to investigate in detail seismic activity of the Basin and Range province. A comprehensive search of newspapers, earthquake lists, bulletins and catelogs has produced an earthquake catalog for Nevada which is complete for the period 1852-1961. A fault map has been prepared for the Basin and Range province from photogrammetric studies. Extensive use of IBM punchcards for recording of data on all phases of the seismological program has led to adoption of computer techniques for much of our routine analysis, including epicenter location. A method for determination of focal depth has been tested and was found to give promising results.

1804

Nevada U. Mackay School of Mines. Reno.

COMPUTER PROGRAM FOR AUTOMATIC

PROCESSING OF BASIN AND RANGE SEISMIC DATA, by A. Ryall and A. E. Jones. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-2904) (AF AFOSR-64-646) Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 2295-2310, Dec. 1964.

A program has been written for the University of Nevada's IBM 1620 computer which locates epicenters of seismic events that occur within the Nevada region. The program utilizes readings of P and S waves at up to eight stations in the Basin and Range province, rejects readings for events which are outside the region of interest or events recorded at less than three Nevada stations, establishes trial epicenters for locatable events by means of a table-lookup routine which utilized P-time differences between pairs of stations, and adjusts the trial epicenter by a least-squares procedure based on a sloping-layer crustal model derived from recent U. S. Geological Survey seismic refraction profiles. Epicenters calculated by the program are found to be affected by near-surface structural irregularities in the vicinity of receiving stations, but are not affected either by near-surface features in the source region or direction of the propagation paths with respect to regional structural trends. Travel-time delays calculated for Nevada seismographic stations appear to correlate with Bouguer gravity anomalies at the station sites.

1805

Newcastle U. Dept. of Inorganic Chemistry, Newcastle upon Tyne (Gt. Brit.).

HETEROCYCLIC ORGANOBORON COMPOUNDS. PART II. PREPARATION AND PROPERTIES OF 1-AZA-5-BORATRICYCLO(3, 3, 3, 0) UNDECANE AND RELATED COMPOUNDS, by N. N. Greenwood, J. H. Morris, and J. C. Wright. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0691) (AF EOAR-62-27) AD 616188 Unclassified

Also published in Jour. Chem. Soc. (London), No. 917: 4753-4761, Dec. 1964.

Hydroboronation of the 3 double bonds in triallylamine yields a tricyclic compound (I) with bridgehead nitrogen and boron atoms and a direct B-N bond; it is unreactive, volatile solid which hydrolyzes slowly to dipropylaminopropyiboronic acid (II) and tripropylamine. Hydroboronation of triallylborane yields the analogous bicyclic dibora-compound (IV) which is highly reactive and forms adducts with nitrogen donors. The infrared spectrum of azaboratricycloundecane is compared with those of triethanolamine borate and triisethyleneglycol diborate, and its boron and proton nmr spectra are also elucidated.

1606

New Hampshire U. [Dept. of Chemistry] Durham.

ELECTROPHILIC DISPLACEMENT REACTIONS. XV. KINETICS AND MECHANISM OF THE BASE-CATALYZED PROTODEBORONATION OF ARENEBORONIC ACIDS, by H. G. Kuivila, J. F. Reuwer, Jr., and J. A. Mangravite. [1963] 32p. (AFOSR-5097) (AF 49(638)312) AD 414037 Unclassified

Also published in Canad. Jour. Chem., v. 41: 3081-3090, Dec. 1963.

An investigation of the kinetics of the protodeboronation of benzeneboronic acid in water in the pH range 2.0 to 6.7 is described. In addition to the acid catalyzed reaction studied earlier a reaction whose rate is independent of pH and one whose rate increases linearly with hydroxide ion concentration have been observed. The effect of malonate buffer concentration at low pH confirms the earlier observations of general acid catalysis. Changes in buffer concentration at pH 6.70 have no effect on rate indicating specific hydroxide ion catalysis. Effect of substituents in the ortho, meta and para position of the benzene ring on the rate of photodeboronation have been examined. Ortho-para ratics for this reaction are high; possible reasons for this are discussed. The Hammett equation on using sigma correlates the rates for meta and para substituents.

1807

New Hampshire U. Dept. of Physics, Durham.

CONDUCTION THEORIES IN GASEOUS PLASMAS AND SOLIDS. Final rept. Nov. 1, 1961-Dec. 31, 1962. Mar. 1963, 31p. incl. diagrs. (AFOSR-5119) (AF AFOSR-62-105) AD 414401 Unclassified

The studies were concerned with improving the correlation between theoretical prediction and experimental observation of the transport properties of ionized media. The microwave diagnostic techniques were extended and brought to final completion. With this formulation it is possible to examine in some detail the properties of an anisotropic dielectric or plasma in a geometry which minimizes the effect of boundaries. In addition an attempt was made to ascertain the effect of a modified collision model on the electromagnetic properties of a partially ionized plasma in the presence of a dc magnetic field. The results, while of some theoretical interest, are of negligible practical importance - except possibly in the magnetohydrodynamic limit. The primary efforts concerned (a) Interaction between electromagnetic waves and cold plasmas, and (b) Conductivity theory of partially ionized plasmas.

1808

New Mexico State U. Dept. of Mathematics, University Park.

A PARTIAL ANALYSIS OF GO, by E. O. Thorp and W. E. Walden. [1964] [5]p. incl. diagrs. (AFOSR-66-1750) (AF AFOSR-63-457) AD 641727 Unclassified

Also published in Comput. Jour., v. 7: 203-207, 1964.

A game called Computer Go is defined. Computer Go

differs from the game of Japanese Go only in that certain imprecisely defined conventions have been replaced by precise rules. Some general theorems on Computer Go are given, as well as a scheme for analyzing the game with the aid of a computer. Several reduced versions of Computer Go were analyzed, and the resultant strategies are briefly described.

1809

New Mexico U., Albuquerque.

TRANSFERS IN HANDEDNESS IN THE RAT RESULTING FROM SMALL CORTICAL LESIONS AFTER LIMITED FORCED PRACTICE, by G. M. Peterson and J. V. Devine. [1963] [5]p. incl. illus. diagr. table. (AFOSR-64-0199) (AF 49(638)501) AD 432561 Unclassified

Also published in Jour. Compar. and Physiol. Psychol., v. 56: 752-756, 1963.

This study has shown that building in a certain amount of ability with the nonpreferred hand can increase the likelihood of getting a transfer in handedness with very small lesions. The limit of lesion size may eventually be made smaller but at present it appears to be between 1/2 and 1 cu mm. Even with lesions this large the results indicate that there is no critical area common for all Ss but a shifting of the region in individual Ss. Layers 5 and 6 probably contain the cells controlling handedness, but a more definitive determination requires techniques not at present available.

1810

New Mexico U. Engineering Experiment Station, Albuquerque.

WHOLE-FIELD METHODS IN THE MEASUREMENT OF POST-ELASTIC SURFACE STRAINS, by F. D. Ju. Final rept. June 1963, 103p. (AFOSR-5191) (AF AFOSR-62-208) AD 424340 Unclassified

Several whole-field methods were studied and a new technique was developed for the purpose of measuring post-elastic surface strains in metals. Critical evaluation was given to the following experimental techniques: the moire effect and the birefringent coating. In both methods, the principal experimental model designed for the study of the techniques was a simple tension plate with a central, circular hole as a stress raiser. Fringe patterns developed in both methods were recorded by photography.

1811

New Mexico U. Engineering Experiment Station, Albuquerque.

APPLICATIONS OF LOGARITHMIC THEORY OF PLANE ELASTIC DISLOCATIONS, by F. D. Ju, W. J. Sieger, and D. D. Kana. [1963] [12]p. incl. diagrs. (AFOSR-J1221) (AF AFOSR-62-208) AD 423955 Unclassified

Also published in Jour. Franklin Inst., v. 276: 106-117, Aug. 1963.

The logarithmic theory of plane elastic dislocation is applied to two problems. One deals with a single logarithmic dislocation cut; the second is a dual-radial dislocation cut problem. In both cases, equations developed by the logarithmic theory are employed to solve the stress potential functions. Then the stresses at some pertinent points are obtained for both cases and compared with photoelastic experiments. In both cases, the analytical solutions agree very well with the experimental data.

1812

New Mexico U. Engineering Experiment Station, Albuquerque.

ON THE LOGARITHMIC HYPOTHESIS OF PLANE DISLOCATION STRESS POTENTIAL FUNCTIONS, by F. D. Ju. [1963] [11]p. incl. diagrs. (AFOSR-J1222) (AF AFOSR-62-208) AD 423954 Unclassified

Also published in Jour. Franklin Inst., v. 276: 95-105, Aug. 1963.

The paper presents a comprehensive study for elastic dislocation cuts which initiate from some interior boundary of a multiply-connected plane region and terminate partially in the elastic region. The conditions governing the behavior of material at the neighborhood of the dislocation cut are stated in five theorems. The complex variable representation is chosen as best applied to the plane problem of this type. The complex stress potential functions are defined on a multi-staircase Riemannian surface to provide the necessary discontinuity results. The hypothesis is based on the logarithmic Riemannian surface. Equations, expressing the dislocation theorems, are derived from such logarithmic hypothesis. Together with the boundary conditions, this paper lists the complete set of working equations for this type of plane elastic dislocation problem. (Contractor's abstract)

1813

New Mexico U. Engineering Experiment Station, Albuquerque.

STUDY OF DISLOCATION FAILURE PHENOMENA IN UNIFORM RADIAL AND TENSILE FIELDS, by F. D. Ju. Aug. 20, 1964, 72p. incl. illus. diagrs. (Rept. no. ME-10) (AFOSR-64-1715) (AF AFOSR-63-250) AD 609855 Unclassified

In this report two states of plane elastic dislocation were studied. In one, dislocation patterns were the result of uniform radial stress fields. In another, the dislocation cuts appear in a uni-axial stress field. The uni-axial stress field yields a predetermined pattern of dislocation cuts. But the radial stress field produces dislocation patterns more or less of a random order. The model of the radial stress field problem is a large plate bounded at the interior by a circular hole. The model is subjected to a load that produces a

uniform, radial tensile stress field with respect to the center of the hole, while the edge of the hole remains traction free. According to theoretical analysis and verified by experiments, the maximum shear occurs at the edge of the hole. Upon certain critical loads, the model yields by formation of Lueders bands. The purpose in this report is to study qualitatively the Lueders band pattern and to observe any regularity of its formation.

1814

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

AN EXACTLY SOLUBLE TWO-BODY PROBLEM WITH NON-CENTRAL FORCES, by B. Davies and L. M. Delves. [1963] [3]p. incl. tables. (AFOSR-64-0582) (AF AFOSR-62-400) Unclassified

Also published in Australian Jour. Phys., v. 16: 311-313, Sept. 1963.

A class of local potentials is given which includes hard cores and a finite-range central, tensor, and L.S. part, and for which the lowest two neutron-proton states are exactly soluble. A numerical example is given in which the form factor for the potentials is a hard core plus square well.

1815

New South Wales U. Dept. of Applied Mathematics Kensington (Australia).

INTEGRATION OVER MULTIDIMENSIONAL HYPER-CUBES. I.A. PROGRESSIVE PROCEDURE, by J. N. Lyness and B. J. J. McHugh. [1963] [7]p. (AFOSR-64-0645) (AF AFOSR-62-400) AD 435929 Unclassified

Also published in Comput. Jour., v. 6: 264-270, Oct. 1963.

A method of numerical integration is described which uses a low order integration rule to obtain a high order result. The error is successively reduced, using a method based on the idea of Richardson's deferred approach to the limit. The method is restricted to hypercubic domains.

1816

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

EXPECTATION VALUES OF VARIOUS OPERATORS IN THE TRITON, by L. M. Delves. [1964] [4]p. incl. tables, refs. (AFOSR-65-1125) (AF AFOSR-62-400) Unclassified

Also published in Phys. Rev., v. 135: B1316-B1319, Sept. 21, 1964.

The trial functions used in a calculation of the triton binding energy with realistic forces have been used to derive the expectation values of a number of operators. These include the Coulomb energy for point and for finite protons; various products of powers of the interparticle distances; and the charge and magnetic moment form factors as given by Schiff.

1817

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

FURTHER RESULTS ON THE BINDING ENERGY OF THE TRITON, by J. M. Blatt and L. M. Delves. [1964] [3]p. incl. diagr. tables. (AFOSR-65-1124) (AF AFOSR-62-400) AD 619140 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 544-546, May 11, 1964.

Three trial wave functions are presented for further investigation of the binding energy of the triton. Significant improvements were obtained in the upper bound of the triton ground-state energy. Results for the three functions are presented and compared to former results.

1818

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

AN UPPER BOUND ON THE NEUTRON-DEUTERON ^2S SCATTERING LENGTH, by L. M. Delves and J. M. Blatt. [1964] [3]p. incl. refs. (AFOSR-65-1125) (AF AFOSR-62-400) AD 620471 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 542-544, May 11, 1964.

The zero-energy experiments on neutron-deuteron scattering (Phys. Rev., v. 83: 700, 1951) lead to a set of quadratic equations for the 2 scattering lengths, a_2, the doublet state, and a_4, the quartet state. This set of equations has 2 solutions. No decision between the solutions is possible on the basis of the data on n-d scattering. Thus, a theoretical calculation is made with the best available nuclear 2-body force laws. The results are presented.

1819

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

UPPER AND LOWER BOUNDS ON GENERALIZED FOURIER COEFFICIENTS, by L. M. Delves. [1964] [6]p. incl. diagrs. (AFOSR-65-1750) (AF AFOSR-62-400) AD 625770 Unclassified

Also published in Jour. Math. Phys., v. 5: 1055-1060, Aug. 1964.

Methods are given for obtaining upper and lower bounds

on the nth Fourier coefficient $C_n^2 \mid \int g^* \sigma U_n \, d\tau \mid^2$ of a function g relative to a sequence of eigenfunctions U_n. These methods fall into three classes: (a) nonvariational upper and lower bounds on C_n^2 which do not involve the solutions of any differential equations; (b) a sequence of nonvariational upper and lower bounds for C_n^2 which involve the solution of a sequence of equations; (c) a variational lower bound on C_n^2. The methods differ in their ease of application and in the amount of information required concerning the eigenvalues associated with the U_n. Some illustrative examples are given.

1820

New South Wales U. Dept. of Applied Mathematics, Kensington (Australia).

A COMP[illegible] CLEO[illegible] ASSIFICATION OF THREE-NU[illegible] T. Kalotas and L. M. Delves. [illegible]. table. (AFOSR-65-2796) (A[illegible]-400) AD 627677 Unclassified

Nuclear Phys., v. 60: 363-368, 1964.

T[illegible] three-nucleon states given by I[illegible] the triton (J = 1/2 π = +) is extende[illegible] arbitrary J^π. (Contractor's abstract)

1821

New South Wales U. Dept. of Nuclear and Radiatic[illegible] Chemistry, Kensington (Australia).

FINE STRUCTURE IN THE DELAYED COINCIDENCE LIFETIME CURVES FOR POSITRONS IN ARGON, by S. J. Tao, J. Bell, and J. H. Green. [1964] [8]p. incl. diagrs. (AFOSR-64-1041) (AF AFOSR-62-398) AD 441494 Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 453-460, 1964.

The lifetimes of positrons in argon and argon-nitrogen mixtures have been measured in more than one hundred experiments. With a high-resolution time-to-pulse-height converter the 'shoulder' after the prompt peak has been studied. The results are interpreted to mean that (1) the τ_2 component is due to the decay of orthopositronium, (2) the shoulder is that part of the τ_1 component arising from the decay of free positrons with energies below the Ore gap and (3) the prompt peak includes the decay of parapositronium, positronium in excited states and metastable collision complexes, for example Are^+, formed from positrons with energies higher than the threshold of the Ore gap. (Contractor's abstract)

1822

New South Wales U. Dept. of Nuclear and Radiation Chemistry, Kensington (Australia).

FORMATION AND QUENCHING OF POSITRONIUM IN GASES. I. RESULTS OBTAINED WITH THE THREE-PHOTON COINCIDENCE METHOD, by G. J. Celitans and J. H. Green. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-1097) (AF AFOSR-62-398) AD 619608 Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 823-831, 1964.

The 3-photon coincidence method has been used to study orthopositronium formation and quenching in argon, nitrogen, oxygen and mixtures of these gases. Quenching rates were found to be proportional to pressure for all gases and gas mixtures, except commercial grade argon. Oxygen-argon mixtures showed a 20% increase in positron[illegible]ation for oxygen concentration of the order of 10 parts per million. An increase of about 50% in the formation fraction was obtained for nitrogen-argon mixtures for nitrogen concentrations of about 10%. A uniform quenching rate was found for oxygen-argon mixtures containing up to 0.1% oxygen, and for nitrogen-argon mixtures containing up to 10% nitrogen.

1823

New South Wales U. Dept. of Nuclear and Radiation Chemistry, Kensington (Australia).

FORMATION AND QUENCHING OF POSITRONIUM IN GASES. II. RESULTS OBTAINED WITH THE POSITRON LIFETIME METHOD, by G. J. Celitans, S. J. Tao, and J. H. Green. [1964] [10]p. incl. diagrs. tables. (AFOSR-65-1098) (AF AFOSR-62-398) AD 619609 Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 833-842, 1964.

The positron lifetime method has been used to study orthopositronium formation and quenching in argon, nitrogen, oxygen and mixtures of these gases. Quenching rates were found to be proportional to pressure for all gases and gas mixtures, except commercial grade argon. Highly quenched orthopositronium lifetimes were observed in pure argon and the formation fraction of positronium was estimated as 0.40 ± 0.04. The quenching rate in oxygen was found to be $(2.3 \pm 0.3) \times 10^7$ sec^{-1} atm^{-1}. This rate holds for oxygen concentration greater than 2% in oxygen-argon mixtures. A constant quenching rate $(2.51 \pm 0.05) \times 10^5$ sec^{-1} atm^{-1} was obtained for lower oxygen concentrations; this rate is not significantly different from the quenching rate $(2.42 \pm 0.07) \times 10^5$ sec^{-1} atm^{-1} obtained for nitrogen-argon mixtures containing less than 10% nitrogen.

1824

New South Waies U. Dept. of Nuciear and Radiation Chemistry, Kensington (Austraiia).

RANGE DISTRIBUTION OF ^{22}Na POSITRONS IN ARGON AND NITROGEN, by G. J. Celitans and J. H. Green. [1963] [4]p. incl. diagrs. (AFOSR-65-1099) (AF AFOSR-62-398) AD 619610 Unclassified

Also publiished in Proc. Phys. Soc. (London), v. 82: 1002-1005, 1963.

Range distributions of ^{22}Na positrons have been measured in argon and nitrogen, using a 2-photon coincidence apparatus. The distributions are compared with theoreticai positron path iength distributions, and are used to caiculate correction factors applicable to the study of positronium formation in gases.

1825

New South Waies U. Dept. of Nuclear and Radiation Chemistry, Kensington (Australia).

ANNIHILATION RATES AND COLLISION COMPLEX OF POSITRONS IN FREON-12, by J. H. Green and S. J. Tao. [1963] [2]p. incl. diagr. tabie. (AFOSR-65-1100) (AF AFOSR-62-398) AD 619139 Unclassified

Also published in Jour. Chem. Phys., v. 39: 3160-3161, Dec. 1, 1963.

The lifetimes of positrons in Freon were measured at pressures from 1 to 5 atm. The apparatus used in the investigation depended on a wide-range nanosec time-to-pulse-height converter. For the ionger iifetime component of positronium, the pressure coefficient is found to be 0.56×10^6 sec^{-1} atm^{-1}. The shorter component is so small that at pressures above 2 atm it is scarcely detectabie but does appear quite definiteiy at iower pressures.

1826

New York State Psychiatric Inst., N. Y.

CARBON DIOXIDE FIXATION IN VERTEBRATE AND INVERTEBRATE NERVOUS TISSUE, by S. Berl, S. C. Cheng, and H. Waelsch. [1964] [6]p. (AFOSR-64-0955) (AF AFOSR-62-221) AD 439987 Unclassified

Also published in Compar. Neurochem., June 10-15, 1962, p. 207-212.

Significant CO_2 fixation in the brain of an animai in vivo was demonstrated, with the aid of C^{14} bicarbonate. The mechanism of cerebrai CO_2 fixation appears to be anaiogous to that in iiver. It was of particular interest to ascertain whether CO_2 fixation is a characteristic of the mammalian brain oniy or occurs also in nervous tissue in generai. For such a study, the nerves of the waiking iegs of the lobsters were chosen. In this nervous tissue also, CO_2 fixation couid be demonstrated. It appears probable that in both tissues CO_2 is fixed via the citric acid cycle. The findings suggest that carbon dioxide fixation is a generai property of the metaboiism of nervous tissues.

1827

New York State Psychiatric Inst., N. Y.

SOME QUANTITATIVE ASPECTS OF THE FIXATION OF CARBON DIOXIDE BY THE LOBSTER NERVE, by S.-C. Cheng and H. Waeisch. [1963] [10]p. (AFOSR-64-0956) (AF AFOSR-62-221) AD 439988 Unclassified

Aiso pubiished in Biochem. Zeitschr., v. 338: 643-653, 1963.

When lobster nerves are incubated in $NaH_{14}CO_3$-containing Ringer's soiution considerabie radioactivity is found in the intermediates of the tricarboxyiic acid cycie and closely related amino acids. The ratios of the specific activities of giutamate: aspartate:malate were found to be 1:3:25. The average contents of giutamate, aspartate, and malate were found to be 0.39, 3.9, and 0.24 µmoi/mg of protein (3.7% protein in lobster nerve). With paired nerves from the same animal, and glucose in the incubation medium, the varlability of the values could be kept within 25%. Ouabain (0.4 mM) reduced the fixation of CO_2. The findings demonstrate a significant CO_2 fixation in the nerve of an invertebrate animai.

1828

New York State Psychiatric Inst., N. Y.

TRANSGLUTAMINASE AND HISTAMINE INCORPORATION IN VIVO, by M. Ginsburg, I. Wajda, and H. Waeisch. [1963] [14]p. (AFOSR-64-0958) (AF AFOSR-62-221) AD 439990 Unclassified

Aiso pubiished in Biochem. Pharmacoi., v. 12: 251-264, 1963.

Incorporation of histamine into iiver protein of mice was investigated; the activity of transglutaminase, the enzyme that catalyzes the incorporation in vitro of amines into protein was determined simultaneousiy. Although the amount of histamine bound to iiver protein is negligible in untreated control mice, after the administration of Salmonella typhosa endotoxin and Haemophilus pertussis vaccine, agents which increase transgiutaminase activity in mouse iiver, a definite fixation of histamine in liver proteins was found. The increase in enzyme activity and the amount of protein-bound histamine showed a significant correlation. When the incorporation of the amine was studied with C^{14}, the relativeiy iow radioactivity of the incorporated histamine suggested an extensive dilution of the labeled amine by unlabeied histamine. Methods for the

determination of small amounts of protein-bound unlabeled histamine and of labeled histamine from C^{14} labeled proteins are described.

1829

New York State Psychiatric Inst., N. Y.

RNA POLYMERASE IN THE CENTRAL NERVOUS SYSTEM, by S. C. Bondy and H. Waelsch. [1964] [4]p. incl. refs. (AFOSR-65-0303) (AF AFOSR-63-443) AD 611922 Unclassified

Also published in Life Sci., v. 3: 633-636, 1964.

RNA polymerase in cerebral cortex is higher than in other regions of the rabbit brain. The average activity of the brain nuclei is higher than that of the liver nuclei. During development, the activity of RNA polymerase increases with maturation.

1830

New York State Psychiatric Inst., N. Y.

QUANTITATIVE ASPECTS OF CO_2 FIXATION IN MAMMALIAN BRAIN IN VIVO, by H. Waelsch, S. Berl and others. [1964] [12]p. incl. refs. (AFOSR-65-0304) (AF AFOSR-63-443) AD 612228 Unclassified

Also published in Jour. Neurochem., v. 11: 717-728, 1964.

The data presented in this paper support the conclusion that CO_2 fixation in the mammalian brain is a process which responds to the change in the metabolic environment. The rate of CO_2 fixation is increased when the tissue is exposed to a metabolic stress, such as elevated ammonia concentraion, which results in an increased synthesis of glutamine. The data show that CO_2 fixation is of considerable significance in brain metabolism and not negligible. It plays an essential role in maintaining the concentration of dicarboxylic acids in the citric acid cycle. The continuous removal of oxoglutarate without replenishment would lead to a breakdown of the citric acid cycle and consequently to a deficiency in the production of ATP, although the data suggest that CO_2 fixation may well replenish the intermediates of the citric acid cycle in case of increased ammonia concentration in brain tissue, these acute experiments give no answer as to the chronic effects of ammonia on the citric acid cycle.

1831

New York State U. Dept. of Chemistry, Buffalo.

DIELECTRIC CONSTANT OF HYDROGEN-BONDED LIQUIDS. II. N-MONOSUBSTITUTED ACETAMIDES, by R.-Y. Lin. [1963] [6]p. (AFOSR-J1523) (AF AFOSR-63-271) AD 426559 Unclassified

Also published in Jour. Phys. Chem., v. 67: 1805-1810, 1963.

Dielectric constants and densities of acetamides, CH_3CONHR, with R methyl, ethyl, butyl, isobutyl, sec-butyl and 1-naphthyl are given. Enthalpy, entropy and free energy of the hydrogen bond formation are discussed.

1832

New York State U. Dept. of Chemistry, Buffalo.

DIELECTRIC CONSTANT OF HYDROGEN BONDED LIQUIDS. III. SUPERHEATED ALCOHOLS, by W. Dannhauser and L. W. Bahe. [1964] [9]p. (AFOSR-64-1519) (AF AFOSR-63-271) AD 446369 Unclassified

Also published in Jour. Chem. Phys., v. 40: 3058-3066, May 15, 1964.

The dielectric constants of the eight lowest aliphatic alcohols have been measured from room temperature to their respective critical temperatures. The densities were also measured if they were not previously available. The data were analyzed in terms of Kirkwood's correlation factor based on a model of linear, hydrogen bonded chains with restricted rotation about the hydrogen bond and variable degree of polymerization. The equilibrium constants are strongly dependent on the size and shape of the alkyl group.

1833

New York State U. Dept. of Chemistry, Buffalo.

DIELECTRIC CONSTANT AND INTERMOLECULAR ASSOCIATION OF SOME LIQUID NITRILES, by W. Dannhauser and A. F. Flueckinger. [1964] [6]p. (AFOSR-64-1794) (AF AFOSR-63-271) AD 449048 Unclassified

Also published in Jour. Phys. Chem., v. 68: 1814-1819, July 1964.

Densities and equilibrium dielectric constants of propio-, acrylo-, pivalo-, benzo-, and 2,6-dimethylbenzonitrile were measured from near their melting points to about 200°C. The Kirkwood-Frohlich correlation factor is less than unity in each case and generally increases with increasing temperature. The dielectric data are analyzed on the basis of an equilibrium between monomer and an antiparalleled dipole pair dimer, and the nature of the association is discussed.

1834

New York State U. Dept. of Physics, Buffalo.

ATOMIC DIPOLE POLARIZABILITIES FROM THE UNCOUPLED HARTREE-FOCK APPROXIMATION, by M.

Yoshimine and R. P. Hurst. [1964] [6]p. incl. tables, refs. (AFOSR-65-0402) (AF AFOSR-63-191) AD 612753 Unclassified

Also published in Phys. Rev., v. 135: A612-A617, Aug. 3, 1964.

Electric dipole polarizabilities are computed for a large number of 2-, 3-, 4-, 10-, 11-, 12-, 18-, 19-, and 20-electron atoms and ions. These results are all obtained within the framework of the uncoupled Hartree-Fock approximation. All calculations are made using analytical Hartree-Fock wave functions. For the lighter atoms and positive ions the results of these calculations are in fairly good agreement with the experimental and other more accurate theoretical values. However, for the heavier atoms and ions the results are too large. It is also found that great care must be exerted in selecting self-consistent functions for use in making polarizability calculations.

1835

New York State U. [Dept. of Physics] Buffalo.

MAGNETIC SUSCEPTIBILITY OF 2 $^3S_1$ STATE OF HELIUM AND SOME LIKE IONS, by J. T. McMullan and R. P. Hurst. [1964] [5]p. incl. tables, refs. (AFOSR-65-0441) (AF AFOSR-63-191) AD 612457 Unclassified

Also published in Phys. Rev., v. 135: A973-A977, Aug. 17, 1964.

The magnetic susceptibility of the 2 $^3S_1$ state of helium and some like ions is computed using a 35 term wave function of the type originally proposed by Hylleraas and Undheim. It is found that it is possible to obtain highly accurate values for the magnetic susceptibility using this wave function if the parameters are accurately determined. Finally, an argument is given which suggests that the magnetic susceptibility obtained in the present work is accurate to at least 5 significant figures.

1836

New York State U. Dept. of Chemistry, Stony Brook.

FURTHER EVIDENCE FOR THE NORMAL CYANIDE STRUCTURE OF GeH_3CN, by T. D. Goldfarb and B. P. Zafonte. [1964] [2]p. incl. tables. (AFOSR-65-0687) (AF AFOSR-63-277) AD 615694 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3653-3654, Dec. 1, 1964.

To confirm the normal cyanide structure for the product of reaction of germyl iodide with silver cyanide, the vibrational frequency shifts were observed for 58% C^{13}- and 98% N^{15}-substituted GeH_3CN and GeD_3CN.

A simple linear MCN or MNC model and a valence force field with no interaction force constants were used to predict the frequency shifts. The observed frequencies of GeH_3CN and GeD_3CN were used to calculate a separate set of stretching force constants for each of these molecules, and these were then used to compute the frequencies of C^{13}- and N^{15}-substituted species. Results are presented in a table.

1837

New York U. Courant Inst. of Mathematical Science, N. Y.

MACROSCOPIC MAGNETO-FLUID DYNAMICS, by J. Berkowitz and H. Grad. Final rept. Sept. 1964, 8p. (AFOSR-64-1647) (AF 49(638)1006) AD 605532 Unclassified

A general program was undertaken to understand the mathematical structure and content of the basic equations of the subject, paying special attention to non-standard mathematical problems which arise. The steady flow past a wedge was studied. The Mach cones in three dimensions were computed and found to be extremely singular. The flow past an airfoil, governed at certain intermediate speeds by a fourth order 'composite' system which is partly elliptic and partly hyperbolic, was studied. An extensive existence theory of the linear Boltzmann equation was developed using newly discovered estimates for the Boltzmann collision operator. Also, a detailed study of wave propagation using normal modes was made.

1838

New York U. Courant Inst. of Mathematical Sciences, N. Y.

RESEARCH IN MATHEMATICAL PROBLEMS. Final rept. Nov. 1, 1962-Oct. 31, 1963 [13]p. incl. refs. (AFOSR-J1515) (AF AFOSR-62-108) AD 429255 Unclassified

Brief abstracts are given of reports dealing with differential equations, partial differential equations, and special functions. Some of the reports completed or in process are: Alternative representations for nonself-adjoint boundary value problems; An atypical problem for linear ordinary differential equations; Instability intervals of Hill's equation; Generalized eigenvectors and separation of variables; Generalized limiting amplitude principle; and Analysis of the Watson Transformation.

1839

[New York U. Courant Inst. of Mathematical Sciences, N. Y.]

STABILITY PROBLEMS FOR SYSTEMS OF LINEAR DIFFERENTIAL EQUATIONS, by M. Segal. [1964] (AFOSR-65-1407) (AF AFOSR-62-108) AD 621562 Unclassified

Also published in Commun. Pure and Appl. Math., v. 17: 401-414, Nov. 1964.

This investigation considers problems of stability of differential equations with periodic coefficients arising from real bi-linear forms. Only the symmetric case is analyzed in detail; however, the technique used applies to the antisymmetric case with small modification. Pairs of the form d = (T(t), Y(t)) are considered where T and Y are real n x n matrices; T is continuous, and Y(t) satisfies $\frac{d}{dt} Y = TY$, Y(0) = 1.

1840

New York U. [Courant Inst. of Mathematical Sciences] N. Y.

OPTIMAL STRATEGIES IN FACTORIAL EXPERIMENTS, by S. Ehrenfeld and S. Zacks. [1963] [12]p. (AFOSR-J1126) (AF AFOSR-62-153) AD 421163
Unclassified

Also published in Ann. Math. Stat., v. 34: 780-791, Sept. 1963.

The present study is concerned with randomization procedures in fractional factorial experiments. The general problem is to choose, in an optimal manner, a fractional replication of a full factorial system and an estimator, for the purpose of making inferences concerning a subset of pre-assigned parameters.

1841

New York U. Courant Inst. of Mathematical Sciences, N. Y.

THEORY OF THE BOLTZMANN EQUATION, by H. Grad. Aug. 1964, 27p. incl. refs. (Rept. no. MF-40) (AFOSR-64-1377) (AF AFOSR-62-266) AD 610162
Unclassified

Presented at Eleventh Internat'l. Cong. of Applied Mechanics, Munich (Germany), Aug. 1964.

A survey is presented of recent developments in the theory of the Boltzmann equation for a dilute monatomic gas. In the singular limit of small mean free path, the traditional Hilbert and Chapman-Enskog expansions have been shown to be asymptotic to true solutions of the Boltzmann equation, but only when the variables are appropriately interpreted. At the opposite extreme of large mean free path where the behavior is again nonuniform, the precise mathematical singularities have been exposed. Over the whole range of linear problems the presence of a continuous spectrum in both the collision operator and the streaming operator points to the inadequacy of traditional exponential 'normal mode' expansions in both initial and boundary value problems. Results in all the regimes have been tied together by the overall qualitative understanding given by a more comprehensive existence theory which, for the first time, is broad enough to encompass the transition to macroscopic continuum flow. (Contractor's abstract, in part)

1842

New York U. Courant Inst. of Mathematical Sciences, N. Y.

A UNIFORMLY VALID ASYMPTOTIC THEORY OF RARIFIED GAS FLOWS UNDER THE NEARLY FREE-MOLECULE CONDITIONS, by Y.-P. Pao. Dec. 18, 1964, 125p. incl. diagrs. refs. (Rept. no. MF-43) (AFOSR-65-0276) (AF AFOSR-62-266) AD 612079
Unclassified

An asymptotic theory for obtaining nearly free-molecule solutions which are uniformly valid throughout the flow field of an infinite rarefied gas is proposed in the present study for the linearized Boltzmann equation with hard-sphere molecules. Power-law molecules can be treated in a like manner. The theory is based on a new integral formulation of the linearized Boltzmann equation. An inner-and-outer-expansion procedure is used. The simplification in the inner region is that the collisional effects are only secondary while outside of the inner region the angle subtended by the body is small so that the flow field is essentially that created by a source at the origin. In order to examine the mathematical nature of this asymptotic theory, a two-dimensional circular cylinder rotating in a rarefied gas, which is at rest at infinity, is studied. It is proved that the inner and outer solutions obtained by the theory are indeed asymptotic to the true solution throughout the physical space.

1843

New York U. Courant Inst. of Mathematical Sciences, N. Y.

DRAG ON AN OBJECT IN NEARLY-FREE MOLECULAR FLOW, by M. H. Rose. [1964] [8]p. incl. refs. (AFOSR-67-1248) (AF AFOSR-62-266)
Unclassified

Also published in Phys. Fluids, v. 7: 1262-1269, Aug. 1964.

In the nearly-free molecular flight of a body through a neutral gas the departure from free-flow conditions becomes marked within roughly the distance of a mean free path from the body. This is the region to be studied here. In order to do this as simply as possible, the distribution function for the gas is assumed to be governed by the Krook equation with the addition of a point source term; this term is identified with the radial flow issuing from the object and is easily related to its shape and to the boundary condition both at its surface and at infinity. The Krook equation may be linearized about the distribution function at infinity and then solved using Fourier transform techniques. The knowledge thus obtained of the distribution function near the body leads to the expression for the first order perturbation of the drag over its free-molecular value. This is the exact first-order solution in the sense that all collisions between particles are taken into account and not merely "first collisions." The case of a sphere undergoing diffuse reflection at high Mach number is worked out in detail and an explicit expression for the drag is derived.

1844

New York U. Courant Inst. of Mathematical Sciences, N. Y.

THE ENERGY DECAY OF SOLUTIONS TO THE INITIAL-BOUNDARY VALUE PROBLEM FOR THE WAVE EQUATION IN AN INHOMOGENEOUS MEDIUM, by B. B. Lieberman. June 1964, 18p. (Research rept. no. BR-45) (AFOSR-64-1642) (AF AFOSR-64-537) AD 605508 Unclassified

The paper is concerned with the decay of the energy of disturbances which are propagated according to the wave equation with variable index of refraction in the exterior of a finite star-shaped reflecting body. It is shown that the energy of the disturbance decays like some t^{-1}. Certain conditions of growth and continuity are made on the index in order to insure some decay factor. The energy decay is obtained by estimating the solution of an integral equation which results when one applies the Friedrichs' 'A-B-C method' to the modified wave equation operator. Using the energy estimate with other familiar estimates, one obtains a rate of decay for the disturbance itself. (Contractor's abstract)

1845

New York U. Data Processing and Computation Lab., N. Y.

THE MEASUREMENT OF VOCALIC AND TONAL CONTEXTS, by D. Rothenberg. Final rept., pt. 1, Dec. 1964, 7p. (AFOSR-65-0129) (AF AFOSR-64-484) AD 610597 Unclassified

A mathematical model has been developed that defines a collection of sets each of which can be used to 'measure' the distance between any pair of a given finite set of points in such manner that the distance, as defined by a procedure for counting points on the measuring set, is invarlant under translation of such measuring set. A circular model has been applied to the perception of tones in context, and a 'Gestalt' theory of perception results from the interpretation. Predictions suitable for experimental verification or refutation of the model are provided by the results of computations performed. These results are in accord with the musical materials and practices of all the cultures thus far examined. Previously unexplained pecularities of Balinese music are accounted for. Discrepancies between Indlan musical theory and practice are explained. Examination of other non-western musical cultures lends further support to the theory.

1846

New York U. [Dept. of Chemistry] N. Y.

ORIENTATION AND REACTIVITY IN FREE RADICAL AROMATIC SUBSTITUTION, by R. T. Morrison. Final technical rept. 1961-1963. Apr. 17, 1964, 8p. (AFOSR-64-1108) (AF AFOSR-62-34) AD 601695 Unclassified

A method of analysis of biaryl mixtures was worked out that gives rate factors about ten times as accurate as previous methods have given; and a method was devised for collecting reference samples of biaryls that eliminates the need for lengthy synthesis. Rate factors were measured by this method for eight peroxide-substrate systems, and it was found that these results are consistent with the operation of polar effects. It was found that, in certain cases, the esters reported from peroxide decomposition are not the simple substituted phenyl benzoates previously assumed. Data were obtained about the effect of oxygen and peroxide concentration on yield of benzoic acid that strongly suggest the operation of a cage effect in free radical substitution.

1847

New York U. Dept. of Electrical Engineering, N. Y.

CONTROL SYSTEMS, by S. S. L. Chang and J. Ragazzini. Final rept. Mar. 1, 1962-Apr. 30, 1963, 18p. (AFOSR-64-1005) (AF AFOSR-62-321) AD 602685 Unclassified

The report is concerned with basic theoretical research in the area of 'control systems theory.' The report summarizes the research work performed. The central problem of this project was optimal control systems and their realization.

1848

New York U. Dept. of Electrical Engineering, N. Y.

THE GENERAL THEORY OF DIGITAL FILTERS WITH APPLICATIONS TO SPECTRAL ANALYSIS, by K. Steiglitz. May 1963 [112]p. incl. diagrs. refs. (Technical rept. no. 400-99) (AFOSR-64-1664) (AF AFOSR-62-321) AD 609980 Unclassified

The filtering theories for both continuous-time and discrete-time signals are formulated in terms of abstract Hilbert space, with the notion of a stable filter defined as a bounded linear operator. A specific isomorphism is then constructed which connects the filtering theories for continuous-time and discrete-time signals, and in the linear time-invariant case the two theories are shown to be essentially identical. This means that many optimization problems can be solved simultaneously for continuous-time and digital systems. The isomorphism developed above is used to reduce the approximation problem for digital filters to that for continuous-time filters. The problem of estimating the power-spectral-density of a signal from equally spaces samples is discussed. It is shown that bandpass digital filters generate a class of spectral windows which produce always positive estimates of the power-spectral-density. The optimum bandwidth and shape of such a filter are then derived. A method for identifying unknown parameters in the power-spectral-density of a digital signal is presented.

1849

[New York U. Dept. of Electrical Engineering, N. Y.]

THE COST FUNCTION AND ITS MINIMIZATION: FOR A GENERAL CLASS OF SELF-ADAPTIVE SYSTEMS, by H. J. Perlis. [1964] [13]p. (AFOSR-64-1830) (AF AFOSR-62-321) Unclassified

This paper presents a detailed analysis of a general class of self-adaptive systems under realistic conditions. The particular set of systems considered are those in which the following conditions exist: the nominal transmittance of the time-varying primary system is known, there are k varying parameters and 2Q adjustable parameters, output transducer noise is not negligible, and the spectral densities of the parameter variations and of the measurement noise are known. The auxiliary systems are closed-loop and employ perturbation-correlation identification techniques. An over-all system, quadratic cost function expression is developed. This is shown to be a function of the variance of the system transmittance which, in turn, is a function of the spectral properties of the parameter variations and the measurement noise. An optimization procedure is presented for minimizing the cost function of the over-all, self-adaptive system.

1850

[New York U. Dept. of Electrical Engineering, N. Y.]

THE MINIMIZATION OF MEASUREMENT ERROR IN A GENERAL PERTURBATION-CORRELATION PROCESS IDENTIFICATION SYSTEM, by H. J. Perlis. [1964] 11]p. incl. diagrs. refs. (AFOSR-64-2127) (AF AFOSR-62-321) AD 452380 Unclassified

Also published in IEEE Trans. Automatic Control, Oct. 1964, p. 332-339.

A general identification system is studied for an important class of realistic, time-varying processes. This class consists of those in which the process is nominally known and the statistical characteristics of its varying parameters and of the environment also are known. The expression for identification error in terms of the spectral properties of the parameter variations and of the output transducer noise is developed. Optimization procedures are given to minimize the perturbation-correlation system's mean square identification error.

1851

New York U. [Dept. of Electrical Engineering] N. Y.

A GEOMETRIC TEST SYNTHESIS PROCEDURE FOR A THRESHOLD DEVICE, by P. Kaszerman. Mar. 29, 1963, 20p. incl. diagrs. refs. (Technical rept. no. 400-79) (AFOSR-64-0391) (AF AFOSR-63-24) AD 435652 Unclassified

Also published in Inform. and Control, v. 6: 381-398, Dec. 1963.

A Boolean function may be defined as a mapping from the vertices of an n-dimensional hypercube whose vertices are n-tuples of 1 and -1 to (0, 1). A threshold function is then a Boolean function whose 1 or TRUE vertices are separable from the 0 or FALSE vertices by a hyperplane. Using this geometric representation, one may show that a threshold device realization may be approximated as follows: Form the vector sum of the TRUE vertices. The components of the resultant vector can then serve as the weights. The threshold is approximated by 2 to the n-1 minus the number of TRUE vertices. If the function under consideration is a threshold function, the vector formed from the first approximation and the threshold may be repeatedly rotated until it converges on a position such that its components form an exact threshold device realization. A specific procedure for performing these rotations is given.

1852

New York U. [Dept. of Electrical Engineering] N. Y.

ON THE SYNTHESIS OF THRESHOLD DEVICES, by P. Kaszerman. Sept. 1963, 127p. incl. diagrs. refs. (Technical rept. no. 400-84) (AFOSR-64-0394) (AF AFOSR-63-24) AD 437294 Unclassified

A Boolean function of n variables may be defined as a mapping from the vertices of an n-dimensional hypercube to (TRUE, FALSE). A threshold function is defined as a Boolean function whose TRUE vertices are separable from the FALSE vertices by a hyperplane. It is shown that the vertices of the above hypercube lie on the surface of a hypersphere and are distributed uniformly over the surface of this hypersphere. A comparison is made between a threshold function and a continuous threshold functions, i.e., the set of points on the surface of the hypersphere which lie on the TRUE side of the hyperplane. Based on this comparison, an approximate threshold device realization for any Boolean function is developed. Further, an algorithm is derived which, starting with the approximation, develops a valid realization if the function is a threshold function.

1853

New York U. Dept. of Electrical Engineering, N. Y.

ALGORITHMS FOR THE ENCODING OF THREE-DIMENSIONAL GEOMETRIC FIGURES, by K. Ruttenberg. June 1963, 1v. incl. diagrs. tables. (Technical rept. no. 400-86) (AFOSR-64-0560) (AF AFOSR-63-24) AD 434320 Unclassified

Procedures are developed for the chain encoding of lines, planes, conic sections, and quadric surfaces. Encoding of geometric figures in terms of chains facilitates their analysis and manipulation with a digital computer. Various algorithms for chain encoding are introduced and it is shown how basic algorithms can be combined to solve the problem of the intersection of a plane with a closed surface.

1854

New York U. [Dept. of Electrical Engineering] N. Y.

A CRITERION FOR QUANTIZATION OF PLANAR CONTOURS, by J. M. Glass. Feb. 1964, 48p. incl. illus. diagrs. (Technical rept. no. 400-91) (AFOSR-64-0940) (AF AFOSR-63-24) AD 600310 Unclassified

A criterion is presented for choosing the grid size used when planar contour curves are encoded in digital form. The criterion is based on representing the curves by flexed, thin elastic beams and measuring the corresponding strain energy. This energy is compared with that obtained from a 'smoothest possible' curve, or minimum-energy curve, which is shown to be uniquely determined by the quantized data. This minimum-energy curve serves as a reconstructed approximation to the original curve. The energy difference between the two curves, which varies with the grid size, is used as a basis for deciding how well the quantized data represent the original curve. In particular, the criterion requires that the minimum-energy curve generated from the quantized data reproduce the highest strain-energy density sections of an original curve to within some prescribed tolerance.

1855

New York U. Dept. of Electrical Engineering, N. Y.

A STUDY OF THE CHAIN-DIFFERENCE CORRELATION TECHNIQUE FOR CONTOUR LINE PATTERNS, by E. B. Socci. Mar. 1964, 54p. incl. diagrs. tables. (Technical note no. 400-22) (AFOSR-64-0941) (AF AFOSR-63-24) AD 600276 Unclassified

A correlation technique for contour-line patterns which is invariant to rotation is described. The technique is based on the so-called chain-encoding method for contour-line data, in which a given contour is represented by a 'chain' of elements that in sequence trace out the contour path. The correlation technique permits a comparison between two contours without regard to relative orientation or scale. It is based directly on the intrinsic curvature properties of contour-line patterns. An algorithm for forming correlation sequences is developed and programmed for a digital computer. Results obtained by correlating some sample contours are discussed. (Contractor's abstract)

1856

New York U. [Dept. of Electrical Engineering] N. Y.

APICTORIAL JIGSAW PUZZLES: THE COMPUTER SOLUTION OF A PROBLEM IN PATTERN RECOGNITION, by H. Freeman and L. Garder. [1964] [10]p. (AFOSR-64-1386) (AF AFOSR-63-24) AD 444464 Unclassified

Also published in IEEE Trans. Electron. Comput., v. EC-13: 118-127, Apr. 1964.

This paper describes the development of a procedure that enables a digital computer to solve "apictorial" jigsaw puzzles, i.e., puzzles in which all pieces are uniformly gray and the only available information is the shape of the pieces. The problem was selected because it provided an excellent vehicle to develop computer techniques for manipulation of arbitrary geometric patterns, for pattern identification, and for game solving. The kinds of puzzles and their properties are discussed in detail. Methods are described for characterizing and classifying piece contours, for selecting and ordering pieces that are "most likely" to mate with a given piece, for determining likelihood of fit, for overcoming ambiguities, and for evaluation of the progressive puzzle assembly. An illustration of an actual computer solution of a puzzle is given.

1857

New York U. [Dept. of Electrical Engineering] N. Y.

A NONLINEAR-SUMMATION THRESHOLD DEVICE, by P. Kaszerman. May 1, 1963, 2p. (AFOSR-64-1391) (AF AFOSR-63-24) AD 444462 Unclassified

Also published in IEEE Trans. Electron. Comput. Dec. 1963, p. 914-915.

This note describes a particular network consisting of AND circuits and a single linear-summation threshold device which realizes Boolean functions identified by boundaries other than hyperplanes. It is referred to as a 'nonlinear-summation threshold device.' A specific synthesis procedure is given as well as a method for generating the desired boundary. In contrast to the linear-summation threshold device, the nonlinear-summation threshold device is capable of realizing any Boolean function.

1858

New York U. Dept. of Electrical Engineering, N. Y.

ON THE ANALYSIS AND SYNTHESIS OF SWITCHING NETWORKS COMPOSED OF M-OUT-OF-N DECISION GATES, by M. Raship. June 1964, 128p. incl. diagrs. tables, refs. (Technical rept. no. 400-95) (AFOSR-64-1378) (AF AFOSR-64-24) AD 604043 Unclassified

A formal algebra, called m-out-of-n decision logic, is developed for the analysis and synthesis of switching networks made up of m-out-of-n decision gates. An m-out-of-n decision gate is defined as a device that can be described by a threshold function whose weights and threshold are positive integers. Such a threshold function is also referred to as m-out-of-n decision function. A set of theorems is derived from an axiom set, and the inclusion of Boolean algebra and 3-input majority-decision logic as special cases of the m-out-of-n decision logic is demonstrated.

1859

New York U. Dept. of Electrical Engineering, N. Y.

ON THE REALIZATION OF BINARY SWITCHING

FUNCTIONS WITH MAJORITY GATES, by M. Raship. Sept. 30, 1964, 38p. (Technical rept. no. 400-100) (AFOSR-64-2495) (AF AFOSR-64-24) AD 609504 Unclassified

For switching circuit design with majority gates, an augmented function is derived that permits the residue test to determine which of the constants 0 and 1 as well as which of the literals of a binary switching function must appear as inputs in a realization. An approach to the realization of switching functions with majority gates based on having only these required literals and constants as inputs is shown to be useful. A synthesis procedure employing this approach is presented that yields an upper bound on the number of stages required. A table is derived of all switching functions which may be realized with a network composed of two stages of three-input majority gates.

1660

New York U. Dept. of Electrical Engineering, N. Y.

AN ALGEBRAIC-GEOMETRIC TECHNIQUE FOR THE REALIZATION OF SWITCHING FUNCTIONS WITH M-OUT-OF-N DECISION GATES, by M. Raship. Oct. 1964, 34p. incl. diagrs. (Technical rept. no. 400-101) (AFOSR-64-2496) (AF AFOSR-64-24) AD 609505 Unclassified

An algebraic-geometric technique is presented for the realization of binary switching functions with networks composed of m-out-of-n decision gates. An m-out-of-n decision gate is defined as a device that may be described by a threshold function whose weights and threshold are positive integers. An expansion theorem is proved that can produce a variety of gate configurations ranging between the two extremes of 2(n-1) stages of 3-input majority gates, and a 2-stage form composed of gates having a much greater number of inputs. For realization with two stages, the terms of the expansion theorem may be mapped on to one-half of a Karnaugh diagram. The map displays all possible combinations of terms which may be combined according to the m-out-of-n decision logic, and provides a basis for formalizing the initial step in a reduction procedure. (Contractor's abstract)

1661

New York U. Dept. of Electrical Engineering, N. Y.

PATTERN-ANALYSIS OF PLANAR GEOMETRIC CONFIGURATIONS, by H. Freeman. Final rept. Nov. 1, 1963-Dec. 31, 1964 [26]p. incl. diagr. (AFOSR-65-0389) (AF AFOSR-64-24) AD 612020 Unclassified

The study covered five separate investigations. Of these, four were directly concerned with the processing of encoded graphical data in a digital computer, and the fifth was concerned with a special form of majority logic, the so-called m-out-of-n decision logic. The report briefly summarizes these investigations and lists the publications (with abstracts) resulting from the research work.

1662

New York U. Dept. of Electrical Engineering, N. Y.

RESEARCH INVESTIGATIONS IN SYSTEMS THEORY, by J. K. Wolf and J. R. Ragazzini. Final rept. Oct. 1, 1963-Sept. 30, 1964. Oct. 1, 1964, 16p. (AFOSR-64-2176) (AF AFOSR-64-499) AD 609450 Unclassified

The following investigations are discussed: A study of time-optimal controls for continuous and sampled data systems, The synthesis of approximately optimal control systems, The synthesis of multiple loop feedback amplifiers, Cumulative codes as variable redundancy codes, On an extended class of error-locating codes, On codes derivable from the tensor product of check matrices, The cost function and its minimization for a general class of self-adaptive systems, The minimization of measurement error in a general perturbation-correlation, process identification system, and The utilization of external, correlated signals to reduce the self-adaptive cost function.

1663

New York U. Dept. of Electrical Engineering, N. Y.

CUMULATIVE CODES AS VARIABLE REDUNDANCY CODES, by J. K. Wolf. [1964] [7]p. incl. diagrs. (AFOSR-65-0333) (AF AFOSR-64-499) AD 611936 Unclassified

Also published in IEEE Internat'l. Convention Record, Pt. 5: 66-72, 1964.

A cumulative decision feedback system is considered whereby the digits are decoded on the basis of all the digits in all of the repeated blocks. If an (n, k) binary group code is repeated (N-1) times, the resultant digits are considered as nN-tuples derived from an (nN, k) code. The parity check matrix, minimum distance and generator polynomial (for cyclic codes) are determined for the (nN, k) code. A method for partitioning the error detection and correction capabilities of the (Nn, k) code is suggested on the basis of a constant fail-safe probability criterion.

1664

[New York U. Dept. of Physics, N. Y.]

THE GENERATION AND PROPAGATION OF WAVES IN A COMPRESSIBLE ATMOSPHERE, by D. W. Moore and E. A. Spiegel. [1964] [24]p. (AFOSR-64-0605) (AF AFOSR-62-366) AD 436372 Unclassified

Also published in Astrophys. Jour., v. 139: 46-71, Jan. 1, 1964.

The equations governing the aerodynamic generation and the propagation of waves in a compressible atmosphere are exhibited. Fluctuating terms which are turbulent sources for aerodynamic noise are approximated by an externally applied, time-harmonic, point force. Lighthill's results for the asymptotic radiation field in

an anisotropic medium are applied to an isothermal atmosphere. The surfaces of constant phase, group velocity, and intensity of the far field are computed. For finite frequencies above the critical frequency for vertical propagation, a monopole component is produced in the field by gravitational effects. The propagation problem is studied for arbitrary temperature profiles, and in certain regions in the solar atmosphere there exist finite bands of non-propagating frequencies. The oscillations in the solar atmosphere should result from forced excitations of these non-propagating frequencies.

1665

New York U. [Dept. of Physics] N. Y.

THE EFFECT OF RADIATIVE TRANSFER ON CONVECTIVE GROWTH RATES, by E. A. Spiegel. [1964] [16]p. (AFOSR-64-1978) (AF AFOSR-62-366) AD 452397 Unclassified

Also published in Astrophys. Jour., v. 139: 959-974, Apr. 1, 1964.

Calculations of the convective growth rate, η are carried out for an inviscid, radiating, polytropic layer. The effect of a radiative damping is studied in two special cases. First assume a layer thickness much less than the scale height, but with arbitrary optical thickness of disturbances. In this case the growth rate is a monotonically increasing function of the horizontal wavenumber, k. Second, the case of a layer of arbitrary vertical extent is considered, but only for disturbances with large k. In this case, Newton's law of cooling is valid for the perturbation equations. When the polytropic index, m, is 6, it is demonstrated that for the convective modes, η approaches the non-radiative value for large k, while for the acoustic modes overstability can occur. Arbitrary values of m are then treated in the boundary-layer approximation.

1866

Nobel Inst. for Physics, Stockholm (Sweden).

RANGE DISTRIBUTIONS OF W^{167} IONS OF KEV ENERGIES IN TUNGSTEN, by J. Uhler, B. Domeij, and S. Borg. [1963] [7]p. (AFOSR-J657) (AF EOAR-62-66) AD 416381 Unclassified

Also published in Arkiv Fysik, v. 24: 413-419, 1963.

Until now no measurements of complete range distributions of an ion in its own element have been made. In this work the ranges of W^{167} ions in the energy interval 1.6-127 kev are measured. Comparison is made with distributions of noble gas ions in W. The data confirm the significance of the distributions obtained for ranges of gas ions. The ranges found are shown to be considerable larger than predicted by theory.

1867

Nobel Inst. for Physics, Stockholm (Sweden).

PROTON ANGULAR DISTRIBUTIONS FROM $O^{16}(d,p)O^{19}$ AT ED EQUALS 7.0 MEV, by G. Wickenberg, S. Hjorth and others. [1963] [11]p. (AFOSR-64-0639) (AF EOAR-62-66) AD 435943 Unclassified

Also published in Arkiv Fysik, v. 25: 191-201, May 22, 1963.

The angular distributions of protons corresponding to the 0, 0.096, 1.47 and 2.35 mev O^{19} states from the reaction $O^{18}(d,p)O^{19}$ and of elastically scattered deuterons by O^{16} have been measured at a bombarding energy of 7 mev. DWBA analyses of the distributions have been performed by G. R. Satchler and some results from these calculations are shown. For the (d, p) transitions to the ground state and 1.47 mev state spectroscopic factors agree well with those obtained from PWBA analyses as well as with those previously measured at 15 mev deuteron energy.

1668

North American Avlation, Inc. Atomics International Div., Canoga Park, Calif.

RESEARCH ON PROPERTIES OF HIGH CURRENT, LOW FREQUENCY ELECTRODELESS DISCHARGES, by C. A. Guderjahn. Annual technical summary rept. 1964, 45p. (Rept. no. AI-64-46) (AFOSR-64-0999) (AF 49(636)1222) AD 603935 Unclassified

Alternating current, low pressure electrodeless discharges were excited in cesium, rubidium, potassium, and mercury vapors by magnetic induction. In each case the discharge tube was a toroid forming the secondary of an iron core transformer whose frequency range was 1 to 40 kc. The resistivities of the discharges were measured as a function of current density (1 to 30 amp/sq cm) and pressure (1 to 300 microns). The discharges were diffusion controlled and strongly ionized with electron-charged particle interactions being the principal contribution to resistivity. Resistivities were of the order of 0.2 omega cm.

1669

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

STEADY-STATE ROCKET COMBUSTION OF GASEOUS HYDROGEN AND LIQUID OXYGEN. PART I. EXPERIMENTAL INVESTIGATION, by L. P. Combs and F. W. Hoehn. June 1964, 56p. incl. illus. diagrs. (Research rept. no. 64-24) (AFOSR-64-1952) (AF 49-(638)617) AD 615796 Unclassified

Combustion of gaseous hydrogen and liquid oxygen was studied experimentally under rocket conditions in an uncooled transparent-walled two-dimensional combustion chamber which simulated a 1-inch-wide dlametrical section of a conventional cylindrical rocket combustor.

Tests were made with three injector types using hydrogen chilled to simulate regenerative rocket engine injection temperatures. Photographic data were obtained which yielded considerable qualitative insight and quantitative information concerning the propellant combustion processes. (Contractor's abstract)

1870

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

THE ANHARMONICITY CORRECTION FOR POLYATOMIC MOLECULES. PART II. METHANE, by E. C. Curtis. [1964] [18]p. incl. tables, refs. (AFOSR-65-0568) (AF 49(638)1135) AD 614088 Unclassified

Also published in Jour. Molec. Spectros., v. 14: 292-307, Nov. 1964.

The anharmonic correction to the vibrational frequencies of methane and all of its deuterium and tritium substituted derivatives was computed using a method reported earlier. The harmonic force constants and anharmonicity parameters were determined by Jones and McDowell. To compare this method to the conventional Dennison method it was necessary to devise an arbitrary method of classifying vibrations. This is described and the fit is satisfactory in both cases. The vibrational frequencies are then calculated for the unmeasured unsymmetrically substituted derivatives of methane.

1871

North American Aviation, Inc. Rocketdyne Div., Canoga Park, Calif.

THE ANHARMONICITY CORRECTION FOR POLYATOMIC MOLECULES. PART I. METHODS AND APPLICATION TO CH_2O, by E. C. Curtis. [1984] [13]p. incl. diagr. tables, refs. (AFOSR-65-0589) (AF 49-(638)1135) AD 614177 Unclassified

Also published in Jour. Molec. Spectros., v. 14: 279-291, Nov. 1964.

A new approach is offered for computing anharmonicity factors for simple polyatomic molecules from the observed fundamental vibrational frequencies. This involves addition of terms for anharmonicity to a conventional normal coordinate analysis based on the amplitude of the normal vibrations. For an example, the method is applied to formaldehyde in several degrees of approximation, one of which was able to reproduce the observed frequencies within the experimental error.

1872

North American Aviation, Inc. [Space and Information Systems Div.] Downey, Calif.

RECENT STUDIES IN BOUNDARY LAYER TRANSITION, by E. R. van Driest. Nov. 1963, 36p. (Rept. no. SID-64-548) (AFOSR-64-0589) (AF 49-(638)1178) AD 437283 Unclassified

Presented at Founders' meeting of the Society of Engineering Science, Purdue U., Lafayette, Ind., Nov. 4-6, 1963.

Experimental effects of controlled surface roughness and freestream turbulence on boundary layer transition are described and theoretical correlations of the data presented. Recent results on the transition of boundary layers in non-Newtonian fluids are also discussed. It is found that a small increase in fluid plasticity strongly delays transition.

1873

North American Aviation, Inc. Space and Information Systems Div., Downey, Calif.

STUDIES ON BOUNDARY LAYER TRANSITION FOR YEARS 1963-64, by E. R. van Driest and C. B. Blumer. Summary rept. Dec. 1964, 31p. incl. diagrs. tables. (Rept. no. SID-64-2191) (AFOSR-65-0203) (AF 49(638)1178) Unclassified

The present report reviews the results of studies on boundary layer transition carried out during the years 1963-64 under the above contract. Studies included (a) effect of cooling on roughness-induced transition, (b) effect of roughness on transition on the face of a blunt body, (c) non-newtonian effects, and (d) roughness effects in hypersonic flow. (Contractor's abstract)

1874

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

EVALUATION OF TRUNCATION METHODS FOR ACCURATE CENTROID LATTICE PARAMETER DETERMINATION, by J. Taylor, M. Mack, and W. Parrish. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-65-0159) (AF 49(638)620) AD 611501 Unclassified

Also published in Acta Cryst., v. 17: 1229-1245, Oct. 1964.

The centroid method provides a rational approach to the problem of the accurate determination of lattice parameters. The method requires (1) precise measurement of the line profiles; (2) calculation of the centroid; (3) correction of the centroid for aberrations, goniometer calibration, etc., and (4) knowledge of the centroid of the incident spectral distribution. Four proposed methods for establishing finite limits by truncating a diffraction line profile are reviewed. The methods are evaluated from both a theoretical and practical viewpoint and the superiority of 1 of the methods is demonstrated. The effects of $K\beta$ lines, $K\alpha$ satellite lines and the background on the centroid are discussed. Lattice parameters of silicon and tungsten derived using both $FeK\alpha$ and $CuK\alpha$ radiations are given. The results are free of systematic error, and it appears that

the centroid method can be used to obtain lattice parameters of greater accuracy than has been possible before, provided accurate spectral centroid data can be obtained.

1875

[North American Philips Co., Inc.] Philips Labs., Irvington-on-Hudson, N. Y.

METHODS OF DETERMINING CENTROID X-RAY WAVELENGTHS: CuKα AND FeKα, by M. Mack, W. Parrish, and J. Taylor. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-85-0181) (AF 49(638)620) AD 456499 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1118-1127, Apr. 1964.

Centroids of CuKα and FeKα two-crystal spectrometer profiles prepared by Bearden have been calculated and corrected for axial divergence, distortions arising from variation in absorption across the spectral distributions, crystal asymmetry, and other factors. To determine the centroid wavelength it is necessary to truncate the profile; equivalence of λ and θ is maintained by truncating the powder and spectral profiles in the same manner. Four methods for systematically truncating the profiles have been published; the methods are evaluated and the superiority of one of the methods is demonstrated. It is shown that the centroid wavelength is a function of integration (wavelength) range, primarily as a result of inclusion or exclusion of the Kα satellite group within the truncated profile. The two-crystal spectrometer profiles are compared with models based on a Cauchy distribution. The necessity for additional spectral data before reference centroid wavelengths can be established is discussed. (Contractor's abstract, in part)

1878

North Carolina State Coll. [Dept. of Mathematics] Raleigh.

THE EFFECT OF A PENNY-SHAPED CRACK ON THE DISTRIBUTION OF STRESS IN A LONG CIRCULAR CYLINDER, by I. N. Sneddon and R. J. Tait. Apr. 18, 1963, 19p. (AFOSR-J1518) (AF 49(638)1159) AD 427982 Unclassified

Also published in Internat'l. Jour. Eng. Sci., v. 1: 391-409, 1963.

An analysis is presented of the distribution of stress in a long circular cylinder of elastic material when it is deformed by the application of pressure to the inner surfaces of a penny-shaped crack situated with its center on the axis of the cylinder and its plane perpendicular to that axis. It is assumed that the cylindrical surface is free from shear and is supported in such a way that the radial component of the displacement vector vanishes on the surface. By making a suitable representation of the stress function for the problem, the problem is reduced to the solution of a Fredholm integral equation of the second kind. Expressions for the various quantities of physical interest are derived for small values of the ratio of the radius of the crack to that of the cylinder by finding an iterative solution of this equation. For values of this ratio near unity the integral equation has been solved numerically using a high-speed computer and the relevant quantities calculated.

1877

North Carolina State Coll. [Dept. of Mathematics] Raleigh.

AN EXTERNAL CRACK PROBLEM WITH ASYMMETRICAL LOADING, by M. Lowengrub. Sept. 20, 1963, 9p. (AF AFOSR-83-444) AD 421177 Unclassified

Considered is the problem of determining the distribution of stress in an infinite elastic solid containing an external crack which is opened by the application of an asymmetrical pressure. Throughout, it is assumed that the equations of the classical (infinitesimal) theory of elasticity hold.

1878

North Carolina State Coll. [Dept. of Mathematics] Raleigh.

NUMERICAL TREATMENT OF AN INTEGRAL EQUATION ARISING IN A MIXED-BOUNDARY ELASTICITY PROBLEM, by J. T. Welch, Jr. Apr. 28, 1964, 48p. (AF AFOSR-83-444) AD 437920 Unclassified

The non-singular Fredholm integral equation is solved numerically. The equation has been derived by Sneddon and Collins in the analytical treatment of the stress field in a long cylinder containing a penny-shaped crack being opened by an arbitrary axially symmetric pressure. In the discussion of the numerical treatment, emphasis is on techniques which allow the treatment of additional cases, without excessive recomputation. Results are given for constant, parabolic and step pressures across the crack, with variations in crack width and Poisson's ratio. The shape of the crack is also obtained in many cases.

1879

North Carolina State Coll. Dept. of Mathematics, Raleigh.

THE USE OF TRANSFORM METHODS IN ELASTICITY, by I. N. Sneddon. Nov. 8, 1964, 193p. incl. diagrs. tables. (AFOSR-64-1789) (AF AFOSR-84-444) AD 453791 Unclassified

These notes give a fairly complete account of the applications of the theory of the more familiar integral transforms (Fourier and Hankel) to the solution of boundary value problems in elastostatics. The first chapter contains some introductory materials on the equations of elastic equilibrium and their solution. Chapter II is concerned with plane strain problems and uses only the theory of Fourier transforms. In Chapter

III three-dimensional problems are considered and here one of the natural tools to use is the Hankel transform. The remaining two chapters are given over to the treatment of two special classes of spatial problems—the calculation of thermal stresses and the solution of certain simple forms of the contact problem. Some unfamiliar properties of Fourier and Hankel transforms are collected together in an appendix.

1880

North Carolina U. [Dept. of Mathematics] Chapel Hill.

ON A BOUND USEFUL IN THE THEORY OF FACTORIAL DESIGNS AND ERROR CORRECTING CODES, by R. C. Bose and J. N. Srivastava. [1964] [7]p. (AFOSR-4833) (AF AFOSR-63-84) AD 611931 Unclassified

Also published in Ann. Math. Stat., v. 35: 408-414, Mar. 1964.

Consider a finite projective space PG(r − 1, s) of r − 1 dimensions, r ≥ 3, based on the Galois field GF_s, where $s = p^h$, p being a prime. A set of distinct points in PG(r − 1, s) is said to be a non-collinear set, if no three are collinear. The maximum number of points in such a non-collinear set is denoted by $m_3(r, s)$. It is the object of this paper to find a new upper bound for $m_3(r, s)$. This bound is of importance in the theory of factorial designs and error correcting codes. The exact value of $m_3(r, s)$ is known when either $r \leq 4$ or when $s = 2$. When $r \geq 5$, $s > 3$, the best values for the upper bound on $m_3(r, s)$ are due to Tallini and Barlotti. Our bound improves these when $s = 3$ or when s is even.

1881

North Carolina U. [Dept. of Mathematics] Chapel Hill.

THE CONSTRUCTION OF TRANSLATION PLANES FROM PROJECTIVE SPACES, by R. H. Bruck and R. C. Bose. [1964] [18]p. incl. refs. (AFOSR-65-0091) (AF AFOSR-63-84) AD 455737 Unclassified

Also published in Jour. Algebra, v. 1: 85-102, Apr. 1964.

Can every (nonDesarguesian) projective plane be imbedded (in some natural, geometric fashion) in a (Desarguesian) projective space? The question is new but important, for, if the answer is yes, two entirely separate fields of research can be united. This paper provides a conceptually simple geometric construction which yields an affirmative answer for a broad class of planes. A plane π is given by the construction precisely when π is a translation plane with a coordinatizing right Veblen-Wedderburn system which is finite-dimensional over its left-operator skew-field. The condition is satisfied by all known translation planes, including all finite translation planes. (Contractor's abstract)

1882

North Carolina U. [Dept. of Physics] Chapel Hill.

RADIATION DETECTION BY DECORATION IN SILVER CHLORIDE CRYSTALS, by C. B. Childs and I. M. Slifkin. 1963, 29p. (AFOSR-J1553) (AF 49(638)865) AD 427405 Unclassified

A review is given of the decoration of imperfections in silver halides with emphasis on volume decoration used in radiation detection. The selection, preparation, and decoration of silver chloride crystals are discussed with illustrations of decorated imperfections. Examples of primary cosmic ray particles and high energy proton collisions in silver chloride crystals are presented. The unique features of these crystals as radiation detectors are absence of humidity effects, absence of distortion, nonchemical development at room temperature, delineation of tracks in less than two hours, and crystal thicknesses greater than 3000μ.

1883

North Carolina U. Dept. of Physics, Chapel Hill.

THEOREM ON SEPARATION OF VARIABLES WITH APPLICATION TO STATIC-SOURCE MESON THEORY, by E. A. Remler. [1964] [5]p. (AFOSR-65-0480) (AF AFOSR-63-153) AD 616463 Unclassified

Also published in Phys. Rev., v. 136: B491-B495, Oct. 26, 1964.

A general formulation is given of the process by means of which one eliminates certain redundant degrees of freedom occurring in interacting quantum-mechanical systems. This may be considered a generalization of the transformation to center of mass in problems having translational invariance. When applied to the pion-nucleon system, the static-source approximation arises as the first term in a series, the higher terms of which are easily calculable using an algorithm developed in the Appendix. This system is not an expansion in the inverse mass of the nucleon, and it is shown that the static approximation need not be considered as a non-relativistic approximation.

1884

North Carolina U. Dept. of Physics, Chapel Hill.

FALLING CHARGES, by C. M. DeWitt and B. S. DeWitt. [1964] [18]p. incl. refs. (AFOSR-65-0481) (AF AFOSR-63-153) AD 614166 Unclassified

Also published in Physics, v. 1: 3-20, 1964.

The radiative damping force on an electrically charged particle falling freely in a static weak gravitational field is computed in the nonrelativistic limit of small velocities. It is shown that, in this limit, the force separates naturally into 2 components: (1) a conservative part which arises from the fact that the mass of the particle is not concentrated at a point but is partly distributed as electric field energy in the space

surrounding the particle and (2) a non-conservative part which depends linearly on both the velocity and the Riemann tensor. The conservative force is shown to correspond to a repulsive inverse square potential and to make a retrograde contribution to the perihelion precession. The nonconservative part is shown to produce an average energy loss identical with that of the traditional formula which is used for accelerations caused by nongravitational forces. Because the nonconservative force depends on the velocity rather than its 2nd derivative, however, the phenomenon of preacceleration does not occur with gravitational forces.

1885

North Dakota State U. Coll. of Chemistry and Physics, Fargo.

THE ANODIC OXIDATION OF CHLORIDE TO PERCHLORATE ON A SEMI-MICRO SCALE, by J. E. Billigmeier and R. L. McDonald. [1964] [3]p. incl. diagr. table. (AFOSR-64-1506) (AF AFOSR-63-65) AD 446368 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 663-665, 1964.

A non-compartmentalized cell was designed which gives good conversion of LiCl to $LiClO_4$ while operating with a total liquid volume of 3 ml or less. Results of the electrolysis of both LiCl and HCl solutions are presented. A good yield of perchlorate can be obtained from LiCl in a matter of 6 hr or less. On the other hand with HCl the yield is poor even after 24 hr of electrolysis. The pronounced decrease in yield observed after 24 hr for HCl may not be real. The $KClO_4$ recovered in this run was extremely fine and thus difficult to filter; some loss may have occurred. This work demonstrates that it is possible to obtain high yields of perchlorate from small volumes of relatively dilute LiCl solutions.

1886

North Dakota State U. Coll. of Chemistry and Physics, Fargo.

IRON (III) EXTRACTION BY NITROBENZENE-BENZENE MIXTURES (Abstract), by R. L. Erickson and R. L. McDonald. [1964] [1]p. (AFOSR-65-2071) (AF AFOSR-63-65) AD 628826 Unclassified

Also published in Proc. North Dakota Acad. Sci., v. 18: 112, 1964.

In the present work, the solvation of $HFeCl_4$ by nitrobenzene in the inert diluent benzene has been studied by observing the variation of the distribution ratio with nitrobenzene concentration while all other variables are held constant. The extracted metal species existing in the organic phase at nitrobenzene concentrations greater than 3 M may be represented as $HFeCl_4 - 14PhNO_2 - x\ H_2O$ where x is being determined. At nitrobenzene concentrations below approximately 3.0 M the data are inconclusive. The large number of nitrobenzene molecules per metal atom may indicate that the anion is also solvated in this system.

1887

Northrop Corp., Hawthorne, Calif.

TRANSITION FROM AMBIPOLAR TO FREE DIFFUSION IN A DECAYING PLASMA. CASE I - INITIAL DISTRIBUTION A DIRAC DELTA "FUNCTION", by C. D. Maldonado. Jan. 1963, 45p. incl. diagrs. (Rept. no. NSL-63-15) (AFOSR-5072) (AF 49(638)-1160) Unclassified

The hypotheses of congruence and proportionality are used to study the transition from ambipolar to free diffusion in a decaying plasma. Time dependent "imperfect" ambipolar diffusion coefficients are obtained for both the electrons and ions. For a decaying plasma which is initially a Dirac delta distribution and in a quasi-neutral state, the temporal evolution of these diffusion coefficients is from a common limit of "perfect" ambipolar diffusion to their respective limits of free diffusion as time increases. The period or time required to make this transition is different for both coefficients and depends to a great extent on the initial number of charged particles. Plots of these coefficients as a function of the initial number of charged particles for different values of time and vice versa are presented. Also for a given initial number of charged particles the spatial behavior of the charge density, electric field and potential consistent with Poisson's equation are plotted for different values of time during the transition period. (Contractor's abstract)

1888

Northrop Corp., Hawthorne, Calif.

THREE-FLUID NONEQUILIBRIUM PLASMA ACCELERATORS. PART II, by P. D. Lenn, J. R. Bodoia and others. [1963] 25p. (AFOSR-J767) (AF 49(638)-1160) AD 414040 Unclassified

Presented at AIAA Electric Propulsion Conf., Colorado Spring, Mar. 11-13, 1963.

The three-fluid theory of nonequilibrium plasma flow with emphasis on crossed-field accelerators is extended through the use of improved analytical models and less restrictive physical assumptions. A theory of the heat transfer to the electrodes of a crossed field accelerator is developed which includes the effects of the three-fluid behavior of the plasma and of the applied electromagnetic fields. The analysis indicates that the electrical power dissipation in the electrode drop region is the major source of heat transfer to cold electrodes. Experimental heat transfer values were determined from calorimetric measurements on the water-cooled electrodes. Data obtained over a range of magnetic field strengths, accelerator power levels and channel pressures are shown to fit a correlation of the form developed analytically.

1669

Northrop Corp., Hawthorne, Calif.

PLASMA PROPERTIES BY MOMENTUM CHANGE, by P. D. Lenn and D. L. Ward. May 1964, 65p. incl. illus. diagrs. tables, refs. (AFOSR-64-1000) (AF 49-(638)1160) AD 603097 Unclassified

The use of the momentum change technique to determine average properties of a plasma from its interaction with applied electric and magnetic fields was investigated. Experiments were performed using a linear crossed field accelerator. An analysis for the calculation of average values of the scalar conductivity, Hall coefficient and ion slip coefficient is developed and applied to experimental results obtained with argon at the pressures of 2, 4 and 6 mm Hg. From those values, the electron temperature and number density and the mean electron-ion collision time were calculated. Assuming a relation between the electron and heavy particle temperatures, the heavy particle densities, the mean ion-atom collision time and the ion-atom collision cross-section were calculated.

1690

Northrop Corp., Hawthorne, Calif.

MOMENTUM TRANSFER TO PLASMAS BY LORENTZ FORCES, by S. T. Demetriades. [1964] [32]p. incl. illus. diagrs. refs. (AFOSR-64-2252) (AF 49(638)-1160) AD 452371 Unclassified

Also published in Physico-Chemical Diagnostics of Plasmas, 1964, p. 297-326.

A theoretical and experimental study of momentum transfer to plasmas by Lorentz forces is described. A generalized Ohm's law is used to predict changes in the direction and magnitude of the momentum of a stream of plasma and other observable macroscopic effects in a crossed-field accelerator in terms of species temperatures and concentrations and other plasma parameters. The assumption of local thermal equilibrium is not required in this approach. Measurements of momentum change and other effects are presented that are substantially in agreement with theory. Gross mean estimates of the plasma parameters in the cross-arc region are obtained from the measured momentum changes and power input. (Contractor's abstract)

1691

Northrop Corp., Hawthorne, Calif.

THREE-FLUID NONEQUILIBRIUM PLASMA ACCELERATORS. PART I, by S. T. Demetriades, G. L. Hamilton and others. [1963] [50]p. incl. illus. diagrs. tables, refs. (AF 49(636)1160) Unclassified

Presented at the ARS Electric Propulsion Conf., Berkeley, Calif., Mar. 14-16, 1962.

Published in Astronaut. and Rocketry, v. 9: 461-511, 1963.

A three-fluid theory of nonequilibrium plasma flow is developed, and the underlying assumptions are discussed, with emphasis on crossed-field plasma accelerators. Use is made of a simplified model of the geometry of the discharge to analyze the effect of magnetic induction on the thrust at constant total current. The mechanism of current transfer between low-temperature electrodes is also discussed. Measurements are reported of mass flow rate, thrust, axial pressure distribution, total current, electrode voltage, magnetic induction, electrode and insulator erosion, and electrode cooling rates for a continuous crossed-field accelerator. The plasma generator and accelerator were connected by a gas-tight adapter and were both mounted on the thrust stand. Mass flow rates from 0.001 to 0.003 lbm/sec were used, and thrust levels of up to 3.6 lb were developed. Water cooled copper electrodes were employed with negligible erosion rates. Electrode power losses were about 20% of accelerator power. Accelerator running times are currently limited by test-tank heating to approximately 30 min at these power levels. The experimental results are shown to be in agreement with the theoretical analysis based on Cowling's 3-fluid current density equation.

1692

Northrop Corp., Hawthorne, Calif.

INVESTIGATION OF THE SCATTERING OF A LASER BEAM BY THE ELECTRONS OF A PLASMA, by D. W. McMorris and H. N. Olsen. Dec. 1964, 36p. incl. illus. diagrs. tables, refs. (Rept. no. NSL-64-166-1) (AFOSR-65-0033) (AF 49(638)1336) AD 610167 Unclassified

The radiation scattered from the beam of a laser by free electrons of a test plasma has been investigated as a possible tool for plasma diagnostics at electron densities in the range of 10^{16} to 10^{17} cm^{-3} and temperatures from 10,000°K to 20,000°K. A perturbing effect on the plasma background-radiation was observed which masked the expected Thomson scattering. This perturbation is interpreted as a plasma heating resulting from energy transferred to the plasma from the laser beam by coupling of the electromagnetic field with the plasma charged particles.

1693

Northwestern U. Dept. of Chemistry, Evanston, Ill.

KINETICS AND MECHANISMS OF THE HYDROLYSIS OF SOME CHLORAMMINERHODIUM(III) COMPLEXES, by S. A. Johnson, F. Basolo, and R. G. Pearson. [1963] [7]p. incl. diagrs. tables, refs. (AFOSR-4707) (AF 49(638)315) AD 429276 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 1741-1747, June 20, 1963.

The rates of hydrolysis of certain chloramminerhodium(III) complexes were investigated as a function of

steric effects, the extent of chelation and other variables. It was observed that various nucleophiles have no effect on the rate of chloride ion release from these systems. These results are similar to the behavior of analogous cobalt(III) systems. Striking differences were also found: (1) the rate of reaction of a rhodium(III) complex is insensitive to the charge on the complex, (2) alkali has little or no effect on the rate of hydrolysis and (3) reactions of rhodium(III) complexes occur with almost complete retention of configuration. These results are discussed in terms of probable mechanisms for reactions of rhodium(III) complexes. (Contractor's abstract)

1894

Northwestern U. [Dept. of Electrical Engineering] Evanston, Ill.

A NEW REFLECTION COEFFICIENT FOR LOW DENSITY, by M. A. Plonus. 1984, 3p. (AFOSR-64-2544) (AF 49(638)1377) AD 453885 Unclassified

Also published in Proc. Nat'L Electronics Conf., Chicago, Ill., v. 20: 14-18, Oct. 1964.

Scattering from an aggregate of particles can usually be divided into two kinds, an incoherent and a coherent scatter. Incoherent scattering results when the distribution of particles is random. It can be shown that the boundaries which define a particle system will give rise to a coherent scatter, since in a sense a boundary can be looked upon as a particular variation in density of particles. After some mathematical manipulations, one discovers that this coherent scatter from the boundaries is really the physical optics scatter of a dielectric body whose shape coincides with that of the boundaries of the particle system. By exploring this relationship, which essentially relates Rayleigh scattering of the individual particles to the physical optics scattering of the particle system, a new definition for reflection coefficient from the boundaries of a dielectric body can be made. In this paper it is shown that this method can be successfully applied to a simply-shaped dielectric body which is made of a dielectric whose losses are small and the dielectric constant is approximately equal to unity.

1895

Northwestern U. Dept. of Electrical Engineering, Evanston, Ill.

OPTIMUM LOCATIONS OF SWITCHING CENTERS AND THE ABSOLUTE CENTERS AND MEDIANS OF A GRAPH, by S. L. Hakimi. [1964] [10]p. (AFOSR-64-2321) (AF AFOSR-83-98) AD 452325 Unclassified

Also published in Operations Research, v. 12: 450-459, May-June 1984.

The concepts of the 'center' and the 'median vertex' of a graph are generalized to the 'absolute center' and the 'absolute median' of a weighted graph (a graph with weights attached to its vertices as well as to its branches). These results are used to find the optimum location of a switching center in a communication network and to locate the best place to build a 'police station' in a highway system. It is shown that the optimum location of a switching center is always at a vertex of the communication network while the best location for the police station is not necessarily at an intersection. Procedures for finding these locations are given. (Contractor's abstract)

1896

Northwestern U. Dept. of Electrical Engineering, Evanston, Ill.

GENERATION AND REALIZATION OF TREES AND K-TREES, by S. L. Hakimi and D. G. Green. [1964] [9]p. (AFOSR-84-2322) (AF AFOSR-63-98) AD 452324 Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 247-255, June 1964.

In this paper is considered an analysis-synthesis problem in graph theory. The analysis problem is that of efficient generation of trees, 2-trees, and k-trees of a given labeled graph. The synthesis problem is that of finding a graph that realizes a given set of trees, 2-trees, or realizes given sets of trees and 2-trees simultaneously. These results have a strong bearing upon topological analysis and synthesis of electrical networks.

1897

Northwestern U. Dept. of Electrical Engineering, Evanston, Ill.

A NOTE ON ACTIVE RC REALIZATION OF VOLTAGE TRANSFER FUNCTIONS, by L. S. Bobrow and S. L. Hakimi. [1964] [2]p. inci. diagr. (AFOSR-65-1012) (AF AFOSR-83-98) AD 614554 Unclassified

Also published in IEEE Trans. on Circuit Theory, v. CT-11: 493-494, Dec. 1964.

The usual practice in active RC synthesis of using ideal negative impedance converters or ideal controlled sources is postulated to be unnecessary. It is shown that any rational voltage transfer function can be realized by a grounded network containing resistors, capacitors, and any 3 vacuum tubes or transistors. A vacuum tube circuit is used in the investigation. It is also shown that there are no restrictions on the values of plate resistances or amplification factors, and therefore the tubes can be replaced by field-effect transistors.

1898

Northwestern U. [Dept. of Electrical Engineering] Evanston, Ill.

ON THE PROBABILISTIC NETWORKS, by Y. Fu. 1983, 17p. (AF AFOSR-83-98) AD 438497 Unclassified

A probabilistic network is defined as a linear graph with its branch weights being statistically independent discrete random variables. A general probabilistic network function is formulated in terms of the reliabilities of individual branches. Application to probabilistic switching network is also considered.

1899

Northwestern U. [Dept. of Electrical Engineering] Evanston, Ill.

VERTEX REDUCTION NETWORK ANALYSIS, by H. Frank. Mar. 1, 1964, 44p. (Technical rept. no. 9) (AF AFOSR-63-98) AD 438498 Unclassified

The problem of topological network analysis is discussed, and various methods of tree generation summarized. It is concluded that no totally satisfactory method is available to generate the trees of a graph. The 'pliars entry' and generalized star mesh transformations are then introduced and a method to reduce any multi-port passive netowrk to a three terminal representation is described. The concepts thus developed are extended to include active networks whose currents have unique solutions. Finally, the applications of the reduction techniques to digital computer solutions are considered, and several related problems are introduced.

1900

Northwestern U. Dept. of Materials Science, Evanston, Ill.

MAGNETIC STUDY OF DEFORMATION IN AN AGE HARDENED Ni-Ti ALLOY, by M. M. Dawance, D. H. Ben Israel, and M. E. Fine. [1964] [8]p. incl. diagrs. refs. (AFOSR-64-2101) (AF 49(638)524) AD 451347 Unclassified

Also published in Acta Metall., v. 12: 705-712, June 1964.

The effect of deformation on the Curie temperature of a quenched and aged alloy of Ni-10.3 at.-% Ti, 0.6 at.-%Al was determined. For short aging times (5 hr) at 525°C there is a large decrease in Curie temperature on deformation, but for long aging times (200 hr) the Curie temperature is little affected by deformation. This result indicates that at first the decomposition product is a fluctuation of composition in the solid solution but later a discrete nonferromagnetic precipitate forms. The former qualitatively confirms the recent theories of decomposition which begins inside the spinodal.

1901

Northwestern U. Dept. of Materials Science, Evanston, Ill.

PRECIPITATE AND DISPERSION HARDENING OF CRYSTALLINE SOLIDS, by M. E. Fine. [1963] [21]p. incl. diagrs. table, refs. (AFOSR-64-2525) (AF 49(638)524) AD 453801 Unclassified

Also published in Proc. Conf. on the Relation between Structure and Strength in Metals and Alloys, Teddington, Middlesex (Gt. Brit.), Jan. 7-9, 1963, p. 299-320.

It should first of all be emphasized that precipitate and dispersion hardening (that is, particle hardening) of crystalline solids does not arise from a single origin. There are a large number of possible sources of hardening and in most specific instances more than one is important. It is very difficult to ascribe quantitatively the hardening to specific sources in specific alloys at the present time. The plan of this paper is to give first a general outline of the important considerations, then take up some of them in more detail, discussing specific alloys.

1902

Northwestern U. [Dept. of Materials Science] Evanston, Ill.

THEORETICAL ANALYSIS OF THE EFFECT OF SUBSTITUTIONAL POINT DEFECTS ON THERMAL EXPANSION, by T. J. Hughes and J. O. Brittain. [1964] [4]p. (AFOSR-64-2527) (AF 49(638)780) AD 453825 Unclassified

Also published in Phys. Rev., v. 135: A1738-A1741, Sept. 14, 1964.

A thermal-expansion theory has been derived for primary solid-solution binary alloys treating the solute atoms as elastic spheres imbedded in an infinite elastic continuum and considering the interactions between the thermal expansion of these point defects and the matrix. The theory predicts that the thermal-expansion coefficient of the alloy can be determined from the thermal-expansion coefficients and the elastic constants of the constituents, and from the atomic volume of the solute atom. The theory is verified for various alloys in the temperature and composition ranges consistent with the assumption of the theory; i.e., for temperature and composition ranges which obey the Grueneisen law of thermal expansion for the pure components and for the alloy.

1903

Northwestern U. [Dept. of Materials Science] Evanston, Ill.

STRAIN HARDENING AND STRESS DEPENDENCY OF DISLOCATION VELOCITY IN ALPHA-IRON ALLOYS WITH A DISPERSED PHASE, by F. Felberbauer, E. P. Lautenschlager, and J. O. Brittain. [1964] 8p. (AFOSR-65-0162) (AF 49(638)780) AD 611493 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 230: 1596-1603, Dec. 1964.

Experiments were made in alpha-iron specimens with controlled amounts of carbon and/or Al_2O_3. They were tested at various temperatures between 195 and 373°K under a variety of conditions of concentration, strain rate, and quench aging. The resulting yield strength, flow strength, and strain hardening increased with addition of Al_2O_3. The parameter m, measured from changes in strain rate, was used to describe the stress dependency of the dislocation velocity. m was found to increase with additions of Al_2O_3, increasing carbon in solution, and with increasing temperature. When applied to a recent model for yielding based upon dislocation multiplication and velocity characterisitics, the values of m alone did not successfully predict yielding for the materials of this investigation, but had to be adjusted with a consideration of the number of unlocked dislocations nucleated heterogeneously at discontinuities or inclusions. The change of yield strength with Al_2O_3 interparticle spacing appeared to obey a theory of Orowan.

1904

Northwestern U. Dept. of Materials Science, Evanston, Ill.

SOLID SOLUTION AND PRECIPITATION HARDENING IN Mg-Fe-O ALLOYS, by G. W. Groves and M. E. Fine. [1964] [7]p. incl. illus. diagrs. refs. (AFOSR-65-0785) (AF AFOSR-63-327) AD 616046 Unclassified

Also published in Jour. Appl. Phys., v. 35: 3587-3593, Dec. 1964.

Iron was introduced into single crystals of MgO by diffusion to produce thin homogeneous slices of alloy crystals containing up to about 4% Fe/(Mg+Fe). When the iron is present as Fe^{2+} the MgO crystal is not appreciably strengthened but 1% Fe^{3+} retained in solution by quenching approximately doubles the flow stress of the original crystal. The strengthening due to Fe^{3+} can be enhanced slightly by aging the crystal in air at 700° to 1000°C. This causes a precipitate of magnesioferrite to form as octahedra which are perfectly oriented within the MgO, the faces of the octahedra being parallel to {111} in the MgO. The fracture process is not greatly affected by the presence of this coherent precipitate. Continued aging reduces the strength and coarsens the precipitate without change in shape over a size range of 100A to 1μ.

1905

Northwestern U. Dept. of Mathematics, Evanston, Ill.

FLUCTUATION AND MULTIDIMENSIONAL PROBLEMS, by M. Dwass. Final rept. Mar. 1, 1965, 1p. (AFOSR-65-0552) (AF AFOSR-63-67) Unclassified

This report lists the research which was done wholly or in part under the grant. Three reports were published in Ann. Math. Stat. Citations are given for these articles. Two reports are listed which will be published.

1906

Northwestern U. [Dept. of Physics] Evanston, Ill.

THE VISCOSITY OF ARGON, KRYPTON, AND XENON IN THE DENSE GASEOUS REGION, by E. G. Reynes and G. Thodos. [1964] [14]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1477) (AF AFOSR-63-45) AD 623198 Unclassified

Also published in Physica, v. 30: 1529-1542, 1964.

The effect of pressure on the viscosity of argon, krypton, and xenon has been established experimentally for pressures ranging up to 820 atm at 100, 150, and 200°C. For xenon additional measurements were carried out at 50°C. These measurements were made using an unsteady flow transpiration type capillary viscometer, whose basic dimensions were accounted for in order to operate it in an absolute manner. The residual viscosities resulting from these measurements were normalized with the parameter, $\xi = T_c^{1/6} M^{1/2} P_c^{2/3}$, to produce values of $(\mu - \mu^*)\xi$, which correlated with the corresponding reduced density, ρR, to produce a single continuous function for these three monatomic gases.

1907

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

A SPECTROSCOPIC STUDY OF THE THERMODYNAMIC STATE OF ARGON IN A CONICAL ELECTROMAGNETIC SHOCK TUBE, by J. A. Thornton and A. B. Cambel. [1964] [22]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0297) (AF AFOSR-62-307) Unclassified

Also published in Jour. Quant. Spectros. Radiative Transfer, v. 4: 539-557, 1964.

This paper describes time resolved spectroscopic experiments in which the average thermodynamic state across the diameter of the accelerated argon plasma generated in a 3 in. diam conical type electromagnetic shock tube was determined at ambient pressure of 50 μ, 300 μ, and 1 mm Hg and at positions of 15·25 cm, 20 cm and 35·5 cm downstream from the ring electrode. Luminous front velocities ranged from 0·25 to 1 cm/μsec, temperatures from 13,000 to 18,000°K and peak electron densities from 10^{16} to 10^{17} cm^{-3}. The data indicate complete thermodynamic equilibrium. In all tests the temperatures were significantly higher than those predicted by the shock equations assuming a cold gas ahead of the luminous front. Microwave transmission measurements indicate that the electron density ahead of the luminous front is less than 5×10^{10} cm^{-3}. It is concluded that luminosity of the kind observed is from the driver plasma or a mixture of the driver

and driven plasmas, depending on the ambient pressure, and that the thermodynamic state of the accelerated plasma must therefore be determined experimentally. (Contractor's abstract)

1908

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

GENERALIZED SELF-SIMILARITY AND SOLUTIONS FOR MAGNETOGASDYNAMIC FREE JETS, by W. F. Hug. 1964, 80p. (Rept. no. NU-GDL-B-3-64) (AF AFOSR-62-307) AD 608170 Unclassified

The method of self-similar solutions has been shown to be a powerful analytical tool in the investigation of the mixing region of a laminar two-dimensional magnetogasdynamic jet which is freely expanding into an unbounded stagnant region. The general conditions under which self-similitude can be expected are investigated. Two undocumented solutions are shown to be available: (1) The subsonic gasdynamic free jet with non-unitary Prandtl number and a viscisoty which is proportional to the square root of temperature. Solution to this problem is given in closed form in the 'incompressible' von Mises solution plane with a transformation back to physical coordinates accomplished by numerical integration. (2) The subsonic magnetogasdynamic free jet with non-unitary Prandtl number, a viscosity which is proportional to the square root of temperature, and an electrical conductivity which is proportional to the square root of the temperature cubed.

1909

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

MICROWAVE DIAGNOSTICS OF ARC HEATED ARGON PLASMA FLOWS, by R. C. Warder, Jr. Apr. 1963, 238p. (Rept. no. NU-GDL-B-L-63) (AF AFOSR-62-307) AD 602543 Unclassified

An experimental investigation of the electrical properties of arc-heated plasma flows was conducted using microwave diagnostic techniques. The basic theory underlying the propagation of electromagnetic waves in isotropic and anisotropic plasmas necessary for the interpretation of the microwave measurements is presented. Phase shift and attenuation measurements at 78 and 85.3 kmc were made to determine the electron density and electron collision frequency of the plasma flows. The electron densities which were determined experimentally agree quite well for the two operating frequencies. Comparison of the experimental electron densities with theoretical predictions indicates that the plasma flow is not in equilibrium. The attenuation measurements at the two frequencies agree qualitatively; however, the electron collision frequencies derived from these measurements do not agree quantitatively. Comparison with theoretical predictions indicates that electron-ion collisions are the predominant dissipative mechanism.

1910

Northwestern U. Gas Dynamics Lab., Evanston, Ill.

TWO-DIMENSIONAL HEATED JET WITH AN ARBITRARY PRANDTL NUMBER AND MAGNETOGASDYNAMIC FREE JET, by D. C. Smith and A. B. Cambel. Oct. 1964 [57]p. incl. refs. (Rept. no. B-2-64) (AFOSR-65-0926) (AF AFOSR-63-329) Unclassified

Most of the existing solutions to the free jet problem are restricted by assumptions of constant viscosity, a unitary Prandtl number and incompressible fluids. The solution of the 2-dimensional, laminar jet of a compressible fluid with an arbitrary Prandtl number is presented for subsonic flow. A solution is also obtained for any Mach number flow for a Prandtl number of 1. The laminar, compressible, two-dimensional jet of an electrically conducting fluid with an applied transverse magnetic field is solved by a perturbation technique. The perturbation parameter is the non-dimensional ratio of the magnetic force to the inertia force of the jet. The velocity and temperature distributions are found in closed form to first order in the perturbation parameter. The velocity profiles are also obtained, to first order, for an electric field applied in a direction normal to both the magnetic field and the axial direction. The solution is valid for an electric field that is the same order of magnitude as the v x B force.

1911

Northwestern U. [Information-Processing and Control Systems Lab.] Evanston, Ill.

OPTIMUM DESIGN OF NONLINEAR SAMPLED-DATA CONTROL SYSTEMS, by T. Meksawan and G. J. Murphy. [1963] [5]p. (AFOSR-J1206) (AF AFOSR-63-270) AD 423121 Unclassified

Also published in Regelungstechnik, v. 7: 295-299, Jan. 11, 1963.

A simple and systematic procedure is presented for the design of certain time-optimal nonlinear sampled-data control systems. The method leads to the design of a digital compensating network to fulfill an optimal performance requirement. The synthesis technique presented is applicable to an n^{th}-order linear system with a zero-memory nonlinear element cascade, provided that the linear system is completely controllable.

1912

Northwestern U. Information-Processing and Control Systems Lab., Evanston, Ill.

OPTIMAL SYNTHESIS OF LINEAR PULSE-WIDTH-MODULATED COMPUTER-CONTROLLED SYSTEMS, by G. J. Murphy and T. Meksawan. [1964] [12]p. incl. diagrs. table, refs. (AFOSR-64-0970) (AF AFOSR-63-270) Unclassified

Also published in Jour. Franklin Inst., v. 277: 128-139, Feb. 1964.

The purpose of this paper is to present a technique for optimal synthesis of linear control systems with pulse-width modulation. The criterion of system performance is a quadratic index, which is taken in an illustrative example to be the sum of the squares of the error at sampling instants for the case in which the input to the system is a step function. The technique, which is based on the state-variable concept and on dynamic programming, leads to the determination of a computer program for calculating the optimum sequence of signals to be applied to the input of the pulse-width modulator. (Contractor's abstract)

1913

Northwestern U. Information-Processing and Control Systems Lab., Evanston, Ill.

TIME-OPTIMAL PULSE-WIDTH CONTROL OF LINEAR SYSTEMS, by G. J. Murphy and T. Meksawan. [1964] [5]p. incl. diagrs. tables. (AFOSR-64-2323) (AF AFOSR-63-270) AD 452326 Unclassified

Also published in Proc. Nat'l. Electronics Conf., v. 20: 1964.

This paper presents a technique for the synthesis of linear systems with pulse-width modulation to fulfill a time-optimal performance criterion. The synthesis procedure is developed by use of the state-transition method of representation of performance of the system. By the use of the design procedure presented, a pulsed-data network can be designed to produce the time-optimal deadbeat response of the system to a specified deterministic input, which is chosen to be a step function in the illustrative example.

1914

Northwestern U. Information-Processing and Control Systems Lab., Evanston, Ill.

A STABILITY CRITERION FOR PULSE-WIDTH-MODULATED FEEDBACK CONTROL SYSTEMS, by G. J. Murphy and S. H. Wu. [1964] [8]p. incl. diagrs. refs. (AFOSR-65-0627) (AF AFOSR-63-270) AD 614489 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 434-441, Oct. 1964.

Aizerman's method for investigating asymptotic stability in the large, which was extended by Kodama to encompass nonlinear sampled-data systems, is further extended in this paper. The concept is developed with specific reference to pulse-width-modulated feedback systems, but the method is applicable to a more general class of nonlinear discrete-time systems. The significant difference between the class of systems treated here and the class treated by Kodama is that in the latter class the nonlinear factor is a scalar, whereas in the former, it is a vector. This difference is not trivial; the presence of the vector nonlinearity requires a substantial change in the procedure for determining the range of a parameter over which the system is asymptotically stable in the large. By application of the method presented in this paper, one can obtain a sufficient condition for asymptotic stability in the large of pulse-width-modulated feedback systems. The method is not limited to cases in which the poles of the transfer function of the plant are real and/or simple and the result obtained, at least in those cases investigated to date, is not highly conservative.

1915

Northwestern U. [Technological Inst.] Evanston, Ill.

THERMOELASTIC DISSIPATION IN HIGH-FREQUENCY VIBRATIONS OF CRYSTAL PLATES, by J. Tasi and G. Herrmann. [1964] [9]p. incl. diagrs. (AFOSR-64-1027) (In cooperation with Columbia U. AF 49(638)430) (AF AFOSR-62-465) AD 440980 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 100-110, Jan. 1964.

A system of approximate, two-dimensional equations is derived for the thermoelastic response of crystal plates. The equations take into account the coupling of thickness-shear, flexural, and extensional motion with symmetric and antisymmetric thermal modes. The thermoelastic dissipation predicted at high frequencies by the approximate theory is compared with a three-dimensional solution, using the free vibrations of AT-cut quartz plate as a basis of comparison. (Contractor's abstract)

1916

Northwestern U. Technological Inst., Evanston, Ill.

INSTRUMENTATION TO STUDY THE DYNAMIC BEHAVIOR OF CYLINDRICAL SHELL INCLUDING THERMAL EFFECTS, by G. Hermann and J. F. Fleming. 1963, 11p. (AFOSR-64-0112) (AF AFOSR-63-100) AD 430674 Unclassified

Presented at Symposium on Measurement and Evaluation of Dynamic Effects and Vibrations of Constructions, Budapest, 1963.

The paper describes the instrumentation which was developed and is being used to study the dynamic response of cylindrical shells at room and at elevated temperatures, and which is readily usable for simpler structural elements, such as beams, slabs, etc. This instrumentation permits the excitation of numerous principal modes of free vibration of a shell subjected to various mechanical and thermal initial stresses, and the determination of the mode shape, natural frequency and damping properties associated with each principal mode. The salient features and operating characteristics of the various components of the equipment used are described, with particular emphasis on the behavior at elevated temperatures. The possibilities are discussed of adapting the present equipment to more complicated structural elements, such as conical shells, and to more complicated dynamic phenomena, such as mechanical and thermal impact loading.

1917

Northwestern U. Technological Inst., Evanston, Ili.

ON THE STABILITY OF ELASTIC SYSTEMS SUBJECTED TO NONCONSERVATIVE FORCES, by G. Herrmann and R. W. Bungay. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-2240) (AF AFOSR-63-100) AD 452400 Unclassified

Presented at Summer Conf. of the Applied Mechanics Div., American Society of Mechanical Engineers, Boulder, Colo., June 9-11, 1964.

Free motions of a linear elastic, nondissipative, two-degree-of-freedom system, subjected to a static nonconservative loading, are analyzed with the aim of studying the connection between the two instability mechanisms known to be possible for such systems. An independent parameter is introduced to reflect the ratio of the conservative and nonconservative components of the loading. Depending on the value of this parameter, instability is found to occur for compressive loadings by divergence, flutter, or by both with multiple stable and unstable ranges of the load. In the latter case either type of instability may be the first to occur with increasing load. For a range of the parameter, divergence is found to occur for tensile loads. Regardless of the nonconservativeness of the system, the critical loads for divergence can always be determined by the Euler method. The critical loads for flutter can be determined, of course, by the kinetic method alone. (Contractor's abstract)

1918

Northwestern U. Technological Inst., Evanston, Ill.

ON SECOND-ORDER THERMOELASTIC EFFECTS, by G. Herrmann. [1964] [10]p. (AFOSR-65-0558) (AF AFOSR-63-100) AD 614749 Unclassified

Also published in Zeitsch. Angew. Math. und Phys., v. 15: 253-262, 1964.

It is of interest in second-order thermoelasticity to determine the thermal effects accompanying an isochoric deformation, a state of pure shear strain, a state of pure shear stress, and also to find the states of strain and stress associated with isothermal shear. In this paper Brot's second-order theory of elasticity is extended to include thermal effects. Expressions for entropy and temperature change in an adiabatic deformation are derived, following Biot's presentation of linear thermoelasticity, which indicate that the thermal second-order effects are governed primarily by the product formed by the temperature rate of change of the shear modulus and the second invariant of the strain deviator.

1919

Northwestern U. Technological Inst., Evanston, Ill.

[DYNAMIC BEHAVIOR OF SOLIDS], by G. Herrmann. Final scientific rept. Oct. 1, 1963-Sept. 30, 1964, 16p. incl. refs. (AFOSR-65-0460) (AF AFOSR-64-100) Unclassified

Analytical and experimental studies were conducted involving thermal effects in thin-walled shells, effects of moving and rapidly applied loads, and effects of structural interaction between thin shells and other contacting media. The results have application to the dynamic response and stability of structural elements and structural systems used for aerospace vehicles of various types.

1920

Northwestern U. Technological Inst., Evanston, Ill.

SHELL BUCKLING AND NONCONSERVATIVE FORCES, by G. Herrmann and R. W. Bungay. [1964] [1]p. (AFOSR-65-0560) (AF AFOSR-64-100) AD 615186 Unclassified

Also published in AIAA Jour., v. 2: 1165-1166, June 1964.

In a former note it was advanced that the wide scatter of observed buckling loads of pressurized shells might be attributed to the presence of nonconservative generalized forces. In this paper the theory is refuted as being not applicable in the sense envisaged by the author and having only limited validity. Problems in static and dynamic loading are considered.

1921

Ohio State U. [Research Foundation] Dept. of Aeronautical and Astronautical Engineering, Columbus.

FORMATION OF DETONATION WAVES IN COMBUSTIBLE GASEOUS MIXTURES, by L. E. Bollinger. Apr. 1964, 48p. incl. refs. (WSS/CI Paper no. 64-15) (AFOSR-65-2205) (AF AFOSR-63-203) AD 625489 Unclassified

Presented at Spring Meeting of the Combustion Institute, Western States Section, Stanford U., Calif., Apr. 1964.

A review is presented of selected papers and reports which pertain to the formation of detonation waves in combustible gaseous mixtures. During the past decade, extensive progress has been made in elucidating the mechanism, and the parameters that influence it, by which a deflagration wave accelerates and forms a stable detonation. Propulsion devices which employ stabilized detonation waves are being studied; thus, it is necessary to learn more about the transition process. Many investigators believe that a better understanding of the process of detonation-wave formation will assist in the explanation and eventual control of combustion instability in rocket engines. (Contractor's abstract)

1922

Ohio State U. [Research Foundation. Dept. of Chemistry] Columbus.

THE SYNTHESIS OF 3-ETHYL-4-METHYLPHENOL AND 3-ISOPROPYL-4-METHYLPHENOL FROM 3,4-DIMETHYLPHENOL VIA TRICHLOROMETHYL INTERMEDIATES, by M. S. Newman and F. Bayerlein. [1963] [3]p. incl. diagrs. refs. (AFOSR-557) (AF 49-(638)277) AD 429295 Unclassified

Also published in Jour. Org. Chem., v. 28: 2804-2806, Oct. 1963.

On refluxing solutions of 3,4-dimethyl-4-trichloromethyl-2,5-cyclohexadienone (I) in the acetic anhydride containing an acid, rearrangement to the acetate of 4-methyl-3(β,β,β-trichlorethyl)phenol (II) occurs in high yield. Treatment of II with piperidine yields 4-methyl-3-(β,β-dichlorovinyl)phenol (III) which on hydrogenation is converted into 3-ethyl-4-methylphenol (IV). Condensation of IV with carbon tetrachloride (aluminum chloride) affords 3-ethyl-4-methyl-4-trichloromethyl-2,5-cyclohexadienone (V) which may be converted into 4-methyl-3-isopropylphenol (VI) by a series of reactions analogous to those by which II is converted into IV. (Contractor's abstract)

1923

Ohio State U. Research Foundation. Dept. of Chemistry, Columbus.

SYNTHESIS AND REARRANGEMENT OF COMPOUNDS CONTAINING TRIHALOMETHYL GROUPS, by M. S. Newman. Final rept. July 1, 1958-Dec. 31, 1962. Apr. 16, 1963, 6p. incl. diagrs. (AFOSR-4874) (AF 49(638)277) AD 414030 Unclassified

Several new reactions that have been discovered are discussed. These relate mainly to the migrations of the trichloromethyl group so that it can now be predicted with reasonable accuracy what reactions will occur with cyclohexadienone type compounds which contain the trichloromethyl group.

1924

Ohio State U. [Research Foundation. Dept. of Chemistry] Columbus.

FURTHER STUDIES ON 2,5-CYCLOHEXADIENONES CONTAINING THE TRICHLOROMETHYL GROUP, by M. S. Newman and J. A. Eberwein. [1964] [4]p. incl. diagrs. table, refs. (AFOSR-64-1947) (AF 49(638)277) AD 450513 Unclassified

Also published in Jour. Org. Chem., v. 29: 2516-2519, Sept. 1964.

The products of reactions of 3,4-dimethyl-4-trichloromethyl-2,5-cyclohexadienone with phenyl-, methyl-, and ethoxyethynylmagnesium bromide and of 4-trichloromethyl-2,4,5-trimethyl-2,5-cyclohexadienone with ethoxyethynylmagnesium bromide are described. In no case could the expected carbinol be isolated, since rearrangements occurred under mild conditions. In all cases 1,3- or 1,5-migration of the trichloromethyl groups occurred. (Contractor's abstract)

1925

Ohio State U. Research Foundation. Dept. of Physics [and Astronomy] Columbus.

RESEARCH ON ROTATING RF FIELD PLASMA, by M. L. Pool. Final rept. Nov. 1, 1962-Sept. 30, 1964. Oct. 1964, 1v. incl. illus. diagrs. tables, refs. (Rept. no. 1566) (AFOSR-64-2227) (AF AFOSR-63-202) Unclassified

Three-phase ion-cyclotron frequency power input to a magnetic bottle has produced a plasma over a wide range of hydrogen and deuterium pressures. Electrons and ions which escape from the ends of the bottle have energies in the neighborhood of 0.1 kev. A pulsed 9400 mc input peak power of 30 kw created x-rays in the neighborhood of 20 kev. Hard superconductors of Nb and of Nb-Zr were shown to be superconducting at the ion-cyclotron frequency of 4.2 mc. A Michelson type of microwave diagnostic assembly at 27.5 Gc frequency was made operative for measuring electron densities as low as $10^{10}/cm^{-3}$. Two-phase ion-cyclotron frequency power input to the magnetic bottle has produced a plasma. A 30-joule diagnostic laser was installed and operated for measuring electron densities in the region of $10^{13}/cm^{-3}$. The various diagnostic data indicate that (a) a higher powered two-phase ion-cyclotron oscillator and (b) a stronger magnetic bottle field are needed for achieving a significant increase in the ion density, the ion temperature, and the ion retainment time.

1926

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

TOWARD A TAXONOMY OF ORGANIZATIONS, by N. J. Johnson. 1963, 239p. (AFOSR-5361) (AF 49(638)-447) AD 426089 Unclassified

This exploratory study presents an attempt to develop a taxonomy of organizations. The evidence from this study seems to indicate that the basic approach used by the biologist can fruitfully be used in developing a classification system for organizations. Data were collected on 99 characteristics. The sample consisted of 75 organizations which were selected so as to maximize heterogeneity. The data were collected by means of tape-recorded interviews with the top executives of the organizations. The interviews were transcribed verbatim and content analyzed. The evidence from this study seems to indicate that the basic approach was fruitful.

1927

Ohio State U. [Research Foundation. Dept. of Psychology] Columbus.

THE SIZE OF THE SUPPORTIVE COMPONENT IN ORGANIZATIONS: A MULTI-ORGANIZATIONAL ANALYSIS, by E. Haas, R. H. Hall, and N. J. Johnson. 1963, 9p. (AFOSR-64-0257) (AF 49(638)447) AD 432525 Unclassified

In an analysis of thirty organizations of various types, the authors examine the relation of varying size of the supportive component to other organizational characteristics such as total size, age, number of operating sites, diversification of activities performed, and type of organizational function. Total organizational size and number of locations appear to be related to size of supportive component but they vary inversely.

1928

Ohio State U. Research Foundation. Dept. of Psychology, Columbus.

PERSONALITY FACTORS IN MOTIVATION, by J. B. Rotter. Final rept. Dec. 2, 1963, 16p. incl. refs. (Rept. no. 1007) (AFOSR-J1371) (AF 49(638)741) AD 426514 Unclassified

This investigation is concerned with two general areas of study. One has to do with the general conditions which make for a perception of external control, chance, fate, etc., and the conditions which lead the individual to seek reinforcements as contingent upon himself. In this area we are also interested in the characteristics of the individual's behavior or changes in him as a result of such a perception, as well as the conditions which produce such a perception. The second broad area of individual differences. Given the same situation one individual may interpret what happens to him as determined by luck or fate, and another may interpret it as a result of his own actions. Individual differences in such perception might have important implications for problems of efficiency of learning, social behavior, adjustment and psychotherapy, social attitudes, and all interpersonal behavior. (Contractor's abstract, modified)

1929

Oklahoma State U., Stillwater.

PHOTOEFFECTS AND RELATED PROPERTIES OF SEMICONDUCTING DIAMONDS, by C. Johnson, H. Stein and others. [1964] [10]p. (AFOSR-64-2094) (AF 18(603)40) AD 451342 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 827-836, 1964.

A number of properties of natural semiconducting diamonds have been investigated. The studies were concerned with the optical transmission, photoconductivity, mobility and activation energies of carriers, also the lifetime and trapping of carriers. Optical transmission as a function of the temperature was measured. Optical absorption characteristic of type IIb diamond was observed. Photoconductivity was determined as a function of excitation wavelength, intensity of illumination, temperature and electric field strength. A number of maxima in photoconductivity occur in the visible and near infrared ranges which are not resolved in the optical transmission measurements.

1930

Oklahoma State U. Dept. of Chemistry, Stillwater.

NUCLEOPHILIC DISPLACEMENT REACTIONS ON ORGANOPHOSPHORUS ESTERS BY GRIGNARD REAGENTS. I, by K. D. Berlin, T. H. Austin, and K. L. Sione. [1964] [4]p. incl. table, refs. (AFOSR-64-1509) (AF AFOSR-63-132) AD 446110 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 1787-1790, May 5, 1964.

Careful examination by gas chromatography of the various reaction mixtures from the condensation of trimethyl phosphite with the phenyl Grignard reagent under nitrogen revealed only trivalent phosphorus compounds. In no instance were products detected which suggested the occurrence of a Michaelis-Arbuzov rearrangement; thus, previously reported data are repudiated. A mechanism is postulated for the step-wise displacement of methoxy groups in which the initial Grignard-phosphite complex is attacked by the Grignard reagent. With a 1:1 ratio of phosphite to Grignard reagent, considerable methyl diphenylphosphinite was observed; this is in contrast to other reports. An explanation of the observed products is postulated to involve equilibria between complexes of Grignard reagent and intermediate esters. (Contractor's abstract)

1931

Oklahoma State U. Dept. of Chemistry, Stillwater.

UNSYMMETRICAL TERTIARY PHOSPHINE OXIDES FROM DIPHENYL PHENYLPHOSPHONATE; A CONVENIENT SYNTHESIS, by K. D. Berlin and M. Nagabhushanam. [1964] [2]p. incl. table, refs. (AFOSR-64-1510) (AF AFOSR-63-132) AD 446118 Unclassified

Also published in Chem. and Indus. (London), June 6, 1964, p. 974-975.

In view of recent developments concerning the cleavage of triphenylphosphine oxide by lithium reagents to give lithium intermediates which are useful in the synthesis of organophosphorus compounds, the availability of unsymmetrical tertiary phosphine oxides of the type $ArP(O)R'_2$ appears important. From current reviews it is apparent that although several synthetic routes exist for this class of phosphine oxides, no one method appears of general utility and the yields reported are modest. Phosphonates have been suggested as precursors via reactions with Grignard reagents but a systematic study could not be found. Diphenyl phenylphosphonate has now been revealed as a convenient reagent for the preparation of phenyl-substituted phosphine oxides. Addition of the compound to a 1 mol excess of the appropriate Grignard reagent in etherbenzene gave excellent yields of a variety of unsymmetrical phosphine oxides. (Contractor's abstract)

1932

Oklahoma State U. [Dept. of Chemistry] Stillwater.

NUCLEOPHILIC DISPLACEMENT REACTIONS ON PHOSPHORUS HALIDES AND ESTERS BY GRIGNARD AND LITHIUM REAGENTS, by K. D. Berlin, T. H. Austin and others. [1964] [39]p. incl. refs. (AFOSR-64-1949) (AF AFOSR-63-132) AD 450507 Unclassified

Also published in Topics in Phosphorus Chem., v. 1: 17-55, 1964.

The contents of this report are: Reactions of trivalent phosphorus halides with Grignard reagents; Reactions of tetravalent phosphorus halides with Grignard reagents; Reactions of pentavalent phosphorus halides with Grignard and lithium reagents; Reactions of trivalent phosphorus esters with Grignard reagents; Reactions of tetravalent phosphorus esters with Grignard reagents; Reactions of organophosphorus halides and esters with lithium reagents; Reactions of sulfur-containing organophosphorus halides and esters with Grignard and lithium reagents.

1933

Oklahoma State U. [Dept. of Physics] Stillwater.

THEORY OF ELECTRON CAPTURE IN H^+—H COLLISIONS, by B. Roth. Final rept. Sept. 1963, 21p. incl. diagr. table. (AFOSR-J1309) (AF AFOSR-63-31) AD 424236 Unclassified

Also published in Phys. Rev., v. 133: A1257-A1262, Mar. 2, 1964

The theory of electron capture in H^+—H collisions at kv energies is developed. A strong coupling is assumed between the electron ground states in the target and scattered atoms. The method depends upon an approximate which amounts to neglecting terms of order K^{-1} compared to 1, where K is the wave number in atomic units for the collision of the two protons. Calculations were made for lab energies from 0.6 to 50 kev and the results compare favorably with the experimental results of Lockwood and Everhart. The center of mass correction accounts for the damping of resonances and otherwise produces a considerable effect. The method is applied to developing a formula for the relative probability for capture into an excited state. It is estimated that this probability is small. (Contractor's abstract)

1934

Oklahoma U. [Dept. of Mathematics] Norman.

OPTIMAL PROGRAMS FOR AN ASCENDING MISSILE, by G. M. Ewing and W. R. Haseltine. [1964] [23]p. (AFOSR-64-2488) (AF AFOSR-63-211) AD 453782 Unclassified

Also published in SIAM Jour. Control, Series A, v. 2: 66-88, 1964.

In 1919, R. H. Goddard proposed the problem of minimizing the mass of a given propellant required to transfer a rocket along a vertical path from rest on the earth to an assigned maximal height. He identified this as an unsolved problem of the calculus of variations but attempted neither a solution nor a precise formulation. Although this problem in one version or another, has interested many writers, no adequate treatment of any version has been published insofar as the present authors are aware. The object here is to give one.

1935

Oklahoma U. [Dept. of Physics] Norman.

DIRECT MEASUREMENTS OF THE LIFETIMES OF EXCITED STATES OF NEUTRAL HELIUM, by R. G. Fowler, T. M. Holzberlein and others. [1964] [5]p. (AFOSR-64-2467) (AF 49(638)-[illegible] and AF AFOSR-62-378) AD 453959; AD 451825 Unclassified

Also published in Proc. Phys. Soc. (London), v. 84: 539-543, 1964.

A straightforward method of measuring lifetimes of He I excited states, by following the decay of excited states, has yielded generally good agreement with other methods and with theory. Additional information about the importance of indirect population processes is provided by the new technique. In the 3D system a fraction ranging from 75% to nearly 100% is contributed indirectly.

1936

Oklahoma U. Dept. of Physics, Norman.

DIRECT MEASUREMENT OF ATOMIC LIFETIMES: HELIUM, by T. M. Holzberlein. [1964] [6]p. incl. illus. diagrs. table, refs. (AFOSR-64-2468) (AF 49-(638)639 and AF AFOSR-62-378) AD 450245 Unclassified

Also published in Rev. Scient. Instr., v. 35: 1041-1045, Aug. 1964.

A complete system for direct observation of decay of excited states is described. It comprises an inverted triode excitation tube with coaxial symmetry, capable of responding to an electrical cutoff with a risetime of about 10 nsec. Tests in helium have shown that in its present form it can give reliable lifetimes at least as small as 30 nsec. (Contractor's abstract)

1937

Oklahoma U. Dept. of Physics, Norman.

INELASTIC ELECTRON-ATOM COLLISIONS UNDER NEAR-RESONANCE CONDITIONS: ANALYSIS OF TRANSITIONS INVOLVING STRONG COUPLING, by N. F. Lane and C. C. Lin. [1964] [15]p. incl. diagrs. tables, refs. (AFOSR-64-1982) (AF AFOSR-63-252) AD 452310 Unclassified

Also published in Phys. Rev., v. 133: A947-A961, Feb. 17, 1964.

A method has been devised to calculate the cross sections of inelastic electron-atom collisions under near-resonance conditions. This method (referred to as the method of resonance distortion) consists of solving the limiting exact-resonance problem as the zeroth-order approximation and using this solution to obtain the first-order solution by an iteration procedure, and is particularly suitable for treating optically allowed transitions produced by electron impact where the coupling between the initial and final states is strong and of long-range type. Application of this method has been made to a schematic model with an isotropic inverse-square interaction potential and to the problem of electron-atom collisions with ns - np transition. The general results indicate that (1) for weak coupling the collision strengths calculated by the resonance-distortion scheme reduce to those calculated by the method of distorted waves, (2) the resonance-distortion method and Seaton's BTI method give nearly equal partial cross sections for large l, and (3) a very low l, the BTI partial cross sections are substantially larger than those determined from the resonance-distortion method. (Contractor's abstract, in part)

1938

Oklahoma U. Dept. of Physics, Norman.

ABSOLUTE ELECTRON EXCITATION FUNCTIONS OF HELIUM AND THEIR PRESSURE DEPENDENCE, by R. M. St. John and C. C. Lin. [1964] [6]p. incl. diagrs. tables. (AFOSR-64-1983) (AF AFOSR-63-252) AD 452308 Unclassified

Also published in Atomic Collision Processes; Proc. Third Internat'l. Conf. on the Physics of Electronic and Atomic Collisions, University Coll., London (Gt. Brit.) (July 22-26, 1963), ed. by M. R. C. McDowell. Amsterdam, North-Holland Publishing Co., 1964, p. 163-168.

Absolute values of cross sections for excitation of helium atoms by electron impact have been determined for electron energies from 20 to 500 ev. Excitation to the 4^1S, 5^1S, 6^1S, 3^1P, 4^1P, 4^1D, 5^1D, 6^1D, 4^3S, 5^3S, 3^3P, 3^3D, 4^3D, 5^3D and the 6^3D states was observed. Helium pressures ranged from 4×10^{-4} to 2×10^{-1} torr. Imprisonment of resonance radiation and excitation transfer are not effective at lower pressures, but are at the higher pressures, causing a gradual change in some of the apparent excitation functions with pressure change. All light intensity measurements were made by observation of radiation emitted at 90° relative to the electron beam. This data was processed and recorded by an electronic, continuous readout system. Corrections for polarization of the emitted light are made for the 3^1P case by the use of published helium polarization data. (Contractor's abstract)

1939

Oklahoma U. [Dept. of Physics] Norman.

ABSOLUTE ELECTRON EXCITATION CROSS SECTIONS OF HELIUM, by R. M. St. John, F. L. Miller, and C. C. Lin. [1964] [10]p. (AFOSR-64-1984) (AF AFOSR-63-252) AD 452307 Unclassified

Also published in Phys. Rev., v. 134: A888-A897, May 18, 1964.

The absolute apparent electron excitation functions of helium were measured for various excitation states at pressures sufficiently low so that the effects of radiation imprisonment and collisional excitation transfer can be neglected. Corrections due to polarization of the radiation and the cascading from the upper excited states were applied to the experimental data and the true excitation functions obtained. The peak values and the shape of these excitation functions are compared with the results reported from other laboratories. Generally good agreement is found with the previous works where the collisional excitation transfer was properly reduced and allowance was made for the cascading effect.

1940

Oklahoma U. Dept. of Physics, Norman.

PRODUCTION OF EXCITATION AND IONIZATION IN HELIUM BY SINGLE-ELECTRON IMPACT, by R. M. St. John and C. C. Lin. [1964] [3]p. incl. diagrs. (AFOSR-64-2309) (AF AFOSR-63-252) AD 451931 Unclassified

Also published in Jour. Chem. Phys., v. 41: 195-197, July 1, 1964.

The production of excited He^+ ions by single-electron impact collisions with ground-state helium atoms has been observed by the optical method. The absolute value of the cross section for the collision process yielding the n = 4 → n = 3 transitions in He^+ was determined for incident electron energies ranging from 60 to 470 ev. The excitation-ionization cross section exhibited a single broad maximum at 200 ev with an onset at 75 ev. The peak value of the cross section was 4.2×10^{-21} cm^2. Stepwise ionization and excitation was nowhere in evidence. The excitation-ionization function obtained at a number of gas pressures was independent of pressure. Light yield was proportional to the electron beam currents. Comparisons with previous experimental work and with theoretical calculations were made. (Contractor's abstract)

1941

Oklahoma U. Dept. of Physics, Norman.

ELECTRON-EXCITATION CROSS SECTIONS FOR HYDROGEN STATES WITH LARGE PRINCIPAL QUANTUM NUMBERS, by G. M. Cunningham and C. C. Lin. [1964] [2]p. incl. table. (AFOSR-65-0103) (AF AFOSR-63-252) AD 455853 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3268-3269, Nov. 15, 1964.

Results of cross section calculations for the S, P, and D series of the hydrogen atom are reported for $3 \leq n \leq 30$. It is found that within the limits of the Born approximation, the cross-sections for each series are proportional to n^{-d} where d = 3.07, 3.02, and 2.98 for L = 0, 1, and 2 respectively.

1942

Optics Technology, Inc., Belmont, Calif.

DIFFRACTION AT DIELECTRIC AND CONDUCTING APERTURES OF A FEW-WAVELENGTH SIZE (Abstract), by J. J. Burke, N. S. Kapany, and K. Frame. [1963] [1]p. (AFOSR-J1310) (AF 49(638)1200) Unclassified

Presented at 1963 Fall meeting of the Opt. Soc. of Amer., Chicago, Ill., Oct. 23-25, 1963.

Also published in Jour. Opt. Soc. Amer., v. 53: 1332, Nov. 1963.

This paper deals with a comprehensive theoretical and experimental study of diffraction at metallic and dielectric apertures of 31.7, 15.7, 7.5, 5.7, 5.0, 3.8, 2.3, and 2.12λ size. The theoretical approach follows Keller's "Geometrical Theory of Diffraction." The model represents the slit as formed by opposing wedges with rounded ends. The far field at wide angles is the sum of two partial fields, one associated with diffracted rays, the other with reflected rays. Each partial field is evaluated numerically on a C. D. C. 1604 computer. Experimental data are correlated with both the classical theory and the geometrical theory of diffraction.

1943

Optics Technology, Inc., Belmont, Calif.

ROLE OF FIBER OPTICS IN PHOTOGRAPHY, by N. S. Kapany. [1964] [4]p. incl. diagrs. (AFOSR-65-0445) (AF 49(638)1200) AD 612637 Unclassified

Presented at Internat'l. Commission for Optics Conf. on Photographic and Spectroscopic Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

Fiber optics assemblies in the form of field flatteners, image dissectors, image intensifiers, FOCONS, and fiber coupling plates are described for use in various high speed, high resolution photographic systems and photoelectronic devices.

1944

Optics Technology, Inc., Belmont, Calif.

RADIATION CHARACTERISTICS OF OPTICAL WAVEGUIDES (Abstract), by J. J. Burke, K. Frame, and N. S. Kapany. [1964] [1]p. (AFOSR-65-0451) (AF 49-(638)1200) Unclassified

Presented at Forty-ninth annual meeting of the Opt. Soc. of Amer., New York, Oct. 6-9, 1964.

The radiation characteristics of isolated circular optical fibers capable of supporting only low-order dielectric waveguide modes are studied both theoretically and experimentally for several combinations of mode, wavelength, diameter, and fiber numerical aperture. Photographic and photoelectric measurements of the far-field intensities are compared with numerical predictions. For a cross-sectional intensity distribution in the mode pattern of the form $J_n^2(ur/a) + PJ_{n-2}^2(ur/a)$, the predicted Fraunhofer pattern has the approximate form: $(UJ_{n-1}^{(u)}J_n^{(x)} - J_{n-1}^{(x)}J_n^{(u)})^2/(x^2-u^2)^2(x^2+q^2)^2$, where J_n is the Bessel function of order n, $u(=ka\sin\theta_0)$ the customary diffraction parameter. θ_0 is the characteristic angle of the mode in the fiber of core refractive index N_1 and coating N_2. (Contractor's abstract, modified)

1945

Oregon State U., Corvallis.

ELASTIC DISPLACEMENT OF PRIMARY WAVES FROM EXPLOSIVE SOURCES, by J. W. Berg, Jr. and G. E. Papageorge. [1964] [13]p. (AF AFOSR-62-376) AD 444058 Unclassified

Also published in Bull. Seismol. Soc. Amer., v. 54: 947-959, June 1964.

Equations derived from Blake's model of diverging

waves from a point source were programmed for computer analysis. Variations of the displacement resulting from changes in the pressure function, propagational velocity, range, and cavity size were investigated. Results of the research are given. In general, Fourier amplitudes at frequencies below the natural frequency of the cavity scale to the first power of charge size, and Fourier amplitudes at frequencies above the natural frequency of the cavity scale to a fractional power of charge size.

1946

Oregon State U., Corvallis.

THEORETICAL AND FIELD STUDIES OF SEISMIC WAVES, by J. W. Berg, Jr. Final research rept. Apr. 1, 1962-Apr. 1, 1964, 6p. (AF AFOSR-62-376) AD 612033 Unclassified

The objective of the research was to determine a method for evaluating the size of a seismic source using amplitudes and/or energy content of the seismic waves generated by the source. Each distance range (local, near-regional, regional, and teleseismic) was considered separately to divide the major problem into several smaller ones. Only the initial seismic disturbance was considered for this work. Data recorded from Gnome, Hardhat, Haymaker, and Shoal nuclear explosions were chosen to represent the seismic sources for this work. The research that was done for seismic waves recorded in the various distance ranges will be discussed. In general, the continuity of energy of the seismic waves recorded from the above explosions was sought for the entire range of distances over which the seismic waves were recorded.

1947

Oregon State U. [Dept. of Chemistry] Corvallis.

INVESTIGATIONS OF THE STRUCTURES AND DYNAMICS OF MOLECULES BY ELECTRON DIFFRACTION, by K. Hedberg and L. Hedberg. Final rept. 1963, 10p. (AFOSR-4659) (AF 49(638)783) AD 410007 Unclassified

The contents of this report are: Geometry: dinitrogen pentoxide, fluorine fluorosulfonate, cyclopropane, butadiene-1,3, disiloxane, hexachlorobenzene, and hexabromobenzene; Amplitudes of vibration: phosphorus trichloride; Methods of structure determination: least squares; Work in progress: cyclooctadiene-1,5, disilyl sulfide, nitrogen dioxide, and arsenic tribromide.

1948

Oregon State U. [Dept. of Chemistry] Corvallis.

THE MOLECULAR STRUCTURE OF DISILOXANE, $(SiH_3)_2O$, by A. Almenningen, O. Bastiansen and others. [1963] [6]p. (AFOSR-64-0932) (AF 49(638)-783) AD 439974 Unclassified

Also published in Acta Chem. Scand., v. 17: 2455-2460, 1963.

The structure of gaseous disiloxane (disilyl ether) has been studied by electron diffraction. The Si-O-Si angle is extraordinarily large, in agreement with conclusions from infrared and Raman spectroscopy, and with results of an earlier electron-diffraction investigation. The structural results are derived from a least squares analysis based on intensity curves. The standard errors contain estimates of systematic errors. The large Si-O-Si bond angle and the short SI-O bond distance are most likely due to conjugation of unshared electron pairs on the oxygen atom with d orbitals from the silicon atom.

1949

Oregon State U. Dept. of Chemistry, Corvallis.

LEAST-SQUARES REFINEMENT OF MOLECULAR STRUCTURES FROM GASEOUS ELECTRON-DIFFRACTION SECTOR-MICROPHOTOMETER INTENSITY DATA. I. METHOD, by K. Hedberg and M. Iwasaki. [1964] [5]p. (AFOSR-67-0275) (AF 49(638)783) Unclassified

Also published in Acta Cryst., v. 17: 529-533, May 1964.

An adaptation of the method of least squares to the refinement of molecular structures, based on gaseous electron-diffraction sector-microphotometer intensity data, is presented. The method has the advantages of permitting simultaneous refinement of many more parameters than can be handled by trial-and-error methods and of opening the possibility of obtaining realistic standard errors and error correlations in place of the more subjective 'error limits.' Although the problem of weighting of the observations is not solved, it is felt that the method provides a more straightforward way to take account of factors known to introduce uncertainties than does the alternative approach based on radial distribution functions. A brief account of general experience with the method is given. (Contractor's abstract)

1950

Oregon State U. Dept. of Chemistry, Corvallis.

LEAST-SQUARES REFINEMENT OF MOLECULAR STRUCTURES FROM GASEOUS ELECTRON-DIFFRACTION SECTOR-MICROPHOTOMETER INTENSITY DATA. II. ADAPTATION TO AUTOMATIC COMPUTATION, by M. Iwasaki, F. N. Fritsch, and K. Hedberg. [1964] [5]p. incl. diagrs. (AFOSR-67-0276) (AF 49-(638)783) Unclassified

Also published in Acta Cryst., v. 17: 533-537, May 1964.

A description is given of a computer program representing an adaptation of a least-squares method of molecular structure refinement based on gaseous electron-diffraction sector-microphotometer data. (Contractor's abstract)

1951

Oregon State U. Dept. of Chemistry, Corvallis.

LEAST SQUARES REFINEMENT OF MOLECULAR STRUCTURES FROM GASEOUS ELECTRON-DIFFRACTION SECTOR MICROPHOTOMETER DATA. III. REFINEMENT OF CYCLOPROPANE, by G. Bastiansen, F. N. Fritsch, and K. Hedberg. [1964] [6]p. incl. diagrs. refs. (AFOSR-67-0277) (AF 49(638)783) Unclassified

Also published in Acta Cryst., v. 17: 538-543, May 1964.

The method of least squares was applied to the cyclopropane structure, using data from the Norwegian diffraction apparatus (Skancke, 1960). The general refinement (including H ··· H interactions) led to results for six distances and root-mean-square amplitudes of vibration, all in Å, and two interesting angles. The standard errors include estimates of all known systematic effects deriving from the experiments and method of data reduction, and estimates of correlation among the intensity data. However, tests of various refinement conditions have revealed certain systematic changes in the values of the mean amplitudes of unknown cause, which suggest caution. No such effects on the distances were observed, and we feel they may be accepted with confidence. (Contractor's abstract, modified)

1952

Oregon State U. Dept. of Chemistry, Corvallis.

THE MECHANISM OF THE DISPROPORTIONATION OF SULFINIC ACIDS. THE THERMAL DECOMPOSITION OF p-TOLUENESULFINYL p-TOLYL SULFONE AND ITS REACTION WITH p-TOLUENESULFINIC ACID, by J. L. Kice and N. E. Pawlowski. [1963] [2]p. incl. table. (AFOSR-J657) (AF AFOSR-63-106) AD 415467 Unclassified

Also published in Jour. Org. Chem., v. 28: 1162-1163, Apr. 1963.

Evidence was presented to show that there was no direct reaction between p-toluenesulfinyl p-tolyl sulfone (I) and p-toluenesulfinic acid (II) in anhydrous dioxane. Rather, consumption of II occurred as a result of its reaction with intermediates formed by a rate determining unimolecular decomposition of I. Kinetic studies revealed that I decomposed rapidly in dioxane at 50°. This decomposition followed first-order kinetics and had a half life of 25 min. The rate constant was the same as in the absence of II. Although without kinetic influence, added II was consumed during the decomposition of I, and its presence altered the product composition from that obtained in its absence. Decomposition of a 0.05M solution (2.50 mmol) of I in the absence of II gave 1.2 mmol p-tolyl p-toluenethiolsulfonate, 0.20 mmol p-tolyl disulfide, and 1.86 mmol p-toluenesulfonic acid. One plausible structure for the intermediate was the sulfenyl sulfonate ($ArSO_2OSAr$) (II). By analogy with the chemistry of sulfenyl halides, III should react rapidly with the sulfinic acid to give the observed products.

1953

Oregon State U. [Dept. of Chemistry] Corvallis.

MECHANISMS OF REACTIONS OF SULFINIC ACIDS. VI. THE MECHANISM OF THE DISULFIDE-SULFINIC ACID REACTION, by J. L. Kice and E. H. Morkved. [1964] [9]p. (AFOSR-64-1508) (AF AFOSR-63-106) AD 446141 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2270-2278, June 5, 1964.

A significant extension of our understanding of the disulfide-sulfinic acid reaction have now been achieved through study of the reaction of a wide variety of disulfides with p-toluenesulfinic acid. For all alkyl disulfides the principal reaction product is the alkyl p-toluenethiolsulfonate, accompanied by small amounts of p-tolyl p-toluenethiolsulfonate and alkyl p-tolyl disulfide. Because of the relative availability of the starting materials and the predominant formation of the alkyl p-toluenethiolsulfonate, the reaction offers a potentially practical route for the synthesis of unsymmetrical thiolsulfonates. The kinetics of the reaction vary with disulfide structure, being second order in disulfide for nucleophilic primary alkyl disulfides, such as methyl or n-butyl, and first plus second order for both less nucleophilic primary ones, such as benzyl and sec-alkyl disulfides, such as isopropyl.

1954

Oregon State U. [Dept. of Chemistry] Corvallis.

THE REACTION OF SEC-ALKYL SULFIDES WITH P-TOLUENESULFINIC ACID, by J. L. Kice and E. H. Morkved. [1964] [3]p. (AFOSR-64-1816) (AF AFOSR-63-106) AD 449066 Unclassified

Also published in Jour. Org. Chem., v. 29: 1942-1944, July 1964.

The reaction of several sec-alkyl sulfides with p-toluenesulfinic acid has been investigated. As with their primary counterparts, the principal reaction involves cleavage of the sulfide, the products being p-tolyl p-toluenethiolsulfonate, the sec-alkyl p-toluenethiolsulfonate, and the ketone derived from oxidation of the sec-alkyl group. However, with 2-octyl sulfide the reaction appears to be somewhat more complex than usual, since some of the sulfide is also oxidized to the sulfoxide. The reactivity of sec-alkyl sulfides is distinctly lower than expected from the reactivity of primary alkyl sulfides. Evidence is presented that this is due to the influence of steric hindrance on the initial equilibrium involving sulfinic acid and sulfide.

1955

Oregon State U. Dept. of Chemistry, Corvallis.

CONCOMITANT ELECTROPHILIC AND NUCLEOPHILIC CATALYSIS OF SULFUR-SULFUR BOND CLEAVAGE IN ARYL THIOLSULFINATES, by J. L. Kice and C. G. Venier. [1964] [6]p. incl. tables. (AFOSR-65-0009) (AF AFOSR-63-106) AD 455705 Unclassified

Also published in Tetrahedron Ltrs., No. 48: 3629-3634, 1964.

It was found that in acetic acid containing small amounts of water and sulfuric acid phenyl benzenethiolsulfinate reacts much more readily with aromatic sulfinic acids ($ArSO_2H$) than it undergoes disproportionation. Kinetic study of the reaction under conditions where the sulfinic acid is in considerable stoichiometric excess shows that the reaction is first order in both sulfinic acid and thiolsulfinate, subject to what appears to be general acid catalysis by added sulfuric acid, and little affected by a change in the stoichiometric concentration of water.

1956

Oregon State U. Dept. of Chemistry, Corvallis.

THE DECOMPOSITION OF AROMATIC SULFINYL SULFONES (SULFINIC ANHYDRIDES). THE FACILE HOMOLYSIS OF A SULFUR-SULFUR BOND, by J. L. Kice and N. E. Pawlowski. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0010) (AF AFOSR-63-106) AD 455929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 4898-4904, Nov. 20, 1964.

Aromatic sulfinyl sulfones undergo rapid decomposition at 50°C, the rate being little affected by either solvent or the nature of the aryl group. Experiments using galvinoxyl, and the trapping of $ArSO_2$ radicals by an added olefin, show that the decomposition involves the facile homolysis of the sulfur-sulfur bond to give $ArSO_2$ and ArSO. In the absence of a radical trap these radicals then recombine, yielding the sulfenyl sulfonate.

1957

Oregon U. Dept. of Chemistry, Eugene.

RESEARCH ON MOLECULAR COMPLEXATION AND REACTIONS OF NON-POLAR MOLECULES AT POLARIZING SURFACES. PART I, by L. H. Klemm. Final rept. Sept. 1, 1956-Aug. 31, 1962. Jan. 10, 1963, 27p. incl. diagrs. tables. (AFOSR-4496, Pt. 1) (AF 49(636)473) AD 610813 Unclassified

Studies were undertaken to ascertain (1) the stereorelationships involved in surface-substrate interactions of non-polar organic molecules on polarizing inorganic surfaces and (2) the effect of such surface-substrate interaction on chemical reaction between the adsorbed substrate and a third substance (either adsorbed or in solution). The following methods of approach were investigated: adsorption chromatography on alumina; molecular complexation chromatography; polarographic reduction at the mercury cathode; catalytic hydrogenation using platinum; molecular complexation in Diels-Adler condensation. It was possible to correlate the physiochemical processes which occur when non-polar molecules undergo reaction at polarizing surfaces and to observe the relative degrees of importance of resonance, polar, and steric factors in the processes investigated.

1958

Oregon U. Dept. of Chemistry, Eugene.

RESEARCH ON MOLECULAR COMPLEXATION AND REACTIONS OF NON-POLAR MOLECULES AT POLARIZING SURFACES. PART II. THE CATALYTIC HYDROGENATION OF ALKENYLNAPHTHALENES, by R. H. Mann. (Doctoral thesis) Final rept. Sept. 1, 1958-Aug. 31, 1962. Jan. 10, 1963, 85p. incl. illus. diagrs. tables, refs. (AFOSR-4496, Pt. 2) (AF 49(638)473) AD 610814 Unclassified

The rates of catalytic hydoogenation of 14 alkenylnaphthalenes and related compounds in acetic and propionic acid were determined. Activation energies were determined but no significant differences were found from compound to compound. The values of the rate constant for the reduction of the alkonic double bond were found to depend on chemical structure. The rate of hydrogenation decreased with the amount of substitution of the alkenic double bond. For trisubstituted alkenes, satisfactory conformation was found with the theory that the rate of hydrogenation should decrease as the steric hindrance to attainment of coplanarity increases. For disubstituted and monosubstituted alkenes the α-substituted naphthalenes reacted more rapidly than the β-substituted naphthalenes in agreement with the higher free valence on the α-carbon than on the β-carbon of naphthalene itself. (Contractor's abstract)

1959

Oregon U. Dept. of Chemistry, Eugene.

RESEARCH ON MOLECULAR COMPLEXATION AND REACTIONS OF NON-POLAR MOLECULES AT POLARIZING SURFACES. PART III. MOLECULAR COMPLEXATION AND DIENE CONFORMATION IN THE DIELS-ALDER REACTION, by W. C. Solomon. Final rept. Sept. 1, 1958-Aug. 31, 1962. Jan. 10, 1963, 167p. incl. diagrs. tables, refs. (AFOSR-4496, Pt. 3) (AF 49(638)473) AD 610815 Unclassified

Systems using vinylnaphthalenes with tetracyanoethylene were employed in an attempt to decide the role of molecular complexation in Diels-Alder reactions, and in a study of the effect of changing diene conformation upon the rate of Diels-Alder addition.

1960

Oregon U. Dept. of Chemistry, Eugene.

POLAROGRAPHIC REDUCTION OF SOME ALKYL-, ALKYLENE-, AND POLYMETHYLNAPHTHALENES, by L. H. Klemm and A. J. Konlik. [1963] [6]p. tncl. diagrs. tables, refs. (AFOSR-J1151) (AF 49(638)473) AD 423131 Unclassified

Also published in Jour. Org. Chem., v. 28: 2044-2049, Aug. 1963.

Polarography was conducted on naphthalene and twenty-seven substituted naphthalenes. Using naphthalene as a standard of comparison the change tn the half-wave reduction potential, $-\Delta E_{1/2}$, for the stngle wave obtained for each of the dertvatives is postive, consistent with a decrease in ease of electroreduction due to the substituent(s). For the monoalkyl dertvatives plots of $-\Delta E_{1/2}$ vs σ^*, the polar substituent constant, for the 1- and for the 2-series are ltnear. There ts no tndication of a stertc effect due to the bulkiness of the alkyl group. For dimethylnaphthalenes approximate addivity in $-\Delta E_{1/2}$ exists, except for the cases of the 1,8- and 2,3-tsomers, where an enhancement potential must be included in order to retain additivity. (Contractor's abstract)

1961

Oregon U. Dept. of Chemtstry, Eugene.

CATALYTIC HYDROGENATION OF SOME NAPHTHYL ALKENES, by L. H. Klemm and R. Mann. [1964] [5]p. tncl. diagrs. table, refs. (AFOSR-64-1413) (AF 49-(638)473) AD 444445 Unclassified

Also published tn Jour. Org. Chem., v. 29: 900-904, Apr. 1964.

Rates of catalytic hydrogenation of twelve naphthyl alkenes and two cycloakyl naphthalenes have been studied using acetic and proptontc acids as solvents, Adams' platinum as catalyst, both constant volume and constant temperature (5°-40°C), and 1-2-atm pressure. For most of the naphthyl alkenes, first-order rate plots (with respect to the pressure of hydrogen) showed two ltnear portions corresponding to (1) more rapid reduction of the alkenyl double bond (accompanted by some reduction of the naphthalene ring) and to (2) slower reduction of the resultant alkyl naphthalene, respectively. In general, rate constants of hydrogenation tncreased wtth increasing temperature, with change from acetic acid to propionic acid, and (for process 1) with decrease in number of substituents on the carbon atoms of the alkenyl double bond. There was no evidence of preliminary double bond mtgration. (Contractor's abstract)

1962

Oregon U. Dept. of Chemtstry, Eugene.

OPTICAL RESOLUTION OF 9-SEC-BUTYLPHENANTHRENE BY MOLECULAR COMPLEXATION CHROMATOGRAPHY, by L. H. Klemm, K. E. Desai, and J. R. Spooner, Jr. [1964] [3]p. (AFOSR-64-1414) (AF 49(638)473) AD 444444 Unclassifted

Also publtshed in Jour. Chromatog., v. 14: 300-302, 1964.

Klemm and Reed described the use of columns of siltctc acid tmpregnated with the optically active molecular complexing agent (+)- or (-)-α-(2,4,5,7-tetranitro-9-fluorenylidenea-mtnooxy)-propionic acid for optical resolution of an ether and of an ester contatning one center of asymmetry (on carbon) for each compound. In addition the method was used for optical resolution of a hydrocarbon whereth optical activity results from sertous restriction to totation around a pivotal bond of the btphenyl type. The successful extension of the method to the partial optical resolution of 9-sec-butylpehnanthrene, a hydrocarbon containtng a single center of asymmetry and expected to have a small specific rotation ts reported. (Contractor's abstract)

1963

Oregon U. Dept. of Chemtstry, Eugene.

GAS-SOLID ADSORPTION CHROMATOGRAPHY OF SOME AROMATIC HYDROCARBONS AND NITROGEN HETEROCYCLES ON ALUMINA, by L. H. Klemm and S. K. Airee. [1964] [8]p. tncl. diagrs. tables, refs. (AFOSR-64-1415) (AF 49(638)473) AD 444451 Unclassifted

Also publtshed in Jour. Chromatog., v. 13: 40-47, 1964.

By means of gas-solid adsorption elution chromatography on alumtna, either platn or pre-treated with non-eluting quinucltdine, retention times and heats of adsorption were determtned for benzene, etght monalkylbenzenes, m-xylene, naphthalene, and 2,6-lutidine. In general both retention time and heat of adsorption decreased on tmpregnating the alumtna with quinuclidine. (Contractor's abstract, modified)

1964

Oregon U. Dept. of Mathematics, Eugene.

BASIC RESEARCH IN PROBABILITY AND STATISTICS OF SEVERAL SAMPLE PROBLEMS. Ftnal rept. July 1, 1961-June 30, 1963. July 31, 1963, 53p. tncl. tables, refs. (AFOSR-5230) (AF 49(638)1057) AD 415959 Unclassified

This paper develops for the several sample problem the notions of a parametrtc famtly of non-parametrtc alternatives. In sectton two tt gives a detatled characterization of the class of all locally most powerful rank order tests for testtng the hypothesis of equality of several continuous distrtbutions. In section three tt is shown that the class of all locally most powerful rank order tests coincides with the class of all locally least powerful tests. Section four considers a multiple decision problem with non-parametric slippage alternattves and charactertze the class of all locally best symmetric dectsion procedures based on rank orders.

1965

Oregon U. [Dept. of Mathematics] Eugene.

FOURIER SERIES IN SEVERAL VARIABLES, by V. L. Shapiro. [1964] [46]p. (AFOSR-64-0572) (AF AFOSR-63-351) AD 434319 Unclassified

Also published in Bull. Amer. Math. Soc., v. 70: 48-93, Jan. 1964.

This article is a survey of certain aspects of the theory of multiple Fourier and trignometric series. The main theorems are proved in a discussion of two bibliographies, a bibliography for the survey itself, and a general bibliography in which is described the classical theory of the Bochner-Riesz summability of multiple Fourier series and the Abel summability of multiple Fourier series. Bochner's counter-example for the critical index in summability theory in considerable detail is presented. Also the uniqueness of multiple trigonometric series is presented which proves the main theorem in the subject so far, i.e., uniqueness under Abel summability. Some results in conjugate multiple Fourier series are described, defined by means of the Calderon-Zygmund kernel and related topics, i.e., analyticity in several variables, and the Riemannian theory of multiple trigonometric series, some applications to geometric integration theory and potential theory.

1966

Oregon U. [Dept. of Physics] Eugene.

OPTICAL ABSORPTION IN CaO SINGLE CRYSTALS, by V. I. Neeley and J. C. Kemp. [1963] [4]p. (AFOSR-64-0417) (AF AFOSR-62-180) AD 435664 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 24: 1301-1304, 1963.

The optical absorption of CaO single crystals has been measured in the range 14.5μ-200 mμ. Absorption bands begin at approximately 250 mμ on the high energy side of the visible region and at 10μ on the low energy side. $Ca(OH)_2$, which readily forms on the surface of these crystals when left standing shows the strong (OH) streiching absorption at 2.755 μ. Surface effects also cause a weaker band at 260 mμ. Special precautions were necessary to eliminate these spurious absorptions.

1967

Oslo U. Inst. for Theoretical Physics (Norway).

ON THE CONCEPTION OF GENERALIZED SPIN OF FREE DIRAC PARTICLES, by E. A. Hylleraas. [1964] [9]p. (Inst. rept. no. 22) (AFOSR-65-0453) (AF 61(052)134) AD 614219 Unclassified

Using the spinor matrix method, several concepts of free Dirac particles are developed. First shown is the similarity in spin eigenvalue equations as expressed by Pauli matrices and spinor matrices. An energy eigenvalue equation is given, and then some combined energy-spin solutions are derived. Other forms of modified and generalized spin are considered in the field of Lorentz transformations such as Rose spin and the Foldy-Wouthuysen transformation. Also discussed is the question of spin-energy quantized eigenfunction and the mean value of spin.

1968

Oslo U. Inst. for Theoretical Physics (Norway).

THE GENERAL ORTHOGONALITY THEOREM IN THE HYLLERAAS-SCHERR-KNIGHT VARIATIONAL PERTURBATION METHOD, by J. Midtdal. 1964 [8]p. (Inst. rept. no. 25) (AFOSR-65-0454) (AF 61(052)134) AD 614220 Unclassified

The present report is concerned with the problem of whether some corresponding orthogonality relations may be stated when using the Hylleraas-Scherr-Knight variational perturbation method. The theorem is developed by summarizing this method and by reviewing work done previously for orthogonality relations. Sufficient orthogonality requirements for excited states are given, and from this the following general orthogonality theorem is developed: The approximate perturbation wave functions furnished by the variational equations of the Hylleraas-Scherr-Knight procedure will automatically, to any order, satisfy the same orthogonality conditions as the exact perturbation wave functions.

1969

Oslo U. Inst. for Theoretical Physics (Norway).

[ON FORMULATION OF SPINORS. II. THE QUESTION OF GENERALIZED SPIN] Über die Darstellung von Spinoren. II. Zur Frage des generalisierten Spins, by E. A. Hylleraas. [1964] [6]p. (Inst. rept. no. 24) (AFOSR-65-0717) (AF 61(052)134) AD 615067 Unclassified

Also published in Zeitschr. Phys., v. 182: 58-63, 1964.

The method of spinor matrices leads to a simple definition of a generalized spin, i.e., of like spin operator, which one may quantize for a free-moving Dirac particle in any arbitrary direction. This spin is compared with other forms of generalized spins.

1970

Oslo U. Inst. for Theoretical Physics (Norway).

SOME THEORETICAL INVESTIGATIONS FOR CLOSED STATES OF THE NEGATIVE HYDROGEN ION. PART I, by J. Midtdal. 1964 [33]p. incl. diagrs. tables, refs. (Inst. rept. no. 21) (AFOSR-64-1256) (AF EOAR-64-32) AD 605259 Unclassified

This report contains previous investigations, coordinate systems and sets of wave functions; the singlet and triplet S-states of two s-electrons; the $1s2p\ ^3P$ state

of a two-electron system; the states $(2p)^2\ ^3P$ and 2p3p ^3P; perturbation theory expansion of the non-relativistic energy of the state $(2p)^2\ ^3P$.

1971

Oslo U. Neurophysiological Lab. (Norway).

EXCITATORY AND INHIBITORY BLADDER RESPONSES TO STIMULATION OF THE CEREBRAL CORTEX IN THE CAT, by R. Gjone and J. Setekleiv. [1963] [12]p. incl. diagrs. refs. (AFOSR-65-1290) (AF EOAR-62-36) AD 620945 Unclassified

Also published in Acta Physiol. Scand., v. 59: 337-348, 1963.

A continuous intravesical pressure recording was established in 22 anesthetized cats by operative canalization of the bladder cavity, leaving the urinary outlet intact. The intravesical pressure variations caused by controlled volume changes were studied, and the alterations in bladder activity in response to stimulation of the cerebral cortex were recorded. The following excitatory bladder reactions on cortical stimulation are described: (1) augmentation of the rhythmic contractions; (2) dropwise expulsion of the bladder contents with incomplete emptying of the vesical cavity; and (3) a normal micturition act with forceful detrusor contractions. With regard to inhibitory effects the following responses were obtained: reduction or complete inhibition of the rhythmic bladder activity, arrest of the urination act or suppressed micturition. In agreement with previous investigations excitatory bladder responses were obtained from the first sensory-motor area and from the anterior cingulate region. In addition, excitatory effects were elicited by stimulation of the anterior ectosylvian and anterior sylvian gyri. (Contractor's abstract, modified)

1972

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. I. ISOTONIC AND ISOMETRIC RECORDING IN VIVO. INFLUENCE OF ANESTHESIA AND TEMPERATURE, by J. Setekleiv. [1964] [11]p. incl. diagrs. refs. (AFOSR-65-1574) (AF EOAR-62-36) AD 623346 Unclassified

Also published in Acta Physiol. Scand., v. 62: 68-78, 1964.

A technique for isotonic and isometric recording of uterine contractions in vivo is described. No significant difference was found in the spontaneous contractions recorded simultaneously from the 2 horns by the 2 methods. Differences were found, however, in the responses to gradually increasing stimuli, such as increasing concentrations of noradrenaline or of increasing strength of stimulation of the hypogastric nerve. The isotonic response rapidly reached a maximum, whereas the isometric response increased more gradually. Since the isotonic response can be maximal in spite of submaximal activation, the isometric response is a more reliable quantitative measure, which is in agreement with previous findings with in vitro recording. However, the qualitative evaluation of responses near threshold stimulation, isotonic recording at low loads is preferable. (Contractor's abstract, modified)

1973

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. II. RESPONSE TO DISTENSION, by J. Setekleiv. [1964] [15]p. incl. diagrs. refs. (AFOSR-65-1575) (AF EOAR-62-36) AD 623347 Unclassified

Also published in Acta Physiol. Scand., v. 62: 79-93, 1964.

The myometrial response to rapid distension consists of a quick contraction, the early stretch response, followed by an increase in the rhythmic activity. The latency and amplitude of the early contraction has been studied during increasing degrees of distension and during repetitive distensions. The frequency of the rhythmic contractions increases with increasing distension; the amplitude and the external work performed by each contraction at first increases and later decreases. Data obtained from isometric and isotonic recordings indicate that the pacemaker activity is not directly related either to the intra-uterine volume or to the intra-uterine pressure but rather to the tension in the myometrial cells. The independency with which the 2 horns respond to distension, the lack of effect of local and spinal anesthesia and of autonomic blocking agents indicates that the active response to distension is of myogenic origin. The intra-uterine pressure is not maintained during constant distension but decreases at first rapidly, later more slowly. (Contractor's abstract)

1974

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. III. RESPONSE TO HYPOGASTRIC AND SPLANCHNIC NERVE STIMULATION, by J. Setekleiv. [1964] [13]p. incl. diagrs. refs. (AFOSR-65-1576) (AF EOAR-62-36) AD 623348 Unclassified

Also published in Acta Physiol. Scand., v. 62: 137-149, 1964.

The amplitude of the uterine contraction elicitied by a few sec stimulation of the hypogastric nerve depends on: (1) the stimulus frequency, the contraction being maximal at 30 to 50 cps; (2) the excitability of the myometrium, being increased in a period from 20 to 60 sec following a preceding stimulus, and (3) the degree of uterine distension. Whereas stimulation for a few sec elicits a single contraction, prolonged stimulation (for several min) at low frequencies (5-10 cps) evokes a series of rhythmic contractions. Prolonged stimulation at frequencies above 10 cps causes in addition a transient elevation of the minimum pressure. The iv

administration of cocaine does not potentiate the response to hypogastric nerve stimulation, whereas potentiation by cocaine is obtained when the agent is applied intra-uterinely. This effect, as well as the response to adrenergic blocking agents, indicates the presence of adrenergic fibers in the hypogastric nerve supplying the myometrium. (Contractor's abstract, modified)

1975

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. IV. REFLEX EXCITATION AND INHIBITION, by J. Setekleiv. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-1577) (AF EOAR-62-36) AD 623349 Unclassified

Also published in Acta Physiol. Scand., v. 62: 304-312, 1964.

The uterus can be reflexly activated by stimulation of the rectum, various somatic nerves, and the central and peripheral ends of the cut vagus nerve. The initial uterine contraction is followed by a period of reduced rhythmic activity. Similar responses can be elicited by asphyxia and by clamping of the common carotid arteries. All these responses are due to activation of the sympathico-adrenal system. A transient inhibition of the spontaneous rhythmic activity is obtained by electrical stimulation of the depressor nerve. Since it is abolished by sympathetic blocking agents, it is most likely due to a reduction of a sympathetic tonic influence. The results indicate that although the autonomy of the myogenic rhythmic uterine activity is strong in the estrogenized rabbit, it can be influenced by various reflexes. It is suggested that the sympathetic nervous system exerts a tonic influence on the uterus in vivo. (Contractor's abstract)

1976

Oslo U. Neurophysiological Lab. (Norway).

UTERINE MOTILITY OF THE ESTROGENIZED RABBIT. V. RESPONSE TO BRAIN STIMULATION, by J. Setekleiv. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-1578) (AF EOAR-62-36) AD 623350 Unclassified

Also published in Acta Physiol. Scand., v. 62: 313-322, 1964.

Uterine contractions were elicited by electrical stimulation of points located in the lateral part of the medulla oblongata, whereas inhibitory responses were induced from the midline medullary region. Cerebellar stimulation determined an inhibition of the rhythmic uterine activity followed by a rebound effect, on cessation of the stimulation. From the hypothalamus 3 different responses were obtained: (1) excitatory effects from the periformical, the dorsal, lateral and posterior hypothalamic areas due to sympathetic activation, (2) uterine excitation by oxytocin liberation induced from the ventromedial part of the hypothalamus, and (3) inhibition of the uterine rhythmic activity by stimulation of a restricted region in the lateral hypothalamic area. Excitatory responses were also evoked from the amygdala, from sensorimotor cortex, and the anterior limbic region. Inhibitory uterine responses were produced from the 2 cortical areas just mentioned as well as from the orbital surface. (Contractor's abstract)

1977

Oxford U. Dept. of Anatomy (Gt. Brit.).

INHIBITION OF OVULATION IN THE GONADOTROPHIN-TREATED IMMATURE RAT BY CHLORPROMAZINE, by M. X. Zarrow and K. Brown-Grant. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-1546) (AF EOAR-62-111) AD 624013 Unclassified

Also published in Jour. Endrocrinol., v. 30: 87-95, 1964.

The effect of age and dose of a single injection of pregnant mare serum gonadotrophin on spontaneous ovulation in immature Wistar rats is described. Ovulation could be induced by human chorionic gonadotrophin at least 6 days before it occurred when pregnant mare serum gonadotrophin alone was given. Chlorpromazine was shown to block pregnant mare serum gonadotrophin-induced ovulation at a dose level (0.25 mg in a 60 g rat) which has no effect on the ovulatory response to human chorionic gonadotrophin. Higher doses interfered with the action of injected human chorionic gonadotrophin. Ovulation could be induced in the chlorpromazine-blocked animals by the systemic injection of an extract of bovine median eminence, but the sensitivity was too low to use this response for an assay method. (Contractor's abstract)

1978

Oxford U. [Dept. of Anatomy] (Gt. Brit.).

EFFECTS OF ENDOCRINES OF DEVELOPMENT AND BEHAVIOR, by G. W. Harris. Final rept. Apr. 1, 1964-Sept. 30, 1964, 8p. (AFOSR-65-0667) (AF EOAR-64-3) AD 614590 Unclassified

The investigation has consisted of four projects concerning the release of lutcinizing hormone in the rabbit, the releasing factor content of portal vessel blood, ovulation in immature rats, and concentration and activity of thyrotrophic hormone in blood.

1979

Oxford U. [Dept. of Anatomy] (Gt. Brit.).

SEX HORMONES, BRAIN DEVELOPMENT AND BRAIN FUNCTION, by G. W. Harris. [1964] [22]p. incl. illus. diagrs. refs. (AFOSR-65-1295) (AF EOAR-64-3) AD 621460 Unclassified

Presented at Annual meeting of the Endocrine Soc., San Francisco, Calif., June 19, 1964.

Also publtshed tn Endocrinology, v. 75: 627-648, Oct. 1964.

The view that gonadal hormones exert a double action on the central nervous system, t.e., tnducttve during development and exctttatory tn the adult allows a direct compartson between the bratn and genttal tract as target organs for these hormones. In both cases tt ts generally the male hormone whtch ts domtnant tn the tnductive actton tn amphtbtans and mammals. The presence to testis hormone tnduces, tn both genetic males and females, the development of a male genital tract and male type brain. The absence of testis hormone, tn the normal female or after gonadectomy tn both sexes, allows the development of a female genttal tract and a female type brain. Since the tnductive tnfluence of the male hormone tn the rat appears to be exerted on the genttal tract at an earlter stage of development than on the brain, tt ts posstble by expertmental procedures (castration of the male at birth, or admtntstration of testosterone to the neonatal female) to obtatn a normally crgantzed genttal tract tn the presence of deviated development of the brain.

1980

Oxford U. [Dept. of Biochemtstry] (Gt. Brit.).

THE INFLUENCE OF POTASSIUM, SODIUM AND CHLORIDE ON THE MEMBRANE POTENTIAL OF THE SMOOTH MUSCLE OF TAENIA COLI, by H. Kurtyama. [1963] [14]p. (AFOSR-64-1070) (AF EOAR-62-5) AD 441483 Unclassifted

Also published tn Jour. Physiol. (London). v. 166: 15-28, 1963.

Transmembrane potential and tenston of the smooth muscle of tsolated taenia colt of the gutnea-pig were recorded tn soluttons of normal and abnormal tonic composttion. The relation between the membrane potential and the logartthm of the external K^+ concentration was observed. The experimental results are discussed tn relation to the discrepancy between membrane potential of taenia colt and the predicted potasstum equiltbrium potential. They are conststent with the view that chlortde and sodium permeabilities are of greater tmportance for the determtnatton of the membrane potential of the spontaneously active smooth muscle than they are for the resting skeletal muscle.

1981

Oxford U. [Dept. of Btochemtstry] (Gt. Brtt.).

THE EFFECT OF ADRENALINE ON THE SMOOTH MUSCLE OF GUINEA-PIG TAENIA COLI IN RELATION TO THE DEGREE OF STRETCH, by E. Bulbrtng and H. Kurtyama. [1963] [15]p. (AFOSR-64-1071) (AF EOAR-62-5) AD 441487 Unclassifted

Also publtshed tn Jour. Physiol. (London), v. 169: 198-212, 1963.

The effect of stretch on membrane potential, membrane activity and tension was observed tn the smooth muscle of guinea-pig taenia colt. The degree of stretch was defined by the ratio (wet wetght/length), the W:L ratio, whtch corresponds to the cross-sectional area. In the steady state the membrane potential, the amplttude and rate of rise of the spike were maximum at W:L = 0.9. The membrane potential was lower tn completely loose, unstretched tissue (W:L > 0.9). It was much lower in stretched muscle (W:L < 0.9), tn whtch the membrane potential decreased tn direct proportion to the decrease of the W:L ratio. After sudden stretch the adaptation of tension took 10-20 sec, but the membrane potential reached a steady state only tn 5 mtn. Simtlarly, after sudden release, membrane activity and tenston were completely aboltshed, and adaptation took up to 5 mtn.

1982

Oxford U. [Dept. of Btochemtstry] (Gt. Brtt.).

EFFECTS OF CHANGES IN IONIC ENVIRONMENT ON THE ACTION OF ACETYLCHOLINE AND ADRENALINE ON THE SMOOTH MUSCLE CELLS OF GUINEA-PIG TAENIA COLI, by E. Bulbrtng and H. Kurtyama. [1963] [16]p. (AFOSR-64-1072) (AF EOAR-62-5) AD 441477 Unclassifted

Also published tn Jour. Physiol. (London), v. 166: 59-74, 1963.

The effects of acetylcholtne and adrenaltne on membrane potential, electrical activity and tenston have been observed tn the tsolated taenia colt of the gutnea-ptg. The degree of depolartzation caused by acetylcholtne depended on the inttial membrane potential prevailtng at the ttme of applicatton. During the acceleration of sptke discharge the amplitude and the rates of rise and fall of the action potential were decreased. In K^+-free solution the depolartzation caused by acetylcholtne was abolished. When the membrane was prevtously depolarized by excesstve K^+ acetylcholtne still caused depolarization, but tt became tneffective when the potential was reduced to 15 mv. At thts level acetylcholtne somettmes tncreased the membrane potential. In Na^+-free solution acetylcholtne did not accelerate the spike discharge but still depolartzed the membrane.

1983

Oxford U. [Dept. of Btochemtstry] (Gt. Brit.).

EFFECTS OF CHANGES IN THE EXTERNAL SODIUM AND CALCIUM CONCENTRATIONS ON SPONTANEOUS ELECTRICAL ACTIVITY IN SMOOTH MUSCLE OF GUINEA-PIG TAENIA COLI, by E. Bulbrtng and H. Kurtyama. [1963] [30]p. (AFOSR-64-1073) (AF EOAR-62-5) AD 441476 Unclasstfied

Also published tn Jour. Physiol. (London), v. 166: 29-58, 1963.

The membrane acttvity and tenstor tn the presence of normal and abnormal tontc concentrations were recorded tn the tsolated taenia colt of the gutnea-ptg. In Kreb's solution the mean membrane potential was 55 mv and the mean parameters of the action potential were: spke amplitude 62 mv, half-duration 7.5 msec, maximum

rate of rise and fall 7.6 and 7.4 v/sec, respectively. Total absence of Na^+ in the external solution (replacement with Tris+) transiently hyperpolarized the membrane and stopped spontaneous discharge for a few min. In the absence of Na^+ the time during which spontaneous activity continued as well as the spike amplitude were a function of the external calcium concentration. When in the absence of Na^+ and Ca^{2+} all activity had ceased, the addition of calcium restored spontaneous discharge of action potentials for 30 min. In excess Na^+ the absence of Ca^{2+} caused the membrane potential to oscillate.

1984

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

ELECTROPHYSIOLOGICAL OBSERVATIONS ON THE MOTOR INNERVATION OF THE SMOOTH MUSCLE CELLS IN THE GUINEA-PIG VAS DEFERENS, by H. Kuriyama. [1963] [16]p. (AFOSR-64-1074) (AF EOAR-62-5) AD 441473 Unclassified

Also published in Jour. Physiol. (London), v. 169: 213-228, 1963.

Neuromuscular junction potentials, action potentials and tension, evoked by nerve stimulation and field stimulation of the muscle, were recorded from single cells in the hypogastric nerve-vas deferens preparation of the guinea-pig. The junction potentials elicited by short pulses (0.01 msec) with either type of stimulation and recorded from the save muscle cell were qualitatively alike although not always of the same amplitude. Facilitation was seen with both types of stimulation, either independent or mutually influencing each other, the overlap being variable in different cells.

1985

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

BRAIN STEM STIMULATION AND ETHOLOGICAL STUDIES ON BIRDS, by N. Tinbergen, D. M. Vowles, and J. D. Delius. Final technical rept. Dec. 1, 1962-Dec. 31, 1963, 7p. (AFOSR-64-0106) (AF EOAR-62-22) AD 430662 Unclassified

This research was conducted to provide detailed descriptions of the birds' behavior and to analyze in greater detail the motivation of various behavioral systems, in order to provide a descriptive and motivational basis by which the behavior of birds in the wild may be compared with that obtained by stimulation techniques. A number of behavioral systems—territorial behavior, pair-bond formation and maintenance, copulation, nest-building, incubation, grooming the body surface and bathing were examined. Preliminary analysis suggests that care of the body surface is motivated by two, probably independent, systems: preening and 'comfort.' It has been shown that preening is controlled by a combination of postural facilitation and local external stimulation.

1986

Oxford U. Dept. of Biochemistry (Gt. Brit.).

METABOLISM OF C_1 COMPOUNDS BY MICRO-ORGANISMS, by H. Krebs and J. R. Quayle. [Final rept.] 1963 [20]p. incl. tables, refs. (AFOSR-J1179) (AF EOAR-62-45) AD 422920

Growth of Pseudomonas methanicaon methane or methanol as sole carbon source has been studied by following the course of incorporation of C^{14} labelled growth substrate into cell constituents using chromtographic and radioautographic techniques. It has been found that radioactivity from either C^{14} methane or C^{14} methanol appears most rapidly in phosphorylated compounds. This is in contrast with the incorporation of C^{14} methanol or C^{14} formate into Pseudomonas AM1 growing respectively on methanol or formate, where fixation occurs predominantly into serine. The new results with Pseudomonas methanica suggest the possibility of a different pathway. A thiamine pyrophosphate-dependent hydroxymethylation of pentose phosphate has been suggested as one such possibility.

1987

Oxford U. [Dept. of Biochemistry] (Gt. Brit.).

CARBON ASSIMILATION BY PSEUDOMONAS OXALATICUS (OX 1). DECARBOXYLATION OF OXALYL-COENZYME A TO FORMYL-COENZYME A, by J. R. Quayle. [1963] [12]p. (AFOSR-64-1189) (AF EOAR-62-45) AD 442996 Unclassified

Also published in Biochem. Jour., v. 89: 492-503, 1963.

Cell-free extracts of oxalate-grown, Pseudomonas oxalaticus catalyze the decarboxylation of oxalyl-CoA and the decarboxylation of oxalate in the presence of catalytic quantities of oxalyl-CoA. An enzyme has been purified from the cell-free extract which catalyzes the decarboxylation of oxalyl-CoA to formyl-CoA. The formyl-CoA has been characterized by chromatography, electrophoresis, formation of hydroxamate, absorption spectrum and hydrolysis to formate. Formyl-CoA is capable of sparking the decarboxylation of oxalate by crude extracts of Pseudomonas oxalaticus. The oxalyl-CoA decarboxylase requires thiamine pyrophosphate as cofactor and is stimulated by the presence of Mg^{2+} or Mn^{2+} ions. The decarboxylation is unaffected by the presence of iodoacetate or N-ethylmaleimide. The pH optimum for the decarboxylation is 6.6. No evidence could be found for reversibility of the reaction.

1988

Oxford U. Dept. of Biochemistry (Gt. Brit.).

MICROBIAL GROWTH ON C_1 COMPOUNDS. 6. OXIDATION OF METHANOL, FORMALDEHYDE AND FORMATE BY METHANOL-GROWN PSEUDOMONAS AM1, by P. A. Johnson and J. R. Quayle. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-1580) (AF EOAR-62-45) AD 623380 Unclassified

Also published in Biochem. Jour., v. 93: 281-290, 1964.

A stuoy is presented of the oxidation of C_1 compounds by cell-free extracts of methanol-grown Pseudomonas AM 1. By using 3-amino-1, 2, 4-triazole, a known inhibitor of catalase, the independence of methanol oxidation from catalytic activity was shown. The only enzyme capable of oxidizing methanol was a dehydrogenase that can be linked to phenazine methosulphate and required the presence of NH_4^+ ions. An aldehyde dehydrogenase that reduced 2, 6-dichlorophenolindophenol or phenazine methosulphate in the presence of formaldehyde, and a nicotinamide-adenine nucleotide-linked formate dehydrogenase were found in cell-free extracts and purified by ammonium sulphate precipitation. A comparative study of the oxidation of C_1 compounds by cell-free extracts of Protaminobacter ruber, Pseudomonas extorquens, and Pseudomonas methanica, is also presented.

1989

Oxford U. Dept. of Nuclear Physics (Gt. Brit.).

RESEARCH ON INELASTIC PROCESSES, by J. R. Rook and D. Mitra. Summary technical note. [1963] 10p. (AFOSR-4056) (AF 61(052)455) AD 290701 Unclassified

Work performed for the year 1961-62 is summarized. The topics covered are K mesic atoms, double nuclear stripping, compound nucleus theory and the application of the pairing force model.

1990

Oxford U. Dept. of Nuclear Physics (Gt. Brit.).

RESEARCH ON INELASTIC PROCESSES, by J. R. Rook and D. Mitra. [1964] 16p. incl. refs. (AFOSR-5506) (AF 61(052)455) Unclassified

In this report the information that can be obtained from analysis of K^- mesic atoms and nuclear reactions is investigated. In the case of K^- mesic atoms it is established that nuclear capture takes place in the extreme surface region of the nucleus. It is also established to first order of perturbation theory that there is considerable evidence for nucleon clusters in the nuclear surface. It appears however that second order effects may be sufficiently large to invalidate this conclusion and further experimental evidence is required. In the case of conventional nuclear reactions, (t, p) reactions are mainly analyzed showing that a straightforward application of the zero range distorted wave theory yields angular distributions in disagreement with experiment. It has been shown that finite range or strong coupling effects might resolve this difficulty. The (t, p) reaction is used to obtain information concerning the structure of Li^9 and Ca^{42}. (Contractor's abstract)

1991

Oxford U. Dept. of Pharmacology (Gt. Brit.).

HISTORICAL INTRODUCTION: SPECIFIC INTERACTIONS BETWEEN CATECHOLAMINES AND TISSUES, by H. Blaschko. [1964] [8]p. incl. refs. (AFOSR-65-2961) (AF EOAR-62-80) AD 627851 Unclassified

Also published in Prog. Brain Research, v. 8: 1-8, 1964.

A brief review is given of the development of ideas on specificity. One of the specific sites of importance in the formation of the catechol amines is the enzyme L-dopa decarboxylase. The significance of the phenolic hydroxyl groups, of the alpha-hydrogen atom and of the amino group is discussed. These ideas concern the importance of the meta-hydroxy group and also the fact that the alpha-methyl-amino acids are decarboxylated. It is shown that the new ideas on the structure of pyridoxal enzymes are compatible with earlier pictures of the enzyme-substrate interaction. (Contractor's abstract)

1992

Oxford U. Dept. of Pharmacology (Gt. Brit.).

BENZYLAMINE OXIDASE AND HISTAMINASE: PURIFICATION AND CRYSTALLIZATION OF AN ENZYME FROM PIG PLASMA, by F. Buffoni and H. Blaschko. [1964] [16]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1297) (AF EOAR-64-12) AD 620596 Unclassified

Also published in Proc. Roy. Soc. (London), v. 161B: 153-167, 1964.

The enzyme benzylamine oxidase of pig plasma was purified and some of the properties of the pure preparation were studied. The purification procedure included several precipitations with ammonium sulphate and separations of proteins by column chromatography, first on DEAE-cellulose, followed by DEAE-Sephadex and lastly on a hydroxyapatite column. Crystals were prepared from solutions of the purified enzyme by adding ammonium sulphate. The crystalline preparation was homogeneous when studied by starch-gel electrophoresis and by ultracentrifugation. The molecular weight, as determined on the analytical ultracentrifuge, was 195,000. The copper content of the enzyme, as determined by radioactivation analysis, was about 4 atoms of Cu/molecule of enzyme. Concentrated solutions of the enzyme had a pink color; the color disappeared when substrate (benzylamine) was added under anaerobic conditions. (Contractor's abstract, modified)

1993

Oxford U. [Engineering Lab.] (Gt. Brit.).

RESEARCH ON WAVES IN ANISOTROPIC MEDIA, by H. Motz. Final technical rept. Mar. 15, 1963, 3p. (AFOSR-4754) (AF EOAR-62-62) AD 408481 Unclassified

The radiation impedance of various sources is computed

and it is shown that the average Poynting vector has the direction of the group velocity. The one dimensional problem of R-f-confinement was investigated and solved completely by analytic means. Boltzmann's equation was solved by means of dyadic Green's functions to establish a conductivity tensor valid for elevated temperatures. Temperature and collision effects in a plasma were investigated and dispersion surfaces computed. Photo-emission from a tungsten point was obtained with light from a ruby laser.

1994

Oxford U. [Engineering Lab.] (Gt. Brit.).

DIAMAGNETIC RESONANT ELECTRONIC EXCITATION OF MICROWAVES, by M. J. Lazarus. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-0417) (AF EOAR-63-33) AD 612321 Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 1075-1084, 1964.

A theoretical study has been made of the interaction of two opposing and interpenetrating streams of charged particles when subjected to a longitudinal magnetostatic field in a waveguide. The calculations have been made both classically and quantum mechanically and they show that, for two frequencies, stimulation is possible. These are of the order of $\frac{1}{2}$ x cyclotron resonance frequency, and the system is therefore promising as a generator or amplifier for very high frequencies. The practical realization of this device is discussed and a solid state version using electrons and holes in a semiconductor is suggested. (Contractor's abstract)

1995

Oxford U. Inorganic Chemistry Lab. (Gt. Brit.).

RECOMBINATION OF CHLORINE ATOMS, by J. W. Linnett and M. H. Booth. [1963] [2]p. incl. diagr. (AFOSR-64-0305) (AF EOAR-63-32) AD 434513 Unclassified

Also published in Nature, v. 199: 1181-1182, Sept. 21, 1963.

The rate of recombination of chlorine atoms has been investigated using a flow system. The atoms were produced in a microwave discharge, and the atom decay followed by means of a movable thermocouple probe at which recombination occurred. The reaction tube of 4-cm internal diameter was poisoned with boric oxide. Runs using chlorine only, and chlorine/argon mixtures, were carried out. Linear flow speeds in the range 30-250 cm/sec, and total pressures of 0.24-3 mm mercury were used.

1996

Paris U. (France).

CRYSTALLOGRAPHIC STUDY OF DOMAINS IN BARIUM TITANATE (Etude cristallographique des domaines dans le titanate de baryum), by M. Lambert, A. M. Quittet and others. [1964] [11]p. incl. illus. (AFOSR-64-2095) (AF 61(052)310) AD 451352 Unclassified

Also published in Jour. Phys., v. 25: 345-355, Mar. 1964.

The unit cell parameters of tetragonal barium titanate are generally slightly altered. However, some crystals which show a very small tetragonality have been studied: an optical and crystallographic study reveals that the ferroelectric domains are then periodically distributed, the period being proportional to the crystal thickness. This domain configuration seems to be related to the small tetragonality and can be observed in ordinary crystals when they are heated to several degrees below the ferroelectric transition temperature.

1997

Paris U. Lab. de Physique des Solides, Orsay (France).

X-RAY SCATTERING BY POINT-DEFECTS, by A. M. Levelut and A. Guinier. Final technical rept. [1964] [28]p. incl. illus. diagrs. (AFOSR-65-0060) (AF EOAR-62-51) AD 610006 Unclassified

A device is described which was designed to detect the diffuse x-ray scattering caused by point defects in a crystal. Tests concerning the sensitivity of the apparatus are summarized, as are results of its application to problems involving the degree of order in diffuse solid solutions and the effects of irradiation crystals.

1998

Paris U. [Lab. de Physique Théorique et Hautes Energies] Orsay (France).

CRITICAL POINTS OF THE FREQUENCY SURFACES IN THE SILICON CRYSTAL, by M. Balkanski, W. Nazarewicz, and E. da Silva. Sept. 15, 1963, 24p. (Technical note no. 1) (AFOSR-5429) (AF 61(052)572) AD 611144 Unclassified

The one-phonon and two-phonon infra-red absorption spectrum (10-130 μ) in silicon crystals reveals a structure due to Van Hove's critical points for frequency surfaces. From the experimental data it is possible to obtain the precise values of phonon energies for the various branches of the frequency spectrum at the following points in the reduced zone: γ (0, 0, 0), X (1, 0, 0), L(1/2, 1/2, 1/2), W(1, 1/2, 0) and σ (3/4, 3/4, 0). These results agree with a set of critical points for the symmetry properties established on the basis of theoretical, topological and group considerations.

1999

Paris U. [Lab. de Physique Théorique et Hautes Energies] Orsay (France).

SINGLE PHONON ABSORPTION BANDS IN FAST NEUTRON IRRADIATED SILICON, by M. Balkanski and W. Nazarewicz. Sept. 15, 1963, 18p. (Technical note no. 2) (AFOSR-5430) (AF 61(052)572) AD 611145 Unclassified

Theoretical considerations on the photon phonon interaction and experimental results concerning fast neutron irradiated silicon have been presented. The infrared absorption spectrum contains absorption bands at 488, 417, 332, and presumably at 140/cm attributed to a single phonon absorption process connected with the excitation of the fundamental modes, TO, LO, LA, and TA, respectively. These fundamental modes become active because of the lattice polarization bombardment.

2000

Paris U. [Lab. de Physique Théorique et Hautes Energies] Orsay (France).

SPECTROSCOPY OF POINT DEFECTS, by M. Balkanski, E. da Silva, and W. Nazarewicz. Sept. 15, 1963, 25p. (Technical note no. 3) (AFOSR-5431) (AF 61(052)572) AD 611194 Unclassified

Also published in Jour. Phys., v. 24: 451-457, July 1963. (AFOSR-64-0768; AD 438242)

The absorption spectra of such impurities as oxygen, carbon, and nitrogen are being studied in the lattice of silicon and molecular vibrations are obtained at 9 μ 12.2 μ, and 10.6 μ, respectively. High density defects created by irradiation with fast neutrons, polarize the lattice and make it possible to observe the direct photon-phonon interaction. The infrared absorption spectra due to single phonons are composed of bands at 488, 417, and 331, as well as at 140/cm, corresponding to modes TO, LO, LA, and TA, respectively. The energies of TO, for example, are determined under high resolution at the point of maximum density of modes at γ L, W, and X. They are 516.5 ± 1, 488.5 ± 1, 474 ± 1, and 447 ± 1.

2001

Paris U. [Lab. de Physique Théorique et Hautes Energies] Orsay (France).

LOCALIZED VIBRATIONS DUE TO BORON AND LITHIUM IN THE SILICON LATTICE, by M. Balkanski and W. Nazarewicz. Sept. 15, 1963, 15p. (Technical note no. 4) (AFOSR-5432) (AF 61(052)572) AD 611195 Unclassified

The infrared absorption spectrum of silicon crystals containing two electrically compensated impurities, boron and lithium, in concentrations above 10^{19}/cm reveals six absorption peaks at: 648, 657, 585, 564, 534 and 522/cm 1 attributed to localized vibrations due to those impurities.

2002

Paris U. [Lab. de Physique Théorique et Hautes Energies] Orsay (France).

STUDY OF THE OPTICAL PROPERTIES OF HIGHLY DOPED AND DEGENERATE SILICON, by M. Balkanski and J. M. Besson. Oct. 15, 1963, 16p. (Technical note no. 5) (AFOSR-5437) (AF 61(052)572) AD 611146 Unclassified

An investigation was made of the free carrier absorption, the absorption peak at 2.3 μ, and the energy shift of the fundamental absorption edge. The 2.3 μ peak was attributed to intraband transition.

2003

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

THEORETICAL STUDIES OF NUCLEON-NUCLEON INTERACTION AND FORCES, by M. Levy. Feb. 20, 1963, 3p. (AFOSR-J1370) (AF EOAR-62-10) Unclassified

Most of the work done under this grant has been directed toward following problems: (1) High Energy Interactions of nucleons and anti-nucleons, (2) Application of models to the theory of scattering, (3) Weak interactions, and (4) The Many-body problem.

2004

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

ON THE THEORY OF CLASSICAL FLUIDS. III, by L. Verlet. Mar. 1963, 15p. incl. tables. (Technical note no. 9) (AFOSR-4767) (AF EOAR-63-47) AD 407167 Unclassified

Also published in Physica, v. 30: 95-104, 1964.

It is shown that Percus' method can be used to write down explicitly integral equations for the two-body correlation function which generalizes the PY and HNC equation. A first test of the fitness of such equations was given in the case of the hard cube gas. Further information will be provided in a future paper where the equations given in the present paper will be applied to the case of the lattice gas.

2005

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

INTERPLAY OF COMPETING RESONANCES, by B. d'Espagnat and F. M. Renard. May 1963, 27p. incl. diagrs. (Technical note no. 10) (AFOSR-5053) (AF EOAR-63-47) AD 415450 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 536-550, Oct. 16, 1963.

Final state interactions in the $\theta_1 + \theta_2 + N$ system with the possibility of the reactions $\theta_1 + N \rightleftharpoons V_1$ and $\theta_2 + N \rightleftharpoons V_2$ are studied. An integral equation and a variational method for approximating it are examined. Interesting "succion" effects of one resonance on the other are obtained. (Contractor's abstract)

2006

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

EIGHTFOLD WAY AND WEAK INTERACTIONS, by M. Gourdin. May 1963, 23p. incl. tables. (Technical note no. 11) (AFOSR-5054) (AF EOAR-63-47) AD 414646 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 587-602, Oct. 16, 1963.

The octet model is generalized to include the weak interactions. It turns out that the more simple solution is an eight-fold way based on the orthogonal group in an eight-dimensional space SO(8). The mathematical structure of the inclusion between the algebra of the unitary group and the algebra of the orthogonal group is studied. The reduction under uritary transformation of the irreducible representations of the orthogonal group is examined and it can be shown that the orthogonal SO(6) group can generalize the octet model but not the triplet model.

2007

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

THE COLLECTIVE VIBRATIONS OF A MANY-FERMION SYSTEM, by B. Jancovici and D. H. Schiff. [1964] [9]p. incl. refs. (AFOSR-65-0629) (AF EOAR-63-47) AD 600266 Unclassified

Also published in Nuclear Physics, v. 58: 678-666, 1964.

The energy levels of a many-fermion system are investigated through an extension of the generator coordinate method of Peierls-Yoccoz and Wheeler-Griffin. A trial wave function Ψ for the system is taken as a superposition $\Psi = \int F(z)\, \Phi(z)\, dz$ of all possible independent particle wave functions Φ in the neighborhood of the Hartree-Fock ground-state wave function Φ_0; the functions Φ depend on many parameters z. An integral equation is established for the generator function F(z). Through appropriate approximations, this integral equation is transformed into the Schrödinger equation for a set of coupled harmonic oscillators, which can be solved. The energies and wave functions are obtained for the ground state and the low excited states of the system. The present approach is equivalent to the random phase approximation. (Contractor's abstract)

2008

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

NON-LOCAL QUANTUM ELECTRODYNAMICS, by M. Levy. [1964] [39]p. incl. diagrs. refs. (AFOSR-65-0830) (AF EOAR-63-47) AD 600265 Unclassified

Also published in Nuclear Phys., v. 57: 152-190, 1964.

A gauge invariant non-local form of quantum electrodynamics is constructed by introducing, in the interaction Lagrangian, averages of the Dirac field operators over time-like paths. It is shown that this theory leads to convergent results to every order of perturbation theory. Observable quantities are averaged subsequently over all possible time-like paths. The theory contains a finite renormalization of the photon mass which does not conflict with gauge invariance. The experimental requirement that the physical mass of the photon should vanish corresponds to an additional condition, imposed by the parameters of the theory.

2009

Paris U. Lab. de Physique Théorique et Hautes Energies, Orsay (France).

INTEGRAL EQUATION FOR CLASSICAL FLUIDS AND THE LATTICE GAS, by D. Levesque and L. Verlet. [1964] [2]p. incl. refs. (AFOSR-65-0831) (AF EOAR-63-47) AD 632222 Unclassified

Also published in Phys. Ltrs., v. 11: 36-37, July 1, 1964.

Various integral equations have been proposed recently to calculate the two-body correlation function of classical fluids. One of them, the so-called hypernetted chain (HNC) equation, may be obtained either by summing the terms of the cluster expansion of the correlation function which involve only convolution integrals or by a new approximation scheme introduced by Percus. In order to gain more insight on these equations, they were applied to the lattice gas with an interaction with the nearest neighbors.

2010

[Paris U.] Lab. de Physique Théorique et Hautes Energies, Orsay (France).

THE RICCATI EQUATION AND REGGE POLES, by K. Chadan and J. Y. Guennegues. [1964] [25]p. incl. diagrs. refs. (AFOSR-65-1756) (AF EOAR-63-47) AD 625355 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 665-689, Nov. 1, 1964.

The Schrödinger equation with a central potential is transformed into a Riccati equation by the methods of the theory of ordinary differential equations. The equation is chosen in such a way that its solution, in the limit $r \to \infty$, gives the scattering amplitude. By studying the analyticity of the solution and of its limit, information can be obtained on the domains in energy and angular momentum where poles cannot lie. As it is shown, the limitations obtained on the location of Regge poles are very severe. For usual superpositions of Yukawa potentials, poles in the λ-plane must lie in small finite domains for all energies in a large region of the complex plane. In particular, this region includes the whole real positive energy axis. As a result, dispersion relations in momentum transfer need at most a finite number of subtractions. Finally, the amplitude is shown to vanish when λ goes to infinity in the entire right-hand half-plane, including the imaginary axis.

2011

Parma U. Inst. of Human Physiology (Italy).

PHYSIOLOGY OF CENTRAL VISUAL PATHWAYS, by A. Arduini. Final rept. Dec. 31, 1964 [24]p. incl. diagrs. table, refs. (AFOSR-65-0873) (AF EOAR-64-38) AD 617572 Unclassified

The lateral geniculate nucleus and the visual cortex have been considered on the basis of the linear systems theory. An attempt has been made at determining their transfer functions in conditions of retinal dark adaptation and under stimulation with steady, diffuse, white light of different intensity. The experiments have been conducted in cats under barbiturate anesthesia, by monitoring activity in the input and output fiber tracts to these structures with both micro- and gross-electrodes.

2012

Parma U. Inst. of Human Physiology (Italy).

[RECORDING ACTIVITY IN THE CENTRAL VISUAL PATHWAYS] Registrazione dell'attività nelle vie ottiche centrali, by A. Arduini and G. Rizzolatti. [1964] [4]p. (AFOSR-65-2967) (AF EOAR-64-38) Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 885-888 [1964].

Activity in the retinogeniculate, geniculocortical, and corticothalamic pathways has been compared in cats with mid-pontine, and rostro-pontine pretrigeminal sections. An electrode was inserted into the optic chiasma and used to stimulate the cat with rectangular impulses. Evoked responses were recorded with a bipolar electrode consisting of two 0.1 mm diameter copper wires in an uninsulated 0.5 mm diameter steel tube. Evoked potentials in the corticifugal pathways not previously recorded with macroelectrodes were recorded with this electrode. The authors have shown that it is possible to record activity in the corticothalamic and thalamocortical projections selectively when the activity is represented as a discharge of impulses, rather than as evoked potentials.

2013

Pennsylvania State U. [Dept. of Biology] University Park.

THE EFFECT OF CAROTENOID PIGMENTS ON PHOTOOXIDATIONS OF SOME PHOTOSYNTHETIC BACTERIA, by L. A. Feldman and E. S. Lindstrom. [1964] [7]p. (AFOSR-64-1649) (AF AFOSR-62-263) AD 449976 Unclassified

Also published in Biochim. et Biophys. Acta, v. 79: 266-272, 1964.

The photooxidase activity of normal and carotenoidless mutants of Rhodopseudomonas spheroides and Rhodospirillum rubrum were compared. With Rhodopseudomonas, carotenoids were shown to act as accessory pigment in indophenol photooxidation. The lack of carotenoids resulted in a greater specific activity of the photooxidase system. In Rhodopseudomonas, carotenoids apparently function as an accessory pigment and as a buffer for the photooxidant. With Rhodospirillum, no accessory pigment function could be demonstrated in indophenol photooxidation, and the absence of carotenoids did not result in an increased photooxidase activity.

2014

Pennsylvania State U. Dept. of Chemistry, University Park.

STEREOCHEMICAL EVIDENCE FOR BRIDGED RADICALS. PHOTOBROMINATION OF CIS- AND TRANS-4-BROMO-T-BUTYLCYCLOHEXANE, by P. S. Skell and P. D. Readio. [1964] [4]p. incl. refs. (AFOSR-66-1036) (AF 49(636)457) AD 635642 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 66: 3334-3337, 1964.

Photobromination of cis-4-bromo-t-butylcyclohexane (I) is a highly selective reaction, yielding trans-3-cis-4-dibromo-t-butylcyclohexane (II). By contrast, trans-4-bromo-t-butylcyclohexane is considerably less reactive and less selective to attack by bromine atoms. These results are interpreted in terms of bromine assistance in the transistion state and a bridged radical intermediate which opens in accord with the "diaxial rule." This neighboring group effect is operative only with a neighboring axial bromine. (Contractor's abstract)

2015

Pennsylvania State U. Dept. of Chemistry, University Park.

THE FREE-RADICAL ADDITION OF DEUTERIUM BROMINE TO CIS- AND TRANS-1-DEUTERIO-1-HEXENE, by P. S. Skell and P. K. Freeman. [1964] [3]p. incl. refs. (AFOSR-66-1039) (AF 49(636)457) AD 635639 Unclassified

Also published in Jour. Org. Chem., v. 29: 2524-2526, 1964.

The radical-chain addition of deuterium bromide to a terminal olefin, 1 deuterio-1-hexene, is a stereospecific reaction.

2016

Pennsylvania State U. Dept. of Chemistry, University Park.

STEREOSPECIFIC TRANS PHOTOADDITION OF ELEMENTARY IODINE TO ALIPHATIC OLEFINS. BRIDGED IODOALKYL RADICALS, by P. S. Skell and R. R. Pavlis. [1964] [1]p. incl. diagrs. (AFOSR-66-1042) (AF 49(636)457) Unclassified

Also published in Jour. Amer. Chem. Soc., v. 66: 2956, 1964.

Elementary iodine adds readily under illumination to 1-butene, the 2-butenes, and isobutene at -40° to produce colorless crystalline diiodides. The additions are stereospecific trans. Bridged structures have been assigned to the iodoalkyl radical intermediates.

2017

Pennsylvania State U. [Dept. of Chemistry] University Park.

PHYSICAL PROPERTIES OF ISOTOPICALLY SUBSTITUTED FLUIDS, by W. A. Steele. Jan. 21, 1964 [9]p. incl. illus. tables. (AFOSR-64-1417) (AF AFOSR-61-27) AD 604468 Unclassified

The work consisted essentially in the design and construction of a low temperature, high pressure density balance and the associated equipment for the precise measurement and control of temperature and pressure. Some work was also done on the problem of purification of the gases to be used in the balance. A balance was constructed which appears to have the desired performance. The report is primarily concerned with a description of this apparatus and the problems met in its design and construction.

2016

Pennsylvania State U. Dept. of Chemistry, University Park.

POLARIZATION OF NEAR ULTRAVIOLET ABSORPTION AND PHOSPHORESCENCE OF AROMATIC KETONES, by V. G. Krishna. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0690) (AF AFOSR-62-39) AD 615696 Unclassified

Also published in Jour. Molec. Spectros., v. 13: 296-304, July 1964.

Polarizations of the phosphorescence ($T_1 \rightarrow S_0$) relative to the lowest $\pi^* \leftarrow n$ and $\pi^* \leftarrow \pi$ absorption have been investigated in acetophenone, benzophenone, and anthrone. The results indicate that the lowest triplet state is an (n, π^*) state, the lowest singlet state is a ^1U state, and that the lowest (π, π^*) state can be described analogous

to ^1L_b state in aromatic hydrocarbons. The $^1U \leftarrow {}^1A$ transition is allowed by the mixing of the ^1U state with (π, π^*) state of A_1 symmetry. In acetophenone and benzophenone the mixing of ^1U with ^1W also contributes to the $^1U \leftarrow {}^1A$ transition probability.

2019

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

MECHANISM OF FATIGUE IN CLOSE PACKED CRYSTALS, by M. A. Wilkov. Oct. 1963 [34]p. incl. illus. refs. (AFOSR-J1364) (AF AFOSR-62-273) AD 426562 Unclassified

Face-centered cubic materials of high and low stacking fault energy were fatigued at both room temperature and liquid nitrogen temperature. Observation of the mode of crack formation, using the electron microscope together with a process of successive replication, showed that the fatigue crack begins as a series of surface cavities which propagate and join to form a microcrack. Application of low temperature did not change this basic behavior except to make the cavity formation process more discrete and bear a closer resemblance to the void formations observed in high temperature creep. Such void formations have been attributed to a process of vacancy condensation. Based upon this observation, a low-temperature fatigue mechanism was proposed which utilizes the dislocation to sweep up point defects, created by the non-conservative motion of dislocation jogs, and deposit them on suitable nuclei on the external surface to form voids.

2020

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

ELASTIC-PLASTIC RESPONSE OF A SLAB TO A HEAT PULSE, by Y.-C. Lee and W. Jaunzemis. Mar. 1963, 155p. incl. diagrs. tables, refs. (Technical rept. no. 6) (AFOSR-4939) (AF AFOSR-63-128) AD 405691; AD 414201 Unclassified

The objective of the present study is to establish thermodynamically valid, non-isothermal stress strain relations for the elastic-plastic range, and to obtain solutions of typical one-dimensional problems involving unsteady temperatures. The entropy balance equation and the expression for production of internal entropy are considered. The limitations imposed by the second law of thermodynamics upon plastic flow rules are investigated, and a set of non-isothermal plastic stress strain relations is introduced. It is shown that these relations are in accord with thermodynamic irreversibility whenever the yield criteria of Tresca and von Mises are used. The stress strain relations of von Mises are a special case of the non-isothermal stress strain relations proposed here. Precise criteria for elastic loading and repeated plastic flow are presented, thus completing the characterization of the elastic-plastic response. The second part is concerned with an application of the general theory to a problem for the infinite half-space constrained against lateral motion, and subjected to a heat pulse uniformly applied over its boundary.

2021

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

DIRECT OBSERVATIONS OF FATIGUE INDUCED DEFORMATION FAULTING IN THIN FOIL STAINLESS STEEL, by L. E. Murr and P. J. Smith. Final scientific rept. Jan. 1-Dec. 31, 1963. May 1964, 53p. incl. illus. diagrs. refs. (AFOSR-64-1004) (AF AFOSR-63-165) AD 602797 Unclassified

A study was made by transmission electron microscopy of thin foils of 304 stainless steel fatigued external to the electron microscope in reversed bending, and of thin foils fatigued directly within the microscope in alternating tension. The build-up of slip deformation striations and stacking faults in the thin foils during fatigue was correlated with the dislocation structures found in thin films prepared from fatigued bulk specimens. The performance of the special devices designed for fatigue of thin foils so outlined, and the importance of alternative methods of preparation of more uniform fatigue specimens by vapor deposition is emphasized. (Contractor's abstract)

2022

Pennsylvania State U. [Dept. of Engineering Mechanics] University Park.

A COMPARISON OF DISLOCATION ARRANGEMENTS IN STAINLESS STEEL FOILS, by L. E. Murr. [1964] [6]p. incl. illus. refs. (AFOSR-64-2241) (AF AFOSR-63-165) AD 452311 Unclassified

Also published in Appl. Materials Research, July 1964, p. 153-156.

The present work is an investigation of dislocation arrangements in thin metal foils produced by the direct deformation of the material inside and external to the electron microscope. The techniques employed demonstrate the feasibility of thin foil research, and the application of thin foil research to the dynamic analysis of deformation mechanisms in metals. With the present techniques, it is possible to observe directly deformation induced dislocation arrangements and to follow the change of events in imperfection arrangements and to follow the change of events in imperfection structure as the mode and frequency of deformation are altered.

2023

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

A CONTINUOUSLY PUMPED ULTRA-HIGH VACUUM-SORPTION SYSTEM FOR THE PREPARATION OF

HIGHLY ORDERED SINGLE-CRYSTAL METAL FOILS, by L. E. Murr. [1964] [6]p. incl. illus. diagrs. table. (AFOSR-65-0279) (AF AFOSR-63-165) AD 611612 Unclassified

Also published in Brit. Jour. Appl. Phys., v. 15: 1511-1515, 1964.

A simple sorption-type ultra-high vacuum system has been devised in which thin metal foils can be prepared quickly, with perfection and measurable reproducibility. Ultimate vacuum of 3×10^{-10} torr had been obtained using liquid nitrogen around the sorption, and evaporation chambers. Ultimate vacuum of 3×10^{-9} torr has been routine prior to evaporation of gold, silver, copper, and nickel foils which ranged in thickness from 500-2000 A. High purity single crystal silver foils have been repeatedly prepared in this system which are suitable for direct analysis of deformations by transmission electron microscopy. A comparison is made between the order and quality of these ultra-high vacuum prepared foils with foils prepared using commercially available high vacuum equipment. (Contractor's abstract)

2024

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

A LOW-TEMPERATURE FATIGUE TESTING MACHINE, by M. A. Wilkov and L. E. Murr. [1964] [3]p. incl. illus. diagr. (AFOSR-65-0280) (AF AFOSR-63-165) AD 611611 Unclassified

Also published in Materials Research and Standards, v. 4: 285-287, June 1964.

The machine is described as an extremely versatile mechanical system. The strain amplitude is adjustable over a wide range of measurable values, and the operating frequency is independent of the stress amplitude. Specimens can be fatigued in any liquid environment by the direct immersion of the specimen gripping section. A simple double-Dewar cryostat is used to contain a coolant that provides the low-temperature environment. The basic elements of the testing machine are an eccentric electric motor driving unit, a machined stainless-steel body, and a set of adjustable specimen grips.

2025

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

DYNAMIC ANALYSIS OF METALLIC DEFORMATION BY TRANSMISSION ELECTRON MICROSCOPY, by L. E. Murr. [1964] [18]p. incl. illus. diagrs. refs. (AFOSR-65-2476) (AF AFOSR-63-165) AD 627977 Unclassified

Also published in Proc. Pennsylvania Acad. Sci., v. 38: 126-143, 1964.

The paper describes techniques which enable thin metal foils to be deformed directly, and immediately observed in the electron microscope. The advantages of these dynamic testing methods are discussed, and typical observations of deformation as a result of fatigue, impact, and contact stressing are presented. Some consideration is also given to the theoretical interpretation of the imaging of defects by transmission electron microscopy. Selected area electron diffraction techniques are also employed to investigate the mechanism of contact stress fracture, which is directly observed in the electron microscope.

2026

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

EXPERIMENTAL AND ANALYTICAL STUDIES IN THEORY OF PLASTICITY WITH HYDROSTATIC STRESS EFFECT, by L. W. Hu. Final rept. Nov. 1, 1963-Oct. 31, 1964. Nov. 23, 1964, 5p. (AFOSR-64-2411) (AF AFOSR-64-127) Unclassified

Accomplishments and progress are reported on the following 4 phases of the grant: (a) triaxial stress experiments on yield conditions of metals, (b) instrumentation for high pressure experiments, (c) plastic analysis of anisotropic plates, and (d) optimum weight design of pressure vessels for nuclear power reactors.

2027

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

PLASTIC ANALYSIS OF ORTHOTROPIC CIRCULAR PLATES, by J. Markowitz and L. W. Hu. [1964] [42]p. incl. diagrs. (AFOSR-64-2463) (AF AFOSR-64-127) AD 453741 Unclassified

Also published in Jour. Eng. Mech. Div., Proc. Amer. Soc. Civil Engineers, v. 90: 251-292, Oct. 1964.

The method of limit analysis is used to determine the load-carrying capacities of thin orthotropic circular plates composed of rigid-perfectly plastic material. It is assumed that the principal axes of anisotropy coincide at all points with the principal axes of stress and that the material obeys the modified Tresca yield condition and its associated flow rules. Investigation is restricted to rotationally symmetric types of loading and support. Design charts for ten loading conditions are constructed and an example is presented illustrating their use in the design of a pressure vessel head.

2028

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

TENSILE PLASTIC STRESS-STRAIN RELATIONS OF 2017-T4 ALUMINUM ALLOY UNDER HYDROSTATIC PRESSURE, by L. W Hu and H. E. Shull. [1964] [2]p. incl. diagrs. table. (AFOSR-64-2464) (AF AFOSR-64-127) AD 453828 Unclassified

Also published in Jour. Appl. Mech., Sept. 1964.

For the aluminum alloy 2017-T4 tested in tension under hydrostatic pressures up to 50,000 psi, the following conclusions can be made: (1) The presence of hydrostatic pressure has no apparent effect on the strain-hardening coefficient n and the strength coefficient k of the tensile plastic stress-strain relations. (2) The necking of the specimen at fracture became more localized as the superimposed hydrostatic pressure increased. (3) The diameter at the neck of fractured specimens decreased as the intensity of hydrostatic pressure increased. Such variation was found to follow a linear relationship. (4) The reduction in area at fracture increased as the intensity of pressure increased.

2029

Pennsylvania State U. Dept. of Engineering Mechanics, University Park.

BASIC STUDY OF DISPERSION HARDENING FOR THE ATTAINMENT OF HIGH TEMPERATURE STRENGTH IN MATERIALS, by M. C. Inman, L. E. Murr, and P. J. Smith. Dec. 1964 [22]p. incl. illus. diagrs. tables. (AFOSR-64-2508) (AF AFOSR-64-669) AD 610393 Unclassified

Electron microscope studies of the substructure of nickel strengthened by dispersed particles of thoria were made. The particle size distribution of thoria in the 'as received' material was determined from electron transmission micrographs of thin films, as a basis for future studies of the effect of temperature upon size distribution and bulk strength. In addition, a color photography technique was developed which will be employed in studies of dispersed particles..

2030

[Pennsylvania State U. Dept. of Mathematics, University Park]

SOME PROPERTIES OF HARMONIC FUNCTIONS GENERATED BY THE BERGMAN-WHITTAKER OPERATOR, by J. Cima. [1963] [25]p. incl. refs. (AFOSR-65-0089) (AF AFOSR-62-59) AD 455926 Unclassified

Also published in Ann. Mat. Pura Appl., v. 63: 175-199, 1963.

Properties of singular curves of harmonic functions generated by the Bergman-Whittaker operator are discussed and an analogue of the Eisenstein theorem for a certain class of such harmonic functions is obtained. (Contractor's abstract)

2031

Pennsylvania State U. Dept. of Physics, University Park.

NUMERICAL CALCULATIONS OF REFLECTION COEFFICIENTS FOR DIFFERENT SURFACE POTENTIAL BARRIER MODELS, by P. H. Cutler, J. C. Davis, and J. J. Gibbons. [1963] [6]p. incl. diagr. table, refs. (AFOSR-J575) (AF AFOSR-61-100) AD 408017 Unclassified

Also published in Phys. Stat. Solidi, v. 3: K113-K118, 1963.

This note reports some results of numerical computations on the elastic scattering of slow electrons from different models of the surface potential barrier.

2032

Pennsylvania State U. [Dept. of Physics] University Park.

REFLECTION AND TRANSMISSION OF ELECTRONS THROUGH SURFACE POTENTIAL BARRIERS, by P. H. Cutler and J. C. Davis. Aug. 5, 1963, 21p. (AFOSR-64-1219) (AF AFOSR-61-100) AD 442847 Unclassified

Also published in Surface Sci., v. 1: 194-212, 1964.

A numerical treatment has been made of the reflection properties of several 1-dimensional surface potential barrier models. Curves of reflection coefficient vs energy have been obtained for the classical image barrier, the modified or corrected image barrier and the Bardeen potential in both the zero and finite field cases. For zero field, the smoothly varying Bardeen potential yields smaller reflection except for energies close to zero. This result suggests that the presence of the discontinuous derivative in the potential function introduces spurious reflection. There is no appearance of the elastic scattering component found in low-energy electron diffraction for any of the 1-dimensional models investigated. With fields, the curves are qualitatively similar except near the barrier maximum. However, for incident energies above the barrier, the image and modified image are larger in magnitude than the Bardeen model. The present treatment is compared with a recent numerical computation of the periodic deviations in the Schottky effect.

2033

Pennsylvania State U. [Dept. of Physics] University Park.

THE EFFECT OF CORRELATION ON THE SURFACE POTENTIAL OF A FREE ELECTRON METAL, by T. L. Loucks and P. H. Cutler. [1964] [9]p. (AFOSR-64-1220) (AF AFOSR-61-100) AD 442925 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 105-113, 1964.

A one-electron Hamiltonian including correlation corrections is derived using the Bohm-Pines formalism. The total energy of the system is found using a product wave function of a plasmon ground state and a Slater determinant of one-electron wave functions. From this

one-electron Hamiltonian with correlation is developed and applied to the calculation of the electronic potential energy in the surface region of a free electron metal. One term is the usual exchange integral except for the appearance of a screening factor. The screened exchange potential is evaluated in the surface and interior of the metal for several values of the screening parameter and for two different forms of the screening factor. It is found that the effect of correlation is to raise the one-electron potential energy but that the general shape near the surface remains similar to that found by Juretschke.

2034

Pennsylvania State U. [Dept. of Physics]
University Park.

BAND STRUCTURE AND FERMI SURFACE OF BERYLLIUM, by T. L. Loucks and P. H. Cutler. [1964] [11]p. (AFOSR-64-1221) (AF AFOSR-61-100) AD 442848
Unclassified

Also published in Phys. Rev., v. 133: A819-A829, Feb. 3, 1964.

Using a self-consistent potential, the energy eigenvalues along the symmetry edges, on the zone faces, and at the equivalent of 5164 general points in the first Brillouin zones were calculated for beryllium by expanding the conduction electron wave functions in a linear combination of 23 orthogonalized plane waves. From this the Fermi energy and density of states were calculated and the Fermi surface constructed.

2035

Pennsylvania State U. [Dept. of Pbysics]
University Park.

FURTHER RESULTS ON THE FERMI SURFACE OF BERYLLIUM, by T. L. Loucks. [1964] [3]p. (AFOSR-64-2167) (AF AFOSR-61-100) AD 451734
Unclassified

Also published in Phys. Rev., v. 134: A1618-A1620, June 15, 1964.

Tbe conduction eigenvalues for beryllium at the equivalent of over 80,000 points in the first Brillouin zone (all in the immediate vicinity of the Fermi surface) were calculated. The constant energy surfaces were constructed for several values of the energy near the Fermi energy. Tbe hole and electron volumes were calculated for each case, and the Fermi energy was determined by the requirement that the two volumes be equal. This is the first time that this well-known result has actually been used to determine the Fermi energy in a band calculation. The corresponding Fermi surface was defined by about ten cross sections perpendicular to the (0001) direction. The agreement between these results and experiment is generally good and slightly improved over the previous results.

2036

Pennsylvania State U. [Dept. of Physics]
University Park.

ULTRASONIC ATTENUATION IN THIN FILMS (Abstract), by W. L. Ghering. [1963] [1]p. (AFOSR-65-1607) (AF AFOSR-63-43)
Unclassified

Presented at Sixty-sixth Meeting of the Acoust Soc. Amer., Ann Arbor, Mich., Nov. 6-9, 1963.

Also published in Jour. Acoust. Soc. Amer., v. 35: 1882, Nov. 1963.

When the physical shape of a liquid approaches a thin film, the surface tension and configuration effects are predominant in influencing the loss factor. In this paper the effective loss factor of a number of liquids and semi-solid substances is measured for various film thicknesses. The data show the effect of film thickness on the loss factor and the effectiveness of the substance for ultrasonic damping. Tbe arrangement employed uses parallel-mounted quartz crystals in tuned circuits. The system is excited to resonance by a pulse and the response and decay of the system are recorded. By means of energy considerations, the effective loss factor of the sample is determined.

2037

Pennsylvania State U. Dept. of Physics,
University Park.

MEASUREMENT OF ULTRASONIC ATTENUATION IN SOLIDS BY A REVERBERATION TECHNIQUE (Abstract), by J. N. Lange. [1963] [2]p. (AFOSR-65-1608) (AF AFOSR-63-43)
Unclassified

Presented at Sixty-sixth meeting of the Acoust. Soc. Amer., Ann Arbor, Mich., Nov. 6-9, 1963.

Also published in Jour. Acoust. Soc. Amer., v. 35: 1883-1884, Nov. 1963.

A technique, similar to the method of measurement of reverberation times in arcbitectural acoustics, is investigated to provide accurate measurements of ultrasonic attenuation in solids. Sound is introduced into the specimen through a quartz transducer excited by an rf pulse. The radio frequency of the pulse is warbled and the pulse duration is longer than the amount of time that it takes for the initial wavefront to travel to one of the reflecting surfaces of the specimen. Preliminary measurements indicate a loss factor for aluminum approximately ten times less than previously measured, due to the absence of any apparent attenuation due to grain scattering.

2038

Pennsylvania State U. Dept. of Physics,
University Park.

SEARCH FOR HIGH-Q LIQUID-FILLED SYSTEMS

(Abstract), by M. M. Simon. [1963] [1]p. (AFOSR-65-1609) (AF AFOSR-63-43) Unclassified

Presented at Sixty-sixth Meeting of the Acoust. Soc. Amer., Ann Arbor, Mich., Nov. 6-9, 1963.

Also published in Jour. Acoust. Soc. Amer., v. 35: 1898, Nov. 1963.

The bulk modulus and its associated loss factor for small viscoelastic specimens can be determined by placing the sample at a velocity node of a liquid-filled system. The Q of this system must be high in order to obtain accurate results. Thus, to develop systems of high Q with the aim in mind of eventually measuring the Q of test specimens, the frequency response and Q of several systems are determined, including tubes and spheres of metal or glass containing liquids of various viscosity and density.

2039

Pennsylvania State U. Dept. of Physics, University Park.

MEASUREMENT OF HIGH-Q RESONANCES IN LIQUID-FILLED SPHERES (Abstract), by M. [M.] Simon. [1964] [1]p. (AFOSR-65-1610) (AF AFOSR-63-43) Unclassified

Presented at [Sixty-eighth] Meeting of the Acoust Soc. Amer., Austin, Tex., Oct. 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36: 2000, Oct. 1964.

In order to measure the Q factor of a small solid specimen, a high-Q liquid-filled system must be obtained. In this paper, a successful method is presented for exciting the radial modes of a water-filled sphere suspended in a vacuum. A small barium titanate crystal is cemented to the end of a brass tube and placed at the center of the sphere. Using this crystal for both driving and receiving, Q's as high as 72,000 are obtained for several resonances in two water-filled spheres of different wall thickness and diameter. Small samples are placed at the center, and changes in the Q are measured.

2040

Pennsylvania State U. [Dept. of Physics] University Park.

HIGH-Q QUARTZ-CRYSTAL SYSTEM FOR USE IN ABSORPTION MEASUREMENTS (Abstract), by W. L. Ghering. [1964] [1]p. (AFOSR-65-1611) (AF AFOSR-63-43) Unclassified

Presented at [Sixty-eighth] Meeting of the Acoust. Soc. Amer., Austin, Tex., Oct. 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36: 2000, Oct. 1964.

A high-Q resonant system employing an X-cut quartz crystal is devised for use in absorption measurements of small samples. To determine the constants of the system, the Q of the system is measured under various clamping and loading conditions. The clamping losses are determined by comparing the system Q to the crystal Q in free fall in a vacuum. The system Q is found to be mainly a function of the clamping losses, and various supporting methods are investigated. System Q's in the order of 800,000 are obtained allowing the detection of the damping effect of a small sample or thin film.

2041

Pennsylvania State U. Dept. of Physics, University Park.

PULSE PROPAGATION IN CYLINDERS AT THE LOWER ULTRASONIC FREQUENCIES (Abstract), by J. N. Lange. [1964] [1]p. (AFOSR-65-1613) (AF AFOSR-63-43) Unclassified

Presented at [Sixty-eighth] Meeting of the Acoust. Soc. Amer., Austin, Tex., Oct. 1964.

Also published in Jour. Acoust. Soc. Amer., v. 36: 2000, Oct. 1964.

The presence of mode conversion at the lower ultrasonic frequencies of wave propagation in a cylinder is not presently understood. This paper discusses the origin of mode conversion and its relation to the end resonances as derived by McNiven. The roots of the Pochhammer-Chree frequency equation are reviewed critically with these phenomena.

2042

Pennsylvania State U. [Dept. of Physics] University Park.

FERMI STATISTICS OF TWO-DIMENSIONAL FREE-ELECTRON SYSTEMS, by J. P. McKelvey and E. F. Pulver. [1964] [13]p. (AFOSR-65-0174) (AF AFOSR-63-73) AD 611497 Unclassified

Also published in Amer. Jour. Phys., v. 32: 749-761, Oct. 1964.

The variation of the Fermi energy with temperature and free-particle concentration is calculated analytically for a number of two-dimensional systems, including the free-particle gas, the intrinsic semiconductor and the impurity semiconductor. The Fermi energy as a function of temperature and concentration is in some cases calculated in closed form, while in other it is obtained implicitly as the solution to a fairly simple transcendental equation. The physical significance of the variation of Fermi energy as a function of temperature and concentration is discussed, and the deviation of the product of the concentration of free electrons and holes for the two-dimensional semiconductor from the Boltzmann mass-action result is calculated and discussed in detail.

2043

Pennsylvania State U. [Dept. of Physics]
University Park.

HIGH-TEMPERATURE TRANSITIONS IN RARE-EARTH NIOBATES AND TANTALATES, by V. S. Stubican. [1964] [4]p. (Rept. no. C-62-63) (AFOSR-64-1225) (AF AFOSR-63-208) AD 442810 Unclassified

Also published in Jour. Amer. Ceram. Soc., v. 47: 55-58, Feb. 1964.

The high-temperature transition monoclinic/tetragonal in the rare-earth tantalates and niobates with the formula ABO_4 was investigated using a high-temperature x-ray diffractometer. The transition was reversible and proceeded by a gradual change in symmetry. The temperature of the first appearance of the tetragonal phase increased as the ionic size of the rare-earth ions decreased and was considerably higher for the rare-earth tantalates than for the rare-earth niobates. The mechanism of the change is discussed.

2044

Pennsylvania State U. [Dept. of Physics]
University Park.

THE USE OF A NEW SURFACE POTENTIAL MODEL IN THE THEORY AND FIELD EMISSION, by D. Nagy and P. H. Cutler. [1964] [2]p. (AFOSR-64-1779) (AF AFOSR-63-213) AD 449047 Unclassified

Also published in Phys. Ltrs., v. 10: 263-264, June 15, 1964.

The effect of a modified surface potential barrier on the emitted current in the field emission regions was studied. The resulting current density curve exhibits the same high field deviations found experimentally. The model of the surface barrier is the same used by Cutler and Gibbons in their recent work on the theory of the thermionic periodic deviations in the Schottky effect. The potential is essentially a quantum modification of the classical image force and is based on quantum mechanical calculations of the electronic potential in the surface region of a metal.

2045

Pennsylvania State U. [Field Emission Lab.]
University Park.

BOMBARDMENT OF TUNGSTEN WITH 20-KEV HELIUM ATOMS, by M. K. Sinha and E. W. Muller. [1964] [6]p. (AFOSR-64-1212) (AF AFOSR-62-96) AD 443018 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1256-1261, Apr. 1964.

Fast He atoms are shot into one side of the tungsten emitter tip of a field ion microscope, and the resulting damage to the surface, consisting of vacancies, interstitials, and their clusters, is observed in atomic resolution. About one-half of the number of atoms calculated to have received a displacement energy of 50 ev in the interior appear as surface defects. The surface integrates the damage by focusing collisions coming from as deep as 1000 A. Stress enhanced mobility of subsurface interstitials is detectable at 21°K, and rapid thermal diffusion from the depth occurs at 90°K.

2046

Pennsylvania State U. [Field Emission Lab.]
University Park.

FIELD ION MICROSCOPY OF RHENIUM, by E. W. Muller. [1964] [2]p. incl. illus. (AFOSR-65-0778) (AF AFOSR-62-96) AD 617834 Unclassified

Also published in Proc. Third European Regional Conf. on Electron Microscopy, Prague (Czechslovakia), 1964 p. 161-162.

This note examines the ion microscopic image of rhenium. Features of the ion image discussed are the evaporation field at 20°K, the intensity alternation of net plane rings around the 0001 pole, the decoration by the bright atoms of six [21$\bar{1}$0] zone lines emerging radially from the 0001 plane, the existence of a high dislocation density in a concentric area 20 to 30° off the c-axis, and the adsorption of residual gas. Illustrations of ion images of rhenium are presented.

2047

Pennsylvania State U. [Field Emission Lab.]
University Park.

THE EFFECT OF POLARIZATION, FIELD STRESS, AND GAS IMPACT ON THE TOPOGRAPHY OF FIELD EVAPORATED SURFACES, by E. W. Muller. [1964] [11]p. incl. illus. refs. (AFOSR-65-0780) (AF AFOSR-62-96) AD 617242 Unclassified

Also published in Surface Sci., v. 2: 484-494, 1964.

Field evaporation of pure metals can produce highly perfect surfaces. The field evaporation end form is established by balancing the local field at the evaporation site with the binding energy of the evaporating metal atom. A considerable part of this energy is due to polarization which can be described by field penetration rather than by the polarizability of the free atom. Polarization also stabilizes characteristic low-coordination sites. In several metals the field stress causes specific lattice defects. The field evaporation end form is further modified by the presence of the imaging gas when the molecules effectively transfer their dipole attraction energy in the collision with surface atoms. (Contractor's abstract)

2048

Pennsylvania U. [Dept. of Linguistics] Philadelphia.

ON ENGLISH PRONOUNS AND THEIR VERBAL

AGREEMENT, by A. F. Brown. Sept. 1963, 32p. (AFOSR-64-0948) (AF AFOSR-64-477) AD 600220 Unclassified

An attempt is made to cover all the crucial environments and to set up a minimal but sufficient number of morphemic components to account for the occurrence of pronominal forms in these environments, or, conversely, to account for the effect of these pronominal forms upon their environments.

2049

Pennsylvania U. [Dept. of Linguistics] Philadelphia.

THE DISCONTINUOUS VERB IN ENGLISH, by A. H. Live. Oct. 1963, 23p. (AFOSR-64-0950) (AF AFOSR-64-477) AD 600219 Unclassified

A discussion is given of discontinuous verbs from the point of view of a few consistent syntactic patterns, involving transitivity, passive transformation, word order, and relative stress.

2050

[Pennsylvania U. Dept. of Linguistics, Philadelphia]

ENGLISH CANONICAL FORMS AND STYLE LEVELS, by A. F. Brown. Sept. 1964 [62]p. incl. tables, refs. (AFOSR-64-1666) (In cooperation with Lehigh U., Bethlehem, Pa.) (AF AFOSR-64-477) AD 607376 Unclassified

In an effort to characterize different levels of style in spoken and written English, one element of style - the lexical material - is examined. There appears to be a general association of borrowed lexical material with formal styles, and of native lexical material with informal styles. Also, there is evidence that, while some proportion of loan forms have been well-naturalized into native English shapes and may be not distinguishable as loans, a large number of loan forms still have shapes which set them off from native forms. Some proper names and verb forms are examined as samples of the lexical material. The relation of variants of some proper names to levels of style is discussed, as well as the relation of native vs loan verbs to levels of style.

2051

Pennsylvania U. [Dept.] of Metallurgical Engineering, Philadelphia.

A NEW THEORY OF WORK HARDENING IN CRYSTALS, by D. Kuhlmann-Wilsdorf. [1963] [17]p. incl. refs. (AFOSR-4005) (AF 49(636)435) AD 290692 Unclassified

Presented at Internat'l. Conf. on Crystal Lattice Defects, Tokyo and Kyoto (Japan), Sept. 3-4, 1962.

Also published in Jour. Phys. Soc. Japan, v. 16: 68-73, Mar. 1963.

The three stages of the usual work hardening curve of fcc metals, easy glide, stage II, and stage III, are examined theoretically. The manifold and complex observations regarding easy glide may be understood from the idea that easy glide is the stage during which dislocations move and multiply, spreading throughout the specimen until a quasi-uniform dislocation density, commensurate with the applied stress, has been established. The cause for the amazingly consistent ratio of θ_{II}, the work-hardening coefficient during stage II, to G, the modulus of rigidity, such that $G/\vartheta_{II} = K \sim 300$ is investigated. Stage II is explained on the basic assumption that multiplication and movements of dislocations take place in such a manner that the dislocation configurations first established change in scale only, but not in character. Stage III is understood to commence at the onset of additional modes of dislocation motion, besides slip, be it climb, or cross slip or both. The dislocation pattern then changes in character.

2052

Pennsylvania U. Dept. of Metallurgical Engineering, Philadelphia.

EXPERIMENTAL VERIFICATION OF THEORIES ON DISLOCATION BEHAVIOUR OF STRAINED F.C.C. METALS, by D. Kuhlmann-Wilsdorf, H. J. Levinstein and others. [1963] [13]p. incl. illus. diagrs. refs. (AFOSR-J1102) (AF 49(636)435) Unclassified

Also published in Jour. Australian Inst. Metals, v. 6: 102-114, May 1963.

In a recent investigation, based on a high-resolution etch-pitting technique, the dislocation distribution in strained silver single crystals was examined. Several new results of considerable interest were obtained. A careful analysis and comparison of these, and of previous results, shows them to disprove theories on the phenomenon of dislocation tangling which are built on the assumption that either cross-slip or dislocation intersections are the decisive mechanism. Also discredited are theories of work-hardening based on dislocation jogs or long-range stresses as responsible for the greater part of work-hardening in stage II. By contrast, the basic hypotheses and major conclusions of the theory of "mushrooming", and the theory of work-hardening by one of the authors (D. K. W.), are in striking agreement with all the results. This is interpreted as constituting a virtual proof of the basic framework of these theories. (Contractor's abstract)

2053

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

DISLOCATION MOVEMENTS AND DISLOCATION ARRAYS, by D. [Kuhlmann-] Wilsdorf. Final rept. June 1, 1958-Aug. 31, 1963. Sept. 19, 1963, 15p. incl. refs. (AFOSR-J1125) (AF 49(638)435) AD 421195 Unclassified

In an effort towards the understanding of deformation

bands, single crystals of aluminum were grown oriented for single slip, in the form of wavy ribbons. Since the bands were to be studied in all phases of development, it was necessary to search for methods for the early detection and quantitative examination of deformation bands. Experiments in this direccion, employing the Berg-Barrett x-ray method were begun. Contrary to expectations, polygonization behavior strongly depends on the relative position of any given volume element in a specimen. A noteworthy observation was that the angular misorientation associated with a wall does not ordinarily change on annealing.

2054

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

CONTRIBUTIONS TO THE CRYSTAL CHEMISTRY OF NORMAL AND DEFECT TETRAHEDRAL STRUCTURES, by E. Parthe. [1963] [21]p. (AFOSR-64-0760) (AF 49(636)1027) AD 436490 Unclassified

Also published in Zeitschr. Krist., v. 119: 205-225, 1963.

A scheme has been developed which allows one to calculate the compositions of all thecretically possible normal and defect tetrahedral structures. Some 200 tetrahedral-structure compounds are known which all fit in the composition scheme.

2055

Pennsylvania U. [Dept. of Metallurgical Engineering] Philadelphia.

Sc_5Ga_3 AND Y_5Ga_3 WITH $D6_6$ STRUCTURE, by O. Schob and E. Parthe. [1964] [2]p. incl. table. (AFOSR-65-0770) (AF 49(636)1027) AD 617209 Uncla Unclassified

Also published in Acta Cryst., v. 17: 1335-1336, Oct. 1964.

In the continuation of an investigation on the occurrence of compounds with $D6_6$ structure, the phases $Sc_5 Ga_3$ and Y_5Ga_3 have been synthesized. Induction melting of the metals mixed in proper weight proportions in a boron nitride crucible under argon has given homogeneous samples of $Se_5 Ga_3$ and $Y_5 Ga_3$. Including these 2 compounds the total number of known $D6_6$ phases is 46.

2056

Pennsylvania U. [Office of Computer Research and Education] Philadelphia.

A SYNTAX-ORIENTED COMPILER FOR LANGUAGES WHOSE SYNTAX IS EXPRESSIBLE IN BACKUS NORMAL FORM AND SOME PROPOSED EXTENSIONS THERETO, by P. Z. Ingerman. Master's thesis, May 1963, 1v. (AF 49(636)951) AD 419103 Unclassified

A syntax-oriented compiler for languages with a context-free syntax expressed in Backus Normal Form is discussed. The technique discussed is applicable to an iterated compilation process, where each phase of the compilation generates the rules of syntax required for the next phase of the compilation. Complete flow charts are included for the major processors; these flow charts are essentially machine-independent. Also included is a discussion of the extensions required which allow the compilation technique to be extended to context-dependent syntax, although a non-terminating compilation may result in certain cases if these extensions are included.

2057

Pennsylvania U. School of Medicine, Philadelphia.

NEUROHUMORAL CONTROL OF THE PITUITARY, by S. M. McCann. Final rept. Aug. 1, 1962-July 31, 1963. Dec. 4, 1963, 6p. (AFOSR-J1373) (AF AFOSR-62-133) AD 426402 Unclassified

The objective of this work has been to clarify the hypothalamoanterior hypophysial interrelationship. Work has been done in two areas: (1) regulation of ACTH secretion, and (2) regulation of the secretion of gonadotrophins.

2056

Pennsylvania U. School of Medicine, Philadelphia.

A HIGHLY SENSITIVE TEST FOR LH-RELEASING ACTIVITY: THE OVARIECTOMIZED, ESTROGEN PROGESTERONE-BLOCKED RAT, by V. D. Ramirez and S. M. McCann. [1963] [6]p. incl. diagrs. tables, refs. (AF AFOSR-62-133) AD 427576 Unclassified

Also published in Endocrinology, v. 73: 193-198, Aug. 1963.

The LH-releasing effect of crude acidic extracts of rat stalk-median eminence tissue was evaluated in chronically ovariectomized rats in which LH secretion had been partially blocked by injection of estrogen and progesterone. Ten min after intravenous administration of these extracts a significant increment in plasma LH was detectable, as measured by the ovarian ascorbic acid depletion test. The minimal effective dose (MED) of stalk-median eminence extract was approx 40 μg wet weight of tissue extracted. By contrast, cerebral cortical extract was completely inactive at doses up to 5,000 μg wet weight of tissue extracted. The quantity of Pitressin required to produce a positive response is approx 200-400 times greater than the quantity of vasopressin found in the MED of hypothalamic extract. The MED for epinephrine was 5 μg, a quantity several thousand times the amount present in the MED of stalk-median eminence. (Contractor's abstract)

2059

Pennsylvania U. School of Medicine, Philadelphia.

PURIFICATION OF LUTEINIZING HORMONE-RELEASING FACTOR FROM BEEF HYPOTHALAMUS, by V. D. Ramirez, R. Nallar, and S. M. McCann. [1964] [5]p. (AFOSR-64-1708) (AF AFOSR-62-133) AD 448266 Unclassified

Also published in Proc. Soc. Exper. Biol. and Med., v. 115: 1072-1076, 1964.

Experimental work from a number of laboratories has convincingly demonstrated a gonadotrophin-releasing action of extracts from the stalk-median eminence region of several species. Campbell et al showed that direct injection of crude acidic extracts of beef stalk-median eminence into the anterior lobe of the pituitary of rabbits would evoke ovulation, and similar results were obtained in the rat by Nikitovitch-Winer. More recently, Johnson has obtained ovulation in androgen-sterilized rats after intravenous injection of beef hypothalamic extracts. Since the LH-releasing activity was diminished by peptic and eliminated by tryptic digestion, it was concluded that the LH-releasing factor (LH-RF) was a polypeptide.

2060

Pennsylvania U. School of Medicine, Philadelphia.

EFFECT OF ESTRADIOL IMPLANTS IN THE HYPOTHALAMOHYPOPHYSIAL REGION OF THE RAT ON THE SECRETION OF LUTEINIZING HORMONE, by V. D. Ramirez, R. M. Abrams, and S. M. McCann. [1964] [6]p. (AFOSR-64-2157) (AF AFOSR-62-133) AD 452041 Unclassified

Bilateral implants of estradiol or estradiol diluted with cholesterol were placed in various parts of the brain or pituitary of ovariectomized rats. Implants of estradiol in either the median eminence region or the anterior lobe of the pituitary prevented the post-castration rise of plasma luteinizing hormone (LH). The minimal effective dose of implanted estradiol to lower plasma LH was approx the same whether the implant was located in the median eminence or pituitary gland. Median eminence implants lowered hypophysial LH content, whereas hypophysial implants did not. Implanted estradiol in both these loci also enlarged the anterior lobe of the hypophysis.

2061

Pennsylvania U. School of Medicine, Philadelphia.

THE EFFECTS ON ACTH AND GONADOTROPHIN SECRETION OF IMPLANTS OF GONADAL STEROIDS IN THE HYPOTHALAMO-HYPOPHYSIAL REGION, by I. Chowers and S. M. McCann. [1963] [13]p. (AFOSR-64-2158) (AF AFOSR-62-133) AD 452039 Unclassified

Also published in Israel Med. Jour., v. 22: 11-12, 420-432, Nov.-Dec. 1963.

Implants of testosterone and estradiol into the median eminence (ME) and mammilary bodies (MB) produced a decrease in weight of seminal vesicles and ventral prostate on comparison with weights found in normal or cholesterol-implanted controls. Since peripheral injection of testosterone was associated with an increased weight of the accessory sexual organs and since implants of gonadal steroids in a variety of other loci in the hypothalamo-pituitary region were without effect, it is suggested that the action of the effective implants is a local one on cells specifically sensitive to the steroids. Gonadal hormones implanted in the anterior pituitary and MB also caused a significant increase in adrenal weight when compared to the unimplanted or cholestrol-implanted rats. Estradiol implants in the ME also increased adrenal weight; however, testosterone was without effect on adrenal weight in this locus.

2062

Pennsylvania U. School of Medicine, Philadelphia.

THE NEUROENDOCRINE REGULATION OF HYPOPHYSEAL LUTEINIZING HORMONE SECRETION, by S. M. McCann and V. D. Ramirez. 1964, 51p. (AFOSR-64-2479) (AF AFOSR-62-133) AD 453820 Unclassified

Also published in Recent Progress in Hormone Research, v. 20: 131-181, 1964.

This review presents an overall picture of the regulation of luteinizing hormone (LH) secretion and syntheses. Nearly all results reported are based on the ovarian ascorbic acid depletion assay, with a brief description of this method. This is followed by consideration of the factors that influence LH secretion in the normal and castrate rat, and, finally, by a discussion of the neural control of secretion of this trophin.

2063

Pennsylvania U. School of Medicine, Philadelphia.

HYPOTHALAMIC FSH AND LH-RELEASING FACTORS, by S. M. McCann, V. D. Ramirez, and M. Igarashi. [1964] [12]p. incl. diagrs. table, refs. (AFOSR-65-1508) (AF AFOSR-62-133) AD 624005 Unclassified

Presented at Brook Lodge Conf. on Proteins and Polypeptides, Kalamazoo, Mich., Oct. 7-9, 1963.

Also published in Metabolism, v. 13: 1177-1189, Oct. 1964.

The stalk-median eminence of the hypothalamus appears to contain a luteinizing hormone-releasing factor, LH-RF, which is a small, active polypeptide with mol wt less than 3500, and is dissimilar from known neurohypophysial hormones and corticotrophin-releasing factors. Hypothalamic control over LH secretion also appears to be mediated by means of secretion of LH-RF into hypophysial portal vessels. It remains to be determined if the LH-RF and follicle stimulating hormone-releasing factor are distinct entities or part of a gonadotrophin-releasing complex.

2064

Pennsylvania U. School of Medicine, Philadelphia.

THIOGLYCOLLATE-STABLE LUTEINIZING HORMONE AND CORTICOTROPHIN-RELEASING FACTORS, by V. D. Ramirez and S. M. McCann. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-65-1510) (AF AFOSR-62-133) AD 623496 Unclassified

Also published in Amer. Jour. Physiol., v. 207: 441-445, Aug. 1964.

Crude acidic extracts of beef stalk-median eminence tissue depleted ovarian ascorbic acid on injection into immature rats pretreated with gonadotrophins. They also elevated plasma luteinizing hormone (LH) activity in ovariectomized rats which had been pretreated with both estrogen and progesterone. It is concluded that beef stalk-median eminence tissue contains a specific LH-releasing factor (LH-RF). These same extracts possessed an ACTH-releasing action, as judged by adrenal ascorbic acid depletion induced in rats with median eminence lesions, which could not be accounted for by the minimal contamination of the extract with ACTH itself. It is concluded that the LH-RF and corticotrophin-releasing factor resident in beef hypothalamic tissue are dissimilar from the known neurohypophysial polypeptides.

2065

Pennsylvania U. School of Medicine, Philadelphia.

COMPARISON OF EFFECT OF ENVIRONMENTAL AND PREOPTIC COOLING ON PLASMA CORTISOL LEVELS, by I. Chowers, H. T. Hammel and others. [1964] [6]p. incl. diagrs. table, refs. (AFOSR-65-1511) (AF AFOSR-62-133) AD 623293 Unclassified

Also published in Amer. Jour. Physiol., v. 207: 577-582, Sept. 1964.

The acute exposure of dogs to an environmental temperature of 0°C evoked an elevation in plasma cortisol concentration which was apparent within 15 min and persisted for the 45 min of exposure. Gradual cooling of the environment over a 45-min period to a minimal temperature of 0°C failed to elevate plasma cortisol concentrations, although other compensatory mechanisms such as cutaneous vasoconstriction were active. Acute lowering of preoptic temperature also evoked a rise in plasma cortisol concentrations associated with lowering of pinna and elevation of rectal temperature. In this case the response was transient; plasma cortisol levels began to fall after 15 min of cooling even though cutaneous vasoconstriction was maintained. The results are interpreted to mean that acute lowering of environmental or preoptic temperature can activate the pituitary-adrenal system. (Contractor's abstract)

2066

Pisa U. (Italy).

NEUROPHYSIOLOGICAL STUDIES OF CONDITIONING, by G. Ricci. May 1, 1963, 1v. (AFOSR-4884) (AF EOAR-62-102) AD 415115 Unclassified

Atropine, in doses with little or no effect on the EEG arousal, impaired the acquisition of conditioned responses (CR) in the naive monkey and caused a decreased generalization of the responses to the negative stimulus in well trained animals. In doses sufficient to block the EEG arousal, atropine also caused a disappearance of the CR. In these animals both the EEG arousal and the conditioned responses could be restored by administering eserine. A dissociation between EEG and conditioned responses could be found in the monkey only when amphetamine was given in animals previously treated with atropine. A slight pupillary constriction was found to occur during the first part of the conditioned trial. The facilitation of the visual cortical responses observed during conditioning was found to occur during both the pupiliary constriction and the first part of the following period of pupiliary dilatation.

2067

Pisa U. [Dept. of Mathematics] (Italy).

[THE MINIMUM PRINCIPLE IN THE CALCULUS OF VARIATIONS] Il principio di minimo nel calcolo delle variazione, by G. Stampacchia. [1964] 20p. incl. refs. (AFOSR-65-1031) (AF EOAR-63-29) AD 619541 Unclassified

Also published in Atti Simposio Lagrangiano, Torino (Italy) [Apr.] 1964, p. 1-20.

This note reports developments of the minimum principle in the theory of elliptic partial differential equations.

2068

Pisa U. [Dept. of Mathematics] (Italy).

[ANALYTIC METHODS FOR ABELIAN VARIETIES OF POSITIVE CHARACTERISTIC. PARTS 1, 2] Metodi analitici per varietà abeliane in caratteristica positiva. Capitoli 1, 2, by I. Barsotti. July 17, 1963, 28p. (AFOSR-65-2731) (AF EOAR-63-29) AD 627550 Unclassified

Also published in Ann. Scuola Norm. Super. Pisa, v. 18: 1-25, 1964.

This paper is devoted to an extension of the theory of Witt vectors. First Cov R (the Witt covectors) is introduced as the set of sequences $(\cdots, x_{-2}, x_{-1})$ from R satisfying a suitable convergence condition. Like the Witt vectors, they are added by certain universal formulas for the components, and there are natural operators t, π, and p on them. Cov R is a topological (Vect k)-module. The bivectors $(\cdots, x_{-1}, x_0, x_1, \cdots)$

are then defined as those sequences for which $(\cdots, x_n)$ is a covector for all n. They form a topological group which is completable to Biv R. This last is a complete topological ring, as well as a topological (Vect KR)-module. Finally, the topology in R permits the introduction of analysis--the exponential, logarithmic and Artin-Hasse exponential series are introduced and briefly studied.

2069

Pisa U. [Inst. of Aeronautics] (Italy).

LINEARIZED SUPERSONIC FLOW OF A JET IN A SUPERSONIC STREAM AT AN ANGLE OF ATTACK, by E. Pistolesi and M. Marini. Mar. 1963, 31p. (AFOSR-4825) (AF EOAR-62-97) AD 407027
Unclassified

Within the linearized theory, a method has been found to study the flow in a supersonic jet on a wing disposed in a supersonic stream based on the use of particular singularities, called 'pseudodoublets' disposed on the jet axis. A method has also developed the study of the characteristics of the flow around a cylindrical duct of finite length at an angle of attack to obtain results easily suitable for the application of the proposed method. A detailed development of the proposed method giving the complete results for the flow in the jet and in the external stream is presented.

2070

Pisa U. Inst. of Physiology (Italy).

OCULAR MOVEMENTS IN THE MIDPONTINE PRETRIGEMINAL PREPARATION, by F. A. King and P. L. Marchiafava. [1963] [12]p. (AFOSR-J611) (AF 61(052)107) AD 632622; AD 414020
Unclassified

Also published in Arch. Ital. Biol., v. 101: 149-160, 1963.

The original purpose of this study was to examine further the suggestion that the midpontine pretrigeminal preparation with a consistently low voltage, fast EEG is actually awake by determining what correlations exist between type of EEG pattern and vertical optokinetic nystagmus. It was found, however, that complete transection results in a total loss of the optokinetic reflex regardless of the form of cortical electrical activity. Inasmuch as the pretrigeminal preparation still responds to objects moving in the visual field by vertical following eye movements, the lack of optokinetic nystagmus is not interpreted as an indication that the animal is actually not awake. It is hypothesized that interference with reflex circuitry may account for the failure of the optokinetic reflex. Findings indicate that vertical optokinetic nystagmus and vertical following movements require different central mechanisms and stimulus conditions for their elicitation.

2071

Pisa U. Inst. of Physiology (Italy).

PONTINE RETICULAR FORMATION: RELATION TO LATERAL GENICULATE NUCLEUS DURING DEEP SLEEP, by E. Bizzi and D. C. Brooks. [1963] [3]p. (AFOSR-J1324) (AF 61(052)107) AD 424524; AD 632623
Unclassified

Also published in Science, v. 141: 270-272, July 19, 1963.

Irregular groups of monophasic waves (seven waves per sec) appear synchronously in the pontine reticular formation and in the lateral geniculate nucleus during the deep (low-voltage, fast) phase of sleep. The geniculate potentials can be triggered by low-rate stimulation of the pontine reticular formation, but the reverse effect has never been obtained.

2072

Pisa U. Inst. of Physiology (Italy).

PYRAMIDAL ACTIVITY DURING SLEEP AND WAKEFULNESS, by A. Arduini, G. Berlucchi, and P. Strata. [1963] [15]p. (AFOSR-J1325) (AF 61(052)107) AD 424233; AD 632624
Unclassified

Also published in Arch. Ital. Biol., v. 101: 530-544, 1963.

Results of this study may be summarized as follows. During wakefulness the pyramidal discharge attains a quasi steady value, provided that the animal does not accomplish large movements. During the stage of sleep characterized by EEG with high voltage, low frequency waves and activity still present in the neck muscles, the mean level of pyramidal activity is noticeably lower than during wakefulness. Peaks of discharge, synchronous with the spindle trains of the EEG, characterize the pyramidal activity in this stage. Corresponding to the transition from the phase of sleep just described to the 'fast' type of sleep, with low amplitude, fast EEG waves and muscular atonia, the base line of the pyramidal record rises to a level equal to, or higher than, that reached during wakefulness. This level is maintained throughout this stage, with some short-lasting peaks of discharge synchronous with the muscular twitches.

2073

Pisa U. [Inst. of Physiology] (Italy).

EEG-ACTIVATING INFLUENCES IN THE CERVEAU ISOLE PREPARATION, by G. Moruzzi. [1963] [5]p. (AFOSR-J1327) (AF 61(052)107) AD 424223; AD 632619
Unclassified

Also published in Perspectives in Biology, New York, Elsevier Publishing Co., 1963, p. 434-438.

The experiments suggest that tonically active desynchronizing structures are present in the isolated

cerebrum following post-collicular transection. These structures would be driven reflexively by a tonic retinal inflow, which in the complete absence of light obviously corresponds to the retinal dark discharge. It is likely that the behavioral and EEG activation following chronic midbrain transection is due to a compensatory enhancement of the tonic discharge of these structures, which in the acute preparation would simply counteract, but never overwhelm, the strong tendency to synchronization of the cerveau isole. The same explanation might hold true for the predominance of low-voltage fast activity in the chronic cerveau isole dog.

2074

Pisa U. Inst. of Physiology (Italy).

FUNCTIONAL CONNECTIONS BETWEEN PONTINE RETICULAR FORMATION AND LATERAL GENICULATE NUCLEUS DURING DEEP SLEEP, by E. Bizzi and D. C. Brooks. [1963] [25]p. (AFOSR-J1328) (AF 61(052)107) AD 424222; AD 632621 Unclassified

Also published in Arch. Ital. Biol., v. 101: 666-680, 1963.

The waves present in the pontine reticular formation and the lateral geniculate nucleus during deep sleep were found to be synchronous. Low frequency (2/sec or less) stimulation of the pons at the level of the nucleus reticularis pontis caudalis led to a response in the lateral geniculate nucleus which consisted of either a single wave or a group of 2-3 waves. During deep sleep, synchronized sleep and arousal it was impossible by stimulating the lateral geniculate nucleus to produce pontine responses resembling deep sleep waves. Deep sleep waves could not be recorded from the optic chiasm and optic tract. Deep sleep waves were still present in the lateral geniculate nucleus of animals in which the visual cortex had been removed.

2075

Pisa U. Inst. of Physiology (Italy).

THE EFFECTS OF FLICKER AND STEADY ILLUMINATION ON THE ACTIVITY OF THE CAT VISUAL SYSTEM, by A. Arduini and L. R. Pinneo. [1963] [22]p. (AFOSR-J1329) (AF 61(052)107) AD 424110; AD 632620 Unclassified

Also published in Arch. Ital. Biol., v. 101: 508-529, 1963.

The amount of activity of the optic chiasm and dorsal nucleus of the lateral geniculate body, was measured in response to flickering light alone, steady light alone, and combinations of flicker and steady illumination. Animals were nembutal anesthetized and awake chronically prepared cats. Activity of the visual system was found to be increased over the level of the dark discharge by low frequency flickering light, but was substantially depressed below the level of dark discharge with high frequencies of flicker. In general, the drop in tonic activity was linearly related to flicker frequency, but tended to reach a steady level at the highest frequencies. The final level of activity at the highest frequencies was slightly higher than the level produced by steady illumination of the same intensity.

2076

Pisa U. Inst. of Physiology (Italy).

BRAIN STEM ELECTRICAL ACTIVITY DURING DEEP SLEEP, by D. C. Brooks and E. Bizzi. [1963] [18]p. (AFOSR-J1330) (AF 61(052)107) AD 424234; AD 632618 Unclassified

Also published in Arch. Ital. Biol., v. 101: 648-665, 1963.

In the sleeping cat, frequent discrete episodes of deep sleep were observed, during which the cortical EEG developed low voltage fast activity, the posterior cervical EMG became flat, and erratic eye movements were recorded. Theta activity was consistently recorded from the hippo-campus during deep sleep. During deep sleep a distinctive pattern of electrical activity was recorded from three regions: a broad zone of the pons at the level of the nucleus reticularis pontis caudalis, the oculomotor nucleus and the lateral geniculate nucleus. This pattern, which has been termed deep sleep wave activity, consisted of intermittent groups of essentially monophasic waves having a rather uniform amplitude.

2077

Pisa U. Inst. of Physiology (Italy).

THE TONIC ACTIVITY OF THE LATERAL GENICULATE NUCLEUS IN DARK AND LIGHT ADAPTATION, by A. Arduini and L. R. Pinneo. [1963] [15]p. (AFOSR-J1331) (AF 61(052)107) AD 424228; AD 632625 Unclassified

Also published in Arch. Ital. Biol., v. 101: 493-507, 1963.

Experiments conducted on cats in nembutal anesthesia, midpontine pretrigeminals, cerveau isole and intact -brain with chronically implanted electrodes, have shown that the activity of the lateral geniculate nucleus follows closely the changes of level of the retinal output, as described in a previous paper. When the retina is continuously and diffusely illuminated the overall activity of the lateral geniculate decreases following the decrease in the level of the retinal output. During reversible retinal black-out, the overall activity of the lateral geniculate of the anesthetized animal decreases dramatically, reaching the level of the noise measured in the dead animal. Part of the activity remains in non-anesthetized preparations. The results are discussed.

2078

Pisa U. Inst. of Physiology (Italy).

NEUROPHYSIOLOGICAL ANALYSIS OF THE

"MOBBING RESPONSE" IN THE CHAFFINCH (FRINGILLA COELEBS), by P. Strata. [1964] [7]p. incl. diagr. refs. (AFOSR-64-1833) (AF 61(052)107) AD 449965 Unclassified

Also published in Arch. Ital. Biol., v. 102: 22-28, 1964.

The behavior of two groups of chaffinches in response to an owl has been analyzed. In one group of animals, a cerebral hemisphere and the ipsilateral eye were ablated, while in the other group a cerebral hemisphere and the contralateral eye were destroyed. The first group did not exhibit the mobbing response, whereas the second group did. Both groups were able to distinguish between true and false seeds. Both groups showed normal mobility and the capacity to use the cells normally associated with mobbing response. It is concluded that the absence of a mobbing response in the first group of chaffinches is due specifically to the ablation of the cerebral hemisphere, and that the cerebral hemispheres are responsible for the elaboration of the visual messages which provoke to mobbing response. (Contractor's abstract)

2079

Pisa U. [Inst. of Physiology] (Italy).

THE PROBLEM OF A TRUE CONSENSUAL LIGHT REFLEX IN BIRDS, by G. Berlucchi and P. Strata. [1964] [7]p. (AFOSR-64-1834) (AF 61(052)107) AD 449966 Unclassified

Also published in Arch. Ital. Biol., v. 102: 29-35, 1964.

The problem of the consensual light reflex in birds was studied with the aid of two techniques which have recently been introduced into ocular physiology: examination under infrared light and photocoagulation of the optic papilla. The results obtained in the owl were: (1) In the normal owl the photic stimulation of one eye elicits a consensual pupillary constriction which is easily visible if the experiment is performed in the dark. (2) In the unilaterally blinded owl, photic stimulation of the normal eye elicits consensual pupillary constriction on the inactivated eye. (3) In the same experimental situation as in (2), the stimulation of the blind eye elicits a weak pupillo-constrictory response in the normal eye and a still weaker one in the blind eye. (4) After bilateral blinding it is no longer possible to elicit any iris response in either eye.

2080

Pisa U. [Inst. of Physiology] (Italy).

THE TONIC DISCHARGE OF THE RETINA AND ITS CENTRAL EFFECTS, by A. Arduini. [1963] [23]p. (AFOSR-64-2389) (AF 61(052)107) AD 452250 Unclassified

Also published in Prog. Brain Research, v. 1: 184-206, 1963.

This paper deals with the so-called spontaneous activity of the retina and discusses the results of a series of observations made from 1958 to 1961. Last year attention was transferred to the eye, and an attempt was made to relate the peripheral aspects of the retinal discharge to the results obtained at the level of the visual pathways and to the effects upon the EEG. The present studies have been concerned with fibre recordings from the optic chiasma with gross electrodes in collaboration with Dr. Pinneo, and from the retinal papilla with semimicroelectrodes in collaboration with Dr. Cavaggioni. This investigation is still under way. However, enough information is now available to present a rough picture of the behavior of the retina in dark adaptation and of the changes in the adaptation level brought about by steady illumination.

2081

Pisa U. Inst. of Physiology (Italy).

RESEARCH ON RELATIONS OF BRAIN STEM RETICULAR FORMATION TO ANIMAL BEHAVIOR, by G. Moruzzi. Final technical rept. June 15, 1962-Sept. 15, 1963, 13p. incl. refs. (AFOSR-J1323) (AF EOAR-62-9) AD 424838 Unclassified

The following themes have been the object of these investigations: (1) Intracellular recording from reticular neurons, (2) Dark discharge of retinal units, (3) Electrical activity of the lateral geniculate body during desynchronized sleep, (4) Neural mechanisms underlying visual accomodation, and (5) Behavioral investigations on the relationships between vision of polarized light and orientation in spiders. (Contractor's abstract, modified)

2082

Pisa U. Inst. of Physiology (Italy).

RESEARCH ON THE STRUCTURE AND PHYSIOLOGY OF THE EYES OF A LYCOSID SPIDER. II. THE ROLE OF DIFFERENT PAIRS OF EYES IN ASTRONOMICAL ORIENTATION, by F. Magni, F. Papi and others. [1964] [14]p. incl. illus. diagrs. refs. (AFOSR-64-1701) (AF EOAR-62-9) AD 448265 Unclassified

Also published in Arch. Ital. Biol., v. 102: 123-136, 1964.

The functional role of single pairs of eyes of the wolf-spider Arctosa variana C. L. Koch in astronomical orientation was studied. The visual fields above the horizon of individual eyes were determined by the method of Homann. The principal eyes alone are able to ensure a correct astronomical orientation, although less precise than that of normal animals. The orientation is strongly disturbed if secondary eyes alone are left uncovered; it becomes altogether erratic if one single pair of secondary eyes alone is left uncovered.

2083

Pisa U. [Inst. of Physiology] (Italy).

RETICULAR INFLUENCES ON THE EEG, by G. Moruzzi. [1964] [17]p. (AFOSR-64-1702) (AF EOAR-62-9) AD 448266 Unclassified

Also published in Electroencephalog. and Clin. Neurophysiol., v. 16: 1-17, 1964.

This report is concerned exclusively with the influence of the brain-stem on spontaneous electro-cortical activity in two opposite conditions, wakefulness and sleep, and our main aim will be to relate behavior and EEG with the activity of different parts of the brain-stem. Experimental data are presented.

2084

Pisa U. [Inst. of Physiology] (Italy).

ACTIVE PROCESSES IN THE BRAIN STEM DURING SLEEP, by G. Moruzzi. [1963] [64]p. (AFOSR-64-1709) (AF EOAR-62-9) AD 448273 Unclassified

Also published in The Harvey Lectures, Series 58: 233-297, 1963.

The present report is centered around the deafferentation hypothesis of sleep, with particular regard to its historical development and to the challenge which arises from the observations made during the last five years, all pointing to an active participation of the brain stem in the process of falling asleep and in the maintenance of sleep.

2085

Pisa U. [Inst. of Physiology] (Italy).

SLOW PERIODICITY IN THE DARK DISCHARGE OF RETINAL UNITS, by D. Ascoli and L. Maffei. [1963] [2]p. (AFOSR-64-1710) (AF EOAR-62-9) AD 448264 Unclassified

Also published in Experientia, v. 20: 226-227, 1964.

During experiments concerned with the statistical parameters of retinal discharge under conditions of complete dark adaptation, an almost regular periodic firing pattern was sometimes observed in retinal ganglion cells. In a number of experiments, the firing of the dark adapted cells was observed to fluctuate, disappearing and reappearing with a certain periodicity. The time course of these fluctuations was sometimes of a few seconds. Frequently, however, a surprisingly slow periodicity, of the order of a few and even of several minutes, was observed.

2086

Pisa U. [Inst. of Physiology] (Italy).

[PERIODIC ACTIVITY IN THE CAT RETINA]

Attivita' periodica nella retina del gatto, by D. Ascoli and L. Maffei. [1963] [2]p. (AFOSR-64-2153) (AF EOAR-62-9) AD 452328 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 39: 1998-1999, Sept. 1963.

A rhythmic discharge has been observed in the retinal cells of dark-adapted cats during microelectrode recordings from the optic papilla or ganglion cells. In some cases this regular discharge demonstrates a rhythmic disappearance and reappearance with a periodicity of a few seconds; this periodicity has already been reported in the literature. At only a few points in the retina, however, the author observed a slower periodicity of the order of several minutes which has not been previously described.

2087

Pisa U. Inst. of Physiology (Italy).

THE PROPERTIES OF RETICULO-SPINAL NEURONS, by W. D. Willis and F. Magni. 1964, 11p. (AFOSR-65-2847) (AF EOAR-62-9) AD 629204 Unclassified

Also published in Prog. Brain Research, v. 12: 56-64, 1964.

Reticulo-spinal neurons are identified by intracellular recording of the antidromic action potentials resulting from stimulation of the spinal cord. The characteristics of their action potentials are described. The axons of reticulo-spinal cells are found to conduct at rates up to 130m/sec and to have relatively low thresholds for electrical stimulation. The axons project as far caudally as S1 and travel in the ventral part of the cord. Reticular neurons with axons projecting both caudally into the cord and rostrally to the midbrain are described. The functional role of the reticulo-spinal neurons studied is discussed.

2088

Pisa U. Inst. of Physiology (Italy).

AFFERENT CONNECTIONS TO RETICULO-SPINAL NEURONS, by F. Magni and W. D. Willis. [1964] [13]p. (AFOSR-65-2848) (AF EOAR-62-9) AD 629207 Unclassified

Also published in Prog. Brain Research, v. 12: 246-258, 1964.

Reticulo-spinal neurons of the cat brain stem have been shown to receive excitatory connections from a wide area of the cerebral cortex. The strength of the connections varies both with the cortical area stimulated and with the particular neuron investigated. The effects of changing stimulus parameters are described. Examples are given of excitatory and inhibitory postsynaptic potentials evoked in reticulo-spinal neurons by stimulation of a pathway traversing the region of the central tegmental tract of the mesencephalon. The action of peripheral nerves of the forelimb upon reticulo-spinal neurons is shown in many cases to be complex.

2089

Pisa U. Inst. of Physiology (Italy).

SUBCORTICAL AND PERIPHERAL CONTROL OF BRAIN STEM RETICULAR NEURONS, by F. Magni and W. D. Willis. [1964] [15]p. (AFOSR-65-2849) (AF EOAR-62-9) AD 629205 Unclassified

Also published in Arch. Ital. Biol., v. 102: 434-448, 1964.

Several types of neurons of the brain stem reticular formation are shown to receive postsynaptic potentials from stimulation in the region of the central tegmental tract in the rostral mesencephalon. The transmission of excitatory postsynaptic potentials is monosynaptic. An incidental finding which is reported is the reversal of sign of the after-potential immediately following the spike potential in a reticulospinal neuron as the membrane potential changes. The action of volleys in a cutaneous and a muscular nerve of the forelimb upon reticulospinal neurons was studied. The effects appear to be mediated chiefly by low threshold cutaneous fibers and group II muscle afferent fibers. The interaction of postsynaptic potentials from peripheral nerve and cerebral cortical stimulation is described.

2090

Pisa U. Inst. of Physiology (Italy).

CORTICAL CONTROL OF BRAIN STEM RETICULAR NEURONS, by F. Magni and W. D. Willis. 1964, 20p. (AFOSR-65-2850) (AF EOAR-62-9) AD 629206 Unclassified

Also published in Arch. Ital. Biol., v. 102: 18-33, 1964.

The effects of corticofugal volleys upon reticular neurons were studied in anaesthetized and pyramidal cats. Most reticulospinal neurons were excited by cortical volleys, as were reticular neurons with axons projecting both rostrally and caudally. Reticular neurons with long ascending axons were, however, only occasionally affected. Inhibitory postsynaptic potentials were seldom observed and then only following excitatory potentials. There was a widespread convergence of excitatory action from many areas of the cerebral cortex upon individual reticular neurons.

2091

Pisa U. Inst. of Physiology (Italy).

COMPARATIVE NEUROPHYSIOLOGY OF VISION, by G. Moruzzi. Final technical rept. Sept. 15, 1964, 9p. incl. refs. (AFOSR-65-0039) (AF EOAR-63-9) AD 455012 Unclassified

The following themes have been the object of investigations: (1) Behavior of retinal units during dark adaptation, (2) Study of biological noise in the retina, (3) Transfer properties of the cat's eye, (4) Effect of darkness on the onset of sleep in birds, (5) Electroretinography in Lycosa tarentula, (6) Intracellular recording from reticular neurons, and (7) Relationships between midline thalamic nuclei and reticular formation. (Contractor's abstract, modified)

2092

Pittsburgh U. [Dept. of Biology] Pa.

FLASH SPECTROSCOPY AND FLASH FLUORIMETRY IN PHOTOSYNTHETIC STUDIES, by J. L. Rosenberg. Final rept. Feb. 1, 1962-Jan. 31, 1963. Apr. 1, 1963, 4p. (AFOSR-4703) (AF 49(638)762) AD 409594 Unclassified

A comparative study of the flash induced formation of a pigment, X, absorbing at 515 mμ in different classes of algae was made. This material X, still unidentified, had previously been observed principally in the green algae. The X is formed during saturating flashes also in the blue-green Anacystis nidulans and in the red Porphyridium Cruentum. In Porphyridium, the ratio of the maximum X formation to total chlorophyll was observed to be only 10% of the value of this ratio in the green alga Chlorella. Another measured difference is that the rate constant for disappearance of X in the dark following a flash is five times as great in Porphyridium as in Chlorella.

2093

Pittsburgh U. Dept. of Chemistry, Pa.

SOME DEOXYGENATION REACTIONS OF AMINE OXIDES, by T. Cohen. Final rept. Aug. 28, 1963, 15p. incl. refs. (AFOSR-J1078) (AF 49(638)788) AD 419928 Unclassified

This project involves a survey of the reactions of amine oxides with various electrophilic compounds such as anhydrides, esters, α,β-unsaturated carbonyl compounds and epoxides. A new oxidation of epoxides by amine oxides or dimethyl sulfoxide was discovered. The reactions of pyridine-N-oxide with dimethyl acetylenedicarboxylate and with naphthoquinone result in self-reactions of the latter compounds. Pyridine-N-oxide was found to form a 2:1 molecular complex, presumably of the charge-transfer variety with tetrahydroxydinaphthalene. The structure of the "hydrazone" of dehydrodinaphthoquinone was reinvestigated. An unusual redox reaction occurred when N-acyloxypyridinium halides were pyrolyzed producing pyridine, the carboxylic acid and halogenated organics. Other reactions are discussed.

2094

Pittsburgh U. [Dept. of Chemistry] Pa.

SOME N-BUTYL AND PHENYL PHOSPHONIUM SALTS, by G. Witschard and C. E. Griffin. [1964] [1]p. (AFOSR-64-1489) (AF AFOSR-62-48) AD 446142 Unclassified

Also published in Jour. Chem. and Eng. Data, v. 9: 255, Apr. 1964.

During the course of a study of the infrared spectra of phosphonium structures, a number of unreported n-butyl and phenyl phosphonium salts were prepared. These salts were obtained in acceptable yields by simple quaternization of the appropriate phosphine by an alkyl halide in refluxing benzene or in the absence of solvent. In two instances, the halides obtained from the reaction mixture could not be crystallized satisfactorily; conversion to the corresponding iodide led to the formation of crystalline material.

2095

Pittsburgh U. Dept. of Chemistry, Pa.

MAGNETIC CHARACTERISTICS OF LAVES PHASES CONTAINING LANTHANIDE METALS COMBINED WITH NICKEL, by E. A. Skrabek and W. E. Wallace. [1963] [2]p. inci. diagr. table, refs. (AFOSR-64-1513) (AF AFOSR-63-167) AD 446361 Unclassified

Also published in Jour. Appl. Phys., v. 34: 1356-1357, Apr. 1963.

Studies have been made of the series of compounds represented by the formula ANi_2, in which A is Y, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, and Lu. These compounds are all isostructural, possessing the $MgCu_2$ structure. Nine of the compounds exhibit magnetic ordering at temperatures ranging from 6°K (for $PrNi_2$) to 90°K (for $GdNi_2$). The Y, Ce, and Lu remain paramagnetic down to liquid helium temperatures. YNi_2 and $LuNi_2$ exhibit Pauli paramagnetism from 4° to 300°K suggesting that nickel has a filled 3d shell and is not carrying a moment in these phases. $CeNi_2$ likewise exhibits Pauli paramagnetism, which implies that Ce has been ionized to the quadripositive state. The measured saturation moment extrapolated to 0°K is in good agreement with the value expected if nickel is nonmagnetic and the lanthanide component carries the moment of the free tripositive ion in the case of $GdNi_2$ but is in poor agreement for the eight other compounds which order magnetically.

2096

Pittsburgh U. Dept. of Chemistry, Pa.

MAGNETIC PROPERTIES OF $GdFe_2$ AND $DyFe_2$, by M. Mansmann and W. E. Wallace. [1963] [2]p. inci. diagr. table. (AFOSR-64-1514) (AF AFOSR-63-167) AD 446359 Unclassified

Also published in Jour. Chem. Phys., v. 40: 1167-1168, Feb. 15, 1964.

Magnetization-temperature data were obtained over the range 4.2 to 825°K and saturation magnetizations were measured at 4.2, 77°K and room temperature (taken to be 300°K). The magnetization-temperature behavior of $DyFe_2$ closely resembles that of $GdFe_2$ except at temperatures below 60°K. $DyFe_2$ is considerably harder magnetically than $GdFe_2$, and hence it is not clear as yet whether its reduced moment below 60°K is an intrinsic property or is merely due to magnetic hardness. For most of the temperature range the magnetization decreases almost linearly with temperature. This unusual temperature dependence and the magnitude of the observed moments strongly suggest that $DyFe_2$ and $GdFe_2$ are ferrimagnetic materials.

2097

Pittsburgh U. Dept. of Chemistry, Pa.

A THEORY OF LIGHT UTILIZATION IN PLANT PHOTOSYNTHESIS, by J. Franck and J. L. Rosenberg. [1964] [26]p. inci. refs. (AFOSR-3039) (AF AFOSR-63-349) Unclassified

Also published in Jour. Theoret. Biol., v. 7: 276-301, 1964.

A model for the photochemical steps in photosynthesis is described in which only one type of reaction center participates in the chemical conversion of excitation energy. Two types of energy-collecting pigment systems can occur, but in distinction to most current models the energy is delivered to a unique type of chlorophyll-enzyme complex. Of the two photochemical steps in photosynthesis, one is mediated by the metastable triplet state of chlorophyll in this complex and the other requires singlet excitation for efficient operation. The nature of chlorophyll in the two pigment systems is identified on the basis of spectroscopic evidence. The far-red absorbing pigment, P700, is considered to be a crystallized chlorophyll that may participate in photosynthetic energy collection but is not essential for the overall process. The model is tested by comparisons with experimental evidence from fluorescence, aftergiow, the Emerson effect, reversible bleaching, and alternate photochemical pathways. (Contractor's abstract)

2098

Pittsburgh U. [Dept. of Chemistry] Pa.

FLASH SPECTROSCOPY OF PORPHYRIDIUM, by E. Inselberg and J. L. Rosenberg. [1964] [3]p. (AFOSR-64-2269) (AF AFOSR-63-349) AD 452434 Unclassified

Also published in Plant Physiology, v. 39: 810-612, Sept. 1964.

The objective of this study was to investigate flash-induced absorption changes in Porphyridium cruentum, especially the occurrence of the 515 mμ change.

2099

Pittsburgh U. Dept. of Chemistry, Pa.

DIFFERENTIAL REACTIVITY OF EXCITED SINGLETS AND TRIPLETS, by J. L. Rosenberg. [1964] [4]p. incl. refs. (AFOSR-65-2752) (AF AFOSR-63-349) Unclassified

Also published in Photochem. and Photobiol., v. 3: 295-298, 1964.

Experimental data from the oxygen quenching of excited states, from the acidities of excited states, and from the kinetics of photosynthesis indicate that the lowest excited singlet and the lowest triplet states of aromatic molecules may not have the same reactivity. The reasons for these differences may be connected with the energy deficit of triplets, with spin conservation rules, with differences in the nuclear geometry, or with differences in the electronic configuration or polarizability. With improved theoretical representations of excited states, the observed differences in reactivity may serve to increase our understanding of the nature of primary photochemical events.

2100

Pittsburgh U. [Dept. of Pharmacology] Pa.

ATROPINE DETOXICATION DURING HYPOTHERMIA BY THE ISOLATED PERFUSED RAT LIVER. Final technical rept. Oct. 2, 1963, 10p. (AFOSR-J1058) (AF AFOSR-63-87) AD 419701 Unclassified

Considerable information was gained on the metabolism of C^{14} atropine by the isolated, perfused rat liver under normothermic and hypothermic conditions. The half-life of the drug is prolonged under hypothermic conditions, and the per cent of drug remaining in the plasma 4 hr after administration is greater at the low temperatures. At all temperatures, the material appearing in the bile is an altered form of the drug and none of the 5 chromatographically separable compounds is tropic acid. Biliary secretion of atropine metabolites by intact, nephrectomized rats shows good agreement with similar data obtained from the isolated, perfused liver at 37°C and at 25°C.

2101

Pittsburgh U. [Dept. of Physics] Pa.

QUESTION OF SIZE CORRECTIONS TO THE STEADY DIAMAGNETIC SUSCEPTIBILITY OF SMALL SYSTEMS, by L. Friedman. [1964] [9]p. (AFOSR-64-1215) (AF AFOSR-63-196) AD 443021 Unclassified

Also published in Phys. Rev., v. 134: 336-344, Apr. 20, 1964.

The order of magnitude of the (orbital) diamagnetic susceptibility of a free-electron gas is investigated for the case of "small" systems. A small system is, by definition, one whose characteristic linear dimensions are very much less than the radii of the average classical electronic orbits in an applied dc magnetic field. For the case of plane-slab geometry, exactly the Landau susceptibility (i.e., no size effect) is obtained for Maxwell-Boltzmann statistics. Furthermore, on the basis of the latter calculation, it is explicitly demonstrated that the use of the WKB approximation leads to a spurious size effect, suggesting that this (or equivalent) approximations may be responsible for size corrections found by other authors. For the degenerate case, the Landau result is also obtained, to within a numerical factor.

2102

Pittsburgh U. [Dept. of Physics] Pa.

EFFECT OF NONUNIFORM MAGNETIZATION ON THE SPINWAVE SPECTRUM IN THIN FERROMAGNETIC FILMS, by J. T. Davies. [1964] [2]p. (AFOSR-64-1216) (AF AFOSR-63-196) AD 443022 Unclassified

Also published in Jour. Appl. Phys., v. 35: 804-805, Mar. 1964.

It was first suggested by Portis that the linear positioning of the first few spin-wave modes observed in some ferromagnetic films could be due to a nonuniform static magnetization M, and he examined a simple model which showed this effect. This model, where the magnetization falls parabolically from the film center, has been studied in greater detail. The modes found by Portis are incorrect in detail, since they all collapse onto the uniform mode as the distortion of M goes to zero. A more suitable choice of boundary conditions gives rise to a spectrum where the lower modes are linearly positioned whereas the higher modes tend to the more usual quadratic positioning. For a given relative distortion, the number of linear modes should be greater the thicker the film.

2103

Pittsburgh U. [Dept. of Physics] Pa.

DENSITY MATRIX FORMULATION OF SMALL-POLARON MOTION, by L. Friedman. [1964] [14]p. (AFOSR-64-2115) (AF AFOSR-63-196) AD 451577 Unclassified

Also published in Phys. Rev., v. 135: A233-A246, July 6, 1964.

A density-matrix treatment of small-polaron motion is presented for the case in which the electronic overlap term of the total Hamiltonian is a small perturbation. The principal result of the density matrix formalism is that total small-polaron mobility can be expressed as the sum of a band part, characteristic of the low-temperature regime, plus a part describing the hopping motion dominant at high temperatures. This verifies the separation of the above two types of motion made on the basis of physical arguments.

2104

Pittsburgh U. [Dept. of Physics] Pa.

A STUDY OF ELECTRICAL AND THERMAL RESISTIVITIES OF Fe, Co AND Ni USING A TWO-BAND MODEL, by L. Colquitt and D. A. Goodings. [1965] [3]p. incl. diagrs. refs. (AFOSR-65-0807) (AF AFOSR-63-196) AD 618004 Unclassified

Also published in Proc. Internat'l. Conf. on Magnetism, Nottingham (Gt. Brit.), Sept. 1963, p. 29-31.

A description is given of recent calculations of the contributions to the electrical resistivity ρ and the thermal resistivity W of Fe, Co and Ni due to "spin disorder" scattering, i.e. the scattering of conduction electrons by spin waves occurring through the s-d exchange interaction. The single-band theory of Kasuya and others has been extended to a model consisting of 2 spherical energy bands, representing the 4s-4p conduction band and the itinerant d electrons in these metals. At the lowest temperatures the electrons are mainly scattered within each band, but at higher temperatures scattering involving s-d transitions becomes important and gives contributions to ρ and W about an order of magnitude larger than the single-band contributions. (Contractor's abstract)

2105

Plasmadyne Corp., Santa Ana, Calif.

A FUNDAMENTAL THEORETICAL AND EXPERIMENTAL STUDY OF ROTARY MAGNETOHYDRODYNAMICS, by V. A. Erma and B. Podolsky. Final rept. Jan. 21, 1964, 88p. incl. illus. diagrs. refs. (Rept. no. FR113-1149) (AFOSR-64-2475) (AF 49(638)1149) AD 609812 Unclassified

A combined theoretical and experimental investigation of the magnetohydrodynamics of a magnetically driven vortex, including both a closed cycle (homopolar) and open cycle (helical) configuration, constructed in this laboratory, was made. The theory of the magnetohydrodynamics of the homopolar device for the general case of an incompressible conducting fluid is presented, and the resulting system of equations simplified appreciably. Detailed discussions of the two special cases of very high and very low conductivity are given. The cases of a homopolar device with a compressible fluid, and a helical device with an incompressible fluid are likewise discussed in a preliminary manner. A detailed experimental study of the homopolar device, including exhaustive measurements of the static pressure, azimuthal and radial velocities, boundary layer behavior, and the effect of a changing electrode radius was made. The experimental work concerned with the helical device was preliminary, and was limited to measurements of the net outflow velocity.

2106

Politecnico di Torino. Laboratorio de Meccanica Applicata (Italy).

ANALYSIS OF SOME EXPERIMENTAL RESULTS ON THE DISSOCIATION OF DIATOMIC GASES IN THE SHOCK TUBE, by G. Jarre. Jan. 1963, 20p. (Technical note no. 23) (AFOSR-4857) (AF 61(052)511) AD 631563 Unclassified

The experimental results, given by recent shock tube techniques, on the dissociation of diatomic gases are analyzed. A characteristic frequency of association is derived, which allows one to correlate suitably the experiments on different gases. An elementary thermodynamic derivation of the chemical rate constants is presented.

2107

Politecnico di Torino. Laboratorio di Meccanica Applicata (Italy).

EXPERIMENTAL RESEARCH WITH A SHOCK TUBE OF THE "CENTRO STUDI SULLA DINAMICA DEI FLUIDI", by A. Romiti. June 1964, 13p. incl. illus. diagrs. refs. (Scientific rept. no. 1; technical note no. 25) (AFOSR-64-1876) (AF EOAR-63-96) AD 449981 Unclassified

Shock speed, wall temperature, heat flux, and pressure measurements are given. Particularly emphasized is the description of some original results on the behavior of a metallic probe in a stream of high temperature, partially ionized gas.

2108

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

AN EXPERIMENTAL INVESTIGATION OF THE TURBULENT MIXING ON NON-HOMOGENEOUS COAXIAL JETS, by L. J. Alpinieri. Aug. 1963, 64p. incl. diagrs. (PIBAL-789) (AFOSR-5242) (AF 49(638)217) AD 421741 Unclassified

Experimental results on the turbulent mixing process between carbon dioxide and hydrogen central jets exhausting into a moving concentric stream of air are presented. The diffusion of mass and momentum only are considered, since both streams are at approximately equal temperature. Principal points of investigation are the condition of equal velocity between jets and the condition of equal mass flow per unit area between jets. Radial and axial distributions of concentration and velocity are presented. On the basis of the measurements it is concluded that no tendency towards segregation of the stream exists when either the velocities or the mass flows of the streams are equal. Furthermore, it is demonstrated that the product of local density and eddy kinematic viscosity coefficient can be assumed to be solely dependent upon the axial coordinate.

2109

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

A REVIEW OF THE WORK PERFORMED AT THE

POLYTECHNIC INSTITUTE OF BROOKLYN AEROSPACE INSTITUTE UNDER CONTRACT AF 49(638)217, by A. Ferri and R. Vaglio-Laurin. Sept. 1, 1957-Aug. 31, 1963. Sept. 1963, 3'ρ. incl. refs. (PIBAL-609) (AFOSR-5426) (AF 49(636)217) AD 621162
Unclassified

A summary is given of theoretical and experimental investigations on fundamental aspects of inviscid and viscous flow problems in the supersonic and hypersonic speed regimes.

2110

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

EXTERNAL HYPERSONIC FLOWS, by A. Ferri and R. Vaglio-Laurin. [1963] [9]p. incl. refs. (AFOSR-J436) (AF 49(638)217) AD 407697 Unclassified

Also published in Aerospace Eng., v. 22: 23-31, Jan. 1963.

An account is presented of solved and unsolved questions bearing on the analysis of flows about practical hypersonic vehicles. Fluid-mechanical aspects and features of the problem are considered first; methods of analysis for two-dimensional and general three-dimensional configurations in continuum inviscid flows, as well as recent investigations of aerodynamic characteristics in the rarified flow regime, are reviewed. Physicochemical aspects of the problem are considered next; required extensions of the aforementioned methods to include effects of chemical reactions and radiation, as well as current capabilities for determining and correlating observables in complete flow patterns, are discussed. Finally, recent investigations of trails left behind vehicles upon re-entry into the atmosphere are considered. Unsolved questions and topics for future research in each problem area are indicated.

2111

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

TURBULENT MIXING OF COAXIAL JETS, by J. L. Alpinieri. [1964] [8]p. incl. diagrs. table, refs. (AFOSR-64-2232) (AF 49(638)217) AD 452342
Unclassified

Also published in AIAA Jour., v. 2: 1560-1567, Sept. 1964.

Experimental results on the turbulent mixing process between carbon dioxide and hydrogen central jets exhausting into a moving concentric stream of air are presented. The diffusion of mass and momentum only are considered, since both streams are at approximately equal temperature. The flow velocities are in the low to high subsonic range. Principal points of investigation are the condition of equal velocity between jets and the conditions of equal mass flow per unit area between jets. Radial and axial distributions of concentration and velocity are presented. On the basis of the measurements, it is demonstrated that the product of local density and eddy kinematic viscosity coefficient can be assumed to be solely dependent upon the axial coordinate. Furthermore, it is concluded that no tendency toward segregation of the streams exist when either the velocities or the mass flows of the streams are equal. In agreement with previous results, it is found that mass appears to diffuse more readily than momentum.

2112

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

SOME PERTURBATION SOLUTIONS IN LAMINAR BOUNDARY LAYER THEORY. PART 2. THE ENERGY EQUATION, by H. Fox and P. A. Libby. [1964] [19]p. (AFOSR-64-1677) (AF 49(638)217) AD 449982
Unclassified

Also published in Jour. Fluid Mech., v. 19: 433-451, 1964.

Solutions for two types of problems involving the energy equation for flows with velocities described by the Blasius solution are presented. The first type arises in flows with arbitrary initial distributions of stagnation enthalpy and with surfaces downstream of the initial station either with constant wall enthalpy or with zero heat transfer. Exact solutions in these cases are obtained for constant $\rho\mu$ and Prandtl number of unity; they are given in terms of complete orthogonal sets of functions which can be used to obtain first- and higher-order corrections for the effects of variable $\rho\mu$, nonunity Prandtl number, and deviations of the velocity field from that described by the Blasius solution. The second type of problem pertains to flows with power-law descriptions of the wall enthalpy.

2113

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

A FURTHER NOTE ON THE CREEP ANALYSIS OF ANNULAR PLATES, by B. Venkatraman, S. A. Patel, and M. R. Birnbaum. May 1964, 13p. incl. diagrs. (PIBAL-695) (AFOSR-64-1039) (AF 49(636)1360) AD 604467
Unclassified

Also published in Jour. Franklin Inst., v. 276: 246-255, Oct. 1964.

On the basis of a creep law formulated in terms of the Tresca criterion, the creep bending of annular plates were analyzed by Venkatraman and Patel. The present note considers the solutions presented there for plates with sufficiently small holes and sufficiently large holes and quantitatively defines the transition from one solution to the other. The note concludes with the complete solution to the problem of an annular plate with its inner edge free and outer edge clamped and under uniform lateral pressure. (Contractor's abstract)

2114

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

LARGE DEFLECTIONS OF AN AXIALLY COMPRESSED OVAL CYLINDRICAL SHELL, by J. Kempner and Y. N. Chen. [1964] [7]p. incl. diagrs. table. (AFOSR-67-2067) (AF 49(638)1360) Unclassified

Also published in Proc. Eleventh Internat'l. Conf. Applied Mechanics, Munich (Germany), 1964, p. 299-305.

In the present investigation the principle of minimum potential energy is applied to the nonlinear analysis of a family of oval cylinders whose cross sections are characterized by a simplified form of an expression for the curvature proposed by Marguerre. The present approximate solution is analogous to that commonly applied in energy analyses of the circular cylinder, except that the total potential energy is no longer considered as a continuous function of a circumferential wave-length parameter. The selection of the radial deflection function is based upon those functions previously considered for the circular cylinder, as well as upon the Fourier series solution employed in the classical buckling problem of the oval cylinder.

2115

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

INVESTIGATION OF PLATES AND SHELLS UNDER EXTERNAL LOADING AND ELEVATED TEMPERATURES, by J. Kempner. Final rept. Apr. 1963, 14p. (PIBAL-664) (AFOSR-4706) (AF AFOSR-62-200) AD 407886 Unclassified

The studies briefly described stem from continuing investigations of plates and shells under external loading and elevated temperatures, and include problems of special interest to designers of missiles and aircraft. Chapter I presents the results of investigations of the effects of creep in structures, with particular emphasis on the bending of circular plates. Chapter II outlines the work performed on heat conduction problems using Biot's variational method. Chapter III discusses the problem of the buckling and postbuckling of noncircular cylindrical shells under axial compression. Chapter IV describes work on the analysis of the effects of concentrated loads applied to reinforcing frames of finite and infinitely long circular cylindrical shells. Chapter V discusses the results obtained from the analysis of the dynamic response of plastic spherical shells.

2116

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

CREEP OF COMPRESSIBLE CIRCULAR PLATES, by S. A. Patel, F. A. Cozzarelli, and B. Venkatraman. [1963] [9]p. incl. diagrs. tables. (AFOSR-J230) (AF AFOSR-62-200) AD 400685 Unclassified

Also published in Internat'l. Jour. Mech. Sci., v. 5: 77-85, 1963.

The present paper is concerned with the creep bending analysis of compressible circular plates. The analysis stems from a non-linear creep law formulated on the basis of an assumed complementary energy function for an analogous elastic material. The method of analysis is one of iteration and is applicable in general to such plates subjected to radially symmetric loads. Solutions for moments and deflexions are obtained for simply supported and clamped edge circular plates under uniformly distributed loads. (Contractor's abstract)

2117

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LAMINAR BOUNDARY LAYERS WITH CHEMICAL REACTIONS, by H. Fox. June 1964, 56p incl. diagrs. tables, refs. (PIBAL-835) (AFOSR-64-1394) (AF AFOSR-62-200) AD 605321 Unclassified

A complete discussion is presented of the chemically reacting laminar boundary layer. Included in the study are separate homogeneous and hetergeneous reactions; additionally there is considered the problem of simultaneous gas phase and wall reaction. The basic solution, under conditions of unit transport properties, i.e., mass density-viscosity product constant, Prandtl number and Schmidt unity were derived using previous devised operator techniques. For gas phase reaction the solution for the species distribution is seen to reduce to an integral equation; the temperature arising by quadrature. It is shown that simple first order results for chemistry of the usual complexity occurring in hypersonic boundary layer flows can be obtained without resort to large scale computation. The flow over a catalytic wall is derived from unit solutions to the basic problem.

2118

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

EIGENVALUES FOR THE EQUATION OF SPECIES CONSERVATION WITH HETEROGENEOUS REACTION, by G. S. Janowitz and P. A. Libby. [1964] [2]p. incl. diagr. table. (AFOSR-65-0031) (AF AFOSR-62-409) AD 611615 Unclassified

Also published in AIAA Jour., v. 2: 1849-1850, 1964.

In a prior paper, two initial value problems are presented involving the energy equation for laminar boundary layers with velocity fields described by the Blasius function. Two boundary conditions exist; in the one the wall enthalpy is constant and in the other the heat transfer is zero. The solutions for the energy distribution given can be applied to certain related problems

involving species and/or element conservation. The purpose of this note is to outline an extension of the considerations of the former paper with no gas phase reaction but with surface catalyticity in the downstream region. A number of related eigenvalues are given.

2119

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

OPTIMUM LAUNCHING OF A SATELLITE BY TWO IMPULSES OF UNEQUAL SPECIFIC IMPULSE, by L. Ting and M. Pierucci. [1963] [10]p. incl. diagrs. (AFOSR-4824) (AF AFOSR-63-1) AD 450007 Unclassified

Also published in Astronaut. Acta, v. 9: 174-183, 1963.

The problem of launching a satellite from a planet by two impulses of unequal specific impulse is investigated. When the ratio, λ, of the specific impulse of the first impulse to that of the second is less than $1/\beta$, the ratio of the radius of the planet to the radial distance of the perigee of the final orbit, i.e., $\lambda < 1/\beta$, the optimum launching orbit starts on the surface of the planet at an angle $\varphi_1 = \arccos(\lambda\beta)$, and ends at its apogee, which coincides with the perigee of the final orbit. When $\lambda \geq 1/\beta$, the optimum launching orbit is of the Hohmann type; i.e., it starts at its perigee and ends at its apogee. The latter coincides with the perigee of the final orbit for $\bar{\lambda} > \lambda > 1/\beta$ and with the apogee for $\infty > \lambda > \bar{\lambda}$ where $\bar{\lambda}$, lying between 1 and $1/\beta$, is a given function of β and α, where α is the ratio of the apogee distance of final orbit to the radius of the planet.

2120

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

LAMINAR, TRANSITIONAL, AND TURBULENT HEAT TRANSFER AFTER A SHARP CONVEX CORNER, by V. Zakkay, K. Toba, and T. -J. Kuo. [1964] [7]p. incl. diagrs. refs. (AFOSR-5318) (AF AFOSR-63-1) Unclassified

Also published in AIAA Jour., v. 2: 1389-1395, Aug. 1964.

A flow model has been previously developed for treating the boundary-layer characteristics downstream of a surface discontinuity. The flow field in the neighborhood of the discontinuity or a sharp corner is divided into three regions: the flow upstream of the discontinuity which is obtained by standard techniques, that immediately downstream which is obtained by expanding both the supersonic and subsonic flow fields upstream of the discontinuity inviscidly around the corner, and that downstream of the discontinuity. The flow in the last region is represented by a viscous nonsimilar sublayer that starts at the discontinuity and by a viscous shear layer that has the profiles immediately downstream of the discontinuity as initial conditions. Based upon this flow model, analysis has been developed using the inner and outer expansion techniques. It is the purpose of this report to improve on the treatment of the laminar analysis and to extend the technique of application of this model to include turbulent and transitional flow downstream of the corner. (Contractor's abstract)

2121

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

AXIALLY SYMMETRIC HETEROGENEOUS MIXING, by A. Ferri. Sept. 1963, 34p. (PIBAL-787) (AFOSR-5326) (AF AFOSR-63-1) AD 422973 Unclassified

Heterogeneous mixing is considered. Numerical methods are used to investigate the importance of simplifying assumptions usually introduced in the analysis of laminar mixing. Experiments on turbulent mixing are analyzed in order to obtain information on turbulent transport properties.

2122

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

APPROXIMATE ANALYTIC SOLUTIONS FOR THE RANGE OF A NONLIFTING RE-ENTRY TRAJECTORY, by T. R. Kornreich. [1963] [2]p. incl. table. (AFOSR-J1226) (AF AFOSR-63-1) AD 424299 Unclassified

Also published in AIAA Jour., v. 1: 1925-1926, Aug. 1963.

Presented is the development of approximate analytic solutions for the evaluation of the range of re-entry trajectories. An investigation was carried out to establish a simple criterion for the determination of whether a given supercircular re-entry trajectory is of the skip or direct impact type.

2123

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

GENERAL ASYMPTOTIC SUCTION SOLUTION OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER WITH HEAT TRANSFER, by M. Morduchow. [1963] [3]p. (AFOSR-J1227) (AF AFOSR-63-1) AD 424298 Unclassified

Also published in AIAA Jour., v. 1: 1949-1951, Aug. 1963.

For very large suction velocities at the wall, the asymptotic solution of the steady compressible two-dimensional laminar boundary layer over a surface of negligible curvature is derived under the following general conditions: an arbitrary prescribed axial pressure gradient, variable suction velocity, an arbitrary prescribed variable wall temperature, variable density, an arbitrary Mach number, a constant but arbitrary

Prandtl number, and constant specific heats but variable coefficients of viscosity and, hence, of heat conductivity. It is shown that the dimensionless asymptotic velocity and temperature profiles remain the same regardless of the pressure gradient and of the variability of both the suction velocity and the wall temperature. A Reynolds analogy for this solution is demonstrated. Finally, comparison of the asymptotic solution is made with recent numerical similarity solutions. (Contractor's abstract)

2124

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

INTEGRAL METHOD SOLUTIONS OF LAMINAR VISCOUS FREE-MIXING, by M. H. Steiger and M. H. Bloom. [1963] [3]p. incl. diagrs. tables. (AFOSR-J1228) (AF AFOSR-63-1) AD 424310 Unclassified

Also published in AIAA Jour., v. 1: 1672-1674, July 1963.

This paper deals with laminar, two-dimensional, symmetric and axisymmetric, incompressible, uniform pressure wakes and jets. Solutions are derived by using the simple one-strip integral method and are presented in closed form. It is shown that the present theory agrees reasonably well with other more accurate, but very cumbersome, methods of solution. Compressibility, turbulence, thermal, and other diffusive properties can be studied by analogous means.

2125

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

VORTICITY EFFECT ON HEAT TRANSFER TO THE CONICAL PORTION OF A BLUNT BODY, by L. Ting. Sept. 1963, 21p. incl. diagrs. refs. (PIBAL-797) (AFOSR-J1457) (AF AFOSR-63-1) AD 426427 Unclassified

Due to the fact that, associated with the vortical layer, there is a steep density gradient with density decreasing rapidly toward the wall, and that in the matching region the density is very low, it is permissible to neglect the product of density and gradient of first order normal velocity as compared with the product of the first order normal velocity and density gradient. With this approximation it is then possible to deduce proper matching conditions for the next order inner solution from the governing equations of next order outer solution without actually solving them. With these proper matching conditions, the differential equations for the next order inner solutions are solved. Numerical results on velocity profiles and enthalpy profiles are presented. The effects of vorticity on heat transfer and friction coefficients are obtained as functions of the outer stream Mach number and the ratio of outer stream enthalpy to wall enthalpy.

2126

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

OPTIMUM LAUNCHING TO HYPERBOLIC ORBIT BY TWO IMPULSES OF UNEQUAL SPECIFIC IMPULSE, by S. Lubard. Jan. 1964, 29p. incl. diagrs. (PIBAL-824) (AFOSR-64-0742) (AF AFOSR-63-1) AD 600963 Unclassified

Also published in Astronaut. Acta, v. 10: 138-151, 1964.

In this analysis the optimum launching of a body into a non-intersecting hyperbolic orbit by two impulses is presented. The effects of planet rotation and atmospheric drag were not included. The conclusions of this analysis can also be applied to the optimum landing on a planet from a hyperbolic orbit. Only the planar case was investigated, since this is always more economical than the non-planar case. This problem can be defined in terms of three-dimensionless parameters. It was found convenient to use λ, a and b, where λ is the ratio of the specific impulse of the first impulse to that of the second, and a and b are the ratios of the radius of the planet to the focal distance to the asymptote and to the perigee of the hyperbolic orbit respectively.

2127

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

SKIP-IMPACT CRITERIA OF A RE-ENTRY TRAJECTORY WITH NEGATIVE LIFT, by C. J. Ruger. [1964] [3]p. incl. table. (AFOSR-64-1025) (AF AFOSR-63-1) AD 440978 Unclassified

Also published in AIAA Jour., v. 2: 585-587, Mar. 1964.

For nonlifting re-entry trajectories it is known that if a nonlifting body re-enters the atmosphere with subcircular re-entry velocity the trajectory will be of the direct-impact type, whereas for a supercircular re-entry velocity the trajectory will be either a skip- or direct-impact type, depending on the values of the re-entry angle and velocity. This note presents an approximate method for determining the critical re-entry angle at which a trajectory switches from a skip- to a direct- impact type when given a re-entry velocity and a constant negative lift coefficient.

2128

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

EFFECT OF SHOCK-INDUCED VORTICITY ON THE COMPRESSIBLE BOUNDARY LAYER ALONG A FLAT PLATE, by L. Ting. [1964] [4]p. incl. diagrs. refs. (AFOSR-64-1026) (AF AFOSR-63-1) AD 440979 Unclassified

Also published in AIAA Jour., v. 2: 490-493, Mar. 1964.

Along the conical surface or the flat surface of a blunt-nosed body in high-speed flight there exists a vortical layer induced by the curved shock. It is the purpose of this paper to study the effect of the vortical layer on the boundary layer by the systematic procedure of matching the solution of the inner boundary layer to that of the outer layer.

2129

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

THE LAMINAR BOUNDARY LAYER WITH UNIFORM INJECTION, by P. A. Libby and K. Chen. June 1964, 8p. (PIBAL-836) (AFOSR-64-1395) (AF AFOSR-63-1) AD 606074 Unclassified

The non-similar velocity distribution in a two-dimensional laminar boundary layer with uniform external stream and with either uniform suction or injection is obtained by a series expansion in terms of a mass transfer parameter. The results are compared with more accurate analyses and shown to be in good agreement for a range of values of this parameter. The solution for the velocity distribution is then employed for the calculation of the distributions of energy and element mass fraction when there are imposed requirements for energy and mass balance at the exposed surface of a porous plate with uniform injection. As one example of several possible applications of these solutions, there is computed the flow associated with the injection of hydrogen into an airstream according to the flame sheet model.

2130

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

LINEARIZED ANALYSIS OF UNSTEADY, REACTING FLOWS WITH BODY FORCES, by P. M. Sforza. Sept. 1964, 19p. incl. diagrs. (PIBAL-848) (AFOSR-64-1673) (AF AFOSR-63-1) AD 609574 Unclassified

An investigation of the effect of body forces on a one-dimensional, unsteady flow of a reacting gas is presented. The model proposed for this study is that employed by Sforza and Bloom i. e. a central region of gas is perturbed from the state and flow reference values of the ambient and the subsequent temporal and spatial variations of the imposed perturbations are studied analytically. In the present report the configuration of the perturbed region is taken to be slablike; this corresponds to a steady two-dimensional jet-or-wave-like flow. Results indicate that the effect of buoyancy forces on the velocity field is inversely proportional to the amount of energy absorbed in the chemical relaxation process. In particular, solutions for the case of very small chemical energy absorption become unbounded with time within the present approximation. (Contractor's abstract)

2131

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

SIMILARITY IN AXISYMMETRIC VISCOUS FREE MIXING WITH STREAMWISE PRESSURE GRADIENT, by M. H. Steiger. [1964] [1]p. (AFOSR-65-0918) (AF AFOSR-63-1) AD 617235 Unclassified

Also published in AIAA Jour., v. 2: 1509, Aug. 1964.

An earlier paper presented a nonlinear similarity equation for axisymmetric free-mixing with pressure gradients. In this note a brief derivation is presented of the axisymmetric similarity equation in more general form, and a particular solution is presented which may be expressed in closed form.

2132

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

ON THE COMPRESSIBLE LAMINAR BOUNDARY LAYER WITH SUCTION, by M. Morduchow and S. P. Reyle. Oct. 1963, 67p. (PIBAL-607) (AF AFOSR-63-1) AD 436886 Unclassified

The compressible laminar boundary layer in a pressure gradient with suction, for a Prandtl number of unity and a linear viscosity-temperature relation, is analyzed on the basis of the momentum and thermal integral equations in conjunction with sixth and (for separation) seventh degree velocity, and seventh degree stagnation enthalpy profiles. For flows over a flat plate, and for flows in a pressure gradient, straight-forward and simple methods of calculating the boundary layer for a given Mach number, a given uniform wall temperature, and a given suction distribution are shown.

2133

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

A STUDY OF THE IMPULSIVE MOTION OF A SEMI-INFINITE FLAT PLATE USING A LINEAR MODEL OF THE UNSTEADY BOUNDARY LAYER EQUATIONS, by R. C. Ackerberg. Dec. 1963, 23p. (PIBAL-621) (AF AFOSR-63-1) AD 602667 Unclassified

The impulsive motion of a semi-infinite flat plate in a fluid initially at rest is studied using a linear model of the unsteady boundary layer equations (introduced by Stewartson) and conventional Fourier and Laplace transform techniques. By imposing the physical condition that the skin friction be integrable at the leading edge, a unique solution is found which agrees with that obtained by Stewartson using a different method. All transforms are inverted in a formal way using a theorem on Laplace transforms due to Van der Pol, and the non-unique solutions are discussed.

2134

Polytechnic Inst. of Brooklyn. Dept. of Aerospace Engineering and Applied Mechanics, N. Y.

CREEP DEFORMATIONS IN MEMBRANE SHELLS, by F. A. Cozzarelli and S. A. Patel. [1964] [16]p. incl. diagrs. (AFOSR-64-2246) (AF AFOSR-63-419) Unclassified

Also published in Jour. Franklin Inst., v. 277: 45-60, July 1964.

Creep deflections in membrane shells are analyzed in this report. Governing equations are developed in detail for shells with one infinitely large radius of curvature, and for circumferentially closed shells of revolution. For illustration, solutions are obtained for a circular cone under wind load; a cycloidal vault under uniform dead load; and a hemispherical cap under wind load. (Contractor's abstract)

2135

Polytechnic Inst. of Brooklyn. [Dept. of Aerospace Engineering and Applied Mechanics] N. Y.

CREEP OF ANNULAR PLATES UNDER SYMMETRICAL LATERAL PRESSURE, by S. A. Patel. [1964] [5]p. incl. tables. (AFOSR-65-0921) (AF AFOSR-63-419) AD 419425 Unclassified

Also published in Proc. Conf. on Thermal Loading and Creep, Westminster (Gt. Brit.) 1964.

This paper investigates the creep bending of annular plates subjected to radially symmetric loads. The analysis is based on a non-linear creep law formulated in terms similar to those used in plasticity theory. The method of solution involves an iterative procedure applicable, in general, to such problems. The solutions for moments and deflections are given for some particular examples.

2136

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

SHOCK-WAVE PROPAGATION IN LIQUID PROPELLANT ROCKET ENGINES, by W. Chinitz and V. D. Agosta. [1964] [19]p. incl. diagrs. refs. (AFOSR-65-0565) (AF 49(638)165) AD 614201 Unclassified

Also published in Pyrodynamics, v. 1: 299-317, 1964.

A model is presented for longitudinal shock-wave propagation in liquid propellant rocket engines. The equations, which include the effects of gaseous dissociation, contain appropriate terms to account for the drag, possible shattering, evaporation, and subsequent combustion of the liquid fuel drops. The equations are solved numerically on a digital computer. A comparison of the results obtained with previous experimental work performed in a shock tube indicates good agreement for shock-wave pressure ratios above about 3.5.

2137

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

LONGITUDINAL WAVE PROPAGATION IN LIQUID PROPELLANT ROCKET MOTORS, by S. S. Hammer and V. D. Agosta. [1964] [3]p. incl. diagr. (AFOSR-65-0573) (AF 49(638)1263) AD 615187 Unclassified

Also published in AIAA Jour., v. 2: 2042-2044, Nov. 1964.

Longitudinal wave propagation studies are being conducted in a liquid propellant rocket motor in order to define the parameters that determine whether an input disturbance will attenuate or amplify. This has an important relation to combustion instability. Some recent experimental data on wave-shape behavior in a liquid rocket motor and measurements of the effect of Mach number on the frequency of wave propagation are presented.

2138

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

ON LINEAR EQUATIONS OF ISOTROPIC ELASTIC PLATES AND SHELLS, by Y.-Y. Yu. Feb. 1964, 34p. (Scientific rept. no. 2) (AFOSR-64-2088) (AF 49(638)-1290) AD 610139 Unclassified

Also published in Jour. Franklin Inst., v. 280: 395-416, Nov. 1965.

A generalized Hamilton's principle and the associated variational equation of motion for nonlinear elasticity theory were given in a previous paper. Presented in this paper is a modified linearized version, from which the corresponding variational principle for an isotropic shell of arbitrary thickness is deduced by means of the series expansion method. The complete system of shell equations are obtained as the Euler equations. These reduce to Mindlin's result for isotropic plates as a special case. When the infinite series is truncated, the first-order approximation yields for the shell the stress equations of motion of the usual type, the strain-displacement relations given previously by Sanders, and, with the exception of those for transverse shearing stresses and strains, the stress-strain relations that are reducible to those given by Reissner.

2139

Polytechnic Inst. of Brooklyn. Dept. of Mechanical Engineering, N. Y.

GENERALIZED HAMILTON'S PRINCIPLE AND VARIATIONAL EQUATION OF MOTION IN NONLINEAR ELASTICITY THEORY, WITH APPLICATION TO PLATE THEORY, by Y.-Y. Yu. [1964] [10]p. incl. refs. (AFOSR-64-0912) (AF AFOSR-63-60) AD 439867 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 36: 111-120, Jan. 1964.

A generalized Hamilton's principle and the associated variational equation of motion are presented for finite elastic deformations. By means of the generalized variational equation of motion, it is possible to deduce immediately the usual nonlinear equations of elasticity, such as were discussed by Novozhilov. The inconsistency in Novozhilov's work for a simplified nonlinear case of technical importance is pointed out. In its linearized version, the generalized variational equation of motion is next employed in the derivation of plate equations for both flexural and extensional motions, which are finally compared with those given by previous authors.

2140

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

VISCOELASTIC DAMPING OF VIBRATIONS OF SANDWICH PLATES AND SHELLS, by Y.-Y. Yu. [1964] [21]p. incl. diagrs. refs. (AFOSR-65-0919) (AF AFOSR-63-60) AD 617987 Unclassified

Also published in Proc. I.A.S.S. Symposium on Non-Classical Shell Problems, Warsaw (Poland) (Sept. 2-5, 1963), Amsterdam, North Holland Publishing Co., 1964, p. 551-571.

This note studies the viscoelastic damping of vibrations of sandwich plates and shells. A variational principle is presented which may be considered as a generalized Hamilton's principle. It is used in the derivation of the complete system of equations for a sandwich cylindrical shell, which are reducible to those of a sandwich plate as a special case. The equations of the sandwich plate and cylindrical shell are then used to investigate the undamped vibrations of these structures. An analysis is given of the coupling between the flexural and extensional motions of the sandwich cylindrical shell as well as a demonstration of the importance of transverse shear deformation in the vibrations of the sandwich plate and cylindrical shell. Finally, the effectiveness of viscoelastic damping of vibrations in the sandwich plate and cylindrical shell is investigated through the use of the concept of the damping parameters.

2141

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

PRESSURE GRADIENTS IN A LIQUID PROPELLANT ROCKET MOTOR, by W. T. Peschke and S. S. Hammer. [1964] [3]p. incl. diagrs. (AFOSR-65-1478) (AF AFOSR-63-86) AD 622838 Unclassified

Also published in AIAA Jour., v. 2: 1467-1469, Aug. 1964.

The characteristic gradients or signatures produced by various injectors are important parameters in determining the stability or instability of a thrust chamber system. In this report various injectors are tested and data presented both as pressure vs axial distance and pressure gradient vs the average axial distance over which the gradient was computed. The data can be used to establish design criteria for steady-state operation and to predict critical conditions that can exist because of large pressure gradients that result in high heat-transfer rates to the injector face or rocket chamber wall.

2142

Polytechnic Inst. of Brooklyn. [Dept. of Mechanical Engineering] N. Y.

PROPAGATION OF SOUND IN A REACTING GAS MIXTURE NEAR EQUILIBRIUM, by J. J. Roseman and V. D. Agosta. [1964] 32p. (PIBAL-796) (AFOSR-65-2307) (AF AFOSR-63-86) AD 627904 Unclassified

Presented at Third Conf. on Performance of High Temperature Systems, Pasadena, Calif., Dec. 7-9, 1964.

The one-dimensional propagation of sound and the significance of the two sound speeds (frozen and equilibrium) is examined in detail for the case of a gas mixture at or near equilibrium, consisting of gases which obey the ideal gas law and Dalton's law of partial pressures and which have all their degrees of freedom fully excited.

2143

Polytechnic Inst. of Brooklyn. Dept. of Physics, N. Y.

TUNGSTEN (110) SURFACE CHARACTERISTICS IN LOW-ENERGY ELECTRON DIFFRACTION, by R. M. Stern. [1964] [3]p. incl. illus. diagrs. (AFOSR-65-0774) (AF 49(638)1369) AD 617828 Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 218-220, Dec. 1, 1964.

This investigation studies the diffraction patterns of tungsten (110) surfaces of crystals. When observed in post accelerated low-energy electron diffraction, the surfaces do not exhibit the expected diffraction pattern. Instead, 3 different patterns are seen: a basic pattern having twofold symmetry, its mirror image, and a superposition of the 2 patterns. This results from an impurity in the crystal which is shown to be carbon. Two possible structures are proposed which would give rise to the 3 patterns: a super-lattice consisting of the points of coincidence of a regular (110) plane mesh with one which has been slightly distorted and rotated by the carbon impurity, and a stable tungsten-carbon compound. The adsorption of oxygen on the tungsten (110) surface is also discussed.

2144

Polytechnic Inst. of Brooklyn. Dept. of Physics, N. Y.

FREE ELECTRON MODEL CALCULATION OF THE DEPENDENCE OF THE ATTENUATION OF TRANSVERSE SOUND WAVES ON A MAGNETIC FIELD

PARALLEL TO THE LATTICE DISPLACEMENT, by H. L. Grubin. [1983] 79p. incl. tables. (AFOSR-4725) (AF AFOSR-82-258) AD 410109 Unclassified

The results of a calculation of the attenuation of ultrasonic waves in a metal when a dc magnetic field is present in a direction parallel to the polarization direction of a sound wave is described. A principal part of the report includes tables of use to anyone interested in attenuation calculations. Graphical results for the case in question are included.

2145

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

WIDE-SENSE MARKOFF SEQUENCES AND RECURSIVE FILTERING, by A. Papoulis. June 25, 1964, 14p. (PIBMRI-1230-84) (AFOSR-64-1375) (AF 49(838)1402) AD 804041 Unclassified

In the introductory section of the paper, the orthogonality principle for random variables is stated and proved. This principle is the basis of all linear mean square estimations. In the second section, a number of basic properties of wide-sense Markoff sequences is given. It is finally shown that recursive filtering is an immediate consequence of the orthogonality principle.

2148

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

DECOMPOSITION AND STATE ASSIGNMENT FOR SEQUENTIAL MACHINES, by Z. Kohavi. Aug. 19, 1964, 33p. incl. diagrs. tables. (PIBMRI-1231-84) (AFOSR-84-1487) (AF 49(638)1402) AD 809253 Unclassified

Necessary and sufficient conditions are developed for two (or more) machines to be cascade decomposable in such a way that both have one common component machine that may be factored and shared by the two machines. To obtain the common machine the concept of implication table is introduced. The implication table is shown to be the state table of the factored machine. It is further shown how machines that do not obey these conditions can be augmented in such a way that the conditions are satisfied and the factoring is possible. The problem of reducing the output circuit is also considered. For machines that do not have any partition with substitution property or partition pairs it is shown how to obtain simpler assignments and output circuits with reduced dependencies by recognizing the partially independent subsets.

2147

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

HIGH-FREQUENCY COMPENSATION OF TRANSISTORS, by S. Deutsch, J. G. Corbellini and others. Aug. 1964 [22]p. incl. diagrs. tables. (PIBMRI-1234-64) (AFOSR-64-1831) (AF 49(838)1402) AD 608131 Unclassified

If a relatively small collector load resistor is used so that the gain of a transistor stage is low, the addition of a peaking coil yields substantial improvements in bandwidth or rise time. Still further improvements result from the use of a peaking capacitor in addition to the coil. Normalized values of L and C are derived for critically damped transient, maximally-flat amplitude and maximally-flat delay designs. The associated response curves are also given. (Contractor's abstract)

2148

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

METHODS OF MEASURING INACCESSIBLE ARBITRARY LINEAR MICROWAVE TWO-PORTS, by H. M. Altschuler. Sept. 8, 1964 [154]p. incl. diagrs. tables, refs. (PIBMRI-1238-64) (AFOSR-64-2367) (AF 49-(638)1402) AD 610230 Unclassified

New methods have been developed which make possible the measurement of the complete network description of inaccessible, arbitrary, linear microwave two-ports located in highly frequency sensitive environments and under the constraint of very low permissible power levels. Here "arbitrary" implies that the unknown two-port, r, may be nonreciprocal or reciprocal, active or passive, and symmetric or asymmetric; "inaccessible" is meant to describe two-port r as being located between two other unknown, perhaps arbitrary, two-ports, x and y, which are of no interest in themselves. The constraint that two-ports x and y cannot be measured independently of each other is also imposed. While the measurement methods and the associated network problems are stressed, the circuitry developed for actually carrying out such measurements and the results of experiments intended to demonstrate the capability of this system are also given.

2149

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

PROCEEDINGS OF THE SYMPOSIUM ON QUASI-OPTICS, New York June 8-10, 1964, Vol. XIV, ed. by J. Fox. Brooklyn, Polytechnic Press, 1964, 1v. incl. illus. diagrs. tables, refs. (AFOSR-65-0260) (In cooperation with the IEEE and Optical Society of America) (AF 49(838)1402) AD 454666 Unclassified

Papers are presented on the following topics: Quasi-Optic Diffraction; The Progressing Wave Formalism; Generalized Scattering Matrix Analysis of Waveguide Discontinuity Problems; Cerenkov Radiation and Allied Phenomena; Coupling and Conversion Coefficients for Optical Modes; Beam tracing and Applications; Semi-Geometric-Optical Approaches to Scattering Phenomena; and Microwave Model Techniques to Study VLF Radio Propagation in the Earth-Ionosphere Waveguide.

2150

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SINGULAR LINEAR SEQUENTIAL MACHINES: SOME FURTHER GROUP PROPERTIES AND CANONICAL FORM REALIZATIONS, by P. Lavallee. Oct. 12, 1964, 20p. (PIBMRI-1250-64) (AF 49(638)1402) AD 612642 Unclassified

Singular autonomous linear sequential machines are analyzed following simple group properties introduced by Gill (IEEE Trans. Electron. Comput., v. EC-13: 226-231, June 1964). It is shown that the set of junction states for the confluence sets form a group, with as normal subgroup, the sets of states on the cycle sets. The set of states mapping into the null (0) state also forms a group called the null tree group. The cycle set group and the null tree group are realized separately and the direct sum of these two groups completely characterizes the operation of the machine. The null tree is shown to be characterized by a set of m disjoint paths: to each of these paths there corresponds a shift register having as many delay elements as there are states in that path.

2151

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A SUMMARY OF CURRENT RESEARCH AT THE MICROWAVE RESEARCH INSTITUTE, by E. Weber. Progress rept. no. 26, Apr. 1-Sept. 30, 1964, 149p. (PIBMRI-R-452.26-64) (AF 49(638)1402) AD 609133 Unclassified

Contributions are compiled under six descriptive subject headings: electromagnetics, plasma electrophysics and electronics, solid state and materials research, microwave circuits, network theory, and systems, communications, and control.

2152

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE IDENTIFICATION OF OVERDAMPED PROCESSES IN THE TIME-DOMAIN, by J. M. Mendel. Apr. 19, 1963, 142p. incl. diagrs. tables, refs. (PIBMRI-1131-63) (AFOSR-4927) (AF AFOSR-62-280) AD 407687 Unclassified

The problem of characterizing overdamped systems, from data in the time-domain, by means of exponential functions is studied. Particular attention is given to: (1) the choice of a suitable error criterion based upon performance measures the approximate system is to meet; (2) the choice of weighting functions and their effect on the approximations; and (3) the extension of the orthonormal exponential approximations of Kautz and Huggins to approximations of any asymptotic-order in the s-domain.

2153

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ON SENSITIVITY IN OPTIMAL CONTROL SYSTEMS, by P. Dorato. [1963] [2]p. (AFOSR-J1522) (AF AFOSR-62-280) AD 427952 Unclassified

Also published in IEEE Trans. Automatic Control., v. AC-8: 256-257, July 1963.

The sensitivity problem in optimal control systems is discussed and a procedure for sensitivity analysis in the case of small parameter variations is worked out. The performance index is set down as a function of the input where the plant (controlled object) output is related to the plant input (control input) by a vector differential equation. The procedure for the evaluation of the variations in the performance index due to infinitesimal parameter variations is worked out. The relative merits of closed-loop and open-loop control with respect to the sensitivity problem are compared.

2154

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ADAPTIVE CONTROL, by L. Braun and J. G. Truxal. [1964] [8]p. incl. diagrs. refs. (AFOSR-64-1315) (AF AFOSR-62-280) AD 444270 Unclassified

Also published in Appl. Mech. Rev., v. 17: 501-508, July 1964.

Approximately seven years ago, a new control concept fired up the imaginations of most engineers and scientists working in the field of automatic control. This was the concept of inclusion within a control system of the capability to adapt to changes in system input signals and/or system parameters. This paper is concerned with a brief consideration of the basic concepts of such systems and certain means which have been devised to implement these concepts.

2155

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

STABILITY ANALYSIS OF NONLINEAR SYSTEMS IN THE PARAMETER PLANE, by M. L. Shooman. [1964] [3]p. incl. diagrs. tables, refs. (AFOSR-64-2316) (AF AFOSR-62-280) AD 452329 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-9: 267-269, July 1964.

This paper treats the analysis of nonlinear systems in the parameter plane. A stability diagram is drawn using the Routh test or an analog computer to obtain the stability boundary-(s). The technique may be applied to a system with one nonlinearity after replacing the nonlinearity with a describing function model. If the system contains two type-one nonlinearities, both are

replaced by describing functions models and the system constraints on these models are computed. The latter method is superior to the lumping of the two nonlinearities together with any interstitial dynamics into a frequency dependent describing function, which in most cases is too complex to be practical.

2156

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

SENSITIVITY AND STABILITY IN MULTILOOP SYSTEMS, by R. A. Haddad and J. G. Truxal. [1964] [8]p. incl. diagrs. table. (AFOSR-64-2416) (AF AFOSR-62-280) Unclassified

Also published in Proc. Joint Automatic Control Conf., Stanford U., Calif., June 1964, p. 162-169.

The stability of a multiloop, multiparameter system is studied from the standpoint of the system sensitivity functions. A correlation is found between relative stability with respect to a parameter and the real-frequency behavior of the corresponding sensitivity function. A pair of stability margins, the parameter gain and parameter phase margins, is introduced to provide a quantitative measure of the destabilizing effects of a parameter variation. These margins are shown to be multiloop generalizations of the familiar gain and phase margins of the single-loop servo system.

2157

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

REAL-FREQUENCY STABILITY CRITERIA FOR LINEAR TIME-VARYING SYSTEMS, by J. J. Bongiorno, Jr. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0323) (AF AFOSR-62-280) AD 611742 Unclassified

Also published in Proc. IEEE, v. 52: 832-841, July 1964.

Bounds on the time-varying parameters that are sufficient to insure stability in linear time-varying systems are developed. The important and significant property of the stability criterion developed is that the bounds on the time-varying parameters can be established from the real-frequency characteristics of the time-invariant part of the system. Therefore, the stability criterion is applied easily in high-order systems. Techniques which permit the determination of decaying exponential bounds on the system signals are also presented. The application of the results obtained to parametric devices, satellite attitude control and adaptive systems is illustrated via examples.

2158

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

SINGULAR NETWORK ELEMENTS, by H. J. Carlin. [1964] [6]p. incl. diagrs. (AFOSR-65-0621) (AF AFOSR-62-280) AD 613919 Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-11: 67-72, Mar. 1964.

The properties of n-ports can be examined in terms of simple properties of linear vector spaces. This approach leads to a very general type of network formalism which in turn casts light on the physical realizability (or nonrealizability) of the singular linear network elements: the nullator (simultaneously an open and a short circuit), and the norator (the unique nonreciprocal one-port with arbitrary port voltage and current). Furthermore, a two-port (the "nullor") which combines these two elements can be shown to be a unique active building block which exhibits the extraordinary nature of the two singular one-ports, but which has other properties which make it amenable for use in practical systems.

2159

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE STABILITY OF LINEAR SYSTEMS, by D. C. Youla. [1963] [4]p. (AFOSR-65-0622) (AF AFOSR-62-280) AD 616464 Unclassified

Also published in IEEE Trans. Circuit Theory, v. CT-10: 276-279, June 1963.

A linear system is considered which is describable in terms of the input-output equation: $y(t) = \int_0^t W(t,\tau)x(\tau)d\tau$, $t \geq 0$. The stability of a linear system is defined and the theorem established that a linear system of the form given above with two additional requirements is stable if and only if there exists a quite constant C such that $\int_0^t |W(t,\tau)|d\tau < C$.

2160

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ON THE USE OF ORTHOGONAL EXPONENTIALS IN A FEEDBACK APPLICATION, by J. M. Mendel. [1964] [3]p. incl. diagrs. (AFOSR-65-0638) (AF AFOSR-62-280) AD 615354 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-[9]: 310-312, July 1964.

This paper presents a discussion of the use of orthogonal exponentials in a time domain identification of a plant f(t) located in the forward path of a feedback control system. The identification $f_a(t)$ is subject to the constraint that it is to be used in place of the actual plant in a stability analysis of the closed-loop system.

2161

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

FREQUENCY MODULATION NOISE, by J. T. Frankle. [1964] [70]p. (PIBMRI-1041-62) (AFOSR-4504) (AF AFOSR-62-295) AD 608942 Unclassified

The noise characteristics of a commercial FM receiver were determined experimentally and compared with the theoretical results of Middleton and Stumpers. The theoretical solutions are derived on the basis of both gaussian and rectangular receiver IF characteristics. The experimental results follow the rectangular solution for low carrier to noise ratio and the gaussian solution for high carrier to noise ratio. This is explained by the characteristics of the receiver and FM noise theory. A novel technique, employing an envelope detector, is used to measure carrier to noise ratio prior to the FM detector.

2162

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

CANONICAL FORM OF TWO TANDEM-CONNECTED FOUR-PORTS, by A. L. Reynolds. June 1963, 44p. incl. diagrs. tables. (PIBMRI-1092-62) (AFOSR-4547) (AF AFOSR-62-295) AD 296228 Unclassified

Under the rather general conditions it is possible to represent a 4-port by means of an ideal directional-coupler together with certain 2-ports in each of its lines. Such a representation is called the 'canonical-form' of the given 4-port. The canonical-form of two tandem-connected 4-ports and the coupling coefficient of the associated ideal directional coupler are determined. The presentation is of a thoeretical nature.

2163

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ERROR CONTROL IN DIGITAL COMMUNICATION, by A. M. Manders. Jan. 1963, 73p. incl. diagrs. (PIBMRI-1076-62) (AFOSR-4688) (AF AFOSR-62-295) AD 402113 Unclassified

A solution to the problem of obtaining the maximum transmission rate subject to a fixed permissible error rate and a fixed equipment complexity is studied. The method by which this is accomplished is to use an error correcting device (ECD) that examines the signal for signs that a burst of impulse noise is likely to have occurred. The bits that are in doubt are erased and replaced by use of a two-dimensional parity check. This method allows a few errors to pass undetected by the ECD and will therefore give a small but definite probability of errors in the presence of noise bursts. Some of these errors can be corrected if the code used has some error correction capability.

2164

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ANALYSIS AND SYNTHESIS OF SEQUENTIAL SWITCHING CIRCUITS, by Z. Kohavi. June 1963, 88p. incl. diagrs. refs. (PIBMRI-1090-62) (AFOSR-4718) (AF AFOSR-62-295) AD 297066; AD 406097 Unclassified

Two of the most difficult problems in the synthesis of the sequential switching circuits are discussed: the problem of simplifying the flow tables of completely and incompletely specified switching functions; and the problem of assigning the secondary variables to the different states of the circuit. A graphical method is developed for the reduction of the number of states in the sequential machine. The method simplifies the techniques of finding the closed sets of compatibles which from the new set of states of the reduced machine. The last chapter includes further development of existing methods for the secondary assignment for both synchronous and asynchronous sequential machines. A discussion is also given on the decomposition of sequential machines and its relations to the secondary assignment. (Contractor's abstract)

2165

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE MATRIX MANIPULATION OF BILINEAR TRANSFORMATIONS, by H. M. Altschuler. Apr. 9, 1963, 11p. (PIBMRI-1137-63) (AFOSR-4721) (AF AFOSR-62-295) AD 403278 Unclassified

The matrix character of bilinear transformations is explored, "bilinear matrices" are described, and the rules which govern their use are established. Bilinear matrices find their application in simplifying many manipulations which involve bilinear transformations. Several simple examples of such applications are given and short tables of bilinear matrices pertinent to microwave networks are included.

2166

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SMALL SAMPLE SEQUENTIAL DETECTION, by R. R. Boorstyn. Apr. 1963, 56p. (PIBMRI-1128-63) (AFOSR-4722) (AF AFOSR-62-295) AD 403431 Unclassified

Wald's sequential analysis was applied to problems in statistical communications. These techniques are extended to the class of applications requiring small sample size, for which the elegant results of Wald are inapplicable. The method for solution is discussed in detail and then applied to three examples, two of which are of extreme importance in communications work -- the normal (Gaussian) and Rayleigh distributions.

Briefly, it is demonstrated that even for very small average sample sizes a significant improvement is obtained.

2167

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

5 REACTANCE 3 TERMINAL PEAKING CIRCUIT, by L. E. Foley. Feb. 28, 1963, 25p. incl. diagrs. tables. (PIBMRI-1119-63) (AFOSR-4724) (AF AFOSR-62-295) AD 400264 Unclassified

A five reactive network with three terminals is analyzed on a normalized basis and compared to the simple RC network which will be called the uncompensated reference. Two capacitive elements in the network represent the division of the distributed parasitic capacitance into lumped elements while the remaining three elements are physical entities. After the parameters for the reactive elements have been selected the normalized equations for amplitude, time delay, and step response are derived and plotted for comparative purposes. Pole-zero plots are also drawn to give a more succinct picture of the networks analyzed.

2168

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE INTERCHANGE OF SOURCE AND DETECTOR IN MICROWAVE MEASUREMENTS, by H. M. Altschuler. Apr. 11, 1963 [17]p. incl. diagrs. (PIBMRI-1149-63) (AFOSR-4830) (AF AFOSR-62-295) AD 403390 Unclassified

The technique for interchanging generator and detector in the impedance measurement of microwave one-ports is a useful, known procedure often applied when low powers are indicated. The necessary and sufficient conditions for the validity of such measurements are critically examined and direct extensions of this technique to similar measurements of reciprocal two-ports are given. A completely separate analysis is necessary when such an interchange is made in the case of an interference bridge to be used for the determination of the scattering parameters of general (active or passive and reciprocal or nonreciprocal) two-ports. This analysis is presented in detail.

2169

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

LONG LINE EFFECT IN CONNECTION WITH CAVITY RESONANCES, by H. M. Altschuler. Apr. 17, 1963, 12p. incl. diagrs. (PIBMRI-1148-63) (AFOSR-4831) (AF AFOSR-62-295) Unclassified

When resonant cavities are separated from relatively small obstacles by long waveguides, either multiple resonances or resonant frequency shifts may occur. This long line effect is explored for both transmission and reflection cavities and is found to be much more serious in the former than in the latter case. It can usually be eliminated by matching procedures. (Contractor's abstract)

2170

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SWITCHING NETWORKS BY LINEAR GRAPH THEORY, by P. Lavallee. May 13, 1963, 42p. incl. refs. (PIBMRI-1146-63) (AFOSR-4962) (AF AFOSR-62-295) AD 406896 Unclassified

An analytic tool in the realization of circuit matrices is presented. The method is based on forming linear trees with each row of a fundamental circuit matrix and combining them to form a tree of the graph. With this method, more difficult problems in the synthesis of contact networks by linear graph theory can be considered. A method of simultaneous synthesis is developed in which two or more switching functions are realized by sharing contacts in an optimal form. Finally the multi-terminal procedures are extended to the synthesis of non-bilateral, 1 port switching networks.

2171

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

SYNTHESIS OF TWO-TERMINAL CONTACT-DIODE NETWORKS, by E. J. Smith, C. M. Healy, and W. C. W. Mow. Apr. 15, 1963 [25]p. incl. diagrs. refs. (PIBMRI-1144-63) (AFOSR-5086) (AF AFOSR-62-295) AD 410150 Unclassified

An approach to the design of contact-diode networks having different forward and reverse transmission functions is described. Linear graph theory forms the basis for the synthesis procedure which is an extension of Gould's method. The properties of single-diode networks are considered first. For such networks, the two specified forward and reverse transmission functions are mapped onto a single-contact switching function. Next, an oriented circuit matrix is obtained and the synthesis of a graph corresponding to the matrix is attempted on a maximum-loop basis. If no graph exists, the number of columns in the matrix (correspondingly increasing the number of diodes or contacts) must be increased until one such matrix yields a realizable network.

2172

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE DYNAMICS OF GYROSCOPE DAMPING FOR GEOCENTRIC ATTITUDE CONTROL, by M. Messinger and H. E. Parker. May 1963, 119p. incl. diagrs. refs. (PIBMRI-1147-63) (AFOSR-64-0350) (AF AFOSR-62-295) AD 419083 Unclassified

The geocentric attitude stabilization of an earth satellite is studied. The system considered in this report utilizes differential gravity to control the vehicles orientation and gyroscopes to provide vehicle damping. Several different gyroscope configurations that provide indirect gyroscope damping about all three of the vehicle axes are presented. For each of these configurations, the equations governing the dynamics of the system are systematically developed in terms of the attitude deviation angles and the parameters of the orbit. The expressions for the steady state deviation angles and the torque which must be supplied by gyroscope torquers are also obtained. (Contractor's abstract, in part)

2173

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

NOISE ANALYSIS OF AN AUTOMATIC GAIN CONTROL SYSTEM, by H. Schachter and L. Bergstein. [1964] [7]p. incl. diagrs. (AFOSR-64-2138) (AF AFOSR-62-295) AD 452286 Unclassified

Also published in IEEE Trans. Automatic Control, v. AC-[9]: 249-255, July 1964.

A common automatic gain control system is analyzed for a white Gaussian noise input and the effects of the noise on the gain of the system are found. Relations are found between the parameters of the system and the mean and variance of the gain, and the parameters are determined that will reduce the ripple caused by the input noise to a minimum. (Contractor's abstract)

2174

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

GENERALIZED TIME-SPACE PERIODIC MODULATION IN CYCLOTRON PARAMETRIC AMPLIFIERS, by E. S. Cassedy, Jr. Mar. 4, 1963, 15p. (PIBMRI-1133-63) (AFOSR-65-1720) (AF AFOSR-62-295) AD 624078 Unclassified

It is proposed to investigate the coupling of electron beam modes under the influence of parametric pumping fields. The effects of the complete set of time-space harmonics are included in the study, as well as additional coupling mechanisms created by pump harmonics. A particular condition, called the synchronous harmonic condition, is predicted and proposed for theoretical and experimental study. None of the time-space harmonics may be neglected in this condition created by a traveling wave-quadrupole pumping field. This condition, fully explored, could be the basis for a new device: a synchronous harmonic generator. A comprehensive study of parametric wave coupling in cyclotron devices is proposed with pump conditions ranging from dc to the adler type pump and various pump field configurations considered for the quantitative effects on amplification efficiency and extraneous coupling. The new approach proposed is the complete treatment of all harmonics created by the pump modulation, making no assumptions a priori as to which coupling components are present.

2175

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

PROBING OF THE DYNAMICAL RESPONSE OF A PLASMA, by H. Friedman. June 1963, 48p. incl. illus. diagrs. (PIBMRI-1168-63) (AFOSR-65-1721) (AF AFOSR-62-295) AD 624081 Unclassified

The dynamical response of a gaseous plasma to the self-induced magnetic fields in a toroid switch tube is experimentally investigated using a magnetic field probe and a set of excitation current measurements. The magnetic field, experimentally measured, is compared with the representation of the plasma current distribution as an ideal current sheet. The excitation current measurements reveal oscillations in the plasma whose detailed nature, unexplainable by the current sheet model, may yield information on the thermal pressure within the plasma. (Contractor's abstract)

2176

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

THE ELECTROMAGNETIC FIELDS OF CERTAIN UNIAXIALLY ANISOTROPIC DIELECTRIC SLABS, by F. M. Labianca. Apr. 9, 1963, 41p. (PIBMRI-1151-63) (AF AFOSR-62-295) AD 405754 Unclassified

Two problems are considered. In the first problem, the properties of surface waves propagating in a slab of uniaxially anisotropic dielectric are studied. Two cases are studied simultaneously, one being the case where the optical axis is chosen parallel to the slab, and the other being the case where the optical axis is chosen perpendicular to the slab. It is found that at any frequency the resonances are finite in number. In the second problem, the electromagnetic fields of a uniaxially anisotropic plasma slab in the presence of a magnetic line source are studied. The geometry is the same as for the first problem, except that the optical axis is chosen parallel to the slab and perpendicular to the direction of the line source.

2177

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

TUDY OF THE APPLICATION OF CODING THEORY, A. E. Laemmel. Final rept. Feb. 27, 1964, 93p. MRI-1206-64) (AF AFOSR-62-295) AD 601696 Unclassified

This report deals mostly with discrete codes. The codes which are discussed are used principally to compress information into the fewest possible digits, and little attention is given to error-reducing codes.

Several other aspects of coding processes beside information-compression are considered and some coding process results might better be classified under finite state machine theory. Also, some attention has been given to digital computer design and synthesis.

2178

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

SECONDARY STATE ASSIGNMENT FOR SEQUENTIAL MACHINES, by Z. Kohavi. Mar. 1963, 26p. (PIBMRI-1174-63) (AFOSR-5159) (AF AFOSR-63-453) AD 409277 Unclassified

Also published in IEEE Trans. on Electron. Comput., v. EC-13: 193-203, June 1964.

A method is presented for obtaining for any given machine, M, an equivalent machine, M, which has a partition with the substitution property and therefore can be decomposed into several submachines connected in cascade or in parallel. It is also shown that for machine M we can find an assignment with self dependent subsets. The method is shown to be general for any completely or incompletely specified sequential machine.

2179

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

OPTIMAL MULTIPLICATIVE CONTROL, by A. Bhojwani and P. Dorato. June 1964, 65p. (PIBMRI-1210-64) (AFOSR-64-1119) (AF AFOSR-63-453) AD 601536 Unclassified

This study is concerned with the optimal control of systems whose dynamics are represented by n first order differential equations. The systems are linear and deterministic. The performance indices considered are (1) the mean squared error, (2) the regulator problem, and (3) the minimum time problem. Pontryagin's maximum principle is used to derive the optimization equations for each of the above problems. The general theory is illustrated by various first and second order examples. A short discussion of the problem of stability and singular control is included.

2180

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

UNIAXIAL DIELECTRIC RODS IN CYLINDRICAL CAVITIES, by R. F. Lohr, Jr. Apr. 1964, 50p. (PIBMRI-1219-64) (AFOSR-64-1120) (AF AFOSR-63-453) AD 601693 Unclassified

In frequency regions well above the lowest resonant frequencies of a circularly cylindrical cavity, the mode density, i.e., the number of modes within a given, relatively small frequency interval, is generally quite high, and the identification of experimentally found resonances with specific cavity modes cannot usually be accomplished by frequency considerations alone. Two techniques useful in such identifications are presented here. One of these can be employed to gain information concerning the angular periodicity, of the mode, while the other gives an indication of its axial periodicity. A new method of measuring the dielectric constants (tensor) of a uniaxial material, which is based on the exact solution of a large dielectric rod located in a circularly cylindrical cavity is also presented.

2181

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

EFFECTS OF A STATIC MAGNETIC FIELD ON THE CHARACTERISTICS OF A HELIUM-NEON LASER, by P. Fenster. Apr. 1964, 39p. (PIBMRI-1222-64) (AFOSR-64-1121) (AF AFOSR-63-453) AD 601694 Unclassified

The application of even modest magnetic fields to the amplifying material in the helium-neon laser profoundly modifies the operational characteristics of the laser. The magnetic field introduces a Faraday effect and a Zeeman effect. Both of these effects tend to reduce the power output of the laser. A simple theory is set forth which describes the impact of these effects on the output. The experimental work which was carried out with a laser oscillating at a wavelength of 6328 A is generally in agreement with the theory. An attempt is made to explain some observed deviations from the expected results

2182

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

RESONANT MODES OF OPTIC INTERFEROMETER CAVITIES. I. PLANE-PARALLEL END REFLECTORS, by L. Bergstein and H. Schachter. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-64-1909) (AF AFOSR-63-453) AD 450313 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 887-903, July 1964.

A study is made of the resonant or normal modes of optic and quasioptic interferometer cavities with plane-parallel end reflectors. The solution of the integral equation governing the relation between the normal modes and the geometry of the cavity is found by means of a series expansion of orthogonal functions. The terms of the series for the normal modes can be interpreted as Fraunhofer diffraction patterns characteristic of the geometry of the end reflectors. Various geometries, such as the infinite-strip, rectangular, and circular end reflector cavities, are considered and the results plotted and interpreted.

2163

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

A FAST SWITCHING HIGH POWER C BAND FERRITE CIRCULATOR, by L. M. Silber and A. Weis. [1964] 5p. incl. diagrs. (AFOSR-64-2226) (AF AFOSR-63-453) AD 452370 Unclassified

Also published in IEEE Internat'l. Conv. Record, Part 2, 1964, p. 32-36.

A differential phase shift circulator for C band was developed using non-reciprocal transverse field ferrite elements of novel configuration. In this configuration the non-reciprocal phase shifters are constructed using ferrite toroids with a wire running axially inside the ferrite to magnetize it to remanence. This replaces the usual double ferrite slabs and external magnet. This configuration realizes two advantages. First, the magnetizing coil is inside the waveguide rather than outside and it is not necessary to propagate the switching pulse through the waveguide walls. Second, the ferrite toroids form a closed magnetic path. This allows the ferrite, once magnetized, to remain at remanence without having to maintain the magnetizing current. The device switched at all peak powers up to 550 kw, in 20 nano sec or less.

2164

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

ANALYSIS OF A DISTRIBUTED COUPLING STRIP LINE CIRCULATOR, by Y. Konishi. July 31, 1963 [35]p. incl. diagrs. refs. (PIBMRI-1160-63) (AFOSR-65-1722) (AF AFOSR-63-453) AD 624079 Unclassified

This paper proposes and analyzes a new type or circulator — the distributed coupling strip line circulator. It has parallel coupled strip lines partially loaded with dielectric material in order to obtain circular polarization on its surface. A ferrite bar is put on the surface of the dielectric. The equivalent circuit of the circulator is developed, and design formulas are derived for calculating the values of the elements of the equivalent circuit. (Contractor's abstract)

2165

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A SIMPLE APPROACH TO THE ZERO-CROSSING PROBLEM, by A. Papoulis. Oct. 1, 1963, 6p. incl. diagr. (PIBMRI-1194-63) (AFOSR-65-1723) (AF AFOSR-63-453) AD 624265 Unclassified

Given a normal stationary process x(t) with zero mean, the probability $p(\Delta t)$ that $x(t) = 0$ is solved for some t in the interval $(t_0, t_0 + \Delta t)$. It is found that $\cos [\pi\, p(\Delta t)] = \frac{R(\Delta t)}{R(0)}$, where $R(\tau)$ is the autocorrelation of x(t).

2166

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

EXPANSION OF A NON-PERIODIC PROCESS x(t) INTO A FOURIER SERIES WITH UNCORRELATED COEFFICIENTS, by A. Papoulis. Jan. 15, 1964, 7p. incl. diagr. (PIBMRI-1203-64) (AFOSR-65-1724) (AF AFOSR-63-453) AD 624266 Unclassified

If a stationary non-periodic process x(t) is expanded into a Fourier series in an interval $|t| < T/2$, then the coefficients of the expansion are not orthogonal. In this note it is shown that x(t) can be approximated by a series $x(t) \simeq \sum_n b_n e^{jn\omega_0 t}$ $\omega_0 = \frac{2\pi}{T}$ whose coefficients are exactly orthogonal $E\{b_n b^*_m\} = 0$ $n \neq m$. The approximation improves with increasing n. (Contractor's abstract)

2167

Polytechnic Inst. of Brooklyn. [Microwave Research Inst.] N. Y.

ERGODICITY OF THE DISTRIBUTION FUNCTION OF A STATIONERY PROCESS, by A. Papoulis. Jan. 20, 1964, 4p. incl. diagr. (PIBMRI-1205-64) (AFOSR-65-1725) (AF AFOSR-63-453) AD 624307 Unclassified

Given a stationary process x(t) with one and two-dimensional distribution functions $F(x) = P\{x(t) \leq x\}$ $F(x_1, x_2; \tau) = P\{x(t+\tau) \leq x_1,\ x(t) \leq x_2\}$ respectively, it is shown that, with $y(x,t) = \begin{cases} 1 \text{ if } x(t) \leq x \\ 0 \text{ if } x(t) > x \end{cases}$ the time average $\bar{y}_T(t) = \frac{1}{2T} \int_{-T}^{T} y(x_1 t)dt$ tends to F(x) in the m. s. sense, provided, $\lim_{T\to\infty} \frac{1}{T} \int_0^{2T} (1 - \frac{\tau}{2T})$ $[F(x, x, \tau) - F^2(x)]\, d\tau = 0$.

2168

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

A CLASS OF SOLID-BURST ERROR-CORRECTING CODES, by A. G. Schillinger. Apr. 1964 [72]p. incl. diagrs. refs. (PIBMRI-1223-64) (AFOSR-66-0047) (AF AFOSR-63-453) AD 637475 Unclassified

An efficient class of codes which correct errors in

adjacent digits (solid bursts) is derived. Several properties of polynomials over GF(2) are found and these lead to the choice of generator polynomials g(x) of $(2^m - 1, 2^m - 1 - 2m)$ cyclic codes which correct errors in $2^{m-1}-1$ adjacent digits or less per codeword. Algebraic properties of cyclic codes in general are considered next by examining the structure of the parity check matrix H. Among several simple relationships which are shown to exist one finds that the columns of H can be always chosen to form a cyclic group.

2189

Polytechnic Inst. of Brooklyn. Microwave Research Inst., N. Y.

FIVE-REACTANCE BROADBAND COMPENSATION DESIGNS, by B. M. Albrecht, Jr. June 1964, 37p. (PIBMRI-1218-64) (AF AFOSR-63-453) AD 600449 Unclassified

The most detrimental factor to the high frequency response of an amplifier is the total parasitic capacitance that shunts the output terminals. In particular, this shunt capacitance causes serious distortion to the step response and the amplitude response of the amplifier. Nevertheless, considerable improvement of the high frequency response can be achieved by the addition of a filter to the output terminals. This report shows the design of such a filter having five reactive elements, and a constant voltage source with a finite internal impedance.

2190

Pomona Coll. [Dept. of Physics] Claremont, Calif.

X-RAY FLUORESCENCE ANALYSIS FOR SODIUM, FLUORINE, OXYGEN, NITROGEN, CARBON, AND BORON, by B. L. Henke. [1964] [29]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1913) (AF AFOSR-62-415) AD 450506 Unclassified

Also published in Advan. X-ray Anal., v. 7: 460-488, 1964.

Optimized vacuum spectrographic measurement of low-energy fluorescence has been found to yield counting rates and peak-to-background ratios which are enough to permit the extension of fluorescence analysis for elementary chemistry into the light-element range—sodium through boron. This is accomplished with an efficient, demountable ultrasoft x-ray source, with close coupling among source, crystal, and detector, with KAP and multilayered stearate analyzers, and with optimized flow-proportional counting. Specific methods for achieving peak-to-background ratios on practical samples containing these light elements are presented. The extension of these methods of light-element analysis with the use of curved long-spaced crystals for x-ray macroprobe and electron microprobe measurements is discussed. The design and construction of multilayered soap film "crystals" for long-wavelength x-ray analysis is described. (Contractor's abstract)

2191

Pomona Coll. [Dept. of Physics] Claremont, Calif.

REFLECTION EFFICIENCIES OF A PERIODIC ABSORBING SURFACE, by J. C. Miller. [1964] [4]p. incl. diagrs. (AFOSR-64-1961) (AF AFOSR-62-415) AD 453597 Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 353-356, Mar. 1964.

The reflection efficiencies for the various orders of diffraction produced by a grating are calculated under the following assumptions. The grating is for the most part flat, but with a fraction ϵ of the periodicity interval a described by a profile function $z = f(x)$. The reflection and transmission efficiencies are calculated as a series expansion in ϵ. Numerical calculations have been performed for the case of ultrasoft x rays incident at near grazing angles, using a complex index of refraction $\eta = 1 - \delta_0\lambda^2 + i\beta_0\lambda^{3.25}$ or tabulated values. No effects of shadowing by the grating profile have been considered, and the numerical work has been done for a symmetrical triangular trench incised in the flat surface. (Contractor's abstract)

2192

Pontifical Catholic U. of Rio de Janeiro (Brazil).

EFFECT OF PENETRATING RADIATION ON THE PERSISTENT INTERNAL POLARIZATION OF CARNAUBA WAX ELECTRETS, by P. V. Murphy, S. C. Ribeiro and others. [1963] [2]p. (AFOSR-64-1990) (AF AFOSR-61-140) AD 452332 Unclassified

Also published in Jour. Appl. Phys., v. 34: 338-339, 1963.

The discharge of the persistent internal polarization of carnauba wax electrets by gamma rays has recently been reported on by Gross and de Moraes. The decrease of residual polarization with radiation dose was approximately exponential. However, measurements of samples exposed to a high dose were subject to considerable uncertainty due to a voltaic effect caused by the thermal gradient in the measuring system. In the present work, irradiation experiments on electrets have been extended using an improved measuring system. Samples of different thicknesses have been studied, and irradiations have been carried out at ambient temperature and at reduced temperatures. The results differ from those of the earlier work in that the relation between residual polarization and radiation dose cannot be approximated by a simple exponential.

2193

Princeton U. [Dept. of Aeronautical Engineering] N. J.

MEASUREMENT OF MEAN PARTICLE SIZES OF

SPRAYS FROM DIFFRACTIVELY SCATTERED LIGHT, by R. A. Dobbins, L. Crocco, and I. Glassman. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-J1082) (AF 18(600)1527) Unclassified

Also published in AIAA Jour., v. 1: 1882-1888, Aug. 1963.

The angular distribution of scattering for polydispersion of particles distributed according to the upper limit distribution function is examined and found to lack the sensitivity necessary to permit determination of size distribution. However, the volume-to-surface mean diameter is found to be directly dependent upon angular distribution of intensity for a wide variety of shapes of the distribution function. Therefore, the combination of both a scattering experiment together with a transmission experiment can be used to obtain both particle concentration and volume-to-surface mean diameter of particles in a spray.

2194

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE DEVELOPMENT OF A SMALL MACH 10 HYPERSONIC WIND TUNNEL, by N. A. Zarin and I. E. Vas. Mar. 1963 [28]p. incl. illus. diagrs. refs. (Rept. no. 666) (AFOSR-5329) (AF 49(638)465) AD 424293 Unclassified

A hypersonic wind tunnel was constructed at the Gas Dynamics Laboratory using air as the working fluid. This tunnel, capable of operating from Mach 5 to 10 at Reynolds numbers per in. of 0.03 to 0.40 million, has a test section diameter of 3 1/4 in. The key part of the installation is a storage heater which consists of a coil of heavy-walled inconel pipe which is preheated electrically to the desired stagnation temperature. A maximum temperature of 2000°R at a pressure of 1500 psia is generated for running times of 6 to 12 min. Preliminary calibration tests using conical nozzles at M = 7 and 10 have verified the basic design and operating range. (Contractor's abstract)

2195

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

THE GAS PHASE DECOMPOSITION OF HYDRAZINE PROPELLANTS, by I. J. Eberstein. 1964, 1v. incl. illus. diagrs. tables, refs. (Rept. no. 708) (AFOSR-84-2034) (AF 49(838)1288) AD 807334 Unclassified

The decomposition of hydrazine, hydrazine-water mixtures, UDMH, and monomethylhydrazine were studied in the Princeton adiabatic flow reactor. The overall reaction order of all three monopropellants was found to be very close to unity. A comparison of the reaction rates showed that, in the temperature regime of this study, UDMH decomposition is fastest, hydrazine decomposition is slowest, and the monomethylhydrazine decomposition rate is intermediate. A study of hydrazine-water mixtures showed their rates to be slower than those of the anhydrous material by approximately a factor of 10, and independent of the amount of water added.

2196

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE LANGMUIR PROBE IN A COLLISIONLESS PLASMA, by S. H. Lam. Mar. 1964 [64]p. incl. diagrs. tables. (Rept. no. 681) (AFOSR-84-0353) (AF 49-(638)1271) AD 434842 Unclassified

This paper presents an asymptotic analysis of the Langmuir probe problem in a quiescent, collisionless plasma in the limit of large body dimension to Debye length ratio. The structures of the electric potential distribution about spheres and cylinders are analyzed and discussed in detail. It is shown that when the probe potential is smaller than approx 1/2-KT, where T is the undisturbed temperature of the repelled particles, there exists no sheath adjacent to the solid surface. At large body potentials, for which a sheath is present, the electric potential distribution is given in terms of several universal functions.

2197

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE COMBINATORY INTEGRAL TRANSFORM AND ITS APPLICATION TO HEUN'S EQUATION, by H. H. Chiu and S. I. Cheng. Feb. 1964, 31p. incl. diagrs. (Rept. no. 678) (AFOSR-84-0899) (AF 49(638)1271) AD 606090 Unclassified

The combinatory integral transforms mean the successive application of the Euler and the Laplace transforms in proper combination. Solutions to a certain class of Heun's equations and many classes of third order equations can be obtained through the use of the combinatory transform. Several properties of the Euler and the Laplace integral transforms are developed in Sections 2 and 3. The combinatory transform is studied in Section 4. The application of this transform in solving a Heun's equation is demonstrated in Section 5.

2198

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

THE PRINCETON UNIVERSITY HIGH PRESSURE HYPERSONIC NITROGEN TUNNEL N-3. PART I. FACILITY DESCRIPTION. PART II. CALCULATION OF GAS CHARACTERISTICS AND EVALUATION OF EFFECTS OF VIBRATIONAL NON-EQUILIBRIUM. PART III. PRELIMINARY MEASUREMENTS, by I. E. Vas and G. Koppenwallner. July 1964 [100]p. incl. illus. diagrs. tables, refs. (Rept. no. 890) (AFOSR-64-1422) (AF 49(838)1271) AD 808588 Unclassified

A hypersonic wind tunnel using nitrogen as the test

wave-shaped walls are superposed to yield recirculatory flow patterns for such cavities. It is found that the flow at low and moderately low Reynolds numbers does not separate from the corner at the upstream end, and at low Reynolds numbers it is much easier to create an extensive length of flow with greatly reduced skin friction than a truly recirculatory cavity flow.

2199

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

MARKOV CHAIN THEORY OF FREE-MOLECULE FLOW, by Y. Wu. Dec. 1964, 19p. (Rept. no. 711) (AFOSR-65-0193) (AF 49(638)1271) AD 622566 Unclassified

A mathematical model is proposed which describes the motion of each molecule of free-molecule flow by a probability distribution function in a multi-reflection system. The probability function is determined by its initial probability function and successive transition probabilities in a discrete sample space. The successive transition probability functions are determined from the diffuse reflection law and the geometry of the system, and are independent of time. Such a mathematical model is equivalent to a stationary Markov chain process in probability theory. Two examples are presented of free molecular flow through a sphere and through multi-connected spheres.

2200

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

ON A NEW ULTRA-HIGH VACUUM PUMP, by Y. Wu. Dec. 1964 [12]p. incl. diagrs. tables. (Rept. no. 715) (AFOSR-65-0194) (AF 49(638)1271) AD 615149 Unclassified

The theory of highly rarefied cascade flow has been presented, and a proposal for a new axial-flow pump in the free-molecule range has been made. An unconventional cascade has been suggested which will produce an extremely high compression ratio, up to 30,000, in a single stage at very high blade speed, $S = V_b / \sqrt{2RT} \sim 20$. This new pump can be used to reach any ultrahigh vacuum state, i.e. an almost empty state.

2201

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

ROTATIONAL STAGNATION POINT FLOW, by W. D. Hayes. [1964] [9]p. (AFOSR-65-0555) (AF 49(638)-1271) AD 613732 Unclassified

Also published in Jour. Fluid Mech., v. 19: 366-374, 1964.

The constant-density inviscid rotational flow in the neighborhood of a general stagnation point on a wall is investigated. In all but very special cases, the solution is non-analytic and the vorticity at the wall is infinite; the stagnation streamline is tangent to the wall at the stagnation point; stagnation points of saddle-point type cannot exist. The boundary-layer equations corresponding to the inviscid solutions studied are presented.

2202

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

THE RESPONSE OF PRESTRESSED ALUMINUM, by O. W. Dillon, Jr. [1964] [13]p. (AFOSR-64-1882) (AF 49(638)1306) AD 449996 Unclassified

Experimental data on the propagation of changes in strain associated with an unstable load are presented. These deformations frequently propagate at speeds which are less than 10 in/sec. These large amplitude deformations are the result of adding small increments of the load at long time intervals. The wave speed calculated from the Karman-Taylor wave theory and based on a smooth stress-strain relation for the material is 18000 in/sec. One large change in strain propagates at an average speed of 0.0037 in/sec. These slowly propagating deformations occur only at certain discrete loads in prestressed specimens of annealed aluminum. Between these loads, the response is approximately that of a linearly elastic material. Some data on preloaded specimens tested in a torsional impact apparatus are also included.

2203

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

RESEARCH ON SOLID PROPELLANT IGNITABILITY AND IGNITER CHARACTERISTICS, by E. H. Grant, Jr. and J. Wenograd. Final technical rept. Oct. 1, 1961-Sept. 30, 1962. Oct. 31, 1963, 1v. incl. illus. diagrs. tables, refs. (Rept. no. 662) (AFOSR-J1467) (AF AFOSR-62-91) AD 425651 Unclassified

The purpose of this research was to study the ignition of composite solid propellants in a small rocket motor. Hot gaseous products from a small gas-fed pyrogen-type igniter supplied a convective ignition stimulus to the internal surface of a thin-webbed, cylindrical solid propellant grain. The gas rocket igniter is a valuable tool for investigating the essential nature of the ignition process because it offers a wide range of controllable parameters such as heat transfer, chemical reactivity of the igniting gas, flame temperature, mass flow, chamber pressure and solid propellant compositions.

2204

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

RESEARCH ON SOLID PROPELLANT COMBUSTION

fluid was built to operate in the continuum and slip flow regimes. The free stream Mach number in the 6-8 in. diam test section varies from 16-25 with stagnation pressures from 2000-5000 psia and stagnation temperatures to 3000°K. The testing time is presently limited to 25 min. For the temperatures and pressures encountered, no dissociation effects are experienced but vibrational effects must be included. A freezing criterion was developed and applied to the nozzle configuration. For the operating conditions, it was found that the gas can be considered to be frozen during the entire expansion process. Measurements of wall static pressure and transverse pitot pressure traces were conducted in the test region generated by the conical nozzle. The effect of stagnation pressure on Mach number was found to be important.

2205

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

A CRITICAL EXAMINATION OF THE FLUID DYNAMIC PROBLEM POSED BY THE LAMINAR JET DIFFUSION FLAME, by A. Goldburg and S. I. Cheng. July 1964, 56p. (Rept. no. 702) (AFOSR-64-1595) (AF 49(638)-1271) AD 606770 Unclassified

The paper discusses the laminar diffusion flame: a combustion process which occurs in a region which is located in the mixing zone between the undiluted fuel and the undiluted oxidizer and in which the mixing is carried out by molecular diffusion only. The boundary layer similar solutions are presented for the relevant distributions of the physical properties and species concentrations in a planar laminar jet diffusion flame.

2206

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

LAMINAR SEPARATED FLOW WITHIN REJOINING OR REATTACHING BOUNDARY LAYERS, by S. I. Cheng. July 1964, 44p. (Rept. no. 701) (AFOSR-64-1596) (AF 49(636)1271) AD 608208 Unclassified

The separated flow next to where the supersonic boundary layers rejoin or reattach was studied with the Navier-Stokes equations around the stagnation point, enclosed between the boundary layers. For the separated, recirculatory flow to be dynamically possible, it was found that at the rear stagnation point the rejoining wake flow must possess: (1) a parabolic dividing streamline (D.S.L.), (2) a proper axial pressure gradient, and (3) an outer inviscid stream parallel to the axis of symmetry of the recirculatory flow. Likewise, at the reattachment point, the recirculatory flow must possess (1) a linear D.S.L., (2) a positive axial pressure gradient and (3) a given ratio for the slopes of the inviscid streamline over the reattachment point and of the stagnating D.S.L. A model for the analysis of the recirculatory wake is discussed.

2207

Princeton U. Dept. of Aerospace and Mechanical Sciences, N. J.

PARTICLE IMPINGEMENT ON A NOZZLE WALL, by S. I. Cheng and Y. Rimon. July 1964 [28]p. incl. diagrs. table. (Rept. no. 696) (AFOSR-64-1659) (AF 49(638)1271) AD 612267 Unclassified

The percentage of the mass flux of fine particles carried in a two phase fluid that impinge on the wall of the convergent section of a nozzle is investigated. If the particles are uniformly distributed over the nozzle entrance and if the diameter of the particles is less than 5 μ, the particles in the turbulent core outside the displacement area of the turbulent boundary layer on the wall of the rocket chamber will pass through. The percentage of particle mass flux that impinges on the nozzle wall is very small. Most of the impingement takes place in the entrance region, where the heat transfer condition is not so severe as is in the throat region. The percentage mass flux of particle impingement is insensitive to nozzle shape near the throat but depends heavily on the nozzle geometry near the entrance.

2206

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

HYPERSONIC FLOW OVER A WEDGE WITH UPSTREAM NON-UNIFORMITIES AND VARIABLE WEDGE ANGLE, by A. R. George. Dec. 1964 [137]p. incl. diagrs. table. (Rept. no. 695) (AFOSR-65-0002) (AF 49(636)1271) AD 612286 Unclassified

The paper analyzes the supersonic and hypersonic flow over a wedge placed in a parallel but non-uniform free stream. The free stream property or velocity gradients are assumed to be small and in the spanwise direction. The substitution principle allows the transformation of a general non-uniform parallel free stream into one with constant velocity. In both the supersonic and hypersonic cases a perturbation analysis is used giving linear theories. Thus superposition is valid under certain restrictions and the problem treated is taken to be a small spanwise step in free stream properties. As the flow will then be conical the problem may be reduced to dependence upon only two independent variables.

2209

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

INCOMPRESSIBLE CAVITY FLOWS IN TWO DIMENSIONS AT LOW REYNOLDS NUMBER, by H. J. Hagerup. June 1964 [33]p. incl. diagrs. (Rept. no. 691) (AFOSR-65-0056) (AF 49(636)1271) Unclassified

Steady, 2-dimensional shear flow is studied at low and moderately low Reynolds numbers past shallow surface depressions with slope discontinuities at the ends. Linearized solutions for simple shear flow past

INSTABILITY, by R. H. Woodward and J. Wenograd. Final technical rept. May 1, 1962-Apr. 30, 1963. Apr. 1, 1964 [24]p. incl. illus. diagrs. tables, refs. (Rept. no. 635) (AFOSR-4693) (AF AFOSR-62-460)
Unclassified

One previously developed explanation of combustion instability is that the driving disturbance originates with a pressure interaction between the surface flame and the oscillating gas field. A clue to the nature of the acoustic interaction should be obtainable by a measurement of the entropy variation in the gas emerging from the thin flame. An experimental search for entropy waves and attempts to measure entropy variations were made with high-speed cinematography and with spectral radiometry, using a 2 in. I.D. T-tube rocket combustor. Waves of the expected length (order of 1 cm) have been observed at frequencies about 200 cps and mean pressures about 900 psi with AP-nitrocellulose composite propellant. In experiments with conventional AP composite propellants at similar frequencies, but lower mean pressures and larger amplitudes (+ 25% p), more complicated wave structures were observed, and in one experiment, the entropy amplitude was zero, a surprising result. No firm explanations have yet been found. (Contractor's abstract, in part)

2210

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

A CRITICAL REVIEW OF RECENT RESEARCH ON THE MECHANISM OF IGNITION OF SOLID ROCKET PROPELLANTS, by M. Summerfield, R. Shinnar and others. Aug. 26, 1963, 1v. (Rept. no. 661) (AFOSR-5311) (AF AFOSR-63-92) AD 416332; AD 419882
Unclassified

Presented at Fourteenth Cong. of the Internat'l. Astronautics Federation, Paris (France), Sept. 1963. (AFOSR-J1017; AD 419166)

A number of experimental techniques varying in form and concept have been used to study the ignition of composite and nitrate ester propellants. Both slow and fast ignitions have been studied, and ignition delays have ranged from 20 sec down to less than a msec. In the experiments which have been conducted, the propellants have been heated by hot wires, test furnaces of various types, flowing gas streams at elevated temperatures, shock tubes and shock tunnels, highly reactive oxidizing gases, arc-image furnaces, etc. This review contains a description of the various theories which have been used to account for the phenomenon of propellant ignition, a discussion of the experimental methods which have been applied to this study, and an evaluation of the reported results.

2211

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

SOLID PROPELLANT IGNITION STUDIES: IGNITION OF THE REACTION FIELD ADJACENT TO THE SURFACE OF A SOLID PROPELLANT, by C. E. Hermance, R. Shinnar, and J. Wenograd. Final technical rept. Oct. 1, 1962-Sept. 30, 1963. Dec. 1, 1963, 108p. (Rept. no. 674) (AF AFOSR-63-92) AD 428602
Unclassified

The object of this research was to elucidate ignition mechanisms of solid propellants, to identify the component processes, and to lay the basis for a theory of ignition. Experiments were performed in which composite propellant samples and polymeric fuel samples were exposed to high and low speed flows of oxygen containing gases at high temperature and pressure in a shock tunnel. Ignition of either propellant or fuel could not be obtained in high speed flows even in pure oxygen; in addition, no charring or decomposition of the fuel was observed. At low flow speeds, on the other hand, ignition of the composite propellant and the polymeric fuel did occur, and the ignition delay was found to depend on the gas phase oxygen concentration.

2212

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

A GENERAL THEORY FOR THE FLOW OF WEAKLY IONIZED GASES, by S. H. Lam. Apr. 1963, 1v. (Rept. no. 644) (AFOSR-4662) (AF AFOSR-63-112) AD 416367
Unclassified

A general theory is developed for the flow of a weakly ionized gas about arbitrary solid body or bodies with absorbing surfaces. The main interest lies in the prediction of the electrical response on the body surface as a function of the pertinent properties of the flow. The theory is based on continuum formulation, and is valid when (1) the mean-free-path of the charged particles is at most the order of a Debye length and (2) the Debye length is much smaller than the thickness of the boundary layer adjacent to the body surface. The entire range of flow velocity in terms of an electric Reynolds number R is investigated. It is found that the electrical disturbances can be divided distinctly into three physically distinct but mathematically uncoupled regions, namely the outer region, the ambi-polar diffusion region, and the sheath region.

2213

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

EXPERIMENTAL LAMINAR HEAT TRANSFER FROM AN OSCILLATING FLAT PLATE, by N. A. Evans. Feb. 1963, 1v. (Rept. no. 639) (AFOSR-4906) (AF AFOSR-63-112) AD 420983; AD 423312
Unclassified

An externally-heated ceramic flat plate, instrumented on both surfaces with short time response platinum film resistance thermometers, was used to compare the amplitude of the additional unsteady heat transfer rate, during oscillation in its own plane in a steady parallel air stream, with the corresponding steady state heat transfer rate without oscillation. The theoretical treatments

considered the case of constant plate surface temperature, while practical experimental limitations produced an approximate parabolic surface temperature distribution.

2214

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

A THEORETICAL ANALYSIS OF HEAT TRANSFER IN REGIONS OF REVERSE FLOW, by R. W. Garvine. June 1963, 23p. (Rept. no. 652) (AFOSR-5330) (AF AFOSR-63-112) AD 424398 Unclassified

Inquiry is made into a fundamental aspect of heat transfer in a laminar flow where separation has induced a reverse or backward moving layer of fluid. A Couette flow model is chosen with linear velocity profile but with a portion of the profile reversed. In this model, the features of simultaneous upstream and downstream convection are retained. Analytic solutions are found for the case of a sinusoidal wall temperature. It is concluded that the convection effect of the reverse layer cannot be ignored in practical cases.

2215

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

FURTHER DEVELOPMENT OF A GRAPHITE HEATER FOR HIGH PRESSURE NITROGEN OPERATION, by I. E. Vas and J. K. Harvey. Oct. 1963 [22]p. incl. illus. diagrs. (Rept. no. 669) (AFOSR-5440) (AF AFOSR-63-112) AD 600010 Unclassified

An experimental study was conducted to extend the operation of a graphite resistance nitrogen heater to pressures above the 1000 psi previously obtained. Using a somewhat modified design, a single pass spiral heater element was fabricated and tested at 5000 psi and 5000°R. Test runs of 5 to 15 min were carried out with total operating times at elevated temperatures and pressure exceeding several hours using the same element. The temperature was determined by the mass flow technique and checked against a thermocouple installed in the stagnation chamber. (Contractor's abstract)

2216

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

INTERACTIONS OF HEAT TRANSFER AND HYPERSONIC BOUNDARY LAYERS UNDER HIGHLY FAVORABLE PRESSURE GRADIENTS, by S. H. Lam. [1963] [14]p. (AFOSR-J846) (AF AFOSR-63-112) AD 416385 Unclassified

Also published in Proc. Heat Transfer and Fluid Mechanics Inst., Calif. Inst. of Tech., Pasadena (June 12-14, 1963), Stanford U. Press, 1963, p. 44-57.

The boundary layer in a hypersonic nozzle is studied. The main interest lies in the interaction between the wall thermal condition and the development of the boundary layer itself. It is shown that for reasonable nozzle shapes and for high values of γ, the Falkner-Shan pressure gradient parameter, β, is generally large. Taking advantage of this observation, the boundary layer on the nozzle walls is analyzed in detail by means of the method of inner and outer expansions.

2217

Princeton U. [Dept. of Aerospace and Mechanical Sciences] N. J.

MASS FLOW THROUGH A CIRCULAR ORIFICE AND A TWO-DIMENSIONAL SLIT AT HIGH KNUDSEN NUMBERS, by D. R. Willis. Mar. 1964, 32p. (Rept. no. 583) (AFOSR-64-0858) (AF AFOSR-63-112) AD 600968 Unclassified

This paper presents the results of numerical calculations of the total mass flow through both a circular orifice and a two-dimensional slit. The calculations are restricted to one iteration in the integral iteration scheme and the effect of molecules which, due to collision, return through the orifice is neglected. No further simplifying assumptions, such as those used by Narasimha, are employed.

2218

Princeton U. Dept. of Chemical Engineering, N. J.

KINETICS OF THE BRANCHING STEP IN THE REACTION OF HYDROGEN WITH OXYGEN, by S. C. Kurzius. Doctoral thesis, Dec. 1964, 136p. incl. diagrs. tables, refs. (AFOSR-66-1311) (AF 49(638)-32) AD 635159 Unclassified

Lower explosion limits in hydrogen-oxygen and deuterium-oxygen mixtures have been measured in the diffusion regime. From the data, the rate constants for the reaction $H + O_2 - OH + O$ and its isotope effect are calculated between 800 and 1000°K. Both the absolute rate theory and the classical collision theory of reactions fail to explain the apparently reliable experimental observations. A theory is presented for reactions of essentially zero activation energy which, when applied to the above reaction and its reverse, leads to a rate constant expression which is a hybrid between that of the absolute rate theory and that of the classical collision theory of reactions. Subsidiary observations and theory related to the kinetics of the branching reaction and its elucidation by the method of explosion limits are reported.

2219

Princeton U. [Dept. of Chemistry] N. J.

REDOX ANALYSIS OF CRYOGENICALLY STABLE PRODUCTS OF DISSOCIATED WATER VAPOR, by

H. M. Gladney and D. Garvin. 1963, 8p. (Technical note no. 9) (AFOSR-1266) (AF 18(603)134) AD 434509 Unclassified

A study is reported of the oxidizing and reducing powers of the products that can be frozen at liquid nitrogen temperature from water vapor dissociated by an electrodeless discharge. The frozen material exhibits a greater oxidizing and reducing power than does the solution formed after melting of the products. This extra titer does not show a stoichiometric relation to the oxygen evolved upon warming. The ratio of oxidation to reduction equivalents is about 1:2. It is suggested that the unstable species is either H_2O_3 or H_2O_4.

2220

Princeton U. [Dept. of Chemistry] N. J.

PHOTONOMETRIC TITRATIONS, by C. G. Enke. Final rept. Sept. 1, 1958-Aug. 31, 1963, 9p. (AFOSR-65-1443) (AF 49(638)467) AD 621272 Unclassified

The possibility of using light as a quantitative reagent in chemical reactions was investigated. Photolytic reactions with a reproducible quantum yield and whose products are generally useful analytical reagents, e.g., oxidizing or reducing agents, were studied. The photochemical generation of hydrogen peroxide from solutions of various organic acids was investigated for quantitative interest. It was found that dissolved oxygen was a required reactant and determined directly the amount of peroxide formed. Photochemical generation of reactant was used for the photolytic determination of trace amounts of organic material in water. The technique proved to be extremely sensitive. A list of resulting publications is included.

2221

Princeton U. Dept. of Chemistry, N. J.

SOLVENT EFFECTS ON THE INFRARED FREQUENCY OF THE N—C BAND IN ISONITRILES AND THE SIGN OF ∂_u/∂_r, by W. D. Horrocks, Jr. and R. H. Mann. [1963] [10]p. incl. diagrs. tables, refs. (AFOSR-J1155) (AF AFOSR-63-242) AD 423130 Unclassified

Also published in Spectrochim. Acta, v. 19: 1375-1384, 1963.

Spectra in the N—C stretching region are recorded for t-butyl and p-tolyl isonitriles in the vapor phase and in solution in 14 solvents. A number of solvents were found to shift the N—C band to frequencies higher than the vapor-phase value. Bands due to the N—C bond in co-ordinated isonitriles in molecules of the type $Co(CO)(NO)(RNC)_2$ in the same solvents are also reported. The N—C band shifts in solution correlate qualitatively with the theory of Dricknmer and coworkers and allow us to assign a negative sign to $\partial\mu/\partial r$ for the N—C stretching vibration. A band at frequencies considerably higher than the vapor phase value is found for solutions of isonitriles in hydrogen bonding solvents. (Contractor's abstract)

2222

Princeton U. Dept. of Chemistry, N. J.

INFRARED SPECTROSCOPIC STUDY OF ISONITRILE DERIVATIVES OF THE IRON CARBONYL HALIDES, by R. C. Taylor and W. D. Horrocks, Jr. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1517) (AF AFOSR-63-242) AD 446135 Unclassified

Also published in Inorg. Chem., v. 3: 584-589, Apr. 1964.

The complexes $Fe(CO)_{4-n}(CNR)_nX_2$, where n = o-4, R = p-tolyl or t-butyl, and X = Cl, Br, or I, were prepared and the infrared spectra studied in the carbonyl and isonitrile stretching regions. The π-electron accepting abilities of the coordinated carbonyl and isonitrile groups are discussed. Structures of a number of these compounds are postulated on the basis of the number and intensity of the observed infrared bands. Spectral shifts in a series of compounds are found to correlate well with the electronegativities of the halogens. (Contractor's abstract)

2223

Princeton U. [Dept. of Chemistry] N. J.

ISOTROPIC PROTON MAGNETIC RESONANCE SHIFTS IN PI BONDING LIGANDS COORDINATED TO PARAMAGNETIC NICKEL (II) AND COBALT (II) ACETYLACETONATES, by W. D. Horrocks, Jr., R. C. Taylor, and G. N. LaMar. [1964] [6]p. (AFOSR-64-1792) (AF AFOSR-63-242) AD 449050 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3031-3038, Aug. 1964.

Isotropic proton magnetic resonance shifts due to contact and pseudo-contact interactions have been observed for protons in certain triaryl-phosphines and isonitrile molecules when these are placed in solution in CDC13 with the paramagnetic Ni(II) and Co(II) acetylacetonates. The alternation in sign of the observed shifts for adjacent protons on the phenyl rings is evidence for delocalization of spin density into the π-orbitals of these ligands when coordinated to both Co(II) and Ni(II) acetylacetonates. Evidence for a large upfield pseudo-contact shift in the cobalt systems is presented. Proton spin-spin coupling constants for the arylphosphines and isonitriles are given.

2224

Princeton U. [Dept. of Chemistry] N. J.

ISOTROPIC PROTON RESONANCE SHIFTS OF SOME BIS-(TRIARYLPHOSPHINE) COMPLEXES OF

COBALT(II) AND NICKEL(II) DIHALIDES, by G. N. La Mar, W. D. Horrocks, Jr., and L. C. Allen. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0688) (AF AFOSR-63-242) AD 615687 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2126-2134, Oct. 1964.

Isotropic proton resonance shifts have been observed for some bis-(triarylphosphine) complexes of cobalt(II) and nickel(II) dihalides. The equations for the pseudocontact shifts were extended to include these complexes which possess g tensors with C_{2v} symmetry. The isotropic shifts for the nickel complexes are interpreted as arising solely from a contact interaction with unpaired spin in the π orbital of the ligand. Based on the postulate that unpaired spin will distribute itself in the same way in a given ligand whether attached to cobalt or nickel, the shifts for the cobalt complexes are separated into contact and pseudocontact contributions. The relative magnitudes of the pseudocontact shifts correspond well with the expected relative strength of the C_{2v} distortion of the tetrahedral ligand field of the cobalt complexes.

2225

Princeton U. [Dept. of Chemistry] N. J.

ISOTROPIC SHIFTS OF SOME IONIC COMPLEXES OF COBALT(II) AND NICKEL(II) EVIDENCE FOR ION PAIRING, by G. N. La Mar. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0885) (AF AFOSR-63-242) AD 618444 Unclassified

Also published in Jour. Chem. Phys., v. 41: 2992-2998, Nov. 15, 1964.

Isotropic proton resonance shifts have been observed for the ionic complexes, $[Bu_4N][(\varphi_3P)CoI_3]$ and $[Bu_4N][(\varphi_3P)NiI_3]$. In addition to the phenyl (φ) proton shifts for the complex anions, isotropic shifts were observed for the cation protons as well. These shifts for the tetra-n-butylammonium cations are interpreted as arising solely from a pseudocontact interaction with the metal in the complex anion through partial ion pairing in the deuterochloroform solutions. From the magnitudes of the shifts for the butyl protons, an estimate is made for the relative extent of g-tensor anisotropies for the 2 anionic complexes. The observed shifts for the phenyl protons are interpreted as arising from both contact and pseudocontact interactions.

2226

Princeton U. Dept. of Chemistry, N. J.

INORGANIC STRUCTURE AND SPECTRA, by W. D. Horrocks, Jr. Final rept. Jan. 1, 1963-Dec. 31, 1964, 2p. incl. refs. (AFOSR-65-0980) (AF AFOSR-63-242) AD 618041 Unclassified

A list is presented of the publications completed under this contract. The publications summarize the work accomplished. A number of other continuing studies are briefly reported. The work is concerned largely with transition metal complexes.

2227

Princeton U. [Dept. of Chemistry] N. J.

EXPERIMENTAL DATA ON ALUMINUM AS AN UNSTABLE SOLID, by O. W. Dillon, Jr. [1963] [18]p. incl. diagrs. (AFOSR-65-2474) (AF AFOSR-63-406) AD 628398 Unclassified

Data are presented on annealed aluminum where large changes in strain occur long after the load increment has been applied. These changes occur suddenly and frequently, without warning. The specimens are loaded in small increments with many minutes between loads. In this way a good approximation to equilibrium exists at the time the increase in load is added. It is shown that very slow 'waves' exist in the material. This means that in tests made at more conventional loading rates, the material frequently is not actually in equilibrium. These waves travel at speeds which are more than five orders of magnitude slower than those based on conventional test results.

2228

Princeton U. [Dept. of Geology] N. J.

STRUCTURE OF THE EARTH'S CRUST FROM SPECTRAL BEHAVIOR OF LONG PERIOD BODY WAVES, by R. A. Phinney. Feb. 1964, 65p. (AF 49(638)1243) AD 432362 Unclassified

Long period P-waves from distant earthquakes have been analyzed at Albuquerque and Bermuda in light of Haskell's theory for the spectral response of a layered crust. By using the ratio of the vertical spectrum to the horizontal component spectrum, one obtains a function which depends on structure beneath the station. Due to the poorly understood nature of the signal which follows the first P motion, the notions of power spectral analysis were applied and a lag window selected to discriminate against long time correlations within the signal. Corrections for the differing responses of the three components are made using the power spectral matrix of calibration signals. At Albuquerque the crust is about 40 km thick and the lower crust has velocities in the range 6.6-7.0 km/sec. The Moho under Bermuda is 12 km below sea level, and the structure appears to be a normal oceanic crust depressed elastically by the weight of the volcanics which compose the island.

2229

Princeton U. [Dept. of Mathematics] N. J.

POTENTIAL-THEORETIC APPROACH TO ANALYTIC BOHR ALMOST PERIODIC FUNCTIONS IN HALF-PLANES, by S. Bochner. [1963] [6]p. (AFOSR-J1264) (AF 49(638)578) AD 424344 Unclassified

Also published in Math. Ann., v. 150: 150-155, 1963.

Results are derived using real variable methods without linking these to the existence and to the properties of the resulting series when there is a boundedness requirement and the function is almost periodic.

2230

[Princeton U. Frick Chemical Lab., N. J.]

A STUDY OF THE KINETICS AND MECHANISM OF ELECTROLYTIC FILM FORMATION REACTIONS, by C. G. Enke. Final rept. Nov. 1, 1962-Oct. 31, 1964 [6]p. (AFOSR-65-1560) (AF AFOSR-63-151) AD 624264 Unclassified

A summary is presented of an investigation on the development of electrochemical tools for studying the electrode-electrolyte interface and on their application to systems of interest. A triangular sweep generator was designed and constructed for use with potential sweeping experiments, and the palladium-hydrogen electrode was studied. Two new techniques for the measurement of double-layer capacitance at solid electrodes were also developed. Capacitance measurements were made on silver electrodes in perchlorate solutions, and a method of wetting a platinum surface with liquid mercury was discovered.

2231

Princeton U. Frick Chemical Lab., N. J.

VERSATILE TRIANGULAR SWEEP GENERATOR, by W. D. Weir and C. G. Enke. [1964] [5]p. incl. diagrs. (AFOSR-65-2197) (AF AFOSR-63-151) AD 625678 Unclassified

Also published in Rev. Scient. Instr., v. 35: 833-837, July 1964.

A versatile, all-electronic cyclic linear-sweep generator is described. This device produces a symmetric or asymmetric triangular waveform of high quality with sweep rates continuously variable from 5 mv/sec to 2000 v/sec, independent of amplitude; positive and negative sweep limits are independently variable from 0-3 v relative to a reference level which is itself variable with respect to signal ground. Provision is made for controlling the output voltage at a preset level prior to initiation of the sweep, and the sense of the initial sweep may be selected. The cyclic sweep may be halted at either limit, either mechanically or electronically. An auxiliary output provides a square wave with peak-to-peak amplitude equal to the peak-to-peak amplitude of the triangular waveform, based at signal ground, and with period regulated by the sweep rate controls. (Contractor's abstract)

2232

Princeton U. Frick Chemical Lab., N. J.

IONIC COPOLYMERIZATION OF STYRENE AND p-METHYLSTYRENE, by B. D. Phillips, T. L. Hanlon, and A. V. Tobolsky. [1964] [15]p. incl. tables, refs. (AFOSR-65-2198) (AF AFOSR-63-157) Unclassified

Also published in Jour. Polymer Sci., Pt. A, v. 2: 4231-4245, 1964.

The copolymerization of styrene and p-methylstyrene has been initiated by Friedel-Crafts metal halides, benzoyl peroxide, a Ziegler catalyst from triethylaluminum and titanium tetrachloride, alkali metal dispersions, and alkali metal-naphthalene complexes in a variety of polar and nonpolar solvents. The composition of the initial copolymer from an equimolar monomer mixture was used as the basis for comparison of these systems. By a suitable choice of initiator and solvent, the copolymer composition was varied within the range 25-79 wt.-% styrene. Cationic catalysts yield copolymers with low styrene contents while anionic and electron transfer initiators produce copolymers with high styrene contents. The compositions of the initial copolymers are briefly discussed in relation to the ionic character of the growing polymer-gegenion ion pair and the polarity of the reaction medium. (Contractor's abstract)

2233

Princeton U. [Palmer Physical Lab.] N. J.

NO FUGITIVE AND CLOISTERED VIRTUE, by J. A. Wheeler. [1963] [3]p. incl. illus. (AFOSR-J817) (AF 49(638)304) AD 413767 Unclassified

Also published in Phys. Today, v. 16: 30-32, Jan. 1963.

This note is a tribute to Niels Bohr, who died on Nov. 18th, 1962. It consists of an address delivered on the occasion of the presentation of the first Atoms for Peace Award to Bohr on Oct. 24, 1957 in Washington, D. C.

2234

Princeton U. Palmer Physical Lab., N. J.

PROOF OF A CONJECTURE OF S. WEINBERG, by W. Hunziker. [1964] [4]p. (AFOSR-64-2130) (AF 49(638)-1333) AD 452424 Unclassified

Also published in Phys. Rev., v. 135: B800-B803, Aug. 10, 1964.

A proof is given of Weinberg's conjecture that the irreducible N-particle kernel is of Hilbert-Schmidt type if the potentials, which describe the pair interactions, are square integrable.

2235

Princeton U. [Palmer Physicsl Lab.] N. J.

TESTS OF THE CONSERVED VECTOR CURRENT AND

PARTIALLY CONSERVED AXIAL-VECTOR CURRENT HYPOTHESES IN HIGH-ENERGY NEUTRINO REACTIONS, by S. L. Adler. [1964] [4]p. (AFOSR-64-2131) (AF 49(638)1333) AD 452426 Unclassified

Also published in Phys. Rev., v. 135: B963-B966, Aug. 24, 1964.

Tests of the conserved vector current and the partially conserved axial-vector current hypotheses, based on the theorem given in the report, are proposed.

2236

Princeton U. [Palmer Physical Lab.] N. J.

COLLISION THEORY, by M. L. Goldberger and K. M. Watson. New York, Wiley and Sons, 1964, 919p. incl. diagrs. refs. (AFOSR-65-0839) (AF 49(638)1333) Unclassified

General scattering theory is presented and extensively illustrated with applications to elementary particles, nuclear, and atomic physics. The theory and observations are discussed of collisions between particles and systems of particles. The relationship of observation and theory is developed first, with careful attention to a proper wave packed description of scattering processes. The role of symmetry principles in limiting the variety and kinds of events is then discussed systematically, including symmetrization for identical particles, time reversal invariance, and angular momentum conservation. Formal scattering theory and powerful algebraic techniques are developed and illustrated by examples. The rest of the book is devoted to applications.

2237

Princeton U. [Palmer Physical Lab.] N. J.

PCT, SPIN AND STATISTICS, AND ALL THAT, by R. F. Streater and A. S. Wightman. New York, W. A. Benjamin, Inc., 1964, 181p. incl. diagrs. refs. (AFOSR-65-0840) (AF 49(638)1333) Unclassified

This book is an exposition of general insights into field theory as elucidated by research in quantum field theory. The first of four chapters contains a summary of the transformation properties of physical states in relativistic quantum mechanics and provides a language in which physical states with simple transformation properties have a simple description. The second chapter is an exposition of the mathematical tools that are required, and the third defines the notion of field as it is used in the book. It is shown that a field theory is defined by the vacuum expectation values of products of field operators. In Chapter 4 the three preparatory chapters are applied to get some general theorems of quantum field theory, of which the PCT theorem and the theorem on the connection of spin with statistics are the best known.

2238

Princeton U. Palmer Physical Lab., N. J.

PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI"; COURSE 29 ON DISPERSION RELATIONS AND THEIR CONNECTION WITH CAUSALITY, Varenna (Italy), July 15-Aug. 3, 1963, ed. by E. P. Wigner. New York, Academic Press, 1964 [265]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0841) (AF 49(638)1333) AD 618420 Unclassified

The aim of the lecture series was to present the main steps to follow in the standard proof of dispersion relations. Seven papers which were presented in course number 29 are contained in this book. These papers are: (1) The Role of Invariance Principles in Natural Philosophy, by E. P. Wigner; (2) The Proof of Dispersion Relations, by M. Froissart; (3) Causality, R-Matrix, and Collision Matrix, by E. P. Wigner; (4) Dispersion Relations and Applications, by D. Y. Wong; (5) The Nonrelativistic Angular-Momentum Plane, by R. G. Newton; (6) Production Amplitudes, by P. V. Landshoff; and (7) High-Energy Scattering and Dispersion Theory, by R. Oehme.

2239

Princeton U. Palmer Physical Lab., N. J.

LIFETIME AND DECAY OF UNSTABLE PARTICLES IN S-MATRIX THEORY, by M. L. Goldberger and K. M. Watson. [1964] [9]p. incl. diagrs. (AFOSR-65-0842) (AF 49(638)1333) AD 616048 Unclassified

Also published in Phys. Rev., v. 136: B1472-B1480, Dec. 7, 1964.

An investigation is made of the possible time dependence of decay laws for unstable particles. A simple treatment is given of the decay of unstable states within the framework of conventional nonrelativistic quantum theory and carried over further into the relativistic regime. The possibility of nonexponential decays is discussed, and an experiment for the detection of unstable particle decays is described. The probability of unstable particle decay is expressed in terms of S-matrix quantities, and conclusions indicate that the exponential decay law $P = e^{-\Gamma t}$ is only one of a discrete set of possible decay laws.

2240

Princeton U. Palmer Physical Lab., N. J.

AMPLITUDE BOUND IN LADDER GRAPH MODELS. II, by G. Tiktopoulos and S. B. Treiman. [1964] [4]p. incl. diagrs. (AFOSR-65-0843) (AF 49(638)1333) AD 617210 Unclassified

Also published in Phys. Rev., v. 136: B1217-B1220, Nov. 23, 1964.

A procedure described earlier for bounding ladder-graph scattering amplitudes is applied here to two models: exchange of pairs of scalar particles, bubbles, and

exchange of vector particles. The forward-scattering absorptive amplitudes are bounded from above. Apart from logarithmic factors, the correct amplitudes are known to grow with energy like S^{α}, and the results determine upper bounds on the exponents α. For the case where the exchanged particles are massless, the upper bounds in fact coincide with the exact results for α as given in the literature.

2241

Princeton U. Palmer Physical Lab., N. J.

THE VACUUM TRAJECTORY IN CONVENTIONAL FIELD THEORY, by M. Gell-Mann, M. L. Goldberger, and F. E. Low. [1964] [10]p. incl. diagrs. tables. (AFOSR-65-1062) (AF 49(638)1333) AD 618282 Unclassified

Also published in Rev. Modern Phys., v. 36: 640-649, Apr. 1964.

A study is made of the conventional field theory of vector bosons interacting through a conserved current with spin one-half fermions. The generation of a Pomeranchuk-like trajectory is investigated in second-order perturbation theory and is found analogous to the trajectories of potential theory. It is shown that the existence of a perturbation theory vacuum trajectory is consistent with unitarity and analyticity, and the scalar nucleon theory appears to Reggeize as easily for it as the spin 1/2 theory. A description is given of the relevant states of the $\gamma\gamma$ $N\bar{N}$ systems, and the different scattering amplitudes are Reggeized.

2242

Princeton U. Palmer Physicsl Lab., N. J.

SPATIAL SEPARATION OF EVENTS IN S-MATRIX THEORY, by M. Froissart, M. L. Goldberger, and K. M. Watson. [1963] [7]p. incl. diagr. (AFOSR-64-0265) (AF AFOSR-62-390) AD 432750 Unclassified

Also published in Phys. Rev., v. 131: 2820-2826, Sept. 15, 1963.

Just as the derivative of the argument of the S matrix with respect to energy gives a time interval for events, it is shown that the corresponding derivative with respect to momentum transfer gives a space interval. This space interval corresponds to the classical impact parameter in the classical limit. More generally, it is suggested that these two derivatives may provide a basis for introducing space-time intervals into physical theory. (Contractor's abstract)

2243

Princeton U. Palmer Physical Lab., N. J.

USE OF INTENSITY CORRELATIONS TO DETERMINE THE PHASE OF A SCATTERING AMPLITUDE, by M. L. Goldberger. [1963] [24]p. (AFOSR-64-0515) (AF AFOSR-62-390) AD 434316 Unclassified

Also published in Phys. Rev., v. 132: 2764-2787, Dec. 1963.

A new technique is described for observing scattered particles in a scattering experiment. This involves a measurement of the correlated counting rates of two detectors and is based on an idea proposed by Hanbury-Brown and Twiss for astronomical observations. With this technique it is possible, for example, to explicitly measure the phase of a scattering amplitude.

2244

Princeton U. Palmer Physical Lab., N. J.

KHURI-TREIMAN REPRESENTATION AND PERTURBATION THEORY, by J. B. Bronzan and C. Kacser. [1963] [9]p. (AFOSR-64-0526) (AF AFOSR-62-390) AD 436162 Unclassified

Also published in Phys. Rev., v. 132: 2703-2711, Dec. 15, 1963.

It is characteristic of decay amplitudes that the spectral functions for their integral representations have branch points overlapping the integration contour. For the amplitude satisfying the Khuri-Treiman dispersion representation, the prescription for passing the branch points is shown to be incomplete. The full prescription is obtained using pertubation theory as a guide.

2245

Princeton U. Palmer Physical Lab., N. J.

ON THE BORN APPROXIMATION IN THE POTENTIAL SCATTERING OF PARTICLES WITH ARBITRARY SPINS, by F. Calogero and J. M. Charap. [1964] [17]p. (AFOSR-64-0552) (AF AFOSR-62-390) AD 434310 Unclassified

Also published in Ann. Phys., v. 26: 55-71, Jan. 1964.

For abstract see item no. 1124.

2246

Princeton U. Palmer Physical Lab., N. J.

ANALYTICITY PROPERTIES IN ENERGY OF THE COMPLEX J PARTIAL WAVE AMPLITUDES IN THE SCATTERING OF PARTICLES WITH SPIN, by F. Calogero. [1964] [11]p. (AFOSR-64-0553) (AF AFOSR-62-390) AD 434313 Unclassified

Also published in Ann. Phys., v. 26: 44-54, Jan. 1, 1964.

The energy dispersion relations for the complex J partial wave amplitudes for the scattering of particles with arbitrary spin are derived. A discussion is given of the Gribov-Pomeranchuk-Azimov essential singularities, and of a mechanism which might prevent their

propagation to indefinitely large values of J. Some properties of Jacobi functions are collected in an appendix.

2247

Princeton U. Palmer Physical Lab., N. J.

POLARIZATION EFFECTS IN HIGH-ENERGY WEAK INTERACTIONS, by S. L. Adler. [1963] [20]p. (AFOSR-64-0649) (AF AFOSR-62-390) AD 435927 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 1020-1039, Nov. 16, 1963.

The cross-section for the production of a polarized lepton and baryon reaction is computed. Results are given (a) in covariant form, and (b) in the center-of-mass system of the reaction, expressed directly in terms of the lepton and baryon decay asymmetries. Results are discussed with emphasis on determining the form factors in the strangeness-changing weak interactions, on isolating induced scalar and induced pseudoscalar effects, and on testing time-reversal invariance in high-energy weak interactions.

2248

Princeton U. Palmer Physical Lab., N. J.

ANALYTIC CONTINUATION IN COMPLEX ANGULAR MOMENTUM AND INTEGRAL EQUATIONS, by G. Tiktopoulos. [1964] [8]p. (AFOSR-64-1014) (AF AFOSR-62-390) AD 441059 Unclassified

Also published in Phys. Rev., v. 133: B1231-B1238, Mar. 9, 1964.

An attack is made on the problem of the analytic continuation in the angular momentum variable of amplitudes defined by integral equations beyond the value of Re l at which the kernel ceases to be of the Schmidt type and the Fredholm theory cannot be applied. A general technique is developed and applied to the Yukawa potential case.

2249

[Princeton U. Palmer Physical Lab., N. J.]

RESONANCES IN THE SCATTERING OF PSEUDOSCALAR MESONS, by C. Hong-Mo, P. C. DeCelles, and J. E. Paton. [1964] [24]p. (AFOSR-64-2132) (AF AFOSR-62-390) AD 451929 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 70-93, July 10, 1964.

The bootstrap mechanism is used to study the resonant scattering of pseudoscalar mesons under the assumption of mass degeneracy and the existence of the vector resonances. The general bootstrap conditions on the mass and the coupling constants are formulated and Capp's result on SU_3 symmetry is rederived from the more general equations. The question of the possible existence of further resonances is reduced to a simple eigenvalue problem.

2250

Princeton U. Palmer Physical Lab., N. J.

WEAK-COUPLING LIMIT FOR SCATTERING BY STRONGLY SINGULAR POTENTIALS, by G. Tiktopoulos and S. B. Treiman. [1964] [4]p. (AFOSR-64-2133) (AF AFOSR-62-390) AD 452277 Unclassified

Also published in Phys. Rev., v. 134: B844-B847, May 25, 1964.

The validity of certain cutoff procedures, which have lately been employed in the treatment of termwise divergent perturbative expansions in nonrenormalizeable field theories, is investigated in the context of nonrelativistic scattering from strongly singular repulsive potentials. For the cases considered the heuristic cutoff prescription indeed yields the correct expression for the weak-coupling limit of the phase shift.

2251

Princeton U. Palmer Physical Lab., N. J.

MEASUREMENT OF TIME CORRELATIONS FOR QUANTUM-MECHANICAL SYSTEMS, by M. L. Goldberger and K. M. Watson. [1964] [10]p. incl. diagr. (AFOSR-64-2134) (AF AFOSR-62-390) AD 452276 Unclassified

Also published in Phys. Rev., v. 134: B919-B928, May 25, 1964.

Measurements that are of limited accuracy, are incomplete, or require a finite time to make, do not generally permit one to construct a wave function for describing a physical system. The use of such partial information to predict the results of subsequent measurements is studied here. There are several practical applications of this problem, including the use of the autocorrelation function for a particle counter in a scattering experiment.

2252

Princeton U. Palmer Physical Lab., N. J.

RELATIVISTIC CALCULATION OF THE DEUTERON ELECTROMAGNETIC FORM FACTOR, I, by F. Gross. [1964] [15]p. (AFOSR-64-2135) (AF AFOSR-62-390) AD 452278 Unclassified

Also published in Phys. Rev., v. 134: B405-B419, Apr. 27, 1964.

The foundations of a relativistic theory of the deuteron-electromagnetic form factor are discussed. The theory is based on single-variable unsubtracted dispersion

relations and coupled unitarity equations. Because of the presence of very low anomalous thresholds, only a few diagrams need be considered to give a satisfactory low-momentum transfer theory, and the diagrams with thresholds below 36μ are tabulated. The scalar theory for a subset of these diagrams (corresponding to a one-pion-exchange approximation) is examined and found to be in close correspondence with potential theory. Special attention is given to the anomalous thresholds. The role of the 3-pion state is discussed.

2253

Princeton U. Palmer Physical Lab., N. J.

VARIATIONAL UPPER AND LOWER BOUNDS FOR MULTICHANNEL SCATTERING, by R. Sugar and R. Blankenbecler. [1964] [20]p. (AFOSR-65-0134) (AF AFOSR-62-390) AD 455794 Unclassified

Also published in Phys. Rev., v. 136: B472-B491, Oct. 26, 1964.

Upper and lower variational bounds are given for all elements of the reaction matrix. These, in turn, lead to upper and lower bounds on the elastic and inelastic cross sections. Two-particle scattering, coupled two-particle channels, and three-particl scattering situations are discussed, and the methods will work for any number of particles. Numerical examples are given, including phase shift bounds for S-wave electron-hydrogen scattering. It is hoped that this approach will lead to a tractable calculational scheme for strongly interacting relativistic particles.

2254

Princeton U. Palmer Physical Lab., N. J.

EUCLIDEAN APPROACH TO THE BETHE-SALPETER EQUATION FOR SCATTERING, by G. Tiktopoulos. [1964] [6]p. (AFOSR-65-0135) (AF AFOSR-62-390) AD 455795 Unclassified

Also published in Phys. Rev., v. 136: B275-B280, Oct. 12, 1964.

It is shown that the mass-shell scattering amplitude in the physical scattering region (two particle branch cut) can be directly obtained from the resolvent of the Bethe-Salpeter kernel transformed according to Wick (rotation of the energy integration paths to the imaginary axis). As an illustration and under the assumption that the kernel is approximated by any finite set of irreducible graphs, the scattering amplitude is given in terms of a Fredholm formula whose convergence is explicitly demonstrated.

2255

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. IV. COPPER (II) AND N-HYDROXYETHYLETHYLENEDIAMINETRIACETATONICKELATE(II), by T. J. Bydalek and D. W. Margerum. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1404) (AF 49(638)60) AD 444459 Unclassified

Also published in Jour. Inorg. Chem., v. 2: 678-683, Aug. 1963.

The kinetic expression, for the rate constants, and the activation energy for the copper(II) reaction with the N-hydroxyethylethylenediaminetriacetate (HEEDTA) complex of nickel(II) are nearly identical with the corresponding terms for the copper(II) reaction with the ethylenediaminetetraacetate (EDTA) complex of nickel(II) despite the difference in the coordination of HEEDTA and EDTA. This kinetic behavior is consistent with previously proposed dinuclear reaction intermediates where the multidentate ligand is partially unwrapped from the nickel ion and an iminodiacetate segment is coordinated to the attacking copper ion prior to the rate-determining step. The cleavage of the nickel-nitrogen bond of the last chelate (a glycinate gr) is the probable rate-determining step. (Contractor s abstract)

2256

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. V. COPPER(II) AND CYCLOHEXYLENEDIAMINETETRAACETATONICKELATE(II), by D. W. Margerum and T. J. Bydalek. [1963] [6]p. incl. diagrs. tables. (AFOSR-64-1406) (AF 49(638)60) AD 444457 Unclassified

Also published in Jour. Inorg. Chem., v. 2: 683-688, Aug. 1963.

The kinetics of the substitution reaction between the hydrated copper(II) ion and the cyclohexylenediaminetetraacetatonickelate(II) ion are studied from pH 1.5 to 3.5. In contrast to the dominant role of copper ion attack in the similar reaction with ethylenediaminetetraacetatonickelate(II), there is no copper ion attack of cyclohexylenediaminetetraacetatonickelate(II). The reaction is first order in the complex and independent of copper concentration but it is highly pH dependent. The acid dissociation rate constants are resolved. (Contractor's abstract, in part)

2257

Purdue U. Dept. of Chemistry, Lafayette, Ind.

EXCHANGE REACTIONS OF MULTIDENTATE LIGAND COMPLEXES, by D. W. Margerum. [1963] [15]p. incl. diagrs. table, refs. (AFOSR-64-1407) (AF 49(638)-60) AD 444456 Unclassified

Also published in Record Chem. Prog., v. 24: 238-251, Dec. 1963.

Exchange reactions of multidentate ligand complexes can be designed to give slow reaction rates even with very labile metal ions. The mechanism of these

exchange reactions can be analyzed successfully in terms of the stability of intermediates bonded to segments of the initial chelate. Good agreement is obtained for the measurement of very fast reaction rates including the rate of loss of the first sphere of water coordinated to a metal ion. The exchange reactions with excess metal ion have proved useful in measuring anion effects on the rate of water loss from metal ions.

2258

Purdue U. Dept. of Chemistry, Lafayette, Ind.

MULTIDENTATE LIGAND KINETICS. VI. THE EXCHANGE OF ETHYLENEDIAMINETETRAACETATE ION WITH TRIETHYLENETETRAMINENICKEL(II) AND TETRAETHYLENEPENTAMINENICKEL(II), by D. B. Rorabacher and D. W. Margerum. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1408) (AF 49(638)-60) AD 444319 Unclassified

Also published in Jour. Inorg. Chem., v. 3: 382-390, Mar. 1964.

This displacement of triethylenetetramine and of tetraethylenepentamine from their nickel complexes by EDTA is several orders of magnitude faster than the aqueous dissociation of these complexes at the same pH. The rapid EDTA exchange reactions are studied at 25°C, from pH 5.6 to 11.5 using a cyanide quench and a coordination chain reaction method. The reactions are first order in EDTA and first order in the nickel polyamine. A reaction mechanism is proposed involving a series of mixed ligand intermediate complexes where steric effects prevent full chelation of the six coordination sites of the nickel ion by the two multidentate ligands. The postulated rate-determining step is applicable to EDTA reactions with other metal complexes and with aqueous metal ions.

2259

Purdue U. Dept. of Chemistry, Lafayette, Ind.

CHEMISTRY OF FERROCENE AND RELATED COMPOUNDS, by R. A. Benkesser. Final rept. Jan. 1963, 14p. incl. tables. (AFOSR-4498) (AF 49(638)-297) AD 600969 Unclassified

Research on the following areas of study is summarized: Electrical effects in ferrocene, Addition reactions of vinylferrocene, and Alkylferrocene metalation.

2260

Purdue U. Dept. of Chemistry, Lafayette, Ind.

A RULE OF TRANS-NUCLEOPHILIC ADDITION, by W. E. Truce. Final rept. Jan. 25, 1963, 8p. (AFOSR-4495) (AF 49(638)531) AD 446157 Unclassified

This report describes the formulation and development of a new chemical rule "The Rule of Trans-Nucleophilic Addition." This rule states that reactions of addition (e.g., to acetylenic and olefinic systems), initiated by an electron donor, tend to proceed in a steric pattern, such that the nucleophile and displaced electron pair end up trans to each other. It complements the older rule of trans-Nucleophilic Addition, which covers the reverse process. These rules are of general application in organic systems.

2261

Purdue U. Dept. of Chemistry, Lafayette, Ind.

RECENT DEVELOPMENTS IN THE CHEMISTRY OF PERCHLOROPOLYSILANES, by G. Urry. [1964] [6]p. incl. refs. (AFOSR-64-0926) (AF 49(638)927) AD 443942 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 409-414, 1964.

The amine induced disproportionations of disilicon hexachloride and trisilicon octachloride produce Si_5Cl_{12} and Si_6Cl_{14} in good yields. The product is determined by the conditions under which the disproportionation is effected. The implications of the formation of these and higher perchloropolysilanes and a possible mechanism for the disproportionation of the perchloropolysilanes are discussed.

2262

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE PREPARATION AND SOME PROPERTIES OF A NEW PENTASILICON DODECACHLORIDE, Si_5Cl_{12}, by A. Kaczmarczyk, M. Millard and others. [1964] [5]p. incl. tables. (AFOSR-64-0927) (AF 49(638)927) AD 443943 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 421-425, 1964.

The conditions under which pentasilicon dodecachloride is produced in the amine-induced disproportionations of disilicon hexachloride and trisilicon octachloride are described. Some of the physical properties of pentasilicon dodecachloride are given along with descriptions of its chemical reactions with silicon tetrachloride, anhydrous hydrogen chloride and antimony trichloride.

2263

Purdue U. [Dept. of Chemistry] Lafayette, Ind.

COMPLEXES OF DISILICON HEXACHLORIDE WITH TRIMETHYLAMINE, by A. Kaczmarczyk and G. Urry. [1964] [6]p. (AFOSR-64-0928) (AF 49(638)927) AD 443944 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 415-420, 1964.

Disilicon hexachloride forms a well defined complex with trimethylamine, $Si_2Cl_6 \cdot 2N(CH_3)_3$, stable below -45°C. For the reaction $Si_2Cl_6 \cdot 2N(CH_3)_3 = Si_2Cl_6 \cdot N(CH_3)_3 + N(CH_3)_3$ a ΔH of approximately 10 kcal per mole can be obtained. The complex $Si_2Cl_6 \cdot N(CH_3)_3$ is stable below -45°C and exhibits no dissociation pressure below that temperature. At -45°C $Si_2Cl_6 \cdot N(CH_3)_3$ disproportionates slowly, obeying zero order kinetics, to silicon tetrachloride, trimethylamine, and non-stoichiometric complex. When the nonstoichiometric complex is warmed to room temperature, the disproportionation continues until the residual composition is a mixture. As a result of the disproportionations, no ΔH could be obtained for the reaction: $Si_2Cl_6 \cdot N(CH_3)_3 = Si_2Cl_6 + N(CH_3)_3$.

2264

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE PREPARATION AND SOME PROPERTIES OF HEXASILICON TETRADECACHLORIDE, Si_6Cl_{14}, by A. Kaczmarczyk, J. W. Nuss and G. Urry. [1964] [7]p. incl. diagr. table. (AFOSR-64-0929) (AF 49-(638)927) AD 443945 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 427-433, 1964.

The conditions under which hexasilicon tetradecachloride is produced in the trimethylamine-induced disproportionations of disilicon hexachloride and trisilicon octachloride are described. The polymorphism of hexasilicon tetradecachloride is described, along with other known physical properties. The behavior of Si_6Cl_{14} towards trimethylamine, silicon, tetrachloride, trichlorosilane, antimony trichloride and dimethyl zinc is noted. (Contractor's abstract)

2265

Purdue U. Dept. of Chemistry, Lafayette, Ind.

ON THE STRUCTURES OF PENTASILICON DODECACHLORIDE, Si_5Cl_{12}, AND HEXASILICON TETRADECACHLORIDE, Si_6Cl_{14}, by J. W. Nuss and G. Urry. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-64-0930) (AF 49(638)927) AD 443946 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 435-444, 1964.

Pentasilicon dodecachloride, Si_5Cl_{12}, and hexasilicon tetradecachloride, Si_6Cl_{14}, produced in the amine induced disproportionation of disilicon hexachloride, form stoichiometric 1:1 adducts with silicon tetrachloride, methyltrichlorosilane, and dimethyldichlorosilane. These adducts dissociate reversibly and plots of the logarithm of the dissociation pressure vs 1/T yielded straight lines from which the ΔH of dissociation was calculated. A discussion of the probable bonding in these adducts is presented. The infra-red spectra of pentasilicon dodecachloride and hexasilicon tetradecachloride in the vapor phase and in solutions of methylene chloride and silicon tetrachloride are presented along with a discussion of these spectra elucidating the molecular structure of pentasilicon dodecachloride and hexasilicon tetradecachloride. (Contractor's abstract)

2266

Purdue U. Dept. of Chemistry, Lafayette, Ind.

THE SYNTHESIS AND CHARACTERIZATION OF NITRONIC ESTERS, by N. Kornblum and R. A. Brown. [1964] [7]p. incl. table , refs. (AFOSR-64-2266) (AF AFOSR-63-122) AD 452529 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2681-2687, July 5, 1964.

Nitroparaffin salts react with trialkyloxonium fluoroborates to give nearly quantitative yields of nitronic esters. In this way nitronic esters derived from strictly aliphatic nitro compounds have been prepared for the first time. By the use of nuclear magnetic resonance spectroscopy it has been shown that nitronic esters exhibit cis-trans isomerism. Although stable indefinitely at -78°, nitronic esters decompose relatively rapidly at room temperature, particularly in the liquid state or in solution; nitronic esters derived from secondary nitro compounds appear to be less stable than those obtained from primary nitro compounds. Significant differences in decomposition rate are observed for stereoisomeric nitronic esters. (Contractor's abstract)

2267

Purdue U. [Dept. of Physics] Lafayette, Ind.

PHASE REPRESENTATION OF ANALYTIC FUNCTIONS, by M. Sugawara and A. Tubis. [1963] [5]p. (AFOSR-J1250) (AF AFOSR-62-132) AD 424317 Unclassified

Also published in Phys. Rev., v. 130: 2127-2131, June 1, 1963.

The phase representation which expresses an analytic function essentially in terms of its phase (not imaginary part) along the cuts is discussed. In particular, the precise conditions under which this phase representation is valid and also the asymptotic behavior of the phase representation are studied in detail. It is proved that the asymptotic behavior is essentially the same at infinity in all directions. The derivation of the high-energy behavior of scattering amplitudes and the N/D representation of the partial-wave amplitude are discussed as applications of the phase representation. Finally, the phase representation is used in determining the total numbers of zeros of the forward pion-nucleon scattering amplitudes. It is found that the

charge nonexchange amplitude has either 2 or 4 zeros, depending upon the signs of the S-wave scattering lengths, while the charge exchange amplitude has 11 zeros.

2268

Purdue U. [Dept. of Physics] Lafayette, Ind.

UNITARY SYMMETRY AND WEAK INTERACTIONS, by S. P. Rosen. [1964] [4]p. incl. refs. (AFOSR-64-0483) (AF AFOSR-63-274) AD 613814 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 408-411, Apr. 6, 1964.

The possibility is demonstrated of deriving the relations between the asymmetry parameters within the framework of unitary symmetry, for non-leptonic modes of Σ, Δ, and Ξ decay from the $\Delta T = 1/2$ rule, time reversal invariance, and 2 symmetry principles.

2269

Purdue U. Dept. of Physics, Lafayette, Ind.

SOME PROPERTIES OF TRIANGULAR REPRESENTATIONS OF SU(3), by S. P. Rosen. [1964] [5]p. incl. refs. (AFOSR-65-0484) (AF AFOSR-63-274) AD 613815 Unclassified

Also published in Jour. Math. Phys., v. 5: 289-293, Feb. 1964.

The occurrence of an equal-spacing mass rule in the unitary decuplet can be explained either by observing that the isotopic spin and hypercharge of each particle are related by $T = 1 + 1/2Y$, or by making use of the Diu-Ginibre theorem. This theorem states that, in all triangular representations of SU(3), the matrix elements of an arbitrary tensor operator depend upon one reduced matrix element instead of two. A new proof of the Diu-Ginibre theorem is presented. It shows that relations of the form $T = \lambda \pm 1/2Y$ exist for all triangular representations. It is further shown that the L and K spins are related to their corresponding hypercharges by $L = \lambda \pm 1/2Y_L$ and $K = \lambda \pm 1/2Y_K$. One consequence is that the masses and magnetic moments of particles in a triangular multiplet are equally spaced. Other consequences are also discussed. (Contractor's abstract, modified)

2270

Purdue U. [Dept. of Physics] Lafayette, Ind.

ELECTROPRODUCTION OF NEUTRAL PIONS FROM DEUTERIUM, by S. L. Brown. [1963] [4]p. incl. diagrs. refs. (AFOSR-65-0485) (AF AFOSR-63-274) AD 613802 Unclassified

Also published in Phys. Rev., v. 131: 1330-1333, Aug. 1, 1963.

Making use of the impulse approximation and the 1-nucleon dispersion theoretical amplitudes, a theoretical expression for the differential cross section of the process $e + d \rightarrow e + d + \pi^0$ has been calculated. An experiment which would be useful in the investigation of the nucleon form factors is proposed. At energies near the 3.3 resonance, the cross sections reach values up to 10^{-35} cm^2/mev sr^2, depending on the electronic 4-momentum transfer λ^2. (Contractor's abstract)

2271

Purdue U. Dept. of Physics, Lafayette, Ind.

CONSIDERATIONS ON THE MAGNETIC FIELD PROBLEM IN SUPERCONDUCTING THIN FILMS, by Y. Nambu and S. F. Tuan. [1964] [14]p. incl. diagrs. refs. (AFOSR-65-0486) (AF AFOSR-63-274) AD 613882 Unclassified

Also published in Phys. Rev., v. 133: A14, Jan. 16, 1964.

Previous results on the magnetic field dependence of the energy gap in superconductivity for bulk specimen are adapted to thin-film superconductors. The model of discrete quantization in momentum space is used. Only the parallel and constant external magnetic field along the film surfaces is considered. It is concluded that: (1) a 2nd-order phase transition should be observed at all temperatures for thin-film thicknesses; (2) a simple scaling rule exists for field and temperature dependence on the energy gap; and (3) the critical field H_c depends on thickness L and reduced temperature t for not too thin films. The behavior changes as the film becomes very thin or as the temperature becomes moderately low.

2272

Purdue U. [Dept. of Physics] Lafayette, Ind.

UNITARY SYMMETRY AND THE TRANSFORMATION $\eta \rightarrow \pi^0$, by S. P. Rosen. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0487) (AF AFOSR-63-274) AD 613813 Unclassified

Also published in Phys. Rev., v. 132: 1234-1239, Nov. 1, 1963.

The transformation $\eta \rightarrow \pi^0$, which appears to play a dominant role in the decay mode $\eta \rightarrow \pi^+\pi^-\pi^0$, is examined in the light of unitary symmetry and several different models for η decay. Besides the models of Gell-Mann, Sharp, and Wagner (GSW), and of Barrett and Barton (BB), these include the strong coupling of pseudoscalar and vector meson octets with the unitary singlet vector meson φ, and the electromagnetic coupling of pseudoscalar and vector mesons. Group-theoretical methods are used to confirm that the contributions of all but one of the lowest order diagrams on the GSW model cancel one another. The same methods show that the cancellations in lowest order are not as serious for the BB model, and are nonexistent for models involving the φ meson. (Contractor's abstract)

2273

Purdue U. Dept. of Physics, Lafayette, Ind.

CONSIDERATIONS ON THE ISOBAR MECHANISM AND RESONANCE POLES FOR PION-BARYON SYSTEMS, by I. P. Gyuk and S. F. Tuan. [1964] [7]p. incl. diagrs. table, refs. (AFOSR-65-0494) (AF AFOSR-64-274) AD 614143 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 227-233, Apr. 1, 1964.

The Peierls-Hwa theory concerning the generation of higher resonance poles for plon-baryon systems is discussed. The role of a resonance pole involving phase-space factors such that an indirect resonance (Ξ^*(1745 mev)) can occur very close to the singularity in the Bohr term is explained. It is indicated qualitatively how the interaction dynamics might intervene to sort out the correct isospin structure for the predicted higher resonances. It is also emphasized that kinematic and mass ratio considerations are especially favorable for the $\pi - \Xi^*$ system.

2274

Purdue U. [Dept. of Physics] Lafayette, Ind.

POSSIBLE EXPERIMENTAL CONSEQUENCES OF TRIANGLE SINGULARITIES IN STRANGE-PARTICLE PRODUCTION PROCESSES, by Y. F. Chang and S. F. Tuan. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0495) (AF AFOSR-64-274) AD 614144 Unclassified

Also published in Phys. Rev., v. 136: B741-B748, Nov. 9, 1964.

Observable consequences of anomalous threshold singularity for triangle diagrams are examined with special reference to cases where baryon resonance of narrow width participate as an internal line in the E channel. It is found that the reaction $K^- + p \rightarrow K + \pi + \Xi$, with Ξ (1530) included as an internal line of the graph, offers the best experimental situation for detecting an anomalous singularity effect by studying the $K\pi$ mass spectrum in final state. (Contractor's abstract)

2275

Purdue U. Dept. of Physics, Lafayette, Ind.

ENERGY PEAKS FOR THREE-BODY MESON SYSTEMS, by S. F. Tuan. [1964] [3]p. incl. diagrs. refs. (AFOSR-65-0496) (AF AFOSR-64-274) AD 614150 Unclassified

Also published in Phys. Ltrs., v. 11: 248-250, Aug. 1, 1964.

The unitarity problem is discussed for 3-body meson systems. No resonance peaking is expected in coupled channels for meson systems, in particular for the coupled 3-body final systems of $M_1 + M_{jk} \rightarrow M_1 + M_m + M_n$. The implications of this theory to $\pi\rho$ interaction at 1100 mev, π-K interaction at 1200 mev, and $\pi K\overline{K}$ peak at 1410 mev are summarized.

2276

Purdue U. Dept. of Physics, Lafayette, Ind.

MESON EFFECTS IN n-p CAPTURE, by G. Stranahan. [1964] [8]p. incl. diagrs. table, refs. (AFOSR-65-0497) (AF AFOSR-64-274) AD 614151 Unclassified

Also published in Phys. Rev., v. 135: B953-B960, Aug. 24, 1964.

A contribution to the n-p capture amplitude which results from the modification of the nucleon current operators by the nuclear interaction is calculated. The 2-nucleon states are represented by Heitler-London states, and the capture amplitude is related to single-nucleon matrix elements by means of an expansion corresponding to the exchange of mesons between the nucleons. These single-nucleon matrix elements are evaluated using the fixed-source theory. (Contractor's abstract, in part)

2277

Purdue U. Dept. of Physics, Lafayette, Ind.

MESON-BARYON SYSTEMS AND THEIR RESONANCES, by I. P. Gyuk and S. F. Tuan. [1964] [4]p. incl. diagrs. diagrs. tables, refs. (AFOSR-65-0498) (AF AFOSR-64-274) AD 614152 Unclassified

Also published in Phys. Rev., v. 134: B1320-B1323, June 22, 1964.

Meson-baryon systems of angular momentum L are analyzed by considering the relevant crossing matrices. The resultant "bootstrap" calculations yield the correct quantum numbers for the observed array of particles and resonances. Specifically it is found that Y_1^* (1385) decays into ($\pi\Delta$) but not ($\pi\Sigma$). Furthermore a Y_1^* resonance in (5/2-) is predicted which may accommodate the recently discovered $Y1^*$ (1765).

2278

Purdue U. Dept. of Physics, Lafayette, Ind.

CROSSING RELATIONS AND LEGENDRE EXPANSIONS IN PION-PION SCATTERING, by T. Kanki and A. Tubis. [1964] [10]p. incl. diagrs. refs. (AFOSR-65-0499) (AF AFOSR-64-274) AD 614153 Unclassified

Also published in Phys. Rev., v. 136: B723-B732, Nov. 9, 1964.

The direct use of crossing relations for pion-pion scattering amplitudes, outside the triangle bordered by the lines s = 0, t = 0, and u = 0 in the Mandelstam diagram, is not generally possible. This is because the regions

of convergence of the usual Legendre expansions for the amplitudes are restricted by cross-channel cuts in appropriate cosθ variables. These convergence difficulties may be relieved by suitably decomposing each amplitude into 2 terms. One term differs in analytic properties from the actual amplitude in that portions of the cross-channel cuts in cosθ nearest cosθ = 1 are absent. The Legendre expansion of this term has a larger region of convergence than that for the actual amplitude. The other term in the decomposition is expressed in terms of the Legendre series for physical scattering in the cross channels. The amplitudes so represented may now be continued from one physical region to another, and crossing relations may, in general, be directly applied outside the triangle. (Contractor's abstract, in part)

2279

Purdue U. [Dept. of Physics] Lafayette, Ind.

UNITARY SYMMETRY AND WEAK INTERACTIONS. II. SU(3) TRANSFORMATION PROPERTIES, by S. P. Rosen. [1964] [4]p. incl. refs. (AFOSR-65-0609) (AF AFOSR-64-274) AD 614154 Unclassified

Also published in Phys. Rev., v. 135: B1041-B1044, Aug. 24, 1964.

It is shown that if weak interactions are T-L invariant and satisfy the $\Delta T = 1/2$ rule, their SU(3) transformation properties are severely limited. The non-leptonic Hamiltonian must belong to an octet, and the leptonic Hamiltonian is restricted to an octet and decuplet. To prove this result, the matrix elements of certain spin-type operators are expressed in terms of the Casimir operators for SU(3). T-L invariance and the $\Delta T = 1/2$ rule impost constraints upon the eigenvalues of these Casimir operators and hence limit weak interactions in the manner described above. The converse of this result is not true; for example, a Hamiltonian belonging to an octet is not necessarily T-L invariant.

2280

Purdue U. Dept. of Physics, Lafayette, Ind.

SU(6) AND WEAK INTERACTIONS, by S. P. Rosen and S. Pakvasa. [1964] [4]p. incl. refs. (AFOSR-66-0074) (AF AFOSR-64-274) AD 630379 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 773-776, Dec. 21, 1964.

An examination is made of weak interactions in the light of SU(6), with special attention given to the transformation properties of the weak Hamiltonian H_W.

2281

Purdue U. Jet Propulsion Center, Lafayette, Ind.

SUMMARY OF EXPERIMENTAL INVESTIGATIONS OF COMBUSTION PRESSURE OSCILLATIONS IN GASEOUS PROPELLANT ROCKET MOTORS, by M. J. Zucrow, J. R. Osborn, and J. M. Bonnell. Final rept. June 1963, 43p. incl. diagrs. table. (Rept. no. F-63-2) (AFOSR-5261) (AF 49(638)756) AD 416365; AD 417505 Unclassified

The experiments conducted were designed for studying the factors promoting combustion pressure oscillations in rocket motors burning either premixed or unmixed gaseous propellants. Investigations were conducted for determining the effects of combustion chamber geometry, the chemical differences in the propellants, and also the effects of several injection variables. Auxiliary studies were conducted regarding the effects of baffles located in the combustion chambers, and the applicability of linear theories to combustion instability phenomena.

2282

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

UNSTABLE BURNING IN SOLID AND LIQUID PROPELLANT ROCKET MOTORS, by J. R. Osborn. [1963] [15]p. (AFOSR-J1084) (AF 49(638)756) AD 421721 Unclassified

Also published in Raketentechnik und Raumfahrforschung, v. 2: 47-61, Apr./June 1963.

Presented is the theoretical and experimental effort devoted to the study and analysis of the phenomena associated with unstable burning in both liquid and solid propellant rocket motors. The theoretical developments, particularly those pertaining to liquid propellant engines, have been concerned primarily with derlving mathematical relationships for estimating the frequencies of the combustion pressure oscillations. The experimental investigations pertinent to both types of engines have been pointed to obtain an insight into the phenomena associated with unstable combustion, and data regarding the physical and chemical parameters having the greatest influence upon the severity of the combustion pressure oscillations, and with empirical methods for either avoiding or suppressing them.

2283

Purdue U. Jet Propulsion Center, Lafayette, Ind.

LIMITING CONDITIONS FOR THE ONSET OF COMBUSTION PRESSURE OSCILLATIONS (TRANSVERSE MODE) IN GASEOUS PROPELLANT ROCKET MOTORS, by M. J. Zucrow, J. R. Osborn, and others. 1964, 15p. (AFOSR-64-2018) (AF AFOSR-62-360) AD 451190 Unclassified

Presented at First AIAA annual meeting, Washington, D. C., June 29-July 2, 1964.

An experimental and a theoretical study were made of the high frequency combustion pressure oscillations occurring in rocket motors burning gaseous propellants with the object of determining the influence of the mixing of the propellants and other rocket motor operating conditions upon the onset of the pressure oscillations.

The experiments were conducted with rocket motors of a fixed combustion chamber geometry equipped with different injectors for burning unmixed ethylene and air. The theoretical study was concerned with the derivation of similarity variables that are sensitive to the oscillatory behavior of the combustion process. The analysis is based on the behavior of an idealized rocket motor combustion system divided into four zones. It was determined both theoretically and experimentally that the incidence of combustion pressure oscillations is dependent on a number of dimensionless parameters.

2284

Purdue U. Jet Propulsion Center, Lafayette, Ind.

CONTINUOUS MEASUREMENT OF THE BURNING RATES OF SOLID ROCKET PROPELLANTS, by J. R. Osborn and R. J. Burick. Interim rept. Apr. 1964 [74]p. incl. illus. diagrs. tables. (Rept. no. I-64-3; JPC 369) (AFOSR-64-1479) (AF AFOSR-63-207) AD 601648 Unclassified

An experimental system for the direct and continuous measurement of solid rocket propellant burning rates was developed. A sample of solid propellant is bonded to a holder with an attached shaft which moves the propellant sample within a two-dimensional rocket motor. The flat burning surface of the propellant sample recedes normally as a servo-mechanism moves the propellant in a direction opposite to the receding propellant surface. The servomechanism operates in such a manner that the burning propellant surface is maintained at a fixed position within the rocket motor. Since the burning surface of the propellant remains fixed, the direct measurement of the velocity of the shaft yields the burning rate. The servomechanism incorporates a radioactive isotope feedback transducer system for detecting the position of the burning surface of the propellant sample. A collimated beam of gamma rays, provided by a 50 millicurie source of Cesium-137, is transmitted through the rocket motor walls and is transformed into an electrical feedback signal by a scintillation probe coupled with a linear ratemeter. (Contractor's abstract, in part)

2285

Purdue U. Jet Propulsion Center, Lafayette, Ind.

ANALYSIS OF A SERVO SYSTEM FOR CONTINUOUS MEASUREMENT OF THE BURNING RATE OF A SOLID PROPELLANT, by J. R. Osborn and R. F. Panella. Interim rept. May 1964, 84p. (Rept. no. I-64-4; JPC-374) (AFOSR-64-1480) (AF AFOSR-63-207) AD 604556 Unclassified

The object of this project was to determine the servo system dynamics. Stability, time response and optimization of the servo system were investigated. A theoretical analysis was made to determine component transfer functions. From the component transfer functions the overall system transfer function was derived. The Bode diagram was then used to determine system stability. The system transfer function was programmed on an analog computer, and the time response of the system was characterized. The servo system was built, and experimental results were obtained to verify the theoretical system transfer function.

2286

Purdue U. Jet Propulsion Center, Lafayette, Ind.

CONTINUOUS MEASUREMENT OF SOLID PROPELLANT BURNING RATES, by J. R. Osborn, R. J. Burick, and R. F. Panella. Final rept. July 1964, 34p. (Rept. no. F-64-3; JPC-386) (AF AFOSR-63-207) AD 615816 Unclassified

Also published in Rev. Scient. Instr., v. 37: 86-92, Jan. 1966. (AFOSR-66-1097; AD 629070)

An experimental apparatus was developed for the direct and continuous measurement of the burning rates of solid rocket propellants under conditions closely approximating those occurring in a solid rocket motor. The apparatus utilizes a positioning type servomechanism as a feed system which moves a sample of solid propellant within a two-dimensional rocket motor so that the receding burning surface of the sample is maintained at a fixed position with respect to the motor walls. Because the burning surface is maintained at a fixed position; the measurement of the velocity of the propellant feed system is identical with the burning rate. The servomechanism incorporates a 50 millicurie Cesium-137 source of gamma rays coupled with a scintillation probe for detecting the position of the burning propellant surface. Experimental data are reported.

2287

Purdue U. [Jet Propulsion Center] Lafayette, Ind.

LONGITUDINAL MODE INSTABILITY, by J. R. Osborn. [1964] [1]p. incl. refs. (AFOSR-66-1988) (AF AFOSR-65-753) AD 644353 Unclassified

Also published in AIAA Jour., v. 2: 2237, Dec. 1964.

The validity of the time lag theory is questioned. The time lag theory predicts and requires the existence of an upper control length whereas none has been found experimentally in gas-rocket motors. It is noted that the results of theoretical analysis based on an Arrhenius type rate function for the combustion zone dynamics do not indicate the existence of an upper critical length.

2288

Purdue U. School of Electrical Engineering, Lafayette, Ind.

LASER POWER AND ENERGY MEASUREMENT USING NONLINEAR POLARIZATION IN CRYSTALS, by A. K. Kamal and M. Subramanian. [1963] [13]p. (AFOSR-64-0809) (AF AFOSR-62-296) AD 438375 Unclassified

Also published in Proc. Symposium on Optical Masers, Polytechnic Inst. of Brooklyn, (Apr. 16-19, 1963), p. 601-613.

A high intensity laser beam propagating through a crystalline medium that lacks inversion symmetry develops a dc polarization in the medium. The dc polarization is shown to be directly proportional to the instantaneous power in the laser beam. This principle has been used in demonstrating that a transmission type of device can be built to measure the power in a laser pulse. The energy in the pulse can be determined by passing the output of the device through an integrating circuit.

2289

Purdue U. School of Electrical Engineering, Lafayette, Ind.

PHILOSOPHY AND STATE OF THE ART OF LEARNING CONTROL SYSTEMS, by J. E. Gibson, K. S. Fu and others. Nov. 1963, 118p. incl. diagrs. refs. (AFOSR-5144) (AF AFOSR-62-351) AD 426919 Unclassified

This report is organized into three chapters. The first chapter discusses relevant background material on learning and learning systems. This includes the psychological background of learning and the psychologists' definition of learning. It also includes a brief description and discussion of the learning devices proposed in the literature. Chapter 2 gives the Purdue CISL approach to learning systems. A learning process is defined as applied to control engineering. A discussion of adaptivity and its relationship to learning is included. Chapter 3 presents several different experimental and theoretical approaches to learning control systems which are currently being investigated at Purdue. Some preliminary results on these systems are included. (Contractor's abstract)

2290

Purdue U. School of Electrical Engineering, Lafayette, Ind.

LEARNING CONTROL SYSTEMS, by K. S. Fu. [1964] [26]p. incl. refs. (AFOSR-65-0326) (AF AFOSR-62-351) AD 611935 Unclassified

Also published in Computer and Information Sciences, Spartan Books, Washington, D. C., 1964, p. 318-343.

An informal introduction of learning control systems was presented. A class of learning control systems was described in detail and the basic functions of a learning controller were discussed. Two example systems were given to illustrate the prepared approach. A complete analytic design procedure of learning control systems is under investigation.

2291

Purdue U. School of Electrical Engineering, Lafayette, Ind.

A HILLCLIMBING TECHNIQUE USING PIECEWISE CUBIC APPROXIMATION, by J. C. Hill. Apr. 1964, 114p. incl. refs. (AFOSR-67-1282) (AF AFOSR-62-351) Unclassified

Three distinct types of hillclimbing techniques are studied in this thesis. The first is variations of the conventional discrete search as proposed by Bocharov and Fel'dbaum. The second is Kushner's method. The third is the piecewise cubic method, which is developed herein. The last two methods operate by building a model from the measurements obtained. The concept of testing various hillclimbing methods on a relatively large number of randomly selected hills is proposed. A class of such hills is presented, the members of which are capable of exhibiting most of the troublesome features of practical hills. This concept is then applied to evaluate the performance of the three types of hillclimber. Experimental evidence via digital simulation is presented for the superiority of the two model building techniques over the Bocharov and Fel'dbaum methods.

2292

Puerto Rico U., Mayaguez.

INTERPRETATION OF SOME SWEEP-FREQUENCY BACKSCATTER ECHOES, by B. Dueno. [1963] [7]p. (AFOSR-J973) (AF AFOSR-62-408) AD 417143 Unclassified

Also published in Jour. Geophys. Research, v. 68: 3603-3609, June 15, 1963.

A relation is obtained for the condition of minimum time delay focusing for a spherical earth geometry assuming an ionosphere with a parabolic distribution of ion density. Theoretical curves for the case of sweep-frequency backscatter (time delay vs frequency) are obtained that agree well with experimental values. Deductions from theory are made that explain characteristics of backscatter records. A frequency-independent constant time delay (22 msec) backscatter echo frequently observed in the south direction is explained with the help of an expression for the time delay used in deriving the minimum time delay condition.

2293

Radiation Applications, Inc., Long Island, N. Y.

RADIATION-INDUCED SOLID PROPELLANT DECOMPOSITION, by G. Odian, T. Acker and others. Technical rept. Dec. 1, 1962-Nov. 30, 1963. Jan. 15, 1964, 30p. (Rept. no. RAI-331) (AF AFOSR-64-1448) (AF 49(638)1125) AD 604475 Unclassified

An investigation was made of the effect of ionizing radiation on the burning rates and tensile strengths of various composite ammonium perchlorate propellants. The results of these studies demonstrated that, in many cases, drastic changes in burning rate and tensile strength occurred upon radiolysis. In order to elucidate the mechanism of these effects, a multipronged study of the effects of radiation on propellants and propellant components was initiated. This involved: (1) a study of the radiation induced decomposition of ammonium perchlorate with an elucidation of the various chemical species produced upon radiolysis and their yields (G values); (2) a study of radiation effects on burning rate by a technique in which the effect of radiation on each of the two components of a propellant, i.e., organic binder and inorganic oxidizer, is studied separately.

2294

Radiation Applications, Inc., Long Island, N. Y.

EFFECT OF RADIATION ON AMMONIUM PERCHLORATE PROPELLANTS, by T. Acker, E. Henley and others. [1964] [1]p. incl. table. (AFOSR-65-1435) (AF 49(638)1125) AD 622649 Unclassified

Also published in AIAA Jour., [v. 2: 1165, June 1964].

The results of a series of experiments conducted to determine the effects of radiation on ammonium perchlorate propellants are presented. The propellant strands were irradiated with a 2-mev Van de Graaff electron accelerator. After exposure to doses from 0-50 mrad, burning rates and tensile measurements were made. It was demonstrated that in many cases, drastic changes in burning rates and tensile strnegths occurred upon radiolysis.

2295

Radio Corp. of America. [Astro-Electronics Div.] Princeton, N. J.

CONTINUUM ASPECTS OF RF GRADIENT ACCELERATION OF PLASMA, by J. A. Cooney. [1963] [3]p. incl. diagr. (AFOSR-64-0147) (AF 49(638)658) AD 432577 Unclassified

Also published in AIAA Jour., v. 1, 2190-2192, Sept. 1963.

A quasi-one-dimensional model of acceleration of a continuum plasma by rf electric field gradient forces is examined. The conditions imposed on the electric field in order to effect sonic transitions are given.

2296

Radio Corp. of America. Astro-Electronics Div., Princeton, N. J.

ACCELERATION OF AN ELECTRON CYCLOTRON PLASMA BY SELF GENERATED ELECTRIC FIELDS, by H. W. Hendel, S. A. Ahmed, and T. J. Faith. [1964] [5]p. incl. diagrs. (AFOSR-66-1101) (AF 49-(638)1342) AD 639010 Unclassified

Also published in Proc. Internat'l. Colloq. on the Interaction of High Frequency Fields Associated with Static Magnetic Field Plasma, Saclay (France), Sept. 16-17, 1964, p. 57-61.

This paper is concerned with the continuous acceleration of a neutral plasma by self-generated electrostatic fields. Energy input to the plasma is achieved by selective transfer of rf energy to the electrons at electron cyclotron resonance. With the density in the acceleration region adjusted such that $\omega_{be}\tau>>1$ the mean path (parallel to the magnetic field) of the electrons between collisions is greater than the Larmor radius (the latter determining the mean free path transverse to B_z). Due to the tensor nature of the electron diffusion coefficient in the presence of a magnetic field at low pressures, an electron space charge is set up by the axial electron flux that accelerates the ions axially. To maintain charge neutrality in the beam that emerges from the accelerator and to conserve momentum, the ion accelerating plasma potential drop must be nearly totally reflective for the electrons and therefore adjusts to a value approximately 6 times higher than the electron temperature. Consequently the final ion energy in the beam is 6 times the thermal energy of the plasma electrons.

2297

Radio Corp. of America. RCA Labs., Princeton, N. J.

AN ANALYSIS OF AN APPROXIMATE SEQUENTIAL PROCEDURE FOR INTERVAL ESTIMATION, by D. A. Walters. July 1963, 101p. incl. diagrs. tables. (Technical note no. 1) (AFOSR-5155) (AF 49(638)1184) AD 438559 Unclassified

This report presents an approximate sequential method of interval estimation suitable for hypothesis tests in current research in artificial intelligence, a study of its properties, and a method of choosing parameter values to maximize its effectiveness. Relationships were found between the parameters of the procedure and its significant properties, including the probabilities of the two types of error and the expected number of samples required by the process. Several sets of parameters were chosen. (Contractor's abstract)

2298

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

OXIDATION OF DIETHYLDIBORANE, by W. H. Bauer,

S. E. Wiberley, and E. l. Sandvik. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-1432) (AF 49(638)-897) AD 622923 Unclassified

Presented at AIAA Heterogeneous Combustion Conf., Palm Beach, Fla., Dec. 11-13, 1963.

Also published in Prog. in Astronaut. and Aeronaut., v. 15: 375-390, 1964.

The gas-phase oxidation of sym-diethyldiborane was studied under both explosive and nonexplosive conditions. With excess oxygen the nonexplosive reaction was a partial oxidation to form ethyl metaborate and hydrogen. The rate of disappearance of sym-diethyldiborane in the partial oxidation was found to be zero order in oxygen and first order in sym-diethyldiborane. The formation of an unstable intermediate in the partial oxidation was observed. The products of explosions with excess oxygen were carbon dioxide, water, and a white solid, B_2O_3. The explosion is believed to be predominantly thermal in nature. The enthalpy change of the partial oxidation has been estimated to be sufficient to initiate complete combustion by the temperature increase caused by energy release on formation of ethyl metaborate and hydrogen.

2299

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

AN INVESTIGATION OF SOME REACTIONS OF ACTIVE NITROGEN, by D. R. Safrany. June 1964, 173p. incl. illus. diagrs. tables, refs. (AFOSR-65-1337) (AF AFOSR-63-174) AD 620226 Unclassifled

The reactions of active nitrogen were studied in a fast-flow, low-pressure system using a mass spectrometer whose leak was located directly downstream from the reaction zone. Reactions of metastable $N_2(A^3\Sigma_u^+)$ molecules, produced by means of surface catalyzed excitation, were also investigated. It was shown that $N_2(A^3\Sigma_u^+)$ molecules generally do not play a major role in the reactions of active nitrogen with inorganic and organic substances, e.g., O_2, O_3, N_2O, C_2H_2 and C_2H_4. Contrary to earlier work, it is found that N-atoms reacting with hydrocarbons produce not only HCN, but also N_2 and sometimes NH_3 and CH_3CN as major products. A general degradation mechanism is also proposed involving the attack of the hydrocarbon by a radical other than the N-atom as the initial step.

2300

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

HCl-CATALYZED REACTION OF HYDROCARBONS WITH ACTIVE NITROGEN, by D. R. Safrany, P. Harteck, and R. R. Reeves, Jr. [1964] [2]p. (AF AFOSR-63-174) AD 622850 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1161-1162, Aug. 15, 1964.

The addition of HCl to mixtures of methane, ethane, and other saturated hydrocarbons, with active nitrogen yielded results which serve to emphasize the general importance of hydrocarbon radical reactions in the kinetics of hydrocarbon reactions with active nitrogen.

2301

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

THE IODINE LAMP: A LIGHT SOURCE FOR SELECTIVE EXCITATION OF CO, by P. Harteck, R. R. Reeves, Jr., and B. A. Thompson. [1964] [6]p. (AF AFOSR-63-174) AD 622657 Unclassified

Also published in Zeitschr. Naturforsch., v. 19: 2-6, 1964.

A light source was developed for photochemical studies which emits the 2062 A line of iodine. This lamp was used to study reactions of CO excited in the $a^3\Pi$ level. Carbon monoxide was irradiated in an experimental lamp incorporating an arrangement of concentric cylinders. The output of this lamp was 2×10^{18} quanta per sec. The CO $a^3\Pi$ molecules react to form CO_2 with a quantum efficiency between a few tenths and unity.

2302

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

THE REACTION OF CH RADICALS WITH AMMONIA, by D. R. Safrany, R. R. Reeves, Jr., and P. Harteck. [1964] [2]p. (AF AFOSR-63-174) AD 622751 Unclassifled

Also published in Jour. Amer. Chem. Soc., v. 86: 3160, 1964.

When ammonia was added upstream from an acetylene-nitrogen flame, the ammonia was substantially consumed and hydrogen and hydrogen cyanide were produced (in addition to that expected if the nitrogen were supplied entirely in the form of molecular nitrogen). The following mechanism is proposed for the reaction and supporting evidence is provided: $CH + NH_3 \rightarrow HCN + H_2 + H + 51$ kcal.

2303

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

MOLTEN SALT DATA. ELECTRICAL CONDUCTANCE, DENSITY, AND VISCOSITY, by G. J. Janz, A. T. Ward, and R. D. Reeves. July 1964, 180p. incl. tables, refs. (AFOSR-64-0039) (AF AFOSR-63-181) AD 605938 Unclassified

Conductance, density, and viscosity data at round values of temperature (K) are given for some 126 inorganic compounds as single-salt melts (fluorides, 15; chlorides, 34; bromides, 20; iodides, 23; oxides, 7; sulphates, 5; nitrates, 7; carbonates, 3; and miscellaneous, 12). Equations expressing the temperature dependence of these properties for the single-salt melts are also given. For mixtures of these salts, the binary systems that have received attention are listed; numerical values for these mixtures are not given but are referenced.

2304

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

STRUCTURE AND PROPERTIES OF MOLTEN SALTS, by G. J. Janz. Final rept. Dec. 1964, 10p. incl. refs. (AFOSR-65-0244) (AF AFOSR-63-181) AD 611164 Unclassified

A summary is given of physico-chemical studies which resulted in new insights into the chemical and structural nature of molten inorganic salts. For the purpose of providing a guide to the selection of molten salts for particular applications or structural studies, a classification scheme is proposed (based on the energies of activation) for viscous flow and electrical conductance.

2305

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

MELTING AND PRE-MELTING EFFECTS IN THE ALKALINE EARTH HALIDES, by G. J. Janz, F. J. Kelly and J. L. Perano. [1963] [5]p. incl. diagr. tables, refs. (AFOSR-65-0382) (AF AFOSR-63-181) AD 612227 Unclassified

Also published in Trans. Faraday Soc., v. 59: 2718-2722, Dec. 1963.

Heats and entropies of fusion, and heat content data for $CaBr_2$, $SrCl_2$, $BaCl_2$ and $BaBr_2$, determined by the method of phase-transition drop calorimetry, are reported. Solid-state transitions were confirmed for $SrCl_2$ and $BaCl_2$, and the possible nature and extent of these transitions are examined. An assessment of the phase-transition properties for the alkaline earth halides and nitrates is developed and the results are discussed relative to pre-melting effects and the process of fusion for these salts. For $SrCl_2$, the relatively small value of the melting and pre-melting effects is note-worthy.

2306

Rensselaer Polytechnic Inst. [Dept. of Chemistry] Troy, N. Y.

MELTING AND PRE-MELTING PHENOMENA IN ALKALI METAL NITRATES, by G. J. Janz, F. J. Kelly, and J. L. Perano. [1964] [4]p. incl. diagr. tables, refs. (AFOSR-65-0383) (AF AFOSR-63-181) AD 611728 Unclassified

Also published in Jour. Chem. and Eng. Data, v. 9: 133-136, Jan. 1964.

Data for the heat content, heats and entropies for the solid-state transition (276°C), and for fusion (307°C), gained by the method of phase-transition drop calorimetry, are reported. The thermal data confirm that the solid-state transition in $NaNO_3$ has unusual features. The change persists from 180° to 280°C, and appears about 60% complete at 270°C. This, and the relatively small magnitude of the thermal effects $\Delta S_{t.}$, 0.32 deg^{-1} mol^{-1}), are examined relative to the nature and extent of the solid-state transition. A comparison of the fusion and pre-fusion parameters for a related series of nitrate and chloride salts is presented and discussed relative to a "premonition of melting" effect as evidenced by such continuous solid-state transition regions. The lower melting point and smaller change in volume on fusion also appear interrelated. (Contractor's abstract)

2307

Rensselaer Polytechnic Inst. Dept. of Chemistry, Troy, N. Y.

FUSION AND PERFUSION IN SILVER NITRATE, by G. J. Janz and F. J. Kelly. [1963] [3]p. incl. refs. (AFOSR-65-0384) (AF AFOSR-63-181) AD 611729 Unclassified

Also published in Jour. Phys. Chem., v. 67: 2848-2850, Dec. 1963.

The note reports heat capacity data for silver nitrate to bridge the gap between 300 and 438°K, and a reexamination of heat of fusion: The significance and interdependence of the structural changes occurring during the transition and fusion processes in the light of recent crystallographic evidence are briefly considered.

2308

Rensselaer Polytechnic Inst. Dept. of Electrical Engineering, Troy, N. Y.

PHYSICAL PHENOMENA FOR LOGICAL FUNCTIONS, by W. R. Beam. Final technical rept. Feb. 15. 1964 [76]p. incl. diagrs. refs. (AFOSR-64-1379) (AF AFOSR-62-194) AD 604046 Unclassified

There are a number of physical phenomena occurring in solids which have some promise for application to logical devices. Some of these have been partially explored and at least for the present, discarded. Others have received no consideration, not even a feasibility evaluation. The purpose of this work is to consider some of these phenomena to discover in what form and how well they might be used to construct devices and implement useful logical functions. Technical study

areas include: Distributed constant neuristors, niobium oxide negative resistance elements, minimum complexity digital electronics, continuous-medium domain logic and memory devices, and some remarks on topology and power supply of logical networks.

2309

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

ZEROES OF BESSEL FUNCTIONS AND EIGENVALUES OF NON-SELF ADJOINT BOUNDARY VALUE PROBLEMS, by D. S. Cohen. [1964] [7]p. (AFOSR-64-1733) (AF AFOSR-63-182) AD 447598 Unclassified

Also published in Jour. Math. and Phys., v. 43: 133-139, June 1964.

The techniques developed here may be applied equally well to obtain new representation of the solution of the analogous non-self-adjoint boundary value problems in domains interior to cylinders and spheres. These investigations require extensive knowledge of the zeroes of certain linear combinations of Bessel functions and their first derivatives considered as functions of the order of the Bessel function.

2310

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

THE VIBRATIONS OF A RANDOM ELASTIC STRING: THE METHOD OF INTEGRAL EQUATIONS, by B. E. Goodwin and W. E. Boyce. [1964] [6]p. (AFOSR-65-0329) (AF AFOSR-63-182) AD 611995 Unclassified

Also published in Quart. Appl. Math., v. 22: 261-266, Oct. 1964.

The theory of Fredholm integral equations is applied to the problem of determining the natural frequencies of transverse vibrations of a tightly stretched elastic string whose mass per unit length varies with position in a stationary random manner. Upper and lower bounds for the statistical moments of the frequencies are given in terms of corresponding moments and appropriate correlation functions for the random linear density. The adequacy of the bounds decreases for the higher frequencies. Extensions to more general random boundary value problems are also indicated. (Contractor's abstract)

2311

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

RANDOM TRANSVERSE VIBRATIONS OF ELASTIC BEAMS, by W. E. Boyce and B. E. Goodwin. [1964] [17]p. incl. tables. (AFOSR-65-0330) (AF AFOSR-63-182) AD 611991 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 12: 613-629, Sept. 1964.

The problem of analyzing the frequencies of transverse vibrations of random elastic beams is considered. Two types of random elements are admitted: (a) the geometry of the cross-section of the beam may be random; and (b) the support mechanism at one or both ends may be random. In the first case, eigenvalues are studied of the differential equation $\{[1 + R(x)]^4 u''\}'' - \lambda[1 + R(x)]^2 u = 0$, where R(x) is a small stationary perturbation of mean zero. For small R(x), a perturbation expansion is taken about the uniform beam. For the higher modes of vibration, an asymptotic analysis is used. In the second case, eigenvalues are studied for the differential equation $u'''' - \lambda u = 0$. The equation is solved by a perturbation method and by recasting the boundary value problem as a Fredholm equation. Results are in good agreement with those found by more straightforward methods, lending support to the creditability of the procedure used. The methods used can be extended, in principle, to a much larger class of problems than those considered.

2312

Rensselaer Polytechnic Inst. Dept. of Mathematics, Troy, N. Y.

EQUILIBRIUM POINTS OF BIMATRIX GAMES, by C. E. Lemke and J. T. Howson, Jr. [1964] [11]p. (AFOSR-65-0628) (AF AFOSR-63-339) AD 613870 Unclassified

Also published in Jour. Soc. Indus. and Appl. Math., v. 12: 413-423, June 1964.

An algebraic proof is given of the existence of equilibrium points for bimatrix (or two-person, non-zero-sum) games. The proof is constructive, leading to an efficient scheme for computing an equilibrium point. In a nondegenerate case, the number of equilibrium points is finite and odd. The proof is valid for any ordered field.

2313

Republic Aviation Corp. [Plasma Propulsion Lab.] Farmingdale, N. Y.

TERRESTRIAL HYPERSONIC FLIGHT PROPULSION, by K. M. Foreman. 1963, 29p. (AFOSR-J1085) (AF 49(638)552) AD 422930 Unclassified

Presented at AIAA-ASME Conf., Ordnance Lab., White Oak, Md., Apr. 23-25, 1963.

This preliminary analytical feasibility study examines several new proposed primary chemical propulsion systems, using the terrestrial atmosphere, with particular emphasis on methods of employing electrical augmentation. Specific weight requirements of practical airborne electric power supplies will be indicated for the various types of applications considered. Although the continuous flight corridor is considered appropriate for this study, an additional approximate envelope of

skip-glide trajectories has been included in the potential flight regime because some aspects of electrically augmented systems appear particularly compatible with what would seem the required power plant characteristics of skip-glide operation (i.e., repeatable, high performance, bursts of thrust, of short duration).

2314

Republic Aviation Corp. Plasma Propulsion Lab., Farmingdale, N. Y.

DIAGNOSTIC STUDIES OF A PINCH PLASMA ACCELERATOR, by D. P. Duclos, L. Aronowitz and others. [1963] [8]p. incl. illus. diagrs. refs. (AF 49(638)552) AD 407769 Unclassified

Presented at the AIAA Electric Propulsion Conf., Colorado Springs, Colo., Mar. 11-13, 1963.

Published in AIAA Jour., v. 1: 2505-2513, Nov. 1963.

Characteristics of a pinch plasma accelerator were investigated by means of measurements of the total discharge current, capacitor voltage, magnetic field distribution and light front velocity. The current distribution and J x B force on the plasma were calculated. The results show that a current sheet resulting from the first half-cycle of current propagates along the electrodes, becoming more diffuse with time. It was observed that there are regions in the sheet where the direction of current density shows local reversals. Magnetic probes indicate that the motion of the current sheet turns from an initially radial to an axial direction and that the magnetic force on the current sheet is essentially in the direction of plasma motion. The impulse produced by J x B forces in the accelerator was computed and was found to be about 80% of the measured thrust. All of the net energy output of the capacitor bank was transferred to the accelerator in the first 2.4 μsec.

2315

Research Triangle Inst., Durham, N. C.

PAIRED-COMPARISON EXPERIMENTS INVOLVING FIVE RESPONSE CLASSES, by W. A. Glenn. Mar. 29, 1963, 21p. incl. tables. (Technical rept. no. 3; Rept. no. SU-74) (AF AFOSR-62-309) AD 416050 Unclassified

A paired comparison is made by presenting two treatments to a judge who is asked to choose the one that he considers the better on the basis of some common characteristic. A paired-comparison experiment involves the pairwise comparisons of two or more treatments by one or more judges. It is proposed to extend the method of Glenn and David to cover paired-comparison experiments involving five response classes. This will be accomplished by making the assumptions that a tie will occur whenever the difference between the judge's responses to two stimuli under comparison lies below a first threshold, a mild preference will be declared whenever the difference lies between the first threshold and a second threshold, and a strong preference will be declared when the difference exceeds the second threshold. There will thus be five admissible response classes, viz. the two mild-preference classes, the two strong-preference classes, and the no-preferences (or ties) class.

2316

Research Triangle Inst., Durham, N. C.

ON THE PROBABILITY OF WINNING WITH DIFFERENT TOURNAMENT PROCEDURES, by D. T. Searls. [1963] [18]p. incl. diagrs. tables. (Reprint Series no. S-28) (AFOSR-65-0342) (AF AFOSR-62-309) AD 612206 Unclassified

Also published in Jour. Amer. Stat. Soc., v. 58: 1064-1081, Dec. 1963.

Paired comparisons among competing items are analogous to games between contestants and the process of determining the winning item among t contestants is analogous to a tournament. Four different types of tournaments are investigated for the eight-player case. Expressions are developed for (1) the probability that each player wins and (2) the expected number of games required. Examples are presented for comparison of tournament types and to study the effects of (a) the initial draw, (b) mis-classification when using a priori information in initial pairing, and (c) 'byes.' Some generalizations in terms of number of players and replication are developed.

2317

RIAS, Inc., Baltimore, Md.

STUDY OF NONLINEAR MECHANICS, by S. Lefschetz and J. P. LaSalle. Final rept. Mar. 31, 1958-Mar. 31, 1963. July 11, 1963, 33p. incl. refs. (AFOSR-5130) (AF 49(638)382) AD 413371 Unclassified

Research results are presented on the following topics: Asymptotic behavior, Functional-differential equations, Stability of dynamical systems, Mathematical theory of control, Qualitative theory of differential equations, and Control theory. Publications for the years 1958-1963 are also listed.

2318

RIAS, Inc., Baltimore, Md.

COBORDISM AND THE EULER NUMBER, by B. L. Reinhart. [1963] [5]p. (AFOSR-J1618) (AF 49(638)-382) AD 427407 Unclassified

Also published in Topology, v. 2: 173-177, 1963.

The Euler number is obtained as a cobordism invariant by making a more stringent definition of cobordism, requiring the existence of a non-singular vector field interior normal on one of a pair of cobording manifolds and exterior normal on the other. The new cobordism groups admit natural-homomorphisms into the usual

ones having as kernels cyclic groups generated by spheres. In even dimensions, these kernels are free cyclic and give the Euler number as an additional invariant. In odd dimensions, the kernels are zero except in oriented cobordism of dimension 4k + 1, where the kernel is cyclic of order 2. In this case, two manifolds are cobordant if and only if they have the same Stiefel-Whitney numbers and bound a manifold of even Euler number. In the oriented case, the kernel is a direct summand, while in the nonoriented case, the even dimensional real projective spaces become of infinite order.

2319

RIAS, Inc., Baltimore, Md.

LINEAR FUNCTIONAL-DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS, by J. K. Hale. [1963] [27]p. incl. refs. (AFOSR-64-0716) (AF 49-(638)382) AD 436508 Unclassified

Also published in Contributions to Differential Equations, v. 2: 291-317, 1963.

This paper is an attempt to obtain some analogies between linear differential-difference equations with constant coefficients and ordinary linear differential equations with constant coefficients. The eigenspaces of the linear equation are discussed in detail and use is made of the adjoint equation to introduce new coordinates in the function space which exhibit in a natural manner the behavior of the solutions on a complementary space. In this manner, it is shown how many of the usual perturbation theorems in ordinary differential can be easily extended to differential-difference equations.

2320

RIAS, Inc., Baltimore, Md.

DYNAMICAL POLYSYSTEMS AND OPTIMIZATION, by D. Bushaw. [1963] [15]p. (AFOSR-84-0717) (AF 49-(838)382) AD 436509 Unclassified

Also published in Contributions to Differertial Equations, v. 2: 351-385, 1963.

The elements of a new general formalism is described which seems to hold promise as a device for the analysis of dynamical systems with alternative inputs, much as the now well-established subject of topological dynamics. Basic definitions and a few fundamental facts are presented. Attention is concentrated on optimization problems and the closely related question of the structure of the boundary of the so-called reachable sets. This line of inquiry culminates in the generalized Jacobi condition and its corollary. Mention is made of the potentially interesting and useful aspects of the theory of dynamical polysystems.

2321

RIAS, Inc., Baltimore, Md.

PHOTOOXIDATION OF CYTOCHROMES C, F, AND PLASTOCYANIN BY DETERGENT TREATED CHLOROPLASTS, by B. Kok, H. J. Rurainski, and E. A. Harmon. [1964] [6]p. (AFOSR-64-1839) (AF 49(638)947) AD 449972 Unclassified

Also published in Plant Physiol., v. 39: 513-520, July 1964.

An analysis was made of the long wavelength sensitized photooxidation by detergent treated spinach chloroplasts of ferrocytochrome c, ferrocytochrome f, and cupro plastocyanin. All systems were stimulated (up to sixfold) by viologen dyes and other autooxidizable low potential, single electron transfer agents. In the presence of viologen, the photooxidation of ferrocytochrome c was stimulated by catalytic amounts of cytochrome f and plastocyanin. These agents respectively stimulated up to 30- and 150-fold and sustained rates up to 1500 and 5000 μ mol/mg chlorophyll hour. In all cases, the quantum yield as well as the light saturated rate was enhanced.

2322

RIAS, Inc., Baltimore, Md.

LIFE SUPPORT SYSTEMS FOR SPACE MISSIONS, by L. Bongers and B. Kok. [1964] [13]p. (AFOSR-64-1840) (AF 49(638)947) AD 449970 Unclassified

Also published in Develop. Indus. Microbiol., v. 5: 183-195, 1964.

A comparative survey is presented of regenerative, partially regenerative, and nonregenerative life support systems. Attention is focused on methods for controlling atmospheric gases and providing food in sealed environments occupied by a crew. Mission requirements strongly influence the control methods which will be employed in the preceding environments. Also, mission time especially influences this selection. As an example, for a mission of short duration, the storage of oxygen, food and water and the disposal of metabolic waste products is the obvious method. However, with an extension of mission time, chemical regeneration will partially displace the simple storage techniques. Specifically, reclamation is indicated of both the waste water and some of the oxygen bound in carbon dioxide. A further increase in mission time and crew size may make food storage uneconomical and would require the recycling of almost all metabolic products. Presently, it seems unlikely that complete regeneration of carbon dioxide and waste products can be accomplished by other than biological means. Therefore, biosynthesis provides the only method of regeneration for missions lasting longer than several months.

2323

RIAS, Inc., Baltimore, Md.

TWO LIGHT REACTIONS IN PHOTOSYNTHESIS, by

G. E. Hoch. [1964] [15]p. incl. diagrs. tabie. (AFOSR-64-2152) (AF 49(638)947) AD 450888
Unclassified

Also published in Record Chem. Prog., v. 25: 165-180, Sept. 1964.

Research in photosynthesis is currently undergoing an exciting resurgence of interest. This increase in interest has been brought about principally by the discovery that two light reactions are required for aerobic photosynthesis (those plants and organisms in which molecular oxygen is evolved). In this article an attempt is made to describe the present status of our knowledge on the nature of the two photoreactions, how they cooperate, and how the plant controls the energy flux into the two reactions.

2324

RIAS, Inc., Baltimore, Md.

RESEARCH ON CONTROL SYSTEMS, by R. E. Kalman. Final rept. Nov. 15, 1962-Sept. 30, 1964, 14p. (AFOSR-64-1788) (AF 49(638)1206) AD 607567
Unclassified

The following areas were studied. (1) stability theory, (2) optimal control and calculus of variations, (3) stochastic variational problems, (4) stochastic optimal filters, (5) finite automata and related topics, (6) applied mathematics and digital computation. The main research effort was in the area of stochastic optimization problems. Considerable progress was achieved, both in the realm of stochastic optimal control and stochastic optimal control and stochastic optimal filtering. A second area of concentration has been the theory of automata. This may be regarded as the algebraic part of control theory, in contrast to the preceding predominately analytical investigations. Much useful work has been accomplished in reconciling automata theory and control theory; much more remains to be done.

2325

RIAS, Inc., Baltimore, Md.

WEIGHTING PATTERNS AND THE CONTROLLABILITY AND OBSERVABILITY OF LINEAR SYSTEMS, by L. Weiss. [1964] [6]p. (AF 49(638)1206) AD 448382
Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 51: 1122-1127, June 1964.

The purpose of this paper is twofold. First, a generalization is presented of Kalman's result which consists of the fact that there are actually four possible decompositions of the state space of a linear dynamical system. Second, the relationship of internal to external system characteristics is discussed. Specifically, a table is given which correlates certain properties of a system's weighting pattern with a certain property of the system's various state space decompositions.

2326

RIAS, Inc., Baltimore, Md.

PION-PION SCATTERING IN THE STRIP APPROXIMATION - I, by B. H. Bransden, P. G. Burke and others. [1963] [23]p. (AFOSR-64-0364) (AF 49(638)-1211) AD 434521
Unclassified

Also published in Nuovo Cimento v. 30: 207-229, Oct. 1, 1963.

Results are presented of calculations on pion-pion scattering in the strip approximation. A cut-off is made to avoid divergences at high energy. The starting point is an assumed form for the low partial wave based on experiment, supplemented by partial wave solutions of the pion-pion problem. The spectral functions are calculated and two sets of predictions are made. Firstly, higher elastic partial waves, in particular the D-waves, are evaluated, as are also the low-energy inelastic partial waves. These predictions are relatively insensitive to the cut-off. Secondly, Regge trajectories are deduced from the asymptotic behavior of the spectral functions.

2327

RIAS, Inc., Baltimore, Md.

GROWTH OF SINGLE CRYSTALS OF SILVER IN THE PRESENCE OF FINELY DIVIDED ALUMINA, by H. R. Peiffer and R. Geckle. Sept. 1963, 16p. (Technical note no. 1) (AF 49(638)1217) AD 425965
Unclassified

The silver phase of silver and finely divided alumina composites is shown to grow as single crystals upon solidification from the melt. These crystals grow without the aid of an externally applied thermal gradient or a mold. The single crystal growth is more readily disrupted as the alumina content varies from the optimum concentration of twenty weight percent. Pretreatment such as variation of fabrication pressure, and presintering of the specimens appears to play a lesser role in this phenomenon.

2328

RIAS, Inc., Baltimore, Md.

LCAO-MO CALCULATIONS ON BORON COMPOUNDS. I. AMINOBORANES, by J. J. Kaufman and J. R. Hamann. [1963] [5]p. (AFOSR-64-2010) (AF 49(638)-1220) AD 451194
Unclassified

Also published in Advan. Chem. Ser., 1963, p. 95-99.

The primary purpose of this study was to reproduce reported experimental observations for a series of heteroatomic boron compounds by simple LCAO-MO Huckel calculations, employing as input data only basic atomic or group parameters derived without reference to the particular molecular environments considered here. Huckel calculations for aminoboranes (using the four possible input parameter sets derivable from other

molecules) were compared, point by point, with experimental observations of seven aspects of the behavior of aminoboranes upon substitution. Each experimental observation was correctly predicted. More important, the trend of the calculational results is insensitive to the choice among the input parameter sets.

2329

RIAS, Inc., Baltimore, Md.

LCAO-MO CALCULATIONS ON BORON COMPOUNDS. II. BORAZINES, by O. Chalvet, R. Daudel, and J. J. Kaufman. [1963] [9]p. (AFOSR-64-2011) (AF 49(638)-1220) AD 451193 Unclassified

Also published in Advan. Chem. Ser., v. 24: 251-258, 1963.

Molecular orbital calculations for borazines using an LCAO technique have been performed in the framework of the following approximations: Huckel, Pariser-Parr (without iteration), and Pople (iterated to self-consistency utilizing the Pariser-Parr approximations for the integrals). Several theoretical models for choice of input parameters have been utilized. Modified values for boron electron-repulsion integrals, which take into account electron correlation effects, have been calculated for each choice of theoretical model.

2330

RIAS, Inc., Baltimore, Md.

LCAO-MO CALCULATIONS ON BORON COMPOUNDS. III. HETEROAROMATIC BORON COMPOUNDS, by J. J. Kaufman and J. R. Hamann. [1963] [8]p. incl. tables. (AFOSR-64-2012) (AF 49(638)1220) AD 451192 Unclassified

Also published in Advan. Chem. Ser., v. 27: 273-280, 1963.

Molecular orbitals for the π-systems of aromatic hydrocarbons, where a B-N pair replaces a C-C pair, have been calculated, using an LCAO technique with the Huckel, Pariser-Parr, and Pople approximations. Several theoretical models were used to choose input parameters, and modified values for boron electron-repulsion integrals were calculated, taking into account electron correlation effects. Complete LCAO-MO-SCF calculations were performed for each choice of input parameters. (Contractor's abstract in part)

2331

RIAS, Inc., Baltimore, Md.

THE EFFECT OF SUBSTITUTION ON THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. VII. THEORETICAL RATIONALIZATION FOR DIFFERING CORRELATIONS FOUND FOR BOND DISSOCIATION ENERGIES WITH IONIZATION POTENTIALS AND ELECTRON AFFINITIES OF ORGANIC OR INORGANIC RADICALS, by J. J. Kaufman. [1964] [3]p. (AFOSR-65-0570) (AF 49(638)1220) AD 613922 Unclassified

Also published in Jour. Phys. Chem., v. 68: 3155-3157, Nov. 1964.

The discrepancy previously noted in the relations of bond dissociation energies into organic radicals or inorganic radicals has been explained on both semi-empirical and theoretical grounds. Earlier research on δ_K values showed that it was possible to place electronegativities, χ, of organic radicals correctly in the experimentally observed order solely on the basis of their ionization potentials. Since $\chi \sim (I + E)/2$, this dependence of χ on I alone indicated that E was small relative to I and/or varied comparatively little for a series of organic radicals. On the contrary, E for a series of inorganic radicals will vary over a much wider range when the central atom is as diverse as N, O, F, Cl, or Br. A theoretical rationalization based on Mullkien's formulas gives further confirmation to the justification for the differing relationship between dissociation energies and ionization potentials or ionization potentials minus electron affinities for organic and inorganic radicals. (Contractor's abstract)

2332

RIAS, Inc., Baltimore, Md.

LCAO-MO-SCF CALCULATIONS OF C_6O_6 SYSTEMS, by J. J. Kaufman. June 1964 [38]p. incl. tables, refs. (Technical rept. no. 64-11) (AFOSR-65-0571) (AF 49-(638)1220) Unclassified

Also published in Jour. Phys. Chem., v. 68: 2648-2651, Sept. 1964.

Simple Huckel MO calculations by West predicted a biradical nature for $C_6O_6^{-4}$, due to the degeneracy of molecular orbitals φ8 and φ9, while experiments showed $C_6O_6^{-4}$ to be diamagnetic. To test the sensitivity of the prediction to MO calculational methods, Pariser-Parr and Pople SCF calculations were performed for C_6O_6, $C_6O_6^{-2}$, and $C_6O_6^{-4}$. Evaluating the configuration interaction matrix elements utilizing the integral values for a Pople SCF calculation of neutral C_6O_6 or $C_6O_6^{-2}$ indicates that electron interaction terms alone do not seem to be sufficient to make the singlet state be lower in energy than the triplet state. The calculational results indicate that for charged species it is not sufficient to use integral values derived from the neutral species, since this leads to physically unmeaningful results for the absolute energies of the species. It is suggested that the splitting of the degeneracy may possibly be due to a type of Jahn-Teller effect-which, however, must necessarily be weak since the electrons involved do not participate strongly in the binding of the molecule. (Contractor's abstract, modified)

2333

RIAS, Inc., Baltimore, Md.

MOLECULAR VIBRATIONS BY A MATRIX FORCE METHOD, by S. Kaufman, D. B. Hall, and J. J. Kaufman. Sept. 1964 [19]p. incl. diagrs. table. (Technical rept. no. 64-16) (AFOSR-65-1803) (AF 49(638)1220) AD 625874 Unclassified

The molecular vibrations of complex molecules are calculated from previously derived force constants by means of a matrix force method. The purpose of the investigation is to ascertain the utility of an existing large IBM 7094 digital program, based on a matrix force method, for making these calculations. The frequencies and normal vibrational modes of the molecule ethylene are computed and compared against experimental and calculated results. From the agreement of the results, it is concluded that the computer program can be successfully used not only in this instance in which a valence force field approximation is used, but also with any force field approximation and for handling extremely large problems.

2334

RIAS, Inc., Baltimore, Md.

A STABILITY THEOREM FOR FUNCTIONAL-DIFFERENTIAL EQUATIONS, by J. K. Hale. [1963] [5]p. (AFOSR-64-0732) (AF 49(638)1242) AD 436514 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 50: 942-946, Nov. 1963.

The term functional-differential equation as used in this paper is a natural generalization of the concept of a differential equation with delayed arguments. The natural setting for a discussion of such equations seems to be in the space C of continuous functions over a finite interval. For ordinary differential equations, the limiting sets of bounded trajectories are contained in the largest invariant set contained in the set where the derivative of a Lyapunov function V vanishes, provided only that V is bounded below and the set where V is less than a constant is bounded. It is the purpose of the present note to extend this result to functional-differential equations.

2335

RIAS, Inc., Baltimore, Md.

ON A SYSTEM OF EQUATIONS IN AUTOMATIC CONTROL THEORY, by K. R. Meyer. [1964] [11]p. (AFOSR-64-1619) (AF 49(636)1242) AD 449259 Unclassified

Also published in Contributions to Differential Equations, v. 3: 173-173, 1964.

Letov has introduced the study of a control system in which the equations of the control take into account the applied load. In particular he has taken an equation of Khokhlov that describes a loaded hydraulic servomotor and used this to describe the action of the automatic roll stabilization system in the Queen Mary. In this paper the system introduced by Letov is examined with the aid of a lemma due to Yacubovich as generalized by Kalman. A rather complete answer can be given for the noncritical case as well as for some critical cases.

2336

RIAS, Inc., Baltimore, Md.

A REMARK ON A RESULT OF LEFSCHETZ, by K. R. Meyer. [1964] [3]p. (AFOSR-65-0319) (AF 49(636)-1242) AD 612456 Unclassified

Also published in Contributions to Differential Equations, v. 3: 435-437, 1964.

A condition for absolute stability as presented by Lefschetz considered a system (1) $x = Ax + b\varphi(\sigma)$, $\sigma = c'x$; and Liapunov function (2) $V = x'Bx + \int_0^{\sigma}\varphi(\sigma)d\sigma$ whose derivative along the trajectories of (1) is (a) $-\dot{V} = 2(Bx + \varphi(\sigma)c)'(Ax + b\varphi)$ and (b) $-\dot{V} = x'Cx - \frac{1}{2}(Bb + 1/2\ A'c)'$ $x\varphi(\sigma) - c'b\ \varphi^2(\sigma)$. If -V is positive definite, then (1) is absolutely stable. In this report an alternate procedure is presented for making $-\dot{V}$ positive definite. The following two conditions are shown to suffice: (a) the system of equations $Ax + b\varphi(c'x) = 0$ has only the solution $x = 0$ for all admissible φ or $c'A^{-1}b \geq 0$ and (b) for some positive definite C, $c'b - (Bb + 1/2\ A'c)'C^{-1}(Bb + 1/2\ A'c) = 0$.

2337

RIAS, Inc., Baltimore, Md.

ON THE PARAMETRIZATION OF THE THREE-DIMENSIONAL ROTATION GROUP, by J. Stuelpnagel. [1964] [6]p. (AFOSR-65-0616) (AF 49(636)1242) AD 614675 Unclassified

Also published in SIAM Rev., v. 6: 422-430, Oct. 1964.

In this paper it is shown why it is topologically impossible to have a global 3-dimensional parametrization without singular points for the rotation group. This is a special case of a corollary to Brouwer's theorem on the invariance of domain. It is also pointed out that, although Hopf showed in 1940 that five is the minimum number of parameters which suffices to represent the rotation group in a 1-1 global manner, the so-called "quaternion method" of parametrizing the group in a 1-2 way, using 4 parameters, is sufficient for practical pruposes. In addition, three 3-dimensional parametrizations, as well as Hopf's method of using 5 parameters, are examined.

2338

RIAS, Inc., Baltimore, Md.

GENERALIZED RECURRENCE IN DYNAMICAL

SYSTEMS, by J. Auslander. [1964] [6]p. (AFOSR-65-2321) (AF 19(638)1242) AD 829269 Unclassified

Also published in Contributions to Differential Equations, v. 3: 65-74, 1934.

In this paper, a notion of recurrence in dynamical systems is introduced which is defined using continuous real valued functions on the phase space. The basic idea is as follows: Consider the class of continuous real valued functions which are nonincreasing along every orbit; then, single out those orbits along which all such functions are constant. This set, which includes the periodic, recurrent, and non-wandering points, is called the generalized recurrent set. Its elementary properties are studied and it is shown that a single suitably chosen function reflects the 'recursive' behavior of the dynamical system. By means of prolongations, an intrinsic characterization of the generalized recurrent set is given. This depends on a purely topological result involving a closed quasi order which is apparently new and may be of independent interest. The connection of the generalized recurrent set with asymptotic and absolute stability of a compact invariant set is discussed. The condition that the dynamical system be free of generalized recurrent orbits is shown to lie between parallelizability and complete instability.

2339

Rice U. [Dept. of Mathematics] Houston, Tex.

THREE CIRCLE THEOREMS IN PARTIAL DIFFERENTIAL EQUATIONS AND APPLICATIONS TO IMPROPERLY POSED PROBLEMS, by K. Miller and J. Serrin. [1964] [29]p. (AFOSR-64-1591) (AF AFOSR-62-233) AD 448533 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 126-154, 1984.

In this paper analogous three circle theorems are found for harmonic functions on a disc, but with respect to L2 or even weaker bounds on the inner and outer circles. In fact, it is sufficient that the function correspond to a Schwartz distribution of finite order on the outer circle. Analogous three line theorems are found for periodic solutions of the heat equation and for periodic solutions of the Cauchy problem for Laplace's equation. In the process, a very general and flexible method is presented for finding uniform bounds on the solution and its derivatives in terms of L2 bounds on the data. Moreover, these bounds are, except for a factor of a most two, best possible. The method involves reduction of the problem to a consideration of the Fourier coefficients of the solutions and maximization of linear functionals of the coefficients with respect to quadratic constraints.

2340

Rice U. [Dept. of Mathematics] Houston, Tex.

ON THE ADJOINT OF A CLOSED TRANSFORMATION, by A. Brown. [1964] [2]p. (AFOSR-64-1592) (AF AFOSR-62-234) AD 446534 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 239-240, Apr. 1964.

The main purpose of this note is to give a new proof of a known theorem. The basic "alternative" relations between an operator and its adjoint, on which Theorem 2 represents one possible formulation, are well known for bounded operators and offer no difficulty for closed operators if the spaces are reflective.

2341

Rochester U. [Dept. of Chemistry] N. Y.

PHOTOLYSIS OF BIACETYL-OXYGEN MIXTURES AT 4358 ANGSTROMS, by N. Padnos and W. A. Noyes, Jr. [1964] [5]p. (AFOSR-84-1803) (AF 49(838)679) AD 449064 Unclassified

Also published in Jour. Phys. Chem., v. 88: 484-466, 1964.

The photolysis of gaseous mixtures of biacetyl (2,3-butanedione) and 0.02-2.0 mm of oxygen by light of 4356 A has been studied. Carbon monoxide, carbon dioxide, water, methanol, and formaldehyde were found as products. The variation of carbon dioxide yields and oxygen consumption with oxygen pressure is similar to that which would be predicted if the only effect of oxygen pressure were on the ratio of triplet biacetyl deactivated in first-order processes to that reacting bimolecularly with oxygen.

2342

Rochester U. Dept. of Chemistry, N. Y.

INTERNATIONAL SYMPOSIUM ON PHOTOCHEMISTRY, by D. J. Wilson. Aug. 28, 1963, 88p. (AFOSR-J1095) (AF AFOSR-83-184) AD 436086 Unclassified

The international symposium on photochemistry was held at Rochester U. on Mar. 27-29, 1963. The event was supported by the Air Force Office of Scientific Research, the University of Rochester, the Eastman Kodak Co., the Xerox Corp., and Wili Scientific. Seventy-five papers covering practically all aspects of photochemistry were presented.

2343

Rochester U. Dept. of Chemistry, N. Y.

THE PRIMARY PHOTOCHEMICAL PROCESS IN COMPLEX MOLECULES AND THE REACTIONS OF CERTAIN RADICALS, by W. A. Noyes, Jr. Final rept. Feb. 1, 1963-Aug. 1, 1964, 7p. (AFOSR-64-1686) (AF AFOSR-63-206) AD 608075 Unclassified

Work in the following areas is summarized: behavior of excited singlet and triplet states of several molecules; reactions of triplet states; photochemistry of certain molecules including reactions of radicals. A bibliography of papers published under the grant is given.

2344

[Rochester U. Dept. of Chemistry, N. Y.]

ENERGY DISSIPATION FROM EXCITED STATES OF POLYATOMIC MOLECULES, by W. A. Noyes, Jr. 1964, 22p. incl. refs. (AFOSR-64-2433) (AF AFOSR-63-206) Unclassified

The knowledge of the excited states from which the emission of radiation proceeds, is of fundamental importance for the study of the kinetics of energy dissipation absorbed by molecules. Having postulated mechanisms of energy dissipation for polyatomic molecules (e.g. benzene, biacetyl and acetone) based on the existence of excited states of different multiplicities of spin, the existing, experimental results, in spite of being scarce, seem to confirm the proposed hypotheses. Finally, forecasts are made on the behavior of the cetene molecule that, when subject to radiations of different wavelengths, originates the radicals CH_2 in excited states with different multiplicities of spin. (Contractor's abstract)

2345

Rochester U. [Dept. of Mechanical and Aerospace Science] N. Y.

PRECURSORS AHEAD OF PRESSURE DRIVEN SHOCK WAVES IN ARGON, by H. D. Weymann and L. B. Holmes. [1963] [5]p. (AFOSR-64-1021) (AF AFOSR-64-478) AD 440977 Unclassified

Also published in Compt. Rend. VIe Conf. Internat'l. sur le Phenomenes d'Ionisation dans les Gaz, Paris (France), v. 4: 261-265, 1963.

Processes that can create electrons ahead of strong shock waves are: photoionization of the gas, photoemission from the shock tube walls, and diffusion from the plasma behind the shock front. Using a glass shock tube and electrostatic probes outside the tube it was possible to distinguish between the precursors generated by these three processes. Experiments on light absorption and the influence of an axial magnetic field supplemented the electrostatic measurements.

2346

Rochester U. Dept. of Physics and Astronomy, N. Y.

NUCLEAR INTERACTIONS OF 900 MEV ALPHA PARTICLES, by M. V. K. Appa Rao and P. J. Lavakare. June 5, 1963 [13]p. incl. diagrs. (Rept. no. NYO-10269) (AFOSR-5055) (AF AFOSR-62-32) Unclassified

The nuclear interactions of 900 mev He^4 nuclei in nuclear emulsion are studied. The mean free path for interaction is found to be 17.0 ± 0.6 cm. This value together with values obtained at various energies shows that the mean free path for nuclear interaction of He^4-nuclei in nuclear emulsion is energy independent. The "in-out" interaction has been studied and the probability, f_{io}, for such an interaction is found to be $12.2 \pm 1.6\%$. (Contractor's abstract)

2347

Rochester U. Dept. of Physics and Astronomy, N. Y.

AN INVESTIGATION ON THE MULTIPLE COULOMB SCATTERING IN NUCLEAR RESEARCH EMULSIONS, by C. Dahanayake and P. J. Lavakare. June 12, 1963 [20]p. incl. diagr. tables. (Rept. no. NYO-10271) (AFOSR-5056) (AF AFOSR-62-32) Unclassified

A stack of Kodak emulsions, exposed to 6.2 bev proton beam, has been used to study the behavior of spurious scattering in these emulsions. The effect of higher order differences has also been considered. A detailed study of the behavior of the scattering constant as a function of cell length is also presented. The results indicate the necessity for a slight modification in the theory of multiple coulomb scattering. (Contractor's abstract)

2346

Rochester U. Dept. of Physics and Astronomy, N. Y.

ON THE MODULATION OF COSMIC RAY NUCLEI WITH $Z > 2$ DURING THEIR PROPAGATION, by M. V. K. Appa Rao. [1963] [13]p. incl. diagr. table. (AFOSR-5263) (AF AFOSR-62-32) Unclassified

The effect of spallation and ionization loss on the relative abundances and energy spectra of cosmic ray nuclei of charge greater than two, during their propagation in the interstellar and interplanetary space, has been determined. Comparison of the results with experimental observations indicate that cosmic ray nuclei travel an amount of interstellar hydrogen proportional to $(\epsilon^2-1)^{-x}$, (where ϵ is the total energy of the nuclei in terms of their rest mass) with x between 0.16 and 0.25 and with the high energy nuclei ($\epsilon = 4$) traversing 2 to 2.5 gms/cm^2 of interstellar hydrogen. (Contractor's abstract)

2349

Rochester U. Dept. of Physics and Astronomy, N. Y.

HIGH ENERGY p-p AND π-p SCATTERING IN SERBER'S MODEL, by H. H. Aly, D. Lurie, and S. Rosendorff. [1963] [3]p. incl. diagrs. table, refs. (AFOSR-64-0508) (AF AFOSR-62-32) AD 436169 Unclassified

Also published in Phys. Ltrs., v. 7: 198-199, Nov. 15, 1963.

In a recent paper by Serber, a fit to the high energy p-p scattering data was attempted using an optical model for a purely imaginary Yukawa potential of the form $V(r) = i\eta \frac{e^{-\lambda r}}{r}$ In this note we shall first

compare the predictions of this model with the experimental high energy data for $\pi^{\pm}$-p scattering. We shall then investigate the question of whether a more complicated potential as suggested by Serber, namely a superposition of two Yukawa potentials of the form $V(r) = i\eta_1 \frac{e^{-\Lambda r}}{r} + i\eta_2 \frac{e^{-\beta\Lambda r}}{r}$ can emprove the agreement. (Contractor's abstract)

2350

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ON THE PEKAR AND PERLIN CALCULATION OF F-CENTER LIFETIMES, by W. B. Fowler and D. L. Dexter. [1963] [3]p. (AFOSR-J1561) (AF AFOSR-62-145) AD 427655 Unclassified

Also published in Phys. Stat. Sol., v. 3: 1865-1867, 1963.

In a recent paper Pekar and Perlin presented a calculation, based upon Pekar's continuum theory of the F-center, of the radiative lifetime of the first excited level of the F-center. Their results are in order-of-magnitude agreement with the experimental results of Swank and Brown. It is suggested that such agreement is fortuitous and is the result of several invalid assumptions made by Pekar and Perlin: (1) they have neglected to include an effective field correction in their calculation; (2) they have used the same electronic wave functions to calculate emission probabilities as one would use (in Pekar's theory) to calculate absorption probabilities, a procedure which we have shown to be susceptible to suspicion; and (3) these electronic wave functions are in fact not consistent with observed absorption oscillator strengths. (Contractor's abstract)

2351

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ELECTRONIC BAND STRUCTURE AND WANNIER EXCITON STATES IN SOLID KRYPTON, by W. B. Fowler. [1963] [9]p. (AFOSR-64-0455) (AF AFOSR-62-145) AD 435917 Unclassified

Also published in Phys. Rev., v. 132: 1591-1599, Nov. 1963.

The electronic band structure of solid krypton has been calculated by a combined tight-binding and orthogonalized plane wave approach first introduced by Knox and Bassani. The crystal potential, constructed as a sum of quasiatomic potentials, contains an exchange potential which has been made to approximate closely the crystal Slater exchange potential. Spin-orbit splittings have been computed, and effective masses have been obtained at points of high symmetry in the Brillouin zone. The smallest computed gap between valence and conduction bands is direct, and has a magnitude of 11.3 ev, in agreement with the direct gap of 11.6 ev inferred by Baldini on the basis of optical absorption data.

2352

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ORIENTATION OF THE M-CENTER, by D. L. Dexter. [1964] [4]p. (AFOSR-64-1258) (AF AFOSR-62-145) AD 442804 Unclassified

Also published in Phys. Stat. Sol., v. 4: 601-604, 1964.

A discussion is given and experiments are suggested regarding the polarization and reorientation of M-centers by optical excitation, with reference to the electron-lattice interaction in ionic crystals.

2353

Rochester U. [Dept. of Physics and Astronomy] N. Y.

OPTICAL PROPERTIES OF THE NOBLE METALS, by M. Suffczynski. [1964] [27]p. (AFOSR-64-1771) (AF AFOSR-62-145) AD 450556 Unclassified

Also published in Phys. Stat. Sol., v. 4: 3-29, 1964.

The theory of the optical properties of metals is based on the conception of free electrons at low energies of incident photons, say below 1eV. In this region the modification of the incident electric field near the metal surface and the collisions of the electrons with this surface are described by the theories of skin effect and anomalous skin effect. Between 0.1 to 1ev the classical Drude theory is most useful. Above a threshold, which for copper and gold lies in the middle of the visible range of the spectrum, interband transitions occur from occupies to unoccupied bands. Additive contributions of the effects of the free and bound electrons give rise to a variety of plasma resonances. At higher photon energies transitions from the deep core levels occur, and finally, at about 50 ev, the typical x-ray region is reached.

2354

Rochester U. [Dept. of Physics and Astronomy] N. Y.

OPTICAL EROSION, by D. L. Dexter. [1964] [13]p. (AFOSR-64-1772) (AF AFOSR-62-145) AD 449254 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 90-102, Apr. 10, 1964.

A review is presented of some of the facts and ideas related to possible erosive action of light on condensed matter. Various mechanisms are described which would be expected to lead to erosion. These include bond-breaking, photoionization, indirect, phonon-assisted processes, local heating phenomena, etc. Some special cases are mentioned in which photo-disintegration has been observed, although these examples are not true erosion in the sense intended here. Areas of possible importance of this effect are mentioned, large ignorance of its efficiency is exposed, and pertinent experiments are suggested.

2355

Rochester U. [Dept. of Physics and Astronomy] N. Y.

ATOMIC MULTIPOLE INTERACTIONS IN RARE-GAS CRYSTALS, by R. S. Knox and M. H. Reilly. [1964] [5]p. (AFOSR-64-2109) (AF AFOSR-62-145) AD 451731 Unclassified

Also published in Phys. Rev., v. 135: A166-A170, July 6, 1964.

It is demonstrated that one of the mechanisms seriously proposed to explain the relative stability of rare-gas solids in the cubic form, namely greater repulsion between induced electrical multipoles in the hexagonal form, is completely ineffective. The present status of the stability problem is briefly discussed.

2356

Rochester U. [Dept. of Physics and Astronomy] N. Y.

THEORY OF THE OPTICAL AND MAGNETIC PROPERTIES OF THE SELF-TRAPPED HOLE IN LITHIUM FLUORIDE, by T. P. Das, A. N. Jette, and R. S. Knox. [1964] [15]p. (AFOSR-64-2110) (AF AFOSR-62-145) AD 451348 Unclassified

Also published in Phys. Rev., v. 134: A1079-A1093, May 18, 1964.

Using a semiphenomenological method, the energy and wave functions of a self-trapped hole (V_k center) in LiF are obtained as a function of the separation between the two F-ions at which the hole is assumed trapped. Only the energy curve for the ground state exhibits a minimum in the expected region of F-ion separation. From the resulting configurational coordinate curves, the optical absorption energy and width are computed and are in order-of-magnitude agreement with experiment. Computed values of the experimentally known isotropic and anisotropic hyperfine constants are used to access the validity of our molecular wave functions.

2357

Rochester U. [Dept. of Physics and Astronomy] N. Y.

THE FRESNEL FIELD IN KOTTLER'S DIFFRACTION THEORY, by B. Karczewski. [1963] [6]p. (AFOSR-64-0053) (AF AFOSR-62-246) AD 431139 Unclassified

Also published in Canad. Jour. Phys., v. 41: 1623-1628, 1963.

The Kottler theory of electromagnetic diffraction has been shown to be in good agreement near the boundary of geometrical shadow with the Kirchoff scalar approach.

2358

Rochester U. [Dept. of Physics and Astronomy] N. Y.

COHERENCE THEORY OF THE ELECTROMAGNETIC FIELD, by B. Karczewski. [1963] [10]p. (AFOSR-64-0814) (AF AFOSR-63-237) AD 438379 Unclassified

Also published in Nuovo Cimento, Series X, v. 30: 906-915, Nov. 10, 1963.

Up to now the degree of coherence of a wave field was only defined on the basis of a scalar wave theory. In the present paper a generalization is proposed applicable to any quasimonochromatic stationary electromagnetic field. The electromagnetic degree of coherence, which is a single scalar quantity, is introduced from the analysis of an interference experiment and it is shown to be related to the trace of the correlation tensor of the electric field introduced by E. Wolf in 1954.

2359

Rochester U. [Dept. of Physics and Astronomy] N. Y.

COHERENCE PROPERTIES OF BLACKBODY RADIATION. I. CORRELATION TENSORS OF THE CLASSICAL FIELD. II. CORRELATION TENSORS OF THE QUANTIZED FIELD, by C. L. Mehta and E. Wolf. [1964] [11]p. (AFOSR-64-1919) (AF AFOSR-63-237) AD 450516 Unclassified

Also published in Phys. Rev., v. 134: A1143-A1153, June 1, 1964.

This paper is concerned with the extensions of some recently reported results, especially those of Bourret (1960), relating to coherence properties of blackbody radiation. An explicit expression for the complex electric correlation tensor of blackbody radiation is derived, and on the basis of it spatial coherence is discussed in detail. The behavior of diagonal as well as nondiagonal components is illustrated by contour diagrams. In particular, it is found that the nondiagonal components of the correlation tensor, even though being zero for zero-space separation ($r = 0$), acquire, in general, nonvanishing values when r is not equal to 0. The magnetic and mixed correlation tensors are so discussed. Expressions are derived for the electromagnetic correlation tensors of blackbody radiation defined on the basis of the theory of the quantized field. Correlation functions of all order are considered, but second-order ones are discussed in detail; it is found that these are identical with those obtained on the basis of semiclassical theory in part 1 of this investigation.

2360

Rochester U. Dept. of Physics and Astronomy, N. Y.

RECENT RESEARCH ON COHERENCE PROPERTIES OF LIGHT, by E. Wolf. [1964] [22]p. incl. diagrs. refs. (AFOSR-65-0436) (AF AFOSR-63-237) AD 612320 Unclassified

Also published in Quantum Electronics III, ed. by P. Grivet and N. Bloembergen. New York, Columbia U. Press, v. 1: 13-34, 1964.

A brief review is presented of the basic notions and results of a theory formulated within the framework of classical optics to explain optical coherence phenomena. A stochastic description of light is given. Coherence effects of the second and fourth order are also presented.

2361

Rochester U. Dept. of Physics and Astronomy, N. Y.

LIGHT FLUCTUATIONS AS A NEW SPECTROSCOPIC TOOL, by E. Wolf. [1964] [2]p. (AFOSR-65-0442) (AF AFOSR-63-237) AD 612501 Unclassified

Presented at Internat'l. Commission for Optics Conf. on Photographic and Spectroscopic Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

A summary is given of a lecture on basic concepts relating to the theory of light fluctuations, features which distinguish the fluctuation properties of thermal and laser light, and new techniques for obtaining information about spectra from fluctuation and correlation measurements. In particular, methods depending on beat phenomena, photo-electric mixing experiments, intensity correlation interferometry, photon coincidence experiments and pulse counting techniques will be reviewed and the possibility of obtaining spectral information from statistical studies of transient interference patterns are considered. Current researches relating to the determination of the phase of the second order complex degree of coherence are discussed. The concept of higher order spectra is explained and the possibility of obtaining some information about them from multiple photon coincidence experiments is mentioned.

2362

Rochester U. Dept. of Physics and Astronomy, N. Y.

STATIONARITY AND THE RANDOM PHASE CONDITION IN THE STATISTICAL THEORY OF THE ELECTROMAGNETIC FIELD, by Y. Yano. [1964] [11]p. incl. refs. (AFOSR-65-1113) (AF AFOSR-62-237) AD 620474 Unclassified

Also published in Ann. Phys., v. 30: 127-137, Oct. 1964.

The quantum mechanical analogue of the classical definition of stationarity of an electromagnetic radiation field is discussed. It is shown to imply that for an ensemble radiation field corresponding to a single momentum-spin state the phase space distribution function of the complex eigenvalues of the photon annihilation operators does not depend on the phases of the eigenvalues, i.e., the stationarity condition implies a uniform distribution of the phase angle of the eigenvalues. However, for a radiation field with a finite or countable infinite number of states, the stationarity condition is not a sufficient condition for the phase independence of the distribution function; it is shown that, in addition, the commutability of the density matrix and the number operator for each mode is required. The physical meaning of this commutability is investigated and it is shown to imply homogeneity of the radiation field.

2363

Rochester U. Dept. of Physics and Astronomy, N. Y.

DETERMINATION OF THE STATISTICAL PROPERTIES OF LIGHT FROM PHOTOELECTRIC MEASUREMENTS, by E. Wolf and C. L. Mehta. [1964] [3]p. incl. refs. (AFOSR-65-1114) (AF AFOSR-63-237) AD 620475 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 705-707, Dec. 14, 1964.

It is shown that it is possible, in principle, to determine the complete probability density of the intensity in a fluctuating light beam from the knowledge of the statistical distribution of photoelectrons released from a photosensitive surface on which the beam is incident. Results indicate that the distribution of the photoelectrons is strictly Poissonian if and only if the incident light is perfectly stabilized in the sense that the time-integrated intensity does not fluctuate.

2364

Rochester U. [Dept. of Physics and Astronomy] N. Y.

PROCEEDINGS OF SEMINAR ON UNIFIED THEORIES OF ELEMENTARY PARTICLES, by D. Lurie and N. Mukunda. July 1963, 427p. (Rept. no. 11) (AFOSR-64-1053) (AF AFOSR-63-427) AD 601502 Unclassified

The following topics are discussed: Vector mesons as bound states, Electron as an energy gap in a cutoff free approximation, Some problems in the theory of the symmetries of strong interactions, Some problems in the theory of the symmetries of strong interactions, Strong coupling solutions of vector coupled fields, Broken symmetries and unconventional solutions of standard field theory, Interaction among gauge vector fields. Considerations on the self-consistent breakdown of symmetries, Some equivalent approaches to the self-consistent bound state of strongly interacting particles, Broken symmetries and zero mass bosons, Broken symmetries, a possible connection between Lorentz space and isotopic spin space, Gauge invariant and gauge covariant Green's functions, Mass differences of particles, Nonlinear spinor model, Aspects of Euclidean field theory and Feynman path integrals, Unsubtracted dispersion relations for weak interactions and the Goldberger-Treiman relation, Broken symmetries in terms of inequivalent representations, and An unconventional view of perturbation expansions.

2365

Rochester U. Dept. of Physics and Astronomy, N. Y.

ISOTOPIC COMPOSITION AND ENERGY SPECTRUM OF LOW-ENERGY HELIUM NUCLEI IN PRIMARY COSMIC RADIATION, by C. Dahanayake, M. F. Kaplon, and P. J. Lavakare. [1964] [19]p. incl. diagrs. tables, refs. (AFOSR-64-2047) (AF AFOSR-63-439) AD 612534 Unclassified

Also published in Jour. Geophys. Research, v. 69: 3681-3699, Sept. 1, 1964.

The isotopic composition and the energy spectrum of low-energy helium nuclei were investigated, using a nuclear emulsion stack flown from Fort Churchill, Canada, on Aug. 4, 1962. The proportion of He^3 nuclei at the top of the atmosphere was determined to be 18 ± 5% within the kinetic energy interval of 160-370 mev/nucleon and 24 ± 8% within the rigidity interval 1.1-1.4 bv/c. The differential energy spectrum in the above energy interval was found to have a maximum around 275-300 mev/nucleon. Assuming that there is no He^3 at the cosmic-ray sources, and that the observed abundance reflects the interactions of the primary radiation in its passage through interstellar matter, we conclude that the low-energy primary radiation has traveled a total of 6 ± 2 g/sq cm in this medium. This result is found to be consistent with the values obtained from the low-energy lithium, beryllium, and boron experiment. The implications of these results are examined on the basis of different models used for the propagation of cosmic radiation through interstellar matter.

2366

Rochester U. Dept. of Physics and Astronomy, N. Y.

ISOTOPIC COMPOSITION OF LOW ENERGY HYDROGEN NUCLEI IN THE PRIMARY COSMIC RADIATION, by G. D. Badhwar. [1964] [5]p. incl. diagrs. refs. (AFOSR-65-1344) (AF AFOSR-63-439) AD 604098 Unclassified

Also published in Jour. Geophys. Research, v. 69: 4435-4439, Nov. 1, 1964.

The abundance of low energy deuterons and tritons was determined in a nuclear emulsion stack exposed at Fort Churchill, Manitoba, Canada on Aug. 4, 1962, under 4.2 g/cm^2 of residual atm. Using the grain density versus residual range method for the identification of tracks produced by particles, the differential flux of deuterons and tritons was determined. The results appear to be consistent with the absence of deuterons and tritons in the primary cosmic radiation. An upper limit has been placed on the amount of hydrogen traversed by low energy cosmic ray particles.

2367

Rochester U. Dept. of Physics and Astronomy, N. Y.

A HEURISTIC MODEL FOR THE VARIATION WITH RIGIDITY OF THE COSMIC-RAY CHARGE SPECTRUM, by M. F. Kaplon and G. Skadron. [1964] [25]p. incl. diagrs. tables. (AFOSR-66-0798) (AF AFOSR-63-439) AD 443044 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1687-1711, Dec. 16, 1964.

An idealized model based on the supernova origin of cosmic radiation is proposed to account for the variation with rigidity of the cosmic-ray charge spectrum. It is assumed that a supernova explosion results in the injection of a pure power-law spectrum and a composition relatively rich in heavy nuclei. Particles are confined within a volume local to the source region by a magnetic boundary resulting in a rigidity-dependent coefficient of reflectivity; this yields a source-region path length varying inversely with rigidity. As a result, the differential spectra of particles escaping from the boundary into the galaxy are determined by the reflectivity; and as a result of the nuclear interactions in the source region, the composition varies with rigidity. The additional effect of intragalactic motion is taken into account and the differential rigidity spectra, as a function of composition at the earth, are calculated. Predictions for the H/M, L/M and He^3/H^4 ratios as a function of rigidity as well as the differential rigidity spectra are compared with experiment and are not in disagreement with the available data. The limitations and plausibility of the model are summarized and discussed. (Contractor's abstract)

2368

Rochester U. [Dept. of Physics and Astronomy] N. Y.

SOME SOLVABLE POTENTIALS FOR THE SCHRODINGER EQUATION, by H. H. Aly and R. M. Spector. Mar. 13, 1964, 11p. (Rept. no. UR 875-25) (AF AFOSR-63-439) AD 439424 Unclassified

Utilizing the modified Mathieu differential equation and Darboux's theorem for second order differential equations, some solvable potentials for the Schrodinger equation are constructed The limitations of the potentials constructed by the use of Darboux's theorem are pointed out and discussed.

2369

Rochester U. Dept. of Physics and Astronomy, N. Y.

DYNAMIC EFFECTS OF VARIABLE G OR INVARIABLE MASS, by M. P. Savedoff and S. Vila. [1964] [4]p. incl. diagr. tables. (AFOSR-64-1916) (AF AFOSR-64-603) AD 450519 Unclassified

Also published in Astronom. Jour., v. 69: 242-245, Apr. 1964.

Two-body motion with time-dependent coupling is discussed for two cases: coupling varying linearly or inverse linearly with time. The inverse linear motion can be treated rigorously using a transformation due to Meshcherskii.

2370

Rochester U. [Dept. of Physics and Astronomy] N. Y.

CALCULATION OF THE G FACTOR OF HYDROGEN AND THE ALKALI ATOMS TRAPPED IN RARE-GAS SOLIDS, by D. Y. Smith. [1964] [11]p. (AFOSR-64-1765) (AF AFOSR-64-611) AD 449091 Unclassified

Also published in Phys. Rev., v. 133: A1087-A1097, Feb. 17, 1964.

The author's variational method of calculating g-factor shifts for atomic hydrogen trapped in a rare-gas solid is applied to the case of the alkali metals as impurities. An alternate derivation of the results is given and a simple physical model is discussed. The calculated shifts are compared with the experimentally observed ones for H, Li, Na, and K trapped in Ne, Ar, and Kr. Reasonable agreement is obtained if it is assumed that where two resonances have been reported the impurities are trapped at substitutional and octahedral interstitial lattice sites. The connection between the variational formalism and a previous perturbation treatment of Adrian is discussed and it is shown that a reinterpretation of the latter yields improved agreement with experiment. Crude estimates of the relaxation about substitutional and interstitial impurities are also given.

2371

Rochester U. Inst. of Optics, N. Y.

A GENERAL LINEARIZATION METHOD FOR AUTOMATIC LENS CORRECTION, by G. H. Spencer. 1963, 18p. (AFOSR-4761) (AF 49(638)668) AD 407605 Unclassified

The use of programmed computing machinery for automatic lens correction requires a definite prescription according to which a lens system may be adjudged: (1) acceptable or not acceptable; or (2) improved or not improved over a previous configuration. Judgments of the first kind may be made on the basis of whether or not a given set of equations are satisfied; judgments of the second kind, on the basis of whether or not the value of a 'merit function' has been reduced. A typical lens design problem will involve both absolute requirements, to which a judgment of the first kind is appropriate, and relative requirements calling for a judgment of the second kind. A linearization method designed to accommodate requirements of both types is described. Several previously described linearization procedures are shown to be included within the framework of the present method.

2372

Rochester U. Inst. of Optics, N. Y.

THE SYMPOSIUM LENS - AN EPILOGUE, by R. E. Hopkins and D. P. Fader. [1963] [5]p. (AFOSR-65-0099) (AF AFOSR-63-50) AD 455832 Unclassified

Also published in Appl. Opt., v. 2: 1227-1231, Dec. 1963.

A lens design problem was proposed by a group of lens designers. Several alternative designs have been corrected on two different automatic correcting programs. The final designs are similar and exhibit a high degree of correction.

2373

Rochester U. Inst. of Optics, N. Y.

A FLEXIBLE AUTOMATIC LENS CORRECTION PROCEDURE, by G. H. Spencer. [1963] [8]p. incl. diagrs. tables, refs. (AFOSR-65-0101) (AF AFOSR-63-50) AD 455833 Unclassified

Also published in Appl. Optics, v. 2: 1257-1264, Dec. 1963.

Since the advent of high-speed automatic computing machinery, workers in the field of optical design have been intrigued by the idea of automating the lens design process. Various methods have been proposed and tested. Most of these do not allow sufficient control to be exercised over the nature of the design solution. Those which do allow such control appear to be inefficient because of slow convergence to a solution. A correction procedure is described which permits a high degree of control over the nature of the design solution and which has shown a reasonably good rate of convergence in a limited number of tests. The operation of a computer program to conduct the procedure is described, and the results of a typical design problem are presented. (Contractor's abstract)

2374

Rochester U. Inst. of Optics, N. Y.

A SERIES OF LENSES DESIGNED ON LARGE COMPUTERS, by R. E. Hopkins. [1965] [6]p. incl. diagrs. tables. (AFOSR-65-0444) (AF AFOSR-63-50) AD 612500 Unclassified

Also published in Internat'l. Commission for Optics, Conf. on Photog. and Spectros. Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

In this study four lenses were designed to meet a given set of specifications by using a powerful automatic correcting program. The designs provide information on what one may expect for performance from lenses of this type, and data gathered can be used to predict performance for a range of other problems. The geometrical energy distributions, the geometrical modulation transfer curves, and the design data are given for the lenses.

2375

Rochester U. Inst. of Optics, N. Y.

1s-2p TRANSITION OF H AND D IN SOLID ARGON,

by G. Baldini. [1964] [4]p. incl. diagrs. refs. (AFOSR-65-0403) (AF AFOSR-63-236) Unclassified

Also published in Phys. Rev., v. 136: A248-A251, Oct. 5, 1964.

The 1s-2p transition of hydrogen and deuterium atoms diluted in solid inert gases has been observed and its energy and half-width measured. In argon, absorption occurs at the energies of 10.55 and 10.565 ev and the half-widths are 0.27 and 0.23 ev, respectively, for H and D. An analysis of these results leads to an estimate of the frequency of a localized vibrational mode associated with the H and D impurities.

2376

Rochester U. Inst. of Optics, N. Y.

EMISSION SPECTRA OF KI:T1 AT 12°K, by K. Teegarden. [1964] [2]p. incl. diagrs. (AFOSR-65-0404) (AF AFOSR-63-236) AD 612656 Unclassified

Also published in Phys. Rev., v. 136: A1091-A1092, Nov. 16, 1964.

Emission spectra were measured for separate excitation by light absorbed in the A, B, C, and D impurity absorption bands of single crystals of KI:T1 at 12°K. Five emission bands are reported. Three emission bands are identified as direct transitions from the energy levels related to the A, B, and C absorption bands. Excitation in the D absorption band is found to excite an additional low-energy emission band which corresponds to a forbidden transition in absorption.

2377

Rochester U. Inst. of Optics, N. Y.

ULTRAVIOLET ABSORPTION OF SOLID DEUTERIUM, by G. Baldini. [1964] [4]p. incl. diagrs. (AFOSR-64-0443) (AF AFOSR-63-236) AD 612638 Unclassified

Presented at Internat'l. Commission for Optics Conf. on Photographic and Spectroscopic Optics, Tokyo and Kyoto (Japan), Sept. 1-8, 1964.

In the course of studying the optical properties of the simplest molecular solids in the far ultraviolet, deuterium was investigated and its absorption spectrum is reported here. Rare gas impurities introduced into the solid yield additional information about its electronic and optical properties.

2378

Rochester U. Inst. of Optics, N. Y.

OPTICAL PROPERTIES OF SOLID RARE GASES AND THEIR ALLOYS, by G. Baldini. Aug. 1964, 19p. (AFOSR-67-1384) (AF AFOSR-63-236) AD 612715 Unclassified

Presented at 1964 Spring meeting of the Amer. Phys. Soc., Philadelphia, Pa.

The theory of excited states in insulators is outlined, the optical absorption spectra of the solid rare gases shown and the experimental results discussed in the light of available theoretical models.

2379

Rome U. (Italy).

NEUROPHYSIOLOGICAL STUDIES OF BEHAVIOUR, by G. Ricci. Final technical rept. Apr. 1, 1963-Mar. 31, 1964. May 1, 1964, 12p. (AFOSR-64-1089) (AF EOAR-63-90) AD 601689 Unclassified

The results of the investigation of (1) behavior and EEG modifications induced by anticholinergic drugs and their combination with amphetamine, (2) modifications of cortical evoked responses after administration of atropine and amphetamine, and (3) modifications of the responses evoked in subcortical structures during avoidance conditioning experiments in the monkey are summarized. Small doses of amphetamine given to animals previously treated with anticholinergic agents restored the conditioned responses while not modifying the EEG activity. The cholinolytic drugs potentiated the excitatory effects of amphetamine. Amphetamine, given to previously atropinized animals restored the stage of diminished amplitude of the cortical responses both in the somatic and visual areas, in spite of the absence of clear-cut EEG modifications. A method was devised for implanting multiple electrodes in deep structures of the brain of the monkey. The preliminary results obtained with the study of the responses evoked in these structures during avoidance conditioning experiments are reported.

2380

Rome U. (Italy).

EFFECTS OF ATROPINE ON THE EEG AND CONDITIONING IN THE MONKEY, by G. F. Ricci and L. Zamparo. [1963] [2]p. (AFOSR-65-0306) (AF EOAR-63-90) AD 612569 Unclassified

Also published in Arch. Ital. Sci. Farmacol., Series III, v. 13: 3-4, July 1963.

Previous workers who had studied the effects of atropine on animal behavior had claimed that the classical EEG picture produced by the drug (slowing of cortical activity and disappearance of the arrest reaction to external stimuli) was not accompanied by behavioral changes. The authors employed classical conditioning techniques to refine behavioral measurements. They concluded that atropine (and probably anticholinergic drugs in general) can exert a measurable effect on attention and the learning process.

2381

Rome U. (Italy).

THE ROLE OF CEREBRAL CHOLINERGIC STRUCTURES IN LEARNING: RELATIONSHIP BETWEEN CONDITIONED RESPONSES AND THE EEG ARREST REACTION, by G. F. Ricci and L. Zamparo. [1964] [4]p. (AFOSR-65-0307) (AF EOAR-83-90) AD 612568 Unclassified

Also published in Riv. Neurol., v. 34: 283-286, May-June, 1964.

Earlier work by the authors had shown that atropine, in doses sufficient to alter the resting EEG and arrest reaction, also altered classical conditioned responses (i.e., affected behavior). The current report deals with other anticholinergics, a cholinesterase, and a sympathomimetic. Scopolamine and benactyzine exerted effects similar to atropine. Eserine, when administered by itself, altered both the EEG and conditioned responses; but when administered to monkeys pretreated with an anticholinergic, it caused the EEG to return to normal and restored conditioned reflexes. Amphetamine given to monkeys pretreated with an anticholinergic did not alter the anticholinergic EEG pattern, but did restore the conditioned response. The authors propose a possible explanation for the differing effects between the cholinergic and sympathomimetic drugs.

2382

Rome U. School of Aeronautical Engineering (Italy).

MODELING TECHNIQUE IN HEAT TRANSFERS. Jan. 1963 [15]p. incl. illus. diagrs. (Technical rept. no. 3; SIARgraph no. 88) (AFOSR-5403) (AF 81(052)198) AD 424339 Unclassified

The present paper is a general summary of the work developed during 1962. Theoretical research includes solution of heat conduction in solids and radiation problems. Experimental research includes investigations on the effect at the stagnation point.

2383

Rome U. School of Aeronautical Engineering (Italy).

GENERAL SATELLITE DYNAMICS. PART 1. EFFECT OF AIR DRAG, by L. Broglio. June 1983 [24]p. incl. diagrs. (Technical note no. 8; SIARgraph no. 87) (AFOSR-5404) (AF 61(052)198) AD 423988 Unclassified

Presented is a study of the determination of the satellites lifetime under the action of an external source of perturbation being it represented by the aerodynamic drag alone. A new theoretical method is presented which allows the problem to be solved in a very quick and easy way by determining some "universal" curves thus noticeably simplying the numerical work involved in the commonly used calculation procedures, and is particularly suitable to be applied to mean size computers. The theoretical research is completed by numerical results and graphs.

2384

Rome U. School of Aeronautical Engineering (Italy).

EFFECT OF A CONCENTRATED INJECTION AT THE FORWARD STAGNATION POINT OF A BLUNT BODY UNDER HYPERSONIC CONDITIONS, by U. Ponzi and A. Castellani. Final rept. Dec. 1964 [24]p. incl. illus. diagrs. tables. (AFOSR-65-1137) (AF 61(052)-198) AD 619514 Unclassified

A preliminary set of results are presented on the effects of high rate of injection localized at the forward stagnation point of a blunt body under hypersonic conditions. The device is envisaged as a possible means to deform the effective shape of noses of vehicles reentering from interplanetary missions; an attempt is made to establish an analogy with spiked bodies. Pressure distribution and heat transfer data are obtained for a Mach number equal to 8 and Reynolds number $0.2.10^8 \div 0.3.10^8$ and injection rates ranging between $C = 0.1 \div 0.8$.

2385

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

STEADY AND UNSTEADY MOTION IN MAGNETOGASDYNAMICS. Final technical rept., pt. 1, July 31, 1963, 6p. (AFOSR-4773, pt. 1) (AF EOAR-81-49) AD 408384 Unclassified

Equations are derived giving the changes across a shock of arbitrary shape and velocity moving in an inviscid gas in which the electrical conductivity varies with the temperature. The analysis is used for the study of deflagration in a combustible gas. A model is taken consisting of a flame, considered to be a discontinuity at which energy is released, ahead of which runs a shock, sufficiently strong to ionize completely the previously non-conducting gas. The Hugoniot curve for the shock reveals two patterns, one similar to the gasdynamic, the other corresponding to density ratios greater than the maximum permitted in gasdynamics. The modified Hugoniot curve for the flame is similar to that obtained in gasdynamics.

2386

Royal Coll. of Science and Tech. Dept. of Mathematics, Glasgow (Scotland).

STEADY AND UNSTEADY MOTION IN MAGNETOFLUID DYNAMICS, by D. C. Pack. Final technical rept. Dec. 31, 1983, 4p. (AFOSR-64-0725) (AF EOAR-63-22) AD 438560 Unclassified

The one-dimensional propagation of a steady detonation wave and also of a deflagration wave in a tube closed at one end is studied for the situation in which the

electrical conductivity jumps from zero to infinity across the leading shock owing to ionization of the gas. An analysis has been made of the jump relations for zero to infinity when the magnetic field is oblique and the upstream particle velocity and magnetic field are coplanar. Special attention is paid to switch-on and switch-off gas-ionizing shocks. A summary is given of work done on supersonic flow of electrically conducting fluid past a non-conduction wedge when there are four attached shocks.

2367

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

POTENTIOMETRIC PURITY CONTROL OF SALT MEDIA FOR EQUILIBRIUM STUDIES. WITH AN APPENDIX ON THE ANALYSIS OF DILUTE SOLUTIONS OF STRONG ACIDS, by L. Ciavatta. [1963] [19]p. incl. diagrs. tables. refs. (AFOSR-64-1456) (AF 61(052)-162) AD 445023 Unclassified

Also published in Arkiv Kemi, v. 20: 417-435, 1963.

A potentiometric titration method, employing a glass or a hydrogen electrode, is described for the estimation of trace amounts of weak acids and oxidizing agents that are often present in solution of salts commonly used as ionic media ($LiClO_4$, $NaClO_4$, Na_2SO_4, NaCl, KCl). The titration is carried out by coulometric generation of OH. Potentiometric titration combined with coulometry serves well for the analysis of dilute solutions of strong acids. For an acid concentration of 10^{-3} M results accurate within ± 0.1% could be attained, in 10^{-4} M solutions the uncertainty of the titration did not exceed ± 1%. (Contractor's abstract)

2366

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE STRUCTURES OF SOME HYDROXO SALTS OF Al^{3+}, Ga^{3+}, In^{3+} AND Tl^{3+}, by G. Johansson. [1963] [22]p. incl. diagrs. tables, refs. (AFOSR-65-1441) (AF 61(052)162) AD 621461 Unclassified

Also published in Svensk Kemisk Tidskrift, v. 75: 41-62, 1963.

A survey is presented of the crystal structure of some hydroxide sulfates and selenates of Al^{3+}, Ga^{3+}, In^{3+}, and Tl^{3+}. Their relations to other structures, particularly to those of the hydroxides, are discussed and an attempt is made to relate the structures of the metal-oxygen complexes in the solids with the composition of the polynuclear complexes determined from investigations on hydrolyzed solutions.

2369

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

THE ION ACTIVITY FUNCTION - AN APPROACH TO THE STUDY OF ELECTROLYTE BEHAVIOUR IN CONCENTRATED SOLUTIONS, by L. Leifer and E. Hogfeldt. [1963] [6]p. incl. diagrs. table, refs. (AFOSR-67-1292) (AF 61(052)162) Unclassified

Also published in Electrochemistry; Proc. First Australian Conf., Sydney (Feb. 13-15, 1963) and Hobart (Feb. 16-20, 1963), New York, Pergamon Press, 1964, p. 107-114.

The combination of Hammett acidity and activity data allowed determination of ion activity and ion activity coefficient functions for the ions in several divalent metal perchlorate-water systems as well as in hydrochloric acid-water mixtures. The fact that a unique ion activity function was obtained for H_3O^+ in several strong acids permits calculation of at least approximate values for ionic hydration as a function of composition. Further, the results indicate the marked stability of $H_9O_4^+$ in concentrated HCl solutions and a likely mechanism for the acid dissociation. (Contractor's abstract)

2390

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

EQUILIBRIUM STUDIES OF POLYANIONS CONTAINING B^{III}, Si^{IV}, Ge^{IV}, AND V^{V}, by N. Ingri. [1963] [32]p. incl. diagrs. tables, refs. (AFOSR-64-1799) (AF EOAR-63-8) AD 449076 Unclassified

Also published in Svensk Kemisk Tidskrift, v. 75: 3-34, 1963.

This paper is a summary of earlier published studies on the equilibria between aqueous polyanions containing B^{III}, Si^{IV}, Ge^{IV} and V^{V}. These studies have given the composition and equilibrium constants of the main species. A comparison has been made between the complexes found in solution and those found in crystals. From this comparison tentative structures have been given for the proposed polynuclear complexes.

2391

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON THE HYDROLYSIS OF NIOBATES IN 3 M K (Cl) MEDIUM, by G. Neumann. [1964] [3]p. incl. diagr. (AFOSR-65-1244) (AF EOAR-63-6) AD 621262 Unclassified

Also published in Acta Chem. Scand., v. 18: 278-280, 1964.

An investigation was made of ionic molecular species

in aqueous solutions of alkali metal niobates. The primary objective of the present work was to decide whether hexa- or pentaniobates predominate in solution. Preliminary results are reported.

2392

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS. PART 49. AN EMF STUDY OF LITHIUM HYDROXIDE IN 3 M $(NaClO)_4$ MEDIUM, by H. Ohtaki. [1964] [3]p. incl. diagrs. tables, refs. (AFOSR-65-1245) (AF EOAR-63-8) AD 621283 Unclassified

Also published in Acta Chem. Scand., v. 18: 521-533, 1964.

An emf study has been made in a system of various concentrations of lithium and hydroxide ions in sodium perchlorate medium using a hydrogen electrode at 25°C. From the difference in emfs between sodium hydroxide solutions with and without lithium ions, the following formation constant of lithium hydoroxide was estimated: $Li^+ + OH^- \rightleftharpoons LiOH$, $K = 0.66 \pm 0.02$ ($\log K = -0.18 \pm 0.01$).

2393

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ARE AQUEOUS METAVANADATE SPECIES TRINUCLEAR, TETRANUCLEAR, OR BOTH? PRELIMINARY LETAGROP RECALCULATION OF EMF DATA, by F. Brito, N. Ingri, and L. G. Sillen. [1964] [2]p. incl. table, refs. (AFOSR-65-1246) (AF EOAR-63-8) AD 621346 Unclassified

Also published in Acta Chem. Scand., v. 18: 1557-1558, 1964.

Emf measurements on metavanadate solutions at 25°C in alkaline 0.5 M Na(Cl) medium were recalculated by means of the computer program, LETAGROP. The results obtained indicate that both trinuclear and tetranuclear species are present in the metavanadate solutions.

2394

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDY OF THE HYDROLYSIS EQUILIBRIA OF CATIONS BY EMF METHODS, by G. Biedermann. [1964] [23]p. incl. diagr. table, refs. (AFOSR-65-1247) (AF EOAR-63-8) AD 621266 Unclassified

Also published in Svensk Kemisk Tidskrift, v. 76: 1-23, 1964.

A survey is presented of the experimental and interpretational problems which were encountered when the composition of the products of ionic reactions, especially those of hydrolysis, was determined by emf measurements. Sixteen investigations provide the data for this survey and these are listed as publications. An equilibrium analysis was used in all of the investigations.

2395

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

ON EQUILIBRIA IN POLYMOLYBDATE SOLUTIONS, by Y. Sasaki and L. G. Sillen. [1964] [1]p. (AFOSR-65-1248) (AF EOAR-63-8) AD 621236 Unclassified

Also published in Acta Chem. Scand., v. 18: 1014, 1964.

Preliminary results are presented for equilibria in polymolybdate solutions. The data have been treated by means of improved versions of the computer program LETAGROP, which was designed in order to adjust six and more equilibrium constants by simultaneous variation. The measurements are as yet, however, in a fairly unfavorable range for deriving a general formula.

2396

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS XLIV. EXTRACTION STUDY OF THE HYDROLYSIS OF VANADIUM (V) AT VERY LOW CONCENTRATION IN ACID PERCHLORATE MEDIA, by D. Dyrssen and T. Sekine. [1964] [11]p. incl. diagrs. table, refs. (AFOSR-65-1275) (AF EOAR-63-8) AD 622889 Unclassified

Also published in Jour. Inorg. and Nucl. Chem., v. 26: 981-991, 1964.

The distribution of carrier-free V^{48} between methyl isobutyl carbinol (hexol) and 0.5 M $(H, NaClO_4)$ has been measured radiometrically at 25°C as a function of $-\log [H^+]$. Both curve-fitting and Letagrop adjustment with a high-speed computer were used to evaluate constants for the following equilibria: $VO_2 + H_2O \rightleftharpoons HVO_3 + H^+$, $\log K_1 = -3.20 \pm 0.09$; $HVO_3 \rightleftharpoons VO_3^- + H^+$, $\log K_2 = -3.78 \pm 0.09$; and $HVO_3(aq) \rightleftharpoons HVO_3(hexol)$, $\log \lambda = 1.99 \pm 0.09$.

2397

Royal Inst. of Tech. Dept. of Inorganic Chemistry, Stockholm (Sweden).

STUDIES ON THE HYDROLYSIS OF METAL IONS.

PART 50. THE HYDROLYSIS OF THE YTTRIUM(III) ION Y^{3+}, by G. Biedermann and L. Ciavatta. [1964] [27]p. incl. diagrs. tables, refs. (AFOSR-65-1648) (AF EOAR-63-8) AD 624324 Unclassified

Also published in Arkiv Kemi, v. 22: 253-279, 1964.

The hydrolysis equilibria of the Y^{3+} ion have been studied at 25°C by measuring with a quinhydrone or a glass half-cell the hydrogen ion concentration of a series of yttrium perchlorate solutions. The [Y(III)] of the test solutions, which were made to contain 3 M ClO_4^- by adding $LiClO_4$, ranged from 0.025 to 1 M. Solutions having an appreciable concentration of hydrolysis products were prepared by two methods: (1) saturating a slightly acidic yttrium perchlorate solution with hydrous yttrium oxide, (2) generating OH^- ions by constant current electrolysis in an initially unhydrolyzed solution and measuring with a coulometer the amount of electricity used. The data obtained in solutions prepared by these methods were found to be in agreement with the emf measurements.

2398

Rutgers U. [Dept. of Physics] New Brunswick, N. J.

A STUDY OF THE PROPERTIES OF MATTER BY MEANS OF NUCLEAR MAGNETIC RESONANCE, by H. C. Torrey and H. Y. Carr. Final rept. Jan. 1, 1960-Dec. 31, 1962. Jan. 30, 1963, 13p. incl. table. (AFOSR-4643) (AF 49(638)755) AD 408547 Unclassified

The small magnets contained in the nuclei of the materials studied provide a means to investigate microscopic details of the environment surrounding the nuclei. These very small magnets transmit signals at a resonance frequency determined in the first approximation by the values of a strong externally applied magnetic field. But the detailed shapes, intensities, and time dependence of the transmitted signals are determined by the electric and magnetic fields associated with the local nuclear environment. By interpretating detailed properties valuable information has been gained concerning the coupling in electron-nuclear systems, the local magnetic fields present during molecular collisions in simple monatomic fluids such as xenon, and the fundamental interactions present in the important diatomic fluid, hydrogen.

2399

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

THE IMPACT OF PHOTOCOPYING ON SCHOLARLY PUBLISHING, by R. F. Clarke. [1963] [5]p. incl. tables. (AFOSR-J1148) (AF AFOSR-62-9) AD 440397 Unclassified

Also published in Library Jour., July 1963, p. 2625-2629.

Claims that photocopying has a damaging effect upon publishing are not substantiated by evidence and should be disregarded. Libraries should continue to copy scholarly materials as they do at present. If technology alters the situation, a study of this kind should be repeated. Internal muitiple-copy photocopying of materials should be studied as a separate and different problem. Librarians should anticipate journal needs further into the future, and should not assume that photocopying is automatically more economical than subscription. Libraries should keep sufficient data to make valid subscription decisions, and should subscribe to journals with subscription prices of $30 per year or less if one-year volumes are needed an average of once per year over a 20-yr period or longer.

2400

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

MEASURE OF INDEXING, by S. Artandi. [1964] [7]p. incl. tables. (AFOSR-64-2260) (AF AFOSR-62-9) AD 452527 Unclassified

Also published in Library Resources and Technical Services, v. 8: 229-235, Summer 1964.

In conjunction with a research project on the automatic indexing of natural language textual materials measures were developed to permit useful comparison of the mechanically produced index for an inorganic chemistry textbook with the average, conventionally-produced index for the same type of material. Evaluation of indexing can be done from the point of view of: (1) the individual product, and (2) the product as compared to other products of the same species, the product as a member of a group. The measures were developed primarily with book indexing in mind and as of this time have not been related to the indexing of periodical, patent, or report literature. Evaluation is based on three criteria: (1) Density of indexing, (2) Distribution of indexing, and (3) Completeness of indexing. Both density and distribution can be measured in a completely objective manner.

2401

Rutgers U. Graduate School of Library Service, New Brunswick, N. J.

AUTOMATIC BOOK INDEXING BY COMPUTER, by S. Artandi. [1964] [8]p. incl. diagrs. tables. (AFOSR-65-0090) (AF AFOSR-64-531) AD 611464 Unclassified

Also published in Amer. Doc., v. 15: 250-257, Oct. 1964.

This paper describes the development and evaluation of an automatic method of deriving suitable index entries from natural language text. A section of a chemistry textbook was selected as the experimental document. Qualitative and quantitative measures were developed to evaluate quality of indexing. Evaluation of the experimental index was based on these measures and on a comparison with the average published manually produced index found in the same type of material.

2402

Saarlandes U., Saarbrücken (Germany).

[THE POSITION OF FOUR RESPONSE VARIABLES IN A FACTOR ANALYSIS AND THEIR RELATIONSHIP TO ANXIETY AND STRESS] Die Stellung von vier motorischen Variablen in einer Faktorenanalyse und ihre Beziehungen zu Angst und Stress, by O. Spreen. [1964] [16]p. incl. tables, refs. (AFOSR-65-0594) (AF 61-(052)483) Unclassified

Also published in Psychol. Forsch., v. 27: 403-418, 1964.

In a factor analysis of 40 variables, the position of 4 response variables was investigated: (a) response rate; (b) tapping rate, i.e., finger oscillation; (c) touch pressure with tapping; and (d) steadiness of the hand with continuous activity. For these 4 variables significant loads [i.e., Ladungen] were found for 3 out of 16 extracted factors in the total analysis. The reaction time showed a [load] for an individual factor "response rate," the tapping rate showed a [load] for a factor for "fine response rate," the touch pressure with tapping showed a [load] for a "response coordination factor" and the factor for "fine response rate," and the steadiness of the hand showed a [load] also for the "response coordination factor." In an analysis of the 4 variables and additional data, no significant effect of the general anxiety level was found on the response performance considered here.

2403

St. Bartholomew's Hospital, London (Gt. Brit.).

RESEARCH ON DRUGS ON NEURONAL TRANSMISSION, by J. P. Quilliam. Final rept. Jan. 1964, 85p. incl. illus. diagrs. tables, refs. (AFOSR-64-0951) (AF 61(052)25) Unclassified

The actions of centrally active drugs and related compounds on transmission across the synapses of the superior cervical ganglion of the cat, rabbit and rat have been studied because these synaptic junction may be regarded as being closely allied to those seen between central neurones. Experiments on the cat ganglion were made in vivo on the isolated ganglia of the rabbit and the rat were made in vitro and usually involved the application of single stimuli to the preganglionic trunk with recording of the evoked ganglionic or postganglionic action potentials. The results are summarized in two parts, firstly, quantitative findings and secondly, qualitative observations with particular reference to modes of action.

2404

St. Bartholomew's Hospital, London (Gt. Brit.).

THE EFFECTS OF CHOLINE AND OTHER FACTORS ON THE RELEASE OF ACETYLCHOLINE FROM THE STIMULATED PERFUSED SUPERIOR CERVICAL GANGLION OF THE CAT, by E. K. Matthews. [1963] [6]p. (AFOSR-64-1086) (AF 61(052)25) AD 441472; AD 631885 Unclassified

Also published in British Jour. Pharmacol. and Chemother., v. 21: 244-249, Oct. 1963.

When the superior cervical ganglion of the cat was perfused with Locke solution, the amount of acetylcholine released into the perfusate decreased during successive periods of repetitive stimulation of the preganglionic nerve. Addition of choline to the perfusion fluid prevented this decrease. Choline also significantly increased ($P < 0.01$) the initial output of acetylcholine. In contrast, variation of the physostigmine concentration or of the pCo_2 and pH of the perfusion fluid had no statistically significant effect ($P < 0.05$) upon the initial release of acetylcholine.

2405

St. John's U. [Dept. of Physics] Jamaica, N. Y.

BORN CROSS-SECTIONS FOR SELECTED INELASTIC COLLISIONS OF PROTONS WITH HYDROGEN ATOMS IN STATES UP TO n = 10, by J. Carew and S. N. Milford. [1963] [6]p. incl. diagrs. tables, refs. (AF AFOSR-61-10) Unclassified

Published in Astrophys. Jour., v. 138: 772-777, Oct. 1, 1963.

Born total cross-sections for inelastic collisions of protons with excited hydrogen atoms may be derived approximately from the Born cross-sections for inelastic collisions of electrons with excited hydrogen atoms. A comparison of the exact and approximate Born cross-sections for the collisions $p + H(ni) \rightarrow p + H(n'l')$: 1s-2s, 1s-2p, 3s-4p, 3d-4f, shows that they agree down to energies near the Born maximum. By using the known electron cross-sections, approximate Born total cross-sections are calculated for proton collisions for some of the transitions 1-n'; 2-n'; 3-4, 5; 4-5, 6; 5-6; 10-11. In addition, a simple formula is given for finding other approximate proton cross-sections in terms of the approximate electron cross-sections calculated recently. (Contractor's abstract)

2406

San Andres U., La Paz (Bolivia).

TIME VARIATIONS IN COSMIC RAYS AND RADIOSONDE MEASUREMENTS, by I. Escobar. Final technical rept. June 1963, 105p. (Rept. no. 25) (AFOSR-J1338) (AF AFOSR-62-395) AD 433133; AD 434540 Unclassified

This report covers the experimental work performed on cosmic ray and radiosonde measurements. In the different selections of this report information based mainly or completely on data resulting from local experiments is given. In the first two parts, papers dealing with cosmic ray studies are presented, one concerning the electromagnetic states of the interplanetary space and the other concerning Forbush decreases.

In the third part of the report, the results of the measurements obtained with the radiosonde equipment installed at Ovejuyo, are given.

2407

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

AORTIC DEPRESSOR FIBERS IN THE RAT: AN ELECTROPHYSIOLOGICAL STUDY, by E. M. Krieger and R. F. Marseillan. [1963] [4]p. incl. illus. table, refs. (AFOSR-64-1174) (AF AFOSR-61-60) AD 442990 Unclassified

Also published in Amer. Jour. Physiol., v. 205: 771-774, Oct. 1963.

In 51 rats the distribution of the aortic depressor fibers which travel in the cervical region with the vagus, sympathetic, laryngeal, or as a separate aortic nerve was investigated by recording the action potential or by stimulating these nerves. A separate aortic depressor nerve was found in only 20% of the rats on the left side and in 5% on the right side. In these animals no depressor fibers were identified in the sympathetic trunk but the laryngeal nerves usually still exhibited depressor fiber activity. In those rats with no separate aortic depressor nerve the aortic fibers were present almost equally in the sympathetic trunk and laryngeal nerves, and on both sides of the neck. Only exceptionally was depressor activity found in the vagus trunk, and stimulation elicited depressor instead of pressor effects in 2 out of 12 rats. Optimal stimuli for obtaining hypotensive effects from the aortic depressor fibers were 80-150 per frequency and 1-2-msec duration.

2408

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

EFFECTS OF ADRENAL CORTICOIDS ON VISUAL EVOKED CORTICAL POTENTIALS IN THE CAT, by M. R. Covian, M. C. Lico, and J. Antunes-Rodrigues. [1963] [12]p. (AFOSR-64-1844) (AF AFOSR-61-60) AD 449973 Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 146: 81-92, Nov. 1, 1963.

The effect of topically adrenal corticoids on the surface of the cat, in relation to visual evoked cortical potential was studied. Hydrocortisone, desoxicorticosterone acetate, cortisone and aldosterone were tested. The effects were more consistent for hydrocortisone and desoxicorticosterone acetate. Hydrocortisone determined a marked increase of the negative component, the positive one being less affected. Desoxicorticosterone acetate caused a diminution of both components; in general the first component was more affected. An explanation of the results is given in terms of changes in brain intracellular Na concentration and Na ratio.

2409

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

HYPOTHALAMIC CONTROL OF SODIUM CHLORIDE AND WATER INTAKE, by J. Antunes-Rodrigues and M. R. Covian. [1963] [7]p. (AFOSR-64-1845) (AF AFOSR-61-60) AD 449974 Unclassified

Also published in Acta Physiol. Latinoamer., v. 13: 94-100, 1963.

Studies on the 2% NaCl and water intake using the self-selection method were made in 35 adult rats. The cyclical variations of ingestion of both fluids in males and females did not keep correlation with changes in temperature, relative humidity and atmospheric pressure of both liquids was related to estrous period, being more marked for NaCl. Changes in NaCl and water intake were observed during the 10 days following sham operation.

2410

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

ON SOME NEURAL EFFECTS OF CHLORPROMAZINE AND METHAMPHETAMINE, by E. Xavier and C. Timo-Iaria. [1964] [6]p. (AFOSR-64-1846) (AF AFOSR-61-60) AD 449975 Unclassified

Also published in Arch. Internat'l. Pharmacodyn. et Ther., v. 147: 512-517, Feb. 1, 1964.

The influences exerted by chlorpromazine and methamphetamine on the effects of stimulation of the midbrain reticular formation on a monosynaptic spinal reflex of the cat, were studied. The changes of the reflex were determined before and after microinjections of those drugs directly into the sites of stimulation, and the curves of excitability of the reflex arc were compared. Chlorpromazine shifted the curves to the side of pure facilitation. Methamphetamine turned any effect into pure inhibition. Such changes only occurred during stimulation. Intravenous injection of chlorpromazine depressed the reflex, probably by blocking the afferent fibers of the arc. When methamphetamine was injected intravenously, the reflex underwent prolonged facilitation, that was abolished by severing the spinal cord at L1 or L2.

2411

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

SPECIFIC ALTERATIONS IN SODIUM CHLORIDE INTAKE AFTER HYPOTHALAMIC LESIONS IN THE RAT, by M. R. Covian and J. Antunes-Rodrigues. [1963] [5]p. (AFOSR-64-1847) (AF AFOSR-61-60) AD 449976 Unclassified

Also published in Amer. Jour. Physiol., v. 205: 922-926, Nov. 1963.

Bilateral electrolytic lesions in the hypothalamus of the rat elicited either a decrease or increase in 2% NaCl intake, without a significant change in water ingestion. Lesions placed in the anterior hypothalamus involving supraoptic or paraventricular nuclei, or both, resulted in a conspicuous fall of NaCl intake. The decreased consumption remained to the end of the experiments which in some rats lasted 105 days and was accompanied by a decrease in NaCl urinary output. On the contrary, lesions placed in the central hypothalamus determined a specific increase of NaCl intake together with an augmented urinary excretion. The increased ingestion was permanent and lasted to the end of the experiment.

2412

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

CAROTID OCCLUSION IN THE RAT: CIRCULATORY AND RESPIRATORY EFFECTS, by E. M. Krieger. [1963] [8]p. (AFOSR-64-1848) (AF AFOSR-61-60) AD 449977 Unclassified

Also published in Acta Physiol. Latinamer., v. 13: 350-357, 1963.

In the rat the temporary occlusion of both common carotids produced increases in blood pressure, heart and respiratory rates. Symptoms of cerebral ischemia with disappearance of the responses supervened when the occlusions were maintained up to 5-10 min. The occlusion of the internal carotids produced weaker but similar responses to those observed when the common carotids were occluded. The data are suggestive that in the rat the responses elicited by the occlusion of both common carotids are only partially due to reflex mechanisms (baro and chemoreceptor) from the sinus area.

2413

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

EFFECTS OF STIMULATION OF THE CEREBELLAR CORTEX ON SPINAL MONOSYNAPTIC REFLEXES, by C. Timo-Iaria and J. J. O'Flaherty. [1964] [11]p. incl. diagrs. refs. (AFOSR-66-0989) (AF AFOSR-62-335) AD 634554 Unclassified

Also published in Acta Neurol. Latinoamer., v. 10: 49-59, 1964.

Electrical stimulation of the cerebellar cortex with single pulses preceding the monosynaptic extensor reflex evoked from afferents of the gastrocnemius branches and tibialis nerve, was performed in lightly anesthetized cats. By plotting the effects of the conditioning pulses on the reflex potentials as a function of time, the following patterns were disclosed: (a) From many loci it was possible to stabilize previously oscillating reflex potentials. (b) In several cases the evoked effect was reduced after the first or second stimuli. (c) Inhibition arose from the ipsilateral vermian and contralateral paravermian zones, from ipsilateral crus II and contralateral crus I, from ipsilateral paramedian lobule and from the ipsilateral dorsal and contralateral ventral paraflocculi. Facilitation was provoked from the symmetric corresponding areas. (d) These influences lasted over 100 msec in most curves but were generally weak. (e) Reciprocal innervation was a definite pattern of such effects.

2414

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

ROLE OF VARIOUS BRAIN STRUCTURES ON PHYSIOLOGICAL FUNCTIONS, by M. R. Covian. Final technical rept. May 1, 1963-May 1, 1964. June 12, 1964, 27p. incl. refs. (AFOSR-64-1272) (AF AFOSR-63-311) AD 602786 Unclassified

Summaries of 15 works completed or being studied are presented. These include work in the following fields: (1) Role of the central nervous system on homeostasis; (2) Sensory and motor systems, (3) Neuroendocrinology, (4) Behavioral studies, and (5) Neurochemistry.

2415

Sao Paulo U. School of Medicine. Dept. of Physiology (Brazil).

EFFECTS OF STIMULATION OF THE SEPTAL AREA UPON BLOOD PRESSURE AND RESPIRATION IN THE CAT, by M. R. Covian, J. Antunes-Rodrigues, and J. J. O'Flaherty. [1964] [14]p. incl. illus. tables, refs. (AFOSR-65-1288) (AF AFOSR-63-311) AD 617819 Unclassified

Also published in Jour. Neurophysiol., v. 27: 394-407, 1964.

In cats under chloralose the septal area was electrically stimulated and blood pressure and respiration changes were studied. The most striking finding observed was a fall of blood pressure gradually beginning during stimulation, or after it, and always outlasting the stimulus by 3-5 min. Bradycardia was often a concomitant feature. Changes in respiration consisted in an inhibition either in inspiration or expiration. In a few cases an increase in blood pressure was elicited, but only during the period of stimulation. Several tests indicate that the depressor reaction is due most probably to an inhibition of vasoconstrictor and cardiac accelerating fibers, but a role for vasodilator facilitation cannot be rules out.

2416

Sao Paulo U. [School of Medicine. Dept. of Physiology] (Brazil).

NEUROGENIC HYPERTENSION IN THE RAT, by E. M. Krieger. [1964] [11]p. (AF AFOSR-63-311) AD 617820 Unclassified

Also published in Circulation Research, v. 15: 511-521, Dec. 1964.

Several techniques of radical denervation of the sino-aortic depressor areas were tried in order to produce a permanent neurogenic hypertension in the rat. A simple one-stage operation for complete sino-aortic barroreceptor denervation is described. This procedure was used in 140 rats that were then studied for periods up to one year. All the operated animals presented some degree of hypertension. Blood pressure measurements made during the first week showed even then that the rats were hypertensive. This observation suggests that in the rat no latent period for the appearance of neurogenic hypertension is present. Hypertension was permanent in 75% of the rats observed up to one year; blood pressure returned to normal values in the remaining 25%, usually after the third month.

2417

Serendipity Associates, Sherman Oaks, Calif.

RESEARCH ON MECHANISMS FOR THE CONTROL OF STRESS, by E. E. Smith. Final rept. Jan. 31, 1964, 56p. incl. refs. (AFOSR-64-0190) (AF 49(638)1216) AD 432823 Unclassified

Informal, extemporaneous joking and laughing occurs in all groups, although its frequency appears to vary according to the situation and group structure. It is assumed that extemporaneous humor must serve one or more important functions in a group, including stress reduction, or it would not occur, and people would not seem to value it. The interests of this project have been directed toward determining the effects of joking on group interactions and outputs, and the personality attributes and roles of those who do most of the joking. The basic premise investigated is that joking behavior facilitates group interaction and productivity, and that this facilitation is particularly effective when the group is operating under stress.

2418

Sheffield U. Dept. of Biochemistry (Gt. Brit.).

USE OF A PURIFIED BACTERIAL FORMATE DEHYDROGENASE FOR THE MICRO-ESTIMATION OF FORMATE, by P. A. Johnson, M. C. Jones-Mortimer, and J. R. Quayle. [1964] [3]p. incl. diagr. tables. (AFOSR-65-2188) (AF EOAR-64-8) AD 628821 Unclassified

Also published in Biochim. et Biophys. Acta, v. 89: 351-353, 1964.

This communication records a simple method of purification of an NAD+-linked formate dehydrogenase from formate-grown Pseudomonas oxalaticus which enables either a determination of 0.05-0.15μmol of formate or the rate of formation of formate in a reaction system to be made directly.

2419

Sheffield U. Dept. of Fuel Tech. and Chemical Engineering (Gt. Brit.).

COMBUSTION INSTABILITY RESEARCH ON SOLID AND LIQUID PROPELLANT ROCKET MOTORS AT SHEFFIELD UNIVERSITY, by J. Swithenbank. June 1963 [24]p. incl. diagrs. refs. (Technical note no. 1); Rept. no. HIC 22) (AFOSR-5292) (AF EOAR-63-101) AD 419582 Unclassified

Presented at AFOSR Contractor's meeting, Nantucket, Mass, June 1963.

Rocket motor combustion instability has been under investigation. The first phase of this work concerned the high frequency tangential mode of oscillation, in a premixed gaseous fuelled rocket motor. In particular the first tangential travelling mode was studied because this is considered the most destructive mode of instability. The research was extended to cast double base propellants.

2420

Sheffield U. [Dept. of Fuel Tech. and Chemical Engineering] (Gt. Brit.).

INTENTIONAL COMBUSTION OSCILLATIONS IN PROPULSION SYSTEMS, by J. Swithenbank and D. Harris. June 1964, 65p. (Scientific rept. no. 1; Rept. no. HIC 45) (AFOSR-64-2029) (AF EOAR-63-101) AD 608206 Unclassified

The object of this research program is to determine useful applications of oscillatory combustion. In particular the generation of MHD power is suggested by the high ionization obtained in a combustion wave. In the limit, a detonation wave releases all the energy of combustion in the 'oscillation' and maximum temperatures are obtained. If the wave is a travelling tangential mode, theoretical studies suggest that either strong isentropic waves or cyclic detonation waves may be formed. Calculations of the MHD power generation by such waves are presented.

2421

Sheffield U. Dept. of Physics (Gt. Brit.).

PARAMAGNETIC RESONANCE IN RARE EARTH METALS, by J. Popplewell and R. S. Tebble. June 30, 1963, 1v. incl. diagrs. table, refs. (AFOSR-5342) (AF EOAR-62-45) AD 422254 Unclassified

The difference between the g values of paramagnetic metals and those of free ions has been attributed to an interaction between the paramagnetic ions and the conduction electrons. g shifts have been observed in gadolinium metal and several of its alloys; namely gadolinium with yttrium, gadolinium with palladium, and gadolinium woth lutetium. The g shift is generally found to be negative though it may be positive for the dilute alloys with yttrium. There would appear to be some small concentration dependence of the g value and this

together with the positive or negative behavior of the g shift, is examined with respect to the Yosida and Kondo models. In this way the behavior of the g shift can be more readily understood. In order to interpret the resonance measurements, preliminary measurements of susceptibility and magnetization were made. In addition it was necessary to measure lattice parameters since phase diagrams for some of the alloy systems are not available. (Contractor's abstract)

2422

Siena U. Inst. of Medical Pathology (Italy).

ELECTROENCEPHALOGRAPHIC DESYNCHRONIZATION DURING DEEP SLEEP AFTER DESTRUCTION OF MIDBRAIN-LIMBIC PATHWAYS IN THE CAT, by G. Carli, V. Armengoi, and A. Zanchetti. [1963] [3]p. incl. diagrs. (AFOSR-J954) (AF 61(052)253) AD 415840 Unclassified

Also published in Science, v. 140: 677-679, May 10, 1963.

Lesions which interrupt the ascending limb of the midbrain-limbic circuit in the cat at different levels, or which even destroy it completely, do not prevent electroencephalographic desynchronization at the beginning of periods of deep sleep, nor do they affect the maintenance of desynchronization throughout the sleep episodes. The pontine mechanisms responsible for these electroencephalographic patterns can apparently exert their influence through ascending pathways other than those directly impinging on the hypothalamus and the limbic system. (Contractor's abstract)

2423

Siena U. Inst. of Medical Pathology (Italy).

EXCITATION AND INHIBITION OF SHAM RAGE BEHAVIOR BY LOWER BRAIN STEM STIMULATION, by E. Bizzi, A. Malliani and others. [1963] [18]p. incl. illus. refs. (AFOSR-64-0092) (AF 61(052)253) AD 431179 Unclassified

Also published in Arch. Ital. Biol., v. 101: 614-631, 1963.

In 60 unanesthetized, acute thalamic cats the medullary and pontine tegmentum was electrically stimulated by means of stereotactically oriented concentric electrodes, and the effect of this stimulation tested on rage behavior. It was shown that both excitation and inhibition of sham rage behavior can reflexly be induced by appropriate electrical stimulation within the reticular formation of the lower brain stem.

2424

Siena U. Inst. of Medical Pathology (Italy).

ASCENDING AFFERENT MECHANISMS MAINTAINING SHAM RAGE BEHAVIOR IN THE ACUTE THALAMIC CAT, by A. Malliani, E. Bizzi and others. [1963] [16]p. incl. diagrs. refs. (AFOSR-64-0093) (AF 61(052)253) AD 430950 Unclassified

Sixty-five acute thalamic cats have been submitted to different types of electrolytic lesions of the midbrain, aiming at interrupting discretely each of various ascending afferent systems. It is shown that not only section of the medial lemnisci and lateral spino-thalamic tracts, but also interruption of those ascending pathways directly projecting upon the hypothalamus, i.e. Schütz's bundle and the mammillary peduncle system, are without apparent effect on the sham rage behavior of the thalamic cat. Only severe encroachment upon the medial and lateral reticular formation can abolish spontaneous and peripherally evoked rage behavior, although leaving efferent hypothalamic pathways partially viable. There is also a good correspondence between reticular lesions precipitating EEG synchronization and those preventing rate activity.

2425

Siena U. Inst. of Medical Pathology (Italy).

CENTRAL NERVOUS MECHANISMS IN CIRCULATION REGULATION, by C. Bartorelli and A. Zanchetti. Final rept. May 25, 1964, 1v. incl. illus. diagrs. refs. (AFOSR-64-1133) (AF 61(052)253) AD 601731 Unclassified

Ascending brain stem mechanisms regulating consciousness and emotional behavior have been studied in intact free-moving, and in acute decorticate cats, with attention to hypothalamic role in circulation control.

2426

Siena U. Inst. of Medical Pathology (Italy).

REFLEX REGULATION OF CONSCIOUSNESS AND EMOTIONAL BEHAVIOUR, by M. Guazzi, A. Malliani, and A. Zanchetti. [1964] [17]p. incl. illus. diagrs. refs. (AFOSR-65-0954) (AF 61(052)253) AD 617633 Unclassified

Also published in Acta Neurochirurg., v. 12: 198-214, 1964.

The afferent modulation of the central nervous mechanisms regulating conscious behavior is discussed, and compared to the effects of afferent and brain stem stimulation on the emotional behavior of diencephalic origin. The electroencephalographic synchronization and sleep induced by stimulating the carotid sinus baroreceptors in encéphale isolé or intact animals is paralleled by the inhibition of the spontaneous sham rage outbursts of the decorticate cat by natural baroreceptive stimulation; on the other hand, the carotid body chemoceptors do not only exert an arousing action, but are also capable of precipitating sham rage fits in the decorticate cat. The rage behavior of the decorticate cat depends, like cortical desynchronization and wakefulness in intact animals, upon a tonic background of ascending reticular activity.

2427

Siena U. Inst. of Medical Pathology (Italy).

[MICROELECTRODE RECORDING OF LOW HYPOTHALAMIC EVOKED RESPONSES TO SENSORY STIMULI] Registrazione microelettrodica di resposte lente ipotalamiche evocate da stimoli sensitivi, by G. Carli, A. Malliani, and P. Rudomin. [1965] [2]p. (AFOSR-65-2744) (AF 61(052)253) AD 629279 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 983-984, 1964.

In the current work tungsten microelectrodes were used to record diencephalic evoked responses in intact cats under local anesthesia and gallamine immobilization. The radial nerves were stimulated with single supermaximal impulses, and light flashes and short clicks were used to stimulate the optic and acoustic afferent systems. The morphology of the evoked responses were generally uniform, consisting of a single negative wave with a latency of about 20-30 msec, except for the posterior and lateral hypothalamus, where the negative wave was preceded by a small positive one and a consequently shorter latent period (about 10 msec). The evoked responses to somatic, visual, and acoustic stimuli were similar except for an early negative wave in the acoustic responses. Thus microelectrode recording of evoked diencephalic activity gave a distribution and morphology that was much the same as that observed with monopolar macroelectrodes.

2428

Siena U. Inst. of Medical Pathology (Italy).

[EXTRACELLULAR RECORDING OF DIENCEPHALIC UNIT ACTIVITY EVOKED BY SENSORY STIMULI] Registrazione extracelluliare dell'attivita unitaria diencefalica evocata da stimoli sensitivi, by G. Carli, A. Malliani, and P. Rudomin. [1964] [2]p. (AFOSR-66-0732) (AF 61(052)253) AD 633286 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 985-986, 1964.

Evoked unit activity was recorded from the posterior and lateral hypothalamus, supramammilary region, subthalamic region, and non-specific thalamic nuclei, but there was no evidence of evoked unit activity in the anterior hypothalamus and preoptic region.

2429

Siena U. Inst. of Medical Pathology (Italy).

[EFFECTS OF PULMONARY VENTILATION ON THE CIRCULATORY RESPONSES TO ELECTRICAL STIMULATION OF THE SINOCAROTID NERVE IN THE DECEREBRATE CAT] Effetti della ventilazione polmonare sulle risposte circolatorie alla stimolazione elettrica del nervo senocarotico nel gatto decerebrato, by M. Guazzi. [1964] [5]p. incl. illus. (AFOSR-66-0737) (AF 61(052)253) AD 632640; AD 633563 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 980-983, 1964.

In the intercollicular decerebrate cat, one of the sinocarotid nerves was stimulated electrically, and the reflex circulatory effects were studied during both spontaneous respiration and artificial respiration at various volumes. When the sinocarotid nerve is stimulated with intermediate voltage impulses, the responses are of the hypertensive type even during hyperventilation. This indicates that only a few of the inhibitory pressoceptor fibers are stimulated when a large part of the chemoceptor component is already involved. Since most of the pressoceptor fibers in the sinocarotid nerve of the cat are excited only by rather high-voltage stimuli, these fibers probably have a smaller diameter than many fibers of the chemoceptor type.

2430

Siena U. Inst. of Medical Pathology (Italy).

SOMATIC FUNCTIONS OF THE NERVOUS SYSTEM, by A. Zanchetti. 1963, 39p. (AF 61(052)253) AD 632647 Unclassified

Also published in Ann. Rev. Physiol., v. 24: 287-324, 1962.

A review is given of research on wakefulness, sleep, and control mechanisms of the reticular formation.

2431

Siena U. Inst. of Medical Pathology (Italy).

[STIMULATION OF VARIOUS GROUPS OF CUTANEOUS FIBERS AT DIFFERENT FREQUENCIES IN THE ACUTE THALAMIC CAT] Stimolazione a varia cadenza di diversi gruppi di fibre cutanee, nel gatto talamico acuto, by G. Carli, A. Malliani, and A. Zanchetti. [1964] [4]p. incl. refs. (AFOSR-66-0788) (AF EOAR-64-41) AD 633332 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 2158-2161, 1964.

The authors describe the effects of various rates of stimulation of different size afferent fibers in the superficial radial nerve of the acute thalamic cat. Among other effects it was found that stimuli combinations that were able to induce sleep in the animals were unable to inhibit spontaneous attacks of sham rage.

2432

Siena U. Inst. of Medical Pathology (Italy).

[PRESSURE CHANGES DURING DEEP SLEEP IN CATS WITH SINOCAROTID AND AORTIC DEAFFERENTATION] Variazioni pressorie durante il sonno profondo nel gatto con deafferentazione senocarotica e aortica, by M. Guazzi and A. Zanchetti. [1964] [3]p. incl. table. (AFOSR-66-1103) (AF EOAR-64-41) AD 639812 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 2156-2158, 1964.

Blood pressure changes associated with deep sleep in cats were studied before and after sinocarotid and aortic deafferentiation. It was found that both systolic and diastolic pressures fall more markedly in the deafferentiated animals than in those left intact. The animals that had been operated on displayed both a greater absolute decrease in pressures and lower minimal pressure levels. In some of the deafferentiated animals the pressure fell so low that epileptiform activity appeared on the electroencephalograms, causing a return to higher blood pressure levels and arousal of the cats.

2433

Siena U. Inst. of Medical Pathology (Italy).

[PERSISTENCE OF THE HIPPOCAMPAL THETA RHYTHM DURING DEEP SLEEP IN THE CAT FOLLOWING LESIONS OF THE MESENCEPHALIC-LIMBIC SYSTEM] Permanenza del ritmo teta ippocampico durante il sonno profondo dei gatto, dopo iesioni dei sistema mesencefaio-limbico, by G. Carli and A. Zanchetti. [1964] [2]p. (AFOSR-66-1104) (AF EOAR-64-41) AD 639539 Unclassified

Also published in Boll. Soc. Ital. Biol. Sper., v. 40: 2162-2163, 1964.

It has been stated by other investigators that the characteristic theta waves present in the hippocampus of cats during deep sleep are evoked by electrical impulses ascending the mesencephalic-limbic pathways. After making extensive lesions in these pathways, the authors still found a clear theta rhythm in the hippocampus. They conclude that the hippocampal theta activity is caused by impulses arriving at least partially by other than mesencephalic-limbic tracts.

2434

Smithsonian Inst. Astrophysical Observatory, Cambridge, Mass.

STUDY OF ATMOSPHERIC ENTRY AND IMPACT OF HIGH-VELOCITY METEORITES (LARGE-SCALE ELECTRON-PROBE MEASUREMENTS OF METEORITES), by F. B. Riggs, Jr. Final rept. [1963] 95p. incl. illus. tables, refs. (AFOSR-5079) (AF 18(600)-1596) AD 415141 Unclassified

A study was made of the effects of ablation on meteorites by metallurgical methods. In conjunction with the study an electron-probe microanalyzer was designed and constructed.

2435

South Carolina U. [Dept. of Electrical Engineering] Columbia.

MULTIPLE INTERNAL REFLECTIONS IN DIELECTRIC PRISMS, by R. G. Fellers. Final rept. Apr. 1, 1962-May 30, 1963. Aug. 31, 1963, 7p. (AFOSR-5281) (AF AFOSR-62-315) AD 417486 Unclassified

Research concerned the transmission of microwave beams around right angle corners by use of double curvature reflectors, the evaluation of the effect of multiple reflections in a prism device and computation of near zone antenna fields. A pair of dielectric prisms were used as an adjustable directional coupler, an adjustable attenuator, and a duplexing device. An analysis is given for the case of matched interfaces at the surfaces of the prisms. Theoretical derivation of the power transmitted to receivers located at right angles to the transmitter was carried out. Experimental results at wavelengths of 8.5 mm were in very good agreement with the theoretical prediction.

2436

South Carolina U. [Dept. of Electrical Engineering] Columbia.

MEASUREMENTS AT MILLIMETER AND SUBMILLIMETER WAVELENGTHS, by R. G. Fellers. 1960-1963, 6p. (AFOSR-5289) (AF AFOSR-62-315) AD 418157 Unclassified

Also published in IEEE Trans. Instrumentation and Measurement, v. IM-12: 139-141, Dec. 1963. (AFOSR-65-2872).

The development of measurement techniques in the millimeter and submillimeter range has been accelerated by improvements in sources and the development of transmission systems including conventional dominant mode waveguide, TE01 mode circular waveguide, oversized rectangular waveguide and free-space transmission systems with and without beam-guiding techniques.

2437

South Carolina U. Dept. of Electrical Engineering, Columbia.

INTERNAL REFLECTIONS IN DIELECTRIC PRISMS, by R. G. Fellers and J. Taylor. [1964] [4]p. incl. diagrs. refs. (AFOSR-65-1101) (AF AFOSR-63-3) AD 619743 Unclassified

Also published in IEEE Trans. Microwave Theory and Tech., v. MTT-12: 584-587, Nov. 1964.

The prism device is useable as an adjustable bidirectional coupler and as an adjustable attenuator. With coupling set at 3 decibels, it can be used as a hybrid junction. The theoretical calculation of coupling in all directions in the presence of internal reflections is shown. The adaptability of the prism device to a wide variety of functions makes it very useful at the shorter mm wavelengths where the elimination of internal reflections is difficult. The calculations presented here appear applicable in this case.

2438

Southampton U. (Gt. Brit.).

THE REACTION OF TITANIUM HALIDES WITH TERTIARY AMINES, by G. W. [A.] Fowles and R. A. Hoodless. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-J184) (AF EOAR-62-48) AD 400072 Unclassified

Also published in Jour. Chem. Soc., v. 5: 33-38, Jan. 1963.

Titanium(IV) chloride and bromide reacted with trimethylamine to give simple adducts TiX_4, NMe_3, that were monomeric in benzene solution. An excess of the amine reduced titanium to the tervalent state and gave the compounds $TiX_3, 2NMe_3$; these were also prepared by direct reaction of trimethylamine with the appropriate trihalide. Pyridine also reduced titanium(IV) halides. Titanium(III) chloride with pyridine or γ-picoline gave 1:3 adducts, and with α-picoline a 1:2 adduct. The spectra of these compounds have been measured and interpreted. (Contractor's abstract)

2439

Southampton U. (Gt. Brit.).

A STUDY OF THE CHEMISTRY AND STRUCTURE OF COMPLEX 5-CO-ORDINATION COMPOUNDS, by G. W. A. Fowles. Final rept. Jan. 1, 1962-Sept. 30, 1964, 8p. (AFOSR-65-0008) (AF EOAR-62-48) Unclassified

A number of 5-co-ordinate compounds of Ti(III), Ti(IV), V(III), V(IV), and Mo(V) have been prepared and characterized. A wide range of compounds of these elements and of Zr, Nb, Ta, Cr, and W have also been characterized in several oxidation states, with co-ordination numbers ranging from 4 to 8. In many instances spectroscopic studies have permitted assignment of unambiguous structures to the complexes.

2440

Southern California U. Dept. of Chemistry, Los Angeles.

SOAP FILMS AND SOME PROBLEMS IN SURFACE AND COLLOID CHEMISTRY, by K. J. Mysels. [1964] [8]p. incl. illus. diagrs. refs. (AFOSR-65-0517) (AF 49(638)309) AD 614293 Unclassified

Also published in Jour. Phys. Chem., v. 68: 3441-3448, Dec. 1964.

Soap films are a powerful tool for the study of surface and colloidal phenomena due to a well-defined geometry, a simple monolayer structure, and an easily observed behavior. The formation and evolution of relatively thick films are controlled by ordinary hydrodynamics, without any indication of the existence of rigidified aqueous layers near the surface. Thinner films show the effect of both double-layer repulsion and van der Waals attractions. These forces balance at a thickness of the order of 100A. Some problems in the interpretation of recent measurements of these equilibrium thicknesses and some approaches leading to further information about these forces are discussed. (Contractor's abstract, modified)

2441

Southern California U. Dept. of Chemistry, Los Angeles.

THE FLUORINATION OF ORGANIC SULFUR COMPOUNDS, by N. Kharasch, C. M. Buess and others. Final rept. Sept. 1, 1959-Jan. 31, 1964. July 1964, 6p. (AFOSR-64-1409) (AF 49(638)718) Unclassified

Research is summarized on (1) methods for the preparation of sulfenyl fluorides, RSF; (2) properties of related compounds of the class RSX S(X - Cl, Br, I, OR, ONO_2, etc.) which might be useful towards conversions to fluorine containing compounds; and (3) evaluation of the literature on the chemistry of sulfenyl fluorides and related substances, with a view to understanding the differences in behaviors of different RSX derivatives, where X varies, as above.

2442

Southern California U. Dept. of Electrical Engineering, Los Angeles.

A SURVEY OF METHODS FOR DYNAMIC SYSTEM IDENTIFICATION AND RESEARCH IN OPTICAL COHERENCE, by R. B. McGhee, G. O. Young, and R. S. Macmillan. Final rept. Mar. 1963, 81p. incl. diagrs. refs. (USCEC rept. 97-101) (AF 49(638)893) AD 405815 Unclassified

The parameter space approach is believed to represent a new point of view regarding the general problem of system identification. The method is restricted only by the requirement that a parametric model of finite dimensionality must be provided for the system under test. The parameter space method involves the determination of transformations defined over a finite dimensional vector space rather than over a Hilbert space. In addition to the computational advantages gained by a parameter space approach, there is the further advantage that no special test signals are required as in the Wiener theory. The model for a nonlinear system can be inferred from normal operating records.

2443

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

RESEARCH IN COMPUTER DECISION PROCESS, by B. O. Young and R. McGhee. Final rept. Aug. 1963, 94p. (USCEC rept. no. 98-101; rept. no. EE-27) (AFOSR-4669) (AF AFOSR-62-69) AD 419695 Unclassified

The report consists of two separate parts representing two distinct investigations. The first part is concerned

with optimization criteria in system design; the second deals with the identification problem for nonlinear systems.

2444

Southern California U. Dept. of Electrical Engineering, Los Angeles.

RESEARCH IN PLASMA MAGNETOHYDRODYNAMICS, by Z. Kaprielian. Mar. 1963 [16]p. incl. diagrs. (USCEC rept. no. 96-101) (AFOSR-4853) (AF AFOSR-62-112) AD 413768 Unclassified

The research reported here involves theoretical and experimental work in five major areas: (1) Electromagnetic radiation from a dipole in an anisotropic plasma, (2) Plasma diagnostics, (3) Modified P.I.G. discharge hot plasma source, (4) Plasma parametric amplifier, and (5) Measurements of thermal radiation from a highly ionized current carrying plasma. The results of these investigations are reviewed briefly.

2445

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

USE OF ELECTRON PROBES IN THE STUDY OF RECOMBINATION RADIATION, by D. B. Wittry and D. F. Kyser. [1964] [4]p. (AFOSR-65-0175) (AF AFOSR-63-76) AD 611498 Unclassified

Also published in Jour. Appl. Phys., v. 35: 2439-2442, Aug. 1964.

The electron probe microanalyzer was used to study the local variations in recombination radiation from gallium arsenide. The intensity of recombination radiation from different specimens varies by several order of magnitude. Local fluctuations are observed which attributed to surface deformation and to nonuniform distribution of impurities. Within experimental error, the wavelength distribution was indistinguishable from the wavelength distribution from GaAs diodes.

2446

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

METHODS OF QUANTITATIVE ELECTRON PROBE ANALYSIS, by D. B. Wittry. [1964] [24]p. (AFOSR-65-0176) (AF AFOSR-63-76) AD 611499 Unclassified

Presented at Twelfth annual Conf. on X-Ray Analysis, Denver Colo., Aug. 7-9, 1963.

Also published in X-Ray Anal., v. 7: 395-418, 1964.

In electron probe analysis quantitative results can be achieved with only pure elements as standards provided (1) the analysis conditions are carefully selected, (2) the observed intensities can be corrected to obtain the primary intensity actually produced in the specimen, and (3) the relationship of the primary intensity and concentration can be calculated. While present methods of making some of the corrections require improvement, and a 'universal' theory for relating the primary x-ray intensities to the concentrations still does not exist, the success achieved with this approach indicates that it should be used to the fullest extent before resorting to calibration curves. Moreover, as information is accumulated, the number of cases requiring the use of calibration curves should diminish, so that eventually it may be possible to perform quantitative analysis in any system with only pure elements as standards.

2447

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

RESEARCH IN OPTICAL COHERENCE AND NONLINEAR ESTIMATION THEORY, by G. O. Young, C. Giese, and R. S. Macmillan. Final rept. Dec. 1963, 116p. (USCEC rept. no. 102-101; rept. no. EE-34) (AFOSR-64-1141) (AF AFOSR-63-188) AD 601764 Unclassified

The theory developed in this report applies to any type of process or source. It is shown that the coherence properties of electromagnetic waves bear a direct relationship to their information carrying capacity. A number of examples are worked out of the coherence properties of monochromatic and polychromatic waves emitted by either point sources or extended objects. The effect of aperture limitation on the coherence properties of the image of the above sources is also investigated. Part II is concerned with the estimation of the dynamic states of a nonlinear differential equation which is quasi-linear in the vector function $x = f(x)$. To demonstrate the nonlinear estimation procedure, an algorithm was programmed for a digital computer which solves the equations for estimation of the dynamic states of an unguided reentry space vehicle.

2448

Southern California U. Dept. of Electrical Engineering, Los Angeles.

RESEARCH IN OPTICAL COHERENCE, by R. S. Macmillan, G. O. Young and others. Final rept. Dec. 1964, 76p. incl. diagrs. refs. (USCEC rept. no. 102-101-1; rept. no. EE-34-1) (AFOSR-65-1690) (AF AFOSR-64-188) AD 624108 Unclassified

The research reported is presented in three parts. Part 1: The normalized mutual coherence function is defined and applied. Its maximization is equivalent to maximizing information transfer through an optical system. Part 2: The covariance matrix for both a backscattered electromagnetic process and a spacial noise process is formulated. Part 3: An exact derivation is presented for the binary detection system.

2449

Southern California U. Dept. of Electrical Engineering, Los Angeles.

FERMI LEVEL POSITION AT METAL-SEMICONDUCTOR INTERFACES, by C. A. Mead and W. G. Spitzer. [1964] [4]p. incl. diagr. table, refs. (AFOSR-64-1351) (AF AFOSR-64-496) AD 444142 Unclassified

Also published in Phys. Rev., v. 134: A713-A716, May 4, 1964.

The position of the Fermi level at a metal-semiconductor interface relative to the conduction band has been found to be a constant fraction of the semiconductor band gap for all but 3 of the 14 group IV or III-V semiconductors studied. In all cases, the position was essentially independent of the metal work function. This general result is not inconsistent with the limited theories of surface state energies now available. The three exceptional cases can be understood in terms of a first-order perturbation to the surface state energies correlated with a similar perturbation observed in the energy gap at the (111) zone edge. Experiments are also reported on Ga(As-P) alloys, and two II-VI materials showing distinctly different behavior.

2450

Southern California U. Dept. of Electrical Engineering, Los Angeles.

CONDUCTION BAND MINIMUM OF CdTe, by W. G. Spitzer and C. A. Mead. [1964] [5]p. incl. diagrs. refs. (AFOSR-64-1352) (AF AFOSR-64-496) AD 444143 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 443-447, 1964.

The spectral dependence of the photovoltaic effect for Au-n-type CdTe surface barrier cells is measured for photon energies near the CdTe intrinsic absorption edge at 298, 77, and 5°K. The results are viewed in terms of phonon assisted direct absorption, phonon assisted exciton creation at a previously proposed lattice defect site, and indirect optical transitions. The data appears to favor the third mechanism although the second one is not ruled out as a possibility. The values for the direct transition energy gap obtained at the different temperatures compare favorably with those given by other work.

2451

Southern California U. Dept. of Electrical Engineering, Los Angeles.

TRANSVERSE PARAMAGNETIC EFFECT IN AN IRREVERSIBLE TYPE II SUPERCONDUCTOR, by M. A. R. Leblanc. [1964] [2]p. incl. diagrs. (AFOSR-64-1584) (AF AFOSR-64-496) AD 446346 Unclassified

Also published in Phys. Ltrs., v. 10: 260-261, June 15, 1964.

A paramagnetic moment or net excess flux parallel to an external field H_a occurs in a hard superconductor when a transport current transverse to the field is introduced after cooling through T_c in the presence of the field. This phenomenon which is referred to as the "transverse paramagnetic effect", is described in the present note.

2452

Southern California U. [Dept. of Electrical Engineering] Los Angeles.

JOINT SERVICES ELECTRONICS PROGRAM. Final rept. Sept. 1, 1963-Sept. 1, 1964 [65]p. incl. refs. (AFOSR-65-0390) (AF AFOSR-64-496) AD 612039 Unclassified

The research efforts of this program are summarized. The solid state phase has consisted of investigations on semiconductors, magnetism, imperfections in crystals, and superconductivity. The applied electromagnetics and plasma research includes the problem of electromagnetic wave propagation. In the field of information sciences, control systems, bioelectronics, and coding theory have been investigated.

2453

Southern California U. Dept. of Electrical Engineering, Los Angeles.

ON THE THEORY OF LINEAR PASSIVE SYSTEMS, by J. Meixner. [1964] [19]p. (AFOSR-65-0914) (AF AFOSR-64-496) AD 617595 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 17: 278-296, 1964.

The main theorems on linear passive systems are quoted. Then 2 subclasses, the relaxation systems of the first and of the second kind, are defined and various properties of them are derived. Sufficient conditions are given that a linear passive system with a stimulus which is a harmonic function for $t > 0$ will have a response which approaches a harmonic function for $t \to \infty$. Finally the representation theorems are derived for vector-valued linear passive systems.

2454

Southern California U. Dept. of Electrical Engineering, Los Angeles.

A GEOMETRICAL STUDY OF TRANSMITTED REFERENCE COMMUNICATION SYSTEM, by R. M. Gagliardi. [1964] [6]p. incl. diagrs. table. (AFOSR-65-2118) (AF AFOSR-64-496) AD 627544 Unclassified

Also published in IEEE Trans. Commun. Tech., v. COM-12: 118-123, Dec. 1964.

A study is presented of a general transmitted reference (TR) system, with the primary objective of finding bounds on these restrictions. It is based upon geometrical considerations using the fact that a transmitted reference system can be described by vectors in, and linear transformations upon, an N-dimensional Euclidean space. In this way it can be shown, for example, that the dimension of the transmitting channel must be greater than that of the space of carrier signals for unique operation. It is shown that a TR system always operates with at least a 3-dB poorer signal-to-noise ratio than that of an ideal locally generated reference system, with the bound increasing to 6 dB if the transmitter is power limited, and gets progressively worse as the transmitter power to noise-power ratio decreases below 0 dB. Some curves are plotted to show the relationships quantitatively.

2455

Southern California U. Engineering Center, Los Angeles.

RESEARCH ON RAREFIED GASDYNAMICS AND PLASMADYNAMICS, by R. L. Chuan. Summary rept. Sept. 1962-Aug. 1963. Dec. 1963, 77p. incl. illus. diagrs. tables, refs. (USCEC rept. no. 93-101) (AFOSR-84-0565) (AF AFOSR-63-55) AD 436451 Unclassified

The work of the project is summarized under the following topics: (a) Hypersonic low density wakes, including free-molecule theory two-dimensional wakes and experiments in low density wakes; (b) Impact pressure at low density (theoretical treatment and experiments); (c) magnetohydrodynamic waves in a flowing plasma; and (d) free molecule electrostatic probe.

2456

Southern California U. Engineering Center, Los Angeles.

ON THE TOTAL FORCE OF ELASTIC SCATTERING - NEUTRAL PARTICLES AND PERFECT CRYSTAL, by E. Beder. [1964] [38]p. incl. diagrs. tables, refs. (AFOSR-85-1154) (AF AFOSR-83-55) AD 818826 Unclassified

Also published in Surface Sci., v. 1: 242-279, 1964.

Quantum and classical-mechanical microscopic theory is developed for the total force on a cold solid plane surface resulting from the elastic scattering of an incident uniform cold beam of particles. The solid is a semi-infinite project dielectric crystal. The particles are neutral noninteracting mass points. The particle-solid interaction potential is that of physical adsorption normal to the surface, with a small sinusoidal perturbation along the surface to represent crystal nuclei. The theory is applied to a 2-dimensional periodic crystal problem. Two limiting cases of purely specular reflection are found at high and low particle energies. Between these limits the forces are computed in a limited number of cases for the incident on LiF. The theory presented is then compared to classical theory.

2457

[Southern Methodist U., Dallas, Tex.]

VELOCITY OF COMPRESSIONAL WAVES IN VARIOUS MINERALS AT PRESSURE TO 10 KILOBARS, by G. Simmons. [1984] [5]p. (AF AFOSR-83-418) AD 439289 Unclassified

Also published in Jour. Geophys. Research, v. 89: 1117-1121, Mar. 15, 1964.

The velocity of compressional waves in several minerals, as a function of pressure to 10 kb, has been measured. Data for single-crystal microcline suggest that measurements of elastic constants should be made under hydrostatic pressure for all material not of gem quality. Velocities for some rocks with high calcium content suggest a correction to the velocity-density-mean atomic weight relationship of Birch for content of CaO.

2458

Southern Research Inst., Birmingham, Ala.

A STUDY OF THE DIFFUSIVITY OF IRON IN LIQUID SLAGS, by E. B. Dismukes. Final rept. Jan. 1, 1959-Dec. 31, 1962. Feb. 4, 1963, 28p. (Rept. no. SRIB-573701954-XIII) (AFOSR-4493) (AF 49(638)523) AD 609459 Unclassified

The self-diffusion coefficients of iron and calcium in silicate melts were measured. These data and comparable data in the published literature do not fully support some of the currently held theories of the structure of silicate melts. The diffusivity of iron, for example, seems to have a surprisingly high energy of activation, and further information is needed concerning the diffusivity. The exchange of iron between solid metal and molten iron silicate was also studied. This phenomenon creates difficulties in determining the diffusivity of iron when it is necessary, as in this study, to use the metal iron as the material of construction for diffusion vessels.

2459

Southwest Research Inst., San Antonio, Tex.

NONDESTRUCTIVE EVALUATION OF METAL FATIGUE, by J. W. Fogwell, F. Kusenberger, and W. L. Donaldson. Mar. 29, 1963, 30p. (AFOSR-5149) (AF 49(638)1147) AD 411421 Unclassified

A nondestructive testing device was developed to monitor the progress of fatigue growth in a rod-type fatigue specimen stress cycled in direct tension. The technique developed was that of using a Hall-effect element to monitor the perturbations in the magnetic field at the surface of the specimen when the specimen was magnetized. Both longitudinal and radial flux orientations in the specimen are possible with the system developed under this contract. Typical inspection records

taken with longitudinal flux orientation are presented. Preliminary tests were made to determine the repeatability and sensitivity of the system.

2460

Southwest Research Inst., San Antonio, Tex.

NONDESTRUCTIVE EVALUATION OF METAL FATIGUE, by F. N. Kusenberger, J. R. Barton, and W. L. Donaldson. Mar. 13, 1964, 78p. (AFOSR-64-0668) (AF 49(638)1147) AD 600277 Unclassified

This report includes a discussion of the magnetic techniques and magnetic inspection - fatigue tester equipments. The design and construction of new electronics for use with the Bismuth Hall probes is summarized. Results obtained from fatigue tests to determine the required stress level for reasonable life are analyzed, and photographs of many fracture surfaces are included. A brief summary of the nondestructive detection of fatigue damage using the magnetic inspection equipment is given.

2461

Space Sciences, Inc., Waltham, Mass.

EXTENSION OF THE MOTT-SMITH METHOD FOR A ONE-DIMENSIONAL SHOCK WAVE, by H. Salwen, C. E. Grosch, and S. Ziering. [1964] [10]p. incl. diagrs. tables. (AFOSR-64-0920) (AF 49(638)1228) AD 439872 Unclassified

Also published in Phys. Fluids, v. 7: 180-189, Feb. 1964.

A method has been developed for adding an arbitrary number of additional terms to the two-term Mott-Smith distribution function for a one-dimensional shock wave and a calculation has been carried out, for a monatomic gas of Maxwellian molecules, with a three term distribution function. For weak shocks, the calculated reciprocal shock thicknesses are within 2% of the Navier-Stokes results. This is a substantial improvement over the Mott-Smith results which, for the same force law, are 15 to 30% too low.

2462

Sperry Rand Corp. Univac Div., Blue Bell, Pa.

MULTI-LIST SYSTEM: ADDITIONAL NOTES ON A STUDY INTO AUTOMATIC ATTRIBUTE GROUP ASSIGNMENT, by E. G. Fossum, G. Kaskey and others. Mar. 27, 1964 [33]p. incl. diagrs. tables. (Technical rept. no. 3) (AFOSR-64-2476) (AF 49(638)1194) AD 609709 Unclassified

This report continues analyses into the automatic attribute assignment program of the Multi-List System using as basic data a large nonrandom sample of 38,402 DDC (formerly ASTIA) documents. The assignment program now has been extended to include the 599 most frequently used descriptors in the sample file; this comprises those used 72 times or more in the 38,402 documents and represents slightly more than 10% of the 5,577 different descriptors in the sample. In addition, a start has been made into analyzing the characteristics of the pair association included among these 599 descriptors and some preliminary statistical data are contained in the report.

2463

Sperry Rand Corp. Univac Div., Blue Bell, Pa.

MULTI-LIST SYSTEM: FINAL NOTES ON A STUDY INTO AUTOMATIC ATTRIBUTE GROUP ASSIGNMENT, by E. G. Fossum, G. Kaskey and others. Oct. 1, 1964 [37]p. incl. tables. (Technical rept. no. 4) (AFOSR-64-2477) (AF 49(638)1194) AD 609710 Unclassified

The report completes the analyses into the automatic attribute group assignment program of the Multi-List System. The array of attribute groups is subject to updating (adjustment) as new documents add new descriptor associations to the file. An analysis is made of the use of the attribute groups as a means of entry to 'lists' of documents having several descriptor ranges in common. It is concluded that the technique is not an efficient method of list organization for a document retrieval application; in general, the objective of combining two or three exclusive descriptors into a 'super-key' cannot be achieved. Some of the data characteristics which a file must possess for this method to be efficient are described.

2464

Stanford Research Inst., Menlo Park, Calif.

THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS. PHASE I: THE MEASUREMENT OF ACOUSTIC ADMITTANCE, by G. M. Muller. Final rept. May 14, 1964, 116p. (AF 49(638)565) AD 443188 Unclassified

A reflected-pulse method for measuring the real part of the complex acoustic admittance ratio of an almost perfectly reflecting surface is described. The method involves sending an acoustic pulse down a long tube terminated by the surface to be investigated, and observing the pressure-time profile of the pulse before and after reflection. A comparison experiment in which the tube is terminated by a perfect reflector allows the separation of changes in the pulse spectrum due to reflection by the surface of interest from those due to the tube. Small finite-amplitude effects do not interfere with the measurement.

2465

Stanford Research Inst., Menlo Park, Calif.

THE STUDY OF THE ORIGIN AND PROPAGATION OF DISTURBANCES IN THE BURNING OF SOLID PROPELLANTS, PHASE II: A STUDY OF COMBUSTION

INSTABILITY AND ITS DEPENDENCE ON PROPELLANT COMBUSTION CHARACTERISTICS, by L. A. Dickinson and E. L. Capener. Final rept. May 14, 1964, 20p. incl. diagrs. tables. (AF 49(638)565) AD 442392 Unclassified

A range of propellants was studied to learn how unstable burning characteristics were affected by (1) burning rate catalysts, (2) oxidizer type, and (3) particle size variation in the oxidizers and metallic fuels. The studies were carried out in a 5-in. diam by 40-in. long motor which was pulsed using a well-proven triggering technique. As the nominal burning rates of the propellants increased, the burning propellants became less increased, the burning propellants became less responsive to pulsing. This was manifested by a steady increase in chamber pressure at which instability would not occur even at pressures as high as 2400 psi. In addition, it was noted that the peak-to-peak pressure amplitude of the oscillation steadily decreases as the burning rate increases. Also of interest to propellant formulators was the observation that incorporation of coarse oxidizer and coarse spherical aluminum powder lowered the pressure level at which instability could be triggered in a propellant.

2466

Stanford Research Inst., Menlo Park, Calif.

INVESTIGATION OF CRYSTAL GROWTH PROCESSES, by W. J. Fredericks, F. E. Rosztoczy, and J. Hatchett. Jan. 1963, 24p. (AFOSR-4731) (AF 49(638)-999) AD 407600 Unclassified

A method for purification of KCl by anion and cation exchange was developed. The crystalline product of the purification process and single crystals grown from this product were evaluated. This investigation shows that the method produces crystals superior to those currently available commercially.

2467

Stanford Research Inst., Menlo Park, Calif.

THE KNOWLEDGE ANALYST: AN APPROACH TO STRUCTURING MAN-MACHINE SYSTEMS, by K. H. Schaeffer, J. B. Fink and others. Feb. 1965, 132p. incl. illus. tables, refs. (AFOSR-4490) (AF 49(638)-1020) AD 297432 Unclassified

In an attempt to evolve a general method for systems analysis, the matrix-network approach for the analysis of complex man-machine systems is presented. This approach consists of seven steps which show how a system can be structured and how mathematical models of systems aspects can be incorporated into the overall analysis. However, some of these steps involve, besides formal rules, the judgment of a knowledgeable analyst. To delve deeper into this judgment function, various logical, methodological, and psychological aspects concerning this function are discussed by different authors. On the basis of these discussions the principal author develops requirements which must be met by successful approaches to the structuring of complex systems.

2468

Stanford Research Inst., Menlo Park, Calif.

APPLICATIONS OF THE BEHAVIORAL SCIENCES TO RESEARCH MANAGEMENT: AN INITIAL STUDY IN THE OFFICE OF AEROSPACE RESEARCH, by H. M. Vollmer. Nov. 1964, 84p. incl. diagrs. tables, refs. (AFOSR-64-2555) (AF 49(638)1028) AD 609356 Unclassified

The method of the study included collection of data by use of personal interviews, a standard written questionnaire, and review of management records. Findings on research organization substantiate the importance of protecting the integrity of research activities and to differentiate them from development, to maintain a participatory style of leadership, to support methods to translate research findings into rapid utilization, and to assure a sense of continuity in laboratory structure and research programs. Findings on the evaluation of research productivity point out methods to measure the quality of research products, as well as quantity. Findings on the recruitment, retention, and utilization of scientists suggest the importance of freedom in the conduct of research as a general incentive related to reproductivity and job satisfaction.

2469

Stanford Research Inst., Menlo Park, Calif.

ADAPTATIONS OF SCIENTISTS IN FIVE ORGANIZATIONS: METHODOLOGY AND TECHNICAL APPENDIX, by H. M. Vollmer, T. R. LaPorte and others. May 1964, 123p. incl. tables, refs. (Technical rept., phase II b) (AFOSR-65-1307) (AF 49(638)1028) AD 621253 Unclassified

This investigation is part of a continuing study of the adaptations of scientists in different organizational contexts. The investigation consists of 2 aspects: (1) the effect on the individual of constraints that research organizations impose; and, (2) the consequences on the organization produced by individual research on the part of these scientific employees. Five government organizations were studied. Data was collected by interviews and questionnaires. Response data is presented in tabular form and copies of the questionnaire and interview guides are included. In analyzing the data, the dynamics of interaction within each organization were assessed and generalizations were made about the type of organization studied.

2470

Stanford Research Inst., Menlo Park, Calif.

ADAPTATIONS OF SCIENTISTS IN FIVE ORGANIZATIONS: A COMPARATIVE ANALYSIS, by H. M.

Vollmer, T. R. LaPorte and others. May 1964, 124p. incl. diagrs. tables, refs. (Tec[illegible] l rept., phase 11b) (AFOSR-65-1308) (AF 49([illegible])1028) AD 619529 Unclassified

A study of adaptations of scientists in five different organizations is presented. Case studies are presented for (1) a university research organization, (2) an aerospace industrial research organization, (3) a nuclear research and development laboratory, (4) a federal government defense research organization, and (5) an independent non-profit research organization. Organizations are compared with respect to such criteria as degree of professionalization, degree of bureaucratization, degree of industrialization, recruitment and displacement, incentives, socialization, status advancement, and research entrepreneurship. An image of what might be called a model professional organization is presented.

2471

Stanford Research Inst., Menlo Park, Calif.

SUDDEN IONOSPHERIC DISTURBANCES AND THE PROPAGATION OF VERY-LOW-FREQUENCY RADIO WAVES. PART II: WHISTLER TAPE ANALYSIS AND INSTRUMENT DEVELOPMENT, by A. L. Whitson and E. T. Pierce. Final rept. Apr. 1963, 60p. (AF 49-(638)1081) AD 410598 Unclassified

The effects of a sudden ionospheric disturbance (SID) on atmospheric noise were investigated using data collected during the International Geophysical Year and the International Cooperation Year. During an SID, atmospheric noise is enhanced at frequencies above 12 and below 1 kc. At frequencies between 3 and 10 kc, it is decreased. A simple device that records the ratio of atmospheric noise at 27 kc over noise at 6 kc was developed as an SID detector. Measurements made during SIDs show that the present method of reporting sudden enhancements of atmospheric (SEA) at 27 kc results in many reports of SIDs when the disturbances were probably due to other causes, notably local thunderstorms. These spurious reports are avoided by the use of a ratio meter.

2472

Stanford Research Inst., Menlo Park, Calif.

FUNDAMENTAL RESEARCH IN SUPPORT OF VELA-UNIFORM, by G. E. Duvall and R. C. Alverson. May 31, 1964, 155p. (AF 49(638)1086) AD 442254 Unclassified

Research is reported on: Thermodynamics of uniaxial compression in an elastic-plastic solid; Stress relaxation in quartzite derived from shock wave measurements; Plane and spherical waves in a compressible plastic-relaxing medium; Spherical waves in an incompressible plastic-relaxing medium; Measurements of compression modulus in uniaxial strain; and Spherical waves in elastic-plastic media.

2473

Stanford Research Inst., Menlo Park, Calif.

OXIDATION OF UNSATURATED HYDROCARBONS, by D. E. Van Sickle and F. R. Mayo. Final rept. Oct. 1, 1961-Sept. 30, 1963. Jan. 10, 1964, 6p. (AFOSR-64-0025) (AF 49(638)1102) AD 429761 Unclassified

Research effort for the last two years has been directed principally toward product studies of low temperature, liquid-phase olefin oxidations. Pure hydrocarbons were utilized where possible, azo initiators employed, and conversions limited to 5%. An attempt has been made to correlate the hydroperoxide produced with the remaining products found and to assign relative rates for two chain propagation reactions. A secondary effort was the study of autocatalysis in oxidation. Cyclopentene was chosen as a model compound, since its oxidation mechanism is the simplest of the olefins studied. Decomposition and initiating properties of hydroperoxides also received attention.

2474

Stanford Research Inst., Menlo Park, Calif.

VISUAL-INFORMATION PROCESSING IN THE BEETLE LIXUS, by J. C. Bliss. [1964] [6]p. (AFOSR-64-1697) (AF 49(638)1112) AD 448261 Unclassified

Also published in Proc. 1962 Ojai Symposium on Neural Theory and Modeling, Calif. (Dec. 4-6, 1962), Stanford U. Press, 1964, p. 325-330. (AFOSR-64-1694)

Results discussed in this report showed that the partial reactions of ommatidial pairs are summed. Also, an analysis of sequential decisions showed that the probability of a decision in a given direction being followed by a decision in the same direction was greater than the zero-order probability in that direction. Electrical recordings from the eye of the beetle Lixus were made of the electroretinogram and of spike potentials. The ERG study demonstrated the nonlinearity of the response and suggested a 13-msec pure delay followed by a simple lag network with corner frequency at 4 cps as an approximation for the response to small changes in light intensity. Spike potentials were obtained from a single cell that fired with an increase in light intensity.

2475

Stanford Research Inst., Menlo Park, Calif.

EXPERIMENTS ON VISUAL RESPONSES IN INSECTS, by J. C. Bliss, W. D. Chapple and others. Final rept. Oct. 14, 1963-Oct. 14, 1964. Nov. 1964, 64p. (AFOSR-65-0042) (AF 49(638)1112) AD 610426 Unclassified

The optomotor response of the milkweed bug Oncopeltus Easciatus Dallas (Hemiptera) is described. Measured optical constants of compound eyes are also described and possible explanations are offered of certain observed phenomena relating to the appearance of 'multiple image planes' behind the array of lenslets. The

cyciic discharge of motor fibers in response to decreases in iight intensity is discussed. Stimulation experiments suggest that response is triggered by a simpie phasic dischargc in the connectives. A physioiogicai modei incorporating the resuits of these experiments is described.

2476

Stanford Research Inst., Menlo Park, Calif.

SHOCK SENSITIVITY OF LOW DENSITY GRANULAR EXPLOSIVES, by M. W. Evans, C. M. Ablow and others. [1963] [17]p. (AFOSR-J1016) (AF 49(636)-1124) AD 417663 Unclassified

Aiso publiished in Internat'l. Conf. on Sensitivity and Hazards of Explosives Research and Deveiopment Estabiishment, London (Gt. Brit.), Sept. 1-3, 1963.

The structure of shocks which initiate a detonation wave in low density granular expiosives is discussed. Measurements of shock sensitivity of ammonium perchiorate, PETN, and mixtures of the two are reported. The data are interpreted in terms of temperature of the receiver on the basis of two simpie modeis: the equilibrium temperature of a locking solid assuming complete compaction, and the temperature of the interstitiai gas at the moment the shock has entered the receiver.

2477

Stanford Research Inst., Menlo Park, Caiif.

LOCAL SEISMIC MONITORING AT SHOAL, by W. H. Westphai and G. S. Brink. Nov. 15, 1963. 16p. (Technical rept. no. 5) (AF 49(636)1205) AD 425386 Unclassified

Local seismic monitoring was initiated in the Fairview Peak region of Nevada in Juiy 1961, and was conducted at intervals until Oct. 21, 1963, five days prior to Shoal event. Since that date, continuous measurements have been made at three seismograph stations located approximately 10 km northeast, 10 km southwest, and 3.4 km west of ground zero. Preliminary evaiuation, of data accumulated through Nov. 11, indicates that the majority of these events had their epicenters in the Fairview Peak fault biock; this was true also of the majority of recorded preshot events.

2476

Stanford Research Inst., Menio Park, Caiif.

SEISMIC AFTERSHOCK INVESTIGATIONS—PROJECT VELA UNIFORM, FISK, MISSOURI, EARTHQUAKE OF 3 MARCH 1963, by A. L. Lange and W. H. Westphai. Aug. 1963, 16p. (Technical rept. no. 3) (AF 49(636)-1205) AD 414677 Unclassified

The aftershock monitoring is reported foiiowing the Fisk, Missouri, earthquake of Mar. 3, 1963 which had an instrumentaliy determined epicenter approximately 13 km southeast of Fisk, Missouri, and 27 km east of Poplar Bluff in the southeast corner of the state.

2479

Stanford Research Inst., Menio Park, Caiif.

SEISMIC AFTERSHOCK INVESTIGATIONS—PROJECT VELA UNIFORM JUAB VALLEY, UTAH, EARTHQUAKE OF 7 JULY 1963, by W. H. Westphai. Oct. 1963, 20p. (Technical rept. no. 4) (AF 49(636)1205) AD 426421 Unclassified

One proposed method of detecting and iocating the source of a clandestine underground expiosion is the monitoring of post-event seismic noises (aftershocks) produced by the expiosion. The basic premise of post-event seismic monitoring is that aftershocks from earthquakes and underground expiosions have different characteristics. The specific objectives are: (1) to determine the characteristics of earthquake and explosion-induced aftershock sequences, (2) to study the relationship of the foci of earthquake aftershocks to the focus of the primary earthquake, and (3) to improve methods of data analysis and interpretation of the resuits of aftershock monitoring.

2460

Stanford Research Inst., Menio Park, Caiif.

DIFFERENTIAL SEISMIC CALIBRATION IN ON-SITE INSPECTION, by W. H. Westphai and S. Rubin. Aug. 1963, 19p. (Technical rept. no. 1) (AF 49(636)1225) AD 414652 Unclassified

Seismic calibration of an area required the occurrence of a seismic event, either an explosion or earthquake in the vicinity of the unkonwn event at a known iocation and of sufficient size to be detectabie at severai teieseismic network stations that aiso recorded the original unknown event. The purpose of the calibration event is to determine the error of the epicenter location of an unidentified event; this error is caused by differences in the velocities of seismic waves from the source of the event to each detecting seismic station. The calibration event must be located close to the epicenter of the unknown event so that the calibration signal foiiows approximateiy the same paths as the original event signai. The calibration signai must be detect d by at ieast three different stations to caiculate a precise correction.

2461

Stanford Research Inst., Menio Park, Caiif.

SYLLABUS OF ON-SITE INSPECTION. Second edition, July 1963, 1v. (AF 49(636)1225) AD 411536 Unclassified

On-site inspection of unidentified seismic events consists of observations and measurements in a defined geographic area. It will be directed toward distinguishing between underground or underwater nuclear explosions and other seismic events. A determined violator of a nuciear test ban by cieverly conceaiing his nuciear test activities might believe he has reduced the iikelihood of identification to zero. However, so iong as an inspection is undertaken there is aiways a possibiiity that the clandestine test could be exposed.

2482

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

BUCKLING TESTS ON THIN CIRCULAR CYLINDRICAL SHELLS HEATED ALONG AN AXIAL STRIP, by B. Ross, J. Mayers, and A. Jaworski. June 1963, 63p. (SUDAER no. 163) (AFOSR-5420) (AF 49(638)223) AD 424060 Unclassified

The results of buckling tests on circular cylinders heated along axial strips are presented and discussed. Calculations of critical temperature based upon the small deflection theory for thtn circular cylindrical shells are included, and a comparison is made between theoretical and experimental results. Cylinders heated along axial strips of given widths have a theoretically predtcted behavior which corresponds reasonably well to the behavior obtained by experiment. Curves are included showing the variation of critical temperature wtth respect to heated axial strtp width.

2483

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

STUDIES IN HYPERSONIC FLOW THEORY, by M. Van Dyke. Final rept. Feb. 1963, 6p. (AFOSR-4785) (AF 49(638)965) AD 408349 Unclassifted

This study included: Effects of nose bluntness on a slender body; Flow past inclined blunt bodies; Unsteady hypersonic flow theory; Vtscous effects on blunt bodies; Irreversible processes in dilute gases; Blunt bodies at low Reynolds number; Vortical layer on an incltned cone; and Interaction of entropy and boundary layer.

2484

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A STATISTICAL INTERPRETATION OF THERMODYNAMICS OF IRREVERSIBLE PROCESSES IN DILUTE GASES, by J.-P. Gutraud. Sept. 1963, 131p. incl. refs. (SUDAER no. 169) (AFOSR-5513) (AF 49(638)-965) AD 426078 Unclassified

A simpltfted theory is proposed which fulftlls the followtng requirement: The Boltzmann equation ts not solved, even approximately, but used only to supply the mtntmum informatton requtred to compute the transport coefficients. This work ts a systematic development ortginally planned as a thorough tnvesttgatton of mixtures of polyatomic gases under the so-called dilute gas approximation, with inclusion of chemtcal kinetics, as well as an investigation of a variety of macroscopic descriptions for mixtures, of whtch, however, only the two extremes are studied.

2485

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

HYPERSONIC VISCOUS FLOW NEAR THE STAGNATION STREAMLINE OF A BLUNT BODY: I. A TEST OF LOCAL SIMILARITY, by H. C. Kao. [1964] [6]p. incl. diagr. table, refs. (AFOSR-65-0597) (AF 49(638)965) AD 613915 Unclassified

Also published tn AIAA Jour., v. 2: 1892-1897, Nov. 1964.

The flow near the stagnation streamline of a blunt body is often analyzed by using the approximation of local similarity, which reduces the equations of motion to a system of ordinary differential equations. This scheme is equivalent to truncating at 1 term a power-sertes expansion of the flow vartables from the stagnatton point, neglecting backward influence. The accuracy of such a truncation is examined in this paper. The principal assumption is that the Navier-Stokes equattons are valid. In additton, it is assumed that the validity of the first truncation can be evaluated by comparing it with the second. The conclusion is that the usual assumption of local stmilarity is remarkably accurate for predicttng flow quantities near the stagnation streamline. (Contractor's abstract)

2486

Stanford U. [Dept. of Aeroanutics and Astronautics] Calif.

HYPERSONIC VISCOUS FLOW NEAR THE STAGNATION STREAMLINE OF A BLUNT BODY: II. THIRD-ORDER BOUNDARY-LAYER THEORY AND COMPARISON WITH OTHER METHODS, by H. C. Kao. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0598) (AF 49(638)-965) AD 613916 Unclassified

Also publtshed tn AIAA Jour., v. 2: 1898-1906, Nov. 1964.

It is shown tn Part I that the assumptton of local similarity is very accurate for predicting flow quanttties near the stagnatton streamltne of a blunt body. Here that assumptton is used to calculate the third-order boundary-layer approximation in this region. The calculation is also made using viscous-layer approximation and direct integration through the shock wave. Comparisons are made to evaluate the relattve applicability of these three approaches. It ts found that third-order boundary-layer theory is valtd in the range from intermediate to very high Reynolds numbers, but fails at low Reynolds number. (Contractor's abstract, tn part)

2487

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A UNIFORMLY VALID SOLUTION FOR THE FLOW OVER AN INCLINED CONE USING THE METHOD OF

MATCHED ASYMPTOTIC EXPANSIONS, by A. G. Munson. Apr. 1964, 46p. incl. diagrs. refs. (SUDAER no. 187) (AFOSR 64-1056) (AF 49(638)1274) AD 603154 Unclassified

The problem of flow over a circular cone inclined slightly to a uniform stream is solved using the technique of matched asymptotic expansions. The outer expansion is equivalent to Stone's solution of the problem. The inner expansion, valid in a thin layer near the body, represents Ferri's vortical layer. The solution to first order in angle of attack so obtained is uniformly valid everywhere in the flow field. In the second-order expansion an additional nonuniformity appears near the leeward ray. This defect is removed by inspection. The first-order solution is in agreement with that of Cheng, Woods, Bulakh and Sapunkov. Formulas are given that may be used to render Kopal's numerical result uniformly valid to second order in angle of attack. A uniformly valid solution restricted to the hypersonic small-disturbance approximation is also given. (Contractor's abstract)

2488

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

A NUMERICAL EXPERIMENT WITH DISCRETE-VORTEX APPROXIMATION, WITH REFERENCE TO THE ROLLING UP OF A VORTEX SHEET, by H. Takami. May 1964, 26p. (AFOSR-64-1292) (AF 49-(638)1274) AD 602789 Unclassified

In view of the criticism against the idea of approximating a real vortex sheet by a row of discrete vortices in an inviscid fluid, the rolling up of a vortex sheet studied by Westwater is reexamined. By means of a simple numerical computation, it is shown that strong randomization of the vortices takes place near the tip of the sheet in contrast to Westwater's previous computation. The same approximation is applied also to some other vortex sheets of similar kind. The distribution of vortices becomes irregular in every case and the 'discrete-vortex approximation' does not seem to give a detailed picture of the behavior of the original continuous sheet. The equations of motion of vortices is seen to be unstable with respect to the initial data.

2489

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A GENERALIZED METHOD FOR TREATING SINGULAR PERTURBATION PROBLEMS, by A. H. Nayfeh. June 1964, 55p. incl. refs. (SUDAER no. 193) (AFOSR-64-1306) (AF 49(638)1274) AD 606083 Unclassified

Some of the existing methods of treating singular perturbation problems are studied, and a generalized method for solving such problems is developed. The generalized method was applied to a restricted three-body problem and to a general second-order linear ordinary differential equation with a turning point of arbitrary order. The results of the latter are used in obtaining the asymptotic expansions of the eigenvalues and eigenfunctions of a second-order linear equation with two turning points of arbitrary order. A special case of the eigenvalue problem is the Graetz problem. It arises in finding the temperature distribution of a fluid with constant properties having a parabolic velocity profile which enters suddenly into a round tube whose wall is kept at a different constant temperature. (Contractor's abstract)

2490

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE CIRCLE AT LOW REYNOLDS NUMBER AS A TEST OF THE METHOD OF SERIES TRUNCATION, by M. Van Dyke. Oct. 1964, 14p. incl. diagrs. refs. (SUDAER no. 211) (AFOSR-64-1832) (AF 49(638)1274) AD 612411 Unclassified

A semi-analytical scheme of successive approximations is described for treating elliptic differential equations. As an extreme test of the method, it is applied to incompressible viscous flow past a circular cylinder. For the Oseen equations the first approximation is found analytically and the second numerically. The results for drag and eddy formation appear to approach the true solution satisfactorily. For the Navier-Stokes equations only the first approximation was calculated, giving drag that agrees only qualitatively with experiment. (Contractor's abstract)

2491

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

INTERACTION OF THE ENTROPY AND BOUNDARY LAYERS ON A BLUNTED WEDGE, by S. Nadir. Dec. 1964, 110p. (SUDAER no. 212) (AFOSR-65-0057) (AF 49(638)1274) AD 464830 Unclassified

A systematic analytical study is made of the interaction of the entropy layer and the laminar boundary layer over a certain blunted semi-infinite wedge in hypersonic viscous flow. The analysis is carried out by constructing the asymptotic solution of the exact problem in the double limit of large Reynolds number and of large distance downstream compared with the nose radius. The resulting singular perturbation problem involving the entropy and boundary layers as the regions of nonuniformity, is treated by the method of matched asymptotic expansions. The asymptotic solution for the limit of large Reynolds number is carried to second order. This comprises the basic inviscid flow, the first-order boundary layer, the flow due to the displacement thickness of the first-order boundary layer, and the second-order boundary layer.

2492

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE INTERACTION OF TURBULENCE WITH RAPID UNIFORM SHEAR, by H. K. Moffatt. Aug. 1965, 41p. (SUDAER no. 242) (AFOSR-65-1795) (AF 49(638)1274) AD 628298 Unclassified

The linear inviscid response of an initially weak random velocity perturbation to a uniform shearing motion is analyzed, first in terms of the individual Fourier components of the perturbation field, then in terms of the development of its spectrum tensor. This analysis reveals that the dominant contribution, both to the disturbance energy and to the Reynolds stress generated comes ultimately from eddies having a cylindrical structure, the axes of the cylinders being parallel to the shear force. The results are relevant to two aspects of turbulent shear flow: (1) the equilibrium structure of a small turbulent 'parcel' of fluid subjected to persistent almost uniform shear, and (2) the structure of the 'large eddies' which derive their energy directly from the shearing of the mean flow.

2493

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

A NON-LINEAR MODEL STUDY OF THE THERMAL BUCKLING OF THIN ELASTIC SHELLS, by N. J. Hoff. Nov. 1963, 22p. incl. diagrs. (SUDAER no. 173) (AFOSR-64-0888) (AF 49(638)1276) Unclassified

Analysis of the simple model proposed yields equilibrium curves in agreement with those obtained by other investigators for axially compressed thin-walled circular cylindrical shells. A rigorous calculation of the stability of the equtlibrium of the model indicates that the snap-through phenomenon can be entirely absent when an imperfect shell is heated in a perfectly rigid testing machine. When the testing machine is sufficiently elastic, snap through will occur. (Contractor's abstract, in part)

2494

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE EFFECT OF RESTRICTING BUCKLE DEPTH IN CIRCULAR CYLINDRICAL SHELLS REPEATEDLY COMPRESSED TO THE BUCKLING LIMIT, by W. H. Horton and S. C. Durham. Nov. 1963 [15]p incl. illus. diagrs. tables. (SUDAER no. 174) (AFOSR-64-0889) (AF 49(638)1276) AD 432763 Unclassified

The reduction in critical buckling load for a thin-walled cylindrical shell which occurs under repeated compression is a function of the depth to which the buckle is permitted to develop. It shows that a nickel cylinder whose R/t is of the order of 400 does not experience any load reduction on repeated load when the buckle depth never exceeds the thickness of the shell, and that buckle depths which are equal to or greater than 2.5t give the same results as are obtained in unrestricted buckling. It proves, too, that by using the method of buckle restriction it is possible to cause a cylindrical shell to buckle uniformly over its entire length. (Contractor's abstract)

2495

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

REPEATED BUCKLING OF CIRCULAR CYLINDRICAL SHELLS AND CONICAL FRUSTA BY AXIAL COMPRESSIVE FORCES, by W. H. Horton and S. C. Durham. Nov. 1963, 19p. incl. illus. diagrs. tables. (SUDAER no. 175) (AFOSR-64-0890) (AF 49(638)1276) AD 439013 Unclassified

The results are reported of a series of tests made to determine the buckling behavior of circular cylinders and conical shells under repeated axial compression. It is shown that if the only restriction placed on buckle depth is that buckle development is such that no permanent gross strain results after load removal, then the buckle load progressively falls with repeated application until a constant lower bound is reached. This effect is considered to be due to the formation of plastic hinges along the edges of the buckles.

2496

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

BUCKLING OF AXIALLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS AT STRESSES SMALLER THAN THE CLASSICAL CRITICAL VALUE, by N. J. Hoff and L. W. Rehfield. May 1964, 27p. incl. diagrs. (SUDAER no. 191) (AFOSR-64-1037) (AF 49(638)1276) AD 603153 Unclassified

Closed-form solutions are given of the linear Donnell equations defining the buckling of thin-walled circular cylindrical shells subjected to uniform axial compression. In addition to the classical simple support conditions requiring the vanishing of the radial displacement, the axial bending moment resultant, the axial additional stress and the circumferential displacement, three other, equally justifiable, simple support conditions are defined and studied in the case of the semi-infinite shell. Two of them yield buckling stresses amounting to about one-half the classical critical stress.

2497

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

LOW BUCKLING STRESSES OF AXIALLY COMPRESSED CIRCULAR CYLINDRICAL SHELLS OF FINITE LENGTH, by N. J. Hoff. July 1964, 37p. incl. diagrs. (SUDAER no. 192) (AFOSR-64-1317) (AF 49-(638)1276) AD 614928 Unclassified

Exact solutions are derived for the classical differential equations defining the deformations of axially compressed thin-walled circular cylindrical shells. The end conditions along the circular edges are assumed as the vanishing of (1) the radial displacement; (2) the longitudinal bending moment; (3) the variation in the axial normal stress, and (4) the circumferential membrane shear stress. Under these conditions of simple support the critical value of the uniformly distributed axial normal stress is one-half the classical critical value. (Contractor's abstract)

2498

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

THE EFFECT OF THE EDGE CONDITIONS ON THE BUCKLING OF THIN-WALLED CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION, by N. J. Hoff. Aug. 1964, 23p. (SUDAER no. 205) (AFOSR-64-1724) (AF 49(638)1276) AD 608203 Unclassified

Presented at Eleventh Internat'l. Cong. of Applied Mechanics, Munich (Germany), Aug. 30-Sept. 5, 1964.

A summary is presented of recent closed-form as well as numerical solutions of the buckling problem of thin-walled circular cylindrical shells subjected to uniform axial compression. The ratio of the critical stress to the classical value of the critical stress has been calculated for nine different combinations of boundary conditions. The minimal values of theling stress ratios are for rigid end fixation and 0.5 for simple supports, while in the case of free ends the buckling stress ratio can be very small. The large effect on the buckling stress of small changes in the boundary conditions is proposed as one of the reasons for the large scatter in the results of buckling experiments.

2499

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

BUCKLING OF CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION, by N. J. Hoff and T.-C. Soong. Aug. 1964, 78p. (SUDAER no. 204) (AFOSR-64-1725) (AF 49(638)1276) AD 608204 Unclassified

The buckling stress of axially compressed thin-walled circular cylindrical shells of finite length is derived from the classical small-deflection equations for nine possible combinations of edge support conditions. It turns out that the effect upon the critical stress of the length-to-diameter ratio of the shell is small except in some cases when the shell is very short. On the other hand, changes in the details of the edge support can lead to reduction factors of 1/2 or less to be applied to the classical value of the critical stress.

2500

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

AUTOMATED DERIVATION AND INTEGER REPRESENTATION OF TOTAL POTENTIAL DIFFERENTIAL EQUATION EXPANSIONS FOR ASSUMED TRIGONOMETRIC SERIES WITH AN APPLICATION TO THE POST-BUCKLING BEHAVIOR OF CIRCULAR CYLINDRICAL SHELLS, by W. A. Madsen, L. B. Smith, and N. J. Hoff. July 1964, 63p. (SUDAER no. 201) (AFOSR-64-1726) (AF 49(638)1276) AD 608205 Unclassified

In this paper, algorithms are presented for deriving a set of nonlinear algebraic equations with the aid of a digital computer. The equations are then stored by means of an integer representation. A Newton-Raphson algorithm for solving the integerform equations is also presented. The method is illustrated by re-deriving the solution for post-buckling behavior of thin-walled circular cylindrical shells under axial compression. The time required for computations is short; with a Burroughs B5000 computer the total potential expression was derived in approximately two minutes; and the major stable portion of the load-shortening curve was found in ten minutes.

2501

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

LINEARIZED THEORY OF TWO-DIMENSIONAL RADIATING GAS FLOW BY A MOMENT METHOD, by P. Cheng. Apr. 1964, 12p. (SUDAER no. 188) (AFOSR-64-1002) (AF 49(638)1280) AD 602684 Unclassified

The author first lists the hydrodynamic equations for the three-dimensional time-dependent flow. This is followed by a discussion of the approximate radiation-transport equations. Finally, the linearized equations for two-dimensional steady flow are obtained.

2502

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

TWO-DIMENSIONAL RADIATING GAS FLOW BY A MOMENT METHOD, by P. Cheng. [1964] [3]p. incl. refs. (AFOSR-65-0029) (AF 49(638)1280) AD 611345 Unclassified

Also published in AIAA Jour., v. 2: 1662-1664, Sept. 1964.

Since the governing equations for multidimensional radiating gas flow are of a complicated integro-differential form, no reasonably simple solutions exist which are valid for the whole range of optical thickness. The problem is especially acute for multidimensional flow problems. Using a scheme of approximation known as the moment method, a system of differential equations

has been obtained for one-dimensional flow problems. In this note the technique is applied to multidimensional radiating-gas-flow problems. Hydrodynamic equations for three-dimensional time dependent flow are given, and the exact transport equation is approximated by a finite number of moment equations.

2503

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

STAGNATION EQUILIBRIUM LAYER IN NONEQUILIBRIUM BLUNT-BODY FLOWS, by R. J. Conti. [1964] [3]p. incl. diagrs. (AFOSR-65-0277) (AF 49-(638)1290) AD 611347 Unclassified

Also published in AIAA Jour., v. 2: 2044-2046, Nov. 1964.

In 1962, Swigart introduced a novel technique for analyzing inviscid perfect gas flows over blunt-bodies in hypersonic flight. The present investigation makes use of this technique to study nonequilibrium flows, and in this paper attention is drawn to the equilibrium layer that exists near the body.

2504

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

[THERMAL HEATING OF THIN-WALLED CIRCULAR CYLINDRICAL SHELLS] Flambement thermique des coques cylindriques circulaires á parois minces, by N. J. Hoff. [1964] [28]p. incl. illus. diagrs. refs. (AF AFOSR-62-146) Unclassified

Published in High Temperatures in Aeronautics; Proc. Symposium held in Turin to celebrate the 50th anniversary of the Laboratorio di Aeronautica, Politecnico di Torino (Italy) (Sept. 10-12, 1962), ed. by C. Ferrari. Milano, Tamburini Editore, 1964, p. 315-342.

The thermal buckling of thin-walled circular cylindrical shells is studied in 3 principal sections. In the first section the possibility of buckling action is examined under one gradient temperature across a surface. The second section describes the buckling caused by heat-treatment of one axial gradient, and the third section describes the buckling caused by one azimuthal gradient. The results from the experiments are compared to the theories.

2505

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

LIFTING-LINE THEORY AS A SINGULAR PERTURBATION PROBLEM, by M. Van Dyke. [1964] [14]p. incl. diagrs. refs. (SUDAER no. 165) (AFOSR-5343) (AF AFOSR-63-96) AD 426471 Unclassified

Also published in Archiwum Mechaniki Stosowanej, v. 3: 601-614, 1964.

The method of matched asymptotic expansions, recently developed for treating singular-perturbation problems, is applied to the flat unswept lifting wing of high aspect ratio. This yields a simplified equivalent of Prandtl's lifting-line theory, with the solution of an integral equation replaced by quadratures. The next approximation is calculated in general terms. Specific application is made to cusped, lenticular, elliptic, and rectangular planforms, and comparison drawn where possible with previous work. Additional non-uniformities at tips and other discontinuities are described, and procedures outlined for their correction.

2506

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

HIGHER APPROXIMATIONS IN BOUNDARY-LAYER THEORY, PART 3. PARABOLA IN UNIFORM STREAM, by M. Van Dyke. [1964] [15]p. (AFOSR-64-1940) (AF AFOSR-63-96) AD 450321 Unclassified

Also published in Jour. Fluid Mech., v. 19: 145-149, 1964.

The classical laminar boundary layer on a parabolic cylinder is calculated using the Blasius series, with modifications to improve convergence, and supplemented by an asymptotic expansion valid far downstream from the nose. The flow due to displacement thickness is thereby found with sufficient accuracy to permit evaluation of its second-order effect upon the boundary layer near the stagnation point. The skin friction and heat transfer are found to be reduced there by both displacement and curvature.

2507

Stanford U. Dept. of Aeronautics and Astronautics, Calif.

THE VORTICAL LAYER ON AN INCLINED CONE, by A. G. Munson. [1964] [19]p. incl. diagrs. refs. (AFOSR-65-0920) (AF AFOSR-63-96) AD 616204 Unclassified

Also published in Jour. Fluid Mech., v. 20: 625-643, 1964.

The problem of flow over a circular cone inclined slightly to a uniform stream is solved using the technique of matched asymptotic expansions. The outer expansion is equivalent to Stone's solution of the problem. The inner expansion, valid in a thin layer near the body, represents Ferri's vortical layer. The solution to first order in angle of attack so obtained is uniformly valid everywhere in the flow field. In the second-order expansion an additional non-uniformity appears near the leeward ray. This defect is removed by inspection. The first-order solution is in agreement with

that of Cheng, Woods, Bulakh and Sapunkov. Formulas are given that may be used to render Kopal's numerical result uniformly valid to second order in angle of attack.

2508

Stanford U. [Dept. of Aeronautics and Astronautics] Calif.

A METHOD OF DATA ACQUISITION AND SYSTEM CONTROL THROUGH TIME SHARING OF MIXED INPUTS, by B. Brentnall and W. H. Horton. Feb. 1963, 33p. (SUDAER no. 147) (AFOSR-5094) (AF AFOSR-63-138) AD 405931 Unclassified

In recent years, the demand for more versatile, remotely readable measuring devices has caused us to progress, for example, from the simple mechanical extensometer to the electrical resistance wire gage and from the purely mechanical dial gage to the variable differential transformer pick up. Instruments of this type—transducers—have a common property, viz., they transform some particular physical behavior into an electrical signal or change thereof.

2509

Stanford U. [Dept. of Biological Sciences] Calif.

ELECTRICAL RESPONSES FROM DUALLY INNERVATED TACTILE RECEPTORS ON THE THORAX OF THE CRAYFISH, by D. Mellon, Jr. [1963] [12]p. (AFOSR-64-0542) (AF AFOSR-62-147) AD 436163 Unclassified

Also published in Jour. Exper. Biol., v. 40: 137-148, 1963.

Electrophysiological recordings have been obtained from tactile receptors which occur in shallow pits on the crayfish carapace. Controlled mechanical stimulation has established that each receptor is innervated by a pair of sensory neurons. One of these neurons responds when the receptor is moved anteriorly, and the partner cell responds to displacement in the opposite direction. The receptors are sensitive to motion of the fluid medium in which they are immersed, and they may provide the animal with a means for determining the speed and direction of water currents.

2510

Stanford U. [Dept. of Biological Sciences] Calif.

SOMA POTENTIALS AND MODES OF ACTIVATION OF CRAYFISH MOTONEURONS, by K. Takeda and D. Kennedy. [1964] [17]p. (AFOSR-65-0046) (AF AFOSR-62-147) AD 455020 Unclassified

Also published in Jour. Cellular and Compar. Physiol., v. 64: 165-181, Oct. 1964.

The modes of activation of efferent neurons which innervate flexor muscles through the third root of the third abdominal ganglion have been studied by dual penetration of their somata. In the 'motor giant' neuron there is normally only passive electrotonic spread of impulses into the soma from distant active areas in the axon, and the polarization of the soma membrane does not affect the events in the root axon. The somata of monopolar non-giant neurons which supply axons to one third root are found on both sides of the third ganglion, and also in the fourth ganglion on the heterolateral side to the root of exit. The action potential recorded in these somata shows three components. One is associated with invasion toward the soma, a second corresponds to the impulse in the main axon and the third represents activity in axon branches which are the site of the presynaptic endings.

2511

Stanford U. [Dept. of Biological Sciences] Calif.

RECEPTIVE FIELD ORGANIZATION AND RESPONSE PATTERNS IN NEURONS WITH SPATIALLY DISTRIBUTED INPUT, by D. Kennedy and D. Mellon, Jr. [1964] [14]p. incl. refs. (AFOSR-65-0299) (AF AFOSR-63-334) AD 611997 Unclassified

Also published in Proc. 1962 Ojai Symposium on Neural Theory and Modeling, Calif. (Dec. 4-6, 1962), 1964, p. 400-413.

The majority of central interneurons which respond to tactile stimulation of the dorsal abdomen in crayfish serve more than one abdominal segment; a given sensory field is thus represented many times centrally but in varying combinations with other fields. The usual pattern of peripheral connection with these multisegmental interneurons is one in which incoming afferent fibers in each ganglion synapse in the segment of entry with the interneuron, but also pass anteriorly for one or more segments and make accessory synaptic contacts with the same interneuron in other ganglia. Such accessory conenections are also sometimes made in the posterior direction, but they are always weaker. The receptive field of the interneurons is therefore capable of broad summation, but it is at the same time fractionated into segmental subareas which have local entry to the interneuron and hence short reflex delays.

2512

Stanford U. Dept. of Biological Sciences, Calif.

INTRACELLULAR RECORDING FROM PHOTORECEPTOR NEURONS IN THE EYES OF A NUDIBRANCH MOLLUSC (HERMISSENDA CRASSICORNIS), by J. Barth. [1964] [6]p. (AFOSR-65-0300) (AF AFOSR-63-334) AD 612244 Unclassified

Also published in Compar. Biochem. and Physiol., v. 11: 311-315, 1964.

Intracellular records obtained from retinal neurons of nudibranch eyes show both excitation and inhibition of impulse discharge upon appropriate photic stimulation, as well as the slow potential changes associated with these events. Evidence is presented that the action potentials originate at some distance from the soma and

do not invade it in a retrograde fashion. The presence of synaptic inhibition is demonstrated, but the additional phenomenon of primary inhibition observed in other molluscs has not been established. (Contractor's abstract)

2513

Stanford U. Dept. of Chemistry, Calif.

THERMODYNAMIC PROPERTIES OF NONPOLAR MIXTURES OF SMALL MOLECULES, by P. J. Flory and A. Abe. [1964] [3]p. incl. tables. (AFOSR-64-2199) (AF 49(638)1341) AD 452348 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3563-3565, Sept. 5, 1964.

The treatment of n-paraffin hydrocarbons and their mixtures presented in Jour. Amer. Chem. Soc., v. 86: 3507 and 3515, 1964, can be recast in a form which appears to be generally applicable to liquid solutions, irrespective of the size and shape of the molecular species provided that they are not hydrogen bonded or highly polar. Here, a preliminary comparison is made of theory with experiment for several representative binary mixtures of small, approximately spherical molecules.

2514

Stanford U. [Dept. of Chemistry] Calif.

FACTORS INVOLVED IN THE STABILITY OF CYCLOPROPANES, by R. H. Eastman. Final technical rept. Oct. 1, 1961-Sept. 30, 1963 [15]p. (AFOSR-64-0843) (AF AFOSR-62-116) AD 438396 Unclassified

The following dissertations are summarized: A study of electronic effects on a ring-chain equilibrium; Evidence against conjugation effects in phenylcyclopropanes; and Valence bond isomerization in the bicyclo (3.1.0) hexene series.

2515

Stanford U. [Dept. of Chemistry] Calif.

CONJUGATION EFFECTS IN PHENYLCYCLOPROPANES, by A. L. Goodman and R. H. Eastman. [1964] [4]p. (AFOSR-64-0934) (AF AFOSR-62-116) AD 439976 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 908-911, 1964.

The ultraviolet absorption spectrum of phenylcyclopropane has previously been interpreted as evidence that the cyclopropane ring electrons interact with those of the benzene ring to form a conjugated system. It has now been shown, using rigid model compounds, that the steric relationship between the cyclopropane and benzene rings is of little consequence spectroscopically.

2516

Stanford U. Dept. of Chemistry, Calif.

CONFIGURATION OF THE POLY-(DIMETHYLSILOXANE) CHAIN. I. THE TEMPERATURE COEFFICIENT OF THE UNPERTURBED EXTENSION, by J. E. Mark and P. J. Flory. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-1492, pt. 1) (AF AFOSR-62-131) AD 445929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 138-141, Jan. 20, 1964.

The temperature coefficient $d \ln \langle r^2 \rangle_0 / dT$ of the unperturbed mean-square end-to-end distance for poly-(dimethylsiloxane) calculated from precise determinations of stress-temperature coefficients for cross-linked networks is 0.78 (± 0.06) x 10^{-3} deg^{-1}. According to the change of the intrinsic viscosity with temperature, determined on athermal solutions of the linear polymer in a low molecular weight dimethylsiloxane fluid, $d \ln \langle r^2 \rangle_0 / dT$ = 0.71 (± 0.13) x 10^{-3} deg^{-1}, in good agreement with the former value. (Contractor's abstract)

2517

Stanford U. Dept. of Chemistry, Calif.

CONFIGURATION OF THE POLY-(DIMETHYLSILOXANE) CHAIN. II. UNPERTURBED DIMENSIONS AND SPECIFIC SOLVENT EFFECTS, by V. Crescenzi and P. J. Flory. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-1492, pt. 2) (AF AFOSR-62-131) AD 445929 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 141-146, Jan. 20, 1964.

Intrinsic viscosities of poly-(dimethylsiloxane) fractions, M = 0.55 to 1.2 x 10^6, have been determined at the θ-point in two solvents: (1) methyl ethyl ketone at 20° and (2) a 1:2 mixture of C_8F_{18} and $CCl_2F \cdot CCl_2F$ at 22.5°. In (1), $[\eta]_\theta / M^{1/2}$ = 7.8 x 10^{-4} (with $[\eta]_\theta$ in dl g^{-1}) in close agreement with previous results in other solvents which, like (1), have cohesive energy densities (CED) exceeding that of the polymer. In (2), for which the CED is less than for the polymer, $[\eta]_\theta / M^{1/2}$ = 10.6 x 10^{-4}. The ratios $\langle r^2 \rangle_0 / nl^2$ deduced from these results are 6.3 and 7.7 compared with 3.3 calculated for free rotation. (Contractor's abstract)

2518

Stanford U. Dept. of Chemistry, Calif.

CONFIGURATION OF THE POLY-(DIMETHYLSILOXANE) CHAIN. III. CORRELATION OF THEORY AND EXPERIMENT, by P. J. Flory, V. Crescenzi, and J. E. Mark. [1964] [7]p. incl. diagrs. table, refs. (AFOSR-64-1492, pt. 3) (AF AFOSR-62-131) AD 445929 Unclassified

Also publtshed tn Jour. Amer. Chem. Soc., v. 86: 146-152, Jan. 20, 1964.

The characteristic ratio $\langle r^2 \rangle_0 / nl^2$ for poly-(dimethylsiloxane) has been calculated by Ising lattice methods ustng the trans-gauche rotational isomeric state model as a convenient device for introducing various bond conformations with appropriate statistical weights. Steric interactions between nonbonded atoms must exclude successive gauche rotations of opposite sign for the pair of bonds on etther side of a stlicon atom; coulombic repulsions of O atoms may largely suppress the similar conformation about O. Bond rotations cannot, therefore, be treated as independent. These inferences from the structure of the siloxane chain are confirmed by experimental values of the charactertstic ratio.

2519

Stanford U. [Dept. of Chemtstry] Calif.

THE TEMPERATURE COEFFICIENT OF THE POLYDIMETHYLSILOXANE CHAIN CONFIGURATION FROM SWELLING EQUILIBRIUM MEASUREMENTS, by J. E. Mark. [1964] [4]p. (AFOSR-64-1494) (AF AFOSR-62-131) AD 445931 Unclassified

Also publtshed in Jour. Phys. Chem., v. 68: 1092-1095, May 1964.

The temperature dependence of the degree of swelling of polydimethylsiloxane (PDMS) networks in equilibrium with an athermal solvent is used to determine the temperature coefficient of the unperturbed dimensions of the polymer chains comprising the network.

2520

Stanford U. Dept. of Chemistry, Calif.

THE CRYSTALLIZATION OF POLYMETHYLENE COPOLYMERS: MORPHOLOGY, by J. B. Jackson and P. J. Flory. [1964] [3]p. (AFOSR-64-1797) (AF AFOSR-62-131) AD 449256 Unclassified

Also published in Polymer, v. 5: 159-161, 1964.

The morphology of a series of melt-crystallized, random copolymers of CH_2 units with small mole percentages of CHR co-units, where R = nC_3H_7 or CH_3, was investigated. At concentrations greater than 2% $n\text{-}C_3H_7$ and 5.9% CH_3 co-unit, spherulites characteristic of the homopolymer are not evident even at 450 X magnification under the polarizing microscope. The absence of spherulites is attributed to the growth of crystallites in whtch a given copolymer chain may participate only once, leading to a suppression of lamellar crystal growth. (Contractor's abstract)

2521

Stanford U. Dept. of Chemistry, Calif.

THE CONFIGURATION OF THE POLYOXYMETHYLENE CHAIN, by P. J. Flory and J. E. Mark. [1964] [11]p. (AFOSR-64-1798) (AF AFOSR-62-131) AD 449073 Unclassified

Also published in Die Makromolekulare Chemie, v. 75: 11-21, 1964.

The polyoxymethylene chain (POM) is discussed in terms of trans and gauche rotational states and is compared with polyethylene (PE) and poly-(dimethylsiloxane) (PDMS). Examination of distances between non-bonded atoms and groups in various conformations suggests dispersion interactions between O and CH_2 as being primarily responsible for preference for the gauche states; coulombic interactions also favor the gauche conformation, but should be comparatively small. Gauche rotations of opposite sign in the pair of bonds adjoining a CH_2 group are effectively precluded by steric interactions of CH_2 groups separated by four bonds.

2522

Stanford U. Dept. of Chemistry, Calif.

STATISTICAL THERMODYNAMICS OF CHAIN MOLECULE LIQUIDS. I. AN EQUATION OF STATE FOR NORMAL PARAFFIN HYDROCARBONS, by P. J. Flory, R. A. Orwoll, and A. Vrij. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-2190) (AF AFOSR-62-131) AD 452369 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3507-3514, Sept. 5, 1964.

A partition function is formulated for chain molecule ltquids using a model consisttng of a linear sequence of segments endowed with hard sphere type repulsive potentials and soft attractions of unspecifted character. The intermolecular energy is represented as varying inversely with the volume over the comparatively small range of volume of the liquid. Account is taken of intermolecular constraints on the segments by expressing the number of external degrees of freedom per segment as 3c where c (< 1) enters as a parameter. In this respect the formulation follows recent treatments based on the cell model, use of whtch is avoided. A reduced equation of state $\tilde{p} = \tilde{p}(\tilde{T}, \tilde{v})$ is derived. (Contractor's abstract, in part)

2523

Stanford U. Dept. of Chemistry, Calif.

STATISTICAL THERMODYNAMICS OF CHAIN MOLECULE LIQUIDS. II. LIQUID MIXTURES OF NORMAL PARAFFIN HYDROCARBONS, by P. J. Flory, R. A. Orwoll, and A. Vrij. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-64-2191) (AF AFOSR-62-131) AD 452369 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 3515-3520, Sept. 5, 1964.

The partition function and equation of state of the preceding paper are reformulated for mixtures of homologous chain molecules. Thermodynamic properties of mixtures of n-alkanes are interpreted according to relationships thus derived. The excess volumes, always negative for these systems, are readily interpolated from the volumes of the pure components with the aid of the reduced equation of state. This scheme is formally equivalent to the Brønsted principle of congruence as it applies to the volume.

2524

Stanford U. Dept. of Electrical Engineering, Calif.

FREQUENCY TRANSLATION OF AN He-Ne LASER'S OUTPUT FREQUENCY BY ACOUSTIC OUTPUT COUPLING INSIDE THE RESONANT CAVITY, by A. E. Siegman, C. F. Quate and others. [1964] [2]p. incl. diagr. (AFOSR-65-0107) (AF AFOSR-63-323)
AD 455981 Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 1-2, July 1, 1964.

The effectiveness of phonon scattering of a laser beam has been greatly increased by placing the scattering medium inside a laser resonant cavity. This technique makes separate but coherently related beams available at 3 different frequencies, from a single laser. If required, nearly full intensity can be obtained in the secondary beams. The modulating frequency is unrestricted by the laser cavity bandwidth or the atomic linewidth. A He-Ne laser at 6328A and a beam mc/sec phonon in a quartz bar were used.

2525

Stanford U. Dept. of Mathematics, Calif.

ESTIMATES FOR THE TRANSFINITE DIAMETER OF A CONTINUUM, by E. Reich and M. Schiffer. [1964] [16]p. (AFOSR-65-1399) (AF 49(638)1345)
AD 621352 Unclassified

Also published in Math. Zeitschr., v. 85: 91-106, 1964.

Some estimates for the transfinite diameter of a continuum are derived in terms of elementary geometric quantities connected with it. The main intention is methodological. Variational methods are applied, and the corresponding extremum continua are described by a functional differential equation. In all cases the determination of the extremum continuum is based on rather simple geometric arguments. It is intended that the arguments used should indicate more general methods of solution which could be applied in the calculus of variations for conformal mappings.

2526

Stanford U. Dept. of Mechanical Engineering, Calif.

A LITERATURE REVIEW ON SUBSONIC FREE TURBULENT SHEAR FLOW, by R. M. Halleen. Apr. 1964, 102p. incl. diagrs. tables, refs. (Rept. no. MD-11) (AFOSR-5444) (AF 49(638)1278) AD 606758 Unclassified

Solutions, for both two-dimensional flow and three-dimensional axially symmetric flow, are reviewed for the three major free turbulent shear flow topics: the turbulent shear layer, the turbulent wake, and the turbulent jet. Several models for the turbulent shear stress were used in some of these solutions. The solutions are compiled in consistent nomenclature and compared. For each of the three topics, the defining partial differential equations for the particular turbulent shear stress models and geometric conditions are given, followed by the transformation of the variables utilized in obtaining a solvable differential equation. Finally, the solution is presented. Experimental mean velocity profile data for each condition are correlated and reduced to a single curve using the least squares curve fitting technique. A table of coordinates for each curve is given, including the standard deviation from the mean. Other experimental information is also tabulated.

2527

Stanford U. Dept. of Mechanical Engineering, Calif.

ON THE SIGNS OF ONSAGER'S RECIPROCITY RELATIONS IN IRREVERSIBLE THERMODYNAMICS, by D. H. Gage and S. J. Kline. Mar. 1964, 11p. (Rept. no. IT-1) (AFOSR-64-1880) (AF 49(638)1278)
AD 607377 Unclassified

The conventional presentation of Onsager's reciprocity relations specifies that the appropriate "flows and forces" used in the rate equations for irreversible, coupled processes are obtained from an arbitrary factorization of the entropy production expression. Closer examination shows that arbitrary selection of "flows", or dependent quantities, in the rate equations leads to an ambiguity of sign in Onsager's relations. For a system with n independent, coupled, irreversible processes, a proof is given that only two of the possible 2^n sets of rate equations obtained by arbitrarily factoring the entropy production expression completely obey $L_{ij} = L_{ji}$. The remaining $2^n - 2$ possible sets of rate equations will have at least one pair of coefficients which will obey the antisymmetric relation $L_{ij} = L_{ji}$. (Contractor's abstract)

2528

Stanford U. Dept. of Mechanical Engineering, Calif.

AN EXPERIMENTAL INVESTIGATION OF THE FLOW STRUCTURE OF THE TURBULENT BOUNDARY LAYER, by P. W. Runstadler, S. J. Kline, and W. C. Reynolds. June 1963, 308p. incl. illus. diagrs. tables, refs. (Rept. no. MD-8) (AFOSR-5241) (AF AFOSR-63-136)
AD 421683 Unclassified

A combination of visual and quantitative measurements is presented, providing a physical picture of the turbulent boundary layer flow structure on a flat plate. The flow structure is shown to consist of three zones; each zone has a one to one correspondence to the well known regions of the u^+, y^+ mean velocity profile. A wall layer region is shown to exist below $y^+ = 10$. An entirely new result of the investigation is the delineation of the structure of the wall layer region. This region is shown to contain a relatively regular structure of low and high velocity fluid streaks alternating in the span direction, together with the ejection of low momentum fluid into the outer flow.

2529

Stanford U. [Dept. of Physics] Calif.

CONSEQUENCES OF A WEAK VECTOR BOSON FOR THE DECAY K MESON TO MUON PLUS NUTRINO PLUS PHOTON, by E. S. Ginsberg and R. H. Pratt. [1963] [3]p. (AFOSR-J852) (AF 49(638)388) AD 416464 Unclassified

Also published in Phys. Rev., v. 130: 2105-2109, June 1, 1963.

Consequences of an intermediate vector boson, with arbitrary anomalous magnetic and quadrupole moments, have been investigated for the decay K meson to muon plus nutrino plus photon. The results of a numerical calculation indicate that such a boson will have observable effects if its mass is not too great. Emission of photons at large backward angles with respect to energetic muons is significantly enhanced. Emission of high-energy photons at small forward angles is suppressed. The dependence of these effects on the mass and magnetic moment of the boson is discussed. Photon polarization phenomena are noted.

2530

Stanford U. Dept. of Physics, Calif.

COULOMB GREEN'S FUNCTION IN CLOSED FORM, by L. Hostler and R. H. Pratt. [1963] [2]p. (AFOSR-J967) (AF 49(638)388) AD 417146 Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 469-470, June 1, 1963.

An expression in closed form for the nonrelativistic Coulomb Green's function has been obtained. Knowing the form of this expression, there is a simple derivation of the Green's function and some further results are summarized.

2531

Stanford U. [Dept. of Physics] Calif.

INELASTIC ELECTRON SCATTERING FROM NUCLEI AND SINGLE-PARTICLE EXCITATIONS, by W. Czyz. [1963] [8]p. (AFOSR-J1241) (AF 49(638)388) AD 424324 Unclassified

Also published in Phys. Rev., v. 131: 2141-2148, Sept. 1, 1963.

Arguments are presented that the single-particle excitations in nuclei induced by inelastically scattered electrons dominate the inelastic cross section in large domains of the momentum transfer (q) and the energy loss (ω). The sum rules for fixed q and ω are derived which include the transverse electron-nucleus interactions to order q^2/M^2 (M being the nucleon mass). The results of the calculations of the inelastic cross section for Cl_2 at θ 135° are discussed and compared with experimental data.

2532

Stanford U. [Dept. of Physics] Calif.

BARYON-BARYON INTERACTIONS AND THE EIGHTFOLD WAY, by R. J. Oakes. [1963] [3]p. (AFOSR-J1435) (AF 49(638)388) AD 427708 Unclassified

Also published in Phys. Rev., v. 131: 2239-2241, Sept. 1, 1963.

The deuteron is shown to belong to a ten-dimensional irreducible representation of the group SU(3) in the symmetry scheme called the eightfold way. The baryon-baryon states, which together with the deuteron comprise this supermultiplet, are studied. Data are discussed which favor the existence of some of these states, and the masses of the remaining states are estimated.

2533

Stanford U. Dept. of Physics, Calif.

SU(4) MASS FORMULA, by R. J. Oakes and D. Speiser. [1964] [3]p. (AFOSR-64-2549) (AF 49(638)1389) AD 453884 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 579-581, Nov. 1964.

The mass formula is given for an arbitrary representation of SU(4) based on the assumption that the mass splittings transform like a component of the 15. This general result is greatly simplified by using different SU(3) subgroups of SU(4). To emphasize the general usefulness of the various subgroups, the electromagnetic properties in SU(4) are briefly discussed also.

2534

Stanford U. Dept. of Physics, Calif.

TABLES OF CLEBSCH-GORDAN COEFFICIENTS, OF SU_3, by P. McNamee and F. Chilton. [1964] [20]p. incl. tables. (AFOSR-65-0130) (AF 49(638)1389) AD 455707 Unclassified

Also published in Rev. Mod. Phys., v. 36: 1005-1024, Oct. 1964.

The Clebsch-Gordan coefficients are listed for the

decomposition of $|N, Y, I, I_3\rangle$ into $|n, y, i, i_3\rangle \otimes |n', y', i', i_3'\rangle$. N ranges from 1 to 64.

2535

Stanford U. [Dept. of Physics] Calif.

BOUNDS ON PROPAGATORS, COUPLING CONSTANTS, AND VERTEX FUNCTIONS, by S. D. Drell, A. C. Finn, and A. C. Hearn. [1964] [13]p. incl. diagrs. refs. (AFOSR-65-0466) (AF 49(638)1389) AD 616183 Unclassified

Also published in Phys. Rev., v. 136: B1439-B1451, Dec. 7, 1964.

Several bounds on renormalization constants and on the asymptotic behavior of propagation functions and vertices are constructed. The inputs are experimental measurements and/or analyticity properties of vertex functions. The connection between zeros in propagators, poles in vertex functions, and the values ot coupling constants are discussed. The possible physical significance of such zeros are considered in terms of an extended Lee model. In particular it is argued that there is no reason to exclude the existence of zeros in the propagator on the basis of this model and the scattering amplitude derived from it. This negates the arguments given for bounding the coupling constants in field theory.

2536

Stanford U. Dept. of Physics, Calif.

NUCLEON-NUCLEON SCATTERING WITH INELASTIC UNITARITY, by P. W. Coulter, A. Scotti, and G. L. Shaw. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0467) (AF 49(638)1389) AD 613841 Unclassified

Also published in Phys. Rev., v. 136: B1399-B1404, Dec. 7, 1964.

The effects of inelastic unitarity on dynamical calculation of nucleon-nucleon scattering are studied, using the N/D formalism for partial-wave amplitudes modified to take into account reaction channels by means of the inelastic factor η. The equations are solved for the D_2 amplitude for which the inelastic scattering is known, for laboratory kinetic energies $E_L \lesssim 800$ mev. Left-hand-cut Born terms determined by Scotti and Wong are used. The calculated phase shift δ agrees very closely with the Scotti-Wong results for $E_L \lesssim 200$ but deviates appreciably at higher energy, peaking at ≈ 400-500 mev and going negative at $\gtrsim 1$ bev.

2537

Stanford U. Dept. of Physics, Calif.

$\mu^- + He^3 \rightarrow H^3 + \nu$ CAPTURE RATE, by R. J. Oakes. [1964] [3]p. incl. re.s. (AFOSR-65-0844) (AF 49-(638)1389) AD 617041 Unclassified

Also published in Phys. Rev., v. 136: B1848-B1850, Dec. 21, 1964.

The muon capture rate in He^3 for the process $\mu^- + He^3 \rightarrow H^3 + \nu$ has been computed using nuclear wave functions suggested by recent analyses of e - He^3 and e - H^3 scattering experiments. The observed values are $(1.41 \pm 0.14) \times 10^3$ sec^{-1}, $(1.52 \pm 0.05) \times 10^3$ sec^{-1}, and $(1.44 \pm 0.09) \times 10^3$ sec^{-1}. It is concluded that the values are in good agreement with those of the Irving wave function, while the Irving-Gunn wave function leads to a rather small capture rate.

2538

Stanford U. Dept. of Physics, Calif.

POSSIBLE TEST OF THE BOOTSTRAP HYPOTHESIS, by A. W. Martin. [1964] [4]p. incl. refs. (AFOSR-65-1066) (AF 49(638)1389) AD 619751 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1809-1812, Dec. 16, 1964.

The purpose of this note is to demonstrate that the spin-parity quantum numbers of 1405 mev Y_0^* provide a test of the reciprocal bootstrap hypothesis. It is pointed out that $p_{1/2}$ is a better spin-parity assignment for Y_0^* than is $s_{1/2}$, but if so, then the reciprocal bootstrap hypothesis must be either abandoned or substantially modified. A $p_{3/2}$ resonance is also considered, and an approach to the problem is suggested through the study of the strong decay $Y_1^*(1660) \rightarrow \Sigma + \pi + \pi$. Consideration is also given to the proposition that the reciprocal bootstrap hypothesis can work in Schwinger's W_3 model.

2539

Stanford U. [Dept. of Physics] Calif.

NEW CALCULATIONS OF THE ATOMIC PHOTOEFFECT, by R. H. Pratt. [1963] 15p. (Rept. no. ITP-104) (AFOSR-J1256) (AF AFOSR-62-452) AD 424291 Unclassified

Presented at Internat'l. Conf. on the Role of Atomic Electrons in Nuclear Transformations, Warsaw (Poland), Sept. 1963.

Accurate predictions of cross section for the photoeffect can at present only be obtained with numerical methods. Such calculations for the K shell were made by Hulme et al for 3 elements and 2 energies and more recently by Hultberg, Nagel, and Olsson (HNO) for a series of energies in 2 heavy elements. Results are presented which have extended these calculations to encompass the range of elements from Z = 13 to Z = 92 and of energies from 200 kev to 2 mev, obtaining differential and total cross sections and all polarization correlations between incoming photon and ejected electron.

2540

Stanford U. [Dept. of Physics] Calif.

THE UNCOUPLED PHASE METHOD FOR INTERACTIONS WITH HARD CORES, by P. Nath, G. L. Shaw, and C. K. Iddings. [1964] [5]p. (AFOSR-64-0790) (AF AFOSR-62-452) AD 436483 Unclassified

Also published in Phys. Rev., v. 133: B1085-B1089, Feb. 24, 1964.

A system of n strongly coupled, two-body channels may be sufficient to describe a given set of reactions. A theoretical calculation on the other hand, might completely neglect one of these channels. The uncoupled phase method (developed by Ross and Shaw) is a nonpertubative formalism (based on a poiential model) relating the uncoupled scaitering ampliiudes describing the n-1 channels to the actual ampliiudes for all n channels. Ii is demonstrated in this paper that the uncoupled phase method remains a quantitative procedure over a wider range of conditions than originally anticipated. The method is derived for inieractions with hard cores.

2541

Stanford U. [Dept. of Physics] Calif.

RADIATIVE CORRECTIONS TO HIGH-ENERGY INELASTIC ELECTRON SCATTERING, by N. T. Meisier and T. A. Griffy. [1964] [5]p. (AFOSR-64-0791) (AF AFOSR-32-452) AD 436482 Unclassified

Also published in Phys. Rev., v. 133: B1032-B1036, Feb. 24, 1964.

A method for calculating radiative corrections to high-energy inelastic electron is deiecied ai a given angle and energy. As an example of this procedure, the radiative corrections to inelastic electron-deuteron scaiiering have been calculaied.

2542

Stanford U. Dept. of Physics, Calif.

THEORY OF THE ELECTROMAGNETIC FORM FACTORS OF H^3 AND He^3, by L. I. Schiff. [1964] [11]p. incl. diagrs. (AFOSR-64-0792) (AF AFOSR-62-452) AD 436481 Unclassified

Also published in Phys. Rev., v. 133: B802-B812, Feb. 10, 1964.

A theoretical background is provided for recent experiments on the elastic scaitering of high-energy electrons from H^3 and He^3. Formulas are derived on the basis of the isoiopic spin formalism that relaie the observed electric charge and magneiic momeni form factors for the two nuclei to the charge and moment form factors of the proton and neutron, iwo form factors thai describe the spaiial distributions of the centers of the like pair of nucleons and the odd nucleon (body form factors), and an exchange magnetic movement form factor that is to be determined empirically. The body form factors are then calculaied analytically for three assumptions as io the dependence of the wave function on the internucleon distance.

2543

Stanford U. [Depi. of Physics] Calif.

HIGH-FREQUENCY REGION OF THE SPECTRUM OF ELECTRON AND POSITRON BREMSSTRAHLUNG. II, by R. J. Jabbur and R. H. Praii. [1964] [2]p. (AFOSR-64-0793) (AF AFOSR-62-452) AD 436480 Unclassified

Also published in Phys. Rev., v. 133: B1090-B1091, Feb. 24, 1964.

The high-frequency limit of the bremsstrahlung spectrum from very high energy electrons has been calculated exactly with numerical methods. Ii is found thai, even in the heaviesi elements, only the s- and p-staie partial waves of the outgoing zero-energy electron contribute significantly to the cross section: For Th(Z = 90) the s state gives 56% of the total and the p staie 42%, while the d-state contribution is 2% and the f-state contribution 0.1%. It is also found that the s- and p-staie cross sections are well represented by analytic expressions which we have given previously.

2544

Stanford U. Dept. of Physics, Calif.

ELECTROMAGNETIC STRUCTURE OF THE GIANT DIPOLE RESONANCE, by F. H. Lewis, Jr. and J. D. Walecka. [1964] [20]p. incl. diagrs. table, refs. (AFOSR-64-1052) (AF AFOSR-62-452) AD 441494 Unclassified

Also published in Phys. Rev., v. 133: B849-B868, Feb. 1964.

The inelastic transverse form factor for electromagnetic excitation of the giant resonance is discussed and calculated on ihe basis of several different models. Particular aiiention is paid to ihe Brown theory of the giant resonance, which is reformulated here in such a way thai no free parameiers are lefi over, i.e., all parameters are determined from other experiments. Numerical calculations are carried out for C^{12} and compared with the 180° electron scattering experiments and with phoioabsorpiion data.

2545

Stanford U [Depi. of Physics] Calif.

OBSER[illegible]NAL BASIS OF MACH'S PRINCIPLE, by L. I. Schi[illegible] [1964] [2]p. (AFOSR-64-1149) (AF AFOSR-62-452) AD 442816 Unclassified

Also published in Rev. Modern Phys., v. 36: 510-511, Apr. 1964.

It appears at present that the observational basis for Mach's principle rests on a comparison between the rotation rates of the inner-planet inertial system and the fixed-stars coordinate system, and that the two systems agree within an uncertainty of about 0.4 sec/ century.

2546

Stanford U. [Dept. of Physics] Calif.

APPROXIMATE SOLUTION TO THE N/D EQUATIONS, by G. L. Shaw. [1964] [4]p. (AFOSR-64-1153) (AF AFOSR-62-452) AD 442784 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 345-348, Mar. 23, 1964.

The purpose of this note is to present an approximate solution to the N/D equations which has the exact same degree of simplicity as the determinantal method but (a) does not have certain drawbacks, and (b) for a number of interesting cases is a closer approximation to the actual solution.

2547

Stanford U. [Dept. of Physics] Calif.

ELECTRO-PRODUCTION OF PIONS FROM NUCLEI, by W. Czyz and J. D. Walecka. [1964] [9]p. (AFOSR-64-1154) (AF AFOSR-62-452) AD 442830 Unclassified

Also published in Nuclear Phys., v. 51: 312-320, 1964.

The contribution of pion production to inelastic electron scattering from nuclei through a given angle and with a given energy loss has been calculated. The amplitude for the production from a single nucleon is taken from the work of Fubini, Nambu and Wataghin. A fermi gas model of the nuclear excitation spectrum is used in order to carry out the sum over final nuclear states. Both incoherent and coherent production are included. The cross sections are computed for energy losses above meson threshold and below the (3,3) resonance. Since the results are strongly dependent on the model of the excitation spectrum such experiments can give valuable information about nuclei.

2548

Stanford U. [Dept. of Physics] Calif.

THE VECTOR THEORY OF STRONG INTERACTIONS AND ANTI-NUCLEON-NUCLEON ANNIHILATION, by S. M. Berman and R. J. Oakes. [1963] [9]p. (AFOSR-64-1748) (AF AFOSR-62-452) AD 449264 Unclassified

Also published in Nuovo Cimento, Series X, v. 29: 1329-1337, Sept. 16, 1963.

The hypothesis that antinucleon-nucleon annihilation at rest is dominated by single-particle intermediate states consisting of vector mesons is examined. The hypothesis is consistent with current experiments and offers an explanation of certain observed features of the annihilation process. Several critical tests are suggested to verify or repudiate the hypothesis.

2549

Stanford U. [Dept. of Physics] Calif.

ELECTROMAGNETIC STRUCTURE OF THE GIANT RESONANCE IN OXYGEN-16, by F. H. Lewis, Jr. [1964] [8]p. (AFOSR-64-1749) (AF AFOSR-62-452) AD 449265 Unclassified

Also published in Phys. Rev., v. 134: B331-B338, Apr. 27, 1964.

The transverse inelastic form factor for excitation of the giant resonance in oxygen-16 is calculated by means of the particle-hole theory of the giant resonance. The calculation is done in such a way that no free parameters are involved. In addition, calculations similar to those of Brown, Castillejo, and Evans have been carried out and the form factor has also been calculated for the Goldhaber-Teller model. The results are compared with 180° electron-scattering experiments and with photoabsorption data. It is found that the particle-hole calculations predict the observed behavior for the squared form factor, and also the change in the shape of the giant resonance cross section which is seen experimentally as the momentum transfer q is varied. Neither of these effects is predicted by the Goldhaber-Teller model.

2550

Stanford U. [Dept. of Physics] Calif.

K-SHELL PHOTOELECTRIC CROSS SECTIONS FROM 200 KEV TO 2 MEV, by R. H. Pratt, R. D. Levee and others. [1964] [18]p. (AFOSR-64-1751) (AF AFOSR-62-452) AD 449262 Unclassified

Also published in Phys. Rev., v. 134: A898-A915, May 18, 1964.

A numerical program has been developed for the calculation of atomic photoelectric differential and total cross sections, including all polarization correlations. The program is designed to calculate relativistic Coulomb wave functions in a screened central potential; the outgoing continuum wave function is obtained in a partial-wave series. Results are presented here for K-shell differential and total cross sections in point Coulomb potentials (i.e., unscreened) ranging from charge Z - 13 to Z = 92, and covering the range of incident photon energies from 200 kev to 2 mev.

2551

Stanford U. [Dept. of Physics] Calif.

NUCLEAR SIZE AND MAGNETIC EFFECTS IN THE

RADIATIVE TAIL OF ELECTRON-NUCLEUS SCATTERING, by E. S. Ginsberg and R. H. Pratt. [1964] [6]p. (AFOSR-64-1752) (AF AFOSR-62-452) AD 449261 Unclassified

Also published in Phys. Rev., v. 134: B773-B778, May 25, 1964.

The spectrum of scattered electrons due to bremsstrahlung from static nuclear charge and magnetic-moment distributions is calculated in Born approximation. As expected, large reductions from point-nucleus cross sections are obtained for scattering involving large momentum transfers and magnetic bremsstrahlung is important in the same large-angle region where magnetic elastic scattering is appreciable. Integrations were carried out numerically on an IBM-7090 computer for some representative cases using form factors from elastic electron scattering.

2552

Stanford U. [Dept. of Physics] Calif.

COULOMB GREEN'S FUNCTIONS AND THE FURRY APPROXIMATION, by L. Hostler. [1965] [21]p. (AFOSR-64-1763) (AF AFOSR-62-452) AD 449052 Unclassified

Also published in Jour. Math. Phys., v. 5: 591-611, May 1964.

The Coulomb Green's function for the nonrelativistic Schrodinger equation is obtained in closed form starting from the partial-wave expansion and using an integral representation for a product of two Whittaker functions with different arguments. The Neumann's series for Jv(kz) is required in evaluating the sum on states. Using the same methods, the Coulomb Green's functions for the Klein-Gordon and iterated Dirac equations are obtained in closed form in the "Furry approximation". The Klein-Gordon Green's function is shown to be at the same time the exact Green's function for the Klein-Gordon equation without the potential squared term.

2553

Stanford U. [Dept. of Physics] Calif.

POLARIZATION CORRELATIONS IN ATOMIC PHOTOEFFECT, by R. H. Pratt, R. D. Levee and others. [1964] [7]p. (AFOSR-64-1925) (AF AFOSR-62-452) AD 450327 Unclassified

Also published in Phys. Rev., v. 134: A916-A922, May 18, 1964.

The seven possible polarization correlations between incident photon and ejected electron in K-shell photoeffect have been obtained ith numerical methods for the range of elements from Z = 13 to Z = 92 and the range of energies from 200 kev to 2 mev. The photoeffect can serve as a polarizer of electrons, a transmitter of polarization from photons to electrons, or an analyzer of polarized radiation. In heavy elements at suitable angles of emission all these correlations can be large. Previous work on the correlations is discussed.

2554

Stanford U. Dept. of Physics, Calif.

ELECTRODYNAMIC PROCESSES WITH NUCLEAR TARGETS, by S. D. Drell and J. D. Walecka. [1964] [16]p. incl. diagrs. (AFOSR-64-1926) (AF AFOSR-62-452) AD 450328 Unclassified

Also published in Ann. Phys., v. 28: 18-33, June 1964.

It is known that two general form factors depending on energy loss and momentum transfer characterize inelastic electron scattering from nuclei in the first Born approximation in $\alpha = 1/137$. The same two form factors appear in all electrodynamic processes connected by one photon exchange with nuclei. This observation is used to compute cross sections and to discuss experiments which are aimed at probing electrodynamics by scattering or pair producing electrons or muons from nuclear targets. (Contractor's abstract)

2555

Stanford U. Dept. of Physics, Calif.

UNIVERSAL THEORY OF SEMI-WEAK INTERACTIONS, by R. E. Marshak, C. Ryan and others. [1964] [25]p. incl. tables, refs. (AFOSR-64-1927) (AF AFOSR-62-452) AD 450329 Unclassified

Also published in Nuovo Cimento, v. 32: 408-432, Apr. 16, 1964.

A universal theory of semi-weak interactions is proposed on the basis of a new baryon-lepton symmetry principle and the conservation of a new quantum number X, the weak hypercharge. The universality of the theory is achieved by coupling two intermediate charged vector bosons of different mass and X assignment to the strangeness-conserving and strangeness-changing currents. Acceptance of the conserved vector current hypothesis for strangeness-conserving processes leads to definite statements concerning the fields describing the electron and muon neutrinos, the $(\Delta Q/\Delta S)$ properties of the strangeness-changing current and the existence of neutrino flip.

2556

Stanford U. Dept. of Physics, Calif.

FORM FACTORS FOR STRONG M1 TRANSITIONS IN LIGHT NUCLEI, by J. Goldemberg, W. C. Barber and others. [1964] [3]p. incl. diagrs. table, refs. (AFOSR-64-1987) (AF AFOSR-62-452 and Nonr-22567) AD 453521 Unclassified

Also published in Phys. Rev., v. 134: B1022-B1024, June 8, 1964.

For abstract see item no. 2599.

2557

Stanford U. Dept. of Physics, Calif.

ELECTRIC DIPOLE MOMENT OF A NUCLEON, by N. T. Meister and T. K. Radha. [1964] [4]p. incl. diagrs. (AFOSR-64-2056) (AF AFOSR-62-452) AD 452381 Unclassified

Also published in Phys. Rev., v. 135: B769-B772, Aug. 10, 1964.

A violation of time-reversal invariance of any of the elementary particle interactions would imply the existence of a static electric-dipole moment for all these particles. A theoretical estimate is made of the electric-dipole moment of a bare nucleon, assuming the existence of an intermediate vector boson (W) and a small violation of T invariance for the weak interactions.

2558

Stanford U. Dept. of Physics, Calif.

CONSEQUENCES OF A WEAK VECTOR BOSON FOR THE DECAY $K \rightarrow \mu + \nu + e^+ + e^-$, by E. S. Ginsberg. [1964] [4]p. incl. diagrs. tables. (AFOSR-64-2057) (AF AFOSR-62-452) AD 452467 Unclassified

Also published in Phys. Rev., v. 135: B792-B795, Aug. 10, 1964.

The effect of an intermediate vector boson with arbitrary anomalous magnetic and quadrupole moments, has been investigated. The presence of the boson can have a striking effect on the orientation of the plane of the Dalitz pair relative to the decay plane. This effect is greatest in a kinematic region where the Dalitz pair emerges at a large backward angle with respect to energetic muons.

2559

Stanford U. Dept. of Physics, Calif.

SELF-CONSISTENT CALCULATION OF THE ρ-MESON REGGE POLE, by M. Bander and G. L. Shaw. [1964] [5]p. incl. diagrs. refs. (AFOSR-64-2058) (AF AFOSR-62-452) AD 452468 Unclassified

Also published in Phys. Rev., v. 135: B267-B271, July 13, 1964.

The left-hand discontinuities in the partial-wave amplitudes for R-R scattering are assumed to be dominated by the exchange of the rho meson in a form suggested by the Regge representation for a resonance.

2560

Stanford U. Dept. of Physics, Calif.

MESON EXCHANGE EFFECTS IN ELASTIC e-d SCATTERING, by R. J. Adler and S. D. Drell. [1964] [4]p. incl. diagrs. refs. (AFOSR-64-2338) (AF AFOSR-62-452) AD 451934 Unclassified

Also published in Phys. Rev. Ltrs., v. 13: 349-352, Sept. 7, 1964.

This note reports a calculation of an effect of the three-pion-exchange current on the electromagnetic interaction of the deuteron.

2561

Stanford U. Dept. of Physics, Calif.

ELECTRON-PROTON COINCIDENCE CROSS SECTION FOR He^3 AND H^3, by T. A. Griffy and R. J. Oakes. [1964] [7]p. incl. diagrs. refs. (AFOSR-64-2339) (AF AFOSR-62-452) AD 451935 Unclassified

Also published in Phys. Rev., v. 135: B1161-B1167, Sept. 7, 1964.

This cross-section is evaluated for the Gaussian, Irving, and Irving-Gunn three-body wave functions, the deuteron being described by a Hulthen wave function. The best agreement with the preliminary experimental results is obtained using the Irving-Gunn wave function.

2562

Stanford U. Dept. of Physics, Calif.

UNITARITY AND FORM FACTORS IN THE PRODUCTION PROCESS $\pi + N \rightarrow \rho + N$, ny M. H. Ross. [1964] [4]p. incl. diagrs. refs. (AFOSR-64-2340) (AF AFOSR-62-452) AD 451928 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 627-630, June 1, 1964.

The peripheral model has provided a relatively successful interpretation of many high-energy reactions. In this paper one of the most thoroughly examined reactions, $\pi + N \rightarrow \rho + N$, is considered in order to better understand the peripheral model and to elucidate the nature of the ρ resonance.

2563

Stanford U. Dept. of Physics, Calif.

ANGULAR CORRELATIONS IN PRODUCTION PROCESSES, by S. M. Berman and R. J. Oakes. [1964] [7]p. incl. tables. (AFOSR-64-2370) (AF AFOSR-62-452) AD 452419 Unclassified

Also published in Phys. Rev., v. 135: B1034-B1040, Aug. 24, 1964.

A simple and general method is suggested for studying processes in which resonances or unstable particles are produced. The method consists of analyzing the experimental data in terms of all the possible angular correlations among the decay products of the produced particles. The specific correlations that can be present in a number of experimentally feasible processes are explicitly tabulated. The usefulness of this method of analysis is illustrated by showing how the correlations provide extensive tests of various dynamical models of the production process such as one-particle exchanges. (Contractor's abstract, in part)

2564

Stanford U. [Dept. of Physics] Calif.

RADIATIVE CORRECTIONS TO ELECTRON SCATTERING, by Y.-S. Tsai. [1964] [7]p. incl. diagrs. (AFOSR-64-2373) (AF AFOSR-62-452) AD 452263 Unclassified

Also published in Proc. Iniernat'l. Conf. on Nucleon Structure, Stanford, Calif. (June 24-27, 1963), ed. by Hofstadter and Schiff. Stanford U. Press, 1964, p. 221-227.

Radiative corrections for an arbitrary one-photon exchange process are calculated, assuming that the target particle is not polarized and thai the final products of the target particle are noi deiected experimentally.

2565

Stanford U. Dept. of Physics, Calif.

THEORY OF PROTON COMPTON SCATTERING, by A. C. Hearn and E. Leader. [1964] [2]p. incl. diagr. (AFOSR-64-2374) (AF AFOSR-62-452) AD 452261 Unclassified

Also published in Proc. Internat'l. Conf. on Nucleon Structure, Stanford, Calif. (June 24-27, 1963), ed. by Hofstadter and Schiff. Stanford U. Press, 1964, p. 314-315.

Preliminary results are reporied of a quantitative calculation of the differential cross section for proion Compton scattering using a fixed-angle dispersion-relation formalism thai has been reporied previously (A. C. Hearn and E. Leader, Phys. Rev., v. 126: 789, 1962).

2566

Stanford U. Dept. of Physics, Calif.

DEPOLARIZATION OF SPIN-1/2 PARTICLES BY ELECTROMAGNETIC SCATTERING, by C. K. Iddings and G. L. Shaw. [1964] [10]p. incl. tables, refs. (AFOSR-64-2512) (AF AFOSR-62-452) AD 453799 Unclassified

Also published in Phys. Rev., v. 135: B1388-B1397, Sept. 21, 1964.

A study is made of the depolarization of polarized, relativistic fermions (spin 1/2) passing through maiter. The final polarization of the projectile shows two features, (1) a rotation of the polarization vector so ihat it does not have the same direction as the initial polarization with respect to the initial or final momenta: rotation; and (2) an unpolarized component so that the magnitude of the polarization has diminished: shrinkage.

2567

Stanford U. Dept. of Physics, Calif.

THERMAL NEUTRON CAPTURE BY DEUTERIUM AND STRUCTURE OF THE THREE-BODY WAVE FUNCTION, by T. K. Radha and N. T. Meister. [1964] [8]p. incl. tables, refs. (AFOSR-65-0136) (AF AFOSR-62-452) AD 455980 Unclassified

Also published in Phys. Rev., v. 136: B388-B395, Oct. 26, 1964.

The study of three-nucleon wave functions has recently drawn considerable attention owing to experiments on elastic scattering of high-energy from H^3 and He^3. An attempt is made to obtain independent information on these wave functions using the available experimental data on slow-neutron capture by deuierium. This reaction goes mainly through magnetic dipole radiation from both exchange and spin magnetic-momeni interaction. Three types of three-body wave functions, Gaussian, irving, and Irving-Gunn are considered. An upper limit on the probability of the S′ staie of mixed symmetry ($^2S_{1/2}$ state wiih $T = \frac{1}{2}$) is deduced from ihe experimental capture rate.

2568

Stanford U. Dept. of Physics, Calif.

ON THE RADIATIVE CORRECTIONS TO THE MUON POLARIZATION FROM PION DECAY, by E. S. Ginsberg and R. H. Pratt. [1964] [5]p. incl. diagr. (AFOSR-65-1356) (AF AFOSR-62-452) AD 621349 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1633-1637, Dec. 16, 1964.

The polarization of muons from pion decay, $\pi \rightarrow \mu + \nu$, or electrons from kaon decay, $K \rightarrow e + \nu$, is not compleie when radiative corrections are taken inio accouni. The transition rates for radiative kaon and pion decay are used to find the lowesi-order radiative correction to the polarization of the emiiied muons or electrons. Ii is concluded ihai the correction is very small for all such decays.

2569

Stanford U. Dept. of Physics, Calif.

INSIDE QUANTUM FIELD THEORY AND LECTURES ON NEUTRINO INTERACTIONS, by F. Chilton. Dec. 1964, 34p. incl. diagrs. (ANL rept. no. 6989) (AFOSR-65-1753) (In cooperation with Argonne National Lab., Ill.) (AF AFOSR-62-452) AD 623189 Unclassified

The fundamental ideas of quantum theory are reviewed and summarized with special emphasis on those features that are relevant to applications and omitting the formalism of second quantization. A formalism is first developed for noninteracting fields. It is shown how inclusion of interacting fields in the formalism can be accomplished by use of the Lagrangian. Rules for calculations are listed and explained, and examples are given. Neutrino interactions are discussed and special consideration is given to hyperon production by neutrinos in an SU_3 model.

2570

Stanford U. [Dept. of Physics] Calif.

CROSS SECTION FOR HYPERON PRODUCTION BY NEUTRINOS, by F. Chilton. Aug. 1963, 14p. (Rept. no. ITP-95) (AF AFOSR-62-452) AD 435577 Unclassified

The cross section, differential in q square, is calculated for hyperon production by neutrinos (or any other spin 1/2 to spin 1/2 reaction). All six form factors are included. A closed form for the total cross section is given in the form of an expansion about asymptotic value assuming a q square dependence of the form factors.

2571

Stanford U. [Dept. of Statistics] Calif.

FINITE STATE TRANSFORMATIONS, by R. C. Jeffrey. [1964] [10]p. (AFOSR-64-0947) (AF AFOSR-62-385) AD 440056 Unclassified

Also published in Inform. and Control, v. 7: 45-54, Mar. 1964.

A notion of index is defined for transformations which map n-tuples of words into m-tuples of words into m-tuples of words, and it is proved that the transformations of finite index are precisely those which are effected by finite state sequential machines, provided these are allowed to have certain unusual features. Further conditions are formulated which, together with the finite index requirement, characterize the transformations which can be effected by finite state sequential machines of the usual sort. (Contractor's abstract)

2572

Stanford U. [Dept. of Statistics] Calif.

SOLUTIONS OF PARABOLIC BOUNDARY PROBLEMS EXISTING FOR ALL TIME, by P. Fife. [1964] [32]p. (AFOSR-64-2277) (AF AFOSR-63-346) AD 452394 Unclassified

Also published in Arch. Rational Mech. and Anal., v. 16: 155-186, 1964.

The primary goal of this paper is to answer two questions concerning parabolic boundary problems existing for all time in the case of second order linear equations, and a question for certain second order quasi-linear equations. A secondary purpose is to apply the results to two important particular cases, the first being when the operator and data are periodic in t (then the solution is also); and the second being when the data and coefficients of the operator approach limit functions of x alone as t approaches infinity.

2573

Stanford U. [Dept. of Statistics] Calif.

PREFERENCE, CREDENCE, AND UTILITY, by R. C. Jeffrey. [1964] [42]p. (AFOSR-64-2498) (AF AFOSR-64-529) AD 609560 Unclassified

Also published in Studies in Inductive Logic and Probability, ed. by R. Carnap, Chapter 1, 1964.

Topics covered in this report include: Bayesian deliberation; Bayesian preference rankings; Preference preserving utility transformations; Gambles, quantization, and boundedness, and Unicity.

2574

Stanford U. [Dept. of Statistics] Calif.

GENERALIZED LEAST SQUARES ESTIMATORS FOR RANDOMIZED FRACTIONAL REPLICATION DESIGNS, by S. Zacks. Mar. 15, 1963, 28p. incl. refs. (Technical rept. no. 86) (AFOSR 4677) (Nonr-22552) AD 400398 Unclassified

Also published in Ann. Math. Stat., v. 35: 696-704, 1964.

Statistical properties of the generalized least squares estimators, under randomized fractional replication designs, are presented. The term generalized least-squares estimators is used since the matrices of the normal equations corresponding to these designs are singular. The factorial models corresponding to the type of fractional replication designs studied in the present paper are also presented. The discussion starts from the factorial model for a full factorial system. The required algebra, and the method of constructing the orthogonal fractional replications is presented. The linear spaces associated with the various orthogonal fractional replication designs are characterized in terms of the linear coefficients of the corresponding factorial models. Some statistical properties under procedures of choosing a fractional replication at random are studied.

2575

Stanford U. [Dept. of Statistics] Calif.

THE ASYMPTOTIC NORMALITY OF TWO TEST STATISTICS ASSOCIATED WITH THE TWO-SAMPLE PROBLEM, by S. Blumenthal. Feb. 28, 1963, 31p. incl. refs. (Technical rept. no. 85) (AFOSR-4678) (Nonr-22552) AD 400399 Unclassified

Also published in Ann. Math. Stat., v. 34: 1513-1523, 1963.

Proofs are presented for the asymptotic normality of two statistics which have been proposed to test the hypothesis that two samples come from the same parent population. Limiting normality under a fairly wide class of alternatives is proven. Comparison is made of the limiting power of these tests. The method, a study of conditional moments, can also be used to prove limiting normality of combinatorial statistics of greater generality than the sum of squares statistics which is studied in detail.

2578

Stanford U. Dept. of Statistics, Calif.

CONVEX HULL OF A RANDOM SET OF POINTS, by E. Bradley. Jan. 25, 1965, 26p. (Technical rept. no. 103) (AFOSR-65-0615) (Nonr-22552) Unclassified

Various expectations connected with the convex hull of a random set of points are derived. The points are chosen independently in the plane or in higher dimensions, and formulas are given for the expected area, perimeter, volume, number of vertices. The formulas are particularly simple for an underlying normal distribution.

2577

Stanford U. Dept. of Statistics, Calif.

ADAPTIVE STATISTICAL PROCEDURES IN RELIABILITY AND MAINTENANCE PROBLEMS, by J. H. Venter and J. L. Gastwirth. Oct. 12, 1964, 30p. incl. diagrs. refs. (Technical rept. no. 99) (AFOSR-65-0633) (Nonr-22552) AD 608726 Unclassified

A system with a lifetime that has the distribution function F(t) is inspected at times, t_1, t_2, ... The inspection plan, the sequence t_1, t_2, ..., is to be chosen in an optimal way. The case considered is that in which the system has an exponential lifetime. Several adaptive or sequential inspection plans are proposed to estimate the unknown parameter in F(t) and thereby approach the plan that would be optimum if the parameter were known. The two types of plans proposed are based on maximum likelihood methods and refinements of the Robbins-Monro stochastic approximation method.

2578

Stanford U. Dept. of Statistics, Calif.

ON SAMPLED DATA FEEDBACK CONTROL, by Y. Suzuki. Oct. 15, 1964 [51]p. incl. tables. (Technical rept. no. 100) (AFOSR-65-0634) (Nonr-22552) AD 608732 Unclassified

In a manufacturing process which continuously produces a certain product and has expressed as a function the deviation from the desired characteristics, the problem is to find the control procedure of the process by which the best performance is attained. Special types of random functions are considered as the output of the manufacturing process without control, and these characterize the manufacturing processes to be controlled. Three types of control procedure, the proportional control, the integral control, and a mixture of both are discussed.

2579

Stanford U. Dept. of Statistics, Calif.

EFFECT OF GROUP SIZE ON GROUP PERFORMANCE, by H. Solomon. Oct. 28, 1964 [24]p. incl. tables, refs. (Technical rept. no. 101) (AFOSR-65-0635) (Nonr-22552) Unclassified

The efficiency of groups over individuals in various problem-solving situations has been explored in recent years. Lorge and Solomon have proposed a model for group behavior in the solution of eureka type problems. This model has been applied to data resulting from a verbal recall experiment. A model for individual behavior in recall has been proposed by Miller and McGill, and this has been used to establish a group behavior model in verbal recall using the Lorge-Solomon model. Data has been available by experimentation, and the implications of the model are examined by use of the data. The group sizes examined are from 2 through 8 individuals.

2580

Stanford U. Dept. of Statistics, Calif.

CALCULATION OF UPPER TAIL PERCENTILES FOR THE CHI-SQUARE DISTRIBUTION, by H. Rubin and J. V. Zidek. Dec. 1, 1964 [13]p. incl. tables. (Technical rept. no. 102) (AFOSR-65-0636) (Nonr-22552) Unclassified

This report describes a procedure for determining upper tail percentiles of the chi-square distribution with an arbitrary number of degrees of freedom. It consists of two main parts. The first is a description of an effective iterative technique, which is to be published by H. Rubin, for solving equations of the form $f(x) = 0$, given the feasibility of computing f and its derivatives. The second, in the application of this technique to the chi-square distribution, is the continued

fraction approximation to the tail tntegral of the chi-square density function. An alternative procedure ts given for the cases in which the sequence of approximatmants to this continued fraction converge slowly.

2581

Stanford U. [Dept. of Statistics] Calif.

THE CONVERGENCE OF A RANDOM DISTRIBUTION FUNCTION ASSOCIATED WITH A BRANCHING PROCESS, by P. E. Ney. Mar. 12, 1964, 26p. (Technical rept. no. 96) (Nonr-22552) AD 434059
Unclassified

A general branching process ts constructed from the standard one by associating with each particle a "type", namely a point in a space which ts taken to be d-dimensional Euclidian space. At any given time, each particle existing at that time ts to be constdered as located at a point tn the given space. The diffusion of the particles throughout the space ts shtelded. The branchtng character of the process alone tmplies detailed results about tts asymptotic behavior, without requirtng any specifte distribution assumptions.

2582

Stanford U. [Dept. of Statistics] Calif.

COUNTER MODELS AND APPLICATIONS TO DETECTION PROBLEMS, by H. Zweig. Apr. 12, 1963, 73p. (Technical rept., no. 87) (Nonr-22552) AD 402352
Unclassified

The quantum efftctency ts dertved of a vartety of detectors for whtch mathematical models already exist and to develop new models for some physical sttuattons which can be examined tn thts light. A summary of the models whtch will be analyzed is given. The application of these models to specific detection problems is indicated. The methods of estimating the parameter of tnterest and the efftctency of the esttmates ts defined. A summary is presented of known dead time counter models and their quantum efftctency ts evaluated. A new class of counters, called coincidence counters, is introduced and evaluated.

2583

Stanford U. [Dept. of Statisttcs] Calif.

AN OBSTACLE-COURSE PROBLEM: I, by J. Kadane. July 30, 1964, 17p. (Technical rept. no. 98) (Nonr-22552) AD 604439 Unclassifted

An obstacle course is presented in whtch n obstacles are given, together with the probability of successfully overcomtng the t(th) obstacle. A runner is permttted to choose r < or = n (r fixed) obstacles and to order them, so that he maximizes his expected value, on the assumption that once he fails to overcome an obstacle he recetves only the potnts previously earned. The optimal ordering of the chosen r ts a stmple function of the obstacle parameters. The optimal chotce of whtch r to attempt is more complicated, and three alternative computational procedures are given, together with a proof that each will termtnate at the optimal r, and an upper bound on the number of compartsons required for each.

2584

Stanford U. [Dept. of Statistics] Calif.

ON AGE DEPENDENT BRANCHING PROCESSES, by H. Weiner. Jan. 27, 1964, 79p. (Technical rept. no. 94) (Nonr-22552) AD 430995 Unclassified

This paper deals with asymptotic properties of various models of age-dependent branching processes. Cell growth ts considered tn whtch a cell proceeds tn a sequential manner through n independent states, state R with tts life distribution FR, R = 1, 2, ... n. At the end of mttosts, the nth state, the cell divides tnto stmtlar cells, the number of which ts governed by a generating function h, tndependent of the dime and other cells of the process. A variation of the given model treats cell growth in whtch the cell proceeds from state to state according to a general semi-Markov process until the mttotic state is completed, when division tnto stmtlar cells in accord with h occurs. Another case ts that of two types of cells, of whtch only one type may divide while the other etther accumulates or ts eventually absorbed in the medium.

2585

Stanford U. [Dept. of Stattstics] Calif.

PERCENTILE MODIFICATIONS OF TWO SIMPLE RANK TESTS, by J. L. Gastwirth. Feb. 11, 1964, 27p. (Technical rept. no. 95) (Nonr-22552) AD 433869 Unclassified

A stmple method ts presented for tncreastng the efficiency of rank tests relattve to the best tests for samples from normal distrtbutions without ustng complicated scortng systems such as the normal scores tests. Two numbers p and r (0 is less than p, r is less than 1) are selected and then scored, with stmple weights, the date tn the upper pth and lower rth percentiles of the combtned sample. The optimum values of p and r depend on the populattons sampled. For most distrtbuttons, the efficiency ts near tts maxtmum in a large neighborhood of the optimum choice of p and r. The crtterion used to compare tests is Pitman's efftctency.

2586

[Stanford U. Div. of Engineering Mechanics, Calif.]

OPTIMUM AND QUASI-OPTIMUM CONTROL OF THIRD- AND FOURTH-ORDER SYSTEMS, by I. Flügge-Lotz and H. A. Titus. [1963] [8]p. incl. diagrs. (AFOSR-66-0039) (AF 49(638)513) AD 640790
Unclassified

Also published in Automatic and Remote Control; Proc. Second Cong. of the Internat'l. Fed. Automatic Control, Basle (Switzerland), 1963, p. 363-370.

Based on experiences with second-order plants, a systematic attempt has been made to approximate the exact switching surfaces for third-order plants. There is an approximation of the surface portion close to the origin (the so-called "inner" surface) and an approximation of the larger portion of the switching surface which is not close to the origin (the "outer" surface). Examples show the use of these surfaces; their results are compared to results with exactly optimum switching. They agree well. The extension to fourth-order systems is indicated.

2587

Stanford U. [Div. of Engineering Mechanics] Calif.

FINITE-DIFFERENCE COMPUTATION OF THE BOUNDARY LAYER WITH DISPLACEMENT THICKNESS INTERACTION, by F. G. Blottner and I. Flügge-Lotz. [1963] [27]p. incl. diagrs. refs. (AFOSR-64-1941) (AF 49(638)550) AD 450324 Unclassified

Also published in Jour. Mècanique, v. 2: 397-423, Dec. 1963.

An implicit finite-difference method is used for solving first-order boundary-layer problems under most general conditions, given pressure distribution and given wall temperature or heat transfer at the wall for realistic Prandtl number and viscosity law. When for higher Mach numbers there is displacement thickness interaction with external flow, the implicit finite-difference scheme is combined with an iteration procedure to solve the boundary-layer equations. Flows along an insulated and along a cold flat plate at Mach number 9.6 are solved with this numerical scheme. This rather severe test case shows the wide applicability of the method. (Contractor's abstract)

2588

Stanford U. Div. of Engineering Mechanics, Calif.

THE LAMINAR COMPRESSIBLE BOUNDARY LAYER ALONG A WAVE-SHAPED WALL, by T. Fannelöp and I. Flügge-Lotz. [1963] [12]p. incl. diagrs. (AFOSR-64-0727) (AF AFOSR-62-242) AD 436524 Unclassified

Also published in Ingen. Arch., v. 33: 24-35, 1963.

As a result of inaccuracies inherent in an economical manufacturing method, the exterior surfaces of aircrafts and missiles may have a slightly wavy contour. The waves have in most cases a very small amplitude but if their wavefronts are in a direction transverse to the external flow, the resulting pressure fluctuations may nevertheless have considerable influence on the behavior of the boundary layer. The same is true for wind tunnels where in particular the diffusor-section may be critical. The first investigation of the effect of periodic pressure fluctuations on the behavior of the incompressible laminar boundary layer was undertaken by Quick and Schröder in 1944 using a numerical method. The purpose of the present investigation is to extend Quick and Schröder's investigation to compressible flow with adiabatic as well as non-adiabatic wall temperatures.

2589

Stanford U. [Div. of Engineering Mechanics] Calif.

THE LAMINAR COMPRESSIBLE BOUNDARY-LAYER IN THE STAGNATION-POINT REGION OF AN AXISYMMETRIC BLUNT BODY INCLUDING THE SECOND-ORDER EFFECT OF VORTICITY INTERACTION, by R. T. Davis and I. Flügge-Lotz. [1964] [30]p. (AFOSR-64-1720) (AF AFOSR-62-242) AD 448279 Unclassified

Also published in Internat'l. Jour. Heat and Mass Transfer, v. 7: 341-370, 1964.

The influence of external vorticity on the laminar compressible boundary layer is examined in the stagnation-point region of an axisymmetric blunt body. The case considered is one where the vorticity is generated by a curved bow-shock wave formed by the body moving at a supersonic speed. The method of solution used is due to Van Dyke and consists of solving first-order (or Prandtl) boundary-layer equations and then solving second-order equations for the vorticity effect, where by second-order is meant second-order in a perturbation parameter related to the inverse square root of a Reynolds number.

2590

Stanford U. Div. of Engineering Mechanics, Calif.

COMPUTATION OF THE LAMINAR COMPRESSIBLE BOUNDARY LAYER, by I. Flügge-Lotz. Final rept. May 1963-June 1964 [155]p. incl. diagrs. tables, refs. (AFOSR-64-1628) (AF AFOSR-63-235) AD 607573 Unclassified

First- and second-order boundary-layer theory are examined in detail for some specific flow cases of practical interest. These cases are for flows over blunt axisymmetric bodies in hypersonic high-altitude (or low density) flow where second-order boundary-layer quantities may become important. These cases consist of flow over a hyperboloid and a paraboloid both with free-stream Mach number infinity and flow over a sphere at free-stream Mach number 10. The method employed in finding the solutions is an implicit finite-difference scheme. It is found to exhibit both stability and accuracy in the examples computed. The method consists of starting near the stagnation-point of a blunt body and marching downstream along the body surface.

2591

Stanford U. Div. of Engineering Mechanics, Calif.

SECOND-ORDER BOUNDARY-LAYER EFFECTS IN HYPERSONIC FLOW PAST AXISYMMETRIC BLUNT BODIES, by R. T. Davis and I. Flügge-Lotz. [1964] [31]p. incl. diagrs. tables, refs. (AFOSR-65-0626) (AF AFOSR-63-235) AD 614719 Unclassified

Also published in Jour. Fluid Mech., v. 20: 593-623, 1964.

First- and second-order boundary-layer theory are examined in detail for some specific flow cases of practical interest. These cases are for flows over blunt axisymmetric bodies in hypersonic high-altitude (or low density) flow where second-order boundary-layer quantities may become important. These cases consist of flow over a hyperboloid and a paraboloid both with free-stream Mach number infinity and flow over a sphere at free-stream Mach number 10. The method employed in finding the solutions is an implicit finite-difference scheme. It is found to exhibit both stability and accuracy in the examples computed. The method consists of starting near the stagnation-point of a blunt body and marching downstream along the body surface.

2592

Stanford U. [High-Energy Physics Lab.] Calif.

A STUDY OF TRANSISTOR BLOCKING OSCILLATORS AS NANOSECOND-PULSE GENERATORS, by J. C. MacDonald. Aug. 1963 [49]p. incl. diagrs. tables, refs. (Technical rept. no. 4813-3; rept. no. SEL-63-068) (AFOSR-5534) (Nonr-225 67) Unclassified

This study presents a method for calculating the switching time and pulse duration of transistor blocking oscillators operating in the nsec time domain. The original theory proposed by Linvill and Mattson is tested using transistors with increasing alpha cutoff frequency. It is found that this theory gives close correlation between measured and calculated switching times for low-frequency transistors; however, for high-frequency units, differences as large as an order of magnitude exist. It is shown that for circuits with switching times of less than 10 nsec, a new circuit model is necessary; for good theoretical and measured correlation. It is shown that a small-signal analysis, as proposed by Linvill and Mattson, adequately describes the circuit operation. Design techniques for minimizing switching time, based on the new circuit models, are presented.

2593

Stanford U. High-Energy Physics Lab., Calif.

EXCITATION OF THE ELECTRIC DIPOLE GIANT RESONANCE BY INELASTIC ELECTRON SCATTERING AT 180°, by J. Goldemberg, Y. Torizuka and others. [1963] [12]p. incl. diagrs. table, refs. (Rept. no. HEPL-280) (AFOSR-J921) (Nonr-225 67) Unclassified

Also published in Nucl. Phys., v. 43: 242-253, 1963.

The cross section for the excitation of the nuclear giant resonance by electrons is calculated in a model in which the protons are assumed to oscillate as a unit against the neutrons (Goldhaber-Teller model). The longitudinal component of the field of the electrons is shown to have a cross section that agrees with results obtained previously by Fallieros, Ferrell and Pal. The transverse component is shown to have a form factor proportional to the elastic scattering form factor. Preliminary measurements in C, Al and Kr with 41.5 mev electrons scattered at 180°, where only the transverse component is present, show cross sections smaller by about a factor of four than the calculated ones.

2594

Stanford U. High-Energy Physics Lab., Calif.

ELECTROMAGNETIC STRUCTURE OF THE GIANT DIPOLE RESONANCE, by F. H. Lewis, Jr., J. D. Walecka and others. [1963] [3]p. incl. diagrs. (Rept. no. HEPL-292) (AFOSR-J968) (Nonr-225 67) Unclassified

Also published in Phys. Rev. Ltrs., v. 10: 1-3, June 1, 1963.

Inelastic electron scattering yields valuable information about the spatial nature of the transition charge, current, and magnetization densities in nuclei. Since the electron part of the process is completely calculable, one can directly compare the experimental inelastic form factors (functions of the momentum transferred to the nucleus) with the predictions of nuclear theory. Different nuclear models can give quite different behavior for these form factors, and thus electron scattering provides a unique tool for elucidating nuclear structure. Some experimental and theoretical results are presented on the nature of the giant dipole resonance in C^{12} illustrating these points.

2595

Stanford U. [High-Energy Physics Lab.] Calif.

INELASTIC ELECTRON-DEUTERON SCATTERING EXPERIMENTS AND NUCLEON STRUCTURE, by C. de Vries, R. Hofstadter and others. [1964] [11]p. incl. diagrs. tables, refs. (Rept. no. HEPL-321) (AFOSR-64-1929) (Nonr-225 67) Unclassified

Also published in Phys. Rev., v. 134: B848-B859, May 1964.

Inelastic electron-scattering experiments are reported for four-momentum transfers from 3.0 to 22.0 F^{-2}. The results of these measurements have been combined with values of proton cross sections measured in the same region of q^2 and have been analyzed in terms of a three-pole Clementel-Villi model for the isotopic

form factors. Parameters appearing in this model have been adjusted by statistical methods. The minimum values of χ^2 obtained show that the different blocks of information on elastic electron-proton and inelastic electron-deuteron cross sections measured at Stanford are consistent with each other. An important result of the analysis is that the cross sections cannot be fitted with only one T = 1, J = 1 multipion resonance, unless the effective mass of such a particle is taken to be approximately 600 mev. (Contractor's abstract)

2596

Stanford U. High-Energy Physics Lab., Calif.

NONSATURATING QUANTAMETER FOR VERY HIGH INTENSITY GAMMA-RAY MONITORING, by H. Fischer and C. Schaerf. [1964] [3]p. incl. illus. diagrs. (Rept. no. HEPL-309) (AFOSR-64-1930) (Nonr-22567) Unclassified

Also published in Rev. Scient. Instr., v. 35: 615-617, May 1964.

A new type of gamma-ray monitor is described which is capable of handling the very high intensities now available from linear electron accelerators. This device provides an output proportional to the incident power. Unfortunately, it is not an absolute monitor.

2597

Stanford U. High-Energy Physics Lab., Calif.

EXCITATION OF THE GIANT RESONANCE IN C^{12} AND O^{16} BY INELASTIC ELECTRON SCATTERING, by J. Goldemberg and W. C. Barber. [1964] [9]p. incl. diagrs. tables, refs. (Rept. no. HEPL-320) (AFOSR-64-1931) (Nonr-22567) Unclassified

Also published in Phys. Rev., v. 134: B963-B971, June 8, 1964.

The excitation of the electric-dipole giant resonance in C^{12} and O^{16} was studied by measuring the spectrum of electrons inelastically scattered at 180°. Experiments were made with incident electrons of 40, 55, and 70 mev; combining these data with the known photon absorption cross section a form factor for the giant resonance cross section is obtained for momentum transfers up to 120 mev/c. The form factor for the combined strength of the main giant resonance in C^{12} and O^{16} which is concentrated between 20 and 25 mev has a very characteristic shape going through a shallow minimum and increasing again with the momentum transfer.

2598

Stanford U. High-Energy Physics Lab., Calif.

FORM FACTORS FOR STRONG M1 TRANSITIONS IN LIGHT NUCLEI, by J. Goldemberg, W. C. Barber and others. [1964] [3]p. incl. diagrs. table, refs. (Rept. no. HEPL-317) (AFOSR-64-1932) (AF AFOSR-62-452 and Nonr-22567) AD 453521 Unclassified

Also published in Phys. Rev., v. 134: B1022-B1024, June 8, 1964.

Strong peaks corresponding to magnetic-dipole excitation of the nucleus were observed in the energy spectrum of electrons scattered at 180° from targets of Li^6C, Mg, and Si. The momentum transfer dependence of the excitation of these peaks was investigated by using primary electrons of 40, 55, and 70 mev. From the measured cross sections and the Born approximation theory the inelastic form factors can be obtained. The radiative transition probability from the excited state to the ground state gives the first point on the curve of form factor as a function of momentum transfer. In the case of C^{12} a shell-model theory of the magnetic-dipole transition gives a form-factor curve in fair agreement with the experimental results.

2599

Stanford U. High-Energy Physics Lab., Calif.

THE OBSERVATION OF A PRONOUNCED FINAL STATE INTERACTION IN THE ELECTRO-DISINTEGRATION OF THE DEUTERON, by M. R. Yearian and E. B. Hughes. [1964] [3]p. incl. diagrs. (Rept. no. HEPL-324) (AFOSR-64-1933) (Nonr-22567) Unclassified

Also published in Phys. Ltrs., v. 10: 234-236, June 1, 1964.

A recent observation of the final state interaction at an incident electron energy of 146.9 mev and a laboratory scattering angle of 135° corresponding to a four-momentum transfer of 1.29 fm^{-1} is reported. The electron beam from the Stanford Mark III linear accelerator, with an energy resolution of 0.33%, was scattered from a 0.375" thin liquid deuterium target. The scattered electrons were momentum-analyzed by a 72" double-focusing magnetic spectrometer and detected by an array of ten scintillation counters located in the focal plane of the spectrometer and operated in coincidence with a single large Cerenkov counter.

2600

Stanford U. High-Energy Physics Lab., Calif.

PHOTODISINTEGRATION OF THE DEUTERON BY POLARIZED PHOTONS, by F. F. Liu. [1964] [9]p. incl. diagr. table. (Rept. no. HEPL-329) (AFOSR-65-0511) (Nonr-22567) AD 601699 Unclassified

Also published in Phys. Ltrs., v. 11: 306-307, Aug. 15, 1964.

The asymmetry in the photodisintegration of deuterons by polarized photons between 80 and 140 mev was measured at 90° in the center of mass system. The results were compared with theoretical predictions.

The asymmetry was noted to undergo a reversal in sign between photon energies of 120 and 130 mev. The data indicates that the magnetic amplitude is larger than that of presently available calculations.

2601

Stanford U. High-Energy Physics Lab., Calif.

CHARGED-PION PHOTOPRODUCTION FROM DEUTERIUM WITH POLARIZED BREMSSTRAHLUNG, by F. F. Liu, D. J. Drickey, and R. F. Mozley. July 13, 1964, 4p. (Rept. no. HEPL-330) (Nonr-22567) AD 612837 Unclassified

Also published in Phys. Rev., v. 136: B1183-B1186, Nov. 23, 1964.

Measurements were made on the ratio of pion-production cross sections at right angles to and along the photon electric-field vector. The positive and negative pions were first momentum-analyzed and counted by means of a counter telescope. Data were taken at 45, 90, and 135° in the c.m. system, and at proton energies of 225, 330, and 450 mev. A comparison of the data is made with the dispersion-relation calculation of McKinley.

2602

Stanford U. High-Energy Physics Lab., Calif.

A DETERMINATION OF RADIATIVE TRANSITIONS WIDTHS OF EXCITED STATES IN C(12), by H. L. Crannell and T. A. Griffy. July 1964, 27p. (Rept. no. HEPL-335) (Nonr-22567) AD 606401 Unclassified

New absolute values for the elastic and inelastic electron scattering cross sections from C^{12} are presented for a range of q^2 from 0.75 F^{-2} to 3.14 F^{-2}. A new method of analysis has been employed to obtain the radiative widths for the first three excited states in C^{12} from the measured inelastic cross sections. This method of analysis does not depend on a model for the transition charge distribution and is useful in determining the multipolarity of the transition.

2603

Stanford U. High-Energy Physics Lab., Calif.

LINEAR ELECTRON ACCELERATOR PROJECT. Status rept. Aug. 1-Oct. 31, 1964. Nov. 1964, 42p. (Rept. no. HEPL-353) (Nonr-22567) AD 609587 Unclassified

The Mark III accelerator operated with good reliability in spite of increasing frequency of the occurrence of water leaks in the rf loads. The loads are being replaced with a leak proof variety on a schedule which interferes very little with Mark III operation for research. Research with Mark II continued as usual. The Mark III electron scattering program has recently installed auxiliary magnets so that the 72in. spectrometer can measure electrons scattered at 180°. With this apparatus the elastic scattering from the magnetic octupole moment of Be^9 and B^{11} has been studied as a function of momentum transfer. These experiments give for the first time a method of studying in detail the space distributions of the static magnetic moments of light nuclei.

2604

Stanford U. High-Energy Physics Lab., Calif.

NEUTRAL MESON PRODUCTION WITH POLARIZED X-RAYS, by D. J. Drickey and R. F. Mozley. [1964] [15]p. (Rept. no. HEPL-296) (Nonr-22567) AD 612836 Unclassified

Also published in Phys. Rev., v. 136: B543-B547, Oct. Oct. 26, 1964.

Measurements of neutral pion photoproduction have been made at 235, 285, 335, and 435 mev, using a beam of polarized x-rays. Using a calculated value of polarization, an analysis is made which indicates a possible need for gamma, rho, pi, or gamma, omega, pi coupling. The polarization calculations are checked by measurements made as a function of photon production angle at 335 mev.

2605

Stanford U. High-Energy Physics Lab., Calif.

QUASI-FREE ELECTRON-PROTON SCATTERING IN H3 AND He3, by A. Johansson. 1964, 23p. (Rept. no. HEPL-326) (Nonr-22567) AD 610055 Unclassified

Measurements have been made of the cross sections of coincidences between scattered electrons and ejected protons, when targets of H^3 and He^3 are bombarded with 550 mev electrons. The variation of the cross-section with proton angle and proton energy has been studied for fixed electron angle and energy. The results are compared with theoretical calculations based on different three-body nuclear wave functions.

2606

Stanford U. Inst. for Mathematical Studies in the Social Sciences, Calif.

EMPIRICAL COMPARISON OF MODELS FOR A CONTINUUM OF RESPONSES WITH NONCONTINGENT BIMODAL REINFORCEMENT, by P. Suppes, H. Rouanet and others. [1964] [21]p. incl. diagrs. tables. (AFOSR-64-2500) (AF 49(638)1037) AD 453964 Unclassified

Also published in Studies in Math. Psychol., 1964, p. 358-379.

The aims of the present experiment have been twofold. The first has been to investigate the extent to which the common predictions of the linear and stimulus

sampling models for a continuum of responses will hold when the reinforcement distribution is no longer unimodal as it was in the case of the Suppes and Frankmann study. Secondly, a larger number of trials was run in this study than in the Suppes and Frankmann study in order to provide an adequate amount of data at asymptote to test the differential sequential predictions of the linear and stimulus-sampling models. In the Suppes and Frankmann and the Suppes and Rouanet studies, no predictions are reported that differentiate the two kinds of models.

2607

Stanford U. Inst. for Mathematical Studies in the Social Sciences, Calif.

A SIMPLE DISCRIMINATION EXPERIMENT WITH A CONTINUUM OF RESPONSES, by P. Suppes and H. Rouanet. [1964] [41]p. incl. diagrs. tables, refs. (AFOSR-64-2501) (AF 49(638)1037) AD 453965 Unclassified

Also published in Studies in Math. Psychol., 1964, p. 317-357.

This paper reports tests of several stochastic learning models for a continuum of responses in a simple discrimination experiment. The basic models are formulated in Suppes (1959, 1960). The only previous experiment in the literature directly testing these models, reported by Suppes and Frankmann (1961), is concerned with a simple learning situation with unimodal noncontingent determinate reinforcement. They describe their experiment as follows: The subject is told that his task on each trial is to predict by means of a pointer where a spot of light will appear on the circumference of a circle: the subject's responses are his pointer predictions. At the end of each trial the "correct" position of the spot is shown to the subject; this is the reinforcing event for the trial. The response x and the reinforcement y vary continuously along the circle from 0 to 2π.

2608

Stanford U. Inst. for Mathematical Studies in the Social Sciences, Calif.

A PROBABILISTIC MODEL FOR FREE-RESPONDING, by M. F. Norman. Dec. 14, 1964, 99p. (Technical rept. no. 67) (AFOSR-65-0288) (AF AFOSR-62-384) AD 611163 Unclassified

A free-responding (or 'free-operant') situation is one in which an organism is permitted to perform (or 'emit') a certain action (or 'response' or 'operant') repeatedly, at any times it chooses. In the free-operant situations considered in this paper, an animal (typically a rat or pigeon) is induced to perform this action (usually a lever press in the former case and a peck at a specified area or 'key' in the latter) by being tendered a reward (or 'positive) reinforcement'—a small amount of food, for instance, occasionally, after the action is performed. B. F. Skinner, Behavior of Organisms, New York, Appelton-Century-Crofts, discovered that various reward regimes (or 'schedules of reinforcement') generate distinctive behavior patterns in free-responding situations. Interest is centered around this phenomenon.

2609

Stanford U. Microwave Lab., Calif.

NOISE AND CORRELATION STUDIES OF MICROWAVE RESONANCES OF A PLASMA COLUMN IN A MAGNETIC FIELD, by G. N. Oetzel. Oct. 1964, 145p. incl. illus. diagrs. refs. (AFOSR-64-2494) (AF 49(638)1321) AD 615553 Unclassified

Recent observations of strong resonances at the harmonics of the electron cyclotron frequency in the noise emission from low temperature plasmas have raised the question of whether the harmonics were being generated in the volume of the plasma or in the sheath. This work presents conclusive evidence that the observed harmonic effects can be explained satisfactorily in terms of electrostatic oscillations in the plasma volume, and that they cannot be explained in terms of effects in the sheath.

2610

Stanford U. [Microwave Lab.] Calif.

GRAVITATIONAL INSTABILITIES IN A COMPRESSIBLE COLLISIONAL PLASMA LAYER, by B. Coppi. Oct. 1964 [27]p. incl. refs. (AFOSR-65-0393) (AF 49(638)-1321) AD 612342 Unclassified

Also published in Ann. Phys., v. 30: 178-200, Oct. 1964.

The stability of a plasma layer under the influence of a gravitational field, in conditions where all the dissipative effects due to collisions are important, is investigated by proper asymptotic methods. Small ratios of the kinetic to the magnetic pressure and regimes where the ion Larmor radius effects are not relevant are considered.

2611

Stanford U. [Microwave Lab.] Calif.

ADDENDUM ON INERTIAL INTERCHANGE MODES, by B. Coppi. [1964] [2]p. (AFOSR-65-0394) (AF 49(638)-1321) AD 612225 Unclassified

Also published in Phys. Ltrs., v. 12: 213-214, Oct. 1, 1964.

An earlier study of electron inertia effects on plasma stability (Phys. Ltrs., v. 11: 226, 1964) gave only the resistive unstable branch of the interchange mode growth rates as significant. This was due to an inconsistency of the ordering process. The present paper gives a consistent consideration and derives a general dispersion relation which has the earlier determined collisional and collisionless analyses as special cases.

2612

Stanford U. [Microwave Lab.] Calif.

ELECTRON OVERTAKING AS A CAUSE OF INSTABILITY AND TYPE III SOLAR RADIO BURSTS, by D. E. Baldwin. [1964] [2]p. (AFOSR-65-0395) (AF 49-(638)1321) AD 612224 Unclassified

Also published in Phys. Ltrs., v. 12: 202-203, Oct. 1, 1964.

It is the purpose of this note to suggest a mechanism whereby a time-dependent source of electrons in an otherwise uniform stable plasma may give rise to electrostatic instabilities even though no beam is generated by the source.

2613

Stanford U. [Microwave Lab.] Calif.

STRUCTURE OF THE SOLAR CHROMOSPHERE, by P. A. Sturrock. [1964] [2]p. incl. diagr. (Rept. no. ML-1167) (AFOSR-65-1077) (AF 49(638)1321) AD 617852 Unclassified

Also published in Nature, v. 203: 285-286, July 13, 1964.

It is generally accepted that the radially increasing temperature of the solar atmosphere is due to propagation of non-thermal energy. The possibility that the sun's magnetic field has any significant effect has been discredited, and this note investigates the solar chromosphere structure theoretically by considering acoustic waves only. It is suggested that the strength of these waves may be a result of their build-up into shock waves, though this paper departs from the usual assumption that acoustic waves of arbitrarily small amplitudes will form shocks. It is assumed here that a wave forms a shock only if $M \sim 1$. The model presented enables one to understand the sharp transition from the chromosphere to the corona.

2614

Stanford U. [Microwave Lab.] Calif.

A NEW MODEL OF SOLAR FLARES, by P. A. Sturrock and B. Coppi. [1964] [2]p. incl. refs. (AFOSR-65-1078) (AF 49(638)1321) AD 619754 Unclassified

Also published in Nature, v. 204: 61-62, Oct. 3, 1964.

A model of a solar flare is set up opposing theories which assume that the mechanism for energy storage is purely magnetic. Because of the high density of the gas envolved, gravitational potential energy is considered as an alternative or complementary form. The pre-flare configuration is visualized as a dense layer of cool gas supported by and compressing a magnetic field. Homologous flares are explained by proposing a mechanism for the slow build-up of such a configuration, which will at some stage become unstable. This instability must be such as to allow the magnetic field to return to its unstressed state. The build-up of such a configuration is further explained.

2615

Stanford U. [Microwave Lab.] Calif.

TEMPERATURE DEPENDENCE OF THE WIDTH AND POSITION OF THE $^2E - {}^4A_2$ FLUORESCENCE LINES OF Cr^{3+} AND V^{2+} IN MgO, by G. F. Imbusch, W. M. Yen and others. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-0906) (AF AFOSR-62-343) AD 439861 Unclassified

Also published in Phys. Rev., v. 133: A1029-A1034, Feb. 17, 1964.

This paper reports measurements of the width and positions of the sharp fluorescence lines of two ions in MgO between 4.2°K and room temperature. A semi-empirical model is used to calculate the temperature dependence of the width and position from the vibrational structure associated with the sharp no-phonon line. The shift agrees well with theory but the linewidth deviates somewhat at low temperatures. (Contractor's abstract, in part)

2616

Stanford U. [Microwave Lab.] Calif.

THE HIGH GAIN LASER AS A WAVELENGTH STANDARD, by L. F. Mollenauer, G. F. Imbusch and others. [1963] [16]p. incl. illus. diagrs. refs. (M. L. rept. no. 1139) (AFOSR-64-0907) (AF AFOSR-63-322) AD 433118 Unclassified

Presented at Symposium on Optical Masers, Polytechnic Inst. of Brooklyn, N. Y., Apr. 16-19, 1963.

The requirements for monochromaticity and stability of an optical maser are discussed. Two methods are shown for obtaining output at the center of the spontaneous emission line. The first uses strong anomalous dispersion to pull oscillation of a single cavity mode close to the atomic line center. By using a short cavity with low reflectivity ends, and a sufficiently sharp atomic line, the output frequency is made highly independent of the cavity dimensions. The second, intended as a convenient secondary frequency standard for spectroscopic work, uses the effective line narrowing created by high overall gain to select mode frequencies at the line center for oscillation at threshold. Such a device, using a clad ruby rod immersed in liquid nitrogen, and without adjustments, has generated a single line whose stability and width are better than two parts in 10^7. (Contractor's abstract)

2617

Stanford U. Microwave Lab., Calif.

NONLINEAR EFFECTS IN LONGITUDINAL ELECTRON-STREAM SLOW-WAVE GUIDE SYSTEMS, by G. C.

Van Hoven. Apr. 1963 [97]p. incl. illus. diagrs. tables, refs. (M. L. rept. no. 1026) (AFOSR-4878) (Nonr-22548) Unclassified

This monograph presents an experimental demonstration of two heretofore unobserved nonlinear effects in systems supporting space-charge waves. The discussion is based on a physical theory which exhibits second order coupling of these waves to those supported by an external circuit. This new interaction makes possible the control of idler harmonic dispersion and, thus, removes a major obstacle to the design of a successful parametric amplifier using space-charge waves. The most important prediction of this theory is the possibility, which has been verified, of removing negative energy kinetic excitation from the slow space-charge wave. The physical theory, a perturbation analysis in displacement variables, describes all possible second order nonlinear interactions. A small signal power theorem, applicable to three frequency excitation, is derived from the dynamical equations. The conditions, restricting the location of higher idler harmonics, under which this simplification is justified are discussed.

2618

Stanford U. Microwave Lab., Calif.

THE THEORY AND APPLICATION OF SOME TRANSVERSE-WAVE INTERACTIONS, by R. E. Hayes. Apr. 1963, 207p. (Technical rept. no. 1025) (AFOSR-4965) (Nonr-22548) AD 404098 Unclassified

The results of a theoretical and experimental investigation of transverse-wave couplers, and of frequency doublers employing these couplers in conjunction with a resonant quadrupole circuit, are described. The theory of both traveling-wave and resonant couplers is developed in detail so that the significant characteristics of the coupling interactions are described in terms of known quantities. The coupled mode theory was extended to include twisted transverse-wave couplers with a resulting clarification of this important class of interactions. The theory shows that the traveling-wave couplers may have a large bandwidth but generally tend to be quite long due to the low interaction impedance characterizing this type of circuit.

2619

Stanford U. Microwave Lab., Calif.

NONLINEAR QUANTUM EFFECTS, by R. C. Smith. Apr. 1963 [174]p. incl. diagrs. refs. (M. L. rept. no. 1027) (AFOSR-4966) (Nonr-22548) AD 405521 Unclassified

The purpose of this research was to study the phenomena of multiple quantum processes and to consider possible applications. These processes involve the interaction of more than a single quantum of radiation with an atomic system and are nonlinear in character. An equation of motion approach is used in the solution of the quantum mechanical problem, allowing the calculation of the observable quantities important for the radiation processes considered. From the results of this research it is thus concluded that a quantum mechanical system possesses nonlinear as well as linear properties and that these nonlinear properties may find application, especially in the submillimeter and optical regions where suitable nonlinear elements do not presently exist.

2620

Stanford U. Microwave Lab., Calif.

HARMONIC GENERATION IN PLASMAS, by J. H. Krenz. July 1963 [148]p. incl. illus. diagrs. refs. (M. L. rept. no. 1055) (AFOSR-64-0348) (Nonr-22548) Unclassified

The generation of harmonics due to the nonlinear properties of a microwave plasma discharge is investigated theoretically and experimentally. The nonlinear effects of collisions, spatial variations of rf electric field and plasma density, and sheaths are analyzed. With the objective of developing and an efficient harmonic generator and understanding the basic discharge mechanisms, various experimental techniques and configurations are explored. (Contractor's abstract)

2621

Stanford U. Microwave Lab., Calif.

THE THEORY OF DIRECT TRANSITIONS IN SEMICONDUCTORS, by R. H. Pantell, M. DiDomenico, Jr. and O. Svelto. Jan. 1964 [23]p. (M. L. rept. no. 1131) (AFOSR-64-0349) (Nonr-22548) AD 431112 Unclassified

The problem of direct interband transitions in semiconducting crystals is considered in detail. The solution of the problem is shown to lead to a system of simultaneous coupled nonlinear differential equations. These equations do not distinguish between static and dynamic fields, and are obtained without recourse to any approximation procedures. They therefore apply for electromagnetic fields of arbitrary amplitude. It is shown, finally, that the linearization of these equations correctly predicts the fundamental optical edge and the photoconductive rate equations which result in photomixing phenomena.

2622

Stanford U. Microwave Lab., Calif.

FAR INFRARED STUDY OF OPTICAL MODES AND INDEX OF REFRACTION IN CADMIUM SULFIDE, by B. Lebech. Nov. 1963 [37]p. incl. diagrs. table, refs. (M. L. rept. no. 1108) (AFOSR-64-0352) (Nonr-22548) Unclassified

The purpose of this work was to investigate the optical modes by some simple means in piezoelectric and polar crystal. A spectrometer was used to investigate CdS in the region near the reststrahlung frequency. The primary results which are presented here show that

the measured index of refraction ($n \sim 2.1$) in the range from 50 to 150μ is consistent with the single resonance of the transverse optical mode at 41.5μ.

2623

Stanford U. Microwave Lab., Calif.

THE EFFECT OF HOLE MOBILITY ON ACOUSTIC WAVE AMPLIFIERS, by K. Blotekjaer. Aug. 1963 [26]p. incl. diagrs. (M. L. rept. no. 1072) (AFOSR-64-0627) (Nonr-22548) Unclassified

Acoustic waves can be amplified by interaction with drifting electrons in piezoelectric semiconductors. Amplifiers built on this principle tend to be unstable, because waves reflected from inhomogeneities or a mismatched output propagate in the backward direction with very little attenuation. It is shown in the present paper that the backward attenuation can be increased substantially by allowing the reflected waves to interact with drifting holes. The propagation characteristics of the waves on the drifting electrons and holes are discussed, and numerical calculations are carried out to show that the presence of the holes tends to stabilize the amplifier. The proposed scheme requires a piezoelectric semiconductor with high intrinsic conductivity.

2624

Stanford U. Microwave Lab., Calif.

TILTED-PLATE INTERFEROMETRY WITH LARGE PLATE SEPARATIONS, by H. W. Moos, G. F. Imbusch and others. Sept. 1963 [6]p. incl. illus. diagr. refs. (M. L. rept. no. 1083) (AFOSR-64-0528) (Nonr-22548) AD 418621 Unclassified

Also published in Appl. Opt., v. 2: 817-822, Aug. 1963.

With very highly collimated monochromatic light sources, such as optical masers, multiple-beam interference fringes between nearly parallel surfaces are obtained at large separations. Sharp fringes displaying the surface contours have been observed as large as 20 cm. The requirements and limitations of the device are described, as well as some possible applications. (Contractor's abstract)

2625

Stanford U. Microwave Lab., Calif.

INTERACTION OF ACOUSTIC WAVES AND ELECTRIC CURRENTS IN SOLIDS, by A. Tonning. Aug. 1963 [25]p. incl. diagr. (M. L. rept. no. 1068) (AFOSR-64-0630) (Nonr-22548) AD 417719 Unclassified

On the basis of Boltzmann's transport equation an expression is derived for the space-charge modulation in a current-carrying solid when a periodically varying force is acting on the electrons. The force may be caused by an acoustic wave interacting with the electrons through the deformation potential or through the piezoelectric effect. These two special cases are discussed and the condition for obtaining amplification of the acoustic wave is derived. The high-frequency properties of the two interaction mechanisms are studied. In an appendix it is shown that the deformation potential mechanism may be described by two linear equations similar to the well-known piezoelectric equations. (Contractor's abstract)

2626

Stanford U. Microwave Lab., Calif.

THE COUPLED MODES OF ACOUSTIC WAVES AND DRIFTING CARRIERS IN PIEZOELECTRIC CRYSTALS, by K. Blotekjaer and C. F. Quate. July 1963 [67]p. incl. diagrs. refs. (M. L. rept. no. 1057) (AFOSR-64-0597) (Nonr-22548) Unclassified

The amplification of acoustic waves in piezoelectric semiconductors is analyzed in terms of the normal modes of the uncoupled system. The characteristics of the growing wave are presented for a range of the crystal parameters in terms of the conduction frequency (σ/ϵ) and the diffusion frequency (v^2/D). Boundary conditions are worked out to show that an acoustic wave at the input to the amplifying section will couple into the growing wave without appreciable initial loss. The experimental results with CdS at 600 mc confirm the general features of the theory and serve to point out the problems which must be overcome.

2627

Stanford U. Microwave Lab., Calif.

PHOTOMIXING IN A BULK SEMICONDUCTOR PHOTODETECTOR, by J. N. Weaver. Aug. 1964 [65]p. incl. diagrs. tables, refs. (M. L. rept. no. 1206) (AFOSR-64-1903) (Nonr-22548) Unclassified

This study is concerned with bulk semiconductors as detectors of the difference frequency between two or more optical signals and as a demodulator of microwave AM modulated light. The basic experiment consisted of mounting single crystals of CdSe, Si, and GaAs in a coaxial mount and illuminating the crystals with the beam of a single laser, which consisted of numerous frequencies separated by multiples of ω_D ($\omega_D = 1.32$ Gc). A dc bias voltage was applied and the microwave and dc photocurrents were measured as a function of light intensity, bias voltage, temperature, microwave match, and the various crystal samples. An outline of the pertinent, simplified photoconductor theory is presented along with an equivalent circuit for the photodetector device. Also, the semiconductor capture cross section, lifetime, and trap density is calculated from the measured values of photocurrent.

2628

Stanford U. Microwave Lab., Calif.

A LINEAR ELECTRON ACCELERATOR FOR SUB-MILLIMETER WAVE GENERATION, by R. H. Miller.

Oct. 1964 [132]p. incl. diagrs. tables, refs. (M. L. rept. no. 1244) (AFOSR-65-0250) (Nonr-22548)
AD 610190 Unclasstfied

The use of a relativistic beam of electrons for the generatton of submtllimeter waves tn large interaction structures was tnvestigated as a possible alternative to the scaling of conventional microwave generators to the extremely small dimensions required. The design of an x-band ltnear accelerator for production of a beam having high harmonic current content is discussed, and various methods of achteving good bunching are constdered. A small angle theory of bunching tn a distributed buncher is developed and used as a guide in the destgn of the buncher section of the accelerator. A new mtcrowave measurement technique for measuring field strength and phase in nonresonant structures was used to determtne the electrtcal properties of the buncher. The effect of auxiliary equipment on the operatton of the distributed buncher and accelerator ts evaluated.

2629

Stanford U. Mtcrowave Lab., Calif.

STUDY OF PARALLEL PUMPING IN MICROWAVE FERRITES, by M. Omori. Dec. 1964 [170]p. incl. illus. diagrs. tables, refs. (M. L. rept. no. 1275) (AFOSR-65-1139) (Nonr-22548) Unclassified

Some aspects of the degenerate pumping in a microwave ferrite along with the degenerate pumping in a pendulum and an electrical tuned circutt were theoretically and experimentally investigated. The studies were divided mainly into two parts, one being the study below the parallel pump tnstability threshold, and the other being the study above the threshold. When the pump strength is below the threshold, there are no parametric oscillations and the pumped system responds passively to the signal, whose frequency is the half of that of the pump. When the pump strength is above the threshold, there will be parametrtc oscillations and, as the oscillation builds up, nonlinearities of the system become effective and the osctllation reaches steady state.

2630

Stanford U. Microwave Lab., Calif.

MICROWAVE RESEARCH. Quarterly status rept. no. 22, May 1-July 31, 1964. Oct. 1964, 33p. (M. L. rept. no. 1235) (Nonr-22548) AD 608506 Unclassified

At the present time there are seven projects active under this contract: 1. Acoustic wave ampliftcation studies; 2. Optical masers; 3. Diffraction of light waves by hypersound; 4. Transient effects in optical masers; 5. Electron-phonon interactions; 6. Interaction of sptn waves and electrons; 7. Geometrical optics of acousttc waves.

2631

Stanford U. [Radio Astronomy Inst.] Calif.

INTERFEROMETER PHASING PROBLEMS AT MICROWAVE FREQUENCIES, by G. Swarup and K. S. Yang. 1963 8p. (AFOSR-J291) (AF 18(603)53) AD 408014 Unclassified

The electric field distrtbution required to realize a desired radiation pattern ts sometimes quickly visualized by means of a transfer function (the spectral sensitivity function) which measures the response of the antenna system to the spatial frequencies of a two-dimensional distribution of brightness. The effects of amplitude and phase errors of individual elements on the directivity and side radiation pattern of an interferometer system are discussed. In the case of phase-switched interferometers it is also important to evaluate the effect of fixed phase error of the switch and feeder system, and phase throw error of the switch, on the radiation pattern. It is shown that these phase errors affect the shape of the radiation pattern only if there exists an odd component in the two-dimensional electrtc field distribution over an aperture.

2632

Stanford U. [Radio Astronomy Inst.] Calif.

OBSERVATIONS AT 9.1 CM OF TAURUS A, THE ORION NEBULA, VIRGO A, CENTAURUS A, SAGITARRIUS A, AND THE OMEGA NEBULA, WITH 2.3 FAN BEAM, by A. G. Little. [1963] [11]p. (AFOSR-J733) (AF 18(603)53) AD 414147 Unclasstfied

Also publtshed in Astrophys. Jour., v. 137: 164-174, 1963.

Fan-beam observations of several of the stronger radio sources were made, using a wide-band parametric amplifier connected to the Stanford mtcrowave spectroheliograph. All sources were scanned in the east-west direction at meridian transit. For the two sources Taurus A and Virgo A the north-south antenna was used to provide two additional scanning directions. From these, the Taurus A source is found to be an ellipse whtle the Virgo A radiation comes from a narrow region away from the position angle of the jet. The central source of Centaurus A is found to be split into two regions, while the Orton Nebula and Sagittarius A are simple sources. The Omega nebula is shown to have a weak source located at the optical center of the nebula and a strong source to the west. The observed transtt times of the maxima are also given.

2633

Stanford U. [Radio Astronomy Inst.] Calif.

RESOLUTION OF CYGNUS A WITH A 52" BEAM, by G. Swarup, A. R. Thompson, and R. N. Bracewell. Feb. 1963, 13p. (AFOSR-4655) (AF 49(638)1059) AD 408484 Unclassified

Direct resolutton of Cygnus A at a frequency of

3292 mc/s using the 52 in. fan beam of a compound interferometer is reported. On the basis of a firm determination of the actual peak-to-peak distance the existing data were examined and it was found that the reported dependence of separation on frequency is simply an appearance produced by the existence of a third-component whose spectrum differs from that of the main components.

2634

Stanford U. Radio Astronomy Inst., Calif.

HIGH-RESOLUTION OBSERVATIONS OF THE RADIO SUN AT 9.1 CENTIMETERS ON JULY 20, 1963, by H. K. Asper, R. N. Bracewell and others. [1964] [3]p. incl. diagrs. (AFOSR-65-2255) (AF 49(638)1059) Unclassified

Also published in Jour. Geophys. Research, v. 69: 1805-1807, May 1, 1964.

The 9.1-cm radio sun at the time of the eclipse of July 20, 1963, had two radio plages. One, of moderate importance, was located near the east limb at 58° ± 2°E and 10° ± 2°N. It had a flux density of about 5×10^{-22} watt m^{-2} $(c/s)^{-1}$ and an angular size in the east-west direction of 1.5′. The brightness temperature was 1×10^{6} °K (effective value for a uniform circular source 1.5′ in diameter). The other was of much lower intensity and was located near the west limb at 80° ± 10°W and 4° ± 2°N. Its flux density was about 2×10^{-22} watt m^{-2} $(c/s)^{-1}$, and its size less than 3.5′ in both north-south and east-west directions. (Contractor's abstract)

2635

Stanford U. Radio Astronomy Inst. Calif.

THE STANFORD COMPOUND-GRATING INTERFEROMETER, by J. S. Picken and G. Swarup. [1964] [4]p. incl. illus. diagrs. refs. (AFOSR-65-2257) (AF 49(638)1059) AD 625991 Unclassified

Also published in Astronom. Jour., v. 69: 353-356, June 1964.

A compound interferometer of high angular resolving power in one coordinate has been constructed at Stanford using the E-W arm of the existing cross antenna. The instrument produces multiple fan beams 52" E-W by 2.3°N-S at 9.1-cm wavelength. It is capable of observing the size and percentage of circular polarization of solar radio plages, the solar disk, and galactic and extragalactic radio sources.

2636

Stanford U. Stanford Electronics Labs., Calif.

WHISTLER-MODE PROPAGATION DATA NO. 2, by D. L. Carpenter and G. B. Carpenter. Jan. 1963, 12p. incl. tables, refs. (Technical rept. no. 1112-1; rept. no. SEL-63-006) (AFOSR-4929) (AF 49(638)1060) Unclassified

Routine data on whistler dispersion and on whistler-mode echoes from VLF-pulse transmissions are tabulated. The whistler data were obtained at Stanford, Calif., at Seattle, Wash., and at Logan, Utah. Data are sampled on a daily basis. The times of occurrence, values of dispersion at 5 kc, and the frequency and travel time at the whistler nose are tabulated. Data on whistler-mode echoes from VLF station NPG (Jim Creek, Wash., 18.6 kc) were obtained at Stanford, Calif. Hourly values of two-hop echo travel time, activity index, and quality factor for the period Nov. 1 to Dec. 31, 1961 are tabulated.

2637

Stanford U. Stanford Electronics Labs., Calif.

STUDY OF NATURAL AND MAN-MADE VLF PHENOMENA. Final rept. Aug. 1, 1962-July 31, 1963, 7p. (AFOSR-J1392) (AF 49(638)1060) AD 428348 Unclassified

The study of natural and man-made VLF phenomena is described under these headings: (1) whistler-mode propagation; (2) magnetosphere electron density studies using whistlers; and (3) wave-particle interactions. A brief description is given of most of the work since details are available in reports and publications listed in an attached bibliography. In addition to the bibliography of published material there is a list included which deals with papers presented at technical meetings and symposia.

2638

Stanford U. Stanford Electronics Labs., Calif.

WHISTLERS EXCITED BY NUCLEAR EXPLOSIONS, by R. A. Helliwell and D. L. Carpenter. [1963] [12]p. incl. illus. diagrs. table, refs. (AFOSR-64-0307) (AF 49(638)1060) AD 424531 Unclassified

Also published in Jour. Geophys. Research, v. 68: 4409-4420, Aug. 1, 1963.

The dynamic spectrums of whistlers excited by five nuclear explosions are found to be identical to those of natural whistlers observed within a few minutes of shot time. Two shots fired at the Nevada proving ground produced normal two-hop whistlers at Stanford, 600 km to the west. Three shots fired over Johnston Island produced one-hop whistlers, some of which were received at northern hemisphere stations as far away as Stanford, 5100 km to the northeast. No whistlers were observed on Kauai, only 1200 km northeast of Johnston Island. Analysis shows that the magnetospheric paths of natural and explosion-excited whistlers are essentially the same, and that these paths are fixed in the ionosphere and are not necessarily close to the impulse source or the receiver.

2639

Stanford U. [Stanford Electronics Labs.] Calif.

PLASMA INSTABILITY IN THE WHISTLER MODE CAUSED BY A GYRATING ELECTRON STREAM, by T. F. Bell and O. Buneman. [1964] [3]p. (AFOSR-64-1376) (AF 49(638)1060) AD 444472 Unclassified

Also published in Phys. Rev., v. 133: A1300-A1302, Mar. 1964.

Excitation of the whistler (electromagnetic) mode in a cold plasma immersed in a static magnetic field cannot be achieved by monoenergetic electrons initially streaming parallel to the field lines, since for this case gyroresonance can occur only when the stream direction is opposed to the direction of the wave, and as demonstrated by Neufeld, the beam will then fail to transfer energy to the wave. However, for streams with finite initial transverse velocity the analysis of Neufeld must be modified, and it is found that a spread of stream electron velocity in the transverse direction leads to an instability of the stream-plasma system in the whistler mode, with the transverse electron gyrations serving as an energy source.

2640

Stanford U. Stanford Electronics Labs., Calif.

TIME REVERSAL OF THE GEOCYCLOTRON MECHANISM, by T. F. Bell. [1964] [3]p. (AFOSR-65-1389) (AF 49(638)1060) AD 622645 Unclassified

Also published in Jour. Geophys. Research, v. 69: 177-179, Jan. 1, 1964.

A possible method is outlined for removing high-energy particles from natural or artificially produced radiation belts. In essence it is the time of reversal of the geocyclotron mechanism, and its object is to de-energize high-energy electrons by means of gyroresonance, a phenomenon in which electrons in the earth's outer ionosphere are decelerated by frequency-modulated, circularly polarized electromagnetic waves generated on the ground. A simple numerical example of the use of such a model is presented, and it is concluded that such a method is possible for the removal of high-energy particles from radiation belts.

2641

Stanford U. Stanford Electronics Labs., Calif.

OPTICAL-MASER AND COHERENT-PLASMA STUDIES, by W. W. Anderson, O. Buneman, and A. E. Siegman. Final rept. June 1963, 7p. incl. diagrs. (Rept. no. SEL-63-089) (AFOSR-J1302) (AF AFOSR-62-286) Unclassified

The work under this contract has included far-infrared maser studies by Professor Siegman, studies of rare-earth ions in semiconductor lattices by Professor Anderson, and plasma studies by Professor Buneman.

2642

Stanford U. [Stanford Electronics Labs.] Calif.

PHOTOLUMINESCENT PROPERTIES OF RARE EARTH DOPED II-VI COMPOUNDS (Abstract), by W. W. Anderson. [1964] [1]p. (AF AFOSR-62-286) Unclassified

Presented at Toronto meeting of the Electrochem. Soc., Canada, May 3-7, 1964.

The emission lines of Tb^{+++} and Nd^{+++} in ZnS are strong narrow (less than 3A wide) at 77°K. Evidence for indirect excitation of the 4f electronic system of the rare earth ions is the presence of the characteristic narrow emission lines even when the exciting illumination is of higher energy than the II-VI compound band gap and the presence of the dark lines in the broad band emission of Nd doped CdS corresponding to the $^4_{9/2} \rightarrow {}^4F_{3/2}$ transition of Nd^{+++}

2643

Stanford U. [Stanford Electronics Labs.] Calif.

FUNCTIONAL NETWORK ANALYSIS AND SYNTHESIS, by R. W. Newcomb and D. A. Spaulding. Aug. 28, 1963, 32p. (AFOSR-J1208) (AF AFOSR-62-349) AD 424272 Unclassified

The primary motivation for this research has been to obtain analysis and synthesis methods for time-varying networks through functional techniques. The original attempts were to generalize Mikusinski's operational calculus to a form usable for time-varying networks. Although this still seems possible, these attempts led to investigations of zero-divisors (in an algebra based upon Volterra composition), which in turn led to the discovery of a time-variable scattering matrix. This research has shown that every linear, passive, solvable network has such a scattering matrix, and several of the key properties have been obtained.

2644

Stanford U. [Stanford Electronics Labs.] Calif.

THE FOUNDATIONS OF NETWORK THEORY, by R. W. Newcomb. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-1732) (AF AFOSR-62-349 and Nonr-22524) AD 448276 Unclassified

Also published in Trans. Elec. and Mech. Eng., May 1964, p. 7-12.

This paper outlines a rigorous theory of networks, set up with the synthesis of time-varying networks in mind. Although the definitions of network properties given hold when considering any type of network, they should not be looked upon as the only possible ones or even the most appropriate. For instance it may be desirable to generalize the notion of solvability such that it is more meaningful for nonlinear networks. In any event, using the notions given, very general results concerning time-variable networks can be obtained.

2645

Stanford U. Stanford Electronics Labs., Calif.

AN FM TECHNIQUE FOR OBSERVATION OF VLF WHISTLER-MODE PROPAGATION, by G. B. Carpenter. Dec. 1963, 52p. incl. illus. diagrs. refs. (Technical rept. no. 3412-2: rept. no. SEL-63-133) (AFOSR-64-0002) (AF AFOSR-62-370) AD 429891 Unclassified

The usefulness of whistlers is somewhat restricted by the relative lack of information concerning lightning-source parameters, while relatively poor multipath resolution has been obtained using the signals of VLF transmitters. A controlled-source experiment intended to overcome these disadvantages is described in this report. The FM technique for detecting and resolving whistler-mode signals is based on the observation of amplitude modulation of the direct subionospheric signal due to the presence of whistler-mode signals. Travel time of the whistler-mode signal is shown to be associated with the periodicity of the envelope changes of the composite signal. Factors such as signal dispersion, value of modulation parameters, and instrumental effects are considered with regard to their influence on detection and resolution. An actual FM experiment is described.

2646

Stanford U. Stanford Electronics Lab., Calif.

ARTIFICIALLY STIMULATED VERY-LOW-FREQUENCY RADIATION FROM THE IONOSPHERE, by R. A. Helliwell, J. Katsufrakis and others. [1964] [4]p. incl. illus. table. (AFOSR-64-1369) (AF AFOSR-62-370) Unclassified

Also published in Jour. Geophys. Research, v. 69: 2391-2394, June 1, 1964.

In the course of experimental studies of whistlers and related ionospheric effects conducted by Stanford University, a new phenomenon has been discovered. It is the triggering of VLF emissions in the ionosphere by whistler-mode signals transmitted from VLF stations operated by the U. S. Navy. Certain important features of this phenomenon are reported.

2647

Stanford U. Stanford Electronics Labs., Calif.

THE DISTRIBUTION OF IONS AND ELECTRONS IN THE EARTH'S EXOSPHERE, by J. J. Angerami and J. O. Thomas. Dec. 1963, 94p. incl. diagrs. tables, refs. (Technical rept. no. 3412-3; rept. no. SEL-63-110) (AFOSR-64-1370) (AF AFOSR-62-370) AD 604040 Unclassified

The factors which govern the distribution of electrons and ions in the earth's exosphere are discussed. The theory takes into account the effect of the electric field which arises from charge separation, the centrifugal force arising from the rotation of the earth and the effect of the earth's gravitational field. It is assumed that the charged particles are constrained to move only along the direction of the earth's magnetic lines of force. The modifications that result in the electron and ion distributions when a temperature variation is assumed along a line of force are also considered. (Contractor's abstract, in part)

2648

Stanford U. Stanford Electronics Labs., Calif.

WAVE PARTICLE GYRORESONANCE INTERACTIONS IN THE EARTH'S OUTER IONOSPHERE, by T. F. Bell. May 1964, 214p. (Technical rept. no. 3412-5; rept. no. SEL-64-065) (AFOSR-64-1908) (AF AFOSR-62-370) AD 607379 Unclassified

An investigation is presented of certain aspects of those gyroresonance interactions which take place between very low frequency VLF electromagnetic waves and charged particle fluxes in the earth's outer ionosphere. Specifically two problems are considered. The first problem involves the stability of the outer ionosphere plasma to whistler-mode waves under conditions in which high energy electron fluxes permeate this plasma. The second problem involves the feasibility of the creation or depletion of an artificial radiation belt utilizing the geocyclotron gyroresonance interaction in order to transfer energy between man-made waves and relativistic electrons trapped in the outer-ionosphere by the earth's magnetic field near the magnetic equatorial plane.

2649

Stanford U. Stanford Electronics Labs., Calif.

STUDY OF NATURAL AND MAN-MADE VLF PHENOMENA, by D. L. Carpenter. Final rept. Aug. 1, 1963-July 31, 1964. Oct. 1964, 14p. (AFOSR-64-2067) (AF AFOSR-62-370) AD 608595 Unclassified

Three principal areas of investigation are reviewed: (1) whistler mode propagation, (2) magnetospheric electron density studies using whistlers, and (3) wave-particle interactions.

2650

Stanford U. [Stanford Electronics Labs.] Calif.

WHISTLER MEASUREMENTS OF ELECTRON DENSITY IN THE MAGNETOSPHERE, by D. L. Carpenter and R. L. Smith. [1964] [17]p. incl. illus. diagrs. refs. (AFOSR-64-2222) (AF AFOSR-62-370) AD 452391 Unclassified

Also published in Rev. Geophys., v. 2: 415-441, Aug. 1964.

The whistler method of measuring electron density in the magnetosphere is discussed. Particular attention is devoted to certain questions that may have been perplexing to workers outside the whistler field.

Profiles of equatorial electron density deduced from whistlers are compared and are found to be in general agreement. Whistler results on the 'knee' in the equatorial electron density profile and on values of electron density near 2 earth radii geocentric distance are found to agree with corresponding results obtained by independent methods of measurement. (Contractor's abstract)

2651

Stanford U. Stanford Electronics Labs., Calif.

ASSOCIATION BETWEEN VLF EMISSIONS AND FLICKERING AURORA, by E. Ungstrup. June 1964, 4p. incl. illus. table. (Technical rept. no. 3412-4; rept. no. SEL-64-050) (AFOSR-64-2223) (AF AFOSR-62-370) AD 610854 Unclassified

During a VLF experiment at Fairbanks, Alaska, an unusual chorus type of emission with a warbling or fluttering sound was heard on four different occasions. An example of the spectrum of the emission is presented which shows a series of bursts in the 1000- to 1800-cps range. Some of the bursts, which last for 1 to 3 sec, show a well-developed fine structure with several sharply rising tones at irregular spacing, each lasting about 0.1 sec. The emission bursts were associated with active periods in the aurora where groups of flashes or flickerings took place and, in the opinion of the observer, each of the short, sharply rising tones was associated with a flash in the aurora. Also presented is a band of hiss in the 600- to 1200cps range.

2652

Stanford U. Stanford Electronics Labs., Calif.

DISCRETE VLF EMISSIONS FROM THE UPPER ATMOSPHERE, by N. Brice. Aug. 1964, 181p. (Technical rept. no. 3412-6; rept. no. SEL-64-088) (AFOSR-65-0070) (AF AFOSR-62-370) AD 610424 Unclassified

A new mechanism for the generation of emissions by energetic electrons—the transverse-resonance plasma instability--was found. The existence of this instability depends on the electron velocity component transverse to the earth's magnetic field rather than the component along the field. The emitted signals propagate along the field in a direction opposite to the drift of the electrons. This instability is nonconvective and, as such, has an inherent advantage over mechanisms previously suggested for explaining the generation of discrete emissions. The hypothesis that discrete VLF emissions are generated by this mechanism leads to a qualitative explanation of their diurnal variation, and much additional support for this hypothesis is found in the data.

2653

Stanford U. Stanford Electronics Labs., Calif.

FUNDAMENTALS OF VERY LOW FREQUENCY EMISSION GENERATION MECHANISMS, by N. Brice. [1964] [8]p. (AFOSR-65-0262) (AF AFOSR-62-370) AD 611463 Unclassified

Also published in Jour. Geophys. Research, v. 69: 4515-4522, Nov. 1, 1964.

The transfer of energy between whistler-mode signals and energetic charged particles is examined. Resonance conditions are derived, leading to a classification of the mechanisms previously suggested for the generation of VLF emissions. The relationship between change in energy and change in pitch angle of the particles is derived for the transverse resonance interaction with longitudinal whistler-mode waves. Features of the transverse resonance plasma instabilities and the anomalous Doppler effect are clarified.

2654

Stanford U. [Stanford Electronics Labs.] Calif.

A QUALITATIVE EXPLANATION OF THE DIURNAL VARIATION OF CHORUS, by N. Brice. [1964] [3]p. (AFOSR-65-0263) (AF AFOSR-62-370) AD 611344 Unclassified

Also published in Jour. Geophys. Research, v. 69: 4701-4703, 1964.

It is suggested that the VLF emissions called chorus are generated by the transverse resonance plasma instability for electrons and that the production of this instability requires anisotropy in the electron velocity distribution. Phenomena which might give rise to the required anisotropy are considered. It is suggested that the compression of the outer magnetosphere by the solar wind would assist in producing the anisotropy. While no attempt is made to explain the systematic shift in the time of maximum chorus occurrence with latitude, it is shown that the compression of the magnetosphere leads to an explanation of the observation that chorus is generally observed between dawn and noon. A conservative estimate of the rate of increase in transverse energy of energetic electrons arising from this compression is found to be orders of magnitude greater than that required to explain the energies observed in chorus.

2655

Stanford U. [Stanford Electronics Labs.] Calif.

STUDIES OF PLANETARY ATMOSPHERES. I. THE DISTRIBUTION OF ELECTRONS AND IONS IN THE EARTH'S EXOSPHERE, by J. J. Angerami and J. O. Thomas. [1964] [24]p. (AFOSR-65-0364) (AF AFOSR-62-370) AD 612352 Unclassified

Also published in Jour. Geophys. Research, v. 69: 4537-4560, Nov. 1, 1964.

For abstract see item no. 2647.

2656

Stanford U. Stanford Electronics Labs., Calif.

A CIRCUIT AND NOISE MODEL OF THE FIELD-EFFECT TRANSISTOR, by G. N. Bechtel, Jr. Apr. 1963 [83]p. incl. diagrs. tables, refs. (Technical rept. no. 1612-1; rept. no. SEL-63-044) (AFOSR-5000) (Nonr-22524) AD 407177 Unclassified

The field-effect transistor is treated from an active R-C transmission-line approach, and a circuit model is derived from a lumped-element approximation to the line. The circuit model is found to be similar to that often stated for the high-frequency (hf) circuit model of the vacuum tube. The model is characterized by the low-frequency (l-f) admittance parameters and two high-frequency parameters: the cutoff frequency (which is the frequency at which the hf transconductance falls to one-half of its l-f value) and a constant relating to the input conductance. A maximum useful frequency for the device, which is close to the cutoff frequency, is calculated from the model.

2657

Stanford U. [Stanford Electronics Labs.] Calif.

MEAN-SQUARE ERROR IN CORRELATION DEMODULATORS, by B. F. Ludovici. [1963] 11p. (AFOSR-64-0336) (Nonr-22524) AD 434512 Unclassified

Also published in Archiv. der Elektrischen Übertragung, v. 17: 278-288, 1963.

Four different methods of extracting the intelligence from an amplitude-modulated carrier in the presence of noise are analyzed on a mean-square error basis. Assumed is band-limited white gaussian noise and a noise-like modulating intelligence of uniform power spectrum ranging from dc to an upper limiting frequency equal to two-thirds of the carrier frequency. Included in the analysis are the square-law, autocorrelation, two-amplifier and crosscorrelation demodulators. As an important result, this investigation shows that the autocorrelation demodulator offers no significant improvement over the simple square-law demodulator.

2658

Stanford U. Stanford Electronics Labs., Calif.

TIME-VARIANT COMMUNICATION CHANNELS, by T. Kailath. Aug. 1963 [21]p. incl. diagrs. refs. (Technical rept. no. 7050-1; rept. no. SEL-63-106) (AFOSR-64-0346) (Nonr-22524) AD 420482 Unclassified

Work on time-variant channels can be broken down into five areas—methods of channel representation, methods for measuring the instantaneous and average behavior of the channel, the derivation of suitable receiver structures for communication over such channels, the evaluation of the performance of such receivers, and studies of signal selection and coding techniques to increase the speed and reliability of communication. A fairly detailed summary of work on the channel-characterization problem is presented.

2659

Stanford U. Stanford Electronics Labs., Calif.

MINIMUM-TIME CONTROL OF A LINEAR COMBINATION OF STATE VARIABLES, by C. E. Hutchinson. Aug. 1963 [86]p. incl. diagrs. refs. (Technical rept. no. 6311-1; rept. no. SEL-63-071) (AFOSR-64-0351) (Nonr-22524) AD 421525 Unclassified

This study is concerned with the problem of controlling linear, time-invariant, one-input, one-output systems with zeros of transmission at some (possibly complex) frequencies. The available control effort is magnitude limited, and there are no disturbances. Only the problem of eliminating initial conditions is considered. A detailed analysis of second- and third-order systems is made. The basic mathematical tool used in finding the solution for the general problem is that of Pontryagin's maximum principle.

2660

Stanford U. Stanford Electronics Labs., Calif.

A THIN-FILM, NICKEL OXIDE SWITCH, by W. E. Beadle. Aug. 1963 [45]p. incl. illus. diagrs. tables. (Technical rept. no. 4719-1; rept. no. SEL-63-075) (AFOSR-64-0621) (Nonr-22524) Unclassified

This report describes an electrically actuated, solid-state switch. The switch is a two-terminal device consisting of a thin nickel oxide film separating two ohmic contacts. The gross properties of the switch are (1) reversible switching between two impedance levels (ON: 100 ohms; OFF: 25 megohms), and (2) electrical actuation of the switch (turn-on: 500-v, 40-μ sec pulse; turn-off: 300-ma, 10-nsec pulse). The fabrication of the device from thermally grown nickel oxide is described. A switching model for the device is established on the basis of a series of experiments, and theoretical calculations of switching times using this model are made. Limited lifetimes observed for the device suggest applications requiring single-shot operations which utilize the insulating properties of the NiO film. (Contractor's abstract)

2661

Stanford U. Stanford Electronics Labs., Calif.

LOOPS IN DIRECTED COMBINATIONAL SWITCHING NETWORKS, by C. R. McCaw. Apr. 1963 [56]p. incl. diagrs. tables, refs. (Technical rept. no. 6208-1; rept. no. SEL-63-040) (AFOSR-64-0622) (Nonr-22524) AD 417465 Unclassified

A loop in a network of directed elements is identified as a closed path which traverses each element encountered in the direction from input to output. An examination of such loops in networks of binary switching gate elements reveals that some of them operate in a

combinational manner, yet others produce a sequential output. In networks of branch elements, sequential operation does not artse. Here the problem with loops arises in attempting to discover the form of the Boolean function expression which corresponds to the network. Three standard matrix forms are presented as tools for analyzing networks with loops. Synthests techntques are presented to discover networks which require loops for minimality.

2662

Stanford U. Stanford Electronics Labs., Calif.

THRESHOLD CURRENT FOR P-N JUNCTION LASERS, by J. L. Moll and J. F. Gibbons. Apr. 1963 [15]p. (Technical rept. no. 1664-1; rept. no. SEL-63-013) (AFOSR-64-0623) (Nonr-22524) AD 404315 Unclassified

In a recent letter, Lasher (IBM Jour., v. 7, Jan. 1963) gave the relation for threshold current in a p-n junction laser. In his calculation, Lasher neglected the effect of α_o (absorption loss in the active region) on the threshold current because he felt that it was difficult to estimate. It ts possible to include the absorptive effects associated with incomplete population tnversion, and it is the purpose of thts report to potnt out how this absorption should be tncluded.

2663

Stanford U. Stanford Electronics Labs., Calif.

STATIC THEORY OF DENSITY AND POTENTIAL DISTRIBUTION IN A BEAM-GENERATED PLASMA, by D. A. Dunn and S. A. Self. July 1963 [36]p. incl. diagrs. table, refs. (Technical rept. no. 0311-1; rept. no. SEL-63-086) (AFOSR-64-0624) (Nonr-22524) AD 418683 Unclassified

An electron beam passing through a gas will ionize the gas; and the electrons and ions so produced will collect in the vicinity of the beam to form a plasma with a number density that can be much greater than the density of the beam. A one-dimensional static theory for such a system with a beam either partially or completely filling the space between two parallel planes that gives the plasma denstty and potential and potential distribution in the space ts presented. The theory requires only minor modifications of the Langmuir-Tonks free-fall theory of the positive column. A plasma filling the space occupied by the beam is found to be separated by a low potential sheath from a somewhat lower density plasma extending to the walls where a second higher potential sheath is formed.

2664

Stanford U. Stanford Electronics Labs., Calif.

LAPLACE TRANSFORMS—DISTRIBUTIONAL THEORY, by R. W. Newcomb and R. G. Oliveira. June 1963 [99]p. incl. diagrs. refs. (Technical rept. no. 2250-3; rept. no. SEL-63-021) (AFOSR-64-0625) (Nonr-22524) AD 413413 Unclassified

As Romans the gods of old Greence once revised,
So here we report in form generalized,
Transforms to whose name S. Laplace does apply,
Abstract at the time when L. Schwartz did espy.
The theory proceeds, distributions its start,
Come then the tdeas Fourier at tts heart.
By sin.ple extension all properties come,
A multtplication tncluded among.
(Contractor's abstract)

2665

Stanford U. Stanford Electronics Labs., Calif.

REPRODUCING DISTRIBUTIONS FOR MACHINE LEARNING, by J. D. Spragins, Jr. Nov. 1963 [113]p. incl. diagrs. tables, refs. (Technical rept. no. 6103-7; rept. no. SEL-63-099) (AFOSR-64-0695) (Nonr-22524) AD 431994 Unclassified

A model is proposed for learntng the nature and value of an unknown parameter, or unknown parameters, in a probability distribution which forms part of a body of statistics related to some system or process. The model is Bayesian, involving the assumption of an a priori probabilty distribution over the possible values of the unknown parameters; the performance of experiments to gain information about the parameters; and the alteration of the a priori probabilities by Bayes' rule. In the limit, as the number of experiments approaches infinity, the a posteriori distribution in most cases encountered in practice approaches a delta function at the true values of the unknown parameters, so the system learns the values of the parameter exactly. The learning process developed tn the paper ts shown to be technically feasible if the a priori and a posteriori distributions are of the same form, with the learning accomplished by calculating new parameters for these distributions.

2666

Stanford U. Stanford Electronics Labs., Calif.

THE DESIGN OF WIDEBAND TRANSISTOR AMPLIFIERS BY AN EXTENSION OF THE SAMPLED-PARAMETER TECHNIQUE, by G. Danon and K. Sorenson. Nov. 1963 [47]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 4815-1; rept. no. SEL-63-121) (AFOSR-64-0901) (Nonr-22524) AD 434820 Unclassified

The work presented here centers on the design of fast-pulse amplifiers by the sampled-parameter technique, in whtch the transistor ts characterized by two-port parameters measured at a set of frequencies through the frequency band of interest. The feedback and coupling networks are selected by computations based on these sampled parameters. An application of thts techntque has led to an tterative stage using a 2N918 transistor, the charactertsttcs of which are described.

2667

Stanford U. Stanford Electronics Labs., Calif.

SEEK-TIME IMPROVEMENT IN A RANDOM ACCESS FILE BY APPLICATION OF AN ADAPTIVE ELEMENT, by W. S. Buslik. Dec. 1963 [49]p. incl. diagrs. (Technical rept. no. 6762-1; rept. no. SEL-63-135) (AFOSR-64-0902) (Nonr-22524) AD 436020 Unclassified

An Adaline (adaptive linear neuron) can be trained to distinguish between sets of inputs. In general, the quantized output is used. This report investigates the usefulness of the analog output of Adaline for measuring the frequency of occurrence of a number of different events. Each event is more or less arbitrarily associated with a pattern and it is shown that the degree to which Adaline has been trained to recognize any one of these patterns can be used as a measure of the frequency of occurrence of the associated event. The application of this use of Adaline to a random-access file is simulated in order to show its use in reducing average access time.

2668

Stanford U. Stanford Electronics Labs., Calif.

THE SYNTHESIS OF NONLINEAR FEEDBACK REGISTERS, by K. B. Magleby. Oct. 1963 [95]p. incl. diagrs. tables, refs. (Technical rept. no. 6207-1; rept. no. SEL-63-118) (AFOSR-64-0903) (Nonr-22524) AD 428081 Unclassified

Two domains that describe the behavior of a feedback shift register were developed. These are the sequence and polynomial domains, which are analogous to the frequency and time domains in the description of continuous sysiems. The domains are related by an expansion of orthogonal functions. The synthesis procedure developed in the polynomial domain consists of four steps: (1) constructing a finite field with the necessary properties; (2) finding the polynomials that correspond to the desired output sequences; (3) obtaining the polynomial that describes the shift register as a product of the polynomials that represent the desired output sequence; and (4) obtaining the feedback network from the polynomial that describes the shift register.

2669

Stanford U. Stanford Electronics Labs., Calif.

CONTACTOR CONTROL BY ADAPTIVE PATTERN-RECOGNITION TECHNIQUES, by F. W. Smith. Apr. 1964 [99]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 6762-1; rept. no. SEL-64-042) (AFOSR-64-1329) (Nonr-22524) AD 443083 Unclassified

The purpose of the research described herein is to explore the possibility of utilizing pattern-recognition techniques in the design of controllers for complex dynamic processes. In this design reverse-time trajectories are used to generate patterns that indicate the position of the minimum-time optimal switching surface. Adaptive pattern-recognition techniques are used to find a readily implemented switching function that closely approximates the optimal switching surface. An adaptive threshold logic element—a trainable, linear, pattern-recognition device—is used in conjunction with other equipment to realize a trainable, nonlinear, pattern-recognition device. The controller-design procedure has been simplified by the ability of the trainable function generator to generalize, i.e., to learn the switching function for all regions of the state space after being trained on patterns from only a part of the space.

2670

Stanford U. Stanford Electronics Labs., Calif.

A FAST DIRECT SOLUTION OF POISSON'S EQUATION USING FOURIER ANALYSIS, by R. W. Hockney. May 1964 [39]p. incl. diagrs. refs. (Technical rept. no. 0255-1; rept. no. SEL-64-056) (AFOSR-64-1330) (Nonr-22524) AD 442209 Unclassified

The demand for rapid procedures to solve Poisson's equation had lead to the development of a direct method of solution involving Fourier analysis which can solve Poisson's equation in a square region covered by a 48 x 48 mesh in 0.9 sec on the IBM 7090. This compares favorably with the best iterative methods which would require about 10 sec to solve the same problem. The method is applicable to rectangular regions with simple boundary conditions and the maximum observed error in the potential for several random charge distributions is 5×10^{-7} of the maximum potential change in the region. (Contractor's abstract)

2671

Stanford U. Stanford Electronics Labs., Calif.

CODING FOR ADAPTIVE CAPABILITY IN RANDOM-CHANNEL COMBINATIONS, by R. A. Scholtz. Dec. 1963 [88]p. incl. diagrs. refs. (Technical rept. no. 6104-8; rept. no. SEL-63-124) (AFOSR-64-1331) (Nonr-22524) AD 439820 Unclassified

The design of a random-channel communication system is discussed. System performance is evaluated using two different performance measures: divergence and probability of error. The divergence measure is an analytic tool for use with general channel statistics, and is compared with a probability-of-error analysis under more restricted statistical conditions. Optimum relations are derived between channel statistics, receiver structure, signal encoding, and adaptive capability.

2672

Stanford U. Stanford Electronics Labs., Calif.

ORTHOGONAL EXPANSION APPLIED TO THE DESIGN OF THRESHOLD-ELEMENT NETWORKS, by

J. A. Cooper. Dec. 1963 [105]p. incl. diagrs. tables, refs. (Technical rept. no. 6204-1; rept. no. SEL-63-123) (AFOSR-64-1332) (Nonr-22524) AD 436598 Unclassified

The design of switching functions using threshold logic units is discussed in this report. In an effort to gain insight into the problem of desigining threshold-element networks and providing mathematical background for design procedures, a study of functions of linearly transformed (modulo-2) input variables is presented. Circuitry for realizing linearly decomposed functions consists of two parts: linear and nonlinear. The linear circuitry design is straightforward. Orthogonal expansion demonstrates that the nonlinear circuitry can always be realized by a single threshold element.

2673

Stanford U. Stanford Electronics Labs., Calif.

IDENTIFICATION AND CONTROL OF RANDOM-PARAMETER DISCRETE SYSTEMS, by J. B. Farison. Jan. 1964 [62]p. incl. diagrs. refs. (Technical rept. no. 6302-4; rept. no. SEL-64-008) (AFOSR-64-1334) (Nonr-22524) AD 440427 Unclassified

In the time-domain, state-space description of linear dynamic systems, the system is represented by the input and transition matrices, which determine how the control input and present state affect the next state. If one or more elements of the matrices are unknown or randomly varying parameters, the system is a random-parameter system. The present work is a study of discrete systems with random parameters that are correlated in time. The correlation of the random parameters permits parameter identification, or real-time learning of the random parameters, by processing the system output sequence.

2674

Stanford U. Stanford Electronics Labs., Calif.

OPTIMUM SAMPLING AND CONTROL PROCEDURES FOR A MULTIPLEXED DIGITAL COMPUTER, by E. J. Skiko. Mar. 1964 [90]p. incl. diagrs. refs. (Technical rept. no. 6302-5; rept. no. SEL-64-012) (AFOSR-64-1335) (Nonr-22524) AD 440428 Unclassified

The purpose of this research has been to derive the optimum sampling and control procedures for a multiplexed digital computer. The mutiple-plant deterministic problem was solved in which the optimum control was derived, and it was shown that the optimum control schedule is explicitly determined by the pre-processing procedure. Finally, it was shown that the computation time required for the pre-processing procedure is rather large, although certainly acceptable under many situations. The modified, single-plant, deterministic case, wherein only one component of the control vector can be applied to the plant at each sampling instant, was solved. The optimum control was derived, and it was shown that the optimum control schedule is explicitly determined by the pre-processing procedure.

2675

Stanford U. Stanford Electronics Labs., Calif.

DYNAMIC PROGRAMMING WITH CONTINUOUS INDEPENDENT VARIABLE, by R. E. Larson. Apr. 1964 [105]p. incl. diagrs. refs. (Technical rept. no. 6302-6; rept. no. SEL-64-019) (AFOSR-64-1336) (Nonr-22524) AD 443041 Unclassified

In this study a computational procedure for solving optimal control problems, called dynamic programming with continuous independent variable, has been developed. This procedure has a high-speed memory requirement several orders of magnitude less than that of conventional dynamic programming, but it still retains the general applicability and other desirable features of the conventional method. In a typical example the reduction in high-speed memory requirement is from 10^6 to about 100 locations.

2676

Stanford U. Stanford Electronics Labs., Calif.

THE SYNTHESIS OF MACHINES WHICH LEARN WITHOUT A TEACHER, by S. C. Fralick. Apr. 1964 [23]p. incl. diagrs. (Technical rept. no. 6103-8; rept. no. SEL-64-028) (AFOSR-64-1337) (Nonr-22524) AD 443109 Unclassified

Techniques of decision theory are applied to the problem of learning to recognize patterns without a teacher. As a result a generalized a posteriori probability computer is obtained which includes the solution of the problem of learning without a teacher, learning with a teacher, and no learning. The resulting equations are shown to describe a system which may be synthesized in delay feedback form, of fixed size, which is stable and converges to that system which would be optimum if a priori knowledge was available so that no learning was required. The solution is used to synthesize three systems in black box form: (1) a general system which learns to make binary decisions, (2) a specific example of this system, and (3) a general system which learns to make multiple-category classifications.

2677

Stanford U. Stanford Electronics Labs., Calif.

CHARACTERISTICS OF PHOTON-COUPLED SYSTEMS, by I. Wunderman. Apr. 1964 [79]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 4814-1; rept. no. SEL-64-016) (AFOSR-64-1338) (Nonr-22524) AD 443189 Unclassified

When appropriately fabricated gallium arsenide diodes are biased in the forward direction, they emit a narrow band of radiation in the near infrared. With the current state of technology, it is feasible to incorporate these devices into active electronic amplifiers. This paper describes the properties and capabilities of circuits which can be made by mating these emitting sources to suitable photodetectors, forming 'photon-coupled pairs.' The unique characteristics of such configurations

are electrical isolation of input and output circuits, and unilateral signal transfer. Two specific application examples are discussed in detail.

2678

Stanford U. Stanford Electronics Labs., Calif.

OPTICAL ABSORPTION AND PHOTOLUMINESCENCE OF DOPED GaAs AND $(In_xGa_{1-x})As$, by C. M. Chang. Apr. 1964 [60]p. incl. diagrs. tables, refs. (Technical rept. no. 5064-2; rept. no. SEL-64-031) (AFOSR-64-1339) (Nonr-22524) AD 442491 Unclassified

Absorption coefficients near the fundamental absorption edge have been measured in P-type and N-type GaAs with various doping concentrations. With the aid of the principle of detail balance, these measurements were used to predict the spectra of spontaneous emissions under small excitations, and actual photoluminescence spectra were found to follow the predicted spectra closely. The photoluminescence spectra of Mn-doped GaAs at several different temperatures were studied. Indium was diffused into doped GaAs to modify the band-gap energy. The photoluminescence spectra and absorption coefficients of the diffused layers were measured. The photoluminescence of the diffused layer was found to be shifted in wavelength by an amount consistent with the indium surface concentration.

2679

Stanford U. Stanford Electronics Labs., Calif.

QUANTUM DESCRIPTIONS ON COMMUNICATION THEORY, by C.-Y. She. May 1964 [197]p. incl. diagrs. refs. (Technical rept. no. 0415-1; rept. no. SEL-64-074) (AFOSR-64-1577) (Nonr-22524) AD 443719 Unclassified

This work is an analytical investigation of the significance of quantum mechanical effects on the channel capacity of a communication system. One of the results of the work is the determination of the state of a quantum system after a simultaneous measurement of noncommuting observables is made with maximum accuracy allowed by the uncertainty principle of quantum mechanics. A second result arises when the theory of simultaneous measurement is applied to the communication system. It is found that each of the repeated measurements introduces one quantum of noise energy into the receiving cavity at the moment the measurement is performed. The noise at any one time is made up of the appropriately attenuated noise quanta introduced by each of the previous measurements.

2680

Stanford U. Stanford Electronics Labs., Calif.

IMPROVING THE RELIABILITY OF DIGITAL SYSTEMS BY REDUNDANCY AND RESTORING ORGANS, by J. K. Knox-Seith. Aug. 1964 [101]p. incl. diagrs. tables, refs. (Technical rept. no. 4816-2; rept. no. SEL-64-094) (Nonr-22524) AD 449371 Unclassified

The use of redundant circuits and restoring organs as a technique for improving the reliability of digital systems has been evaluated, and guidelines for a near-optimum use of this technique in practical systems have been established. Two types of restoring organs, majority vote takers and simple adaptive vote takers, have been considered. A series of nomograms has been developed for determining the optimum trade-off between the number of redundant circuits and the number of vote takers to be used in any given situation, and for determining the resulting increase in system reliability. Several conventional measures of reliability have been considered; in addition the useful life T_Δ of a system has been defined as the longest mission time for which the system can operate with a probability of failure less than Δ, where Δ is usually much less than one.

2681

Stanford U. Stanford Electronics Labs., Calif.

PHOTOLUMINESCENCE IN GALLIUM PHOSPHIDE CRYSTALS, by B. P. F. Wu. July 1964 [64]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 5064-3; rept. no. SEL-64-086) (AFOSR-64-1905) (Nonr-22524) Unclassified

The results of this investigation indicate that: (1) The red photoluminescence centers may be created in GaP crystals by doping the nonluminous GaP with any one of the following elements: Zn, Te, Cd, Au, Cu, In, Al, Mn, S, Si, Se, and Mg. (2) The wavelength (or energy) and the intensity of the red photoluminescence peak created in GaP crystals are dependent on impurity-doping concentration. (3) No absorption band corresponding to the red photoluminescence peak was observed in luminous GaP crystals. (4) Heat treatment of GaP crystals in vacuum at temperatures above 700°C destroyed the red photoluminescence in GaP crystals.

2682

Stanford U. Stanford Electronics Labs., Calif.

QUANTUM EFFICIENCY AND RADIATIVE LIFETIME IN p-TYPE GaAs, by J. Vilms. Nov. 1964 [106]p. incl. illus. diagrs. tables, refs. (Technical rept. no. 5207-1; rept. no. SEL-64-120) (AFOSR-65-0249) (Nonr-22524) AD 453727 Unclassified

A method to measure the quantum efficiency of radiative recombination in uniformly doped p-type gallium arsenide and to study the radiative lifetime has been developed. The method involves measurement of the efficiency (photon yield) of photoluminescence, separation of surface recombination from bulk recombination by varying the absorption length of the excitation light, measurement of electron-diffusion length by the spectral dependence of surface photovoltage and also by the absorption-length dependence of photoluminescence, and a theoretical estimate of the electron mobility.

2683

Stanford U. Stanford Electronics Labs., Calif.

THE SELECTION OF MEASUREMENTS FOR PREDICTION, by D. C. Allais. Nov. 1964 [126]p. incl. diagrs. tables, refs. (Technical rept. no. 6103-9; rept. no. SEL-64-115) (AFOSR-65-0548) (Nonr-22524) AD 456770 Unclassified

This research is concerned with prediction and pattern recognition. The purpose is to study relationships between a machine's performance and the number and quality of its measurements and to devise techniques of measurement selection and processing which yield minimum error. The major emphasis is the prediction, because it provides the more tractable model for analysis. The primary effort is directed toward the development of prediction or pattern-recognition techniques applicable to problems involving relatively many measurements and a limited number of learning samples. Consideration of the normal prediction model leads to particular methods of measurement selection and processing.

2684

Stanford U. Stanford Electronics Labs., Calif.

THE BINARY CODING PROBLEM FOR A RANDOM CHANNEL, by R. A. Scholtz. Jan. 1963, 28p. incl. illus. refs. (Technical rept. no. 2004-7; rept. no. SEL-63-002) (Nonr-22524) AD 299535 Unclassified

The general optimum receiver is found for a class of random channels through which a binary code is being transmitted. Under certain simplifying assumptions the divergence is calculated and used as a measure of system performance. The divergence is then maximized to yield a simple coding criterion involving a specification of the optimum Hamming distance between code words as a function of two channel parameters and the code word length. Intuitive justification and interpretation are given after each optimization procedure has been indicated mathematically.

2685

Stanford U. Stanford Electronics Labs., Calif.

AN EQUATORIAL TO ALTITUDE-AZIMUTH COORDINATE CONVERTER, by E. F. Biondi. Mar. 1963, 34p. (Technical rept. no. 1306-2; rept. no. SEL-63-028) (Nonr-22524) AD 441209 Unclassified

This thesis develops a specialized digital computer which converts equatorial coordinates into altitude-azimuth coordinates. It briefly looks into three different methods of computing altitude-azimuth coordinates. One of these methods is considered best for the practical problem, that of obtaining coordinates for a large radio telescope. A computer based on this chosen method is then considered in detail.

2686

Stanford U. Stanford Electronics Labs., Calif.

THE FOUNDATIONS OF NETWORK THEORY, by R. W. Newcomb. Mar. 1963, 46p. (Technical rept. no. 2250-4; rept. no. SEL-63-022) (Nonr-22524) AD 406110 Unclassified

A basic theory of the most general types of conceivable networks is presented. For this the author abandons the operator concept, which is felt more appropriate to control system studies, and reverts to the concept of allowed pairs, whose origin can be traced to McMillan. The program is to define a system, a network, and an n-port in terms of infinitely differentiable functions of support bounded on the left. The major properties of such n-ports are then defined, such as linearity, time-invariance, passivity and solvability. Such physical networks are then extended to idealized networks and more generalized variables through the use of the theory of distributions. Once this is done, general descriptions of a large class of linear, time-invariant networks can be given by using exponential variables. At this point the (bilateral) Laplace transform approach can be used in the standard manner.

2687

Stanford U. Stanford Electronics Labs., Calif.

LEARNING THE MEAN VECTOR AND COVARIANCE MATRIX OF GAUSSIAN SIGNALS IN PATTERN RECOGNITION, by D. G. Keehn. Feb. 1963, 38p. incl. illus. refs. (Technical rept. no. 2003-6; rept. no. SEL-62-155) (Nonr-22524) AD 299526 Unclassified

This work presents a statistical approach to the problem of pattern recognition. The class of pattern-recognition problems considered is completely general. The pattern observations are viewed as vectors in a signal space on which a gaussian probability law is defined for each pattern class. The mean vectors and covariance matrices of these laws are taken as random objects with known probability laws, and learning observations for each class are assumed. The optimum classifier, the classifier which uses all the available information to minimize the probability of misrecognition, is derived.

2688

Stanford U. Stanford Electronics Labs., Calif.

LOW-TEMPERATURE PROPERTIES OF GALLIUM ARSENIDE DIODES, by D. J. Dumin. Sept. 1964, 77p. (Technical rept. no. 5107-1; rept. no. SEL-64-097) (Nonr-22524) AD 455160 Unclassified

The forward and reverse current-voltage characteristics of zinc-diffused GaAs diodes were investigated at temperatures between 300 and 4.2°K. This study was initiated to explain the portions of the forward and reverse currents that are nonthermal in origin. Zinc-diffused GaAs diodes were produced and tested at temperatures between 300 and 4.2°K. The low-temperature

forward current was explained in terms of a band-to-trap-to-band excess tunnelling model describable by two parameters: the effective tunnelling mass and the recombination probability. The reverse current was explained in terms of a band-to-band tunnelling model at all temperatures below 300°K.

2689

Stanford U. Stanford Electronics Labs., Calif.

NONLINEAR RESONANCE COMPUTER COMPONENTS, by T. Ozawa. Apr. 1963, 84p. (Technical rept. no. 1306-1; rept. no. SEL-63-034) (Nonr-22524)
AD 441215 Unclassified

A mathematical analysis of the series resonant circuit is given. The principle of harmonic balance is applied to the differential equations for the circuit in order to obtain the steady state responses. It is shown that the circuit is a threshold device with respect to the amplitude of the driving voltage. A three phase clock system is used to drive the basic resonant circuits, which are coupled to form threshold logic. Various types of coupling between the circuits are considered. The transient response of the circuit which is closely related to the switching speed is analyzed by a series method.

2690

[Stanford U. Stanford Electronics Labs., Calif.]

OPTIMAL ADAPTIVE ESTIMATION OF SAMPLED STOCHASTIC PROCESSES, by D. T. Magill. May 1964, 78p. (Technical rept.) (Nonr-22524)
AD 600600 Unclassified

This work presents an adaptive approach to the problem of estimating a sampled, scalar-valued, stochastic process described by an initially unknown parameter vector. Knowledge of this quantity completely specifies the statistics of the process, and consequently the optimal estimator must learn the value of the parameter vector. In order that construction of the optimal estimator be feasible it is necessary to consider only those processes whose parameter vector comes from a finite set of a priori known values. The optimal estimator is found to be composed of a set of elemental estimators and a corresponding set of weighting coefficients, one pair for each possible value of the parameter vector. This structure is derived using properties of the conditional mean operator. For gauss-markov processes the elemental estimators are linear, dynamic systems, and evaluation of the weighting coefficients involves relatively simple, nonlinear calculations.

2691

Stanford U. Stanford Electronics Labs., Calif.

PRACTICAL APPLICATIONS FOR ADAPTIVE DATA-PROCESSING SYSTEMS, by B. Widrow, R. J. Brown and others. June 13, 1964, 16p. (Nonr-22524)
AD 451472 Unclassified

The paper summarizes the development and application of adaptive data-processing systems utilizing adaptive threshold elements. Several procedures are described whereby such systems can be adapted to recognize or classify complex digital and analog patterns. Data are presented showing application of adaptive pattern-recognition techniques to practical problems such as speech recognition, weather forecasting, and the diagnosis of heart disease as evidenced in vectorcardiograms. Several new applications are being studied, among which one of the most important is the detection of underwater sound signals.

2692

Stanford U. Stanford Electronics Labs., Calif.

SOME STATE-ASSIGNMENT TECHNIQUES FOR LARGE SEQUENTIAL CIRCUITS, by D. L. Starner. Aug. 1964, 54p. (Technical rept. no. 6203-1; rept. no. SEL-64-076) (Nonr-22524) AD 455645
Unclassified

Two state-assignment algorithms are developed, one of which has been programmed for a computer and will handle sequential machines as large as 128 states and 64 inputs. A flow table is used as the machine representation, and properties of the flow table are used to establish state-pair adjacency relationships. For these adjacency relationships a weighting procedure is presented which is used in determining the state codes. The set of state codes used in the algorithms is selected from those sets having some special properties which not only allow preselection of the codes but also reduce the enumeration required in the algorithms. In general, low-cost assignments were obtained without expending large amounts of time.

2693

Stanford U. Stanford Electronics Labs., Calif.

A THEORETICAL STUDY OF HOT ELECTRONS IN METAL FILMS, by C. A. Bates. Jan. 1963, 57p. (Technical rept. no. 216-1; rept. no. SEL-62-142) (Nonr-22524) AD 404829 Unclassified

An analysis of the motion of hot electrons when passing through a thin metal film is given, with particular reference to the cold-cathode emitter and photoelectric-type devices. Electron-electron collisions are considered to be responsible for the slowing down processes within the film and sufficient collisions are assumed to occur so that the motion is diffusive. The differential-scattering cross section is assumed to be almost spherically symmetrical in the center-of-mass system of coordinates, and thus the equations deduced by Wolff (which include electron multiplication) may be used. Methods of solving the integrodifferential equation are given.

2694

Stanford U. Stanford Electronics Labs., Calif.

TWO-LOOP GENERATOR FOR ONE-THIRD SUBHARMONICS, by Y. Kamp. Dec. 1964, 71p. (Technical rept. no. 6581-1; rept. no. SEL-64-128) (Nonr-22524) AD 457539 Unclassified

A one-third subharmonic generator, with a varactor as coupling element between the two loops, is investigated. The necessary and sufficient conditions are established for the building up of a subharmonic oscillation starting from zero initial conditions. Subsequently, the analysis is restricted to a cubic nonlinear characteristic. The subharmonic steady state and its stability are discussed in terms of the circuit parameters.

2695

Stanford U. Stanford Electronics Labs., Calif.

VECTORCARDIOGRAPHIC DIAGNOSIS UTILIZING ADAPTIVE PATTERN-RECOGNITION TECHNIQUES, by D. F. Specht. June 1964, 54p. (Technical rept. no. 6753-1; rept. no. SEL-64-045) (Nonr-22524) AD 443853 Unclassified

The purpose of this research was to apply adaptive pattern-recognition techniques to the diagnosis of heart disease as evidenced in vectorcardiograms. Two methods by which adaptive pattern-recognition techniques can be applied to the analysis of vectorcardiographic data were developed and tested. The first method, the polyhedron approach, considers tri-axial samples taken from the vectorcardiogram at various times at separate date points in three-dimensional space. The second method, sequential adaptive processing, considers all the time samples from a given record as a single point in n-dimensional space. It was found that sequential adaptive processing yields much better results than the clinical analysis of electrocardiograms for detection of abnormalities, with only a slight decrease in accuracy in the detection of normal waveforms.

2698

STD Research Corp., Pasadena, Calif.

INTERACTION OF A JET OF PLASMA WITH ELECTRIC AND MAGNETIC FIELDS, by A. N. Kontaratos and S. T. Demetriades. [1964] [26]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1418) (AF 49(638)-1445) Unclassified

Also published in Appl. Sci. Research, Sect. B, v. 11: 335-360 [1964].

A generalized ohm's law is used to predict changes in the direction and magnitude of the momentum of a stream of plasma in a crossed field accelerator in terms of plasma properties and species temperatures and concentrations. Measurements are reported of accelerator thrust, plasma jet deflection angle, current-voltage characteristics, accelerator inlet momentum, cooling rates and cross-arc power input for argon and helium plasmas. Estimates are given of the mean values of some of the parameters of argon and helium plasma obtained under nonequilibrium conditions. These results are compared with other methods requiring the assumption of local thermodynamic equilibrium (LTE).

2697

STD Research Corp., Pasadena, Calif.

ON THE FUNCTIONAL DEPENDENCE OF TOWNSEND'S FIRST IONIZATION COEFFICIENT, by A. N. Kontaratos. [1964] [8]p. (AFOSR-65-2503) (AF 49-(638)1445) AD 627958 Unclassified

Also published in Appl. Sci. Research, Sect. B, v. 12: 27-32, 1964.

An expression is derived of Townsend's ionization coefficient in terms of electric field and pressure, which fits the experimental data for air in the range $E/p = 10$ to 10^3 v/cm x mm Hg. (Contractor's abstract)

2698

STD Research Corp., Pasadena, Calif.

BREAKDOWN VOLTAGE CALCULATION FOR AIR IN UNIFORM FIELDS, by A. N. Kontaratos. [1964] [9]p. incl. diagrs. (AFOSR-65-2504) (AF 49(638)1445) AD 628347 Unclassified

Also published in Appl. Sci. Research, Sect. B, v. 12: 18-26, 1964.

Expressions are derived for the determination of the space-charge field in front of an avalanche, for the widening of the avalanche's head due to electrostatic repulsion and for the minimum breakdown voltage of uniform gaps. In principle, this last condition is based on a modification of the criterion for stream advance developed by Raether, Meek et. al. An attempt is made to consider the avalanche as an electric dipole oriented in a direction parallel to the applied field and use is made of the radial instead of the axial field of the avalanche's head. (Contractor's abstract)

2699

Stevens Inst. of Tech., Hoboken, N. J.

ROTATIONAL EXCITATIONS AND TURBULENCE IN LIQUID HELIUM, by L. Mead. May 1963, 26p. incl. diagrs. table, refs. (Rept. no. R-982) (AFOSR-4877) (AF AFOSR-82-125) AD 415463 Unclassified

The density of states function has been calculated from specific heat measurements around the superfluid transition temperature of liquid helium He^4. It exhibits poles and branch points at integer multiples of K times the transition temperature. The superfluid transition exhibits some features in common with the Bardeen-Cooper-Schrieffer and Kac-Uhlenbeck phase transition theories. (Contractor's abstract)

2700

Stevens Inst. of Tech. [Dept. of Mathematics] Hoboken, N. J.

THE ITALIAN CONTRIBUTION TO THE THEORY OF NON-LINEAR ORDINARY DIFFERENTIAL EQUATIONS AND TO NONLINEAR MECHANICS DURING THE YEARS 1951-1961, by R. Conti, D. Graffi, and G. Sansone. [1963] [26]p. (AFOSR-3745) (AF 49(638)-878) AD 427859 Unclassified

Also published in Qualitative Methods in the Theory of Nonlinear Vibrations; Proc. Internat'l. Symposium, Kiev, (SSR), Izdat Akad. Nauk Ukrain., v. 2: 172-180, 1963.

The report is limited to a short presentation of the contribution made during the last decade by Italian mathematicians, with two exceptions. The first refers to the work made by Spanish mathematicians.

2701

Stevens Inst. of Tech. [Dept. of Mathematics] Hoboken, N. J.

NON-LINEAR DIFFERENTIAL EQUATIONS, by G. Sansone and R. Conti, tr. by A. H. Diamond. New York, The MacMillan Co., 1964, 536p. incl. diagrs. refs. (Internat'l. Ser. Monographs in Pure and Applied Math., V. 67) (AFOSR-65-1197) (AF 49(638)-878) Unclassified

The book presents a detailed analysis of the phase portrait of two-dimensional autonomous systems, a survey of the qualitative methods for the discovery of periodic solutions of periodic systems and a study of asymptotic properties, especially stability properties, of the solutions of n-dimensional systems. An extensive analysis is given of singular points of two-dimensional autonomous systems, including perturbed systems. The equations of Vander Pol and Lienard of Oscillations of Relaxation are considered, including questions of existence and uniqueness of periodic solutions, and asymptotic evaluation of the period. There is an extensive treatment of non-autonomous systems with one degree of freedom. Linear systems are described including the concepts of principal fundamental matrix, characteristic exponents and type numbers. Asymptotic stability, uniform stability, orbital stability and asymptotic equivalence are also considered. (Contractor's abstract, modified)

2702

Stevens Inst. of Tech. [Dept. of Physics] Hoboken, N. J.

MEASUREMENTS ON PLASMA VORTICES AND TURBULENCE, by W. H. Bostick, E. Farber and others. [1964] [12]p. incl. illus. diagrs. (AFOSR-65-2133) (AF AFOSR-64-465) AD 629799 Unclassified

Also published in Internat'l. Symposium on Diffusion of Plasma Across a Magnetic Field, Feldafing/ Starnberger (Germany) (June 29-July 3, 1964), p. 220-231.

Plasma vortices are studies in three experimental situations; (1) in plasma flow over a 3-dimensional magnetic dipole, (2) in the plasma coaxial accelerator with hydrogen gas employed, and (3) in firing a plasma gun across a magnetic field. With respect to (1) it is found that the turbulence spectrum for copper plasma contains higher frequency components than that for lithium. For (2) a series of three vortices is usually observed following the current sheet. In nitrogen and argon the vortices are smaller in diameter, more numerous, and persist longer. In (3) the measured decay of the velocity profile can be compared with the calculated decay-by-diffusion. (Contractor's abstract, modified)

2703

Stockholm U. [Dept. of Zoology] (Sweden).

LABORATORY OBSERVATIONS ON THE REPRODUCTIVE BEHAVIOUR OF THE PIGEON (COLUMBA LIVIA) DURING THE PRE-INCUBATION PHASE OF THE BREEDING CYCLE, by E. Fabricius and A.-M. Jansson. [1963] [14]p. (AFOSR-64-1182) (AF 61-(052)195) AD 442993 Unclassified AD 442993

Also published in Animal Behav., v. 11: 534-547, Oct. 1963.

The reproductive behavior of the pigeon has been described. In the pigeon, much of the courtship behavior occurs in the nest or at the nest site, which is usually in a hidden place. To include these behavior patterns in close observations of the breeding cycle, a number of breeding couples in cages was studied. The observations reported here were designed to study the normal sequence of the different actions, and the way they are grouped together to form the behavior characteristic of the preincubation period.

2704

Stockholm U. [Dept. of Zoology] (Sweden).

NEURAL MECHANISMS INVOLVED IN INSTINCTIVE BEHAVIOR, by E. Fabricius. Final rept. Nov. 30, 1963, 1v. (AFOSR-64-0020) (AF EOAR-62-12) AD 429768 Unclassified

Behavioral effects of radiolesions showed that while intersection of the lateral forebrain bundle in the pigeon causes severe disturbance of behavior, intersection of the median forebrain bundle does not affect overt behavior. Fear responses persist after lesions sparing the tractus occipito-mesencephalicus but intersecting other parts of cerebral peduncles. Effects of telencephalic radiolesions showed that restricted radiolesions in the lateral forebrain bundle of the pigeon affect memory. Transection of the tractus occipito-mesencephalicus in a pigeon reduced fear responses. Phylogenetical adaptation showed that in the beaver the abil[illegible] of

constructing dams and lodges is mainly based on inborn stereotyped action patterns. The dam-building behavior is elicited by a particular type of acoustic stimulation. Full imprinting can only be established in the beaver before any fear responses are developed.

2705

Stockholm U. [Dept. of Zoology] (Sweden).

LONG RANGE NAVIGATION IN ANIMALS, by C. Edelstam. June 20, 1963, 14p. (AFOSR-J1166) (AF EOAR-62-108) AD 422919 Unclassified

A laboratory study of the basis of visual acuity in man suggests that vision may not be a limiting factor in astronavigation among vertebrates. Field observations of pigeons navigating without the aid of celestial clues show that the birds shake their heads sideways at intervals. This confirms a prediction made by Ising on the assumption that birds use their semicircular canals for estimating latitude and directions from Coriolis force differences.

2706

Stockholm U. [Inst. of Physics] (Sweden).

K⁻-ABSORPTION IN NUCLEI AND THE Σ HYPERON PION RESONANCE Y_0^*, by A. Frisk. 1964, 12p. (AFOSR-3130) (AF EOAR-62-15) AD 613700 Unclassified

The total energy distribution and the distribution of the invariant quantity M from 106 two prong stars are plotted with a charged Σ hyperon and a pion due to absorptions of negative K-mesons at rest in emulsion nuclei. It should be emphasized that the stars contain no other prongs than those due to the hyperon and the pion. The two distributions have about the same width and it is difficult to conclude anything about Y_0^* production on this basis.

2707

Stockholm U. Inst. of Physics (Sweden).

PION-ELECTRON SCATTERING AT 16 GEV/C, by J. Allan, G. Ekspon and others. [1964] [7]p. incl. diagrs. (AFOSR-64-2037) (AF EOAR-63-11) AD 452510 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 1144-1150, June 1, 1964.

The pion-electron scattering cross-section as a function of the 4-momentum transfer has been measured using 16 gev/c negative pions incident on the CERN 30 cm hydrogen bubble chamber. The results are compared with theory. The overall agreement is good. A tendency, at high momentum transfers, toward lower experimental cross-sections than are expected from the theory for point-charge scattering has been interpreted in terms of an extended pion. No definite conclusion on the pion size can be drawn other than that the radius is smaller than 4.5×10^{-15}m.

2708

Stockholm U. [Psychological Lab.] (Sweden).

PSYCHOPHYSICAL RELATIONS IN THE PERCEPTION OF VELOCITY, by M. Mashhour. Stockholm, Almqvist & Wiksell, 1964, 176p. incl. diagrs. tables, refs. (Acta Universitatis Stockholmiensis, Stockholm Studies in Psychology 3) (AFOSR-65-1303) (AF EOAR-64-29) AD 618289 Unclassified

An investigation is made into some observable aspects of man's reaction to visual stimulus moving at different speeds. General methodological problems and problems concerning motion and velocity perception proper are discussed. Topics treated are the two methods of measurement, magnitude and ratio estimation; power functions for biophysical data; the relationship between subjective velocity, space, and time; the relationship between man's speed of reaction and the velocity of the motion stimulus; and how information about velocity can be supplied to the higher centers. Evidence indicates that man's capability as a measuring instrument beyond the ordinal level is doubtful.

2709

Stockholm U. Psychological Lab. (Sweden).

AN EXPERIMENTAL STUDY ON RELATIVITY, ERROR AND SEX DIFFERENCES IN THE PERCEPTION OF VELOCITY, TIME AND DISTANCE, by M. Mashhour. Sept. 1963, 26p. incl. diagrs. tables, refs. (Rept. no. 159) (AFOSR-65-1305) (AF EOAR-64-29) AD 618133 Unclassified

Using the principle of relativity in perception, the effects are investigated of a moving stimulus involving time, space, and velocity with respect to response involving subjective time, space, and velocity. It was found that: (1) Subjective velocity of a moving object and subjective distance covered by a moving object are relative. (2) The absolute error of the subjective velocity estimates is a parabolic function of the subjective estimates of velocity lying between 0 - 1, while a linear function was found for values beyond 1. (3) Sex differences do not exist in the estimation of subjective time and space, though women have higher estimates of the same subjective speeds than do men. (Contractor's abstract, modified)

2710

Strasbourg U. Inst. de Recherches Nucleaires (France).

RADIATIVE CORRECTIONS IN THE ANGULAR CORRELATION OF MONOPOLE PAIRS FROM O^{16} AT SMALL ANGLES, by S. Corodetzky, F. Scheibling and others. [1963] [5]p. incl. diagrs. table. (AFOSR-64-1753) (AF 61(052)598) AD 449253 Unclassified

Also published in Phys. Rev., v. 131: 1219-1223, Aug. 1, 1963.

The angular correlation of electron-positron pair emission in the $0^+ \rightarrow 0^+$ transition in O^{16} was investigated for very small angles. An enhancement of several percent in the emission rate at these small angles is expected, due to first-order radiative corrections represented principally by the vertex graph. The rapid rise in the correlation at small angles was experimentally verified, and the results are in agreement with the theory. (Contractor's abstract)

2711

Sussex U. Physics Lab., Brighton (Gt. Brit.).

SORPTION OF He^3 BETWEEN 0.6°K AND 4.2°K, by D. F. Brewer, A. J. Symonds, and A. L. Thomson. [1964] [3]p. incl. diagrs. (AFOSR-65-1339) (AF EOAR-64-13) AD 620717 Unclassified

Also published in Phys. Lttrs., v. 13: 298-300, Dec. 15, 1964.

The first step in determining the influence of surface effects on liquid He^3 is made by measuring the adsorption isotherms of He^3 on Vycor porous glass between 0.625° and 4.2°K. A calculated error is used to measure the amount of He^3 adsorbed within approx 2×10^{-3} cm^3/m^2, with the exception of the 4.2°K isotherm. The quantity adsorbed is plotted against relative pressure for 3 representative temperatures below the critical temperature, and for 4.2°K.

2712

Sydney U. Dept. of Aeronautical Engineering (Australia).

APPROACH TO TRANSLATIONAL EQUILIBRIUM IN A RIGID SPHERE GAS, by G. A. Bird. [1963] [2]p. incl. diagrs. (AFOSR-64-0165) (AF AFOSR-63-299) AD 432559 Unclassified

Also published in Phys. Fluids, v. 6: 1518-1519, Oct. 1963.

It is usually assumed that the translational degree of freedom in a gas reaches equilibrium in a time of the order of the mean collision time. The present note reports on an investigation of this problem using a Monte Carlo type method which is valid for gases at normal and low densities, and is sufficiently economical in its computing requirements to enable information to be obtained on the velocity dependence of the rate of approach to equilibrium.

2713

Sydney U. Dept. of Aeronautical Engineering (Australia).

A GAS-DYNAMIC MODEL OF THE OUTER SOLAR ATMOSPHERE, by G. A. Bird. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-2001) (AF AFOSR-63-299) AD 451703 Unclassified

Also published in Astrophys. Jour., v. 139: 684-688, Feb. 15, 1964.

Consideration is given to an atmosphere which is heated by the periodic passage of shock waves. A qualitative physical argument suggests that the atmosphere is likely to be in a state such that it has little effect on the strength of the shock waves. This constant shock-strength hypothesis is used as the basis of a model of the outer solar atmosphere, starting near the base of the chromosphere. The model correctly predicts the magnitude as well as the average gradient of the coronal temperature rise. Details are given of the resulting density and mass-flow distributions. (Contractor's abstract)

2714

Sydney U. Dept. of Aeronautical Engineering (Australia).

THE BEHAVIOR OF SHOCK WAVES IN A GRAVITATIONAL ATMOSPHERE, by G. A. Bird. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-2002) (AF AFOSR-63-299) AD 451702 Unclassified

Also published in Astrophys. Jour., v. 139: 675-683, Feb. 15, 1963.

The effects produced by the variations on properties of a gravitational atmosphere on a shock wave propagating within it are determined by an approximate analytical method. Expressions are presented for the rate of change of the shock strength with distance in plane, cylindrical and spherical atmospheres, with or without steady-mass motions, and with arbitrary distributions of temperature and composition. The special cases of the propagation of strong or weak shock waves in adiabatic or isothermal atmospheres are treated in some detail. (Contractor's abstract)

2715

Sydney U. Dept. of Aeronautical Engineering (Australia).

THE PROPAGATION OF ACOUSTIC WAVES THROUGH THE SOLAR CHROMOSPHERE, by G. A. Bird. [1964] [4]p. incl. diagr. table. (AFOSR-65-0559) (AF AFOSR-63-299) AD 613914 Unclassified

Also published in Astrophys. Jour., v. 140: 288-291, July 1, 1964.

Consideration is given to the acoustic disturbances produced by a piston oscillating with the frequency and amplitude of the photospheric granules. The method of characteristics is used to obtain numerical solutions of the full non-linear equations of motion. It is found that shock waves are formed within distances of the order of 1000 km. These shock waves are expected to propagate through the chromosphere with their strengths virtually unaffected by the atmosphere. It is concluded that the results of linearized theory must be treated with caution. (Contractor's abstract)

2716

Sydney U. School of Physics (Australia).

APPLICATIONS OF CHEBYSHEV SERIES IN NUMERICAL ANALYSIS, by D. Elliott. Final rept. July 1, 1962-Aug. 17, 1963, 1v. incl. diagrs. tables, refs. (AFOSR-J1261) (AF AFOSR-62-397)
AD 424352 Unclassified

Numerical solutions of integral equations by means of Chebyshev series are presented in five reports. These are: A Chebyshev series method for the numerical solution of Fredholm integral equations; Some comments on a paper by Clenshaw and Norton (analytical investigation of the iterative method in the numerical solution of simple problems); The evaluation and estimation of the coefficients in the Chebyshev series expansion of a function; The numerical evaluation of the polynomial of best fit of a differential function; Truncation errors in certain polynomial approximations; A note on the coefficients in the Chebyshev series expansion of a function.

2717

[Sydney U. School of Physics (Australia)]

A CHEBYSHEV SERIES METHOD FOR THE NUMERICAL SOLUTION OF FREDHOLM INTEGRAL EQUATIONS, by D. Elliott. [1963] [10]p. incl. tables, refs. (AFOSR-J1278) (AF AFOSR-62-397)
Unclassified

Also published in Comput. Jour., v. 6: 102-111, Apr. 1963.

An investigation has been made into the solution of non-linear Fredholm integral equation by means of determining directly the coefficients in the Chebyshev series expansion of the unknown function. An error analysis, valid under fairly restrictive conditions, is included together with two worked examples. (Contractor's abstract)

2718

Sydney U. School of Physics (Australia).

THE MESON MULTIPLICITY IN NUCLEON-NUCLEON COLLISIONS AT 3000 GEV, by C. B. A. McCusker and L. S. Peak. [1964] [16]p. incl. diagrs. tables, refs. (AFOSR-65-1809) (AF AFOSR-62-410)
AD 625767 Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 525-540, Feb. 1, 1964.

The mean multiplicity of charged particles in nucleon-nucleon collisions at 2800 gev is determined by two different methods. The two methods give results in good agreement with each other and with Wilson cloud chamber results. The weighted mean from this experiment is $\langle n_s \rangle = 10.8 \pm 0.8$. The mean energy has been found by two different methods, the second of which involves a determination of the cosmic-ray proton energy spectrum from 10^{10} to 10^{16} ev. The change in the average multiplicity in nucleon-nucleon collisions from 16 gev to 2800 gev can be well approximated by a law $\langle n_s \rangle = 4.1 \log E/10$ g 16 where E is the incident proton energy in gev. (Contractor's abstract)

2719

Sydney U. [School of Physics] (Australia).

A PRELIMINARY MEASUREMENT OF THE ANGULAR DIAMETER OF ALPHA-LYRAE, by R. H. Brown, C. Hazard and others. [1964] [2]p. (AFOSR-64-1979) (AF AFOSR-63-302) AD 452360 Unclassified

Also published in Nature, v. 201: 1111-1112, Mar. 14, 1964.

During the final assembly of the new interferometer a series of observations was carried out on the bright star alpha-Lyrae (Vega) with the primary purpose of testing the general performance of the instrument. These observations showed the instrument to be performing satisfactorily although the signal-to-noise ratio was only about a half of that which should be achieved on completion of the alignment of the optical and electronic channels. The results of the observations on Vega represent the first direct measurement of a star of spectral type as early as A0. The interferometer is described.

2720

Sydney U. School of Physics (Australia).

THE STELLAR INTERFEROMETER AT NARRABRI OBSERVATORY, by R. H. Brown. [1964] [6]p. incl. illus. diagrs. (AFOSR-65-0406) (AF AFOSR-63-302)
AD 612518 Unclassified

Also published in Sky and Telescope, v. 28: 2-7, Aug. 1964.

This note describes the stellar intensity interferometer at Narrabri Observatory in Australia, designed to measure the apparent angular sizes and temperatures of stars. It is an improvement of the Michelson interferometer with its need for high mechanical precision, its problem of atmospheric scintillation, and its somewhat subjective judgement and skill.

2721

Sydney U. [School of Physics] (Australia).

THE STELLAR INTERFEROMETER AT NARRABRI, by R. H. Brown. 1964, 3p. (AFOSR-65-0450) (AF AFOSR-63-302) AD 614536 Unclassified

Presented at Internat'l. Commission for Optics Conf. on Interference and Coherence, Sydney (Australia), Aug. 24-27, 1964.

The interferometer at Narrabri makes use of an intensity interferometer to achieve a max resolution of approx 0.0005 sec of arc. It is designed to measure

the apparent angular diameter of all stars brighter than magnitude +2.5 and with spectral type earlier than F. O. The instrument consists of 2 large mirrors 22 ft in diameter which move on a circular track 618 ft in diameter. The mirrors are controlled by a computer to follow the chosen star in azimuth and elevation. A single observation at 1 spacing requires approximately 3 hr for a star of magnitude +1.0.

2722

Sydney U. School of Physics (Australia).

THE DETAILED STRUCTURE OF AIR SHOWER CORES, by A. D. Bray, D. F. Crawford and others. [1964] [20]p. incl. illus. diagrs. tables, refs. (AFOSR-64-2060) (AF AFOSR-63-305) AD 452469
Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 827-846, May 16, 1964.

An array of 64 large plastic scintillators, 5 Wilson cloud chambers and about 500 G-M counters has been used to study the electronic structure of air-shower cores. It has been found that there is no unique structure function that will describe all cores. Cores can be classed as single, multiple or flat-topped. Multiple-cored and flat-topped showers can be simulated by the summation of a number of spatially separated single cores. It is shown that the multiply cored showers cannot be due to cascades produced by the neutral pions from a single interaction but that the core structure is due to the nature of the primary particle. The central density of single-cored showers of a given total size is considerably higher on average than the central density of multiply cored showers of the same size. (Contractor's abstract, modified)

2723

Sydney U. School of Physics (Australia).

ENERGY ESTIMATION FOR HIGH-ENERGY NUCLEAR INTERACTIONS, by L. S. Peak and R. L. S. Woolcott. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-1811) (AF AFOSR-63-305) AD 625564 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1-10, Oct. 1, 1964.

The inaccuracies of the various energy estimators for high-energy nuclear collisions are discussed. A new method of estimation based on a two-center model is proposed, involving measurement of the quartile angle, δ, and catering for multiple collisons. With this model $T\delta$, where T is the energy of the created particles, is shown to be dependent upon the fireball multiplicity and values of $T\delta$ are shown to be consistent with the model and a nucleon-nucleon charged multiplicity of ≈ 10. The method is shown to estimate primary energies more in accordance with the cosmic-ray energy spectrum than the Castagnoli method and is further verified by comparison with machine energies. (Contractor's abstract)

2724

Syracuse U. Dept. of Chemistry, N. Y.

MAGNETIC PROPERTIES OF ZIRCONIUM (III) AND HAFNIUM (III) IODIDES, by W. A. Baker, Jr. and A. R. Janus. [1964] [11]p. incl. diagrs. table, refs. (AFOSR-65-0799) (AF AFOSR-62-215) AD 616211
Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 2087-2097, 1964.

Zirconium triiodide and hafnium triiodide were prepared by aluminum reductions of the corresponding tetrahalides. Green and black species of both compounds were isolated. The magnetic susceptibilities of these compounds were measured over the temperature range 100°-300°K by the Gouy method. A correlation of observed magnetic and structural properties is given in terms of competing ferromagnetic and antiferromagnetic interactions in the lattice. The visible absorption spectrum was measured for species obtained on dissolution of zirconium triiodide in water. Absorption bands were assigned for what is proposed to be the hexaquozirconium ion and a less stable iodinated species of the aquozirconium ion. (Contractor's abstract)

2725

Syracuse U. [Dept. of Mathematics] N. Y.

PROBLEMS OF MEROMORPHIC FUNCTIONS, by A. Edrei. Final rept. July 1, 1959-June 30, 1963, 3p. (AFOSR-J1536) (AF 49(638)571) AD 427526
Unclassified

For a four-year period, the field of meromorphic functions was researched. Stress was placed on the study of Nevanlinna's theory, particularly the notion of 'deficient value.' Bibliographic data are included of papers written on this topic.

2726

Syracuse U. [Dept. of Mathematics] N. Y.

THE DEFICIENCIES OF MEROMORPHIC FUNCTIONS OF FINITE LOWER ORDER, by A. Edrei. [1964] [21]p. (AFOSR-65-0349) (AF 49(638)571) AD 611914
Unclassified

Also published in Duke Math. Jour., v. 31: 1-21, Mar. 1964.

This paper generalizes to functions of lower order μ several results which were previously known for functions of order μ only. It has considerable overlap with the independent work of I. V. Ostrovskii.

2727

Syracuse U. [Dept. of Mathematics] N. Y.

SOME GEOMETRIC ASPECTS OF FUNCTIONS OF

HARDY CLASS H^p, by G. T. Cargo. [1963] [4]p. (AFOSR-65-0866) (AF 49(638)571) AD 617208
Unclassified

Also published in Jour. Math. Anal. and Appl., v. 7: 471-474, Dec. 1963.

This note discusses the geometric character of functions of the Hardy Class H^p. It is proved that a holomorphic function in D which omits a half-line is in H^p if $0 < p < 1/2$, and more generally that a function whose range is contained in a wedge of angular measure α is in H^p if $0 < p < \pi/\alpha$. These results are extensions of Smirnoff's classical theorem concerning functions with positive real parts and, as it is shown, are consequences of Littlewood's subordination principle. A brief description of some related results is given, and a new proof of Prawitz's inequality is skeiched.

2728

[Syracuse U. Dept. of Mathematics, N. Y.]

ENTROPIES OF SEVERAL SETS OF REAL VALUED FUNCTIONS, by G. F. Clements. [1963] [11]p. (AFOSR-64-0714) (AF 49(638)619) AD 436494
Unclassified

Also published in Pacific Jour. Math., v. 13: 1085-1095, 1963.

In this paper the entropies of several sets of real valued functions are calculated. The entropy of a metric set, is a measure of its size in terms of the minimal number of sets of diameter not exceeding 2E necessary to cover it. The most striking use of this notion shows that not all functions of n variables can be represented by functions of fewer variables if only functions satisfying certain smoothness conditions are allowed.

2729

Syracuse U. [Dept. of Mathematics] N. Y.

STRONG AND ORDINARY SUMMABILITY, by G. G. Lorentz and K. Zeller. [1963] [7]p. (AFOSR-64-0715) (AF AFOSR-62-138) AD 436487
Unclassified

Also published in Tohoku Math. Jour., v. 15: 315-321, Dec. 1963.

A discussion is presented of infinite matrices and corresponding matrix transforms and summability methods. A sequence is said to be summable, if all sums exist and converge. The sequence is strongly summable, if all sums exist and converge to zero. Strong summability is usually considered only for positive matrices. In this case the limit is uniquely determined. A row-finite matrix contains only a finite number of non-zero elements in each row; a normal matrix has non-zero elements on the main diagonal and zeros above it. Strong and ordinary summability methods are compared.

2730

Syracuse U. Dept. of Mathematics, N. Y.

[COORDINATE SUMMABILITY AND A THEOREM OF HARDY-BOHR] Abschnittslimitierbarkeit und der Satz von Hardy-Bohr, by G. G. Lorentz and K. Zeller. [1964] [6]p. (AFOSR-64-1719) (AF AFOSR-62-138) AD 447700
Unclassified

Also published in Arch. Math., v. 15: 208-213, 1964.

Working from the theory of Cesaro summability and using a sequence f_k, which, under given conditions is called a C_α-series - factor sequence the theory of Hardy-Bohr is proven, explained, and expanded. This method of proof is advantageous in that the general factors f_k are only introduced at the end of the proof. Before introducing these, other special easily handled and finite sequences of binomial coefficients are used. Using the described procedure asymptotic summability can also be treated. Most important to the method presented is the proof of coordinate summability.

2731

Syracuse U. [Dept. of Mathematics] N. Y.

SUMMATION OF SEQUENCES AND SUMMATION OF SERIES, by G. G. Lorentz and K. Zeller. [1964] [4]p. (AFOSR-65-0321) (AF AFOSR-62-138) AD 611920
Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 743-746, Oct. 1964.

In this paper it is shown that there exist regular sequence summation methods for which the summability field is not contained in the summability field of any regular series summation method. On the other hand there are regular series methods for which the summability field is not contained in the summability field of any regular sequence summation method.

2732

Syracuse U. Dept. of Mathematics, N. Y.

ENTROPY AND ITS APPLICATIONS, by G. G. Lorentz. [1964] [7]p. incl. diagr. (AFOSR-65-0332) (AF AFOSR-63-424) AD 611919
Unclassified

Also published in SIAM Jour. Numer. Anal., Series B, v. 1: 97-103, 1964.

The concept of metric entropy is explained. For a compact metric space A, the metric entropy was devised to describe the massivity, the thickness of A. The entropy of A, $H_\epsilon(A) = \log N_\epsilon(A)$ where $N_\epsilon(A)$ is the minimum number of subsets forming an ϵ-cover of A. A companion invariant of A is the capacity $C_\epsilon(A) = \log M(\epsilon)$ where $M(\epsilon)$ is the maximum number of ϵ-distinguishable points of A. Some examples of entropy are presented, and some applications are considered

for Vitushkin's work on nonlinear approximation and Kolmogorov's representation theorem for continuous functions of two variables. The entropy of A is compared with the properties of A which are important in the theory of approximation.

2733

Syracuse U. [Dept. of Physics] N. Y.

THEORETICAL STUDIES OF VIBRATION SPECTRA AND EFFECTS OF SURFACES ON LATTICE VIBRATIONS. Final rept. July 1963, 10p. (AFOSR-J1115) (AF 49(638)642) AD 420329 Unclassified

Effort was devoted to understanding the lattice vibration spectra of simple, mixed, ionic covalent compounds. Simple compounds crystallizing in the sphalerite and, more recently, in the wurtzite structures were considered. Some problems were studied on the effects of impurities and imperfections on solid state systems. A start was made in the field of ferromagnetism to understand the magnetic structure of $MnBr_2$.

2734

Syracuse U. [Dept. of Physics] N. Y.

MULTIPHONON PROCESSES IN THE PHOTOCONDUCTIVITY OF InSb, by H. J. Stocker, C. R. Stannard, Jr. and others. [1964] [4]p. (AFOSR-64-1245) (AF 49(638)642) AD 442818 Unclassified

Also published in Phys. Rev. Ltrs., v. 12: 163-166, Feb. 17, 1964.

Oscillations periodic in longitudinal optical (LO) phonon energy have been observed in the photoconductivity spectrum of acceptor-valence band transitions in Cu-, Au-, and Ag-doped InSb and in Cu- and Zn-doped Ge. Similar oscillations are found in the photoconductivity due to valence-conduction band transitions in p-type InSb doped with Au, Ag, and Cu. The spacing of the oscillations is characteristic of both the LO phonon energy and the band structure of InSb. A more involved interpretation than previously given has to be adopted to account for the lack of oscillatory structure in the optical absorption.

2735

[Syracuse U. Dept. of Physics, N. Y.]

QUANTUM FIELD THEORY AND ELEMENTARY PARTICLES, by A. O. Barut. Final rept. Jan. 1, 1960-Aug. 31, 1962, 5p. incl. refs. (AFOSR-3539) (AF 49(638)801) AD 285426 Unclassified

The nature of the research carried on under this contract can be summarized under the following results: (1) The S matrix theory has been formulated in an invariant fashion which made it possible to treat scattering of particles with arbitrary spins and isospins and their analytical continuation uniformly; (2) The recent hypothesis about the complex angular momentum poles of the relativistic S matrix has been investigated and properties of these poles determined. Complex angular momentum has been extended to the scattering of particles with arbitrary spins; and (3) The two components higher order spinor equations have been quantized for the first time predicting 'neutrinos' for each fermian. Other research includes the investigation of strange particles and hyperfragments and work on electrodynamics and weak interactions.

2736

Syracuse U. Dept. of Physics, N. Y.

LATTICE VIBRATIONS OF WURTZITE STRUCTURE CRYSTALS, by J. J. Sullivan. [1964] [18]p. incl. diagrs. tables, refs. (AFOSR-66-1267) (AF AFOSR-63-420) AD 641539 Unclassified

Also published in Jour. Phys. and Chem. Solids, v. 25: 1039-1056, 1964.

This article presents expressions based on the general shell model of lattice dynamics, for all important long wavelength properties of the lattice vibration spectrum of a wurtzite structure crystal and for the vibration frequencies having wave vectors along the hexagonal axis of the first Brillouin zone. The dynamics of the wurtzite structure is discussed in terms of sum and difference mode parameters. In an effort to evaluate some of the parameters of the model by fitting theoretical expressions to available experimental data, two approximations have been made: (1) The non-Coulomb force constants are limited to interactions with the four nearest neighbors. (2) The dynamics of the sum modes is made equivalent to the dynamics of a sphalerite crystal. (Contractor's abstract, modified)

2737

Syracuse U. Dept. of Physics, N. Y.

APPROACHES TO PIEZOELECTRICITY AND ELASTICITY IN MIXED IONIC COVALENT COMPOUNDS, by H. Kaplan. [1964] [10]p. incl. tables, refs. (AFOSR-66-1614) (AF AFOSR-63-420) AD 641538 Unclassified

Also published in Lattice Dynamics; Proc. Internat'l. Conf., Copenhagen (Denmark) (Aug. 5-9, 1963), Oxford, Pergamon Press, 1964, p. 615-624.

The problems of calculating the elastic and piezoelectric responses of mixed ionic covalent compounds are reviewed using the sphalerite and wurtzite structures as examples. Most of the discussion centers around the piezoelectric constant. The various lattice dynamical models of piezoelectricity in sphalerite are discussed in detail. The roles of piezoelectricity and elasticity as two facets of lattice dynamics are emphasized. It is concluded that the presently available experimental data on lattice dynamical properties and the lattice dynamics analysis does not allow unique values of important parameters such as the ionic charge to be determined. (Contractor's abstract, modified)

2738

System Development Corp., Santa Monica, Calif.

ON ASSESSING THE EFFECTIVENESS OF ADMINISTERING PRIORITIES IN INFORMATION SYSTEMS, by B. Rome and S. Rome. 1963, 46p. (AFOSR-J527) (AF 49(638)1188) AD 408407 Unclassified

Also published in Proc. Military Operations Research Symposia (Oct. 16-18, 1962), v. 2, Part 1: 31-46.

The problem is that of assessing the effectiveness of command or executive decisions in administering priorities within a large information system. Effective administration of priorities dominates the flow and sequence of productive operations, the organization of communication and decision processes, and therefore the very survival of the organization. A simple index or measure of the resolving power (the ability to process higher priority units in shorter times) of a set of decision rules for assigning and implementing priorities is described. It will be employed in the data-reduction programs of the Leviathan program system.

2739

System Development Corp. [Santa Monica, Calif.].

PROGRAMMING THE BUREAUCRATIC COMPUTER, by B. Rome and S. Rome. [1964] [21]p. incl. diagrs. tables. (AFOSR-65-0295) (AF 49(638)1188) AD 611810 Unclassified

Also published in IEEE Spectrum, Dec. 1964, p. 72-92.

A system of logic in communications is evolved for the hierarchy echelons of large corporations, and wherein the digital computer plays vital parts—from executing the command decisions of the C-in-C to the robotlike obedience of a rear-rank private. Through this method individuals are moulded into effective, coherent social organisms.

2740

System Development Corp., Santa Monica, Calif.

COMMUNICATION AND LARGE ORGANIZATIONS, by B. Rome and S. Rome. Sept. 4, 1964, 108p. incl. illus. diagrs. tables. (Technical rept. no. SP-1690/000/00) (AFOSR-65-0699) (AF 49(638)1188) AD 608587 Unclassified

Presented at AFOSR summer Scient. Seminar on Commun. Cybernetics, Cloudcroft, N. M., June 17-18, 1964.

This note is comprised of 2 related reports; one is an explanation of the Leviathan method for studying communication in large social organizations and the other is a review of some of the results obtained in experimentations with this method. The method comprises a theoretical framework, a system of computer programs, a series of experimental simulations in a laboratory, a repertory of experimental controls, and quantitative measurements of organizational performance. The concept of hierarchy in large social organizations is stressed and the experimental model consists of a bureaucracy of robots from the computer programs and live personnel. Feedback from the computer system is given special attention and the General Operator-Computer Interaction system is introduced. Results indicate the success of this type of investigation.

2741

System Development Corp., Santa Monica, Calif.

DATA FURNISHED SUBJECTS DURING LEVIATHAN LIVE-ARTIFICIAL EXPERIMENTS, by B. Rome and S. Rome. Mar. 15, 1963, 23p. incl. table. (Rept. no. TM-1010/000/01) (AFOSR-65-0700) (AF 49(638)1188) AD 403449 Unclassified

This document specifies the data which will be supplied to the live subjects during the Leviathan live-artificial experiments and describes how it is administered to them by the system. Each subject will receive an individual set of data every epoch. Precisely which data he receives are defined by his status in the hierarchy of command, the territory in the productive system over which he exercises control, and the particular functions for which he is administratively responsible. For any specific configuration of the formal organization specified to the computer and exhibited by the management hierarchy, the computer automatically produces the appropriate data for each live subject.

2742

System Development Corp., Santa Monica, Calif.

RESTATEMENT OF THE LEVIATHAN APPROACH TO LARGE-GROUP ANALYSIS, by B. Rome and S. Rome. July 22, 1963, 6p. incl. refs. (Rept. no. TM-1410/000)00) (AFOSR-65-0701) (AF 49(638)1188) AD 416804 Unclassified

This report is a summary of the Leviathan approach to the study of the organization and management of large information systems. The problem investigated is the shift and development of interaction in a large information organization under rapidly increasing load. The Leviathan studies aim to translate such a situation into orderly laboratory operations and into complex abstract computer models. The resultant Leviathan simulation consists of live responsible executives or officers, hundreds of artificial agents, realized in the computer; and systems for time-ordered input, interaction, an artificial laboratory language, and computer produced feedback information. A distinct advantage of the method is that it is able to explore the consequences of a developing situation in 2 directions, one actually taken, the other contrary to fact.

2743

System Development Corp., Santa Monica, Calif.

INPUT SPECIFICATIONS FOR LEVIATHAN RUN 301, by B. Rome and S. Rome. June 28, 1963, 24p. incl. tables. (Repi. no. TM-1346) (AFOSR-65-0702) (AF 49(638)1188) AD 410872 Unclassified

This report contains the experimenters' input specifications for initiating the Leviathan laboratory operations r in 301, which began May 16, 1963.

2744

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: FIFTH BRIEFING, by B. Rome and S. Rome. June 5, 1964, 71p (Repi. no. TM-1923/005/00) (AFOSR-65-0703) (AF 49(638)-1188) AD 446812 Unclassified

This report contains the data presented during the fifth briefing on manpower for the Intelligence Communications Control Center.

2745

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: FOURTH BRIEFING, by B. Rome and S. Rome. June 5, 1964, 55p. (Repi. no., TM-1923/004/00) (AFOSR-65-0704) (AF 49(638)1188) AD 446797 Unclassified

This report contains the data presented during the fourth briefing on traffic control and priority control for the Intelligence Communications Control Center.

2746

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: THIRD BRIEFING, by B. Rome and S. Rome. June 5, 1964, 42p. (Repi. no. TM-1923/003/00) (AFOSR-65-0705) (AF 49(638)-1188) AD 443758 Unclassified

This report contains the data presented during the third briefing covering code tags and traffic over A-1 and B stations for the Intelligence Communications Control Center.

2747

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: SECOND BRIEFING, by B. Rome and S. Rome. June 5, 1964, 37p. (Rept. no. TM-1923/002/00) (AFOSR-65-0706) (AF 49(638)1188) AD 446810 Unclassified

This report contains the data presented during the second briefing on technological system layout, allocation of territory, and production control of the Intelligence Communications Control Center.

2748

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: FIRST BRIEFING, by B. Rome and S. Rome. June 5, 1964, 14p. (Repi. no. TM-1923/001/00) (AFOSR-65-0707) (AF 49(638)1188) AD 446807 Unclassified

The Leviathan teaching machine was used, as part of the experimental design, to indoctrinate subjects for the Leviathan experiments of 1964. The machine consists of five briefings. At each briefing the first display, which presents the title and contents of the briefing, is controlled by the experimenters, and thereafter each subject controls the sequence and timing of his successive instructional displays. This report contains the data presented during the first briefing on the mission, organization, and management of the Intelligence Communications Control Center.

2749

System Development Corp., Santa Monica, Calif.

LEVIATHAN TEACHING MACHINE: MANUAL OF CHARTS, by B. Rome and S. Rome. June 5, 1964, 17p. incl. diagrs. tables. (Rept. no. TM-1923/000/00) (AFOSR-65-0708) (AF 49(638)1188) AD 446805 Unclassified

The Leviathan teaching machine was used, as part of the experimental design, to indoctrinate subjects for the Leviathan experiments of 1964. This report contains diagrams and tables displaying preliminary organization for the machine.

2750

System Research, Ltd., Richmond, Surrey (Gt. Brit.).

A TYPICAL ADAPTIVELY CONTROLLED EXPERIMENT IN PERCEPTUAL DISCRIMINATION, by G. Pask, B. N. Lewis, and D. Watts. Nov. 1964, 9p. (AFOSR-65-0291) (AF 61(052)640) AD 611542 Unclassified

This report concerns a demonstration of an adaptively controlled perceptual discrimination experiment. The adaptation rule chosen for demonstration purposes is almost absurdly simple and a rather more elaborate system is used in the main experimental programme. The chief aim is to provide a readily manipulable application of this experimental method and to suggest further applications. This method has been used chiefly in connection with explicit learning experiments or in adaptively controlled teaching. In the present arrangement the learning that occurs is implicit and, in a sense, is an unwanted effect. The adaptive system can be said to compensate for the effects of learning and to approximate a stationary measurement condition.

2751

System Research, Ltd., Richmond, Surrey (Gt. Brit.).

RESEARCH ON CYBERNETIC INVESTIGATION OF LEARNING AND PERCEPTION, by G. Pask. Dec. 8, 1964 [176]p. incl. diagrs. tables, refs. (Annual summary rept. no. 2) (AFOSR-65-0292) (AF 61(052)640)
AD 611543 Unclassified

A number of cybernetic models for learning and memory are discussed. Certain experiments for testing these models are described and some results are presented. The report contains a philosophical discussion, an account of tests for macroscopic hypotheses, a description of evolutionary programs simulating learning mechanisms and of algorithmic programs used to simulate sequential descriptions of the learning process.

2752

System Research, Ltd., Richmond, Surrey (Gt. Brit.).

A DISCUSSION OF ARTIFICIAL INTELLIGENCE AND SELF-ORGANIZATION, by G. Pask. [1964] [116]p. incl. diagrs. refs. (AFOSR-65-1168) (AF 61(052)640)
AD 620496 Unclassified

Also published in Advances in Computers, ed. by F. L. Alt and M. Rubinoff. New York, Academic Press, v. 5: 110-225, 1964.

The characteristics of a self-organizing system, a system with a behavior that becomes more ordered, is outlined. A special case is developed for self-organization as it appears in connection with automata or computing machines. Discussion is centered on learning and on mechanisms that give rise to learning behavior. Various psychological and physiological models of human learning and concept acquisition are examined. Man-machine interaction is considered—man educates the machine and the machine extends man's capabilities. It is concluded that an artificial intelligence is more economically created by allowing it to evolve to the environment it will later inhabit providing that we ensure its survival by building into it a set of basic and necessary capabilities.

2753

[Tasmania U. Dept. of Mathematics, Hobart (Australia)]

THE EVALUATION AND ESTIMATION OF THE COEFFICIENTS IN THE CHEBYSHEV SERIES EXPANSION OF A FUNCTION, by D. Elliott. [1964] [11]p. incl. refs. (AFOSR-64-1735) (AF AFOSR-64-600) AD 448275 Unclassified

Also published in Math. Comput., v. 18: 274-284, Apr. 1964.

This paper has considered estimates for the coefficients in the Chebyshev series expansion of a function f(x). The form of the estimate depends upon whether f(z) has poles, or has a branch point on the real axis including the end points z = ± 1, or whether f(x) is an entire function. The results may be superposed.

2754

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. III. AIR OPERATIONS MODEL, PROGRAM SPECIFICATIONS MANUAL, by H. Weintrob, S. Cohen and others. July 1964, 409p. (Rept. no. TR-64-2, v. 3) (AF 49(638)-1179) AD 457521 Unclassified

This document contains a description and explanation of the computer program used in the AUTOVALOR Air Operations Model. The generation, sort, assessment, damage reporting and updating functions are described. Each routine is fully explained by its functional description, inputs, outputs, algorithms, and flow chart. The interrelations between routines and between functions are completely detailed.

2755

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. IV. LOGISTICS MODEL, PROGRAM SPECIFICATIONS MANUAL, by E. D. Steele, H. M. Ferguson, and E. M. Ambrose, Jr. July 1964, 215p. (Rept. no. TR-64-2, v. 4) (AF 49(638)1179) AD 457522 Unclassified

This paper describes in detail the logical processes performed by each routine in the AUTOVALOR Logistics Model program. This model simulates the day by day operations of a Theater logistics system for all major supply categories. Process and routine descriptions, flow charts, as well as input and output descriptions, are provided for each of the five major functions of the model.

2756

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. II. SYSTEM OPERATOR'S MANUAL, by S. Cohen, R. A. Lajoie and others. July 1964, 118p. (Rept. no. TR-64-2, v. 2) (AF 49(638)1179) AD 457520 Unclassified

This manual contains specific instructions to the AUTOVALOR user on what he must do to make the system perform its programmed tasks. It is divided into two parts: one explains to the user how to prepare the data he has compiled for presentation to the computer, and one explains what the computer operater must do to cause the program to operate properly.

2757

Technical Operations, Inc., Washington, D. C.

AUTOVALOR DOCUMENT SERIES. VOL. I. WAR GAMERS' GUIDE, by R. W. Bluehdorn, S. Cohen and others. July 1964, 1v. (Rept. no. TR-64-2, v. 1) (AF 49(638)1179) AD 457519 Unclassified

The AUTOVALOR series contains five documents which completely describe the three models in the AUTOVALOR System. This volume explains to the war gamer, how to organize input data, how to submit orders, and what to expect as output. A General Description section is included for each model followed by a Detailed Description of the data base requirements plus illustrations for each input format. Requirements for player implementation are followed by descriptions of outputs and some analysis aspects.

2758

Technical Operations, Inc., Washington, D. C.

PRELIMINARY ANALYSIS OF STRIKE RECONNAISSANCE, by F. F. Martin. Apr. 1964, 72p. (Rept. no. SM-64-4) (AF 49(638)1179) AD 457518 Unclassified

Search concepts are investigated and analyzed with respect to strike reconnaissance. Search theory, methods, and techniques are discussed. Reconnaissance operations and basic sequence of events are given. Statistical parameters are discussed, and a mathematical mode of strike reconnaissance is developed.

2759

Technical Operations, Inc., Washington, D. C.

STAGE OUTPUT PROCESSOR USERS AND OPERATORS MANUAL ADDENDUM, by N. U. Kaminsky, L. G. Klopfenstein and others. Mar. 1964, 123p. (Rept. no. TR-63-2-2) (AF 49(638)1179) AD 451492 Unclassified

The STAGE Output Processor sorts, compiles tables, and presents the output of the STAGE model in printed form. Fifteen new processes have been added to the model since the publication of the STAGE Output Processor Users and Operators Manual in August 1963. These 15 are discussed here and the output tables they produce are described. Modifications and improvements in the concepts used in the Output Processor are

included, along with a description of items that have been modified or added to the existing output tables. In some cases a table has been changed sufficiently to warrant inclusion of a revised table.

2760

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION 4A. FLOW CHARTS FOR AREA REFUEL MODEL. June 1964, 25p. (Rept. no. TR-61-2-1, Sec. 4A) (AF 49(638)1179) AD 451493 Unclassified

The Area Refuel Model handles the simulation of bomber and tanker refueling operations. This publication contains gross and detailed flow charts, describing the overall simulation.

2761

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION 6A. FLOW CHARTS FOR BASE THREAT MODEL, by A. K. Anderson and C. Rossow. June 1964, 7p. (Rept. no. TR-61-2-1, Sec. 6A) (AF 49(638)1179) AD 451489 Unclassified

The Base Threat Model handles the simulation of sorties that are in a position to threaten bases. This publication contains gross and detailed flow charts that describe the operation.

2762

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION 7A. FLOW CHARTS FOR INDEPENDENT ACTIONS MODEL. May 1964, 43p. (Rept. no. TR-61-2-1, Sec. 7A) (AF 49(638)1179) AD 451491 Unclassified

The Independent Actions Model of the STAGE Simulator handles the simulation of sortie actions that are site-independent. This publication contains both gross and detailed flow charts for each type of site-independent simulation.

2763

Technical Operations, Inc., Washington, D. C.

STAGE SIMULATOR TECHNICAL MANUAL. SECTION 5A. FLOW CHARTS FOR OFFENSIVE BASE ACTIVITIES MODEL. June 1964, 1v. (Rept. no. TR-61-2-1, Sec. 5A) (AF 49(638)1179) AD 451490 Unclassified

The activities referred to in this publication pertain to the operations of tankers and bombers at offensive bases. Gross and detailed flow charts describe these operations, which consist of takeoffs, evacuation, landings, and a type of land-in area.

2764

Technical Research Group, Inc., Melville, N. Y.

FREQUENCY STABILIZATION OF GAS LASERS, by W. R. Bennett, Jr., S. F. Jacobs and others. [1964] [2]p. incl. refs. (AFOSR-65-2795) (AF 49(638)673) AD 629156 Unclassified

Presented at Northeast Electronics Research and Engineering Meeting, Nov. 4-6, 1964.

Also published in NEREM Record, 1964.

This paper summarizes analyses of several possible gas laser stabilization techniques and reviews results obtained recently with a null-balance method proposed previously by one of the authors.

2765

Technical Research Group, Inc., Melville, N. Y.

STRONG 3.27-μ LASER OSCILLATION IN XENON, by W. T. Walter and S. M. Jarrett. [1964] [2]p. incl. diagr. table. (AFOSR-65-2610) (AF 49(636)673) AD 629161 Unclassified

Also published in Appl. Opt., v. 3: 789-790, June 1964.

This letter describes some studies of stimulated emission of a pure xenon discharge contained in a quartz tube with quartz Brewster angle windows and external reflectors.

2766

Technical Research Group, Inc., Melville, N. Y.

ON THE THEORY OF LASER OSCILLATION, by S. R. Barone. [1964] [1]p. (AFOSR-65-2617) (AF 49(638)-673) AD 627967 Unclassified

Also published in Conf. on Quantum Electrodynamics of High Intensity Photon Beams, U. S. Army Research Office, Durham, N. C., Aug. 26-27, 1964.

Conventional theories of laser oscillation neglect the effect of the oscillating field on the atomic response function except in so far as this field determines the atomic populations. Here an attempt has been made to go beyond this by considering the atomic response function to be determined in self-consistent fashion by the oscillating field. The model chosen for calculation consists of two-level atoms and a single (lossy) cavity mode. Retaining only the lowest order correlations between the two-level systems and the field, new effects appear for large values of the oscillating spectral energy density.

2767

Technical Research Group, Inc., Melville, N. Y.

RESEARCH ON PROPERTIES OF LASER DEVICES, ed.

by R. Kaplan. Quarterly technical summary rept. no. 9, June 1-Aug. 31, 1964, 48p. (Rept. no. 134-QTR-9) (AF 49(638)673; AD 447907 Unclassified

This report discusses research on laser devices in two major areas: gas laser media and output control. An apparatus was completed for testing the principle of relaxation of the lower laser level in a gas discharge by inelastic atom-atom collisions. Progress was made in the investigation of improvements in energy radiance which can be achieved by mode selection in a ruby cavity. An accurate technique for measuring pulse energy per unit solid angle was established. A five-fold increase in angular energy density was observed when one reflector was moved far enough away from the ruby to discriminate effectively against off-axis modes.

2768

Technion-Israel Inst. of Tech., Haifa.

TACTICAL CONFIGURATIONS. ON COVERING OF BALANCED INCOMPLETE BLOCK DESIGNS, by H. Hanani. Feb. 20, 1964, 17p. (AFOSR-64-0868A) (Bound with its AFOSR-64-0868B) (AF EOAR-63-60) Unclassified

Also published in Canad. Jour. Math., v. 16: 615-625, 1964. (AFOSR-65-0356; AD 612223)

It is proved that for every v there exists a balanced incomplete block design of v elements and of blocks having three elements each, and a set of F having $f(3,\lambda,v)$ elements such that F has non empty inter-section with every block of the design and $f(3,\lambda,v) = 1/2(v-1)$, $1/2(v+1)$ or $1/2v$.

2769

Technion-Israel Inst. of Tech., Haifa.

TACTICAL CONFIGURATIONS. ON STEINER SYSTEMS, by H. Hanani and J. Schonheim. Feb. 20, 1964, 5p. (AFOSR-64-0868B) (Bound with its AFOSR-64-0868A) (AF EOAR-63-60) Unclassified

It is proved that for every set E having $n = 2^{k-1}-1$ elements, Steiner k-tuple system exists.

2770

Technion-Israel Inst. of Tech., Haifa.

APPLICATION OF TERNARY ALGEBRA TO THE STUDY OF STATIC HAZARDS, by M. Yoeli and S. Rinon. [1964] [14]p. incl. diagrs. tables, refs. (AFOSR-64-0652) (AF EOAR-63-65) AD 436516 Unclassified

Also published in Jour. Assoc. Comput. Mach., v. 11: 84-97, Jan. 1964.

This paper is concerned with the study of static hazards in combinational switching circuits by means of a suitable ternary switching algebra. Techniques for hazard detection and elimination are developed which are analogous to the Huffman-McCluskey procedures. Moreover, the paper derives necessary and sufficient conditions for a ternary function to adequately describe the steady-state and static hazard behavior of a combinational network. The sufficiency of these conditions is proved constructively leading to a method for the synthesis of combinational network containing static hazards as specified.

2771

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

RECENT EXPERIMENTAL STUDIES OF BUCKLING OF CONICAL SHELLS UNDER TORSION AND EXTERNAL PRESSURE, by J. Singer and A. Eckstein. [1963] [12]p. (AFOSR-J850) (AF 61(052)339) AD 416382 Unclassified

Also published in Proc. Fifth Israel Conf. on Aviation and Astronautics, Feb. 27-28, 1963, p. 135-146.

The results of a continuation of an experimental program on the instability of thin truncated conical shells under uniform external pressure, under torsion, and under the combined loading of external pressure and torsion are presented and discussed. The tests of 58 Alclad, stainless steel and aluminum alloy conical shells of varying geometries are described, and the results are compared and correlated with other experimental investigations and with theory.

2772

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

DONNELL-TYPE EQUATIONS FOR BENDING AND BUCKLING OF ORTHOTROPIC CONICAL SHELLS, by J. Singer. [1963] [3]p. (TAE rept. no. 18) (AFOSR-64-1028) (AF 61(052)339; AD 440982 Unclassified

Also published in Jour. Appl. Mech., June 1963, p. 303-305.

A set of Donnell-type differential equations for the bending and buckling of isotropic thin conical shells is derived for orthotropic conical shells. The equations derived reduce to Selde's equations for the case of an isotropic shell, and to the differential equations for orthotropic cylindrical shells given by Bodner when the cone angle approaches zero.

2773

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

AERODYNAMICS OF SUPERSONIC WINGS AND BODIES OSCILLATING AT HIGH FREQUENCY, by M.

Hania. [Final rept.] Jan. 31, 1963, 42p. incl. refs. (TAE rept. no. 26) (AFOSR-4861) (AF 61(052)550) AD 413761 Unclassified

Asymptotic solutions are obtained for the unsteady pressure on wings and bodies that oscillate harmonically at high frequencies while in supersonic flight. The solutions have the form of series in descending powers of the frequency, and they include effects of three-dimensional flow and second-order effects due to the thickness of the wing or the body. The results consist of (a) the first two terms of the series for three-dimensional wings with supersonic trailing edges and for elongated pointed bodies, (b) the first three terms of the series for supersonic two-dimensional airfoils, and (c) the first four terms for very slender wings and bodies. (Contractor's abstract, modified)

2774

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

EFFECT OF ECCENTRICITY OF STIFFENERS ON THE GENERAL INSTABILITY OF STIFFENED CYLINDRICAL SHELLS UNDER HYDROSTATIC PRESSURE, by M. Baruch and J. Singer. [1963] [5]p. incl. diagr. table. (AFOSR-J719) (AF EOAR-62-61) Unclassified

Also published in Jour. Mech. Eng. Sci., v. 5: 23-27, 1963.

The general instability of a simply supported cylindrical shell under hydrostatic pressure is analysed by considering the 'distributed stiffness' of the frames and stringers separately, taking into account their eccentricity. It is shown that frames on the inside of the shell yield general instability loads about 10-15% greater than frames on the outside of the shell. Stringers are much less effective in stiffening a shell under hydrostatic pressure, and the effect of eccentricity is opposite; outside stringers yield critical loads greater than inside stringers. (Contractor's abstract)

2775

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

BUCKLING OF ISOTROPIC, ORTHOTROPIC AND RING-STIFFENED CONICAL SHELLS, by J. Singer, A. Eckstein and others. Sept. 1963, 65p. (TAE rept. no. 30) (AF EOAR-62-61) AD 434845 Unclassified

Results of a continuation of an experimental program on the general and panel instability of thin ring-stiffened conical shells under uniform external pressure are presented and discussed. Tests of ten steel and aluminum-alloy conical shells are described; the results compare favorably with previously developed theories. A method developed previously is now extended to the analysis of the instability of isotropic conical shells under combined torsion and axial compression, and of orthotropic conical shells under combined torsion and external or internal pressure, or axial force.

2776

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

BUCKLING OF ORTHOTROPIC CONICAL SHELLS UNDER COMBINED TORSION AND EXTERNAL OR INTERNAL PRESSURE, by J. Singer, R. Fersht-Scher, and A. Betser. [1964] [11]p. incl. diagrs. tables. (AFOSR-64-1874) (AF EOAR-62-61) AD 449994 Unclassified

Also published in Sixth Annual Conf. on Aviation and Astronautics, Tel Aviv and Haifa (Israel) (Feb. 24-25, 1964), p. 179-189.

A method developed previously for the analysis of buckling of orthotropic conical shells under external pressure is now extended to buckling under combined torsion and external or internal pressure. The method is based on the solution of modified Donnell type stability equations in the presence of slightly relaxed boundary conditions for the u and v displacements. Numerical results are obtained for buckling under pure torsion and a simple approximate method for calculation of the critical torque is found by correlation with equivalent orthotropic cylindrical shells. (Contractor's abstract)

2777

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

ON EXPERIMENTAL TECHNIQUE FOR INTERACTION CURVES OF BUCKLING OF SHELLS, by J. Singer. [1964] [2]p. incl. diagrs. (AFOSR-65-1150) (AF EOAR-62-61) AD 619635 Unclassified

Also published in Exper. Mech., Sept. 1964, p. 1-2.

Experimentally determined points for interaction curves of buckling of shells under combined torsion and external pressure often show excessive scatter. Scatter mainly results from minor differences among shells. Testing of single specimens over the whole range of the curve is recommended even for metal specimens, because the scatter produced by damage due to repeated buckling is much less than that resulting from the initial difference in shape and properties of separate specimens.

2778

Technion-Israel Inst. of Tech. [Dept. of Aeronautical Engineering] Haifa.

GENERAL INSTABILITY OF STIFFENED CIRCULAR CONICAL SHELLS UNDER HYDROSTATIC PRESSURE,

by M. Baruch and J. Singer. June 1963, 61p. (Rept. no. TN-2; TAE rept. no. 26) (AFOSR-5321) (AF EOAR-63-56) AD 419706 Unclassified

Donnell type equilibrium and stability equations are derived for stiffened thin conical shells. The force - and moment - strain relations of the combined stiffener-sheet cross-section are determined by the assumption of identical normal strains at the contact surface of stiffener and sheet. The stabtlity equations are solved for general tnstability under hydrostatic pressure by the method of virtual displacements. The solution proposed for stiffened conical shells tnvolves the concepts of "correcting coefficients" and minimizatton of corresponding "error loads". Typical examples are analyzed and the effect of eccentricity of stiffeners is investigated. Simplified approximate formulae for the critical pressure of frame-stiffened conical shells are also proposed.

2779

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

EQUILIBRIUM AND STABILITY EQUATIONS FOR STIFFENED SHELLS, by M. Baruch. [1964] [6]p. tncl. diagrs. (AFOSR-64-2000) (AF EOAR-63-58) AD 451167 AD 451167 Unclassified

Also published in Sixth Annual Conf. on Aviation and Astronautics, Tel Aviv, and Haifa (Israel) (Feb. 24-25, 1964), p. 117-124.

The usual approach to the analysts of a stiffened shell ts to replace it by an equivalent orthotropic shell. Such an approach, however, does not take into account the eccentricity of stiffeners, and requires a constant orthogonal behavior of the shell. The proposed approach is based on the following assumptions concerning stiffeners. (1) The stiffeners are distributed over the whole surface of the shell. (2) The normal strains in the stiffener and in the sheet are equal at their point of contact.

2760

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

AERODYNAMIC FORCES ON SUPERSONIC AIRFOILS OSCILLATING AT HIGH FREQUENCY INCLUDING SECOND-ORDER THICKNESS EFFECTS, by M. Hanin. [1963] [6]p. (AFOSR-J1029) (AF EOAR-63-66) AD 416296 Unclassifted

Also published in Fifth Annual Conf. on Aviatton and Astronautics, Tel Aviv and Haifa (Israel) (Feb. 27-28, 1963), p. 94-99.

A solution is obtained for the pressure on two-dtmensional airfoils that oscillate harmonically at high frequencies while in supersontc flight. The solution has the form of an asymptottc series in descending powers of the frequency, and its coefficterts tnclude nonlinear effects of airfoil thickness to the second-order. In the derivation, the oscillatory part of the flow is regarded as a perturbation super-imposed on the steady isentropic stmple-wave flow past the airfoil in mean position. The asymptottc solutton ts deduced from the differential equatton and boundary condttions of the oscillatory flow by applying a method of etkonal representatton.

2781

Technion-Israel Inst. of Tech. Dept. of Aeronautical Engineering, Haifa.

APPLICATIONS OF A HIGH-FREQUENCY AERODYNAMIC THEORY TO THE CALCULATION OF FLUTTER AT SUPERSONIC SPEEDS, by M. Hantn and E. Nissim. Final rept. Dec. 1964 [50]p. incl. diagrs. refs. (TAE rept. no. 36) (AFOSR-65-1008) (AF EOAR-63-66) AD 617931 Unclassified

Flutter of airfoil sections in bendtng, torsion, and control-surface rotation at supersonic flight speeds is analyzed by employing an aerosynamic solution for high-frequency oscillattons. The analysts includes effects of airfotl thtckness and shape, and is valid at arbitrary supersonic Mach numbers and sufficiently high values of frequency variable. For flutter problems with 2 degrees of freedom, such as bending-torsion, bending-aileron, and torsion-aileron, explicit expressions for calculating the flutter speed and frequency are obtained. The case of 3 degrees of freedom, bendtng-torsion-aileron flutter, is studied by sclving the determinant equation numeircally. Some calculated results are presented, showing the variation of flutter boundaries with the elastic and inertial properties of the airfoil, the flight conditions and the airfoil thickness. (Contractor's abstract)

2782

Technion-Israel Inst. of Tech. [Dept. of Mechanics] Haifa.

THE PHYSICAL TENSOR AND APPLICATIONS, by Z. Karni. Jan. 7, 1963, 27p. (AFOSR-4960) (AF EOAR-62-57) AD 413337 Unclassifted

The defintton of the physical tensor and tensor field, the transformation laws for its magnitudes with respect to orthogonal and oblique systems, the directional dertvative of a tensor, the curvilinear derivative of the tensor magnitudes and the Christoffel tensor in orthogonal systems, the plane finite rotation tensor and the physical curvature tensor are reported. As applications, the transforming of a Cartesian tensor equation to curvilinear coordinates, a multi-relattve motion with respect to curvtlinear networks and the merging of the Lagrange equations of motion and the geodesics equation into a single physical tensor equation of the Newton type are discussed.

2783

Technion-Israel Inst. of Tech. [Dept. of Mechanics] Haifa.

PHYSICAL TENSORS AND TENSOR FIELDS, by Z.

Karni. [1963] [4]p. (AFOSR-J708) (AF EOAR-62-57) AD 413677 Unclassified

Also published in Fifth Annual Conf. on Aviation and Astronautics, Tel Aviv and Haifa, (Israel) (Feb. 27-28, 1963), p. 147-150.

A definition of the physical tensor is presented, from which the transformation laws for its magnitudes with respect to oblique systems of reference are derived.

2764

Technion-Israel Inst. of Tech. Dept. of Mechanics, Haifa.

THE PHYSICAL TENSOR AND APPLICATION, by Z. Karni. Final scientific rept. Oct. 4, 1964, 46p. incl. refs. (AFOSR-65-0003) (AF EOAR-63-72) AD 610566 Unclassified

The physical tensor as a multilinear vector form, its resolution with respect to oblique coordinate networks, the invariancy under resolution, the general tensor derivative and curvilinear derivative for the physical tensor and the curvature tensors of degree m are introduced. The construction of tensor and generalized differential invariants and their application as integrity bases for some types of singular and quasi-singular multilinear vector forms are discussed. (Contractor's abstract)

2765

Technion-Israel Inst. of Tech. Dept. of Mechanics, Haifa.

A UNIFIED EQUATION OF MOTION IN THE NON-RELATIVISTIC MECHANICS, by Z. Karni. [1964] [6]p. (AFOSR-65-1025) (AF EOAR-63-72) AD 617662 Unclassified

Also published in Israel Jour. Tech., v. 2: 267-294, 1964.

An equation is presented describing the motion of the continua, as well as of the particle and the rigid body, in terms of the tensor derivative of physical tensors, the space-time derivative and the first and second curvature tensors. (Contractor's abstract)

2766

Technion-Israel Inst. of Tech. [Dept. of Physics] Haifa.

REMOVAL OF ORBITAL DEGENERACY IN AN ASYMMETRIC MOLECULAR ENVIRONMENT, by M. Brith and O. Schnepp. [1963] [6]p. incl. rables, refs. (AFOSR-64-2077) (AF 61(052)426) Unclassified

Also published in Jour. Chem. Phys., v. 39: 2714-2719, Nov. 15, 1963.

An investigation is made of the covalent and the dispersion interaction between an impurity metal atom and the host rare gas crystal lattice. The contributions of these interactions to the splitting energy of the atomic excited P state of magnesium in a distorted lattice site in solid argon are calculated. It is concluded that the experimental observations can be accounted for on the basis of physically reasonable models of asymmetric impurity sites and in particular the occurrence of more than one vacancy in the neighborhood of the impurity atom satisfies all requirements. (Contractor's abstract)

2767

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

DYNAMIC MAGNETORESISTANCE LOOPS OF COLD WORKED NICKEL AT LOW TEMPERATURES, by A. A. Hirsch, N. Friedman, and A. Zvikelsky. [1963] [2]p. incl. diagrs. (AFOSR-64-0422) (AF 61(052)461) Unclassified

Also published in Cryogenics, v. 3: 242-243, Dec. 1963.

This letter reports on dynamic magnetoresistance measurements carried out on cold rolled sheets of pure nickel down to liquid helium temperatures. It was concluded that the duration of a magnetization jump is longer in a cold rolled sheet having a large reduction in the thickness than in a normal bulk material. This duration increases appreciably at liquid helium temperatures.

2766

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

TIME AND FIELD EFFECTS IN THE ELECTRICAL CONDUCTION OF THIN METALLIC LAYERS AT LOW TEMPERATURES, by A. A. Hirsch and N. Friedman. [1964] [9]p. incl. diagrs. (AFOSR-64-1207) (AF 61-(052)461) AD 443015 Unclassified

Also published in Physica, v. 30: 369-397, 1964.

The electrical resistance of thin metallic layers measured by a bridge operated at 2400 Hz shows a creep phenomenon when a static electric field is introduded along the direction of the flowing alternating current. This resistance creep is responsible also for observed time-dependent hysteresis loops of the ac resistance. The phenomenon has been investigated from room down to liquid helium temperatures in layers made from silver, cobalt and nickel. A linear relation is found between the logarithm of the change in the ac resistance and the square root of the time measured from the moment when the longitudinal static field was applied. The creep phenomenon increases with the increasing static field. The theoretical model for the resistance creep gives an explanation for the deviation in Ohm's law observed in thin metallic layers at low temperatures. (Contractor's abstract)

2789

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

ELECTRICAL CONDUCTION OF THIN METALLIC LAYERS AT HIGH FREQUENCIES DOWN TO LIQUID HELIUM TEMPERATURES, by A. A. Hirsch and S. Bazian. [1964] [7]p. incl. diagrs. table, refs. (AFOSR-64-1208) (AF 61(052)481) AD 443016 Unclassified

Also published in Physica, v. 30: 258-264, 1964.

The dependence of electrical conduction on current frequency has been studied in thin layers of pure metals at temperatures between 4.2°K and 297°K. The experimental data are given for frequencies up to 2 x 10^6 Hz. As shown by the experimental data the increase in electrical resistance with the increase of the frequency is more pronounced in layers having large dc resistance. In layers with negative temperatures coefficients of resistance, this decrease is more rapid at low temperatures.

2790

Technion-Israel Inst. of Tech. [Dept. of Physics] Haifa.

EFFECT OF COLD ROLLING ON MAGNETIZATION REVERSAL OF HIGH-PURITY NICKEL TAPES, by A. A. Hirsch. [1964] [2]p. (AFOSR-64-1209) (AF 61-(052)481) AD 443017 Unclassified

Also published in Jour. Appl. Phys., v. 35: 909-910, Mar. 1964.

Dynamic magnetoresistance hysteresis loops were used for investigation of the magnetization reversal in cold-rolled tapes of high-purity nickel. When the magnetization field was transverse to the rolling axis, the coercive force could be expressed in a form which may be related to a magnetization reversal occurring through a process of reorientation of spins. The magnetoresistance loops of the samples made by unidirectional cold rolling were asymmetric when they were performed by applying simultaneously two crossed magnetic fields, one ac and the other dc. A magnetic uniaxial anisotropy induced by this rolling seems to be responsible for the observed asymmetry, a possible mechanism for this being the deformation of crystals by slips. (Contractor's abstract, modified)

2791

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

THE INFLUENCE OF COLD WORK ON THE MAGNETORESISTANCE EFFECT OF PURE FERROMAGNETIC METALS AT LIQUID HELIUM TEMPERATURES. PART I. MAGNETORESISTANCE IN THIN FILMS OF PURE FERROMAGNETIC METALS, by A. A. Hirsch. Final scientific rept. Jan. 1961-Apr. 1964, June 15, 1964, 85p. incl. illus. diagrs. tables, refs. (AFOSR-64-1894, pt. 1) (AF 61(052)481) Unclassified

The electrical conduction and the magnetoresistance effect of thin metallic films made by evaporation in a high vacuum were investigated down to liquid helium temperatures as a function of the electric field, the frequency of the current, as well as the simultaneously applied static and variable magnetic fields. The different dependences were interpreted in terms of a granular structure of the films. The grains of the ferromagnetic films were assumed to be one-domain single crystals. (Contractor's abstract)

2792

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

THE INFLUENCE OF COLD WORK ON THE MAGNETORESISTANCE EFFECT OF PURE FERROMAGNETIC METALS AT LIQUID HELIUM TEMPERATURES. PART II. MAGNETORESISTANCE AND DEFORMATION TEXTURES IN COLD ROLLED PURE NICKEL, by A. A. Hirsch. Final scientific rept. Jan. 1961-Apr. 1964, Aug. 15, 1964, 74p. incl. illus. diagrs. refs (AFOSR-64-1894, pt. 2) (AF 61(052)481) Unclassified

A phenomenological analysis is outlined for the magnetoresistance effect in cold roiled pure nickel below magnetization saturation down to ilquid helium temperatures, which is based on the assumption of time dependent hysteresis phenomena. X-ray texture studies are also used in the interpretation of the experimental data on low temperature magnetoresistance. The results are compared with those obtained from magnetoresistance investigations on thin films of pure ferromagnetic metals. (Contractor's abstract)

2793

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETIZATION SWITCHING TIME AT LOW TEMPERATURES, by A. A. Hirsch. [1964] [2]p. incl. diagr. table. (AFOSR-64-2097) (AF 61(052)481) AD 451351 Unclassified

Also published in Physica, v. 30: 563-564, 1964.

This letter reports a new simple experimental method for investigation of magnetization switching time at low temperatures, which is based on the study of dynamic magnetoresistance hysteresis loops obtained by using a triangular waveform magnetizing field.

2794

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETORESISTANCE BELOW MAGNETIZATION SATURATION IN PLASTICALLY DEFORMED NICKEL DOWN TO LIQUID HELIUM TEMPERATURES, by A. A. Hirsch. [1964] [12]p. incl. diagrs. refs. (AFOSR-65-0765) (AF 61(052)481) AD 616038 Unclassified

Also published in Physica, v. 30: 1545-1556, 1964.

A phenomenological analysis is outlined for the magnetoresistance effect in plastically deformed pure nickel below magnetization saturation down to liquid helium temperatures, which is based on the assumption of time

dependent hysteresis phenomena. Both preferred orientation and induced uniaxial magnetic anisotropy are expected to be created by the plastic flow, when the deformation of the polycrystalline material is carried out by cold rolling with high reduction in the thickness of the sample. The magnetoresistance hysteresis loops can be ascribed to a magnetization process, and the field interval corresponding to nonsaturated states of magnetization is higher than expected in ordinary bulk material.

2795

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

THE EFFECT OF FREQUENCY ON THE ELECTRICAL RESISTIVITY OF GRANULAR METAL FILMS, by A. A. Hirsch, N. Friedman, and S. Bazian. [1964] [2]p. incl. diagr. table, refs. (AFOSR-65-0748) (AF EOAR-63-71) AD 615072 Unclassified

Also published in Vacuum, v. 14: 393-394, 1964.

A resistance method is given for the determination of the thickness of thin granular metal films based on the use of impedance measurements at frequencies in order of magnitude of 1 mcps. At these frequencies the intergranular gap resistance can be seen as short circuited by the inter-granular capacitance, so that the measured resistance is that of the metal grains. As shown the resistivity of the individual grains is in general several times greater than the bulk resistivity of the metal. This difference depends strongly on the vacuum conditions and the rates of evaporation.

2796

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

MAGNETIC RELAXATION BEHAVIOUR OF MULTILAYER NICKEL FILMS, by A. A. Hirsch, N. Friedman, and Z. Eliezer. [1964] [3]p. incl. diagrs. (AFOSR-65-1895) (AF EOAR-63-71) AD 625708 Unclassified

Also published in Physica, v. 30: 2314-2316, 1964.

A discussion is presented of the magnetic properties of multilayer films composed of very thin laminations of ferromagnetic metals, starting from the viewpoint of a superparamagnetic state. The films investigated were obtained by depositing alternatively at room temperature layers of nickel and copper in a vacuum of 10^{-6} mm Hg on to substrates made of aluminum foils (70 mm x 100 mm x 0.01 mm). The dependence of the coercive force on the mean distance between the nickel layers of the films indicates that the magnetic interaction between the different layers of the films cannot be neglected in a theoretical interpretation of the remagnetization of multilayer films with superparamagnetic behavior, as is normally done in the case of fine noninteracting particles, the remagnetization of which is discussed by means of a Langevin function.

2797

Technion-Israel Inst. of Tech. Dept. of Physics, Haifa.

A GENERAL METHOD FOR THE USE OF BAND MODELS WITH APPLICATIONS TO INFRARED ATMOSPHERIC ABSORPTION, by U. P. Oppenheim and Y. Ben-Aryeh. [1964] [12]p. incl. diagrs. refs. (AFOSR-64-2250) (AF EOAR-63-111) AD 452358 Unclassified

Also published in Jour. Quant. Spectros. and Radiative Transfer, v. 4: 559-570, 1964.

A new method is described for the application of band models to an observed absorption spectrum. It is shown how the appropriate model (Elasser or statistical) is selected by a simple analysis of the observed spectral data. Once the model has been chosen, the two main parameters of each model are derived by the use of curves of growth. The method is applied to the following atmospheric bands: N_2O (at 4.5μ), CO (at 4.7μ) and H_2O (at 6.3μ). For each band the parameters of the appropriate band model are calculated for a large number of frequencies in the band. (Contractor's abstract)

2798

Technische Hochschule, Hannover (Germany).

INVESTIGATION OF PLATE AND SHELL MODELS BY MATRICES, by E. Pestel. May 1963, 174p. (AFOSR-64-0592) (AF EOAR-61-46) AD 434846 Unclassified

Grid models for arbitrary triangular and trapezoidal shapes are developed, and the effect of shear deformation in bending problems is included. A straightforward method for the application of Hrennikoff's models to shell problems was derived. Also a concise method for the derivation of the stiffness-matrix for Hrennikoff's model is developed. Finally, the use of transfer matrices is discussed for certain basic problems concerning the lumped parameter technique which is ordinarily employed in conjunction with grid models for vibration problems and for the case of random-vibrations which are dealt with via the frequency response of the structure.

2799

Technische Hochschule, Munich (Germany).

STUDIES ON THE CHANGE OF THE CONCENTRATIONS OF INTERMEDIATES DURING PHOTOSYNTHESIS OF CHLORELLA AND ISOLATED CHLOROPLASTS, by O. Kandler. Final rept. no. 1, May 1, 1963, 27p. (AFOSR-64-0021) (AF EOAR-62-42) AD 429777 Unclassified

The changes in the concentrations of intermediates and the distribution of C_{14} after photosynthesis in $C_{14}O_2$ by Chlorella and isolated chloroplasts was

measured under different conditions of photosynthesis and under the effect of metabolic inhibitors. The following results were obtained. (1) The changes in the concentrations of intermediates in Chlorella during the transition from light to dark and vice versa are independent of CO_2, but dependent on anaerobiosis. (2) In Chlorella photosynthesis is inhibited even by a concentration of monoiodoacetic acid which is 100 times lower than that inhibiting respiration. The beginning of inhibition is indicated by an accumulation of labeled PGA. (3) When Chlorella is illuminated in the presence of KCN, the radioactive PGA formed during a preceding period of photosynthesis in $C_{14}O_2$, is still reduced to sugar without a change in the total quantity of PGA in the cell. (4) Arsenate and DNP do not lead to an accumulation of PGA, but do inhibit the formation of RuDP. (5) The distribution of radioactivity on the paper chromatograms showed that ATP and ADP are the first labeled compounds under the two conditions.

2800

Technische Hochschule, Munich (Germany).

[DIFFERENCE METHOD FOR HYPERBOLIC INITIAL VALUE PROBLEMS WITH MORE THAN TWO INDEPENDENT VARIABLES BY USING SEMI-CHARACTERISTICS] Differenzenverfahren für hyperbolische Anfangswertprobleme bei mehr als zwei unabhängigen Veränderlichen mit Hilfe von Nebencharakteristiken, by R. Sauer. [1963] [13]p. incl. diagrs. (AFOSR-J649) (AF EOAR-62-94) AD 418156 Unclassified

Also published in Numerische Math., v. 5: 55-67, 1963.

The method developed is for m > 2 quasi-linear partial differential equations with m > 2 independent variables. It is assumed that the problem is properly posed and hyperbolic. This method uses compatability conditions in the characteristic planes, but uses semi-characteristic directions instead of bi-characteristic directions. directions. This new approach is more flexible and can be used for practical computation.

2801

Technische Hochschule, Munich (Germany).

PRACTICAL NUMERICAL METHODS OF THREE-DIMENSIONAL SUPERSONIC FLOWS, by R. Sauer. Final technical rept. June 1, 1963, 14p. (AFOSR-J1213) (AF EOAR-62-94) AD 423081 Unclassified

Two new difference methods for the numerical solution of initial value problems in quasilinear partial differential equations were developed. One of these methods is applied to problems of the propagation of non-linear pressure waves. Some other investigations now under way, concerning questions in quasilinear equations are briefly discussed.

2802

Technische Hochschule, Munich (Germany).

[SIMPLE WAVES IN THE THEORY OF CHARACTERISTICS OF A SYSTEM OF QUASILINEAR PARTIAL DIFFERENTIAL EQUATIONS] Einfache Wellen in der Charakteristikentheorie von Systemen quasilinearer partieller Differentialgleichungen, by R. Sauer. [1964] [7]p. (AFOSR-64-2415) (AF EOAR-62-94) AD 453619 Unclassified

Also published in Zeitschr. Angew. Math. und Mech., v. 44: 203-209, 1964.

For systems of homogeneous quasilinear differential equations with n independent variables simple wave solutions are deduced with the help of the theory of characteristics. It is assumed that the coefficients of the differential equations do not explicitly depend on the independent variables. For the sake of illustration, applications in gasdynamics (propagation of nonlinear pressure waves) are discussed. (Contractor's abstract)

2803

Technische Hochschule, Munich (Germany).

EXPERIMENTS ON THE EFFECTS OF COMBINED WAVELENGTHS ON PHOTOSYNTHESIS, by O. Kandler. Final technical rept. May 1, 1964, 13p. incl. diagrs. tables. (AFOSR-64-1650) (AF EOAR-63-10) AD 606077 Unclassified

An apparatus for measuring photosynthesis of Chlorella or other algae under the influence of combined monochromatic beams of light are described. Preliminary experiments showed, that the addition of blue light to red light results in a decrease the addition of far red light in an enhancement of photosynthesis. (Contractor's abstract)

2804

Technische Hochschule, Munich (Germany).

EXPERIMENTAL RESULTS ON THE METHOD OF "NEBENCHARAKTERISTIKEN", by W. Werner. June 15, 1964 [11]p. incl. diagrs. tables. (Scientific rept. no. 1) (AFOSR-64-1604) (AF EOAR-63-77) AD 605507 Unclassified

Systems of hyperbolic partial differential equations in 2 or more space variables are integrated numerically by taking derivatives in 'characteristic hyperplanes'. Numerical results are presented and discussed.

2805

Technische Hochschule, Munich (Germany).

GENERAL MULTISTEP FINITE DIFFERENCE

METHODS FOR THE SOLUTION OF $U_{xy} = f(X, Y, U, U_x, U_y)$, by H. J. Stetter and W. Törnig. [1963] [18]p. incl. diagr. (AFOSR-64-2388) (AF EOAR-63-77) AD 452402 Unclassified

Also published in Rend. Circ. Matem. Palermo, Ser. II, v. 12: 1-18, 1963.

This paper presents an adaptation of the general multistep finite difference methods to the numerical solution of the partial differential equations. These methods may in a obvious manner be generalized to systems of equations without changing their stability and convergence properties; the presentation was restricted to the scalar case to keep the notation simpler. Since all quasilinear hyperbolic partial differential equations of second order in two independent variables may be transformed into systems, the resulting numerical methods may well have important applications.

2806

Technische Hochschule, Stuttgart (Germany).

EXPERIMENTAL INVESTIGATIONS OF VORTEX OCCURRENCE AT TRANSITION IN UNSTABLE LAMINAR BOUNDARY LAYERS, by F. X. Wortmann. Final rept. Feb. 10, 1964 [32]p. incl. illus. diagrs. (AFOSR-84-1280) (AF 61(052)220) AD 602796 Unclassified

The behavior of laminar and instably stratified boundary layers towards three-dimensional perturbations, in form of vortices parallel to the direction of flow, was investigated by means of a water tunnel of very low turbulence. For the first time it has been possible to verify the theoretically stated neutral curve of stability. Furthermore the distribution of the disturbation amplitude for different wave lengths and wall distances and also the growth of the vortices in the direction of flow were investigated. These experiments give a verification of the theory of stability and show that the validity of the theory is limited to small disturbation amplitudes. (Contractor's abstract, modified)

2807

Temple U. Research Inst., Philadelphia, Pa.

PLASMA JET CHEMISTRY, by C. S. Stokes, J. A. Cahill and others. Final rept. Dec. 1984, 32p. incl. diagrs. tables. (AFOSR-85-1802) (AF AFOSR-82-196) AD 625591 Unclassified

Three types of plasma jets are described: a noble gases plasma jet, a nitrogen plasma jet, and a plasma jet cathode as chemical feeder. Powder feeding devices and quenching devices are considered. The use of the plasma jet is described for several chemical reactions: metal oxides reduction, refractory metals nitrides formation, and refractory metals carbides formation. The temperatures attainable with plasma jets are in the range of 5000°K to 50,000°K.

2808

Texaco Experiment, Inc., Richmond, Va.

PROPERTIES OF IONS IN FLAMES, by I. R. King. Final rept. June 1959-Feb. 1984, 61p. incl. illus. diagrs. tables, refs. (Rept. no. TP-231) (AFOSR-64-0983) (AF 49(838)850) Unclassified

The properties of ions in flames, with particular emphasis on those properties related to ion recombination, have been studied by Langmuir probes, electromagnetic attenuation, and mass spectrometry. Recombination rates for both natural flame ions and ions resulting from the introduction of easily ionized materials into the flame have been determined under a variety of conditions of pressure, temperature, and fuel type. Identities of many of the ions have been determined, and a tentative mechanism of ion recombination in hydrocarbon flames has been postulated.

2809

Texas A. and M. Coll. Dept. of Physics, College Station.

ELECTRONIC ABSORPTION SPECTRA OF SIMPLE MOLECULES. Final rept. Mar. 1963, 84p. incl. diagrs. tables, refs. (AFOSR-4728) (AF 49(638)593) AD 403079; AD 407128 Unclassified

This report is a compilation of papers and abstracts with the following titles: The Franck-Condon principle and the structure of excited electronic states of molecules; The structure of benzene in the excited electronic state $^1B_{2u}$; A double-minimun potential function with the application to NH_3 and ND_3; Evidence for a double-minimum potential in an excited state of ClO_2 (Abstract); 'Hot' bands of the 2000 A system of NH_3, ND_3, and NT_3; Rotational structure and intensity envelopes of vibronic bands of sulfur dioxide near 3700 A; and the 2900 A absorption system of sulfur dioxide (Abstract).

2810

Texas A. and M. Coll. [Dept. of Physics] College Station.

EVIDENCE FOR A DOUBLE-MINIMUM POTENTIAL IN AN EXCITED STATE OF ClO_2, by J. B. Coon, F. A. Cesani, and C. M. Loyd. [1983] [8]p. (AFOSR-64-0058) (AF 49(838)593) AD 430675 Unclassified

Also published in Faraday Soc. Discussions, v. 35: 118-123, 1963.

Evidence is presented which indicates the existence of a double-minimum potential in the antisymmetrical vibrational co-ordinate of an excited electronic state of ClO_2. A two-parameter double-minimum potential function is adjusted to fit the observed levels of the Q'3 mode. The resulting function has a barrier of 2520 cm-1, and at each potential minimum one bond is 0.065 A shorter and one bond is 0.065 A longer than the

average bond of 1.620 A. A Franck-Condon calculation based on the vibrational wave functions of the double-minimum potential yields intensity ratios in approximate agreement with the experimental ratios.

2811

Texas Instruments, Inc., Dallas.

PARAMAGNETIC RESONANCE OF Cr IN CdS, by T. L. Estle, G. K. Walters, and M. DeWit. [1963] [11]p. incl. diagrs. refs. (AFOSR-64-0877) (AF 49(638)1250) AD 438670 Unclassified

Also published in Paramagnetic Resonance; Proc. First Internat'l. Conf., Jerusalem (Israel) (July 16-20, 1962), ed. by W. Low. New York, Academic Press, v. 1: 144-154, 1963.

The paramagnetic resonance of Cr in CdS has been studied at low temperatures. Six Cr centers, differing only in their orientation are present in equal numbers. Each resonance has a $g_{\perp} \neq 0.02$; consequently no $\Delta M = \pm 1$ transitions are observed. The lines broaden at about 6°K and are unobservable above about 20°K. The hyperfine splitting constants parallel to the z axis of the center are 5.6 gauss for the nearest Cd nuclei and 13.8 gauss for Cr^{53} in an enriched sample. Resonance is atrributed to substitutional Cr^{++} with a Jahn-Teller distortion approximately along the directions bisecting the lines to the nearest sulfur neighbors.

2812

Texas Instruments, Inc., Dallas.

ELECTRON PARAMAGNETIC RESONANCE OF IRON IN INDIUM ARSENIDE, by T. L. Estle. [1964] [3]p. incl. table, refs. (AFOSR-65-0773) (AF 49(638)1250) AD 617054 Unclassified

Also published in Phys. Rev., v. 136: A1702-A1704, Dec. 14, 1964.

The electron-paramagnetic-resonance spectrum of the $3d^5$ configuration of iron in cubic symmetry has been observed in iron-doped indium arsenide. The spin-Hamiltonian parameters describing this spectrum are $g = 2.035 \pm 0.002$ and $a = +(421 \pm 1) \times 10^{-4}\ cm^{-1}$. The inhomogeneously broadened line is approximately 130 G wide. A comparison is made with the Mössbauer effect of Fe^{57} in InAs studied by Bemski and Fernandes. The results are discussed in terms of charge-transfer configuration admixtures introduced by Fidone and Stevens and elaborated by Watanabe and coworkers. (Contractor's abstract)

2813

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. X. HALOPENTAMMINECOBALT (III) NITRATES, $Co(NH_3)_5X(NO_3)_2$, by W. W. Wendlandt and J. P. Smith. [1964] [8]p. (AFOSR-64-0933) (AF AFOSR-63-23) AL 439975 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 445-452, 1964.

The thermal dissociation of the $Co(NH_3)_5X(NO_3)_2$ type complexes was studied by thermogravimetry, differential thermal analysis, thermomagnetic analysis, and by pyrolysis on the mass spectrometer. The TGA curves showed that all of the complexes dissociated in a single step in the temperature range of 130°-290°C. All of the DTA curves were characterized by a large exothermic peak in the 200°-260°C temperature range. The diamagnetic-paramagnetic transition was studied from ambient to 400°C. Pyrolysis products found by the mass spectrometer were H_2O, NH_3, NO, N_2O and N_2.

2814

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

ON THE ALPHA-BETA TRANSITION OF BIS(PYRIDINE) COBALT(II) CHLORIDE, by W. W. Wendlandt. [1964] [2]p. (AFOSR-64-1812) (AF AFOSR-63-23) AD 449083 Unclassified

Also published in Chemist Analyst, v. 53: 71-72, July 1964.

Two forms of bis(pyridine) cobalt(II) chloride, $Co(C_5H_5N)_2Cl_2$, are known: a violet α-form and a blue β-form. Numerous investigations relating to the structure, molecular weight, magnetic properties, absorption spectra, and thermal properties have been made. It is now generally concluded that the α-form involves polymeric chains in which each cobalt is octahedrally surrounded by four chlorine atoms and two nitrogen atoms. The β-form consists of a monomeric structure in which each cobalt is tetrahedrally surrounded by two chlorine atoms and two nitrogen atoms.

2815

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. XII. SOME COPPER(II) AMMINE COMPLEXES, by J. P. Smith and W. W. Wendlandt. [1964] [7]p. (AFOSR-64-1813) (AF AFOSR-63-23) AD 449082 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 1157-1163, 1964.

The thermal dissociation of $(Cu(NH_3)_6)Br_2$, $(Cu(NH_3)_6)Cl_2$, $(Cu(NH_3)_5SO_4$, and $(Cu(NH_3)_4)I_2$, was studied by differential thermal analysis, thermomagnetic analysis, pyrolysis on the mass spectrometer, and by chemical analysis of the residues and reaction products. The complexes dissociated through the loss of ammonia, forming stable lower ammines, and upon further heating, the reduction of the copper(II) to

copper(I) took place. The stoicheiometry of the thermal dissociation reaction was determined.

2816

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. VII. A THERMOMAGNETIC STUDY OF THE Co(III)-Co(II) REDUCTION IN COBALT(III) AMINE COMPLEXES, by W. W. Wendlandt and J. P. Smith. [1963] [6]p. (AFOSR-64-1815) (AF AFOSR-63-23) AD 449086 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 25: 1267-1272, 1963.

The Co(III)-Co(II) reduction reaction was studied by means of a high temperature Gouy magnetic susceptibility apparatus for the complexes: $(Co(NH_3)_6)X_3$, $(Co(NH_3)_6)_2(SO_4)_3 \cdot 2 \cdot 5H_2O$, $(Co(NH_3)_5H_2O)X_3$, $(Co(NH_3)_5X)X_2$, and $(Co(NH_3)_5X)Y_2$. Minimum reduction temperatures were in the 100°-200° temperature range with most of them in the 150°-200° range. The curves for $(Co(NH_3)_5Br)\ I_2$ and $(Co(NH_3)5Cl)\ I_2$ had a pronounced break at 193° and 185° respectively. Two possible reduction mechanisms are indicated for these two complexes.

2817

Texas Technological Coll. [Dept. of Chemistry] Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. XIV. SOME RHODIUM(III) AMMINE COMPLEXES, by W. W. Wendlandt and P. H. Franke, Jr. [1964] [9]p. (AFOSR-64-2503) (AF AFOSR-63-23) AD 453798 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 1885-1893, 1964.

The thermal dissociation of $(Rh(NH_3)_6)Cl_3$, $(Rh(NH_3)_5X)X_2$, and $(Rh(NH_3)_5\ H_2O)X_3$ was studied by TGA, DTA, thermomagnetic analysis, and GEA. The stoichiometry of the thermal dissociation reaction of the $(Rh(NH_3)_5X)X_2$ complexes was also determined by analysis of the decomposition products. A comparison was made between the thermal dissociation of the rhodium(III) complexes and the analogous cobalt(III) complexes.

2818

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE THERMAL DISSOCIATION OF SOME METAL CUPFERRATE CHELATES, by W. W. Wendlandt, S. I. Ali, and C. H. Stembridge. [1964] [8]p. incl. diagrs. table. (AFOSR-65-0378) (AF AFOSR-63-23) AD 612246 Unclassified

Also published in Anal. Chim. Acta, v. 31: 501-508, 1964.

The thermal dissociation of the cupferron complexes with Cu(II), Ni, Co(II), Zn, Cd, Mn(II), Hg(II), Mg, Ca, Ba, Sr, Al, Fe(III), Ce(III), La, and Nd was studied by differential thermal analysis (DTA) and by pyrolysis into a mass spectrometer. The DTA curves consisted mainly of endothermic peaks although some contained exothermic peaks as well. The mass spectrometer showed that cupferron decomposes slightly above room temperature, giving off N_2, NO, N_2O, NH_3 and H_2O.

A mechanism for the thermal dissociation of the copper(II) cupferrate is proposed. (Contractor's abstract)

2819

Texas Technological Coll. Dept. of Chemistry, Lubbock.

THE THERMAL DECOMPOSITION OF METAL COMPLEXES. XIII. SOME TETRAMMINEPALLADIUM (II) COMPLEXES, by W. W. Wendlandt and L. A. Funes. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-0379) (AF AFOSR-63-23) AD 612245 Unclassified

Also published in Jour. Inorg. and Nuclear Chem., v. 26: 1879-1884, 1964.

The thermal dissociation of the palladium(II) tetrammine-complexes, $[Pd(NH_3)_4]X$, was studied by thermogravimetry, DTA, GE, and by analysis of the pyrolysis products. The complexes, except for the nitrate and sulphate, dissociated to give the trans-diammine-complexes, $[Pd(NH_3)_2X]$. The diammine-iodide and bromide complexes dissociated to give the corresponding anhydrous metal halides, PdX_2. The stoicheiometry for the thermal dissociation of the $[Pd(NH_3)_2X]$ complexes, where X was Cl, Br, and I, was determined. (Contractor's abstract)

2820

Texas U. Computation Center, Austin.

MATHEMATICAL PROGRAMMING BY MINIMIZING DIFFERENTIABLE FUNCTIONS, by A. A. Goldstein and B. R. Kripke. [1964] [2]p. (AFOSR-64-0968) (AF AFOSR-63-467) AD 440145 Unclassified

Also published in Numerische Math., v. 6: 47-48, 1964.

This note is concerned with the possibility of using classical techniques for minimizing differentiable functions without constraints to find approximate solutions to certain constrained problems.

2821

Texas U. [Computation Center] Austin.

MINIMIZING FUNCTIONALS ON HILBERT SPACE, by

A. A. Goldstein. [1964] [7]p. (AFOSR-65-1020) (AF AFOSR-62-346 and AF AFOSR-63-467) AD 616351 Unclassified

Also published in Computing Methods in Optimization Problems; Proc. of Conf., California U., Los Angeles (Jan. 30-31, 1964), ed. by A. V. Balakrishnan and L. W. Neustadt. New York, Academic Press, 1964, p. 159-165.

This note involves 2 ideas. The first is a generalization of constructive techniques employed for the minimization of quadratic functionals on a real Hilbert space. The extension is for twice differentiable functionals. The second consists of using differentiable functionals to make uniform approximations of nondifferentiable functionals in related examples. Of the 2 examples given, one arises from control theory, the other from approximation theory in the L_1 metric. In both problems the functional is minimized on a closed linear variety.

2622

Texas U. [Computation Center] Austin.

MINIMAX THEOREMS AND CONJUGATE SADDLE-FUNCTIONS, by R. T. Rockafellar. [1964] [23]p. incl. table. (AFOSR-65-1164) (AF AFOSR-63-467) AD 622636 Unclassified

Also published in Math. Scand., v. 14: 151-173, 1964.

Saddle-elements in minimax theory are studied which are not completely closed, but merely closed. Convex functions and saddle-functions with infinite values are first considered. Three theorems are later presented on the existence and properties of minimax equivalence classes of closed saddle-functions. Several sections deal with conjugates of closed saddle-functions and the subgradient characterization of saddle-points. Finally the main minimax theorem is presented concerning two conditions over a saddle element $\{A, B, K\}$ such that if the first condition is satisfied

$$\max_{x \in A} \inf_{y \in B} K(x, y) = \inf_{y \in B} \sup_{x \in A} K(x, y) < +\infty,$$

and if the second condition is satisfied

$$-\infty < \sup_{x \in A} \inf_{y \in B} K(x, y) = \min_{y \in B} \sup_{x \in A} K(x, y),$$

then K has a saddle-point on A x B.

2623

Texas U. Dept. of Chemistry, Austin.

SOME ASPECTS OF TRANSITIONS BETWEEN ELECTRONIC LEVELS, by W. A. Noyes, Jr. and L. Unger. [1964] [12]p. incl. refs. (AFOSR-65-0890) (AF AFOSR-65-778) AD 617936 Unclassified

Also published in Pure and Appl. Chem., v. 9: 461-472, 1964.

The transitions between electronic levels of polyatomic molecules and their relationship to the photochemistry of such molecules are considered. These transitions often occur without emission or absorption of radiation so that the state first formed by the absorption of radiation may not be the one most concerned with the resulting reaction kinetics. The present discussion reviews the data for a few polyatomic molecules, i.e., ketone, acetone, biacetyl, benzene, and ketones with C atoms γ to the carbonyl group, to determine both the extent of and the character of intersystem cross-overs and of internal conversions. The terms internal conversion and intersystem cross-over refer to a non-radiative transition between states of the same multiplicity and of different multiplicity, respectively. The scope of the subject is limited to the gas phase.

2624

Texas U. [Dept. of Engineering Mechanics] Austin.

CYCLIC DEFORMATION OF THIN FILMS INSIDE THE ELECTRON MICROSCOPE, by F. H. Tuley and M. A. Wilkov. Dec. 1964, 18p. (Rept. no. EMRL-RM-1001) (AF AFOSR-64-560) AD 616263 Unclassified

High purity silver and nickel films were obtained by vapor deposition onto a sodium chloride crystal in an ion pumped vacuum at a pressure greater than 10^{9} Torr. The electron micrographs showed dislocations, stacking faults and interference fringes present and that the films were not of uniform thickness. The results showed that metallic films could be obtained and that the attainment of films representative of the bulk material requires a refinement of the vapor deposition method under ultra-high vacuum conditions.

2625

Texas U. Dept. of Geology, Austin.

PRECAMBRIAN GEOLOGY OF SOUTH-CENTRAL NEW MEXICO, by W. R. Muehlberger and R. E. Denison. [1964] [8]p. incl. diagrs. refs. (AFOSR-65-2909) (AF 49(636)1115) AD 455523 Unclassified

Also published in Fifteenth Field Conf., New Mexico Geological Soc., 1964, p. 62-69.

The Ruidoso country contains no Precambrian outcrops and no wells in the region to penetrate to it. To interpret the Precambrian geology of the actual field trip area a larger area was selected which gives sufficient regional control for interpolation into the Ruidoso country. The extensive outcrop belt of the San Andres Mountains, Sierra Oscura, Los Pinos and southern Manzano Mountains form the western flank; the exposures in southern Torrance County as well as the numerous wells along the western margins of some of the Precambrian belts in eastern New Mexico forms the eastern in Otero County north of the Tertiary intrusive rocks that extend into Trans-Pecos Texas. This contribution furnishes petrographic descriptions of basement well and outcrop samples and a synthesis of Precambrian history in the map area.

2826

Texas U. [Dept. of Geology] Austin.

BURIED BASEMENT ROCKS OF THE UNITED STATES OF AMERICA AND CANADA. VOL. 1 OF 2 AND MAPS, by W. R. Muehlberger, R. E. Denison, and E. G. Lidiak. Final rept. Aug. 1964, 213p. (AF 49(638)1115) AD 449?90 Unclassified

A map of the geology of the buried basement of the United States and Canada is presented. In addition the map attached to this report includes the U. S. Geological Survey compilation of the exposed basement. The accompanying report includes brief descriptions of the rock units recognized and their inferred sequence of formation, insofar as possible. Also included are (1) the locations and rock type of each sample studied petrographically by the contract personnel during the course of the study; (2) specific gravity of corss available to us; and (3) isotopic ages of all rocks analyzed as part of this contract by members of the Isotope Geology Branch, U. S. Geological Survey.

2827

Texas U. [Dept. of Geology] Austin.

LATE PALEOZOIC MOVEMENT ALONG THE TEXAS LINEAMENT, by W. R. Muehlberger. 1964, 9p. (AF 49(638)1115) AD 817442 Unclassified

Also published in Trans. New York Acad. Sci., Series II, v. 27: 385-392, Feb. 1985.

The Texas Lineament is a zone of structural discontinuity extending in a west-northwest direction from south of Corpus Christi to El Paso and westward across southern Arizona to the Transverse Ranges of southern California. About 200-250 miles of right-lateral slip took place along this lineament during the late Paleozoic. Geological evidence is presented as the basis for two lines of reasoning in support of this interpretation.

2828

Texas U. Dept. of Physics, Austin.

CYCLOTRON RESONANCE IN SLIGHTLY IONIZED GASES, by F. C. Fehsenfeld. [1963] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1475) (AF AFOSR-82-270) AD 445170 Unclassified

Also published in Jour. Chem. Phys., v. 39: 1653-1661, Oct. 1, 1963.

Ths conductivity of a slightly ionized gas in a uniform magnetic field has been obtained from the solution of the Boltzmann equation for cases in which the collision frequsncy between electrons and neutral particles are dependent on the electron velocity. The line shapes of the cyclotron resonance absorption of ensrgy from a high-frequency electric field and the derivative with respect to the magnetic field of the resonance absorption have been computed.

2829

Texas U. Dept. of Physics, Austin.

THE PHYSICS OF METASTABLE SYSTEMS, by W. W. Robertson. Final rept. Feb. 1, 1962-Jan. 31, 1963, 8p. incl. refs. (AFOSR-85-1048) (AF AFOSR-82-270) AD 822887 Unclassified

The research on this project has included ths following studies: (1) De-excitation cross sections in units of 10^{-16} cm^2 wers determined for metastable helium atoms He(2^3S) and He(2^1S); (2) Reactions of the metastable heiium triplets He(2^3S) and $Hs_2(^3\Sigma_u^+)$ with Ns, N_2, O_2, and CH_4 were investigated; (3) Metastable helium atom concentrations in the earth's atmosphere were calculated; (4) The processes of metastable destruction were considered in detail; (5) Cross sections for zero activation energy processss were calculated and analyzed by simple collision models with emphasis on the Penning effect; and (8) The electronic energy of the system He(^1S) and He(^3S) was calculated as a function of nuclear separation. A technical resume of the results is presented.

2830

Texas U. [Dept. of Physics] Austin.

SOME EXCITED STATES OF THE HYDROGEN MOLECULE. I. $1\Pi_u(1s2p\Pi)$ AND $3\Pi_u(1s2p\Pi)$, by J. C. Browne. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-2419) (AF AFOSR-63-215) AD 453809 Unclassified

Also published in Jour. Chem. Phys., v. 40: 43-46, Jan. 1, 1964.

Theoretical potential curves, spectroscopic constants, and expectation values for some one-electron operators are given for the $^3\Pi_u(1s2p\Pi)$ (metastable) and $^1\Pi_u$ $(1s2p\Pi)$ states of the hydrogen molecule. Total energies are 0.7188 and 0.7381 a.u. for $^1\Pi_u$ and $^3\Pi_u$, respectively. The experimental total energies are 0.7186 and 0.7381 a.u. for $^1\Pi_u$ and $^3\Pi_u$, respectively. The maximum in the potential curve of the $^1\Pi_u$ state is found to be much smaller and to occur at a larger internuclear separation than estimated by previous theoretical calculations. The $^1\Pi_u$ curve is reasonably consistent with the previous data.

2831

Texas U. Dept. of Physics, Austin.

BINDING ENERGY OF LiH^+ AND THE IONIZATION POTENTIAL OF LiH: MIXED BASIS SET CALCULATION, by J. C. Browne. [1964] [4]p. incl. tables, refs. (AFOSR-68-2798) (AF AFOSR-63-215) AD 844859 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3495-3498, Dec. 1, 1964.

A rigorous lower bound of 0.038 ev for the binding energy of LiH^+ has been obtained via an ab initio quantum mechanical calculation using a generalized valence-bond wavefunction with a mixed basis set of elliptic and Slater-type orbitals. The probable error in the total energy of LiH^+ is 0.15 ev. This invalidates the conclusion of a previous SCF-MO calculation which gave a substantial minimum in the LiH^+ potential curve. A rigorous upper bound of 7.91 ev for the ionization potential of LiH is found by the relation E(LiH^+, calculated) - E(LiH, experimental) ≥ I.P. (LiH). A probable lower bound for I.P. (LiH) is 7.8 ev. Potential curves for the system $Li^+ + H$ from several wavefunctions are tabulated. (Contractor's abstract)

2832

Texas U. Dept. of Physics, Austin.

SOME EXCITED STATES OF THE HYDROGEN MOLECULE. II. $^1\Pi_g(1s2p\pi)$, $^3\Pi_g(1s2p\pi)$, $^1\Delta_g(1s3d\delta)$, $^3\Delta_g(1s3d\delta)$, $^1\Delta_u(1s3d\delta)$, $^3\Delta_u(1s3d\delta)$, by J. C. Browne. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-66-2799) (AF AFOSR-63-215) AD 644936 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1583-1586, Sept. 15, 1964.

Complete theoretical potential curves for the bound states of H_2 and for the long-range portions of the repulsive states of H_2 are reported. Comparison of these results plus results from Paper I of this series to the conventional perturbation theory computations for the long-range interactions of those states shows that the conventional perturbation results may be misleading if "valence" and "overlap" forces are not considered.

2833

Texas U. Dept. of Physics, Austin.

SPECTRA EXCITED IN A HELIUM AFTERGLOW, by C. B. Collins and W. W. Robertson. [1964] [12]p. incl. illus. diagrs. table, refs. (AFOSR-64-1476) (AF AFOSR-63-273) AD 445173 Unclassified

Also published in Jour. Chem. Phys., v. 40: 701-712, Feb. 1, 1964.

The selective excitation of spectra by collisions of the second kind with active helium species was examined in a flowing helium afterglow. Techniques for titrating for the active species in the afterglow are described. Conditions under which a metastable atom, the atomic ion, or the molecular ion predominate in the burner are found and the spectra excited by each are listed.

2834

Texas U. Dept. of Physics, Austin.

HELIUM AFTERGLOW. II. MOLECULAR SPECTRUM, by C. B. Collins and W. W. Robertson. [1964] [4]p. incl. illus. diagrs. refs. (AFOSR-64-1477) (AF AFOSR-63-273) AD 445175 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2208-2211, Apr. 15, 1964.

Spectroscopic investigations of a flowing helium afterglow revealed the presence of strong bands of He_2. An examination of the axial variation and pressure dependence of the intensity of the emission and He_2^+ concentration, as evidenced by titration, served to identify the dominant reaction populating the excited molecular states as being the collisional-radiative recombination of He_2^+. (Contractor's abstract)

2835

Texas U. Dept. of Physics, Austin.

SPECTRA EXCITED IN AN ARGON AFTERGLOW, by J. F. Prince, C. B. Collins, and W. W. Robertson. [1964] [8]p. incl. illus. diagrs. table. (AFOSR-64-1481) (AF AFOSR-63-273) AD 445167 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2619-2626, May 1, 1964.

The selective excitation of electronic spectra of gases by collisions of the second kind with energetic species in an argon afterglow has been investigated. A discharge was excited by a dc source in a high-velocity argon stream which was allowed to interact subsequently with 14 different gases in a reaction chamber several centimeters downstream. The nonluminous argon stream entering the reaction chamber through a nozzle formed cone-shaped diffusion flames in the chamber. Results of the spectroscopic investigation of the flames are presented together with the reaction mechanisms. The observed states of excitation as well as the conditions of the discharge indicate that the exciting species are the argon metastables $^3P_2$ and $^3P_0$. (Contractor's abstract)

2836

Texas U. Dept. of Physics, Austin.

HELIUM AFTERGLOW. I. ATOMIC SPECTRUM, by C. B. Collins and W. W. Robertson. [1964] [7]p. incl. illus. diagrs. refs. (AFOSR-64-1482) (AF AFOSR-63-273) AD 445168 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2202-2208, Apr. 15, 1964.

Spectroscopic investigation of a flowing helium afterglow revealed the presence of strong lines of neutral helium. An examination of the population distribution of the excited atomic states revealed the presence of a Saha

equilibrium between the upper states and the free electrons indicating that the primary process of populating these states was the collisional-radiative recombination of He+. A comparison of the axial variation and pressure dependence of the intensity of the emission with the He_2^+ and He^+ concentrations strengthened this conclusion. (Contractor's abstract)

2637

Texas U. Dept. of Physics, Austin.

SPECTRAL EMISSION OF THE HELIUM AFTERGLOW, by F. E. Niles and W. W. Robertson. [1964] [6]p. incl. diagrs. table, refs. (AFOSR-64-1483) (AF AFOSR-63-273) AD 445169 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2909-2914, May 15, 1964.

The spectral emission from a dc pulsed helium discharge for pressures from 5 to 30 Torr has been investigated during the early afterglow using a spectrometer with gated photomultiplier and from the early afterglow through the late afterglow using interference filters with gated photomultiplier. The afterglow spectrum was predominately that of molecular light which was attributed to the collisional-radiative recombination of molecular ions. The time-decay of molecular light at late times indicated ambipolar diffusion control by an ion with a $D_a p$ of 710 ± 10 cm^2/sec, which corresponds to a μ_0 of 16.4 ± 0.2 $cm^2/V \cdot sec$, in good agreement with values reported for the helium molecular ion employing other techniques. (Contractor's abstract)

2836

Texas U. Dept. of Physics, Austin.

THE MOLECULAR SPECTRUM IN A HELIUM AFTERGLOW, by C. B. Collins, W. B. Hurt, and W. W. Robertson. [1964] [6]p. incl. illus. diagrs. (AFOSR-64-1674) (AF AFOSR-63-273) AD 448257 Unclassified

Also published in Proc. Third Internat'l. Conf. on Physics of Electronic and Atomic Collisions, London (Gt. Brit.) (July 22-26, 1963), Amsterdam, North Holland Publishing Co., 1964, p. 517-524.

A visible afterglow was obtained when purified helium was passed at high velocity through a microwave discharge. The appearance was of a bright pinkish-violet column tailing downstream from the discharge. The length of the afterglow in a particular system varied from a few to fifteen or more centimeters, depending upon the pressure. Both atomic and molecular radiation was observed in the afterglow and the variation in intensity with pressure (5 to 45 mm Hg) and time (60 to 250 μsec from discharge) indicates the origin of the radiation. (Contractor's abstract)

2639

Texas U. Dept. of Physics, Austin.

THE PHYSICS OF METASTABLE SYSTEMS, by W. W. Robertson. Final rept. Feb. 1, 1963-Jan. 31, 1964. 6p. incl. refs. (AFOSR-65-1047) (AF AFOSR-63-273) AD 619099 Unclassified

The interest of this project centered on the energy-rich metastable states of the rare gases. For example, the helium triplet metastable (2^3S) lies 19.6 ev above the ground state and has a calculated radiative half-life of approx 10^5 sec. The experimentally observed half-life is usually of the order of tens of msec depending upon the other destructive processes operating, i.e., diffusion to the walls with deactivation, collisional deactivation by superelastic collisions with electrons, 3-body conversion to molecules, Penning-type reactions with impurities, etc. It was the basic aim of this project to investigate these processes, and to establish the mechanism and cross sections or rate constants for these various reactions along with the temperature dependence.

2640

Texas U. Dept. of Physics, Austin.

QUATERNIONS IN RELATIVITY, by P. Rastall. [1964] [13]p. incl. refs. (AFOSR-65-1017) (AF AFOSR-65-454) AD 616354 Unclassified

Also published in Rev. Modern Phys., v. 36: 620-632, July 1964.

In this note the quaternion formalism is applied to special relativity and Riemannian space-time. Though quaternions introduce some difficulties in manipulation, they combine the advantages of spinor calculus and the matrix notations of Pauli and Dirac, in that one can write field equations in terms of quaternions which correspond to generalizations of the Pauli spin matrices, and which at the same time have a clear physical meaning as the vectors of the reference tetrad. An account of quaternion algebra and an introduction to the tetrad formalism of Riemannian geometry is given. Quaternions are applied to special relativity through quaternion concepts of Lorentz vectors and spinors, and to Riemannian space-time through the tetrad formalism of Riemannian geometry.

2641

Texas U. Dept. of Physics, Austin.

ROTATIONS AND LORENTZ TRANSFORMATIONS, by P. Rastall. [1964] [17]p. (AFOSR-65-1018) (AF AFOSR-63-454) AD 617799 Unclassified

Also published in Nuclear Phys., v. 57: 191-207, 1964.

Any complex 3-dimensional rotation is determined by a complex vector and by a complex angle of rotation. New, short proofs are given of the homomorphisms between the 3-dimensional complex rotation group, the

group of unimodular quaternions or unimodular 2 x 2 matrices, and the restricted Lorentz group. A correspondence is established between certain complex 3-dimensional rotation vectors and 2-dimensional subspaces of Lorentz vectors. The 2-dimensional subspaces which are invariant under a given restricted Lorentz transformation are shown to be determined by those eigenvectors of the corresponding 3-dimensional rotation matrix which belong to real eigenvalues. For non-null restricted Lorentz transformations this leads to a proof of Synge's theorem. (Contractor's abstract)

2842

Texas U. [Dept. of Physics] Austin.

INSTABILITY OF THE EQUIPARTITION STATE IN A FLUID SPHERE, by J. Kristian. [1964] [11]p. incl. diagrs. (AFOSR-65-1019) (AF AFOSR-63-454) AD 618618 Unclassified

Also published in Astrophys. Jour., v. 140: 257-267, July 1, 1964.

Perturbations of a toroidal equipartition state in a homogeneous, compressible sphere are investigated in the tensor virial approximation. The equipartition state mixes the radial pulsation and the lowest-order Kelvin oscillation of the sphere. For any fluid, the sphere is unstable if the magnetic energy $\mathfrak{M}$ exceeds a critical value. This value depends upon γ, the ratio of specific heats of the fluid, but in no case is it larger than 1/3 of the gravitational energy of the sphere. For $\gamma < 8/5$, it is the radial mode which becomes unstable; for $\gamma = 8/5$, it is the Kelvin mode. For $\gamma = 8/5$, neither of the lowest modes reduces to either the radial mode or the Kelvin mode in the limit of small $\mathfrak{M}$. The results are examined in the limit of large γ (nearly incompressible fluid).

2843

Texas U. Dept. of Physics, Austin.

A FLOW-SYSTEM AND BURNER FOR OBSERVING SELECTIVE EXCITATION OF SPECTRA BY METASTABLE SPECIES IN THE AFTERGLOW OF A HELIUM DISCHARGE, by C. B. Collins and W. W. Robertson. [1963] [5]p. incl. diagr. (AFOSR-64-1677) (AF AFOSR-84-273) AD 448258 Unclassified

Also published in Spectrochim. Acta, v. 19: 747-751, 1963.

A flow-system and burner has been developed for producing helium metastable species in a discharge and observing their reactions with admixed gases in a chamber a chosen distance downstream, thereby providing a selective time delay between the production and destruction of the helium metastables. A method for picking out the metastable species responsible for a particular reaction has been developed and examples of its application are given for the admixed gases Ne, N_2 and O_2. (Contractor's abstract)

2844

Texas U. Dept. of Physics, Austin.

ATOMIC EMISSION OF THE HELIUM AFTERGLOW, by F. E. Niles and W. W. Robertson. [1964] [4]p. incl. diagrs. (AFOSR-65-0562) (AF AFOSR-84-273) AD 815189 Unclassified

Also published in Jour. Chem. Phys., v. 40: 3588-3571, June 15, 1984.

The spectral emission from a dc pulsed helium discharge for pressures from 5 to 20 Torr has been investigated during the early afterglow using interference filters with gated photomultiplier. The radiation transmitted by the filters consists generally of both atomic lines and molecular bands and after the termination of the active discharge shows characteristically an initial rapid decrease in intensity followed by a much slower rate. The rapid decrease is due to the atomic radiation, the slower to molecular. By subtracting the molecular emission from the total emission transmitted through an interference filter, the atomic emission is obtained.

2845

Texas U. Dept. of Physics, Austin.

SPATIAL DISTRIBUTION OF INTENSITY IN A HELIUM AFTERGLOW, by F. E. Niles and W. W. Robertson. [1984] [2]p. incl. diagr. (AFOSR-85-0563) (AF AFOSR-64-273) AD 816471 Unclassified

Also published in Jour. Chem. Phys., v. 41: 1523-1524, Sept. 1, 1984.

A graphical presentation is given for the change with time in the spatial distribution of intensity of radiation and thus of ion concentration in a cylindrical discharge cell with an extreme asymmetry in the initial distribution. It is shown that this molecular emission observed during the helium afterglow is the result of a volume process during the afterglow period. It is not the result of radiative processes occurring during neutralization of molecular ions at the wall.

2846

Texas U. [Dept. of Psychology] Austin.

ATTRACTION AS A FUNCTION OF ATTITUDE SIMILARITY-DISSIMILARITY: THE EFFECT OF TOPIC IMPORTANCE, by D. Byrne and D. Nelson. [1984] [2]p. (AFOSR-84-1301) (AF AFOSR-63-261) AD 444265 Unclassified

Also published in Psychonom. Sci., v. 1: 93-94, 1964.

The similarity-dissimilarity of a stranger's attitudes with respect to those of Ss and the importance of the attitudinal topics were experimentally varied, and the attraction response of 112 Ss obtained. Proportions of similar attitudes was found to have a highly significant effect on attraction, but neither topic importance nor the interaction was statistically significant.

2847

Texas U. [Dept. of Psychology] Austin.

THE REJECTION OF DEVIATES AS A FUNCTION OF THREAT, by E. J. Hall, Jr. Doctoral thesis, June 1963, 114p. (AFOSR-5348) (AF AFOSR-63-275) AD 421742 Unclassified

It was hypothesized that (a) Ss from two-man groups would be more rejecting of deviates than Ss from four-man groups; (b) high status deviates would be rejected more strongly than low status deviates; (c) high dogmatic Ss would be generally more rejecting of deviates than low dogmatic Ss; and (d) that high dogmatic Ss would be more accepting of high status deviates and more rejecting of low status deviates than would low dogmatic Ss. The results failed to confirm either the group size or dogmatism hypothesis, but lent significant support to the hypotheses concerning status of the deviate and the interaction of status and dogmatism effects.

2848

Texas U. [Dept. of Psychology] Austin.

AROUSAL, MANAGEMENT, AND REDUCTION OF HOSTILITY, by P. Worchel. Final rept. Aug. 31, 1964, 4p. (AFOSR-64-1960) (AF AFOSR-63-275) Unclassified

Studies undertaken under this contract include: (1) threat and hostility arousal and reduction; (2) the rejection of deviates as a function of threat; (3) reference group relationships and dogmatism as determinants of influence and interpersonal conflict; (4) authoritarianism and anxiety in middle eastern students residing in the United States; and (5) ideology and political behavior.

2849

Texas U. [Labs. for Electronics and Related Science Research] Austin.

QUANTUM ASPECTS OF ELECTRICAL SCIENCE, by A. A. Dougal. Final rept. Apr. 1-Sept. 30, 1964. Oct. 1, 1964, 91p. incl. illus. diagrs. tables, refs. (AFOSR-65-0248) (AF AFOSR-64-487) AD 611338 Unclassified

An experimental and analytical study of the characteristics of coupled optical resonators is presented. The concept of an equivalent laser resonator is introduced and employed in an analysis of coupled resonator systems. Qualitative results from such an analysis agree with the experimental results presented. A dual wavelength beam switching phenomena involving coupled resonators is also reported. Experimental results are presented of a study of thermal pinching in germanium. Incremental negative resistance is observed in the thermal pinched condition. A comparison of the imaging properties of coherent laser light and white light is presented. (Contractor's abstract, modified)

2850

Texas U. Labs. for Electronics and Related Science Research, Austin.

CURRENT SHEATH DYNAMICS AND MAGNETOSONIC OSCILLATIONS IN MAGNETOPLASMAS, by O. M. Friedrich, Jr. and A. A. Dougal. Dec. 15, 1964, 128p. incl. refs. (Technical rept. no. 2) (AFOSR-66-0515) (AF AFOSR-65-766) Unclassified

The electrical breakdown, current sheath formation, and acceleration of current sheaths in deuterium, hydrogen, and argon plasmas are investigated analytically and experimentally. A system of partial differential equations is written from the Maxwell's electromagnetic field equations and plasma equations to describe the current density, resistivity, electron temperature, ion temperature, and degree of ionization as functions of position and time. The plasma equations include: an energy balance equation, an equation relating resistivity to collisions, and ionization equation, and an energy transfer equation. The resulting set of partial differential equations is coded for electronic digital computation using finite difference techniques. Theoretical results are obtained for initial deuterium gas pressures of 1 μ, 100 μ, and 1 mm Hg.

2851

Texas U. [Labs. for Electronics and Related Science Research] Austin.

35-GC/S, 70-GC/S AND 94-GC/S CYTHEREAN RADIATION, by C. W. Tolbert and A. W. Straiton. [1964] [4]p. incl. diagrs. refs. (AFOSR-66-1056) (AF AFOSR-66-766) AD 643017 Unclassified

Also published in Nature, v. 204: 1242-1245, Dec. 1964.

Measurements of Cytherean radiation were conducted at frequencies of 35 Gc/s, 70 Gc/s and 94 Gc/s with a 16-ft diameter antenna. The 35-Gc/s measurements were made to associate the relative brightness temperature of the three frequencies to the brightness temperature of a frequency at which a number of measurements have been reported. While the three frequencies are too widely spaced to yield significant line spectra and even the bandwidth of the radiometer at each frequency is excessively wide for low-pressure gas line resolution, the absorption minima of the Earth's atmosphere at 35 Gc/s and 94 Gc/s make these frequencies attractive for Earth-based observations.

2852

Texas U. [Labs. for Electronics and Related Science Research] Austin.

IONOSPHERIC TRANSMISSION OF TRANSVERSELY PROPAGATED PLANE WAVES AT MICROPULSATION FREQUENCIES AND THEORETICAL POWER SPECTRUMS, by C. E. Prince, Jr., and F. X. Bostick, Jr. [1964] [22]p. incl. diagrs. tables, refs. (AFOSR-66-1070) (AF AFOSR-66-766) Unclassified

Also published in Jour. Geophys. Research, v. 69: 3213-3234, Au[illegible] 1964.

From atten[illegible] and phase constants for plane waves in a partiy [illegible]onized magnetoionic medium, the resultant surface magnetic field for discrete, constant-amplitude input signals at an outer boundary is calculated and is presented as power spectrums. The ionosphere is assumed to be stratified, and the only mode considered is the extraordinary mode, propagating at 90° with respect to the earth's magnetic field. The results are discussed with reference to experimental power spectrums. (Contractor's abstract)

2853

Texas U. Medical Branch. [Dept. of Pharmacology] Galveston.

POST GANGLIONIC CHOLINERGIC MEDIATION OF SYMPATHETIC NERVES, by J. G. Hilton. Annual rept. May 1, 1963-Apr. 30, 1964, 2p. (AFOSR-64-1649) (AF AFOSR-82-241) AD 605726 Unclassified

The question of a non-specific stimulation of ganglion as proposed by Levy and Ahlquist is considered and the differences between a non-specific stimulation and the restoration of blood pressure and return of carotid occlusion response are discussed in the paper. Two additional areas of ganglionic and cardiovascular function during the neostigmine pressor response have been studied during the period of this report. Area 1 is the study of pre- and post-ganglionic nerve potentials. Area 2 is a study of the peripheral vascular tone during the neostigmine pressor response.

2854

Texas U. Medical Branch. [Dept. of Pharmacology] Galveston.

THE EFFECTS OF NEOSTIGMINE UPON GANGLION RESPONSES AFTER ADMINISTRATION OF BLOCKING DRUGS, by P. A. Fenner and J. G. Hilton. [1963] [8]p. (AFOSR-64-1682) (AF AFOSR-63-391) AD 448259 Unclassified

Also published in Brit. Jour. Pharmacol. and Chemother., v. 21: 323-330, Oct. 1963.

The effects of block of autonomic ganglia by chlorisondamine and by hexamethonium, the administration of neostigmine and of atropine upon blood pressure, nervous transmission through the superior cervical ganglion, stimulation of autonomic ganglia by dimethylphenylpiperazinium, and the carotid occlusion reflex, have been studied in the dog anaesthetized with sodium pentobarbitone. The results of these studies have shown that (1) a ganglion blocking agent blocks synaptic transmission in the superior cervical ganglion at the same time as it lowers blood pressure and (2) if the effects of preganglionic nerve stimulation are recorded as a contraction of the nictitating membrane, a ganglion-blocking agent also abolishes this response at the same time that it blocks the reflex rise in blood pressure produced by occlusion of both common carotid arteries.

2855

Texas U. Medical Branch. [Dept. of Pharmacology] Galveston.

EFFECT OF GANGLIONIC BLOCKADE UPON PERIPHERAL BLOOD PRESSURE DURING MAJOR VESSEL OCCLUSION (Abstract), by P. A. Fenner and J. G. Hilton. [1964] [1]p. (AFOSR-64-1842) (AF AFOSR-83-391) Unclassified

Also published in Federation Proc., v. 23: 330, 1964.

Cardiovascular effects of ganglionic blockade were studied in anesthetized dogs using a modification of the major vessel occlusion (MVO) method of Barteistone. Ganglionic blockade did not alter the pattern of response in either of the peripheral blood pressures in the abdominal series but did alter it in the thoracic series. In the abdominal-clamped group, the arterial pressure fell to levels not significantly lower after blockade. Rise in venous pressures during MVO was less after blockade than during control. In the thoracic-clamped series, arterial pressures fell during the entire MVO after ganglionic blockade but stabilized after 20 sec. in the control MVO. Venous pressures rose more rapidly and steadily during control than after ganglionic blockade. (Contractor's abstract, modified)

2858

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

STUDY OF A TRACER METHOD FOR SOLID PROPELLANTS, by D. Fleischer. Final rept. June 19, 1981-June 18, 1982. Feb. 1983, 43p. incl. illus. diagrs. tables. (RMD rept. no. 5502-F) (AFOSR-J1383) (AF 29(600)3020) AD 405[illegible]79 Unclassified

A photometric method for determining local burning rates in solid propellant motors is described. Preliminary strand experiments are used to estimate burning rates of tracer and propellant under engine conditions. These values are introduced in an expression relating accuracy of photometric burning rate to tracer thickness, separation between tracer deposits, and tracer and propellant burning rates. Tracer thickness and separation in the test engine for a desired accuracy are thus defined. Engine burning rates reproducible to ± 7% for a one centimeter separation were easily obtained. (Contractor's abstract)

2857

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

INFLUENCE OF IONS ON ROCKET COMBUSTION, by

T. H. Dimmock. Final rept. Mar. 1, 1958-Mar. 21, 1983, 55p. incl. illus. diagrs. tables, refs. (AFOSR-5493) (AF 49(636)305) AD 431838 Unclassified

A study of the electrical and thermodynamic properties of a seeded, Mach 3 rocket exhaust at an equivalent altitude of 20-25 miles has been made. It was concluded that the ionization and dielectric profile of the jet depends upon many factors. Among these are: (1) The combustion process, including the injector type and stoichiometry; (2) Ths nozzle length and area ratio; and (3) The Mach number, and shock structure in ths jet. These factors are interrelated in a complex manner so that extrapolation of results for dissimilar conditions is not allowed.

2858

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

IONIZATION PROFILES IN LOW PRESSURE EXHAUSTS, by T. H. Dimmock and W. R. Kineyko. Aug. 1963, 16p. (Rept. no. 83-388) (AFOSR-J1089) (AF 49(638)305) AD 421129 Unclassified

Presented at Fifth Biennial Gas Dynamics Symposium, Northwestern U., Evanston, Ill., Aug. 14-16, 1963.

The ionization profile along the axis of a seeded, Mach 3, high altitude rocket exhaust was mapped by microwavs and probe techniques. Ths ionization density in the jet was as high as 10^{13} electrons/cm^3 and was found to vary half an order of magnitude between expansions and shock regions. The relaxation in the jet was evaluated from the measured data. Since the ionization was found to follow the gas density profile, it was concluded that the relaxation time is at least as long as the transit time between the shock waves, and that the residence time in the shock zone was sufficient to sustain this ionization. The thermodynamic properties in the jet were measured by pressure and temperature probes and by line reversal spectroscopy.

2859

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE LOW PRESSURE, COMBUSTION GAS PLASMA, by T. H. Dimmock and W. R. Kineyko. [1963] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-J1477) (AF 49(838)305) AD 426823 Unclassified

Also published in Combustion and Flame, v. 7: 283-291, Sept. 1963.

Studies of the electrical properties of seeded, high-temperature, low pressure flames have been made to determine the influence of electric and magnetic fields on plasma properties and to evaluate plasma diagnostic techniques. The investigation was carried out at prssures from 20 to 100 mm of mercury where both magnetic and fluid viscositiss influenced the flame slectrical conductivity, and whsre ths slectric fisld produced abnormal glow and arc discharges. The deflection of flames at iow pressures was found to reach a limit when slippage of charged particles through the flame fanned out the flame rather than further deflecting it.

2860

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

THE GENERATION OF CHARGED COLLOIDS FOR ELECTRIC PROPULSION VIA HETEROGENEOUS CONDENSATION IN VACUUM OF METAL VAPORS ON A SURFACE, by B. Hornstein. Final rept. Juns 20, 1980-Dec. 19, 1963. Mar. 1964, 37p. incl. illus. diagrs. tabie, refs. (RMD rept. no. 2049-F) (AFOSR-85-0925) (AF 49(836)924) AD 817120 Unclassified

As an approach to the in situ generation of charged colloids for electric propulsion, a heterogeneous condensation method was investigated. The method comprised two distinct steps; first, the formation of neutral particles by the controlled vacuum deposition of metal vapor onto a solid substrats, and second, the inductive charging and electrostatic separation of the particles from the substrate by a strong slectric field. Attempts to inductivel; charge and electrostatically separate such particies from carbon substrates were almost completely unsuccessful, as determined from electron microscope examination. Some experiments with a time-of-flight particle removal and detection system gave evidence that particles had been extracted from ths substrate, acquiring charge-to-mass ratios up to 3000 coulombs/kg. If such particle charging and removal had in fact occurred, only a small fraction of the total deposit could have been involved. (Contractor's abstract, modified)

2861

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

SOLID PROPELLANT TRACING METHODS, by D. Flsischer. Semiannual scientific rept. Oct. 15, 1963-Mar. 14, 1964. Apr. 1964, 36p. (RMD rept. no. 5510-SA) (AFOSR-64-1954) (AF 49(836)1197) AD 807636 Unclassified

The investigation of the use of iight absorption signals in motor exhausts for determining motor burning rates was terminated. It is concluded that erratic absorption and diffraction from solid particles and the shock structure in the exhaust prevent this method from yielding useful results. Work concerning the effects of trace species on the electron concentration in combustion gases was initiated. The systems of interest always contain low ionization potential impurities, whose concentration is affected by ths formation of compounds stabls at flams temperatures. The effect of sodium chloride formation on the concentration of trace amounts of sodium was measured. It has not yet been possibie to provide a conclusive interpretation of this data based on either equilibrium or kinetic considsrations.

2862

Thiokol Chemical Corp. Reaction Motors Div., Denville, N. J.

TRACE SPECIES IN COMBUSTION GASES, by D. Fleischer. Final rept. Oct. 15, 1963-Oct. 14, 1964. Nov. 1964, 36p. incl. diagrs. tables. (RMD rept. no. 5510-F) (AFOSR-65-1053) (AF 49(638)1197) AD 619492 Unclassified

The equilibrium constant for the reaction $NaCl(g) + HBO_2(g) = NaBO_2(g) + HCl(g)$ is determined to be, $K_p = 2.50$ (1980°K). Sodium vapor and boron trichioride (BCl_3) are reacted in a hydrocarbon-air flame contained in a tunnel burner. Conditions are such that the concentrations of HBO_2 and HCl are equal to the total flows of boron and chlorine. The concentration of unreacted sodium is found by line absorption, using an experimentally determined absorption coefficient. The relative contribution of NaCl and $NaBO_2$ to the chemically combined sodium concentration can be assessed by removing the direct proportionality between chlorine and boron flows. This is done by adding chlorine, beyond that present in the BCl_3. The H-atom concentration is also required, and is inferred from the intensity of the $2\pi \rightarrow 2\Sigma$ (0, 0) OH-band. (Contractor's abstract)

2663

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

RESEARCH IN SEMANTIC STRUCTURE, by P. L. Garvin. Jan. 15, 1963, 22p. incl. tables. (AFOSR-4944) (AF 49(638)1126) AD 296426 Unclassified

Presented at Thirty-seventh annual meeting Linguistic Society of America, New York, Dec. 28-30, 1962.

The semantic classification revealed by predication-typing does not coincide with the formal grammatical division into word classes. Function words—such as conjunctions and prepositions—when viewed in the light of predication-typing turn out to have significant elements of meaning in common with content words—such as certain verbs and nouns. An example of this is the semantic spectra of the function word from and the content word result shown on the handout.

2664

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

THE CONVERSION OF PHONETIC INTO ORTHOGRAPHIC ENGLISH: A MACHINE-TRANSLATION APPROACH TO THE PROBLEM, by P. L. Garvin and E. C. Trager. Nov. 1, 1963, 22p. incl. tables. (AFOSR-64-1867) (AF 49(638)1166) AD 425819; AD 450100 Unclassified

Also published in Phonetica, v. 11: 1-18, 1964.

The conversion of phonetic into orthographic English is treated as a special case of machine language translation. A technique of graduated context searching is proposed. A pilot study is presented and its results are evaluated.

2665

Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

SPEAKER IDENTIFICATION AND MESSAGE IDENTIFICATION IN SPEECH RECOGNITION, by P. L. Garvin and P. Ladefoged. [1963] [7]p. incl. refs. (AFOSR-64-0233) (AF 49(638)1166) AD 432521 Unclassified

Also published in Phonetica, v. 9: 193-199, 1963.

This paper treats the problem of the identification of speaker and message in the human and automatic recognition of speech. It presents a classification of speaker-diagnostic features and make some suggestions for future research in the field.

2866

Toronto U. Dept. of Chemistry (Canada).

CHEMICAL REACTIONS IN ELECTRICAL DISCHARGES. I. THE SPECTRUM OF THE METHANE-OXYGEN SYSTEM AT LOW PRESSURE IN THE POSITIVE COLUMN OF A D-C GLOW DISCHARGE, by P. A. Bois d'Enghien and J. M. Deckers. [1964] [19]p. incl. diagrs. refs. (AFOSR-64-1863) (AF AFOSR-62-457) AD 449997 Unclassified

Also published in Canad. Jour. Chem., v. 42: 1792-1810, 1964.

A technique is described which permits the study of changes in the spectra emitted by fast flowing reacting gas mixtures in the plasma of the positive column of a weak d-c glow discharge. In certain cases a quantitative relationship is shown to exist between the concentration of a species and the intensity of emission of its spectrum. In particular such a correlation exists between the emission intensity of CC and its concentration. Use of this fact is then made to follow the rate of formation of carbon monoxide in methane-oxygen mixtures flowing through a discharge. The mechanism of formation of the various emitters either by means of a chemical reaction or by electron impact on molecules or radicals is discussed. It is concluded that to account for the rate of formation of CO, at least in the early stages of the presence of the gases in the discharge, before the steady state concentration of atoms, radicals, and molecules were approached, most of the energy of the electrons is used in breaking chemical bonds. (Contractor's abstract)

2867

Toronto U. Dept. of Chemistry (Canada).

DISTRIBUTION OF ENERGY IN THE PRODUCTS OF REACTIONS UNDER FLAME AND RELATED

CONDITIONS, by J. M. Deckers. Oct. 1964 [42]p. incl. diagrs. refs. (Scientific rept. no. 1) (AFOSR-65-2723) (AF AFOSR-63-375) AD 628228
Unclassified

Subjects discussed in this report are: Measurement of the electrical field in D.C. flow discharges through oxygen, nitrogen and oxygen-nitrogen mixtures; Production of O atoms in the discharge; Emission spectrum of oxygen containing small amounts of carbon monoxide; and Influence of pressure burner size and composition upon the intensity of emission of hydrocarbon-oxygen flames.

2868

Toronto U. Inst. for Aerospace Studies (Canada).

AN INVESTIGATION OF THE FATIGUE OF ALUMINUM ALLOY DUE TO RANDOM LOADING, by S. R. Swanson. Feb. 1963, 1v. (AFOSR-4921) (AF 49(838)548) AD 407071
Unclassified

A study of the aluminum alloy 2024-T4 under random and constant amplitude axial fatigue loading was undertaken using 1500 unnotched extruded bar specimens. In the constant amplitude test series, it was discovered that the stress amplitude - endurance (S-N) relation is well represented by two separate failure distributions such that, as the stress amplitude is lowered, the one distribution recedes while the other distribution becomes predominant. The knee of the S-N curve is then considered as a transition from endurances predominantly of the one distribution to endurances predominantly of the other.

2869

Toronto U. Inst. for Aerospace Studies (Canada).

THE EFFICIENCY OF ENERGY TRANSFER ASSOCIATED WITH MAGNETICALLY DRIVEN SHOCK WAVES IN A TEE TUBE, by J. K. Dukowicz. Apr. 1963 [44]p. incl. illus. diagrs. tables, refs. (UTIA technical note no. 52) (AFOSR-2429) (AF 49(638)823) AD 407953
Unclassified

The energy disposal in a shock tube with magnetically driven shock waves has been studied. The well known T-tube apparatus was used in the experiment. A technique to measure the energy input has been developed involving the simultaneous measurement of the current and the voltage drop across the tube. Schlieren rotating drum camera photographs of the flow provided accurate shock wave trajectories from which the energy contained in the flow was deduced by the use of strong blast wave theory. The efficiency of the T-tube obtained in this way was found to be approximately 20% under a variety of conditions. The use of a backstrap did not change the efficiency but was found to roughly double the amount of energy deposited in the T-tube. In the range 1 - 10 mm Hg, no effect of pressure was detected.

2870

Toronto U. Inst. for Aerospace Studies (Canada).

THEORETICAL INVESTIGATIONS OF THE DYNAMICS OF BODIES ENTERING THE ATMOSPHERE, by B. Etkin. Final technical rept. Feb. 1963, 3p. (AFOSR-4553) (AF AFOSR-62-40) AD 815120 Unclassified

The research was part of a long term program of research on flight dynamics of artificial satellites. Topics discussed in this report are reentry flight paths, satellite dynamics, and flight simulators.

2871

Toronto U. Inst. for Aerospace Studies (Canada).

TURBULENCE-INDUCED PANEL VIBRATION, by M. Y. El Baroudi. Feb. 1964, 1v. (Rept. no. 98) (AFOSR-84-0883) (AF AFOSR-62-267) AD 448045
Unclassified

Motivated by the problem of boundary-layer induced panel noise, a detailed study has been made of the transverse vibration of steel panels flush-mounted in the wall of a turbulent flow duct. The characteristics of the exciting pressure field at the wall and of the resultant vibration of the sample panels were investigated using statistical techniques. Relief charts of the experimental two-point space-time correlation of panel vibration versus longitudinal separation and time-delay showed pronounced oblique ridges and valleys discernable in a more random pattern. These are interpreted as running waves.

2872

Toronto U. [Inst. for Aerospace Studies] (Canada).

DYNAMICS OF GRAVITY-ORIENTED ORBITING SYSTEMS WITH APPLICATION TO PASSIVE STABILIZATION, by B. Etkin. [1964] [7]p. incl. diagrs. refs. (AFOSR-84-2128) (AF AFOSR-82-40 and AF AFOSR-63-222) AD 452027
Unclassified

Also published in AIAA Jour., v. 2: 1008-1014, June 1964.

A theoretical framework is presented for analyzing the motion of a multibody satellite system in a gravity-oriented orbiting reference frame. It consists essentially of expressions for the forces and moments of the body-force field on arbitrary bodies and of their utilization in Lagrange's equation to find the equations of motion. It is then applied to the analysis of a specific system designed for passive attitude stabilization. The equations are linearized and separated into two groups (longitudinal and lateral), and numerical solutions are obtained. Damping to half-amplitude in times of the order of 0.3 orbit is possible in either system separately. For combined three-axis stabilization, somewhat longer times would result from inevitable compromises. The effect of solar radiation on the system is briefly discussed. (Contractor's abstract)

2873

[Toronto U. Inst. for Aerospace Studies (Canada)]

AN EXPERIMENTAL INVESTIGATION OF TURBULENCE EXCITED PANEL VIBRATION AND NOISE (BOUNDARY-LAYER NOISE), by M. Y. El Baroudi, G. R. Ludwig, and H. S. Ribner. Apr. 1963, 33p. (AGARD rept. no. 465) (AFOSR-64-0590) (AF AFOSR-63-223) AD 435911 Unclassified

Presented at AGARD Specialists' Meeting of the Mechanism of Noise Generation in Turbulent Flow, Training Center for Experimental Aerodynamics, Rhode-Saint-Genese (Belgium), Apr. 1-5, 1963.

A study is made of the flexural motion and noise generated by 11 x 11 in. steel panels flush-mounted in the wall of a turbulent flow channel. The mean square exciting pressure fluctuations at the wall, its spectral density, and two-point correlations of the pressure were measured with the use of pinhole microphones. The flexural response of sample panels was studied by correlation techniques. The calculated relief plot of correlation shows qualitative agreement with the experimental results.

2874

Toronto U. Inst. for Aerospace Studies (Canada).

ON SPECTRA AND DIRECTIVITY OF JET NOISE, by H. S. Ribner. [1963] [3]p. incl. diagrs. refs. (AFOSR-64-0911) (AF AFOSR-62-267 and AF AFOSR-63-223) AD 439866 Unclassified

Also published in Jour. Acoust. Soc. Amer., v. 35: 614-616, Apr. 1963.

On the assumption of locally isotropic turbulence superposed on the mean jet flow, the broadly peaked noise spectrum is derived in terms of a sum of two bell-shaped spectra peaked an octave apart. The proportions vary with direction θ from the jet axis, being dominated by the "bass" spectrum at small angles and the "treble" spectrum beyond, say 70°. This is accomplished by a factor $\sim\cos^4\theta$ for the "bass" spectrum. For small angles (e.g., 30°), points of the resultant curve are amplified (vertical shift) by convection of the eddies and "Doppler" shifted (less than the full amount) in frequency. It is suggested that an increase in amplification toward the left may move the amplified peak in that direction. (Contractor's abstract)

2875

Toronto U. [Inst. for Aerospace Studies] (Canada).

NONEQUILIBRIUM EXPANSION FLOW OF DISSOCIATED OXYGEN AROUND A CORNER, by I. I. Glass and A. Takano. June 1963, 1v. (UTIA rept. no. 91) (AFOSR-5441) (AF AFOSR-63-365) AD 426849 Unclassified

A detailed study is presented of the nonequilibrium inviscid expansion flow of dissociated oxygen around a corner. The nonlinear partial differential characteristic equations were solved for a number of cases with different free-stream conditions and wall deflection angles. It was found that the flow produced by the corner consists of seven basic flow areas, some of which are quite complex. The existence of a recombination shock wave at the tail of the expansion wave has been verified. The shock wave is quite weak but increases in strength with larger wall deflection angles, for a given wall angle the shock wave is strongest near the corner and decays with increasing radial distance from the corner.

2876

Toronto U. Inst. for Aerospace Studies (Canada).

NONEQUILIBRIUM EXPANSION FLOW OF IONIZED ARGON AROUND A CORNER, by I. I. Glass and A. Takano. Sept. 1963 [91]p. incl. diagrs. tables, refs. (UTIAS rept. no. 95) (AFOSR-5446) (AF AFOSR-63-365) AD 429222 Unclassified

A study is presented of nonequilibrium, inviscid expansion flows of ionized argon around a corner. The calculating procedure is based on the method of characteristics. Numerical computations were performed on a number of cases with different free-stream conditions and wall angles. The overall flow pattern obtained was found to be qualitatively similar to that of dissociating oxygen. However, an important exception was the nonexistence of a de-excitation shock wave, which was verified even up to large wall angles and even when using a small size of characteristic mesh. Quasi-similarities of the variations of the flow quantities along the wave head and along the wall surface also were found to exist when their appropriately normalized values were plotted as functions of relevant distances.

2877

Toronto U. Inst. for Aerospace Studies (Canada).

A DIGITAL COMPUTER PROGRAM FOR CALCULATING NONEQUILIBRIUM EXPANSION FLOWS OF DISSOCIATED OXYGEN AND IONIZED ARGON AROUND A CORNER, by J. Galipeau and A. Takano. Aug. 1963 [64]p. incl. diagrs. tables. (UTIAS technical note no. 69) (AFOSR-64-0075) (AF AFOSR-63-365) AD 444622 Unclassified

A digital computer program is described that permits calculations of nonequilibrium expansion flows of dissociated oxygen and ionized argon around a corner. The procedure of calculation is based on the numerical-graphical method of characteristics. An overall flow chart of the program is included to indicate clearly the sequence of logical and arithmetic tasks which the program performs. A listing of the program is also given to reveal fully its sequence of commands and operations. The program is divided into five phases. The first two phases designate the input data, which contain the statement of the free-stream values and the prescribed wall deflection angle as well as the control of calculation and printing. In the subsequent phases calculations are performed to derive the flow quantities.

2878

Toronto U. Inst. for Aerospace Studies (Canada).

LANGMUIR PROBE MEASUREMENTS IN THE STAGNATION POINT BOUNDARY LAYER OF A BLUNT-NOSED BODY IN A SUPERSONIC PLASMA FLOW, by A. A. Sonin. June 1963 [38]p. incl. illus. diagrs. table, refs. (UTIA technical note no. 58) (AFOSR-2430) (AF AFOSR-63-366) AD 419146
Unclassified

Langmuir probes were used to traverse the boundary layer at the stagnation point of a blunt-nosed body in a supersonic plasma stream, and the experimental profiles of electron number density compared to the predictions of theory. The agreement of experiment and theory was shown to be fairly good, although the lack of an accurate method of temperature measurement prevented a conclusive comparison.

2879

Toronto U. Inst. for Aerospace Studies (Canada).

THE NOISE OF AIRCRAFT, by H. S. Ribner. Aug. 1964 [60]p. incl. diagrs. refs. (UTIAS rev. no. 24) (AFOSR-64-1310) (AF AFOSR-64-223) AD 448043
Unclassified

Presented at General Lecture, Fourth Cong. Internat'l. Council of Aeronautical Sciences, Paris (France), Aug. 24-28, 1964.

An understanding of the noise from jets, compressors, boundary layers, and sonic booms is still developing. In this lecture current concepts are presented, drawn in part from recent theoretical and experimental research. Where possible simple physical models of the major features of the noise and vibration phenomena are given. The noise from combustion and from propellers and rotors, being better known, is dealt with more briefly. Some mention is made of acoustical fatigue.

2880

Toronto U. Inst. for Aerospace Studies (Canada).

AERODYNAMICALLY GENERATED SOUND, by H. S. Ribner. Final scientific rept. Dec. 1964 [56]p. incl. diagrs. (AFOSR-65-1029) (AF AFOSR-64-223) AD 620338
Unclassified

The research accomplishments of the project are summarized. A study of surface motion in turbulence-induced panel vibration demonstrated that panel motion consists of running waves forced by the convected pressure field superposed on a more irregular pattern. Turbulent structure in the transition region, (4.5 to 8 diams downstream of the nozzle) of a 4-in. low-speed jet was investigated with the aim of relating the turbulence to the noise generating features of such a jet. Progress has been made in improving the accuracy of the hot-wire and time-delay correlator instrumentation, and timing, gate, and relay circuits were developed to semi-automate data processing. An aerofoil probe for measuring the transverse component of turbulence was also developed. Lastly, an anomaly in the directivity pattern of jet noise was resolved.

2881

Toronto U. Inst. for Aerospace Studies (Canada).

THE MEASUREMENT OF ENERGY TRANSFER IN GAS-SOLID SURFACE INTERACTIONS USING ELECTRON BEAM EXCITED EMISSION OF LIGHT, by D. J. Marsden. Nov. 1964 [73]p. incl. illus. diagrs. tables, refs. (UTIAS rept. no. 101) (AFOSR-64-2482) (AF AFOSR-64-276) AD 612017 Unclassified

A new approach is described to the measurement of energy accommodation of a rarefied gas at a solid surface. The rotational energy distribution and number density of molecules can be determined. Measurements can be interpreted to obtain values of energy accommodation coefficients, both for the translational and rotational degrees of freedom of the gas. Measurements made with nitrogen showed that the translational and rotational degrees of freedom both had an accommodation coefficient $\alpha = 0.85$, and that the rotational energy distribution of the reflected molecules correspond to that of gas in thermal equilibrium.

2882

Toronto U. Inst. for Aerospace Studies (Canada).

ANALOGUE NETWORKS FOR HIGH HEAT-TRANSFER RATE MEASUREMENTS, by Z. A. Walenta. Nov. 1964 [50]p. incl. illus. diagrs. refs. (UTIAS technical note no. 84) (AFOSR-65-0261) (AF AFOSR-64-365) AD 462023 Unclassified

An automatic correction circuit for use with thin-film heat-transfer gauges and analog networks has been developed and successfully tested. Such a correction circuit is essential when the gauge temperature becomes high enough to cause changes in the gauge properties, thereby introducing nonlinear effects. The circuit has been tested in the UTIAS 4 in. x 7 in. hypersonic shock tube at shock Mach numbers where ionization was negligible. Excellent agreement has been obtained between theory and the corrected experimental data up to rises in gauge temperatures of 75°C. It is expected that the same results will hold up to 150°C, as long as the thermal diffusivity of the backing material remains sensibly constant. In addition, useful theoretical corrections have also been obtained.

2383

Toulouse U. (France).

EFFECTS OF HEART DISTENSION ON ALDOSTERONE SECRETION, by A. Baisset, L. Douste-Blazy, and P. Montastruc. Final technical rept. Apr. 1, 1960-Mar. 30, 1963, 13p. incl. diagrs. (AFOSR-J1205) (AF 61(052)411) AD 424242 Unclassified

The effects of auricular distension have been studied on the secretion of aldosterone in the intact dog as well as after vagotomy, decerebration, hypophysectomy, or hypothalamic lesions. In the anesthetized dog it was found that: (1) Distension of the right auricle diminishes aldosterone secretion by at least 50%; this effect is suppressed hy vagotomy or posterior hypothalamic lesions; in contrast, hypophysectomy or anterior hypothaiamic lesions do not alter this decrease of aldosterone secretion; and (2) distension of the left auricle does not influence aldosterone secretion.

2884

Trieste U. Mathematical Inst. (Italy).

ANALYTICAL PROBLEMS CONCERNING THE EQUATIONS OF NAVIER-STOKES, by G. Prodi. Final technical rept. [Feb. 1964] 12p. (AFOSR-64-0153) (AF EOAR-62-7) Unclassified

This report is a compilation containing the summaries of four papers prepared under this contract.

2885

Trieste U. Mathematical Inst. (Italy).

[AN APPLICATION OF THE THEORY OF ANY SINGLE INTEGRAL TO THE STUDY OF LINEAR DIFFERENTIAL EQUATIONS OF THE FIRST ORDER] Un'applicazione della teoria degli integrali singolari allo studio delle equazioni differenziali lineari astratte del primo ordine, by L. de Simon. [1964] [19]p. (AFOSR-65-2436) (AF EOAR-62-7) AD 627769 Unclassified

Also published in Rend. Sem. Matem. Univ. Padova, v. 34: 205-223, 1964.

This work is concerned with the p-integrability of the derivative of the solution, u(t), of the abstract Cauchy problem $\frac{du}{dt} + Au = f(t)$, $t \geq 0$ $u(0) = 0$ where f(t) is a function of the real variable t, defined for $t \geq 0$, having values in Hilbert space H, and A is a linear operator in H.

2886

Tufts U. Inst. for Psychological Research, Medford, Mass.

THE EFFECTS OF DISPLACED EARS ON AUDITORY LOCALIZATION, hy S. J. Freedman and K. Stampfer. Apr. 1964, 24p. incl. illus. diagrs. tables, refs. (AFOSR-64-0938) (AF 49(638)1282) AD 604569 Unclassified

The techniques of rearrangement and disarrangement were used to alter the normal relationship between an observer and his auditory or visual environment. In general, rearrangement leads to orderly adaptation of perceptual-motor performance, while disarrangement leads to degradation of performance. This experiment was an auditory rearrangement. 2 of the 4 experimental subjects demonstrated significant shifts averaging 6 degrees in their judgments of auditory direction. The shifts in localization are discussed in terms of the nature of the exposure situation and the factors that are likely to be responsible for compensation.

2887

Tufts U. Inst. for Psychological Research, Medford, Mass.

ADAPTATION AND TRAINING EFFECTS IN ERG. IV. OVERVIEW OF EIGHT YEARS, by S. J. Freedman and L. Ronchi. [1964] [24]p. incl. diagrs. refs. (AFOSR-65-1309) (AF 49(638)1282) AD 620726 Unclassified

Also published in Atti Fondazione G. Ronchi, v. 19: 542-565, Sept.-Oct. 1964.

A summary is given of eight years of investigation of electroretinograms (ERG). Experimental results lend support to the conclusion that the ERG responses recorded in any particular experimental session are significantly affected by previous experience of the subject. It is indicated that ERG is not an objective, stable measure of visual function. Neither the absolute level of response to a fixed stimulus intensity nor the acuity of discrimination was constant for the observers tested. It is concluded that some kind of learning must be involved in ERG responses. A statistical treatment of the evidence is presented.

2888

[Turin U. (Italy)]

[RESEARCH ON THE ASTRONOMICAL ORIENTATION OF EQUATORIAL LITTORAL AMPHIPODA. I. SOLAR ORIENTATION IN ONE SOMALIAN POPULATION OF TALORCHESTIA MARTENSII WEBER] Ricerche sull'orientamento astronomico di anfipodi litorali delia zona equatoriale. I. L'orientamento solare in una popolazione somala di Talorchestia Martensii Weber, by A. Ercolini. [1964] [34]p. incl. diagrs. (AFOSR-65-0951) (AF EOAR-62-100) AD 620528 Unclassified

Also published in Zeitschr. Vergleich. Physiol., v. 49: 138-171, 1964.

In this note the solar orientation of Talorchestia martensii Weber is investigated. The mechanism of solar orientation shows particular time variations of its correctness, due to the local astronomic circumstances. Animals tested immediately after collection, after having been kept under a normal artificial rhythm of light-darkness, or kept segregated in continuous darkness, showed systematic differences from the correct orientation. The existence of an innate correct directional tendency is confirmed in littoral Amphipods. The behavior during the 2 periods of positive and negative solar declination is discussed and 3 hypotheses are offered in explanation.

2889

Turin U. [Inst. of Physics] (Italy).

ON THE GREEN'S FUNCTION OF POTENTIAL SCATTERING, by M. Verde. [1963] [20]p. (AFOSR-J920) (AF EOAR-62-101) AD 416508 Unclassified

Also published in Nuovo Cimento, Series X, v. 28: 547-566, 1963.

The Green's function in some potential scattering problems of spherical symmetry is written as an integral of the product of the Green's functions G_a corresponding to the angular variables and G_r corresponding to the radial variables. The integration is carried along a suitable line C in the plane of complex angular momentum. If C surrounds the spectrum of G_a the usual partial waves expansion is obtained, if C surrounds the spectrum of G_r a different expansion results which is the most suitable for describing collisions involving small wave lengths. In particular it is shown how the Green's function which characterizes a wave propagation phenomenon approaches the classical limit, leading to the ray propagation of ordinary mechanics.

2890

Turin U. Inst. of Physics (Italy).

ON THE CONNECTION BETWEEN S-MATRIX AND THE NEUMANN SERIES EXPANSION OF THE WAVE FUNCTION, by L. Favella. [1964] [14]p. incl. diagrs. refs. (AFOSR-64-2053) (AF EOAR-62-101) AD 452522 Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 890-903, Feb. 16, 1964.

It is proved that the S-matrix may be expressed as the quotient of two series involving the coefficients a_n of the Neumann series expansion of the wave function $\varphi_\nu(x)$. This expansion is equivalent to writing the same wave function as a Lebedev-Kontorovich transform which provides through the differential equation a system of linear algebraic equations in triangular form for the coefficients a_n. (Contractor's abstract)

2891

Turin U. Inst. of Physics (Italy).

ANALYTICITY IN THE ANGULAR MOMENTUM IN POTENTIAL SCATTERING, by V. De Alfaro, E. Predazzi, and C. Rossetti. [1964] [14]p. incl. refs. (AFOSR-64-2054) (AF EOAR-62-101) AD 452523 Unclassified

Also published in Nuovo Cimento, Series X, v. 31: 42-55, Jan. 1, 1964.

A representation is given in the framework of potential scattering for $\varphi(\lambda, k, x)$ and for the Jost function displaying their analytic properties in the angular momentum variable under suitable conditions on the behavior of the interaction at small distances. A perturbative form for the Regge trajectories is also given. The Jost function is obtained as an expansion over meromorphic functions of the angular momentum variable. (Contractor's abstract)

2892

Turin U. Inst. of Physics (Italy).

ON THE GREEN'S FUNCTIONS ASSOCIATED TO THE WIGNER'S LITTLE GROUP, by A. Giovannini and M. Verde. [1964] [8]p. (AFOSR-65-1352) (AF EOAR-62-101 and AF EOAR-64-39) AD 622914 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1306-1313, Dec. 1, 1964.

The irreducible unitary representations of the Wigner's little group, excluding the homogeneous Lorentz group in 4 dimensions, are investigated by the method of Green's functions. The possible different classes of the Wigner's little group are the 3-dimensional rotation group R_3, the 3-dimensional Lorentz group L_3, and the 2-dimensional Euclidean group E_2. Inspection of the different irreducible unitary transformations for these classes generated by Green's functions reveals how they are related to each other.

2893

Turin U. Inst. of Physics (Italy).

ON THE PROPERTIES OF LANDAU CURVES, by T. Regge and C. Barucchi. [1964] [35]p. incl. diagrs. table. (AFOSR-65-1353) (AF EOAR-62-101) AD 622668 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 106-140, Oct. 1, 1964.

A derivation of several properties of Landau curves is carried out with the methods of algebraic geometry. In particular, formulas are established for the Plücker characteristics of large classes of Landau curves. A determinantal formalism by Cayley is shown to be particularly useful in connection with the present theory.

2894

Turin U. Inst. of Physics (Italy).

BOUND STATES AND RENORMALIZATION PROPERTIES, by L. Bertocchi, S. Fubini, and G. Furlan. [1964] [12]p. incl. diagrs. refs. (AFOSR-66-1714) (AF EOAR-64-39) AD 638075 Unclassified

Also published in Nuovo Cimento, Series X, v. 32: 745-756, May 1, 1964.

This paper discusses both in potential scattering and in quantum field theory, the connection between the bound

state problem and the renormalizability of the theory. In particular, it is shown that a meaning can be given to the bound-state condition both in the framework of perturbation theory, and also if all the terms of the series are cut-off-dependent.

2895

Turin U. Inst. of Physics (Italy).

ANALYTICITY IN THE ANGULAR MOMENTUM FOR SINGULAR POTENTIALS, by M. Giffon and E. Predazzi. [1964] [17]p. incl. refs. (AFOSR-66-1718) (AF EOAR-64-39) AD 639547 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1374-1390, Sept. 1, 1964.

The analytic properties in the angular momentum variable of the Jost functions and of the partial-wave S-matrix elements are investigated for a large class of repulsive potentials behaving near the origin as arbitrary inverse powers of the radial variable dominating over the centrifugal term. The asymptotic behavior of the Jost function for large angular momenta is obtained by means of a W. K. B. analysis and the implications of the asymptotic distribution of poles in the lambda plane on the possibility of writing a Mandelstam representation are also briefly discussed.

2896

Turin U. Inst. of Physics (Italy).

ELECTROPRODUCTION AT THE LIMIT OF VERY HIGH ENERGIES, by M. Lacombe and E. Predazzi. [1964] [6]p. incl. diagr. table. (AFOSR-66-1720) (AF EOAR-64-39) AD 639548 Unclassified

Also published in Nuovo Cimento, Series X, v. 33: 1466-1471, Sept. 1, 1964.

The process $e + N \rightarrow e' + N' + A$ is related to $\gamma + N \rightarrow N' + A$ and the latter is calculated in a peripheral model. Detailed numerical results are quoted.

2897

Turin U. Inst. of Physics (Italy).

ON THE GENERALIZATION OF THE OKUBO IDENTITY FOR SU_n, by F. Gliozzi. [1964] [3]p. (AFOSR-66-1724) (AF EOAR-64-39) AD 639544 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 1813-1815, Dec. 16, 1964.

It has been proved that the Gell-Mann-Okubo mass formula is a direct consequence of the Okubo identity. The aim of this paper is to show how to explicitly construct the analogous identities for any SU_n group.

2898

United Aircraft Corp. Research Labs., East Hartford, Conn.

ABSCISSAS AND WEIGHT COEFFICIENTS FOR LOBATTO QUADRATURE, by H. H. Michels. [1963] [8]p. incl. tables. (AFOSR-J1476) (AF 49(638)1133) AD 427565 Unclassified

Also published in Math. Comput., v. 17: 237-244, July 1963.

Abscissas and weights for Lobatto quadrature are presented in tabular form for order n = 3(1)16, 24, 32, 40, 46, 64, 60, 96. All computations were performed on an IBM 7090 digital computer using extended precision routines. The tolerance for iteration on the roots was set at 1×10^{-22}. Several hand calculations of the roots and weight coefficients were performed. Complete agreement with the machine results was found in all cases to 21 decimals.

2899

United Aircraft Corp. [Research Labs.] East Hartford, Conn.

PROBE MEASUREMENTS IN A CESIUM PLASMA CONVERTER, by R. H. Bullis and W. J. Wiegand. [1963] [16]p. (Rept. no. P B38) (AFOSR-5141) (AF 49(636)-1221) AD 411474 Unclassified

Presented at Twenty-third annual conf. on Physical Electronics, Massachusetts Inst. of Tech., Cambridge, Mar. 22, 1963.

Measurements of the properties of the plasma in the interelectrode space of both conventional and arc mode thermionic converters were obtained with coaxial electrostatic probes. In the high-temperature cesium plasma present in the converter, it was found that severe distortion of the probe current-voltage characteristic occurs due to extraneous current leakage to the probe and thermionic emission from the probe tip. By means of techniques previously reported, these distortions were eliminated by employing a coaxial-type probe. A comparison of probe information is made to models of both types of converter.

2900

United Aircraft Corp. Research Labs., East Hartford, Conn.

PLASMA PROPERTIES IN A THERMIONIC CONVERTER, by R. H. Bullis and W. J. Wiegand. [1963] [10]p. incl. illus. diagrs. refs. (AFOSR-64-0898) (AF 49(636)1221) AD 600096 Unclassified

Presented at Twenty-fourth annual conf. on Physical Electronics, Massachusetts Inst. of Tech., Cambridge, Mar. 25-27, 1964.

The properties of the non-equilibrium plasma existing in the interelectrode space of the arc-mode converter were investigated with coaxial electrostatic Langmuir probes. Probe measurements were made as a function of cesium pressure, emitter temperature, interelectrode position and converter output in several low-temperature arc-mode converters. The plasma potential, was found to vary significantly across the interelectrode space. Both the existence of a retarding sheath for electrons very close to the emitter surface and a region farther from the emitter in which the variation in plasma potential is accelerating for electrons have been detected. Significant variations in the plasma potential existing in the space were observed with changes in emitter temperature, cesium pressure, and converter output.

2901

United Aircraft Corp. United Technology Center, Sunnyvale, Calif.

VAPOR-PHASE COMBUSTION OF BERYLLIUM AND ALUMINUM, by R. W. Hermsen and R. W. Woolfolk. Final rept. Dec. 1, 1962-Nov. 30, 1964. Dec. 31, 1964, 51p. incl. illus. diagrs. tables, refs. (Rept. no. UTC 2040-FR) (AFOSR-65-1056) (AF 49(638)1202) AD 617936 Unclassified

An experimental investigation of the vapor-phase combustion of aluminum and beryllium was undertaken using electrically vaporized wires as the source of high-temperature, high-pressure metal vapor. Specifically investigated were (1) the overall reaction rates for the conversion of metal vapor to condensed oxide; (2) the significant species which are present and may act as reaction intermediates; and (3) the detailed mechanism of the combustion including the nucleation and growth of condensed oxide particles.

2902

United Electrodynamics, Inc., Alexandria, Va.

SEISMOLOGICAL APPLICATIONS OF ORTHOGONAL FUNCTION EXPANSIONS, by P. W. Broome and W. C. Dean. Final rept. July 31, 1964, 1v. (AF 49-(636)1117) AD 443977 Unclassified

A method is presented to represent very complicated transients by only a few numbers rather than by curves or by the set of coordinate values necessary to draw the curves. The representation used is an expansion in terms of a set of orthonormalized exponential functions. Procedures necessary to generate these functions, find the expansion coefficients, and use these coefficients in further analysis are described in detail. Section II of the report is concerned with sets of continuous orthonormal functions and is oriented toward analog computation. Section III is devoted to developing sets of orthonormal sequences. These are orthonormal functions which are defined on the set of integers and are used for numerical calculations using sampled data.

2903

United Electrodynamics, Inc., Alexandria, Va.

TABLES OF ZEROS AND WEIGHT FACTORS FOR THE ZERO ORDER LAGUERRE POLYNOMIALS FROM THE 3RD TO THE 100TH DEGREE AND THEIR APPLICATION TO FOURIER - LAGUERRE TRANSFORMS, by E. A. Flinn and W. C. Dean. Supplementary rept. July 31, 1964, 1v. (AF 49(638)1117) AD 443976 Unclassified

Laguerre functions are more suitable for expansion of aperiodic functions, non-vanishing only in positive time, than periodic functions such as sines and cosines. The Fourier transforms of such transients can be readily computed from the Laguerre expansions since the Fourier transforms of the Laguerre functions are known for all frequencies. Section I describes the numerical methods suitable for machine computation of both direct and inverse Fourier transforms from the Laguerre expansions. Section II presents tables of the zeros and weight factors for the zero order Laguerre polynomials necessary for numerical expansion of transients in Laguerre series.

2904

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

LOCALIZED RADIOLESIONS IN THE CENTRAL NERVOUS SYSTEM, by T. Svedberg. Final technical rept. Dec. 21, 1963, 3p. incl. refs. (AFOSR-64-0022) (AF EOAR-62-84) Unclassified

Research performed during July 1962-Aug. 1963 on the effect of high energy protons on the CNS is accounted for by reference to published papers.

2905

Uppsala U. [Gustaf Werner Inst. for Nuclear Chemistry] (Sweden).

RADIATION INDUCED "HYPOPHYSECTOMY" AND HYPOTHALAMIC LESIONS IN LACTATING GOATS, by C. C. Gale and B. Larsson. [1963] [20]p. (AFOSR-64-0954) (AF EOAR-62-84) AD 439986 Unclassified

Also published in Acta Physiol. Scand., v. 59: 299-318, 1963.

Radiolesions were produced in the pituitary gland and/or median eminence-pituitary stalk region of seven lactating goats by use of a narrow, collimated beam of 185 mev protons from a synchrocyclotron. Radiation doses of 25 to 30 krad were restricted to these structures by rotation of the goats' heads around the vertical and horizontal axes of the planned lesion. Ten to 15 days after pituitary irradiation in 4 goats, milk production declined steeply over a 10-day period to about 20% pre-lesion levels. In 2 of the hypophysectomized animals with injury also in the median eminence, diabetes insipidus developed concurrently with the onset of lactation block. Daily replacement with prolactin (luteotrophin), somatotrophin, ACTH, triiodothyronine, and insulin had restored milk synthesis to 60% of pre-radiation levels when destruction trigeminal nerve trunks by continued lateral spread of radiolesions caused by abrupt decline in the health of the goats.

2906

Uppsala U. Gustaf Werner Inst. for Nuclear Chemistry (Sweden).

RESPONSES OF NEONATAL RAT SPINAL CORDS TO HIGH ENERGY PROTONS, by S. A. Gilmore. [1964] [14]p. incl. illus. (AFOSR-64-185); (AF EOAR-62-84) AD 450105 Unclassified

Also published in Acta Radiologica, v. 2: 81-94, Apr. 1964.

High energy protons directed through lumbar spinal cords of rats 3 to 16 days old resulted in a high incidence of neurologic abnormalities regardless of age at time or irradiation. These changes are compared with and discussed in relation to this investigators previous work with roentgen irradiation. The histopathology of these cords is described. Studies of spinal cords of rats irradiated when 3 days old and killed 2 to 11 days later showed a marked decrease in the quantity of neuroglia and a consequent hypo- or amyelination. These rather selective alterations are compared with late, non-specific histopathologic changes in the cords described above. (Contractor's abstract)

2907

Uppsala U. Inst. of Chemistry (Sweden).

RESEARCH ON PHASES CONTAINING TRANSITION METALS AND NON-METALS, by G. Hägg. Final technical rept. Jan. 1, 1958-Dec. 31, 1962. [1963] [12]p. incl. refs. (AFOSR-473) (AF 61(052)40) AD 407711 Unclassified

This report deals with accurate determinations of basic properties of phases in systems of transition metals and non-metals. These studies are mainly confined to the borides, silicides and phosphides of transition metals from Groups VI, VII and VIII. Comprehensive and detailed reviews of the binary transition metal borides, silicides and phosphides have been given. The present report is therefore confined to general aspects only, which are presented in two main paragraphs: 'Phase analyses' and 'Crystal chemistry.' Some further comments are made on very recent results not included above.

2908

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $2HgCl_2.(C_2H_5)_2S$, by

C.-I. Branden. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-64-1552) (AF 61(052)43) AD 446112 Unclassified

Also published in Arkiv Kemi, v. 22: 83-91, 1964.

A considerable number of compounds formed between mercuric chloride and alkyl-sulphides have been isolated with widely different mole ratios of $HgCl_2$:sulphide. Thus in the system $HgCl_2$-$(C_2H_5)_2S$ two compounds, $HgCl_2 \cdot (C_2H_5)_2S$ and $2HgCl_2 \cdot (C_2H_5)_2S$, have been identified. The latter compound has been studied by infrared spectroscopy and a crystal structure determination has now been undertaken as part of an investigation into compounds formed between $HgCl_2$ and oxygen or sulphur donor molecules. (Contractor's abstract)

2909

Uppsala U. Inst. of Chemistry (Sweden).

THE CRYSTAL STRUCTURE OF $HgCl_2 \cdot 2(C_6H_5)_3AsO$, by C.-I. Branden. [1963] [12]p. incl. diagrs. tables, refs. (AFOSR-64-1553) (AF 61(052)43) AD 446113 Unclassified

Also published in Acta Chem. Scand., v. 17: 1363-1374, 1963.

The crystal structure of $HgCl_2 \cdot 2(C_6H_5)_3AsO$ has been determined and refined from three-dimensional x-ray data. The crystals are monoclinic (space-group $P\,2_1/c$) with four molecules in a unit cell with the dimensions a = 16.40 A, b = 10.56 A, c = 16.23 A and β = 106.0°. The structure comprises discrete $HgCl_2 \cdot 2(C_6H_5)_3AsO$ molecules with a highly distorted tetrahedral configuration around the mercury atom. The mean bond-lengths are: Hg–Cl = 2.33 A, Hg–O = 2.35 A, As–O = 1.69 A, As–C = 1.93 A and C–C = 1.40 A. The bond angles subtended at the mercury atom are: Cl–Hg–Cl = 146.5°, Cl–Hg–O = 101.5° (mean value) and O–Hg–O = 92.5°. The bond angle subtended at the oxygen atom is 135.5° (mean value). The two crystallographically different $(C_6H_5)_3AsO$-groups of the molecule exhibit small deviations from three-fold rotation symmetry around the As-O vector, the deviations being different in the two groups. (Contractor's abstract)

2910

Uppsala U. [Inst. of Physics] (Sweden).

HIGH PRECISION NUCLEAR PROPERTIES STUDIES, by K. Siegbahn. Final technical rep't. Mar. 30, 1963, 1v. (AFOSR-4867) (AF EOAR-62-72) AD 414916 Unclassified

The following topics are discussed: Techniques and equipment used in high precision nuclear property studies: Iron-free double focusing, iron yoke double focusing, neutron capture, electron-electron coincidence, universal coincidence, and electron-gamma coincidence spectrometers; Gamma-gamma angular and differential angular correlations; and Atomic beam magnetic resonance.

2911

Uppsala U. Inst. of Physics (Sweden).

IMPROVED EXPERIMENTAL METHODS FOR MEASUREMENTS OF NUCLEAR LIFETIMES DOWN TO 10^{11} SECONDS, by J. Lindskog and T. Sundstrom. [1963] [22]p. incl. diagrs. refs. (AFOSR-J495) (AF EOAR-62-123) AD 407857 Unclassified

Also published in Arkiv Fysik, v. 24: 199-220, 1963.

Improved methods for delayed coincidence measurements of nuclear lifetimes down to 10 ps have been developed. It is shown that when an electron coincidence spectrometer is used for the energy selection the measurements can in many cases be performed in such a way that the energy dependent instrumental time delays do not contribute to the measured lifetime. In addition these instrumental time delays have been carefully investigated.

2912

Uppsala U. [Inst. of Physics] (Sweden).

DETERMINATION OF THE ELECTROMAGNETIC TRANSITION PROBABILITIES IN THE GROUND STATE DECAY OF Au 199, by J. Lindskog, T. Sundstrom and others. [1963] [9]p. (AFOSR-J496) (AF EOAR-62-123) AD 407656 Unclassified

Also published in Arkiv Fysik, v. 24: 161-169, 1963.

The lifetimes of the two levels in Hg 199 which are fed from Au 199 have been measured by the delayed coincidence technique. The result is: 158 kev level: T1/2 = (2.42 ± 0.15) ns. 208 kev level: T1/2 = (66 ± 6) ps. The decay of Au 199 is discussed in terms of the core excitation model. The result of the present measurements is found to be consistent with the predictions of this model.

2913

Uppsala U. Inst. of Physics (Sweden).

A 50-CM DOUBLE FOCUSING BETA SPECTROMETER OF THE CURRENT SHEET TYPE, by K. Siegbahn, C. Nordling and others. [1964] [17]p. incl. illus. diagrs. tables, refs. (AFOSR-64-1008) (AF EOAR-62-123) AD 440986 Unclassified

Also published in Nuclear Instr. and Methods, v. 27: 173-189, May 1964.

A precision beta spectrometer is described. It is an air-cored, double focusing, instrument in which the magnetic field is generated by two coaxial cylindrical coils. Easy access is provided to the source and

detector positions and there is sufficient space for electron-gamma coincidence arrangements. The solid angle accepted by the spectrometer is 0.3% of 4π at a resolution of 0.2, and 0.05% at a resolution of 0.02%. Current regulation and data recording are completely automatic as well as the cooling system for the spectrometer coils. The maximum electron energy of the instrument is 3.5 mev.

2914

Uppsala U. Inst. of Physics (Sweden).

THE LIFETIME OF THE 420 KEV STATE IN Cd^{111}, by P. Sparrman, T. Sundstrom, and J. O. Lindstrom. [1964] [6]p. (AFOSR-64-1009) (AF EOAR-62-123) AD 441054 Unclassified

Also published in Arkiv Fysik, v. 26: 479-484, 1964.

The lifetime of the 420 kev state in Cd^{111} has been measured with the delayed coincidence technique. The electromagnetic transition rates for the 173 kev transition are discussed and compared with the transition rates for a few other transitions in Cd^{111}.

2915

Uppsala U. [Inst. of Physics] (Sweden).

A MEASUREMENT OF THE LIFETIME OF THE 138.9 KEV LEVEL IN Tm^{169}, by T. Sundstrom, P. Sparrman and others. [1964] [5]p. (AFOSR-64-1010) (AF EOAR-62-123) AD 441055 Unclassified

Also published in Arkiv Fysik, v. 26: 377-381, 1964.

The lifetime of the 138.9 kev 7/2+ level in Tm^{169} has been measured by the delayed coincidence technique. The result is T 1/2 = (321 ± 14) ps.

2916

Uppsala U. [Inst. of Physics] (Sweden).

TWO LIFETIMES IN THE GROUND STATE ROTATIONAL BAND OF Tm^{171}, by T. Sundstrom, J. O. Lindstrom and others. [1964] [9]p. (AFOSR-64-1011) (AF EOAR-62-123) AD 441057 Unclassified

Also published in Arkiv Fysik, v. 26: 397-405, 1964.

The lifetimes of two states in the ground state rotational band of Tm^{171} have been measured with the delayed coincidence method. The results are compared with the corresponding data for the very similar rotational states in Tm^{169} and discussed with regard to the unified nuclear model.

2917

Uppsala U. [Inst. of Physics] (Sweden).

THE ELECTROMAGNETIC PROPERTIES OF LEVELS AND TRANSITIONS IN THE GROUND STATE ROTATIONAL BAND OF Tm^{169}, by T. Sundstrom, J. Lindskog and others. [1964] [16]p. (AFOSR-64-1012) (AF EOAR-62-123) AD 441056 Unclassified

Also published in Arkiv Fysik, v. 26. 361-376, 1964.

The experimental data for the electromagnetic properties of the ground state rotational band of Tm^{169} are reviewed and discussed in terms of the unified nuclear model.

2918

Uppsala U. [Inst. of Physics] (Sweden).

PARALLEL FIELD MAGNETOACOUSTIC EFFECT IN ANTIMONY, by O. Beckman, L. Eriksson, and S. Hornfeidt. [1964] [2]p. (AFOSR-64-1222) (AF EOAR-63-53) AD 442850 Unclassified

Also published in Solid State Commun., v. 2: 7-8, 1964.

Oscillations in the acoustic attenuation in antimony are measured with longitudinal sound waves and magnetic field parallel to the 3-fold axis. The result is interpreted as oscillations in the field direction of electrons belonging to extremum orbits of the tilted Shoebert ellipsoids.

2919

Uppsala U. [Inst. of Physics] (Sweden).

DISLOCATION RELAXATION IN ALUMINUM, by M. Mongy, K. Salama, and O. Beckman. [1963] [3]p. (AFOSR-64-1223) (AF EOAR-63-53) AD 442851 Unclassified

Also published in Solid State Commun., v. 1: 234-236, 1963.

Dislocation motions in the three principal planes of single alumium have been studied at ultrasonic frequencies of 10, 20 and 50 mc/sec. The activation energies and the relaxation frequencies, calculated from the position of the Bordoni peak, show a high degree of anisotropy. The results are discussed in connection with Seeger's theory.

2920

Uppsala U. Inst. of Physics (Sweden).

ELASTIC CONSTANTS OF ALUMINUM, by J. Vallin, M. Mongy and others. [1964] [2]p. incl. tables. (AFOSR-64-2121) (AF EOAR-63-53) AD 451565 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1825-1826, June 1964.

The adiabatic elastic constants of aluminum have been measured with an ultrasonic pulse technique at liquid-helium, liquid-nitrogen, and room temperatures. The

values of the elastic constants at 4°K are calculated. The Debye characteristic temperature calculated from the figures is 425°K, in good agreement with the value obtained for specific heat data. The shear elastic constants are discussed with reference to the theory given by Leigh.

2921

Uppsala U. Inst. of Physics (Sweden).

ELASTIC CONSTANTS OF CsBr AND CsI FROM 4.2°K TO ROOM TEMPERATURE, by J. Vallin, O. Beckman, and K. Salama. [1964] [2]p. incl. tables, refs. (AFOSR-64-2351) (AF EOAR-63-53) AD 451937 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1222-1223, Apr. 1964.

The elastic constants of pure single crystals of CsBr and CsI have been measured at liquid-helium, liquid-nitrogen, and room temperatures. The elastic constants give the Debye temperature 148.8°K for CsBr and 125.6°K for CsI. The infrared resonance frequencies calculated from compressibility data are in agreement with those obtained from infrared spectroscopy.

2922

Uppsala U. Inst. of Physics (Sweden).

STUDY OF THE BORDONI PEAK IN SINGLE-CRYSTAL AND POLYCRYSTALLINE COPPER, by M. Mongy, K. Salama, and O. Beckman. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0746) (AF EOAR-63-53) AD 615065 Unclassified

Also published in Nuovo Cimento, Series X, v. 34: 859-877, Nov. 16, 1964.

The Bordoni peak has been investigated in single-crystal and polycrystalline copper by measuring the longitudinal ultrasonic absorption at 10, 20 and 50 mhz, in the temperature range 80° to 300°K. In the single-crystal sample, the measurements have been made in the 3 principal directions [111], [100] and [110]. The values of the activation energy W and the relaxation frequency f_0, calculated from the frequency-dependence of the peak on the temperature scale, show a high degree of anisotropy. The comparison of the shape of the peak with Zener's single relaxation theory shows that the peak in the [111] direction is due to a single relaxation process. In the polycrystalline sample and in the other 2 directions of the single-crystal specimen, the results favor a spectrum of different relaxation frequencies with a constant activation energy. The spectrum width factor γ differs from one case to the other, but γW has approximately the same value which equals the energy obtained in the [111] direction. (Contractor's abstract)

2923

Uppsala U. Inst. of Physics (Sweden).

DOPING STUDIES OF $BI_2(Te,Se)_3$ ALLOYS, by O. Beckman, P. Bergvall, and K. Tripathi. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0747) (AF EOAR-63-53) AD 615066 Unclassified

Also published in Arkiv Fysik, v. 28: 215-221, Dec. 28, 1964.

Alloys of $Bi_2Te_{3-x}Se_x$ ($0 \leq x \leq 1$) doped with controlled amounts of Cu, CuBr and BiI_3 have been prepared according to the Bridgeman technique. The number ϵ, of charge carriers per doping molecule as obtained from thermoelectric and galvanomagnetic measurements is found to vary with the selenium substitution. The results are explained in terms of the chemical bonding in the Bi_2Te_3 lattice.

2924

Uppsala U. [Inst. of Physiology] (Sweden).

RESEARCH ON THE GENESIS OF ACTION POTENTIAL IN EXCITABLE TISSUES, by T. Teorell. Apr. 1, 1963, 25p. (AFOSR-4848) (AF 61(052)363) AD 414084 Unclassified

This report deals with a biophysical formalism applicable to various phenomena of excitability as exposed by living tissues like the nerve axons etc. A quantitative excitability analog was presented in terms of voltage (E), current (I), and a P-factor, located in a membrane containing fixed ionic groups. A physical realization of this formalism has been achieved in membrane experiments where electro-endosmosis plays an essential part (i.e., the membrane oscillator). In such systems the P-factor is identified as a hydrostatic pressure gradient, which is voltage dependent. However, in other systems the P-factor may be equivalent to any other variable that is correspondingly dependent on the electrical variables E and/or I. Examples are presented with references to corresponding physiological observations on nerves and other excitable objects, in particular Nitella cells.

2925

Uppsala U. [Inst. of Physiology] (Sweden).

RESEARCH ON THE GENESIS OF ACTION POTENTIAL IN EXCITABLE TISSUES, by T. Teorell. Final technical rept. Apr. 13, 1964, 44p. (AFOSR-64-0988) (AF EOAR-63-5) AD 600343 Unclassified

This report summarizes the research on the following: (1) Stable and unstable convection phenomena in a fixed charge membrane barrier, (2) Ion fluxes in the membrane oscillator, (3) The electrohydraulic excitatibility analog applied to presso-receptor problems, and (4) Research on ion selectivity in an artificial system.

2926

Uppsala U. Inst. of Physiology (Sweden).

THE ION FLUX ACROSS MEMBRANES DURING ELECTRO-DIFFUSION AND CONVECTION, by T. Teorell. [1964] [2]p. (AFOSR-65-1552) (AF EOAR-64-33) AD 623372 Unclassified

Also published in Acta Physiol. Scand., v. 62: 293-294, 1964.

Ion flux is considered across a membrane containing wide pores and separating 2 concentrations of a single salt. A formula for cation flux is derived for electro-diffusion and convection in the cases where forces present are due to (1) the concentration gradient, (2) the transmembrane potential gradient, and (3) the linear bulk flow velocity (V) through the membrane pores. The formula is valid whether the water streaming V is induced by a hydrostatic or an electro-osmotic pressure difference across the membrane.

2927

Utah State U. Dept. of Chemistry, Logan.

PYROLYSIS STUDIES. VIII. POLAR SUBSTITUENT EFFECTS IN THE VAPOR PHASE THERMAL DECOMPOSITION OF ISOPROPYL BENZOATES, by G. G. Smith and D. A. K. Jones. [1963] [4]p. incl. diagrs. table, refs. (AFOSR-64-0217) (AF AFOSR-62-268) AD 432506 Unclassified

Also published in Jour. Organic Chem., v. 26: 3496-3499, 1963.

The absolute reaction rates of thermal decomposition of a series of meta- and para-substituted isopropyl benzoates have been measured in the vapor phase, using a new pyrolysis apparatus in which the pressure changes were monitored continuously and automatically. The physical properties of eleven new substituted isopropyl benzoates are reported.

2928

Utah State U. [Dept. of Chemistry] Logan.

THE EFFECT OF STRUCTURAL CHANGES ON THE PYROLYSIS OF ORGANIC ESTERS, by G. G. Smith. Final rept. Oct. 1964, 6p. (AFOSR-64-2343) (AF AFOSR-62-266) AD 606632 Unclassified

A brief summary is given of systematic studies concerning linear free energy relationships in solvent free systems where the reaction rates are influenced by substituents. A bibliography of the 14 published papers generated under the contract is included.

2929

Utah State U. Dept. of Chemistry, Logan.

PYROLYSIS STUDIES. XI. POLAR EFFECTS OF ORTHO SUBSTITUENTS, by D. A. K. Jones and G. G. Smith. [1964] [3]p. incl. tables, refs. (AFOSR-65-0535) (AF AFOSR-62-266) AD 617565 Unclassified

Also published in Jour. Org. Chem., v. 29: 3531-3533, Dec. 1964.

Polar σ^0 substituent constants for several substituents have been determined from rate data for vapor phase elimination reactions in which resonance effects are eliminated and proximity effects are minimal. These σ^0_0-values agree fairly well with Taft's σ^*-values, and with σ^0_0-values obtained from other literature data. A table of values is given. (Contractor's abstract)

2930

Utah State U. Dept. of Chemistry, Logan.

PYROLYSIS STUDIES. XII. STERIC INHIBITION OF RESONANCE IN THE VAPOR PHASE, by G. G. Smith and D. V. White. [1964] [3]p. incl. diagr. tables, refs. (AFOSR-65-0536) (AF AFOSR-62-266) AD 613921 Unclassified

Also published in Jour. Org. Chem., v. 29: 3533-3535, Dec. 1964.

A careful determination of the absolute reaction rate constants for the vapor phase thermal decomposition of 1-(4'-methoxyphenyl)ethyl acetate and its 3'-methyl and 3',5'-dimethyl derivatives provides convincing evidence that π-orbital overlap of the methoxy substituent with the π-electrons of the ring is markedly reduced by steric hindrance of methyl groups ortho to the methoxy substituent. Therefore, steric inhibition of resonance is a property of the molecule and does not require solvation of the substituents.

2931

Utah U. [Dept. of Chemical Engineering] Salt Lake City.

IGNITION AND COMBUSTION OF SOLID PROPELLANTS, by R. C. Mitchell, J. A. Keller and others. Oct. 1, 1962-Sept. 30, 1963, 76p. (AFOSR-64-1665) (AF AFOSR-63-40) AD 605729 Unclassified

The spreading rate of the flame zone on the surface of a solid propellant was studied by use of a rarefaction tube. Cold gas flow past the burning zone and across the unburned surface produced high flame spread velocities. The experimental data were interpreted and correlated in terms of two theoretically predicted but experimentally determined parameters. Data obtained by subjecting composite propellant surfaces to thermal radiation fluxes in the range of 2-13 cal/(sec) (sq cm) were adequately explained in terms of a simple ignition theory. A comparison of the ignition characteristics of several types of catalyzed, composite ammonium-based propellants and of propellant type materials formed by pressing AP and non-volatile carbon black or graphite

indicated that, in the range of heat fluxes studied, ignition occurs by decomposition of AP followed by a reaction between the decomposition products and solid fuel binder.

2932

Utah U. [Dept. of Chemical Engineering] Salt Lake City.

COMBUSTION IRREGULARITIES OF SOLID PROPELLANTS, by N. W. Ryan. Progress rept. Sept. 1, 1963-June 30, 1964. Aug. 10, 1964, 11p. (AF AFOSR-63-446) AD 454553 Unclassified

The project progress is summarized along three distinct lines, (1) the study of acoustic instability in a T-burner, (2) the study of non-acoustic instability, and (3) an attempt to develop a gas-burning engine for studying instability with a truly homogeneous, relatively simple combustion system.

2933

Utah U. Dept. of Chemical Engineering, Salt Lake City.

IGNITION AND COMBUSTION OF SOLID PROPELLANTS, by J. A. Keller, A. D. Baer, and N. W. Ryan. Final rept. Oct. 1, 1963-Sept. 30, 1964 [72]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0936) (AF AFOSR-64-40) Unclassified

The results of the study of propellant ignition by high convective heat fluxes have shown that the gas velocity effect often observed in convective heating tests can be attributed to surface roughness. If this surface roughness effect is eliminated by the use of very smooth propellant surfaces or by use of very high gas velocities which prevent ignition of projections on the surface, the relationship between ignition time and surface heat flux is simply the extrapolation of the low-flux ignition data. Also, it appears that the effect of a burning rate catalyst is to increase the rate of reaction of propellant-component decomposition products at the propellant surface. Modification of the thermal ignition theory to include the effects of surface regression for high igniter heat fluxes has lead to results which indicate that an ignition-pressure effect on the overall ignition process can be observed when practical ignition systems even when the thermal response of the propellant itself is independent of pressure. The problem of transition from ignition to steady-state burning can be approximately treated by this model.

2934

Utah U. Dept. of Metallurgy, Salt Lake City.

INVESTIGATION OF THE RECRYSTALLIZATION BEHAVIOR OF DILUTE ALLOYS OF MAGNESIUM AND CHROMIUM, by C. H. Pitt, E. L. Moore and others. Dec. 1964, 66p. incl. illus. diagrs. tables, refs. (Technical rept. no. 1) (AFOSR-65-0755) (AF AFOSR-63-39) AD 615620 Unclassified

An investigation into the recrystallization behavior of pure magnesium and some of its dilute binary alloys and pure chromium has been made. Techniques for preparing thin foils of magnesium suitable for examination in the electron microscope have been developed and photographs taken of dislocations, nucleation of dislocations and migrating grain boundaries. An x-ray technique was developed to measure the degree of recrystallization of magnesium and it was found that surface recrystallization played an important part in the recrystallization process. Activation energies determined for surface recrystallization in magnesium and its alloys range from 28 to 31 kcal/mol while that for bulk recrystallization was 20 kcal/mol. Determination of the percent recrystallization in pure chromium was done by a microscope technique. The activation energy for the recrystallization of pure chromium, i.e., 99.997%, was found to be 76 kcal/mol.

2935

Utah U. [Dept. of Physics] Salt Lake City.

THE EFFECTS OF OPTICAL PROPERTIES ON THIN FILMS ON POLARIZATION AND INTENSITY OF LIGHT DIFFRACTED THROUGH WIDE ANGLES, by F. S. Harris, Jr. and G. R. Orme. [1963] [5]p. (AFOSR-64-1972) (AF 49(638)799) AD 452504 Unclassified

Presented at meeting of the Internat'l. Commission for Optical Materials, Paris (France), July 7, 1961.

Also published in Opt. Acta, v. 10: 293-297, Oct. 1963.

The effect of the edge material and the wavelength on wide-angle diffraction was investigated with a sensitive photomultiplier photometer. Measurements of as little as 10^{-8} fraction of the incident light at an angle of 70° showed the effect on the intensity and polarization of the diffracted light due to the nature of the edge material and depending on the wavelength used.

2936

Utah U. Dept. of Psychology, Salt Lake City.

IDENTIFYING RESEARCH CHARACTERISTICS IN HIGH SCHOOL STUDENTS—A SECOND STUDY, by C. W. Taylor, E. Nielsen and others. Aug. 1964, 1v. incl. tables, refs. (AFOSR-64-2261) (AF AFOSR-63-11) AD 609485 Unclassified

An attempt was made to discover the best predictor of creative scientific talent in high school students. A new study was undertaken with a three-fold purpose: (1) to focus on improving the spread of criterion rating scores over those obtained in the first study of the research participation programs; (2) to obtain cross validities on the best predictors used in the previous summer's study study; and (3) to provide an opportunity to try out a few new predictor instruments.

2937

Utah U. Dept. of Psychology, Salt Lake City.

INFORMATION AND SCIENTIFIC CREATIVITY, by C. W. Taylor. [1964] 20p. incl. refs. (AFOSR-64-2502) (AF AFOSR-63-144) AD 609486 Unclassified

Presented at Second Symposium of the Federal Council for Science and Technology on Technical Information and the Federal Laboratory, Apr. 13, 1964.

In this paper the problem of studying what constitutes effectiveness and creativity in a scientist is discussed. The way the scientist receives and handles information, the intellectual climate in which he works, and the nature of the information received by him are all examined in their bearing on the creative process.

2938

Vanderbilt U., Nashville, Tenn.

LUMINOUS FRONT THICKNESS IN ELECTRIC SHOCK TUBES, by J. P. Barach and J. A. Sivinski. [1964] [3]p. incl. diagrs. (AFOSR-64-1985) (AF AFOSR-63-287) AD 452382 Unclassified

Also published in Jour. Appl. Phys., v. 35: 1426-1428, May 1964.

Five electric shock tube arrangements have been studied by means of photomultiplier signals. The rise time of the luminous front as it passes the detector station is converted to a thickness by means of the measured front speed. These thicknesses are correlated with initial conditions of pressure from 0.15 to 5.0 Torr of argon, and input power from 0.8 to 262 x 10^6 w, for tubes with luminous front speeds from 3 to 30 mm/μ sec. For each tube the front thickness increases with input energy and, in general, the thickness of the luminous transition zone is proportional to the peak current. Identification of the luminous front is with the "hairpin" driving current, rather than with a shock wave initiated by it. A maximum current density picture of this driving current is suggested by the data.

2939

Vanderbilt U., Nashville, Tenn.

PRECURSOR ARC IN AN ELECTRIC SHOCK TUBE, by J. P. Barach and J. A. Sivinski. [1964] [2]p. incl. illus. diagrs. refs. (AFOSR-64-2310) (AF AFOSR-63-287) AD 451930 Unclassified

Also published in Phys. Fluids, v. 7: 1075-1076, July 1964.

As part of an investigation into the characteristics of the flow in electric shock tubes, a grounded probe of fine copper wire was inserted downstream in a coaxial shock tube. An arc of some hundreds of amperes then preceded the shock front, running from the high voltage powering electrode to this ground wire. This arc can extend quite far downstream and currents of a few amperes can still be drawn with the wire separated by as much as 5 microhms from ground. Other electric shock-tube workers may have such arcs in their tubes and they may cause ambiguous results such as the appearance of double structure to the front. The precursor arc may also be of interest as a means of producing and studying appreciable precursor electron densities in electric shock tubes. It also is a means of increasing shock velocities by heating the gas immediately ahead of the front.

2940

Vanderbilt U., Nashville, Tenn.

FLUX TRANSPORT BY A SHOCK PLASMA, by J. P. Barach and J. H. Lee. [1964] [6]p. incl. illus. diagrs. refs. (AFOSR-64-2311) (AF AFOSR-63-287) AD 452411 Unclassified

Also published in Phys. Fluids, v. 7: 1366-1371, Aug. 1964.

A magnetic field of about 50 G is observed to be transported downstream from a sharply localized dc field up to 34 kG interacting tranversely with a shock produced plasma flow of velocity up to 2 cm/μsec. The transported flux is found to be antiparallel to the imposed field and to decay exponentially in time as it moves downstream. The decay of the flux gives an estimate of the gas conductivity. The amount of trapped flux is in agreement with an approximate theory in which the decay of the initial trapped flux, the magnetic deceleration of the flow, and the reduction of the conductivity by the magnetic field are considered. The initial trapped flux is found to be proportional to the reduced conductivity and the flow velocity, as expected. However an increase in the imposed field beyond 17,000 G reduces the trapping effect due to reductions in both the conductivity and the exit flow velocity of the plasma. The e-folding time for field decay is roughly 3.5 μsec and does not increase with increasing shock speed. (Contractor's abstract)

2941

Victoria U. [Dept. of Chemistry] Wellington (New Zealand).

SURFACE ADSORPTION OF Co^{57}, Fe^{57} ON IRON(II) AND COBALT(II) OXALATES, by P. R. Brady and J. F. Duncan. [1964] [6]p. (AFOSR-64-1503) (AF AFOSR-63-27) AD 446357 Unclassified

Also published in Jour. Chem. Soc., v. 130: 653-658, Feb. 1964.

The Mossbauer spectra of sources prepared by adsorption of Co^{57}, Fe^{57} on surfaces of iron (II) and cobalt(II) oxalate were compared with those obtained when the solids were (a) co-precipitated with these radionuclides and (b) used as absorbers with a monochromatic Co^{57}, Fe^{57} source. Some 40% of the adsorbed iron atoms were strongly held on the surfaces in positions which did not appear to be chemically very different from the normal positions in the lattices of these solids. However, when iron(II) oxalate was heated at its temperature of decomposition, the characteristic resonance lines weakened and became unobservable.

2942

Vienna U. Inst. for Theoretical Physics (Austria).

ELASTIC SCATTERING OF NEGATIVE PIONS AT 16 BEV/C, by G. Czapek, G. Kellner and others. June 15, 1962 [11]p. incl. diagrs. refs. (Scientific note no. 5) (AFOSR-3102) (AF 61(052)433) Unclassified

Presented at Aix Conf on Elementary Particle Physics, Sept. 1961.

This paper shows the experimental results from elastic scattering of high energy negative pions on protons. A total cross-section of (26.8 ± 1) mb and an elastic

cross-section of (4.2 ± 0.5) mb were found. The differential elastic cross-section turned out to be in good agreement with an optical model (imaginary potential or grey disk).

2943

Virginia Inst. for Scientific Research, Richmond.

A STUDY OF THE GROWTH AND PERFECTION OF SINGLE CRYSTALS OF THE RARE EARTHS AND ALKALI METALS, by J. F. Kirn. Feb. 1, 1961-Jan. 31, 1963, 23p. incl. illus. diagrs. tables, refs. (AFOSR-J1355) (AF AFOSR-61-41) AD 426565 Unclassified

Single crystals of sodium and potassium were prepared by the Czochralski techniques in glass vessels under vacuum or an argon atmosphere. Methods of cutting, orienting, and studying the samples microscopically were developed. Chlorinated hydrocarbons show considerable promise as etchants. An arc-image furnace was constructed and single crystals of nickel were prepared. The major problem in the use of this furnace is temperature control.

2944

Virginia Polytechnic Inst. Dept. of Chemistry, Blacksburg.

THE KINETICS OF THE CHROMIUM(VI)-ARSENIC(III) REACTION IN ACETIC ACID-ACETATE BUFFER SOLUTIONS, by J. G. Mason and A. D. Kowalak. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-64-2204) (AF AFOSR-63-210) AD 452404 Unclassified

Also published in Inorg. Chem., v. 3: 1248-1251, 1964.

The kinetics of the oxidation of As(III) by Cr(VI) have been investigated over a wide range of As(III) and Cr(VI) concentrations in 0.2 M acetic acid-0.2 M potassium acetate buffers and a constant ionic medium of 1.5 M adjusted with potassium nitrate.

2945

Virginia U. Research Labs. for the Engineering Sciences, Charlottesville.

A MAGNETIC WIND TUNNEL BALANCE, by H. M. Parker and A. R. Kuhlthau. Feb. 1964, 20p. (AFOSR-64-0567) (AF AFOSR-62-92) AD 434844 Unclassified

A preliminary model of a 3-D wind tunnel balance, which has been constructed and operated in low speed continuum flow for the purpose of demonstrating the feasibility of the approach is described in this report.

2946

[Vitro Corp. of America]. Vitro Labs., West Orange, N. J.

FLUID TRANSPIRATION THROUGH ANODIC BOUNDARY OF AN ELECTRIC ARC, by C. Sheer, J. A. Cooney, and D. L. Rothacker. [1964] [7]p. incl. illus. diagrs. table, refs. (AFOSR-64-0917) (AF 49(638)-477) AD 439870 Unclassified

Also published in AIAA Jour., v. 2: 483-489, Mar. 1964.

Consideration of the distribution of dissipated energy in a free-burning arc indicates that the major portion of the input energy is concentrated at the anode-gas interface. This leads to the concept of introducing a working fluid into the arc via the anodic boundary by transpiration through a porous anode. Using porous graphite of sufficiently fine pore size and an inert gas medium, this technique is shown to be successful in generating a sustained plasma-jet without a water-cooled channel or other thermal constraint. At power levels below 10 kw, energy transfer to the gas is in the range 70.8 to 88.5% of input.

2947

Von Karman Inst. for Fluid Dynamics, Brusseis (Belgium).

A POSSIBLE COMPROMISE BETWEEN ROCKET AND ATMOSPHERIC BRAKING, by L. Moulin. June 1964, 42p. (Scientific rept. no. 3; VKIFD TN-17) (AFOSR-64-1139) (AF EOAR-63-39) AD 602391 Unclassified

An attempt was made to optimize the problem of recovering an interplanetary vehicle through the earth's atmosphere. Optimum conditions are defined as the ones which would minimize the dead weight, which includes the fuel required for eventual rocket braking outside the atmosphere, and the mass which is ablated for heat protection during the flight into the atmosphere. It is shown that when chemical or nuclear propulsion is considered, pure atmospheric braking is always the best solution, but when electrical propulsion can be used, an optimum compromise between partial rocket and atmospheric braking may exist, depending upon the respective qualities of the propulsion system and ablating material.

2948

Von Karman Inst. for Fluid Dynamics, Brusseis (Belgium).

APPROXIMATE ANALYSIS OF OPTIMUM LOW THRUST TRANSFER BETWEEN COPLANAR HYPERBOLIC ORBITS, by L. Moulin. May 1964 [22]p. incl. diagrs. (Scientific rept. no. 2; VKIFD TN-15) (AFOSR-64-1140) (AF EOAR-63-39) Unclassified

Optimization of low thrust transfer between coplanar hyperbolic orbits has been analyzed, on the basis of an

approximate analytical solution, in the case of constant thrust set at a constant angle to the velocity vector. The investigation bears upon minimization of fuel consumption and selection of an ideal initial orbit. For given initial and final orbits it is shown that optimum conditions can be obtained with tangential thrust. Further refinement consists of a proper selection of the angular momentum of the initial orbit, so as to either initiate or terminate low thrust propulsion as close as possible to perigee, depending upon the direction of transfer.

2949

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

NOTE ON THE USE OF CHEBYSHEV POLYNOMIALS FOR INTEGRATION OF ORDINARY DIFFERENTIAL EQUATIONS, by L. Moulin. June 1964 [24]p. incl. diagrs. (Scientific rept. no. 4; VKIFD TN-18) (AFOSR-64-1293) (AF EOAR-63-39) AD 603740 Unclassified

The problem of obtaining approximate solutions to ordinary differential equations is discussed with reference to methods which are already in existence. In addition, the possibility has been considered of using direct expansions in Chebyshev polynomials. The analysis indicates that such a method compares favorably with other methods, and may offer further advantages. It is also shown that its application can also be easily extended to the case of nonlinear equations.

2950

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

OPTIMIZATION OF RECOVERY TRAJECTORIES FOR SPACE VEHICLES, by L. Moulin. Final scientific rept. Sept. 30, 1964 [27]p. incl. diagrs. (AFOSR-64-2481) (AF EOAR-63-39) AD 609573 Unclassified

It is shown that optimum recovery conditions must be defined as the ones which minimize an overall deadweight which must include the fuel for eventual rocket braking outside the atmosphere, and the mass which is ablated for heat protection into the atmosphere. The results indicate that when chemical or nuclear propulsion is considered, pure atmospheric braking will always be the best solution, but when electrical propulsion is used, an optimum compromise between partial rocket and atmospheric braking may exist, depending upon the respective properties of propulsion system and ablating material. (Contractor's abstract)

2951

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

APPROXIMATE ANALYTICAL SOLUTION FOR LOW THRUST PROPULSION IN SPACE, by L. Moulin. May 1964, 43p. (Scientific rept. no. 1; VKIFD TN-16) (AF EOAR-63-39) AD 603175 Unclassified

Approximate analytical solutions were derived for the problem of low thrust propulsion, in the case of constant thrust, set at a constant angle to the velocity vector, for any type of initial orbit (elliptic, parabolic or hyperbolic). Simple expressions were obtained, giving energy, angular momentum and excentricity in terms of the excentric anomaly. The solutions allow for calculation of the fuel consumption. Their validity is restricted to the field of orbit correction.

2952

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

MODULATION TECHNIQUES FOR MEASUREMENTS IN LOW DENSITY HYPERSONIC WIND TUNNELS, by J. J. Smolderen. [1964] [15]p. incl. illus. diagr. (AFOSR-64-1875) (AF EOAR-63-41) AD 607382 Unclassified

Presented at Twenty-second Semi-annual Supersonic Tunnell Association meeting, Sept. 24-25, 1964.

A new technique for the measurement of small forces or other low level effects has been developed at the VKIFD low density wind tunnel. Measurement of forces as low as 10 μg appear feasible using ferroelectric transducers in conjunction with a low level tuned amplifier system and synchronous demodulator. This performance is made possible by periodically screening the flow on the model or even chopping the full flow of the wind tunnel by means of a mechanically actuated screen. Such modulation techniques, which result in considerable noise and drift reduction because of the narrow band width of a system using synchronous demodulation are widely used for the measurement of low level dc signals as well as detection of weak radiation, molecular beams, biological phenomena, etc.

2953

[Von Karman Inst. for Fluid Dynamics, Brussels (Belgium)]

LAMINAR SEPARATION IN SUPERSONIC FLOW, by J. J. Ginoux. Final rept. Nov. 1, 1962-Sept. 30, 1963 [59]p. incl. illus. diagrs. refs. (AFOSR-64-0122) (AF EOAR-63-45) AD 429780 Unclassified

A study of three-dimensional flow perturbations in laminar supersonic flows was made on flat plates with swept-back leading edges and in the reattachment region of the flow over flat plates with backward-facing steps. It was shown that a cross-flow existed in the boundary layer on flat plates with supersonic sweptback leading edges of small bluntness, which increased in magnitude from the centerline towards the sides of the models. In separated flows, only an extremely small amount of cross-flow was needed to destabilize the flow and to create regular spanwise variations in total pressure. Larger cross-flows, controlled by a systematic

variation of the angle of sweep either of the leading edge or of the edge of the step, had no further effect.

2954

[Von Karman Inst. for Fluid Dynamics] Brussels (Belgium).

A STEADY-STATE TECHNIQUE FOR LOCAL HEAT-TRANSFER MEASUREMENT AND ITS APPLICATION TO THE FLAT PLATE, by J. J. Ginoux. [1964] [9]p. incl. diagrs. table. (AFOSR-64-1889) (AF EOAR-63-45) AD 450004 Unclassified

Also published in Jour. Fluid Mech., v. 19: 21-29, 1964.

Comparison between theory and experiment has been made in the simple case of a flat plate with constant heat flux for which a rigorous computation could be made based on the theory of Chapman and Rubesin (1949). The model was so conceived that the heat losses were small enough to be neglected. Therefore no corrections, which are often inaccurate, were needed for the experimental results, contrary to what is generally done when using other techniques for heat-transfer measurements. The theoretical analysis showed that the measurements are simply related to the results that could be obtained in the case of an isothermal surface, because of the constant ratio that exists between the corresponding heat-transfer coefficients.

2955

Von Karman Inst. for Fluid Dynamics, Brussels (Belgium).

LAMINAR SEPARATION IN SUPERSONIC FLOW, by J. J. Ginoux. Final rept. Nov. 1, 1963-Oct. 31, 1964 [69]p. incl. illus. diagrs. refs. (AFOSR-65-0352) (AF EOAR-64-7) AD 612407 Unclassified

Detailed experimental investigations were made at a Mach number of 2.21 of laminar flows over ramps, backward facing steps and swept back wings. Large spanwise variations of the heat transfer coefficient (h) were measured, with two different techniques, in the reattachment region of the flow over a backward facing step and were related to streamwise vortices present in the laminar boundary layer. Peaks in h much larger than the turbulent value were measured. By comparing spanwise total head and heat transfer rate distributions, Reynolds analogy was found to apply quantitatively for reattaching flows with streamwise vortices. The effect of free-stream Reynolds number and of leading edge sweep, accuracy of machining, thickness and bevel angle on the intensity of streamwise vortices present in the boundary layer on swept back wings was investigated. Flow separation was detected at the leading edge.

2956

Wales U. Coll. Dept. of Agricultural Biochemistry, Aberystwyth.

SOME APPLICATIONS OF THIN LAYER CHROMATOGRAPHY TO BIOSYNTHETIC STUDIES, by T. W. Goodwin. [1964] [4]p. incl. illus. (AFOSR-64-2167) (AF EOAR-63-24) AD 452366 Unclassified

Also published in Lab. Practice, Apr. 1964.

It is not the purpose of this article to describe the basic techniques of thin-layer chromatography, which are now so well known, but to indicate the versatility of this elegantly simple procedure by outlining some of the applications which have been so useful in studies on terpenoid and lipid biosynthesis in plants. Five examples are considered, each of which emphasizes a different facet of the overall usefulness of thin-layer chromatography. (Contractor's abstract)

2957

Wales U. Coll. Edward Davies Chemical Lab., Aberystwyth.

PYROLYSIS OF ETHYL-, N-PROPYL-, AND N-BUTYL-BENZENE AND THE HEATS OF FORMATION OF THE BENZYL AND N-PROPYL RADICALS, by G. L. Esteban, J. A. Kerr, and A. F. Trotman-Dickenson. [1963] [7]p. (AFOSR-J1011) (AF EOAR-63-23) AD 642867 Unclassified

Also published in Jour. Chem. Soc. (London), v. 719: 3873-3879, July 1963.

Pyrolyses of ethyl-, n-propyl-, and n-butyl-benzene, studied by an aniline-carrier technique, proved to be unimolecular, homogeneous decompositions into alkyl and benzyl radicals and to have the following rate constants: ethylbenzene (603-727°), log k (sec^{-1}) = 14.6 - (70,100/2.3RT); n-propylbenzene (587-735°), log k (sec^{-1}) = 14.9 - (68,600/2.3RT); and n-butylbenzene (590-735°) log k (sec^{-1}) = 14.5 - (67,200/2.3 RT). From the first two results $D(C_6H_5CH_2-H)$ = 94.6; and from the third, $D(C_6H_5CH_2-H)$ = 96.2 $kcal/mol^{-1}$.

2958

[Wales U. Coll.] Edward Davies Chemical Lab., Aberystwyth.

PYROLYSES OF NN-DIMETHYLANILINE, CUMENE, AND PHENYLHYDRAZINE, AND BOND STRENGTHS IN AROMATIC AMINO-COMPOUNDS, by J. A. Kerr, A. F. Trotman-Dickenson, and M. Wolter. [1964] [5]p. incl. tables. (AFOSR-65-1474) (AF EOAR-63-23) AD 622577 Unclassified

Also published in Jour. Chem. Soc. (London), No. 693: 3584-3588, Oct. 1964.

Pyrolyses of NN-dimethylaniline, cumene, and phenylhydrazine have been studied by the aniline-carrier technique and found to be first-order homogeneous reactions with the following rate constants: NN-dimethylaniline (552-661°) log k (sec^{-1}) = 12.9 - (57,000/2.3RT); cumene (619-716°) log k = 14.3 - (66,000/2.3RT); phenylhydrazine (325-437°) log k = 11.8 - (40,000/2.3 RT). From the first two values it is deduced that methyl substitution has about the same weakening effect on N-C and N-H bond strengths in anilines as on the corresponding C-C and C-H bonds in alkylbenzenes. The heat of formation of the amino-radical derived from the pyrolysis of phenylhydrazine agrees with a revised figure [$\Delta H_f^{\circ}(NH_2)$ = 39.3 kcal mol^{-1}] from the pyrolysis of hydrazine. (Contractor's abstract)

2959

Warner and Swasey Co., Flushing, N. Y.

RECENT DEVELOPMENTS IN GAS PROPERTY BY SPECTROSCOPIC METHODS, by R. H. Tourin. Sept. 10, 1963, 12p. (Rept. no. 63WA252) (AFOSR-J1483) (AF 49(638)1132) AD 427539 Unclassified

A monochromatic gas radiation pyrometer has been developed for application of several spectroscopic methods of gas temperature measurement. These methods have been applied to temperature measurement in combustion exhausts, gas flames, liquid propellant flames, solid propellant flames, plasmajets and arcs, detonations and shocks.

2960

Warner and Swasey Co., Flushing, N. Y.

[INFRARED TEMPERATURE DISTRIBUTION MEASUREMENT IN COMBUSTION GASES] by B. Krakow and R. H. Tourin. Final summary rept. Dec. 10, 1964, 6p. (AFOSR-65-0207) (AF 49(638)1132) Unclassified

An investigation was made of the relations between temperature gradients in hot gases and the infrared radiation emitted and absorbed by the specimen. Theoretical and mathematical analyses produced working equations, processes for solving them in terms of thermal structure, knowledge of what measurements and information about the working fluid are needed for the solutions, and the necessary restrictions on measurement methods. An experimental program was carried out, using CO_2 as the working molecule, to test the theoretical and mathematical procedures devised. They proved workable. (Contractor's abstract)

2961

Washington State U. [Dept. of Physics] Pullman.

THE EFFECT OF FILAMENT IMPURITIES ON THE OPERATION OF BAYARD-ALPERT IONIZATION GAUGES, by D. R. Denison, H. F. Winters, and E. E. Donaldson. [1963] [5]p. incl. illus. diagrs. table. (AFOSR-64-0884) (AF AFOSR-63-86) AD 438675 Unclassified

Also published in Trans. Tenth Nat'l. Vacuum Symposium, Amer. Vacuum Soc., Boston, Mass. (Oct. 16-18, 1963), ed. by G. Bancroft. New York, Macmillan Co., 1963, p. 218-222.

The operating of the Bayard-Alpert ionization gauge is studied for low emission currents at pressures below 10^{-8} torr. It is shown that the sodium or potassium impurities normally present in the filament are liberated by chemical etching of the filament or by diffusion. These impurities reach the grid where they are adsorbed. Subsequent bombardment of the grid by electrons releases these impurities as ions which reach the collector of the gauge and which produce an anomalous ion current directly related to the pressure. (Contractor's abstract)

2962

Washington State U. [Dept. of Physics] Pullman.

ADSORPTION OF GASES ACTIVATED BY ELECTRON IMPACT, by H. F. Winters, D. E. Horne, and E. E. Donaldson. [1964] [7]p. incl. diagrs. refs. (AFOSR-65-0531) (AF AFOSR-62-86) AD 613866
Unclassified

Also published in Jour. Chem. Phys., v. 41: 2766-2772, Nov. 1, 1964.

Adsorption of nitrogen which has been activated by electron impact is shown to result from dissociation of the nitrogen molecule and from the interaction of energetic ions with a nickel surface. Excitation of N_2 to states at about 10.3, 12.2, and 14.0 ev causes dissociation. Dissociative ionization at 24.5 ev also leads to additional pumping. Energetic N_2 ions have an adsorption probability of approximately 0.85 when they collide with a nickel surface. It is shown that the ion adsorption probability is practically independent of energy between 30 and 100 ev. It is also shown that thermal energy ions have a very low adsorption probability. These results lead to the postulate that the N_2 ions dissociate in impact and that the atomic nitrogen is subsequently adsorbed. Results have also been obtained which indicate that the adsorption probability of Ar is strongly dependent on surface structure. Annealing of the surface greatly reduces the adsorption probability. (Contractor's abstract)

2963

Washington State U. Dept. of Psychology, Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF ITEM FREQUENCY, by K. E. Lloyd. [1964] [5]p. incl. tables. (AFOSR-65-2164) (AF 49(638)805) AD 629382
Unclassified

Also published in Jour. Psychol., v. 58: 249-253, 1964.

The daily frequency of occurrence of items (letter-word pairs) was varied in a sequential memory task. In this task, S continually received information and, at unpredictable moments, was requested to recall some of it. Two groups of Ss which differed in the range of variation in item frequencies in the sequences presented to them were compared. Total recall was directly related to range of item frequency ($p < .01$). High-frequency items in a high-range group were recalled more often than medium-frequency items in a narrow range group ($p < .01$). Items with a low frequency in both the groups were recalled most often by the highest-range group ($p < .05$). The facilitation of recall in the highest-range groups was not limited to the high-frequency items. (Contractor's abstract)

2964

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF WORD FREQUENCY, by K. E. Lloyd. [1964] [4]p. incl. table, refs. (AFOSR-65-2165) (AF 49(638)805) AD 629383
Unclassified

Also published in Jour. Verbal Learning and Verbal Behav., v. 3: 286-289, Aug. 1964.

The English text frequency of words used in a sequential-memory task was manipulated. In this task S continually received new words to be remembered, and, at unpredictable moments, was requested to recall some of them. Three groups of Ss were compared. One group was presented high-frequency words, another low-frequency words, and a third was presented words which varied in frequency over a wide range. Recall varied as a function of word frequency. Differences in recall were greater when the memory requirements of the task were low than when they were high. (Contractor's abstract)

2965

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF RECALL POINT CODING, by K. E. Lloyd. [1964] [3]p. (AFOSR-64-1163) (AF AFOSR-63-256) AD 442834
Unclassified

Also published in Psychol. Repts., v. 14: 752-754, 1964.

Recall is facilitated if items to be stored are easily coded into familiar chunks. The means of coding the items is usually obvious at the time they are presented. The purpose of the present study was to learn if recall was facilitated when the basis for coding a stored item was delayed until the time of recall. The results indicated a substantial improvement in recall as the appropriateness of the recall point for the stored item was increased. This improvement varied inversely with the storage requirements of the task.

2966

Washington State U. [Dept. of Psychology] Pullman.

SHORT-TERM RETENTION AS A FUNCTION OF ITEM

VALUE, by K. E. Lloyd. [1964] [2]p. (AFOSR-64-1302) (AF AFOSR-63-256) AD 444266 Unclassified

Also published in Perceptual and Motor Skills, v. 18: 297-298, 1964.

Ss stored and recalled unrelated words which differed in their penny value (Group I). The number of words being stored at any one time was also varied. Recall errors decreased regularly from low to high value words in Group I, and remained relatively constant in Group II. Errors varied directly with the storage load at all word value.

2967

Washington U. [Dept. of Physics] St. Louis, Mo.

THE PRIMARY COSMIC-RAY ALPHA PARTICLE ENERGY SPECTRUM IN TEXAS AT A TIME NEAR SOLAR MAXIMUM, by D. E. Guss. 1963, 107p. (AFOSR-130) (AF 49(638)833) AD 414422 Unclassified

The present experiment was designed to study the shape of the alpha particle energy spectrum at kinetic energies above 2 bev/nucleon. By the selection of glass backed emulsions, as opposed to emulsion strips and by designing the processing procedure to reduce emulsion distortions to a minimum, it was possible in the present set of emulsions to measure alpha particle kinetic energies up to 7.5 bev/nucleon.

2968

Washington U. Dept. of Physics, St. Louis, Mo.

GATED INTEGRATOR FOR REPETITIVE SIGNALS, by J. Reichert and J. Townsend. [1964] [6]p. incl. diagrs. (AFOSR-65-0804) (AF AFOSR-62-320) AD 616222 Unclassified

Also published in Rev. Scient. Instr., v. 35: 1692-1697, Dec. 1964.

A gated integrator, using standard analog computing amplifiers, is described. Because of the placement of the diode gate within the feedback integrating loop, many of the previous requirements of high quality insulation and high input impedance electrometers are eliminated. The "holding time" of the integrator is such that, for an "integrating time" of 10^{-4} sec, the time required for a drift of 1% of full-scale (50 v output) is at least 17 min. The minimum sampling time is 0.5 μ sec. A method for taking data using 2 such integrators and a calibrated signal is also presented. (Contractor's abstract)

2969

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRONIC INTERACTION IN KETYL RADICALS, by N. Hirota and S. I. Weissman. [1964] [8]p. (AFOSR-64-2305) (AF AFOSR-62-365) AD 452409 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2538-2545, July 5, 1964.

The existence of paramagnetic dimers of ketyls was confirmed from e.s.r. and optical absorption spectra. Spin-spin dipolar interactions in the dimers were studied from the e.s.r. spectra in rigid media and are discussed in connection with their structures. Slow spin exchange rates were found in the dimers. The equilibria among various forms of ketyls (paramagnetic monomer, paramagnetic dimer, and diamagnetic dimer) are discussed and several thermodynamic quantities are given for the paramagnetic monomer-dimer equilibrium. The factors which affect the equilibria are also discussed.

2970

Washington U. [Dept. of Physics] St. Louis, Mo.

RATES OF OXIDATION-REDUCTION REACTIONS BETWEEN KETYLS AND KETONES, by N. Hirota and S. I. Weissman. [1964] [2]p. incl. diagrs. table. (AFOSR-64-2306) (AF AFOSR-62-365) AD 451936 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 2537-2538, July 5, 1964.

The kinetics for the reaction $R^-M^+ + R \rightarrow R + M^+R$ where M is an alkali metal and R an aromatic ketone have been determined by electro spin resonance spectroscopy. The reactions are first order with respect to each of the reactants. Rate constants between 10^7 and 10^9 M^{-1} sec^{-1} and activation energies between 4 and 6 kcal mol^{-1} were found.

2971

Washington U. [Dept. of Physics] St. Louis, Mo.

EXPERIMENTAL STUDIES IN NUCLEAR PHYSICS, by F. B. Shull, J. M. Fowler and others. Final rept. Aug. 1, 1962-June 30, 1963, 1p. (AFOSR-5284) (AF AFOSR-62-428) AD 417349 Unclassified

Research activities and accomplishments are reported in 2 major sections. The first consists of a study of the Mossbauer effect in β-tin over the temperature range from 1.3° to 370°K, which did not require cyclotron operation for its continuation and a report of the analysis of differential cross-sections of several (d,α) reactions. The second section reports on the progress of the cyclotron redevelopment program and describes current operations and projections for the near future.

2972

Washington U. [Dept. of Physics] St. Louis, Mo.

ELECTRON-EXCHANGE REACTION OF WURSTER'S BLUE IN AQUEOUS SOLUTION, by A. D. Britt. [1964] [3]p. incl. table, refs. (AFOSR-66-2633) (AF (AFOSR-65-771) AD 645169 Unclassified

Also published in Jour. Chem. Phys., v. 41: 3069-3071. Nov. 15, 1964.

The electron exchange between Wurster's Blue and N, N, N', N'-tetramethyl-p-phenylenediamine dihydrochloride is investigated by ESR and NMR. The active form of the dihydrochloride is found to be the neutral diamine, and a simple relationship is derived between the apparent rate constant and the actual rate constant. (Contractor's abstract)

2973

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRA OF CRYSTALLINE C_2H_2, C_2HD, AND C_2D_2, by G. L. Bottger and D. F. Eggers, Jr. [1964] [8]p. incl. diagrs. tables, refs. (AFOSR-64-1547) (AF 49(638)797) AD 446121 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2010-2017, Apr. 1, 1964.

The infrared absorption spectra of polycrystalline films of C_2H_2, C_2HD, and C_2D_2 have been examined at 63°K in the frequency range between 4500 and 450 cm^{-1}. The spectra of the solid state and the gas phase of the various acetylenes are compared and the appropriate vibrational assignments are made. Several adsorptions attributable to combinations of lattice modes and molecular fundamentals were found. The observed multiplet structure of the fundamental vibrations indicates that in the low-temperature modification of C_2H_2 and C_2D_2 the molecules are located at sites of C_{2h} symmetry. Spectra of various solid solutions composed of mixtures of isotopic species were obtained and their significance discussed. The effect of isotopic substitution on the splittings in the ν_5 region led to the conclusion that the dipole-dipole coupling model is sufficient to explain the observed spectra. (Contractor's abstract)

2974

Washington U. Dept. of Chemistry, Seattle.

INFRARED SPECTRUM OF CARBON DIOXIDE, ENRICHED IN OXYGEN-18, by C. V. Berney and D. F. Eggers, Jr. [1964] [11]p. incl. tables, refs. (AFOSR-64-1548) (AF 49(638)797) AD 446130 Unclassified

Also published in Jour. Chem. Phys., v. 40: 990-1000, Feb. 15, 1964.

The spectrum of a sample of CO_2 enriched to ~ atm % with O^{18} was examined in the region 1620-5400 cm^{-1}, using an Ebert grating spectrometer with spectral slit-widths ranging from 5 to 2.5 cm. Ten previously unreported bands were analyzed and assigned to various species of O^{18} substituted CO_2 and Courtoy's results for $C^{12}O^{16}O^{18}$ in the 2μ region were confirmed. Courtoy's unexpectedly high value for the Fermi resonance constant of this species was confirmed by the separation of previously unreported Fermi-resonant bands. The positions of the 2 bands assigned to $C^{12}O^{18}$ suggest that the resonance constant for this species is larger still. A resonance interaction was found in $C^{12}O^{16}O^{18}$ dependent on the potential constant k_{113}.

2975

Washington U. Dept. of Chemistry, Seattle.

OBSERVATIONS ON ALKYLBORANES, by C. A. Lutz and D. M. Ritter. [1963] [15]p. incl. diagrs. tables, refs. (AFOSR-J1079) (AF 18(600)1541 and AF 49(638)-937) AD 420302 Unclassified

Presented at the Symposium on Organometallic Compounds, Vancouver (Canada), Sept. 4-6, 1962.

Also published in Canad. Jour. Chem., v. 41: 1344-1358, 1963.

Some synthesis and exchange reactions of diborance and its alkyl derivatives and of the higher boron hydrides were reviewed as background for new work. In pursuit of an idea prompted by knowledge of the deuterium and B^{10} exchanges found for the reactive and unstable higher boron hydrides B_4H_{10} and B_5H_{11}, mono- and dimethyldihydropentaborane and methyltetraborane have been prepared by direct reaction between the parent htgher hydrides and 1, 2-dimethyldiborane or monomethyldiborane. The identity and the reactions of each product have been dilineated by gas chromatographic separation, gas density, and mass, infrared, and nmr spectrometry. The H^1 nmr spectrum of dihydropentaborane has been reinterpreted and used to decide that monomethyldihydropentaborane is probably a B_{111} derivative which displays stereotsomerism. (Contractor's abstract)

2976

Washington U. [Dept. of Chemistry] Seattle.

HEXABORANE-12 ISOLATION AND IDENTIFICATION by C. A. Lutz, D. A. Phillips, and D. M. Ritter. [1964] [4]p. (AFOSR-64-2265) (AF AFOSR-63-102) AD 452407 Unclassified

Also published in Inorg. Chem., v. 3: 1191-1194, Aug. 1964.

Hexaborane-12 has been isolated in a good state of purity by application of gas chromatography to separation of the products from several boron hydride interconversions. Vapor pressures, melting point, elementary analysis, infrared spectra, and monotsotopic mass spectra are reported; the latter in comparison with hexaborane-10 and pentaborane-11.

2977

Washington U. [Dept. of Chemistry] Seattle.

EQUILIBRIA AND PREPARATIVE METHODS FOR BORON AND SILICON COMPOUNDS, by D. M. Ritter. Final rept. Nov. 1964, 9p. (AFOSR-64-2384) (AF AFOSR-63-102) AD 608755 Unclassified

Tetraborane and dihydropentaborane were successfully methylated by reaction with 1, 2-dimethyl diborane. Hexaborane-12 was isolated and characterized. Work in progress concerning the alkylation of dibcranes, methylated higher hydrides, vinylboranes, and B-Si bonded compounds is summarized.

2978

Washington U. Dept. of Chemistry, Seattle.

THE HYDRATION OF STYRENES, by W. M. Schubert, B. Lamm, and J. R. Keeffe. [1964] [3]p. incl. tables. (AFOSR-65-0231) (AF AFOSR-64-590) AD 611620 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 4727-4729, Nov. 5, 1964.

Evidence is presented which is consistent with the rate-determining step in the hydration of styrenes being a proton transfer to styrene to form a carbonium ion: $H_3O^+ + ArCH = CH_2 \rightarrow H_2O + ArC^+HCH_3 \rightarrow$ products.

2979

Washington U. [Dept. of Electrical Engineering] Seattle.

MAN-COMPUTER INTERFACE STUDY, by D. L. Johnson and A. L. Kobler. Annual rept. June 1963, 155p. (AFOSR-J1540) (AF AFOSR-62-366) AD 428649 Unclassified

This report deals with the progress made in the research of the Man-Computer Interface Study. Part I describes the development of a method for problem solving and learning related to trigonometry problems. The methods of solution and learning discussed and illustrated are sufficiently general that they may be extended to other areas of problems. Part II is concerned with research in computer game playing. The principal effort in this section is devoted to tree-pruning methods as applied to the game of chess. Part III of the report describes continuing research dealing with human attitudes toward the man-machine relationship. The results of an analysis of an attitude scale are provided and discussed in this section.

2980

Washington U. Dept. of Electrical Engineering, Seattle.

MACHINE LEARNING FOR GENERAL PROBLEM SOLVING, by D. L. Johnson. Annual rept. Oct. 1964, 316p. incl. diagrs. tables, refs. (AFOSR-64-2290) (AF AFOSR-64-468) AD 608544 Unclassified

Research relevant to problem solving and learning using trigonometric processes is described in Part I. The incorporation of learning into the process of mechanically proving trigonometric identities presents a unique and major step in the field of artifical intelligence. The processes used, and some of the specific techniques and routines, are sufficiently general that they may be applied to other forms of learning. Part II is concerned with research in tree pruning as related to computer game playing. New min-max methods of pruning have been developed with particular emphasis placed upon machine learning to fix pruning parameters. The programs are operative using the FORTRAN programing language. A sample game as played by the computer is included within this section of the report. Some results of the research dealing with the restraints the man-machine attitudes play upon human use of digital computers in problem-solving contexts are described in Part III. (Contractor's abstract, modified)

2981

Washington U. [Dept. of Physics] Seattle.

NUCLEAR MAGNETIC RELAXATION TIMES, by E. A. Uehling. Final rept. Apr. 2, 1963, 21p. incl. refs. (AFOSR-4708) (AF 49(638)92) AD 406941 Unclassified

The research done deals principally with those nuclear relaxation processes in solids which depend on the presence of an electric quadrupole interaction. The results fall into 2 broad categories, one of which is concerned with the understanding of the various relaxation processes which are encountered, and the other involves the measurement of important physical parameters. Probably the most important single result of this research falls into the second of these two categories. This is the measurement of an activation energy which is of importance in connection with deuteron relaxation in hydrogen bonded crystals. The significance of this connection is described in detail.

2982

Washington U. [Dept. of Physics] Seattle.

SIMPLE HEAT SWITCH FOR LOW TEMPERATURE USE, by J. G. Dash and J. Siegwarth. [1963] [2]p. (AFOSR-64-0450) (AF 49(638)1004) AD 435921 Unclassified

Also published in Rev. Scient. Instr., v. 34: 1276-1277, Nov. 1963.

A description is presented of the design and performance of a heat switch suitable for use from room temperatures to less than 1°K.

2983

Washington U. [Dept. of Physics] Seattle.

MEASUREMENT OF RECOIL-FREE FRACTIONS IN STUDIES OF THE MOSSBAUER EFFECT, by R. M.

Housley, N. E. Erickson, and J. G. Dash. [1964] [9]p. incl. diagrs. table, refs. (AFOSR-64-1747) (AF 49(638)1004) AD 447591 Unclassified

Also published in Nuclear Instr. and Methods, v. 27: 29-37, 1964.

This paper discusses the techniques of measurement of recoil-free fractions f of resonance gamma rays. A theoretical analysis extends the validity of the resonance dip area method, to permit relative f measurements to be made on emission lines of arbitrary shape. The method is also applicable to relative f' measurements on thin absorbers. Some forms of instrumental broadening do not affect the result. A discussion on background intensity measurements includes some techniques for making precise background corrections. Absolute f measurements are discussed in terms of a very wide absorption line, which can be considered to approach the ideal of a black resonance absorber. A mixture of fluoroferrates, having a composite line width of more than 1.4 mm/sec, has been developed. The preparation of nearly black absorbers by compounding the mixture with iron enriched in Fe^{57}, is described in a detailed recipe. The absorbers are so nearly ideal that many f measurements can be made simply, comparing intensities transmitted by a stationary absorber with the corrected intensity transmitted at high Doppler shifts. (Contractor's abstract, modified)

2984

Washington U. [Dept. of Physics] Seattle.

VISCOSITY OF LIQUID He II, by J. T. Tough, W. D. McCormick, and J. G. Dash. [1963] [6]p. (AFOSR-64-0276) (AF AFOSR-62-298) AD 432532 Unclassified

Also published in Phys. Rev., v. 132: 2373-2378, Dec. 15, 1963.

The viscosity of liquid He has been measured between 1.10°K and the lambda point. A new type of viscometer was used, based on the damping of the transverse vibrations of a fine wire stretched between 2 rigid supports. The simplicity of the hydrodynamic problem and the low nuisance damping of the wire make this technique particularly appropriate for the measurement of small viscosities. The smoothed data are presented and found to be in good agreement with the latest rotating cylinder viscometer results.

2985

Washington U. [Dept. of Physics] Seattle.

VIBRATING WIRE VISCOMETER, by J. T. Tough, W. D. McCormick, and J. G. Dash. [1964] [4]p. incl. diagrs. (AFOSR-65-0398) (AF AFOSR-62-298) AD 612858 Unclassified

Also published in Rev. Scient. Instr., v. 35: 1345-1348, Oct. 1964.

The damping of transverse vibrations of a wire in a viscous fluid is the basis for a viscometer of high precision and versatility. A solution to the hydrodynamic problem is indicated, and shown to be valid for a wide range of physical parameters. The device is simple in operation and design, adaptable to various decay constant measuring techniques, and requires only a small volume of sample fluid. The viscosity of liquid helium II between 1.10°K and the lambda point has been measured with this technique, and shows a mean scatter of about 2%. This technique is particularly appropriate for fluids of low viscosity. (Contractor's abstract)

2986

Washington U. [Dept. of Physics] Seattle.

MEAN-SQUARE DISPLACEMENT OF DILUTE IRON IMPURITY ATOMS IN HIGH-PURITY BERYLLIUM AND COPPER, by R. M. Housley, J. G. Dash, and R. H. Nussbaum. [1964] [3]pl incl. diagr. table, refs (AFOSR-65-0186) (AF AFOSR-64-595) AD 456596 Unclassified

Also published in Phys. Rev., v. 136: A464-A466, Oct. 19, 1964.

Absolute values of the Mossbauer fraction f of zero-phonon gamma rays from dilute Co^{57} in Be and Cu were obtained for several temperatures between liquid helium and room temperature using the technique of the black absorber. For Be at 297°K, f = 0.81; for Cu at 297°K, f = 0.71. Systematic errors are estimated to be less than 2%. The Mossbauer spectrum of Be shows a quadrupole splitting $\Delta E = 0.56 \pm 0.03$ mm/sec and a chemical shift $\delta = 0.11 \pm 0.03$ mm/sec with respect to an Fe absorber. (Contractor's abstract)

2987

Wayne State U. [Dept. of Physics] Detroit, Mich.

LOW-TEMPERATURE ELASTIC MODULI OF ALUMINUM, by G. N. Kamm and G. A. Alers. [1964] [4]p. (AFOSR-64-1231) (AF AFOSR-62-379) AD 442807 Unclassified

Also published in Jour. Appl. Phys., v. 35: 327-330, Feb. 1964.

The adiabatic elastic moduli of single crystals of aluminum have been measured from 4.2° to 300°K by using the ultrasonic pulse-echo technique. The values obtained by extrapolation to 0°K are $C_{11} = 11.430$, $C_{12} = 6.192$ and $C_{44} = 3.162$ in units of 10^{11} dyn/cm^2. The Debye temperature obtained from the 0°K modulus values is 430.3°K, in excellent agreement with the value from heat-capacity measurements.

2988

Weizmann Inst. of Science, Rehovoth (Israel).

ANGULAR VARIATION OF COERCIVITY IN ORTHOFERRITE SINGLE CRYSTALS, by S. Reich, S.

Shtrikman, and D. Treves. Aug. 1, 1964, 24p. (Technical note no. 6) (AF 61(052)654) AD 605719
Unclassified

The coercive force Hc as a function of the angle between the easy axis of magnetization and the external field was studied in orthoferrite single crystals using the vibrating sample technique.

2989

Weizmann Inst. of Science, Rehovoth (Israel).

NONLINEARITY OF THE SUSCEPTIBILITY IN WEAK FERROMAGNETS AND ANTIFERROMAGNETS, by S. Shtrikman and D. Treves. Aug. 1, 1964, 7p. (Technical note no. 7) (AF 61(052)654) AD 605720
Unclassified

The symmetry of the tensor describing the quadratic dependence of the magnetization on an applied field is studied for the various magnetic point groups. It is described by at most one parameter in antiferromagnetic materials, and up to ten in ferromagnetic materials. This parameter is calculated from basic principles to various approximations for FeF_2 and CoF_2.

2990

Weizmann Inst. of Science, Rehovoth (Israel).

SPONTANEOUS MAGNETIZATION IN ORTHOFERRITES BETWEEN LIQUID AIR TEMPERATURE AND THE CURIE POINT, by G. Gorodetsky and D. Treves. Aug. 10, 1964, 16p. (Technical note no. 8) (AF 61-(052)654) AD 605721 Unclassified

Results of measurements of the ferromagnetic moment of rare earth orthoferrites between 90°K and the Curie point are presented. These results show that the rare earth ions behave like a paramagnet in an effective field due to the iron ions.

2991

Weizmann Inst. of Science, Rehovoth (Israel).

WEAK FERROMAGNETIC GAUSSMETER, by S. Shtrikman and D. Treves. Aug. 20, 1964, 10p. (Technical note no. 9) (AF 61(052)654) AD 605722
Unclassified

A torque magnetometer G. E. type gaussmeter using weak ferromagnetic rotors is described. Such an instrument gives a reading essentially linear with fields up to 100,000 gauss. The actual torques are higher than those obtained with para- or diamagnetic rotors, even at 100,000 gauss. An experimental instrument was built, and found to yield a linear reading up to the highest field available, i.e., 25 Kgauss.

2992

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

THE THREE BODY PROBLEM IN ATOMIC PHYSICS, by C. L. Pekeris. Final rept. Feb. 21, 1961-Feb. 20, 1963, 11p. incl. refs. (AFOSR-4577) (AF 61(052)510) AD 401373 Unclassified

This report gives several investigations in two-electron spectroscopy carried out during the two-year period of this contract.

2993

Weizmann Inst. of Science. Dept. of Applied Mathematics, Rehovoth (Israel).

THE NUMERICAL INTEGRATION OF THE EQUATIONS OF MOTION OF A VISCOUS FLUID, by J. Gillis and A. Brandt. Oct. 1, 1964 [56]p. incl. diagrs. tables. (Scientific rept. no. 1) (AFOSR-65-0629) (AF EOAR-63-73) AD 614915 Unclassified

The steady state Navier-Stokes equations are solved numerically for the inlet region of a straight channel for values of Reynolds number from 0 to 500. Various properties of the flow are discussed and the results compared with previous approximate solutions for large R. The case R = 0 is also solved analytically. (Contractor's abstract)

2994

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

MECHANISM OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS, by M. Avron. Final technical rept. May 26, 1963, 8p. (AFOSR-5254) (AF EOAR-62-59) AD 416428 Unclassified

The exchange between ADP and ATP found in chloroplasts was concluded to be unrelated to the process of photophosphorylation. Photophosphorylation coupled to the reduction of indophenol dyes was demonstrated. The complex role of indophenol dyes in inhibiting, eliciting, or bring about lag periods in photophosphorylation reactions was clarified. Previous studies on the path of oxygen atoms in photophosphorylation were extended. The effect of irradiating chloroplasts with uv light on their photochemical activity was studied. A sensitive method for measuring the reduction of ferricyanide in photochemical and other enzymatic reactions was developed. A factor which specifically restores the ability to phosphorylate, was isolated from chloroplasts.

2995

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

THE RELATION OF THE ADENOSINE 5'-TRIPHOSPHATE ADENOSINE 5'-DIPHOSPHATE EXCHANGE

ACTIVITY TO PHOTOPHOSPHORYLATION IN SWISS-CHARD CHLOROPLASTS, by S. Ben-Yehoshus and M. Avron. [1964] [7]p. (AFOSR-64-1177) (AF EOAR-62-59) AD 442836 Unclassified

Also published in Biochim. et Biophys. Acta, v. 82: 67-73, 1964.

The presence of an enzyme-catalyzing ATP-ADP exchange in unwashed chloroplasts was confirmed. Chloroplast fragments from swiss-chard possessed little to no ATP-ADP exchange activity while maintaining most of the photophosphorylative activity of unwashed chloroplasts. The ATP-ADP exchange activity was completely recovered in the supernatants collected during the preparation of chloroplast fragments from unwashed chloroplasts. The possibility that the exchange activity found in chloroplasts may be related to phosphoglycerate kinase is discussed.

2996

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

A COUPLING FACTOR IN PHOTOPHOSPHORYLATION, by M. Avron. [1963] [13]p. (AFOSR-64-1178) (AF EOAR-62-59) AD 442795 Unclassified

Also published in La Photosynthese; Colloques Internationaux du Centre National de la Recherche Scientifique, Gif-Sur-Yvette et Saclay, Paris (France) (July 23-27, 1962). Paris, CNRS Pub. no. 119, 1963, p. 543-555.

Chloroplasts or chloroplast fragments preincubated with ethylenediamine-tetraacetate (EDTA) lose all their photophosphorylative activity but not their electron transport (Hill reaction) activity. The loss of photophosphorylative activity is completely prevented by the presence of salts with the EDTA. About 50% of the photophosphorylative activity lost during a preincubation with EDTA, can be reconstituted by a further preincubation in the presence of magnesium ions. Chloroplast fragments which were isolated after a preincubation period with EDTA, then preincubation with magnesium could be reconstituted to an extent of about 20% only when the supernatant was also added.

2997

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

A COUPLING FACTOR IN PHOTOPHOSPHORYLATION, by M. Avron. [1963] [4]p. (AFOSR-64-1181) (AF EOAR-62-59) AD 442992 Unclassified

Also published in Biochim. et Biophys. Acta, v. 77: 699-702, 1963.

The isolation from mitochondria of factors which were necessary for phosphorylation but not for electron transport in oxidative phosphorylation is discussed. The experiments reported also demonstrate the isolation of a similar factor from chloroplasts. The coupling factor is required for photophosphorylation but not for photoreduction.

2998

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

A SENSITIVE AND SIMPLE METHOD FOR DETERMINATION OF FERROCYANIDE, by M. Avron and N. Shavit. [1963] [6]p. (AFOSR-64-1184) (AF EOAR-62-59) AD 442822 Unclassified

Also published in Anal. Biochem., v. 6: 549-554, Dec. 1963.

A simple assay for ferrocyanide is described which is sensitive down to 0.001 μ mol. The method is suitable for a direct assay of ferrocyanide, in the presence of ferricyanide, in supernatants of trichloroacetic acid denatured enzymic reactions.

2999

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

ON THE COUPLING OF PHOTOPHOSPHORYLATION TO ELECTRON TRANSPORT, by M. Avron and N. Shavit. [1963] [8]p. (AFOSR-64-1185) (AF EOAR-62-59) AD 442791 Unclassified

Also published in NAS-NRC Symposium on Photosynthesis Mechanisms in Green Plants, Publication no. 1145, 1963, p. 611-618.

Several properties related to the coupling of photophosphorylation to electron transport in isolated chloroplasts from swiss-chard leaves and the effect of several new and more potent uncouplers have been described. Their differential effect on several photoreactions of chloroplasts was interpreted as pointing to 2 separate sites of ATP production in chloroplasts.

3000

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

MECHANISM OF PHOTOPHOSPHORYLATION, by M. Avron. Final rept. Apr. 30, 1964, 3p. (AFOSR-64-1063) (AF EOAR-63-57) AD 441481 Unclassified

Several aspects of the mechanism of photophosphorylation were investigated. Photophosphorylation was utilized as a tool for the synthesis of specifically P32 labeled ribonucleotides. Two types of light-dependent ATPase were demonstrated. The role of indophenol dyes in photophosphorylation reactions was clarified. Several new inhibitors and uncouplers were investigated, studies on a coupling factor from chloroplasts were continued.

3001

Weizmann Inst. of Science. [Dept. of Biochemistry] Rehovoth (Israel).

ON THE MECHANISM OF PHOTOPHOSPHORYLATION IN CHLOROPLASTS, by M. Avron. [1964] [10]p. incl. diagrs. tables, refs. (AFOSR-65-1299) (AF EOAR-64-19) AD 620529 Unclassified

Also published in Record Chem. Prog., v. 25: 237-246, Dec. 1964.

Recent investigations have demonstrated that the mechanism of utilization of electron transport energy to drive the esterification of ADP by inorganic phosphorus is similar, but not identical, in oxidative phosphorylation and photophosphorylation. Although the general pattern of energy conversion reactions appears to be similar, the difference in behavior and the differential sensitivity of the 2 systems to inhibitors and uncouplers indicates that the intermediates involved are different.

3002

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

BIOLOGICAL SIGNIFICANCE OF HIGH MOLECULAR WEIGHT POLYPEPTIDES, by E. Katchalski. Final technical rept. Apr. 1, 1962-June 30, 1963, 21p. incl. refs. (AFOSR-J1317) (AF EOAR-62-60) AD 424254 Unclassified

A tritium-labeled poly-L-lysine, has been synthesized. Experiments on the inactivation of coliphage T_2 with an I^{131}-labeled copolymer of lysine and tyrosine (molar residue ratio 30:1) have shown that the copolymer enters the phage during the inactivation process. The inactivated phage is still capable of injecting its DNA together with the labeled polypeptide into the host cells of Escherichia coli. New techniques for the preparation of water-insoluble enzyme derivatives have been worked out. Water-insoluble urease and ribonuclease derivatives have been prepared. The mode of action of water-insoluble ribonuclease on low and high molecular weight substrates has been investigated. Membranes possessing papain activity have been prepared with the aid of bifunctional reagents such as bisdiazobenzidine. (Contractor's abstract)

3003

Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

BIOLOGICAL SIGNIFICANCE OF HIGH MOLECULAR WEIGHT POLYPEPTIDES, by E. Katchalski. Final technical rept. July 1, 1963-June 30, 1964, 23p. (AFOSR-65-0281) (AF EOAR-63-59) AD 611183 Unclassified

Summaries of research conducted on the following 3 topics are presented: (1) Use of polyamino acids in the study of cell membranes; (2) Interaction of polyamino acids with viruses; and (3) Preparation and characterization of water-insoluble enzyme derivatives.

3004

Weizmann Inst. of Science. Dept. of Physics, Rehovoth (Israel).

USE OF POLY-ALPHA-ACIDS IN BIOLOGICAL STUDIES, by E. Katchalski. [1964] [18]p. incl. illus. diagrs. table, refs. (AFOSR-65-2170) (AF EOAR-63-59) AD 627485 Unclassified

Also published in New Perspectives in Biology, ed. by M. Sela, Amsterdam, Elsevier Publishing Co., 1964, p. 51-68.

A description of the synthesis of high molecular weight polypeptides is presented. A group of synthetic polymers (poly-L-proline, poly-L-glutamic acid, and poly-L-lysine) were found useful as model compounds in the study of proteins. The data already available indicate that these synthetic polypeptides may be of considerable value in the elucidation of the mode of action of known proteolytic enzymes, in the search for new proteolytic enzymes, and in the clarification of the inhibition of enzymes by macromolecules. The close resemblance between the antibacterial and antiviral properties of basic polyamino acids with those of some natural peptides indicates that both the synthetic model compounds and the natural materials may act biologically by a similar mechanism. Also promising are the results obtained in the investigation of the immunological properties of synthetic polyamino acids and of polypeptidyl proteins, since they may contribute to an understanding of the chemical basis of the antigenicity of proteins.

3005

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

SYNTHESIS OF TRITIATED POLY-L-LYSINE (γ, δ-T_2), by M. Fridkin, M. Sokolovsky, and E. Katchalski. [1964] [7]p. incl. refs. (AFOSR-65-2172) (AF EOAR-63-59) AD 629294 Unclassified

Also published in Biopolymers, v. 2: 123-129, 1964.

Tritiated poly-L-lysine (γ, δ-T_2) (I) was prepared according to the following procedure: Tritiated DL-lysine (γ, δ-T_2) was derived from acetamino-(4-amino-Δ^2-butenyl)-diethylmalonate by tritiation followed by acid hydrolysis. The racemic tritiated lysine was converted to its ϵ, N-trifluoroacetyl derivative, and the latter resolved via its chloroacetyl derivative by means of hog kidney acylase. The optically active tritiated ϵ, N-trifluoroacetyl-L-lysine was converted into the corresponding N-carboxyanhydride with phosgene, and polymerization carried out in dioxane using triethylamine as initiator. The required tritiated poly-L-lysine (I, n = 250) was obtained from the blocked polymer after removal of the protecting groups with piperidine. The tritiated polypeptide possessed an activity of 250 mC/mmol lysine residue. The procedure described

enables, however, the preparation of poly-L-lysine with up to 25 times higher specific activity. (Contractor's abstract)

3006

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

PREPAPATION ADD PROPERTIES OF WATER-INSOLUBLE DERIVATIVES OF UREASE, by E. Riesel and E. Katchalski. [1964] [4]p. incl. diagr. table, refs. (AFOSR-65-2173) (AF EOAR-63-59) AD 627486 Unclassified

Also published in Jour. Biol. Chem., v. 239: 1521-1524, May 1964.

Water-insoluble urease preparations were obtained by coupling unmodified urease, or urease reversibly inactivated with p-chloromercuribenzoate, with a water-insoluble diazonium salt derived from a copolymer of p-amino-DL-phenylalanine and L-leucine. The enzymatic activity of the insoluble preparations derived from inactivated urease was determined after reactivation with cysteine. All of the insoluble derivatives obtained, which contained 15 to 60 mg of protein per 100 mg of water-insoluble enzyme, displayed after preparation an enzymatic activity, per unit of weight of bound protein, corresponding to about half of that of the original urease preparation used in the coupling reaction.

3007

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

A WATER-INSOLUBLE POLYANIONIC DERIVATIVE OF TRYPSIN. II. EFFECT OF THE POLYELECTROLYTE CARRIER ON THE KINETIC BEHAVIOR OF THE BOUND TRYPSIN, by L. Goldstein, Y. Levin, and E. Katchalski. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-66-0291) (AF EOAR-63-59) AD 639506 Unclassified

Also published in Biochemistry, v. 3: 1913-1919, Dec. 1964.

The mode of action of the water-insoluble derivatives of trypsin (IMET), obtained by the covalent binding of trypsin to a copolymer of maleic acid and ethylene (1:1), has been investigated at 25°C. The pH-activity profile of IMET at low ionic strength, using benzoyl-L-arginine ethyl ester as substrate, was found to be displaced by approximately 2.5 pH units toward more alkaline pH values when compared with trypsin under similar conditions. At higher ionic strength, the pH-activity curve of IMET shifted toward more acid pH values, approaching the pH-activity curve of IMET-trypsin. Theoretical analysis of the kinetic data allowed a quantitative correlation of the displacement in the pH-activity curves and the shifts in the Michaelis constants with the electrostatic potential prevailing in the domain of the polyelectrolyte carrier. (Contractor's abstract, modified)

3008

Weizmann Inst. of Science. Dept. of Biophysics, Rehovoth (Israel).

A WATER-INSOLUBLE POLYANIONIC DERIVATIVE OF TRYPSIN. I. PREPARATION AND PROPERTIES, by Y. Levin, M. Pecht and others. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-66-0293) (AF EOAR-63-59) AD 633330 Unclassified

Also published in Biochemistry, v. 3: 1905-1913, Dec. 1964.

A number of water-insoluble polyanionic derivatives of trypsin (IMET) were prepared by coupling the enzyme to a copolymer of maleic anhydride and ethylene, cross-linking with hexamethylenediamine, and hydrolyzing the unreacted maleic anhydride residues. Different IMET preparations with varying bound protein-to-carrier ratios (from 1:20 to 3:1) were obtained. Their esteratic activities per unit weight of bound protein corresponded to 40-70% of that of crystalline trypsin. All of the IMET preparations studied were found to be considerably more stable than trypsin in the alkaline pH range (pH7.0-10.7 10.7). Practically no inhibition of the esteratic activity by soybean-trypsin inhibitor occurred even at a 50:1 weight ratio of inhibitor to bound enzyme protein. The soybean-trypsin inhibitor was found, however, to be an effective inhibitor of the proteolytic activity of the IMET's as tested on casein. The pH-activity profiles of an IMET preparation rich in carrier (IMET-1) and of an IMET preparation rich in protein (IMET-6) at different ionic strengths were determined. (Contractor's abstract, modified)

3009

Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

IMMUNE RESPONSE TO POLYPEPTIDYL PROTEINS IN RABBITS TOLERANT TO THE PROTEIN CARRIERS, by I. Schechter, S. Bauminger and others. [1964] [17]p. incl. diagrs. tables, refs. (AFOSR-65-1300) (AF EOAR-64-22) AD 620593 Unclassified

Also published in Immunochemistry, v. 1: 249-265, 1964.

A study was made of the immune responses to polypeptidyl proteins in rabbits which were either naturally tolerant or made experimentally unresponsive to the protein carriers. Experimentally acquired tolerance to HSA human serum albumin could be terminated by immunization of the unresponsive rabbits with poly-L-tyrosyl derivatives of HSA. Two parameters determined the breakdown of tolerance: (1) the chemical nature of the peptides attached: polytyrosyl HSA was effective in the termination of tolerance to HSA, whereas polyalanyl HSA was not, and (2) the degree of enrichment with tyrosine. There appears to be an optimal degree of enrichment, i.e., of molecular alteration of the HSA, which will confer on the altered antigen the maximal potency to terminate tolerance. The level of tolerance breakdown obtained by polytyrosyl HSA, as measured by the ratio of anti-HSA/anti-polytyrosyl

HSA, was greater than the level obtained previously by other chemically altered antigens. Antibodies were produced to the peptides per se, when attached to proteins towards which the animal is naturally tolerant, or to proteins to which the animal has acquired tolerance (HSA). In both systems, there was a similar pattern of antibody formation, which may reflect a similarity in mechanism between natural and actively acquired tolerance. (Contractor's abstract, modified)

3010

Weizmann Inst. of Science. [Dept. of Biophysics] Rehovoth (Israel).

INDUCTION OF IMMUNOLOGICAL TOLERANCE TOWARDS A PEPTIDE DETERMINANT WITH A NON-IMMUNOGENIC POLYPEPTIDE, by I. Schechter, S. Bauminger, and M. Sela. [1964] [2]p. incl. table, refs. (AFOSR-65-1301) (AF EOAR-64-22) AD 620632 Unclassified

Also published in Biochim. et Biophys. Acta, v. 93: 686-687, 1964.

Newborn rabbits were injected intraperitoneally with multi-chain poly-DL-alanine within 24 hr after birth, 7 days later, and at 2 months. At 90, 104, and 128 days, the animals of the control and the test groups were challenged with an immunizing dose of 15 mg of either poly-DL-alanyl human serum albumin or poly-DL-alanyl ribonuclease in complete Freund's adjuvant. Fourteen days after the third injection the animals were bled and tested for immune response by precipitin reaction. None of the test animals showed antibodies reacting with multi-chain poly-DL-alanine; the control animals, however, formed antibodies, almost all of which reacted with the multi-chain poly-DL-alanine; It is concluded that a substance must not be immunogenic in order to induce tolerance.

3011

Weizmann Inst. of Science. [Dept. of Physics] Rehovoth (Israel).

MOMENTS OF INERTIA AND THE SHELL MODEL, by C. A. Levinson. [1963] [5]p. incl. diagrs. (AFOSR-64-0862) (AF 61(052)337) AD 438647 Unclassified

Also published in Phys. Rev., v. 132: 2184-2188, Dec. 1, 1963.

The variational formula of Skyrme for the moment of inertia is analyzed in some detail. The errors in this formula are studied and an upper bound is given. It is found that in the case of the shell model this approach is quite accurate and allows use of general Hamiltonians. (Contractor's abstract)

3012

Weizmann Inst. of Science. [Dept. of Physics] Rehovoth (Israel).

VARIATIONAL SHELL-MODEL METHODS FOR DEFORMED ORBITALS, by I. Kelson. [1963] [5]p. incl. diagrs. tables, refs. (AFOSR-64-0863) (AF 61(052)-337) AD 438648 Unclassified

Also published in Phys. Rev., v. 132: 2189-2193, Dec. 1, 1963.

A single-particle representation of deformed orbitals in the s-d shell is obtained by using variational self-consistent methods. The 2-body Rosenfeld potential is taken as the effective interaction. The dependence of the single-particle Hamiltonian on the force parameters as well as its dependence on the number of nucleons, is investigated. The results are compared with the deformed harmonic-oscillator model. (Contractor's abstract)

3013

Weizmann Inst. of Science. Polymer Dept., Rehovoth (Israel).

MECHANOCHEMISTRY OF COUPLED CONTRACTILE AND CHEMICAL RATE PROCESSES, by A. Katchalsky. Final rept. Jan. 1964, 188p. incl. diagrs. tables, refs. (AFOSR-64-0993) (AF EOAR-62-58) AD 600541 Unclassified

This work is based on the realization that efficient conversion of chemical into mechanical energy can be based on macromolecular systems of the type encountered in living mechanochemical systems, such as muscles, flagella or contractile membranes. First the general properties of swollen polymeric fibers or bands which retain their rigidity and useful elastic properties even at high degrees of swelling were studied. The behavior of cross-linked and swollen rubbers were studied in detail. The energetic parameters of interaction between the contractile gel and the added reagent were evaluated. It was found that some of the classical notions of rubber behavior could be applied to swollen rubbers. It was found that very suitable mechanochemical engines could be prepared from partially cross-linked collagen fibers and strands.

3014

Western Ontario U. Dept. of Physics, London (Canada).

RESEARCH ON GAS SCINTILLATIONS FROM IONISING RADIATIONS, by R. W. Nicholls. Final technical rept. June 1, 1961-May 31, 1962 [17]p. incl. tables, refs. (AFOSR-2935) (AF AFOSR-61-88) AD 277801 Unclassified

The experimental and theoretical research performed during the grant year is reviewed. Studies were made on: Intensity Measurements of Molecular Spectra; Identification Atlas of Molecular Spectra; Ion Beam Spectroscopy, Plasma-Jet Spectroscopy; Corona

Spectroscopy; Molecular Potentials; Vibrational Wave Functions; Franck-Condon Factors; r-Centroids; Vibrational-Rotation Interaction; and Atomic Collisions. (Contractor's abstract)

3015

Western Ontario U. Dept. of Physics, London (Canada).

A RACETRACK MICROTRON FOR MILLIMETER AND SUBMILLIMETER WAVE GENERATION, by H. Froelich and E. Brannen. [1963] [4]p. incl. illus. diagrs. (AFOSR-4816) (AF AFOSR-62-172) AD 412672 Unclassified

Also published in IEEE Trans. Microwave Theory and Tech., v. MIT-11: 288-291, Sept. 1963.

The accelerator described here is an eight-orbit four-sector racetrack microtron possessing strong focusing action. The magnet gap is only 7 mm, and the accelerating cavity is placed in one of the field-free regions. The energy gain per traversal of the cavity can be varied from 0.4 to 1.5 mev and synchronism obtained by adjustment of the magnetic field strength and the length of the main straight section. A theoretical analysis of the synchrotron oscillations in energy and phase shows that tight bunching can be achieved at almost any point in any desired orbit by changing the frequency of the synchrotron oscillations. This can be accomplished by varying the RF power and therefore the accelerating voltage. (Contractor's abstract, modified)

3016

Western Ontario U. Dept. of Physics, London (Canada).

MILLIMETER ELECTROMAGNETIC RADIATION PRODUCED BY HIGH ENERGY ELECTRON BEAMS, by E. Brannen. Final rept. Nov. 1, 1961-Jan. 31, 1963, 9p. (AFOSR-64-0271) (AF AFOSR-62-172) AD 431119 Unclassified

The central problem studied was the generation of millimeter and sub-millimeter waves with bunched megavolt electron beams, through the interaction with Cerenkov and transition radiators. An experimental study of the latter as a function of hole size was carried out, the highest radiation resistance being 100 ohms. Most emphasis was placed on the development and theoretical analysis of the racetrack microtron as a source of a bunched electron beam. It was shown that tight bunching could be achieved at any position in any orbit by appropriate adjustment of the microtron's operating conditions (magnetic field, energy gain per traversal and length of straight section). (Contractor's abstract, modified)

3017

Western Ontario U. [Dept. of Physics] London (Canada).

A RESEARCH PROGRAMME ON LABORATORY ASTROPHYSICS, by R. W. Nicholls and H. I. S. Ferguson. 1963, 22p. (AFOSR-4804) (AF AFOSR-62-236) AD 414437 Unclassified

Contemporary problems of atmospheric physics, space physics, meteor and re-entry physics and propulsion, require more basic data of atomic and molecular physics than is currently available. Research in the general field of Laboratory Astrophysics supplies such basic data. Current activities on the research program in Laboratory Astrophysics at the University of Western Ontario are reviewed.

3018

Western Ontario U. [Dept. of Physics] London (Canada).

LABORATORY ASTROPHYSICS AND COMBUSTION, by R. W. Nicholls. 1963, 31p. (AFOSR-4805) (AF AFOSR-62-236) AD 414438 Unclassified

The similarities between the methods and concepts of astrophysics and of quantitative combustion spectroscopy are discussed with special reference to radiative properties of hot gases. New transition probability data are presented and discussed for the CN Violet, CN Red, C2 Swan, OH Violet band system.

3019

Western Ontario U. Dept. of Physics, London (Canada).

THE SPECTROSCOPY OF SHOCK-EXCITED POWDERED SOLIDS, by R. W. Nicholls, W. H. Parkinson, and E. M. Reeves. [1963] [12]p. incl. illus. diagr. tables, refs. (AFOSR-4806) (AF AFOSR-62-236) AD 414436 Unclassified

Also published in Appl. Opt., v. 2: 919-930, Sept. 1963.

The shock tube is shown to be an excellent spectroscopic source for controlled thermal excitation of astrophysically interesting spectra. Spectroscopic studies of the luminosity from shock-excited powdered solids made in 3 laboratories during the past 7 yr are discussed in detail. A wide range of inorganic oxides, nitrides, hydrides, carbides, and sulfides and other compounds have been treated in addition to samples of meteorite. A few aromatic organic materials have also been studied. Time-resolved emission and absorption techniques have been used. Spectra of most inorganic materials change from molecular to atomic with increase in shock Mach number, and an over-all thermal excitation mechanism appears to be most probable. The situation with organic materials, which have lower melting points, appears to be more complex. (Contractor's abstract)

3020

Western Ontario U. [Dept. of Physics] London (Canada).

ELECTRONIC TRANSITION MOMENTS AND THEIR EFFECTS ON THE BAND STRENGTHS AND ABSORPTION OSCILLATOR STRENGTHS OF THE NO β AND γ

SYSTEMS, by G. V. Marr. [1964] [8]p. incl. diagr. tables, refs. (AFOSR-64-0807) (AF AFOSR-62-236) AD 438374 Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 293-300, 1964.

The variation of the electronic transition moment with internuclear separation for the NO β ($B\ ^2\Pi$-$x\ ^2\Pi$) and NO γ ($A\ ^2\Sigma^+$-$x\ ^2\Pi$) systems inferred from available intensity measurements is used to evaluate band strengths and band absorption oscillator strengths. It is doubtful whether the concept of an electronic oscillator strength for the whole system is meaningful for these transitions. (Contractor's abstract)

3021

Western Ontario U. Dept. of Physics, London (Canada).

INTERPOLATION OF FRANCK-CONDON FACTORS, by R. W. Nicholls. [1964] [1]p. (AFOSR-65-1085) (AF AFOSR-62-236) AD 619362 Unclassified

Also published in Nature, v. 204: 373, Oct. 24, 1964.

Magnitude estimates of Franck-Condon factors, $q_{v'v''}$ may be used for definitive identification of molecular bands or band systems, or for estimates of radiative heat transfer from hot gases. An interpolation of $q_{v'v''}$ arrays, which have already been calculated, allows a simple means of making such estimates. A transition parameter t which varies from band to band and which may be used for interpolation is therefore required in order that plots of $q_{v'v''}$ vs t can be made for each band of interest. The method of deriving an approximation for t is shown.

3022

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL QUANTUM NUMBERS III: CN, by R. W. Nicholls. [1964] [4]p. incl. diagrs. tables, refs. (AFOSR-65-1087) (AF AFOSR-62-236) AD 622906 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 68A: 75-78, Jan.-Feb. 1964.

Franck-Condon factor arrays are computed numerically to high vibrational quantum numbers for the red ($A^2\Pi_i - X^2\Sigma^+$) and violet ($B^2\Sigma^+ - X^2\Sigma^+$) band systems of CN. The method used is the straightforward numerical method of computation for Morse molecules. (Contractor's abstract, modified)

3023

Western Ontario U. Dept. of Physics, London (Canada).

FRANCK-CONDON FACTORS TO HIGH VIBRATIONAL QUANTUM NUMBERS IV: NO BAND SYSTEMS, by R. W. Nicholls. [1964] [6]p. incl. diagr. tables, refs. (AFOSR-65-1088) (AF AFOSR-62-236) AD 619137 Unclassified

Also published in Jour. Research Nat'l. Bur. Stand., v. 68A: 535-540, Sept.-Oct. 1964.

Franck-Condon factor arrays have been computed numerically to highest known vibrational quantum numbers for the following NO band systems.

β ($B^2\Pi$ - $X^2\Pi$)	Feast 1 ($D^2\Sigma^+$ - $A^2\Sigma^+$)
γ ($A^2\Sigma^+$ - $X^2\Pi$)	Feast 2 ($E^2\Sigma^+$ - $A^2\Sigma^+$)
δ ($C^2\Pi$ - $X^2\Pi$)	Ogawa 1 ($B'^2\Delta$ - $B^2\Pi$)
ϵ ($D^2\Sigma^+$ - $X^2\Pi$)	Ogawa 2 ($b^4\Sigma^-$ - $a^4\Pi$)
β ($B'^2\Delta$ - $X^2\Pi$)	"M" ($a^4\Pi$ - X^2-Π)
γ ($E^2\Sigma^+$ - $X^2\Pi$)	

(Contractor's abstract)

3024

Western Ontario U. Dept. of Physics, London (Canada).

TRANSITION PROBABILITIES OF AERONOMICALLY IMPORTANT SPECTRA, by R. W. Nicholls. [1964] [38]p. incl. diagrs. tables, refs. (AFOSR-65-1088) (AF AFOSR-62-236) AD 618286 Unclassified

Also published in Ann. Geophys., v. 20: 144-181, Apr.-June 1964.

Atomic and molecular radiative transitions which are important in aeronomy are reviewed. The various transition probability parameters of atomic and molecular spectra are defined and the currently available values of transition probabilities of the aeronomical spectra are displayed in tables. (Contractor's abstract)

3025

Western Ontario U. [Dept. of Physics] London (Canada).

THE ELECTRONIC TRANSITION MOMENT OF THE $A\ ^2\Sigma$ - $X^2\Sigma$ SYSTEM OF AlO, by D. C. Tyte and G. R. Hébert. [1964] [3]p. incl. table. (AFOSR-65-1090) (AF AFOSR-62-236) AD 618283 Unclassified

Also published in Proc. Phys. Soc. (London), v. 84: 830-832, 1964.

Photographic intensity measurements have been made on the $A\ ^2\Sigma$ - $X\ ^2\Sigma$ system of AlO excited in a shock tube and by exploding an Al foil. The electronic transition moment was found to have the form $R_e(r)$ = const (1 - 0.46r). This result confirms that previously reported by Hébert and Tyte for the system excited in an ac arc. (Contractor's abstract)

3026

Western Ontario U. Dept. of Physics, London (Canada).

INTENSITY MEASUREMENTS ON THE $A\ ^2\Sigma$ - $X^2\Sigma$

SYSTEM OF ALUMINUM OXIDE, by G. R. Hébert and D. C. Tyte. [1964] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1091) (AF AFOSR-62-236) AD 618284 Unclassified

Also published in Proc. Phys. Soc. (London), v. 83: 629-634, 1964.

Relative integrated band intensities of 29 bands of the blue-green system of aluminum oxide, excited in a low pressure arc, have been measured by photographic photometry. The electronic transition moment was found to have the form $R_e(r) = \text{const}\ (1-0.46\ r)$; $1.50\ A < r < 1.85\ A$. Smoothed relative transition probabilities have been derived for the bands. (Contractor's abstract)

3027

Western Ontario U. [Dept. of Physics] London (Canada).

A THEORETICAL STUDY OF THE $O_2 X\ ^3\Sigma_g^- - B\ ^3\Sigma_u^-$ PHOTODISSOCIATION CONTINUUM, by W. R. Jarmain and R. W. Nicholls. [1964] [8]p. incl. diagrs. table, refs. (AFOSR-65-1093) (AF AFOSR-62-236) AD 618188 Unclassified

Also published in Proc. Phys. Soc. (London), v. 84: 417-424, 1964.

Franck-Condon densities, $q_{\nu, \upsilon''} = |\int \psi_\nu(r)\, \psi_{\upsilon''}(r) dr|^2$, for $\upsilon'' = 0$ in the O_2 Schumann-Runge photodissociation continuum have been calculated for realistic Klein-Dunham potentials. They are combined with measured values of the absorption coefficient to study the variation of the electronic transition moment in the continuum. For comparison, Franck-Condon factors have similarly been used in conjunction with measured oscillator strengths to show the behavior of the transition moment for the $\upsilon'' = 0$ progression of bands. It appears probable that the transition moment is continuous through the dissociation limit. (Contractor's abstract)

3028

Western Ontario U. [Dept. of Physics] London (Canada).

LABORATORY ASTROPHYSICS AND SPACE SCIENCE, by R. W. Nicholls and H. I. S. Ferguson. [1964] [6]p. incl. illus. diagrs. tables, refs. (AFOSR-65-1094) (AF AFOSR-62-236) AD 620708 Unclassified

Also published in Canad. Aeronaut. and Space Jour., v. 10: 163-168, June 1964.

Contemporary problems of space physics, atmospheric physics, meteor and reentry physics, and propulsion require for their solution much more of the basic data of atomic, molecular, and nuclear physics and chemistry than are currently available. Research in the general field of laboratory astrophysics supplies such basic data. Some of the current activities of the research program in laboratory astrophysics at the University of Western Ontario are reviewed. Included are spectroscopic studies on important diatomic molecular spectra, studies of shock excitation of powdered solids, and ablation and impact flash studies in a ballistic pellet range. (Contractor's abstract, modified)

3029

Western Ontario U. Dept. of Physics, London (Canada).

IDENTIFICATION ATLAS OF MOLECULAR SPECTRA. I. THE AlO $A^2\Sigma - X^2\Sigma$ BLUE-GREEN SYSTEM, by D. C. Tyte and R. W. Nicholls. Mar. 10, 1964, 13p. incl. illus. diagrs. tables, refs. (AFOSR-65-2315) (AF AFOSR-62-236) AD 627556 Unclassified

This report contains a set of vibrationally identified spectrograms of the Blue-Green ($A\ ^2\Sigma - X\ ^2\Sigma$) system of AlO. A compilation of all the available molecular data on the states involved, a brief description of the appearance, occurrence and history of the system and a selected bibliography are also included. (Contractor's abstract)

3030

Western Ontario U. Dept. of Physics, London (Canada).

IDENTIFICATION ATLAS OF MOLECULAR SPECTRA. II. THE $N_2\ C^3\Pi_u - B\ ^3\Pi_g$ SECOND POSITIVE SYSTEM, by D. C. Tyte and R. W. Nicholls. Oct. 31, 1964, 17p. incl. illus. diagrs. tables, refs. (AFOSR-65-2316) (AF AFOSR-62-236) AD 627814 Unclassified

This report contains a set of vibrationally identified spectrograms of the Second Positive ($C\ ^3\Pi_u - B\ ^3\Pi_g$) system of N_2. A compilation of all the available molecular data on the states involved, a brief description of the appearance, occurrence and history of the system and a selected bibliography are also included. (Contractor's abstract)

3031

Western Ontario U. Dept. of Physics, London (Canada).

THEORY AND DESIGN OF A RACE-TRACE MICROTRON WITH APPLICATION TO THE GENERATION OF MILLIMETER WAVES, by H. R. Froelich and E. Brannen. Dec. 1964, 117p. incl. illus. diagrs. refs. (Technical rept. no. RMG-T-1) (AFOSR-65-1626) (AF AFOSR-63-297) AD 623802 Unclassified

The race-trace microtron treated is a 4-sector design with homogeneous magnetic fields in the sectors. Synchronism and phase stability are investigated for an energy gain that is variable from 0.5 to 1.0 mev. Stability of betatron oscillations is examined using the "hard-edge" approximation for the shape of the magnetic field. The design of a race-trace microtron is described, whose basic feature is its adaptability to different pole-piece arrangements. Beam bunching in a microtron permits its application to the generation of millimeter and submillimeter waves. The mechanism causing beam bunching is investigated theoretically. Generation of 8 mm waves using the beam of a conventional microtron is described. (Contractor's abstract)

3032

Western Reserve U. Center for Documentation and Communication Research, Cleveland, Ohio.

INFORMATION RETRIEVAL AT WESTERN RESERVE UNIVERSITY, by J. Belzer. [1963] [5]p. (AFOSR-J482) (AF AFOSR-62-35) AD 407254 Unclassified

Also published in Elektron. Datenverabeitung, v. 1: 4-8, 1963.

The manager of the computation department of the Center for Documentation and Communication Research, Western Reserve University, reports on the information retrieval works at the center. The general development, as well as the special research of the center, is described.

3033

Western Reserve U. Center for Documentation and Communication Research, Cleveland, Ohio.

A SEARCHING PROCEDURE FOR INFORMATION RETRIEVAL, by W. Goffman. [1964] [6]p. (AFOSR-64-2262) (AF AFOSR-63-403) AD 452528 Unclassified

Also published in Inform. Storage and Retrieval, v. 2: 73-78, 1964.

A search procedure for an information retrieval system is developed whereby the answer to a question is obtained by maximizing an evaluation function of the system's output in terms of the probability of relevance. Necessary and sufficient conditions are given for a set to be an answer to a query. A partition of the file is made in such a way that all documents belonging to the answer are members of the same class. Hence, the answer can be generated by one relevant document. In this manner, a search of the total file is avoided.

3034

Western Reserve U. Center for Documentation and Communication Research, Cleveland, Ohio.

METHODOLOGY FOR TEST AND EVALUATION OF INFORMATION RETRIEVAL SYSTEMS, by W. Goffman and V. A. Newill. July 1964, 19p. incl. diagrs. table, refs. (Rept. no. CSL: TR-2) (AFOSR-65-0587) (AF AFOSR-63-403) AD 614005 Unclassified

Also published in Inform. Storage and Retrieval, v. 3: 19-25, 1966.

Information retrieval systems are discussed in terms of their purpose and function. The essential components of an information retrieval system are defined. A methodology for evaluating the comparative performance of systems is developed. Specific measures and methods of analysis of results are presented. (Contractor's abstract)

3035

Western Reserve U. Center for Documentation and Communication Research, Cleveland, Ohio.

GENERALIZATION OF EPIDEMIC THEORY. AN APPLICATION TO THE TRANSMISSION OF IDEAS, by W. Goffman and V. A. Newill. [1964] [4]p. incl. table. (AFOSR-65-0588) (AF AFOSR-64-403) AD 614744 Unclassified

Also published in Nature, v. 204: 225-228, Oct. 17, 1964.

A basic problem concerning information retrieval is that of determining circumstances under which it might be necessary to introduce an information retrieval system as an aid to a given population of scientists. It is proposed that this problem be examined in terms of the transmission and development of ideas within a population. Specifically, the transmission of ideas within a population will be treated as if it were the transmission of an infectious disease, i.e., in terms of an epidemic process. An attempt is made to indicate the role of information retrieval in the development of such a process.

3036

Western Reserve U. Center for Documentation and Communication Research, Cleveland, Ohio.

ON RELEVANCE AS A MEASURE, by W. Goffman. [1964] [3]p. (AFOSR-65-0589) (AF AFOSR-64-403) AD 615046 Unclassified

Also published in Inform. Storage and Retrieval, v. 2: 201-203, 1964.

Relevance is defined as a measure of information conveyed by a document, i.e., a set of words conveying information, relative to a query, i.e., a set of words requesting information. Any measure of information must depend on what is already known a fact which must be recognized in any assessment of the relevance of a document with respect to a query. In this note it is shown that the relationship between a document and a query is necessary but not sufficient to determine relevance.

3037

Western Reserve U. Center for Documentation and Communication Research, Cleveland, Ohio.

USE OF META-LANGUAGE IN INFORMATION RETRIEVAL SYSTEMS, by W. Goffman, J. Verhoeff, and J. Belzer. [1964] [9]p. incl. diagrs. (AFOSR-65-1520) (AF AFOSR-63-403) AD 625577 Unclassified

Also published in Amer. Doc., v. 15: 14-22, Jan. 1964.

The usefulness of meta-language, a language used to talk about another language, called the object language, is discussed as it relates to information retrieval systems. The general meta-language concept is explained

and information retrieval systems reviewed. The role of meta-language in documentation is then dealt with. It is felt that for maximum performance from an information retrieval system, the question posed to a system must be in a meta-language and the documents within the system indexed accordingly.

3038

Western Reserve U. [School of Medicine] Cleveland, Ohio.

[VASOPRESSIN BIOSYNTHESIS] Final rept. Feb. 1963, 4p. (AFOSR-4711) (AF 49(638)764) AD 408657 Unclassified

Scientific research on vasopressin is presented in summary form and a list of the other publications for this contract is included.

3039

Western Reserve U. School of Medicine, Cleveland, Ohio.

NEURAL PATHS AND INTEGRATION CENTERS FOR ACTH AND ADH RELEASE, by G. Sayers. Final rept. Apr. 16, 1962-Apr. 15, 1963, 6p. (AFOSR-64-0546) (AF AFOSR-62-3) AD 435910 Unclassified

This work was concerned with neural pathways to the hypothalamus mediating ACTH release. A neural pathway through spinal cord appears essential for ACTH release in response to cutaneous electrical stimulation. Spinal cord transection in the rat at the level of the upper thoracic vertebrae prevents adrenal ascorbic acid depletion following electric shock to the lower extremities. Stimulation of the forelegs of the cord-sectioned rat elicits ACTH release. The relative importance of locally produced toxins and of neural connections in the mediation of ACTH release in response to burns and to operative trauma has been evaluated. There is no evidence for the production in the wounded area of a substance which induces ACTH release from the adenohypophysis. The peripheral nerves appear to play the major role.

3040

Western Reserve U. [School of Medicine] Cleveland, Ohio.

[VASOPRESSIN BIOSYNTHESIS] Final rept. Feb. 1963-Oct. 1964, 3p. (AFOSR-65-0282) (AF AFOSR-63-408) AD 611185 Unclassified

The objectives of the research were to study in vivo and in vitro a number of processes concerned with the biosynthesis, storage, and release of vasopressin. Previous experimental data suggested the possibility that the biosynthesis of vasopressin occurs in a bound, biologically inactive form and that the release of hormone takes place during the formation and maturation of the neurosecretory particles. Data have now been obtained which are consistent with such a 'precursor model' for vasopressin biosynthesis. The in vitro systems, capable of carrying out the biosynthesis and release of vasopressin, offer a considerable number of possibilities for studies concerned with the nuerosecretory process.

3041

Western Reserve U. School of Medicine, Cleveland, Ohio.

VASOPRESSIN BIOSYNTHESIS. III. IN VITRO STUDIES, by Y. Takabatake and H. Sachs. [1964] [9]p. incl. diagrs. tables, refs. (AFOSR-65-0301) (AF AFOSR-63-408) AD 611894 Unclassified

Also published in Endocrinology, v. 75: 934-942, Dec. 1964.

Under appropriate conditions, the hypothalamo-neurohypophysial complex, removed intact from guinea pigs, incorporated ^{35}S-cysteine or ^{3}H-tyrosine into vasopressin and tissue proteins. The appearance of labeled hormone was time-dependent, required an energy source and was inhibited by puromycin. Whereas slices of hypothalamic-median eminence (HME) tissue could also carry out the incorporation of isotopic amino acids into vasopressin in vitro, the distal portion of the neuron could not do so. (Contractor's abstract, modified)

3042

Western Reserve U. School of Medicine, Cleveland, Ohio.

EVIDENCE FOR A PRECURSOR IN VASOPRESSIN BIOSYNTHESIS, by H. Sachs and Y. Takabatake. [1964] [6]p. incl. diagr. tables, refs. (AFOSR-65-0302) (AF AFOSR-63-408) AD 611893 Unclassified

Also published in Endocrinology, v. 5: 943-948, Dec. 1964.

Infusion of ^{35}S-cysteine into the third ventricle of dogs for a period of 1.5 hr did not yield significant quantities of labeled vasopressin. However, animals sacrificed 4.5 hr after 1.5 hr of isotope infusion yielded ^{35}S-vasopressin. If puromycin was administered from the start of the experiment, then labeling of vasopressin was not observed. Puromycin, administered after the isotope had been infused, did not prevent the subsequent appearance of labeled hormone either in vivo or with hypothalamic-median eminence (HME) slices incubated in vitro. The HME slices, in the presence of puromycin, gave rise to ^{35}S- or ^{3}H-vasopressin only if the in vitro incubation was preceded by the infusion of ^{35}S-cysteine or ^{3}H-tyrosine, respectively, into the third ventricle of a dog for 1.5 hr prior to sacrifice. (Contractor's abstract, modified)

3043

[Westinghouse Electric Corp.] Baltimore, Md.

CELESTIAL MECHANICS RESEARCH, by G. Shapiro and E. W. Paul. Final rept. Jan. 28, 1964. 30p. incl. refs. (AFOSR-64-0132) (AF 49(638)1002) AD 434412 Unclassified

In order to examine the effect in lead of the residual

elastic strain (σ) on measurements of the stacking-fault probability (α), α and σ are calculated from the equation $\delta \Delta 2\theta_{p-q} = K_{p-q}\sigma + H_{p-q}\alpha$ and from measurements of the change in separation between 2 pairs of x-ray reflections. The usual assumption of zero residual strain gives values of α very close to those derived at the assumed extreme of isotropic strain. However, the stress values for both are found unreasonable. It is concluded that the contribution of the residual elastic strain is measurable in lead if the averaging assumption holds true; is quite significant, if the extreme of isotropic stress holds true. It is advised to examine as many x-ray peaks as possible in order to take account of the contribution due to residual strains.

3044

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

THE INFLUENCE OF ELECTROMAGNETIC STIRRING ON THE NUCLEATION OF TIN AND TIN-LEAD ALLOYS, by W. C. Johnston, G. R. Kotler, and W. A. Tiller. [1963] [7]p. incl. illus. diagrs. tables, refs. (AFOSR-J1110) (AF 49(638)1029) AD 421000 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 890-896, Aug. 1963.

Experiments carried out on 100 g samples of molten tin and Sn-Pb alloys showed that the magnitude of the field strength, H, does not effect the supercooling, ΔT_N, at which the initial nucleus of solid forms. However, the number of nuclei forming per cc, n, is found to increase greatly with H for fixed ΔT_N and to increase with ΔT_N for fixed H. The value of n increases greatly with the presence of solute and is found to be independent of the cooling rate of the samples. Further, the most effective time for stirring to enhance n is immediately following the initiation of recalescence. The effect of inducing nucleation with the aid of a mechanical impact both in the presence and absence of stirring has also been studied. All proposed mechanisms for the enhancement of n by physical means seem to be inadequate in accounting for these results. (Contractor's abstract)

3045

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

REDISTRIBUTION OF SOLUTE DURING PHASE TRANSFORMATIONS, by W. A. Tiller and R. F. Sekerka. [1964] [4]p. (AFOSR-65-0163) (AF 49(638)-1029) AD 611468 Unclassified

Also published in Jour. Appl. Phys., v. 35: 2726-2729, Sept. 1964.

The redistribution of solute during phase transformations where solute partitioning occurs at the 2-phase interface is mathematically treated for (1) the special case of equal diffusion rate in both the liquid and solid and (2) diffusion only in the liquid under the additional force of a constant electric field. This one-dimensional analysis shows that (1) diffusion in the solid has a small effect on the grown-in solute distribution for $k_0 < 1$ but an appreciable effect for $k_0 < 1$, and (2) the presence of an electric field can significantly alter the grown-in solute distribution. Further, one can deduce from the latter analysis a new experimental method for determining the effective ionic mobility of the solute species in the liquid phase.

3046

Westinghouse Electric Corp. [Westinghouse Research Labs.] Pittsburgh, Pa.

DENDRITES, by W. A. Tiller. [1964] [9]p. incl. illus. diagrs. tables, refs. (AFOSR-65-0771) (AF 49(638)-1029) AD 617045 Unclassified

Also published in Science, v. 146: 871-879, Nov. 13, 1964.

The physics involved in the generation of crystal and dendritic forms is discussed. This generation is considered for both isothermal or unconstrained crystal growth, where crystals grow freely in a large bath of liquid of constant temperature which is below the melting temperature of the crystal; and crystal pulling or constrained crystal growth, where crystals grow from a bath of liquid held at a temperature above the melting temperature of the crystal. Technological applications are also discussed.

3047

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

ICE INTERFACE MORPHOLOGY AND TEXTURE DEVELOPED DURING FREEZING, by J. D. Harrison and W. A. Tiller. [1963] [7]p. incl. illus. diagrs. refs. (AFOSR-65-1996) (AF 49(638)1029) AD 626857 Unclassified

Also published in Jour. Appl. Phys., v. 34: 3349-3355, Nov. 1963.

The freezing of pure water and several aqueous solutions was studied by a direct observation technique. The solid-liquid interface morphology and crystal texture produced during the freezing of water were studied. For the aqueous solutions, 2 families of knife-edged cells formed, one parallel to the basal plane and one parallel to the c axis. Two preferred crystal textures were observed, corresponding to the 2 cell families being aligned with the direction of heat flow. For the freezing of pure water, the same 3 textures were observed; however, the explanation for their occurrence is quite different. Theoretical explanations have been given for all of the texture results and the differences between these results and those found by other investigators. (Contractor's abstract)

3048

[Westinghouse Electric Corp. Westinghouse Research Labs.] Pittsburgh, Pa.

EFFECT OF PRESSURES (UP TO 4KBAR) ON THE POLYMERIZATION OF LIQUID SELENIUM FROM MEASUREMENTS OF VISCOSITY, by D. E. Harrison. [1963] [6]p. incl. diagrs. tables, refs. (AFOSR-65-1999) (AF 49(638)1029) AD 627784 Unclassified

Also published in Jour. Chem. Phys., v. 41: 844-849, Aug. 1, 1964.

The viscosity along the melting curve of selenium is deduced from measurements of the pressure dependence of viscosity taken at various temperatures between 220° - 350°C and at pressures up to 4 kbar. The viscosity is shown to decrease to 1/5 its initial value at 3.0 kbar, then rise with further increase in pressure. Data reveal that the slope of the $\log_{10}$ viscosity vs $1/T^2$ (°K) curve is independent of pressure up to at least 4.5 kbar. Analysis of the effect of pressure on the degree of polymerization in terms of the ring-chain equilibrium theory of Eisenberg and Tobolsky indicates that pressure has only a slight effect on the average chain length. Thus, the minimum in viscosity along the melting curve appears to be a balance between the effects of shorter chain length toward decreasing the viscosity and that of diminished free volume toward increasing the viscosity. (Contractor's abstract, modified)

3049

[Westinghouse Electric Corp. Westinghouse Research Labs.] Pittsburgh, Pa.

A METALLOGRAPHIC STUDY OF SOLUTE SEGREGATION DURING CONTROLLED SOLIDIFICATION IN TIN-LEAD ALLOYS, by H. Biloni and G. F. Bolling. [1963] [10]p. incl. illus. diagrs. table, refs. (AFOSR-65-2034) (AF 49(638)1029) AD 627581 Unclassified

Also published in Trans. Metall. Soc. AIME, v. 227: 1351-1360, Dec. 1963.

The microsegregation in tin specimens containing 0.2, 0.5, or 1 wt % Pb was studied. The specimens were grown from the melt in a controlled fashion and exhibited a well-developed cellular substructure. In general, a severe microsegregation can be observed in all the photomicrographs presented. Some observations of special interest are: the distribution of a second phase, the presence of a eutectic in several forms, the evidence for diffusion of solute in the solid, and the enhancement of segregation of a dislocation subboundary network ("striations"). On the basis of the metallographic observations, it is deduced that the segregation observed is representative of the solute segregation produced during crystal growth. Some deductions are also made about the interplay of the 2 substructures, cells and striations, and about the mode of cellular growth. (Contractor's abstract)

3050

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

EVIDENCE FOR THE EXISTENCE OF OVERLAPPING VALENCE AND CONDUCTION BANDS IN SnTe, by D. H. Damon, C. R. Martin, and R. C. Miller. [1963] [3]p. (AFOSR-64-1250) (AF 49(638)1165) AD 442814 Unclassified

Also published in Jour. Appl. Phys., v. 34: 3083-3085, Oct. 1963.

The electrical conductivity, Hall coefficient, and Seebeck coefficient of a sample of SnTe were measured. The Hall coefficient was measured at several positions along the length of the sample and the agreement of these results indicated the sample was homogeneous. The Seebeck coefficient was determined by establishing a temperature gradient in the material, measuring the temperatures of the ends with copper-Constantan thermocouples in contact with the sample and the thermal emf of the Cu-SnTe-Cu couple. This result was corrected to give the absolute Seebeck coefficient of SnTe. Expressions are derived for the change of Seebeck coefficient with magnetic field for 2 different sets of boundary conditions.

3051

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

DEFECT SITES IN VITREOUS SILICA, by P. G. Klemens, J. G. Castle, Jr., and D. W. Feldman. [1964] [3]p. (AFOSR-64-2104) (AF 49(638)1165) AD 451736 Unclassified

Also published in Phys. Chem. Glasses, v. 5: 104-106, Aug. 1964.

Studies of spin-lattice relaxations in crystalline silica have shown the existence of defects with low-frequency mechanical resonances. These defects should lead to unusual scattering of phonons. Such defects were recently found also in vitreous silica. The theory of spin-lattice interaction must now be modified to take account of the short mean free path of transverse phonons in glass. Some implications of these measurements for thermal conduction are discussed.

3052

[Westinghouse Electric Corp.] Westinghouse Research Labs., Pittsburgh, Pa.

GROWTH AND CHARACTERIZATION OF SINGLE CRYSTALS OF RARE EARTH COMPOUNDS. 1964, 6p. (Quarterly technical rept. no. 10) (AF 49(638)1245) AD 626865 Unclassified

Magnetization measurements were made on the GdNd alloys to ascertain the mode of the spin coupling between a heavy and a light rare earth atom. The magnetic data have substantiated the ferromagnetic spin coupling

assumed in the Dekker theory of electrical resistivity of the rare earth alloys. Low-temperature resistivities were determined of several Pd alloys containing solute atoms of Gd, Rh, and Fe. The electrical data have reconfirmed the absence of the abnormally large spin-polarization effect of the localized moments of the Fe atoms in Pd. Experimental efforts were made to explore the possible occurrence of resistance minimum in the Pd-Gd alloys. The effect of local modes at the impurity centers was examined upon the scattering of electrons in aluminum between 4.2° and 300°K.

3053

Wisconsin U. [Dept. of Bacteriology] Madison.

THE EFFECT OF POLY U SIZE ON THE INCORPORATION OF PHENYLALANINE IN THE CELL-FREE YEAST SYSTEM, by L. Marcus, R. K. Bretthauer and others. [1963] [8]p. (AFOSR-64-2150) (AF 49(638)-31[illegible]) AD 452234 Unclassified

Also published in Proc. Nat'l. Acad. Sci., v. 50: 782-789, Oct. 1963.

This study has demonstrated the possibility of measuring messenger RNA function of oligonucleotides short enough to be completely characterized and thus to establish the correlation of mRNA structure with peptide product structure. The results suggest that at least 3 triplets of poly U are required for phenylalanine polymerization and that each additional 3 nucleotide units augments incorporating activity.

3054

Wisconsin U. [Dept. of Bacteriology] Madison.

TIMING OF ENZYME SYNTHESIS DURING SYNCHRONOUS DIVISION IN YEAST, by J. Gorman, P. Taruo and others. [1964] [7]p. (AFOSR-64-2151) (AF 49-(638)314) AD 452231 Unclassified

Also published in Biochem. and Biophys. Research Commun., v. 15: 43-49, 1964.

The method of Williamson and Scopes was employed to induce the synchronous state with the exception that the centrifugation for sizing cells after 10 days starvation was omitted, and the cells were finally suspended in a 0.2% succinate and salts medium at 25°C. The lag time was 240 min and the generation time 200 min. The total amounts of RNA and protein doubled within each generation and the rate of synthesis doubled at the beginning of each new cell cycle. DNA doubled during each generation; its synthesis was periodic, initiating at 0 time of the generation cycle, but complete in 140 min. Nuclear division occurred at a time when buds appeared and when DNA was not replicated. This may well reflect a period of karyokinesis analogous to that of higher organisms where DNA is replicated only during interphase.

3055

Wisconsin U. Dept. of Bacteriology, Madison.

[MICROPHYSIOLOGICAL STUDIES OF NERVE AND MUSCLE UNITS] by H. O. Halvorson. Final rept. Sept. 1, 1963-Aug. 31, 1964, 9p. incl. refs. (AFOSR-64-2065) (AF AFOSR-63-387) AD 608776 Unclassified

During the course of the past few years a cell-free system was developed from the hybrid yeast Saccharomycetes dobzyanskii x S. fragilis. With this system, it was possible to examine a number of problems dealing with the mechanism of protein synthesis which are included in the final report. In addition, a companion program was initiated with S. lactis to (1) examine the similarities in cell-free incorporating systems from related organisms and (2) to facilitate the isolation of the transfer enzyme, a step towards a completely defined incorporating system. Cell-free incorporating systems are generally inefficient and have a short half-life. One of the major defects is usually attributed to nuclease action. To better understand and control nuclease action in cell extracts, a further characterization of these enzymes was undertaken.

3056

Wisconsin U. Dept. of Chemistry, Madison.

NEW AROMATIC ANIONS. VI. COMPLEXES OF CROCONATE ION WITH SOME DIVALENT AND TRIVALENT METALS, by R. West and J. Y. Niu. [1963] [3]p. incl. diagrs. tables. (AFOSR-64-0223) (AF 49-(638)285) AD 432512 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2586-2588, Sept. 5, 1963.

Complexes of croconate ion with the divalent metal ions Cu, Fe, Zn, Ni, Mn, Co, and Ca and trivalent Al, Fe and Cr have been prepared and characterized by means of analysis, infrared spectroscopy, powder x-ray diffraction, and magnetic studies. All of the divalent metal complexes have the general formula $MC_5O_5 \cdot 3H_2O$. The divalent transition metal compounds are all high-spin complexes, and all have the same polymeric structure, determined from a single-crystal x-ray analysis of the copper(II) compound. The trivalent metal complexes have more complicated formulas containing hydroxyl groups, and those of Fe(III) and Cr(III) show paramagnetism lower than that expected for high-spin complexes.

3057

Wisconsin U. Dept. of Chemistry, Madison.

IONIC REACTIONS IN BICYCLIC SYSTEMS. IV. STEREOCHEMISTRY OF THE ACETOLYSIS OF (+)-ENDOBICYCLO[2.2.2]OCT-5-EN-2-YL p-TOLUENESULFONATE, by H. L. Goering and D. L. Towns. [1963] [4]p. incl. table, refs. (AFOSR-4546) (AF 49-(638)721) AD 439991 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2295-2298, Aug. 5, 1963.

Acetolysis of (+)-endo-bicyclo[2.2.?]oci-5-3n-2-yl p-toluenesulfonate resulis in equal first-order rates of loss of optical activity and solvolysis. The major componeni in the product is exo(axial)-btcyclo-[3.2.1] oct-3-en-2-yl acetaie and this appears to be completely racemic. These results, together with the observation that acetolysis is anchimerically accelerated, are consistent with the view that ionization results tn the direct formation of the symmetrical bicyclo[3.2.1]oci-3-en-2-yl carbonium ion which is stereoselectively converted to the exo-acetate I. (Contractor's abstract)

3058

Wisconsin U. Depi. of Chemistry, Madison.

HYDROGEN-HALOGEN EXCHANGE BETWEEN SILANES AND TRIPHENYLMETHYL HALIDES, by J. Y. Corey and R. Wesi. [1963] [4]p. tncl. diagrs. tables, refs. (AFOSR-64-0161) (AF AFOSR-62-244) AD 432556 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2430-2433, Aug. 20, 1963.

Triphenylmethyl halides will halogenaie silanes at 25°C in polar solvenis. The reaction is rapid in partially chlorinaied hydrocarbons, nitromethane, and nitrobenzene, show in aceionitrile and benzene, and does noi take place in ethers, hydrocarbons, or fully chlorinated hydrocarbons at room temperature. Benzhydryl and i-butyl halides are inactive bui react to give hydrogen-halogen exchange in the presence of boron tribromide. A preliminary siudy of the kinetics of the reaction between triphenylchloromethane and triphenylsilane in benzene indicates probable first-order dependence of the raie on each reactani. A mechanism is suggesied involving 4-center attack of a carbonium ion-halide ion pair on the Si-H bond. Preparative applications of the reaction are also discussed. (Contractor's abstract)

3059

Wisconsin U. Depi. of Chemistry, Madison.

NEW AROMATIC ANIONS. VII. COMPLEXES OF SQUARATE ION WITH SOME INVALENT AND TRIVALENT METALS, by R. Wesi and H. Y. Niu. [1963] [2]p. incl. tables. (AFOSR-64-0216) (AF AFOSR-62-244) AD 432505 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 85: 2589-2590, Sept. 5, 1963.

Complexes of squarate ion (diketocyclobuienediol dianion) with divaleni Cu, Fe, Zn, Ni, Mn, Co, Ca, and Mg, and with trivaleni Al, Fe, and Cr, have been prepared and characierized. All of the divalent metal complexes are dihydraies, and all excepi the Cu and Ca compounds have the same structure. The 3 trivalent metal complexes are isostructural and have the general formula $MC_4O_4(OH)(H_2O)_2$. The magnetic moments of the divalent metal compounds indicaie that they are high-sptn complexes, but the Fe(III) and Cr(III) complexes show somewhai reduced paramagnetism. A polymeric structure ts suggested for divalent metal complexes. (Contractor's abstract)

3060

Wisconsin U. [Dept. of Chemistry] Madison.

PI-BONDED ORGANOSILICON COMPOUNDS, by R. West. Final rept. Feb. 1, 1962-Jan. 1, 1964. Apr. 20, 1964, 11p. (AFOSR-64-1090) (AF AFOSR-62-244) AD 601691 Unclassified

Summaries are given of researches in the following areas: silicontun tons; organometallic azides; organosilicon free radicals, and electronic spectra of organometallic compounds.

3061

Wisconsin U. Depi. of Chemistry, Madison.

SYNTHESIS OF A SILAZAROPHENANTHRENE, by J. M. Gaidis and R. West. [1964] [2]p. incl. diagr. (AFOSR-65-0532) (AF AFOSR-62-244) AD 613923 Unclassified

Also published in Jour. Amer. Chem. Soc., v. 86: 5699-5700, Dec. 1964.

The compound 10, 10-dimethyl-9, 10-azasiladihydrophenanthrene was synthesized by photolysis of an organosilyl azide after unsuccessful attempis by more direct methods, e.g., those used for heteroaromatic boron and phosphorus compounds. This reaction is an example of insertion of monovaleni nitrogen from an organometallic azide into a C-H bond.

3062

Wisconsin U. Depi. of Chemistry, Madison.

A NOVEL REARRANGEMENT OF 1, 2-BIS(TRIMETHYLSILYL)-HYDRAZINE, by R. E. Bailey and R. Wesi. [1964] [1]p. incl. refs. (AFOSR-65-0534) (AF AFOSR-62-244) AD 614290 Unclassified

Also published tn Jour. Amer. Chem. Soc., v. 86: 5369, Dec. 1964.

When 1, 2-bis(trimethylstlyl)hydrazine is treaied with 2 equtv. of n-butyllithium in tetrahydrofuran and then with 2 equiv. of methyl iodide, the reaction mixture is found io contain both the expected product 1, 2-bis(trimethylsilyl)1, 2-dimethylhydrazine, and the rearranged product, 1, 1-bts(trimethylsilyl-2, 2-dimethylhydrazine. The rearrangement involves the migration of silicon from 1 nitrogen to another. Presently, it ts known whether the rearrangemeni occurs durtng or afier treatment with n-butyllithium, or even conceivably during the reaction wiih methyl iodide.

3063

Wisconsin U. Dept. of Chemistry, Madison.

TRIMETHYLAZIDO COMPOUNDS OF GROUP IVA ELEMENTS, by J. S. Thayer and R. West. [1964] [5]p. incl. diagrs. tables, refs. (AFOSR-64-1541) (AF AFOSR-64-623) AD 446134 Unclassified

Also published in Inorg. Chem., v. 3: 889-893, June 1964.

Azidotrimethyl derivatives of silicon, germanium, tin, and lead were prepared, and a comparative study of their physical properties was carried out. Infrared and electronic spectra were interpreted in terms of dative π-bonding in the silicon and germanium compounds. In the organosilicon conversion series, the azide group occupies the same position as isocyanate. (Contractor's abstract)

3064

Wisconsin U. [Dept. of Mathematics] Madison.

A THEOREM OF MAXIMUM MODULUS, by A. Beck. [1964] [5]p. (AFOSR-64-2362) (AF 49(638)868) AD 452232 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 345-349, June 1964.

The theorem states that if D is a domain in the plane of complex numbers, then every analytic function achieves its maximum modulus only at the boundary.

3065

Wisconsin U. [Dept. of Mathematics] Madison.

ON RINGS ON RINGS, by A. Beck. [1964] [4]p. (AFOSR-64-2363) (AF 49(638)868) AD 452233 Unclassified

Also published in Proc. Amer. Math. Soc., v. 15: 350-353, June 1964.

This paper presents a solution to a popular problem in the subject of rings of analytic functions. It was previously shown that two domains D_1 and D_2 in the complex plane were conformally equivalent (to within a certain equivalence relation) if the rings $B(D_1)$ and $B(D_2)$ of all bounded analtyic functions defined on them were algebraically isomorphic. In the case of annuli, two are conformally equivalent if the ratio of the radii of one equals the same ratio for the other. It follows that this ratio must be contained somewhere in the algebraic structure of the ring.

3066

Wisconsin U. [Dept. of Mathematics] Madison.

NONABSORPTION PROBABILITY FOR A GAUSSIAN PROCESS IN THE KARHUNEN REPRESENTATION, by J. Chover. [1964] [17]p. incl. refs. (AFOSR-64-2486) (AF 49(638)868) AD 453795 Unclassified

Also published in Duke Math. Jour., v. 31: 427-443, Sept. 1964.

Sample functions of a given Gaussian process X(t) which have a finite (N-term) Karhunen expansion are considered. It is easy to see how nonabsorption probability depends on three distinct sets of input data: (1) the eigenvalues of r(s, t) (considered as integral kernel), (2) the corresponding eigenvectors, and (3) the boundaries. The nonabsorption probabilities are interpreted in terms of a simple diffusion in N-space. An estimate for the error involved in truncating a Karhunen expansion after the N-th term is given, and a crude lower bound for the nonabsorption probability of a truncated series, for the one-sided case is discussed.

3067

Wisconsin U. [Dept. of Minerals and Metals Engineering] Madison.

STRESS-CORROSION CRACKING OF COPPER-GOLD SINGLE CRYSTALS, by J. Hardwick and R. A. Dodd. 1963, 11p. (AFOSR-5336) (AF AFOSR-61-68) AD 421517 Unclassified

The stress-corrosion susceptibility range of the copper-gold system was measured, using single crystals loaded to give 5% glide strain in 2% ferric chloride. Alloys containing less than about 10 at.-% gold fail by the progressive reduction of cross section due to general corrosive attack. Alloys containing between 10 and 29 at.-% gold fail by stress corrosion, with the stress-corrosion susceptibility steadily increasing up to 29 at.-% gold. Those alloys containing in excess of this gold content are not susceptible to stress-corrosion.

3068

Wisconsin U. Dept. of Minerals and Metals Engineering, Madison.

MECHANISM OF STRESS-CORROSION CRACKING IN FACE-CENTERED-CUBIC METALS, by R. A. Dodd. Final technical rept. [1963] [5]p. (AFOSR-J1128) (AF AFOSR-61-68) AD 421724 Unclassified

The purpose of the research was to attempt an evaluation of those structural parameters which are possibly significant in giving rise to the phenomenon of stress-corrosion cracking in face-centered-cubic metals. Parameters investigated included dislocation configurations, stacking faults and energies, and long and short-range order. Studies included copper-gold and silver-gold single crystals.

3069

Wisconsin U. [Dept. of Minerals and Metals Engineering] Madison.

STRESS-CORROSION CRACKING OF SHORT-RANGE-ORDERED COPPER-GOLD SINGLE CRYSTALS, by J. M. Hardwick and R. A. Dodd. [1964] [2]p. (AFOSR-64-2106) (AF AFOSR-61-68) AD 451701
Unclassified

Also published in Jour. Inst. Metals, v. 92: 339-340, 1963-1964.

Stress-corrosion cracking of solid-solution alloys has been the subject of many investigations, but the mechanism of cracking cannot yet be said to be completely understood. The complicating effects of grain boundaries can be avoided by the use of single crystals, and the following results for copper-gold single crystals show that the stress-corrosion lifetime has a simple dependence on composition which can be satisfactorily explained in terms of a theory for transgranular cracking.

3070

Wisconsin U. [Dept. of Sociology] Madison.

A VERY SHORT TEST OF PERSONALITY: THE BEHAVIORAL SELF-RATING (BSR) FORM, by E. F. Borgatta. [1964] [10]p. (AFOSR-64-0833) (AF AFOSR-62-16) AD 438390 Unclassified

Also published in Psychol. Repts., v. 14: 275-284, 1964.

Reliability and validity data are presented for a factor analytically based short test of personality. The form is essentially a behavioral characteristics, self-rating check list. Use is recommended for screening purposes only where time is at a premium. The names of the 5 scores of the test are: assertiveness, likeability, intelligence, emotionality, and responsibility.

3071

Wisconsin U. [Dept. of Sociology] Madison.

A NOTE ON THE STABILITY OF PEER JUDGMENTS IN INDEPENDENT SITUATIONS, by E. F. Borgatta and B. C. Sperling. [1963] [3]p. incl. table. (AFOSR-64-1484) (AF AFOSR-62-16) AD 445171
Unclassified

Also published in Jour. Psychol. Studies, v. 14: 45-47, 1963.

Utilizing the multitrait-multimethod approach, a replication study is reported indicating the stability of peer assessments in independent situations. Composite peer-ranking scores of assertiveness, sociability, and emotionality based on fraternity and sorority groupings are compared with parallel scores in ad hoc mixed-sex discussion groups. (Contractor's abstract)

3072

Wisconsin U. [Dept. of Sociology] Madison.

A NEW SYSTEMATIC INTERACTION OBSERVATION SYSTEM: BEHAVIOR SCORES SYSTEM (BSs SYSTEM), by E. F. Borgatta. [1963] [21]p. incl. diagr. tables. (AFOSR-64-1485) (AF AFOSR-62-16) AD 445172
Unclassified

Also published in Jour. Psychol. Studies, v. 14: 24-44, 1963.

A new interaction scoring system is presented, along with a brief description of the underlying rationale. A sample study is reported to illustrate the relationship of the observation categories to observed interaction. The observation categories are correlated to peer assessments, and profile data are presented with distribution characteristics. A sample protocol to illustrate scoring is presented in an appendix. (Contractor's abstract)

3073

Wisconsin U. [Dept. of Sociology] Madison.

A NOTE ON THE CONSISTENCY OF SUBJECT BEHAVIOR IN INTERACTION PROCESS ANALYSIS, by E. F. Borgatta. [1964] [8]p. incl. table. (AFOSR-64-1956) (AF AFOSR-62-16) AD 440320 Unclassified

Also published in Sociometry, v. 27: 222-229, June 1964.

Consistency in interaction behavior is examined for 3 observation situations: 5-person and 3-person discussion groups and 3-person, structured role-playing groups. Substantial consistency in subject behavior is found in the first two situations, but there is little prediction to role-playing. Attention is focused on the question of which aspects of social interaction reflect personality most and which are most subject to situational variation. (Contractor's abstract)

3074

Wisconsin U. [Dept. of Zoology] Madison.

FUNCTION OF A LIGHT RESPONSE RHYTHM IN HAMSTERS, by P. J. DeCoursey. [1964] [8]p. (AFOSR-64-1692) (AF 49(638)691) AD 447697
Unclassified

Also published in Jour. Cellular and Compar. Physiol., v. 63: 189-196, Apr. 1964.

An assay both my means of short, single light exposure and by light synchronization experiments indicated a light response rhythm in hamsters. The magnitude and direction of the phase shifts were related to the time in the daily activity cycle at which light occurred. Such a response rhythm appeared highly adaptive for maintaining a nocturnal pattern in a light-dark cycle for all members of the species.

3075

Wisconsin U. [Dept. of Zoology] Madison.

ADAPTIVE ASPECTS OF ACTIVITY RHYTHMS IN BATS, by G. DeCoursey and P. J. DeCoursey. [1964] [14]p. (AFOSR-64-1693) (AF 49(638)691) AD 447698 Unclassified

Also published in Biol. Bull., v. 126: 14-27, Feb. 1964.

Bats living under laboratory or field conditions manifested precise nocturnal activity rhythms. Light-sampling at the light-to-dark transition was apparently the chief means of synchronizing an endogenous, non-24-hr activity rhythm to the daily light cycle. Two horseshoe bats, free-living in separate, small recording rooms, readily adjusted the time of activity to correspond to an L:D schedule. Three horseshoe bats, roosting in a darkened tunnel with no direct view of the 12L:12D schedule of the outside room, anticipated the light-dark change by flying out regularly during the hour before the lights were turned out, then were active for about 8 hr.

3076

Yale U. [Dept. of Astronomy] New Haven, Conn.

A GROUP OF EARTH-TO-MOON TRAJECTORIES WITH CONSECUTIVE COLLISIONS, by V. Szebehely, D. A. Pierce, and E. M. Standish, Jr. [1964] [17]p. (AFOSR-64-2491) (AF AFOSR-64-397) AD 454017 Unclassified

Also published in Prog. Astronaut. and Aeronaut., v. 14: 35-51, 1964.

A set of trajectories connecting the earth and the moon is described. All members of this group of orbits go through, in extension, the centers of the earth and the moon, and are therefore termed orbits with consecutive collisions. The model of the planar restricted problem of three bodies is used, and the equations of motion are regularized in order to obtain solutions through the singularities. The principles of regularization are discussed in some detail. The members of the group of orbits presented in this paper are of considerable interest because they are simple and because several of them are closely related to trajectories proposed for Apollo-type missions.

3077

Yale U. Dept. of Mathematics, New Haven, Conn.

REAL BANACH ALGEBRAS, by L. Zelstam. [1964] [32]p. (AFOSR-65-2611) (AF AFOSR-63-407) AD 629083 Unclassified

Also published in Arkiv Mat., v. 5: 239-270, 1964.

This article contributes to the theory of real Banach algebras in three central areas: (1) the structure of the (quasi-) regular group, (2) abstract characterization of real function algebras, and (3) the relation between real B- and C-algebras.

3078

Yale U. [Dept. of Mathematics] New Haven, Conn.

ON THE MAXIMALITY THEOREM OF WERMER, by T. P. Srinivasan and J.-K. Wang. [1963] [2]p. (AFOSR-66-0015) (AF AFOSR-63-407) AD 631114 Unclassified

Also published in Proc. Amer. Math. Soc., v. 14: 997-998, Dec. 1963.

The maximality theorem proven is as follows: let C denote the sup-norm algebra of all continuous functions on the unit circle, and let A denote the subalgebra of those functions which have analytic extensions to the interior. Then A is a maximal closed subalgebra of C.

3079

Yale U. [Dept. of Physics] New Haven, Conn.

ENERGY OF GRAIN BOUNDARIES IN NaCl TRICRYSTALS, by R. L. Moment and R. B. Gordon. [1963] [23]p. incl. illus. diagrs. refs. (AFOSR-J1214) (AF 49(638)786) AD 425098 Unclassified

Relative grain boundary energy measurements have been made for [100] tilt boundaries in NaCl crystals. Significant torque term effects - dependence of the boundary energy on boundary orientation - occur in this material. The general dependence on boundary energy on misorientation is similar to that in metals. (Contractor's abstract)

3080

Yale U. [Dept. of Physics] New Haven, Conn.

IONIC CONDUCTIVITY IN LiF GRAIN BOUNDARIES, by R. L. Moment and R. B. Gordon. [1964] 18p. incl. diagrs. table, refs. (AFOSR-64-2350) (AF 49(638)786) AD 451939 Unclassified

Also published in Jour. Appl. Phys., v. 35: 2489-2492, Aug. 1964.

Tilt boundaries in LiF bicrystals have been doped with Na^+ ions and the resulting enhanced ionic conductivity measured. The activation energy associated with this conductivity is found to be 0.32 ev and is a constant, independent of the grain misorientation. This activation energy is the same as for the enhanced conductivity observed in Na^+ ion doped edge dislocations in LiF. The results are interpreted in terms of a disordered boundary structure containing a high vacancy concentration. (Contractor's abstract)

3081

Yale U. [Dept. of Physics] New Haven, Conn.

ENERGY OF GRAIN BOUNDARIES IN HALITE, by R. L. Moment and R. B. Gordon. [1964] [4]p. incl. illus. diagrs. (AFOSR-65-0769) (AF 49(638)786) AD 616049 Unclassified

Also published in Jour. Amer. Ceram. Soc., v. 47: 570-573, Nov. 1964.

Relative grain boundary energy measurements were made by the tricrystal method for [100] tilt boundaries in NaCl. The dependence of boundary energy on grain misorientation was similar to that in metals; however, the presence of significant torque term effects, i.e., dependence of the boundary energy on boundary orientation is indicated. A method of measuring the relative magnitudes of the torque terms by applying a driving force to boundaries in bicrystals is described. (Contractor's abstract)

3082

Yale U. [Dept. of Physics] New Haven, Conn.

THE SEMICLASSICAL TREATMENT OF SOME QUANTUM PROBLEMS, by G. Breit. [1963] [22]p. (AFOSR-J279) (AF AFOSR-62-42) AD 400879 Unclassified

Also published in Zeitschr. Phys., v. 171: 149-170, 1963.

The semiclassical treatment of quantum mechanical problems is discussed making use of a generalization of the Hamilton-Jacobi partial differential equation to cases in which only some of the variable of the problem are treated classically. The quantum equations are put into a form in which the effects not covered by the semiclassical approximation are concentrated into one set of terms. This enables one to calculate corrections to the semiclassical theory and to demonstrate that compensations of the decrease of scattering in the coherent (elastic) channel by the increase caused by the presence of incoherent (inelastic) channels which is exact in the semiclassical approximation holds in a certain approximation quantum mechanically. By means of these relationships it is shown that some and presumably the main contributions to the dynamical effects of molecular electrons interacting with protons in experiments on proton-proton and proton-neutron scattering are negligibly small.

3083

Yale U. [Dept. of Physics] New Haven, Conn.

HIGH-ENERGY DIFFRACTION SCATTERING, by L. Durand, III and K. R. Greider. [1963] [9]p. (AFOSR-64-0507) (AF AFOSR-63-394) AD 436167 Unclassified

Also published in Phys. Rev., v. 132: 1217-1225, Nov. 1, 1963.

The experimental data on elastic proton-proton scattering have been analyzed in a phenomenological manner using the impact-parameter representation for the scattering amplitude in the form given by Blankenbecler and Goldberger. The detailed shape and energy dependence of the elastic differential cross section, the small ratio of the elastic-scattering cross section to the total cross section, and the constant total cross section can all be explained with remarkable ease using a smooth weight function with reasonable properties.

3084

Yale U. [Dept. of Physics] New Haven, Conn.

NEUTRON TRANSFER IN $N^{14}(N^{14}, N^{13})N^{15}$ AT LOW ENERGIES, by G. Breit, K. W. Chun, and H. G. Wahsweiler. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-0650) (AF AFOSR-63-394) AD 435939 Unclassified

Also published in Phys. Rev., v. 133: B403-B408, Jan. 27, 1964.

Formulas concerned with approximate quantum mechanical corrections to the semiclassical (SC) treatment of the neutron transfer reaction previously contained or implied in the literature are extended. At 18 and at 12.6 mev reasonable agreement with experimental angular distributions is found close to 90° in the cm system. At smaller angles the experimental values of the cross section are below those calculated at 18 mev, in agreement with the influence of absorption on the recoils suggested for this case; at 12.3 mev the experimental values are somewhat smaller than the theoretical as would be the case in the presence of virtual Coulomb excitation (VCE). Total transfer cross sections show a systematic increase over expectation by a factor of about 2.9 between 9.0 and 12.8 mev as though some VCE were present. The calculated ratio of the 90° cross section at 18 mev to that at 12.6 mev is about 10 times that observed. Possible explanations of this discrepancy are discussed. (Contractor's abstract, modified)

3085

Yale U. Dept. of Physics, New Haven, Conn

NUCLEUS-NUCLEUS REARRANGEMENT SCATTERING. I, by K. R. Greider. [1964] [12]p. incl. diagr. refs. (AFOSR-64-1768) (AF AFOSR-63-394) AD 449268 Unclassified

Also published in Phys. Rev., v. 133: B1483-B1494, Mar. 23, 1964.

Direct-interaction techniques are applied to nucleus-nucleus rearrangement processes in which a nucleon is transferred from one nucleus to the other during the scattering. A formal expression is derived for the transition amplitude assuming a reaction mechanism different from that usually employed in direct-interaction rearrangement processes. The mechanism in the usual theories is due to the potential between the transferred particle and one of the nuclear core systems; in the present treatment the interaction between the two nuclear cores is considered responsible in first order for the rearrangement scattering.

3086

Yale U. Dept. of Physics, New Haven, Conn.

NUCLEUS-NUCLEUS LONG-RANGE INTERACTION POTENTIAL IN ELASTIC SCATTERING, by J. S. McIntosh, S. C. Park, and G. H. Rawitscher. [1964] [12]p. incl. diagrs. tables, refs. (AFOSR-64-2061) (AF AFOSR-63-394) AD 452447 Unclassified

Also published in Phys. Rev., v. 134: B1010-B1021, June 8, 1964.

Differential cross sections are calculated for the elastic scattering of heavy nuclei by heavy nuclei and the results are compared with experiment. The long-range part of the nucleus-nucleus interaction is assumed to be representable by a two-body potential, and the attempt is made to calculate the latter in terms of the experimentally determined nucleon-nucleus optical-model potential extrapolated to negative energies at the surface

of each nucleus. The short-range part of the nucleus-nucleus interaction is represented schematically by a complex potential or an ingoing wave boundary condition, the justification for which as a representation of the optical-model potential is given. Reasonable agreement with experiment is obtained for the experimental data considered, if the average-reduced-width parameter equal to about one-fifth the corresponding single-particle value is employed. (Contractor's abstract)

3087

Yale U. [Dept. of Physics] New Haven, Conn.

ELECTRON AND MUON SCATTERING FROM NUCLEAR CHARGE DISTRIBUTIONS AT INCIDENT MOMENTA BETWEEN 50 AND 183 MEV/C, by C. R. Fischer and G. H. Rawitscher. [1964] [7]p. incl. diagrs. tables, refs. (AFOSR-65-0141) (AF AFOSR-63-394) AD 455827 Unclassified

Also published in Phys. Rev., v. 135: B377-B383, July 27, 1964.

The comparison of theoretical elastic-scattering cross sections of positrons and electrons from Woods-Saxon (WS) and wine-bottle (WB) charge distributions of the nucleus of Au, carried out at 183 mev, is extended to lower energies and repeated for muons of comparable incident momenta. It is found that, for momentum transfers of less than 1.5 F^{-1}, the % change of the cross section corresponding to a change from the WS to the WB charge distribution is largest, of the order of 30% for incident momenta of ~ 100 mev/c, particularly for positrons. At an electron energy of 50 mev the cross section depends mainly on the mean-square radius of the nucleus, and an accuracy better than 5% is needed in order to determine additional nuclear charge distribution parameters. The mean-square radii of the WS and WB charge distributions differ by 6.5% while the corresponding electron cross sections at 50 mev differ by a maximum of 1.5%. A comparison with experimental elastic positron and electron scattering cross sections for Pb is carried out. (Contractor's abstract, modified)

3088

Yale U. [Dept. of Physics] New Haven, Conn.

DETERMINATION OF THE TOTAL ANGULAR MOMENTUM OF RESIDUAL NUCLEAR STATES FROM DEUTERON STRIPPING ANGULAR DISTRIBUTIONS, by K. R. Greider. [1964] [6]p. incl. diagrs. refs. (AFOSR-65-0143) (AF AFOSR-63-394) AD 455941 Unclassified

Also published in Phys. Rev., v. 136: B420-B425, Oct. 26, 1964.

A model based on diffraction techniques yields general formulas for large-angle differential cross sections in deuteron stripping, and other rearrangement, reactions in which the entrance- and exit-channel particles are strongly absorbed. It is found that for a spin-zero target, the character of the large-angle distributions depends critically on the angular-momentum transfer L, or parity of the residual state, in an unusual way. For L even, cross sections exhibit oscillations that have twice the period of the usual forward-angle stripping oscillations, while for L odd, there is almost no oscillatory structure. Furthermore, the even-L oscillations for $L = 4n$ are out of phase with those of $L = 4n + 2$, $n = 0, 1, \cdots$. A unique determination of the total spin $J = L \pm \frac{1}{2}$ of the residual nuclear state in deuteron stripping is possible when entrance- and exit-channel spin-orbit scattering, proportional to $\sigma \cdot l$, is introduced into the diffraction model. The spin-orbit amplitude is characterized by distributions of opposite parity from the spin-independent amplitude. For the case of L odd, the spin-independent amplitude is a relatively smooth function of angle, characteristic of odd-parity distributions, while the spin-dependent amplitude exhibits the even-parity ($L \pm 1$) large-angle diffraction oscillations. (Contractor's abstract, modified)

3089

Yale U. [Dept. of Physics] New Haven, Conn.

SCATTERING OF PIONS BY LIGHT NUCLEI, by M. M. Sternheim. [1964] [9]p. incl. diagrs. refs. (AFOSR-65-0508) (AF AFOSR-63-394) AD 614087 Unclassified

Also published in Phys. Rev., v. 135: B912-B920, Aug. 24, 1964.

The scattering of pions by light nuclei is calculated using an approximate, high-energy, small-angle multiple-scattering expansion which neglects off-the-energy shell scattering. The approximations needed to obtain this expansion from an exact multiple-scattering theory are examined. It is found that the unknown contribution of the off-the-energy shell scattering makes any calculation of pion-nucleus scattering unreliable for large angles. Using pion-nucleon phase shifts and electron-scattering data, results are obtained for the scattering of pions of about 80 mev by lithium, carbon, and oxygen. (Contractor's abstract)

3090

Yale U. Sloane Physics Lab., New Haven, Conn.

RELAXATION RATES OF THE Ar^+ LASER LEVELS, by W. R. Bennett, Jr., P. J. Kindlmann and others. [1964] [3]p. incl. illus. table, refs. (AFOSR-65-0112) (AF AFOSR-64-626) AD 611996 Unclassified

Also published in Appl. Phys. Ltrs., v. 5: 158-160, Oct. 15, 1964.

In order to investigate the relative importance of factors that contribute to the excitation of states such as the $3p^4(^3P)4p$ state of Ar^+ from the neutral ground state, direct measurements were made of the radiative and collision-induced relaxation rates of all the upper Ar^+ laser states. The results show that: (1) the radiative lifetimes of these states range from ~ 7 to 10 nsec; (2) the destructive collision cross-sections are too

small to affect these lifetimes at the optimum pressure for laser oscillation; and (3) direct Ar^+ excitation cross-sections are comparable with those for neutral Ar.

3091

Yale U. Sloane Physics Lab., New Haven, Conn.

REVIEW OF RECENT PROGRESS WITH GASEOUS ION LASERS (Abstract), by W. R. Bennett, Jr. [1964] [1]p. (AFOSR-65-0113) (AF AFOSR-64-626) Unclassified

Also published in Jour. Opt. Soc. Amer., v. 54: 1389, 1964.

Use of high-energy electron impact and high-current discharges has permitted obtaining laser oscillation between ionic states in gas systems on wavelengths ranging from UV to the near IR. In particular, the pulsed and cw power capabilities of the noble-gas ion lasers have exceeded conventional neutral-gas systems by a considerable margin. The visible systems have also been characterized by extremely high gain and strong superradiance effects. Various correlation studies indicate that plasma interactions, e.g., the pinch effect, are involved in the energy-transfer process in these high-current systems. A review of these excitation processes is given and summaries of measured lifetimes, gain, and power coefficients are presented.

3092

Yale U. [Sloane Physics Lab.] New Haven, Conn.

RADIAL PROFILE AND SATURATION CHARACTERISTICS OF THE 1.1523-μ He-Ne LASER TRANSITION (Abstract), by W. R. Bennett, Jr. and J. W. Knutson. [1964] [1]p. (AFOSR-65-0114) (AF AFOSR-64-626) Unclassified

Presented at Spring meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 500, 1964.

Profiles of single-pass gain at optimal pressures were measured with a 2 mm probe and 15 mm discharge tube. Constant-temperature inversion densities satisfy $I(r, \xi) \approx I_{max} J_0(2.4r/R)\xi[2-f(r)\xi]$, where $f(r) \approx 1-0.2(r/R)^2 R$ the tube radius and ξ increases with upper-level excitation. Increasing gas temperature raises I_{max} by increasing lower-state relaxation. Higher-pressure neon discharges exhibit lower-state densities varying as $\approx J_0^2$ as compatible with electron excitation from neon metastables. Observed $I(r, \xi)$ are not compatible with this saturation mechanism near optimum, however. Resonance-trapping by metastable levels may explain the $1/R$ dependence of I_{max}. An interpretational check depends on numerical solutions to the resonance-trapping problem. The form of $I(r, \xi)$ explains selective excitation of odd-symmetric cavity modes at high discharge intensities.

3093

Yale U. [Sloane Physics Lab.] New Haven, Conn.

ADDITIONAL CASCADE LASER TRANSITIONS IN He-Ne MIXTURES (Abstract), by W. R. Bennett, Jr., A. T. Pawlikowski, and J. W. Knutson. [1964] [1]p. (AFOSR-65-0115) (AF AFOSR-64-626) Unclassified

Presented at meeting of the Amer. Phys. Soc., Washington, D. C., Apr. 27-30, 1964.

Also published in Bull. Amer. Phys. Soc., Series II, v. 9: 500, 1964.

Continuous oscillation was obtained on the $3p_4 \rightarrow 2s_4$ and $3p_2 \rightarrow 2s_5$ transitions of neon at 2.0350 and 1.9577 μ. Population of the $3p_4$ level is obtained directly from laser oscillation on the strong $3s_2 \rightarrow 3p_4$ transition at 3.3913 μ. The $3p_2$ presumably arises in collision transfer from the $3p_4$ ($\Delta E \approx 0.9$ cm^{-1}). Stimulated emission was not employed as a lower-state relaxation mechanism. A 3 m confocal laser was used with quartz Brewster-angle windows, 5 mm id and dielectric mirror coatings peaked at 1.95 μ. Both transitions have comparatively high rf levels for oscillation threshold and are enhanced at the leading edge of the excitation pulse when the rf is modulated. Although the 2.0350 μ transition has a lower threshold than the 1.9577 μ line, comparable output-power levels were obtained from both well above threshold. At optimum pressures, i.e., $P_{He} \approx 1$ mm Hg and $P_{Ne} \approx 0.1$ mm Hg, saturation could not be obtained with the rf supply available.

3094

Yale U. Sloane Physics Lab., New Haven, Conn.

SIMULTANEOUS LASER OSCILLATION ON THE NEON DOUBLET AT 1.1523 μ, by W. R. Bennett, Jr. and J. W. Knutson, Jr. [1964] [1]p. incl. diagr. refs. (AFOSR-65-0416) (AF AFOSR-64-626) AD 612327 Unclassified

Also published in Proc. IEEE, v. 52, July 1964.

The inversion possibilities on the $2s_4 \rightarrow 2p_7$ neon transition were examined. Oscillation was obtained on this transition under two different conditions: first, using electron impact in pure neon; second, in helium-neon mixtures, through use of stimulated emission pumping and multiply-resonant mirror coatings. Only the electron impact results appear of practical value for precision measurements. Beam powers ≈ 1 mw were obtained simultaneously from these two transitions in discharges containing pure neon and the gain coefficients for these two lines appear sufficient to permit simultaneous single mode operation in smaller cavities. The present gain measurements are compatible with the previous data at 1.1523 μ and the assumption of a reciprocal diameter dependence of the inversion density at optimum excitation.

3095

Yale U. [Sterling Chemistry Lab.] New Haven, Conn.

MOLECULAR FRAGMENTS IN SHOCK WAVES, by R. S. Berry. Final rept. Nov. 1, 1960-Oct. 31, 1962, 5p. (AFOSR-J1376) (AF AFOSR-61-35) AD 426567 Unclassified

The possibility of observing absorption spectra of free, gaseous negative ions like chloride or oromide was investigated. The technique proposed was the vaporization and dissociation of alkali halides by a shock wave, followed by short duration absorption spectroscopy. The photodetachment spectra, continuous absorption spectra were obtained for chlorine, bromine, and iodine. From these spectra, precise values of the halogen electron affinities were obtained. The fluoride spectrum was also obtained. The method of flash photolysis with flash spectroscopy was applied to three known precursors of benzene: benzenediazonium-2-carboxylate, o-iodophenyl mercuric iodide and di-o-iodophenyl mercury. Chemical products were strongly indicative of the presence of gaseous benzyne, and a transient broad continuous absorption spectra was obtained which has been assigned to benzyme.

3096

Yale U. Sterling Chemistry Lab., New Haven, Conn.

THERMODYNAMICS AND ELEMENTARY PROCESSES OF GASEOUS IONS, by R. S. Berry. [1963] [63]p. incl. diagrs. table, refs. (AFOSR-64-0252) (AF AFOSR-63-183) AD 431491 Unclassified

Presented at AIAA Conf. on Ions in Flames and Rocket Exhausts, Palm Springs, Calif., Oct. 10-22, 1962.

Also published in Prog. Astronaut. and Aeronaut., v. 12: 3-65, 1963.

The thermodynamics and microscopic processes associated with ions in hot gases are surveyed. Processes are classified and discussed according to whether they are charge production, charge conserving or recombination processes. Emphasis is placed on specification of the important physical variables and magnitudes governing the various processes. An attempt is made to describe the present theoretical and experimental situation in each area and to point out recently-solved and outstanding unsolved problems.

3097

Yale U. Sterling Chemistry Lab., New Haven, Conn.

RADIATIVE CAPTURE OF ELECTRONS BY HALOGEN ATOMS, by R. S. Berry and C. W. David. [1964] [6]p. incl. diagrs. refs. (AFOSR-64-1512) (AF AFOSR-63-183) AD 446114 Unclassified

Also published in Proc. Third Internat'l. Conf. on Phys. of Electronic and Atomic Collisions, London (Gt. Brit.) (July 22-26, 1963), ed. by M. R. C. McDowell. Amsterdam, North Holland Publishing Co., 1964, p. 543-548.

This reports the direct spectroscopic observation of radiative capture of electrons by the free gaseous halogen atoms Cl, Br and I. The spectra were obtained from emission produced by alkali halides vaporized and dissociated by shock-heating. The sharp onsets of radiation due to capture of electrons of zero energy are clearly visible. The radiation intensity dependence near onset is within experimental uncertainty, consistent with the photodetachment spectra, the Wigner threshold law and microscopic reversibility. The continua are identified by shape and threshold wavelength, and in the case of Cl and Br, by the presence and wavelength of continua due to the capture of electrons by atoms in their excited states. Threshold wavelengths are in good agreement with the photodetachment thresholds. (Contractor's abstract, modified)

3098

Yale U. [Sterling Chemistry Lab.] New Haven, Conn.

MOLECULAR FRAGMENTS, by R. S. Berry. Final rept. Nov. 1, 1962-Oct. 31, 1964, 4p. incl. refs. (AFOSR-65-1213) (AF AFOSR-63-183) Unclassified

The following work was conducted: (1) Spectroscopic study of free gaseous negative ions; (2) Consolidation of work on benzene; (3) Generalization of the study of gaseous polyatomic fragments, their kinetics and mechanisms of reaction, to include meta and para dehydrobenzenes and nitrenes; (4) Generalization of the negative ion work to the study of radiative capture and of the theory of electron-molecule collisions; and (5) Beginning of an investigation of the behavior of charges in molecular crystals. Publications resulting from this work are listed.

3099

Yale U. Sterling Chemistry Lab., New Haven, Conn.

DIPOLE ASSOCIATION, by C. Treiner, J. F. Skinner, and R. M. Fuoss. [1964] [4]p. incl. diagrs. tables, (AFOSR-65-2381) (AF AFOSR-63-244, AD 626520 Unclassified

Also published in Jour. Phys. Chem., v. 68: 3406-3409, Nov. 1964.

Dimerization of dipolar solutes in solvents of low dielectric constant is proposed, and a method of determining association constants (and dipole moments) from dielectric constants and densities is derived. In dioxane, p-nitroaniline, m-nitrophenol, and pyridinium dicyanomethylide were found to have association constants of 0.37, 0.8, and 3, respectively. The logarithms of these constants are linear in the square of the dipole moments (4.38, 6.91, and 9.2) as expected from theory. (Contractor's abstract)

3100

Yeshiva U. Belfer Graduate School of Science, New York.

INTEGRAL EQUATIONS AND INEQUALITIES IN THE THEORY OF FLUIDS (Abstract), by J. L. Lebowitz and J. K. Percus. [1964] [2]p. (AFOSR-5052) (AF AFOSR-62-64) Unclassified

Using the method of functional Taylor expansion developed previously, an extensive set of equations is obtained for the distribution functions and Ursell functions in a classical fluid. These include in a systematic way many previously derived relations. By terminating the Taylor expansion after a finite number of terms and retaining the remainder, inequalities are also obtained for the distribution functions and thermodynamic parameters of the fluid. For the case of positive interparticle potentials, inequalities are recovered that were first found by Lieb. For non-positive potentials, new inequalities are derived. These inequalities are applied to the case of a hard sphere fluid in three dimensions. (Contractor's abstract)

3101

Yeshiva U. [Belfer Graduate School of Science] New York.

EXACT SOLUTION OF GENERALIZED PERCUS-YEVICK EQUATION FOR A MIXTURE OF HARD SPHERES, by J. L. Lebowitz. [1964] [5]p. (AFOSR-64-1918) (AF AFOSR-62-64) AD 450515 Unclassified

Also published in Phys. Rev., v. 133: A895-A899, Feb. 17, 1964.

The Percus-Yevick approximate equation for the radial distribution function of a fluid is generalized to an m-component mixture. This approximation can be formulated by the method of functional Taylor expansion. The resulting equation yields correctly the virial expansion of the pressure up to and including the third power in the densities and is in very good agreement with the available machine computations for a binary mixture. For a one-component system our solution for C(r) and g(r) reduces to that found previously by Wertheim and Thiele and the equation of state becomes identical with that found on the basis of differential approximations by Reiss, Frisch, and Lebowitz.

3102

Yeshiva U. [Belfer Graduate School of Science] New York.

THE REMAINDER IN MAYER'S FUGACITY SERIES, by O. Penrose. [1963] [7]p. (AFOSR-64-1975) (AF AFOSR-62-64) AD 452507 Unclassified

Also published in Jour. Math. Phys., v. 4: 1488-1494, Dec. 1963.

Upper and lower bounds are obtained for the remainder after a finite number of terms of the expansions in powers of fugacity z for the pressure p, the s-particle distribution functions, the density ρ, and the fugacity coefficient z/ρ for a system of particles with two-body interactions. The interaction potential must be either nonnegative or else have a hard core and decrease faster than r^{-3} at large distances. The results hold for all positive z, and apply to lattice gases as well as to fluids. For nonnegative potentials, the results imply that successive partial sums of each of these fugacity expansions provide alternate upper and lower bounds, valid even if the series diverges, on the physical quantity the expansion represents.

3103

Yeshiva U. [Belfer Graduate School of Science] New York.

AVERAGE DENSITY APPROXIMATION FOR THE RADIAL DISTRIBUTION FUNCTION OF A FLUID, by J. L. Lebowitz and E. Praestgaard. [1964] [8]p. (AFOSR-64-2303) (AF AFOSR-62-64) AD 452410 Unclassified

Also published in Jour. Chem. Phys., v. 40: 2951-2958, May 15, 1964.

The radial distribution function of a fluid, g(r), is directly related to the difference between the work W(r,p) necessary to introduce an extra particle at a distance r from the known position of a particle, and the work W(p) of introducing a particle at an arbitrary point in the fluid. Now a system in which one particle is kept fixed can be thought of as a nonuniform system with density $\rho g(r)$. This suggests that W(r,p) can be written as W(p) where p(r) is some appropriate effective local density. When the equation is solved in a virial expansion it yields reasonably good results for the first few terms. A linearization of this equation leads to an integral equation of the type considered by Kirkwood who was first to consider this type of approximation.

3104

Yeshiva U. [Belfer Graduate School of Science] New York.

THERMODYNAMIC PROPERTIES OF MIXTURES OF HARD SPHERES, by J. L. Lebowitz and J. S. Rowlinson. [1964] [6]p. (AFOSR-64-2312) (AF AFOSR-64-508) AD 452383 Unclassified

Also published in Jour. Chem. Phys., v. 41: 133-138, July 1, 1964.

Investigation has been made of the thermodynamic properties of a binary mixture of hard spheres (with special reference to the existence of a phase transition) by using the recently obtained exact solution of the generalized equations of Percus and Yevick for the radial distribution functions of such a mixture. The distribution function obtained from the equations of Percus and Yevick is only an approximation and so yields two different pressures when used, respectively, in the compressibility equation of Ornstein and Zernike and in the equation of state obtained from the virial theorem.

3105

Yeshiva U. Belfer Graduate School of Science, New York.

CONVERGENCE OF VIRIAL EXPANSIONS, by J. L. Lebowitz and O. Penrose. [1964] [7]p. incl. refs. (AFOSR-65-0109) (AF AFOSR-62-64) AD 455780 Unclassified

Also published in Jour. Math. Phys., v. 5: 841-847, July 1964.

Some bounds are obtained on R(V), the radius of convergence of the density expansion for the logarithm of the grand partition function of a system of interacting particles in a finite volume V, and on R, the radius of convergence of the corresponding infinite-volume expansion (the virial expansion). For potentials with hard cores the maximum density is an upper bound on R(V), though possibly not on R; an example shows how both R(V) and R can be less than the maximum density, even if there is no phase transition. A theorem is proved, analogous to Yang and Lee's theorem on uniform convergence in the complex z plane, defining a class of domains in the complex ρ plane within which the operations $V \to \infty$ and d/d_ρ commute. This theorem is used to show that $\lim_{V \to \infty} R(V) \leq R$, and that there is no phase transition for $0 \leq \rho < 0.28952/(u + 1)B$. (Contractor's abstract, modified)

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The following is a list of all AFOSR reports to which control numbers were assigned and which were actually issued during this period. All omissions are deliberate; the absence of a number implies that the report assigned that number was never published.

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	365	416		1058	2100
	371	1074		1075	1346
	436	2110		1078	2093
	460	1083		1079	2975
	467	840		1082	2193
	476	1296		1084	2282
	482	3032		1085	2313
	495	2911		1089	2858
	496	2912		1090	281
	527	2738		1095	2342
	528	1652		1097	1765
	575	2031		1100	56
	611	2070		1101	1059
	613	557		1102	2052
	635	1232		1108	181
	641	1193		1110	3044
	649	2800		1112	1732
	650	1387		1115	2733
	657	1952		1116	1509
	674	1231		1118	1510
	694	417		1120	1618
	708	2783		1121	1619
	719	2774		1122	1620
	733	2632		1124	1621
	738	797		1125	2053
	739	1792		1126	1840
	767	1888		1127	974
	799	1298		1128	3068
	800	1299		1129	1391
	817	2233		1134	311
	829	310		1135	312
	844	741		1137	67
	846	2216		1141	1728
	847	1434		1142	378
	850	2771		1144	938
	852	2529		1148	2399
	857	1866		1151	1960
	893	413		1155	2221
	908	1218		1157	372
	917	920		1159	1445
	920	2889		1166	2705
	921	2593		1171	770
	925	939		1175	1680
	954	2422		1179	1986
	960	714		1189	1671
	967	2530		1205	2883
	968	2594		1206	1911
	973	2292		1208	2643
	977	1614		1211	1700
	990	1615		1213	2801
	1000	1616		1214	3079

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		Item No.			Item No.
AFOSR-J	1221	1811	AFOSR-J	1374	739
	1222	1812		1375	1319
	1223	1451		1376	3095
	1224	137		1377	1206
	1225	803		1392	2637
	1226	2122		1393	1622
	1227	2123		1395	245
	1228	2124		1396	246
	1235	1433		1404	574
	1237	1408		1413	1254
	1239	786		1421	819
	1241	2531		1426	2058
	1242	672		1435	2532
	1248	1388		1443	1764
	1250	2267		1447	734
	1254	733		1454	1287
	1255	216		1456	277
	1256	2539		1457	2125
	1281	2716		1458	604
	1264	2229		1463	766
	1271	1176		1467	2208
	1278	2717		1475	405
	1280	636		1478	2898
	1290	799		1477	2859
	1297	685		1483	2959
	1302	2641		1489	1770
	1306	573		1515	1838
	1309	1933		1518	1876
	1310	1942		1519	864
	1315	1660		1520	829
	1316	860		1521	454
	1317	3002		1522	2153
	1320	1251		1523	1831
	1323	2081		1530	79
	1324	2071		1536	2725
	1325	2072		1540	2979
	1327	2073		1542	1079
	1328	2074		1545	1623
	1329	2075		1546	1624
	1330	2076		1553	1882
	1331	2077		1555	1058
	1337	149		1557	1392
	1338	2408		1558	1401
	1342	1501		1561	2350
	1343	129		1573	664
	1350	1483		1574	306
	1351	874		1578	947
	1352	88		1579	307
	1355	2943		1581	953
	1356	1382		1586	1744
	1358	418		1595	1511
	1361	366		1597	1512
	1362	783		1607	65
	1363	2858		1608	921
	1364	2019		1616	1089
	1367	1233		1618	2318
	1389	729		1620	102
	1370	2003		1621	471
	1371	1928			
	1373	2057			

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		Item No.			Item No.
AFOSR-64	0001	1090	AFOSR-64	0247	1722
	0002	2645		0250	313
	0003 (See item no. 184)			0252	3096
	0005	871		0257	1927
	0015	491		0258	705
	0017	1277		0259	99
	0018	1407		0262	825
	0020	2704		0263	222
	0021	2799		0264	223
	0022	2904		0265	2242
	0024	1240		0268	1497
	0025	2473		0269	584
	0029	363		0271	3016
	0039	2303		0273	780
	0048	686		0274	585
	0053	2357		0276	2984
	0054	649		0280	1174
	0058	2810		0281	152
	0060	242		0284	760
	0074	1720		0295	518
	0075	2877		0298	455
	0092	2423		0304 (See item no. 1104)	
	0093	2424		0305	1995
	0103	1194		0307	2638
	0105	22		0309	1625
	0106	1985		0310	1626
	0109	679		0311	875
	0111	141		0312	1019
	0112	1916		0313	1020
	0113	142		0315	1627
	0117	1665		0318	247
	0118	1487		0323	1628
	0119	11		0327	1629
	0122	2953		0329	876
	0124	55		0332	1630
	0128	1171		0333	1631
	0130	1371		0336	2657
	0131	1782		0337	1632
	0132	3043		0338	1633
	0134	596		0339	1634
	0147	2295		0340	1635
	0148	1489		0344	877
	0151	1154		0345	878
	0153	2884		0346	2652
	0154	20		0347	1021
	0157	1375		0348	2620
	0161	3058		0349	2621
	0164	1488		0350	2172
	0165	2712		0351	2639
	0176	632		0352	2622
	0190	2417		0353	2196
	0199	1809		0357	390
	0213	940		0364	2326
	0216	3059		0365	1300
	0217	2927		0367	423
	0220	968		0368	424
	0221	1771		0370	425
	0223	3056		0372	217
	0233	2865		0391	1851
	0238	966		0392	49

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		Item No.			Item No.
AFOSR-64	0393	50	AFOSR-64	0599	1022
	0394	1852		0600	1023
	0401	186		0601	1024
	0412	975		0604	900
	0417	1966		0605	879
	0422	2787		0606	880
	0428	1513		0607	1025
	0429	522		0608	1026
	0437	(See item no. 1412)		0609	1027
	0440	524		0610	1028
	0443	1055		0611	901
	0450	2982		0614	902
	0455	2351		0616	903
	0456	414		0619	881
	0457	1393		0620	882
	0459	314		0621	2660
	0460	315		0622	2661
	0465	394		0623	2662
	0468	1514		0624	2663
	0469	1515		0625	2664
	0475	792		0627	2623
	0483	793		0628	2624
	0507	3083		0629	1503
	0508	2349		0630	2625
	0515	2243		0636	486
	0519	715		0638	427
	0520	922		0639	1867
	0521	1301		0640	1363
	0522	426		0645	1815
	0526	2244		0649	2247
	0535	716		0650	3084
	0540	545		0652	2770
	0541	1498		0653	207
	0542	2509		0658	428
	0543	931		0659	429
	0544	932		0660	430
	0545	933		0665	627
	0546	3039		0668	2460
	0549	1499		0683	1794
	0552	(See item nos. 1124; 2245)		0684	730
	0553	2246		0689	883
	0557	91		0690	884
	0560	1853		0691	885
	0562	42		0693	886
	0565	2455		0695	2665
	0567	2945		0697	2626
	0570	613		0700	1543
	0571	626		0702	904
	0572	1965		0703	1029
	0573	472		0704	1030
	0576	1372		0705	1031
	0581	123		0706	1032
	0582	1814		0707	1033
	0583	1446		0709	1034
	0589	1872		0711	722
	0590	2873		0713	1484
	0591	2775		0714	2728
	0592	2798		0715	2729
	0594	153		0716	2319
	0596	154		0717	2320

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AFOSR-64	0718	1459
	0719	1215
	0723	36
	0725	2386
	0727	2588
	0728	1485
	0732	2334
	0733	1270
	0734	742
	0735	1143
	0736	451
	0737	847
	0741	1144
	0742	2126
	0751	1060
	0754	308
	0755	948
	0756	954
	0760	2054
	0768 (See item no. 2000)	
	0769	208
	0776	794
	0777	795
	0790	2540
	0791	2541
	0792	2542
	0793	2543
	0794	92
	0795	93
	0796	461
	0798	1125
	0802	124
	0803	125
	0804	126
	0805	1864
	0807	3020
	0809	2288
	0810	1740
	0814	2358
	0820	579
	0821	580
	0825	789
	0826	1646
	0831	1647
	0832	447
	0833	3070
	0837	872
	0840	40
	0841	1258
	0843	2514
	0848	148
	0858	2217
	0860	836
	0861	800
	0862	3011
	0863	3012
	0865	1302
	0868A	2768
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	0877	2811

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AFOSR-64	0881	657
	0883	2871
	0884	2961
	0885	1795
	0886	726
	0887	727
	0888	2493
	0889	2494
	0890	2495
	0891	1035
	0893	138
	0894	282
	0895 (See item no. 623)	
	0898	2900
	0899	2197
	0900	252
	0901	2666
	0902	2667
	0903	2668
	0904	887
	0906	2615
	0907	2616
	0908	1504
	0910	773
	0911	2874
	0912	2139
	0915	12
	0917	2946
	0918	706
	0920	2461
	0926	2261
	0927	2262
	0928	2263
	0929	2264
	0930	2265
	0932	1948
	0933	2813
	0934	2515
	0935	1373
	0936	1374
	0938	2886
	0940	1854
	0941	1855
	0942	1227
	0947	2571
	0948	2048
	0950	2049
	0951	2403
	0952	822
	0954	2905
	0955	1826
	0956	1827
	0958	1828
	0959	496
	0962	1255
	0966	76
	0967 (See item no. 1294)	
	0968	2820
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AFOSR-64	0975	391	AFOSR-64	1073	1983
	0978	602		1074	1984
	0983	2808		1079	1222
	0986	450		1080	1223
	0988	2925		1081	1224
	0991	835		1082	335
	0992	781		1083	1225
	0993	3013		1086	2404
	0999	1868		1089	2379
	1000	1889		1090	3060
	1001	1218		1092	810
	1002	2501		1107	371
	1003	24		1108	1846
	1004	2021		1109	1783
	1005	1847		1110	913
	1007	1303		1113	105
	1008	2913		1114	1038
	1009	2914		1115	980
	1010	2915		1118	1037
	1011	2918		1117	981
	1012	2917		1118	982
	1013	82		1119	2179
	1014	2248		1120	2180
	1021	2345		1121	2181
	1023	1780		1122	586
	1025	2127		1129	253
	1028	2128		1130	1038
	1027	1915		1132	1039
	1028	2772		1133	2425
	1029	13		1138	1687
	1030	787		1138	889
	1038	408		1139	2947
	1037	2496		1140	2948
	1038	728		1141	2447
	1039	2113		1143	182
	1040	150		1144	1389
	1041	1821		1148	717
	1042	209		1147	718
	1043	210		1148	509
	1044	211		1149	2545
	1045	828		1150	431
	1050	528		1153	2546
	1052	2544		1154	2547
	1053	2364		1155	1394
	1055	1474		1157	403
	1058	2487		1180	448
	1057	1490		1181	77
	1059	1195		1182	1072
	1060	1196		1183	2985
	1061	1197		1188	404
	1062	841		1187	848
	1063	3000		1188	1315
	1064	1664		1189	849
	1066	1259		1170	1271
	1067	1280		1174	2407
	1068	1281		1175	1252
	1069	1282		1178	771
	1070	1980		1177	2995
	1071	1981		1178	2996
	1072	1982		1181	2997

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AFOSR-64	1182	2703	AFOSR-64	1293	2949
	1183	1288		1294	640
	1184	2998		1295	441
	1185	2999		1296	442
	1188	850		1297	443
	1187	851		1298	444
	1189	1987		1299	445
	1192	719		1301	2848
	1195	338		1302	2966
	1196	820		1304	701
	1197	270		1306	2489
	1201	1185		1307	1387
	1202	1168		1308	448
	1203	1167		1310	2879
	1205	1168		1312	594
	1207	2788		1313	595
	1208	2789		1315	2154
	1209	2790		1316	271
	1212	2045		1317	2497
	1213	316		1323	135
	1214 (See item no. 1190)			1329	2669
	1215	2101		1330	2670
	1216	2102		1331	2671
	1217	323		1332	2672
	1219	2032		1334	2673
	1220	2033		1335	2674
	1221	2034		1336	2675
	1222	2918		1337	2678
	1223	2919		1338	2677
	1224	1383		1339	2678
	1225	2043		1340	1295
	1227	1384		1342	905
	1230	41		1343	906
	1231	2987		1344	888
	1233	317		1346	889
	1234	318		1347	890
	1235	395		1348	891
	1236	489		1350	254
	1237	523		1351	2449
	1238	2352		1352	2450
	1240	1349		1353	983
	1241	923		1354	984
	1245	2734		1355	985
	1246	1733		1359	1040
	1247	1734		1380	1041
	1250	3050		1361	1042
	1251	1182		1362	1544
	1252	1163		1383	1545
	1253	1518		1364	1546
	1258	1970		1365	575
	1270	961		1368	578
	1271	830		1367	1547
	1272	2414		1368	1505
	1274	1697		1389	2646
	1275	1681		1370	2847
	1276	1735		1371	581
	1279	1666		1372 (See item no. 151)	
	1280	2806		1373	255
	1291	54		1374	256
	1292	2488		1375	2145

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		Item No.			Item No.
AFOSR-64	1376	2639	AFOSR-64	1486	960
	1377	1841		1487	2146
	1378	1858		1488	134
	1379	2308		1489	2094
	1380	407		1490	590
	1381	1082		1491	591
	1382	1327		1492, Pt. 1	2516
	1383	1328		1492, Pt. 2	2517
	1384	409		1492, Pt. 3	2518
	1386	1856		1494	2519
	1387	1080		1495	1091
	1389	1141		1497	1092
	1391	1857		1498	1093
	1394	2117		1499	1094
	1395	2129		1500	1095
	1396	106		1503	2941
	1397	155		1504	1172
	1404	2255		1505	1173
	1406	2256		1506	1885
	1407	2257		1507	1211
	1408	2258		1508	1953
	1409	2441		1509	1930
	1412	1766		1510	1931
	1413	1961		1511	659
	1414	1962		1512	3097
	1415	1963		1513	2095
	1416	1203		1514	2096
	1417	2017		1515	1241
	1419	501		1516	1242
	1422	2198		1517	2222
	1425	803		1518	452
	1434	1142		1519	1832
	1435	1226		1520	1096
	1439	1706		1522	1097
	1440	935		1525	527
	1441	488		1526	528
	1442	1330		1527	529
	1445	305		1529	1376
	1447	1366		1530	1377
	1448	2293		1531	1378
	1457	16		1532	1379
	1458	2387		1534	832
	1466	1772		1535	1677
	1469	1230		1537	1098
	1470	977		1538	1099
	1471	774		1539	1100
	1472	775		1540	1101
	1473	776		1541	3063
	1474	978		1542	1204
	1475	2828		1543	1205
	1476	2833		1546	1668
	1477	2834		1547	2973
	1478	979		1548	2974
	1479	2284		1549	519
	1480	2285		1550	520
	1481	2835		1552	2908
	1482	2836		1553	2909
	1483	2837		1557	986
	1484	3071		1558	987
	1485	3072		1559	988

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	1561	990		1689	1336
	1562	991		1690	1337
	1563	992		1691	1253
	1564	993		1692	3074
	1565	994		1693	3075
	1566	995		1694	815
	1567	996		1697	2474
	1568	997		1699	1248
	1569	998		1701	2082
	1570	999		1702	2083
	1571	1000		1703	1662
	1574	1548		1704	1338
	1575	1549		1707	352
	1576	1550		1708	2059
	1577	2679		1709	2084
	1579	577		1710	2085
	1580	587		1711	1663
	1581	248		1712	1339
	1583	257		1713	1256
	1584	2451		1714	748
	1589	388		1715	1813
	1591	2339		1719	2730
	1592	2340		1720	2589
	1594	530		1721	392
	1595	2199		1723	1467
	1596	2200		1724	2498
	1599	807		1725	2499
	1604	2804		1726	2500
	1605	1326		1732	2644
	1606	483		1733	2309
	1609	(See item no. 472)		1734	1438
	1616	1455		1735	2753
	1617	1048		1738	1517
	1624	1746		1739	1518
	1627	1410		1740	1519
	1628	2590		1741	665
	1639	541		1742	666
	1642	1844		1744	811
	1647	1837		1745	812
	1649	2853		1746	1738
	1650	2803		1747	2983
	1651	962		1748	2548
	1659	2201		1749	2549
	1661	1468		1751	2550
	1662	1470		1752	2551
	1664	1848		1753	2710
	1665	2931		1754	924
	1670	628		1755	925
	1671	(See item no. 976)		1757	1508
	1672	283		1760	432
	1674	2838		1761	681
	1677	2843		1763	2552
	1679	182		1765	546
	1682	2854		1766	547
	1683	1331		1768	3085
	1684	1332		1770	83
	1685	1333		1771	2353
	1686	1334		1772	2354
	1687	1335		1773	396

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	1777	829
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	1779	2044
	1780	597
	1781	71
	1782	1069
	1783	1889
	1785	2370
	1788	2324
	1789	1879
	1791	858
	1792	2223
	1794	1833
	1796	542
	1797	2520
	1798	2521
	1799	2390
	1802	1475
	1803	2341
	1811	1723
	1812	2814
	1813	2815
	1815	2816
	1818	1954
	1817	1460
	1818	1158
	1819	2335
	1822	272
	1826	1439
	1830	1849
	1831	2147
	1832	2490
	1833	2078
	1834	2079
	1839	2321
	1840	2322
	1841	1145
	1842	2855
	1843	1471
	1844	2408
	1845	2409
	1846	2410
	1847	2411
	1848	2412
	1849	2013
	1850	831
	1851	498
	1854	2906
	1856	823
	1858	858
	1860	2848
	1888	2050
	1867	2864
	1868	1201
	1872	25
	1873	2130
	1874	2778
	1875	2952
AFOSR-64	1876	2107
	1877	2112
	1878	1759
	1879	1721
	1880	2527
	1881	1761
	1882	2207
	1883	2866
	1884	5
	1885	1353
	1886	969
	1887	970
	1888	971
	1889	2954
	1890	680
	1891	288
	1892	287
	1894, Pt. 1	2791
	1894, Pt. 2	2792
	1897	28
	1898	1001
	1899	1002
	1900	1003
	1902	1004
	1903	2627
	1904	2680
	1905	2681
	1906	258
	1908	2648
	1909	2182
	1910	1551
	1912	687
	1913	2190
	1914	1673
	1915	681
	1918	2389
	1918	3101
	1919	2359
	1920	892
	1921	893
	1922	1883
	1924	10
	1925	2553
	1928	2554
	1927	2555
	1929	2595
	1930	2596
	1931	2597
	1932	2598
	1933	2599
	1934	1494
	1935	1495
	1940	2506
	1941	2587
	1943	14
	1947	1924
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	1954	2861
	1956	3073
	1957	702
	1960	743
	1961	2191
	1962	688
	1963	689
	1964	1674
	1968	1182
	1969	1183
	1970	156
	1971	157
	1972	2935
	1975	3102
	1976	1181
	1978	1865
	1979	2719
	1980	690
	1981	691
	1982	1937
	1983	1938
	1984	1939
	1985	2938
	1987	2556
	1990	2192
	1995	1729
	2000	2779
	2001	2713
	2002	2714
	2003	27
	2006	1086
	2009	6
	2010	2328
	2011	2329
	2012	2330
	2014	1257
	2015	421
	2017	1447
	2018	2283
	2019	143
	2020	144
	2021	28
	2026	1155
	2028	107
	2029	2420
	2031	234
	2032	837
	2033	838
	2034	2195
	2037	2707
	2044	227
	2045	228
	2047	2365
	2048	926
	2049	927
	2051	1364
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	2059	462
	2060	2722
	2061	3086
	2063	824
	2065	3055
	2067	2649
	2074	163
	2076	1520
	2077	2786
	2078	1394
	2079	1395
	2080	1396
	2081	1397
	2084	957
	2088	2138
	2089	1521
	2090	1522
	2093	1523
	2094	1920
	2095	1996
	2097	2793
	2098	1073
	2101	1900
	2104	3051
	2105	1164
	2106	3069
	2107	2035
	2108	1385
	2109	2355
	2110	2356
	2112	319
	2115	2103
	2117	324
	2118	419
	2119	420
	2120	1118
	2121	2920
	2123	958
	2127	1850
	2128	2872
	2129	1465
	2130	2234
	2131	2235
	2132	2249
	2133	2250
	2134	2251
	2135	2252
	2136	582
	2137	1005
	2138	2173
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	2149	959		2246	2134
	2150	3053		2247	1782
	2151	3054		2249	660
	2152	2323		2250	2797
	2153	2088		2252	1890
	2154	1263		2253	614
	2157	2060		2254	1228
	2158	2081		2255	1717
	2159	1198		2256	121
	2160	1360		2257	555
	2182	852		2258	556
	2183	853		2259	965
	2164	854		2260	2400
	2185	855		2261	2936
	2167	2958		2262	3033
	2188	1361		2265	2978
	2176	1862		2266	2268
	2182	521		2267	821
	2184	1784		2289	2098
	2185	1785		2277	2572
	2188	1786		2279	1753
	2187	1787		2280	915
	2188	1788		2282	1559
	2189	1789		2283	1560
	2190	2522		2284	1561
	2191	2523		2285	1562
	2192	531		2288	1583
	2193	532		2289	1564
	2195	533		2290	2980
	2196	534		2291	1675
	2197	535		2292	1676
	2198	538		2300	158
	2199	2513		2303	3103
	2200	1724		2305	2969
	2202	1775		2306	2970
	2203	1681		2307	185
	2204	2944		2309	1940
	2208	1243		2310	2939
	2209	592		2311	2940
	2210	1790		2312	3104
	2214	892		2315	1736
	2215	893		2316	2155
	2218	894		2318	384
	2220	578		2319	1159
	2221	249		2320	1180
	2222	2650		2321	1895
	2223	2851		2322	1896
	2224	280		2323	1913
	2225	281		2324	1748
	2228	2183		2325	1440
	2227	1925		2336	433
	2228	145		2338	2560
	2231	749		2339	2561
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	2233	1454		2341	84
	2238	1452		2343	2928
	2240	1917		2345	1524
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	2365	916
	2367	2148
	2368	2805
	2369	856
	2370	2563
	2373	2564
	2374	2565
	2364	2977
	2365	1285
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	2388	785
	2389	2060
	2390	1063
	2406	474
	2407	475
	2408	476
	2409	1793
	2410	1046
	2411	2026
	2413	866
	2414	379
	2415	2802
	2416	2156
	2417	1436
	2419	2830
	2423	1701
	2424	1461
	2429	1290
	2430	1210
	2431	95
	2433	2344
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	2440	232
	2441	233
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	2443	235
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	2447	1056
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	2453	907
	2455	1567
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	2477	2463
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	2479	2062
	2480	1199
	2481	2950
	2482	2881
	2483	367
	2486	3066
	2488	1934
	2489	917
	2490	918
	2491	3076
	2492	816
	2494	2609
	2495	1859
	2496	1860
	2496	2573
	2499	1646
	2500	2606
	2501	2607
	2502	2937
	2503	2617
	2504	569
	2505	456
	2506	675
	2506	2029
	2509	1409
	2511	1466
	2512	2566
	2514	928
	2517	72
	2516	133
	2519	1649
	2521	1526
	2522	1687
	2525	1901
	2526	1061
	2527	1902
	2526	309
	2529	110
	2536	73
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	0008	2439		0118	1309
	0009	1955		0119	434
	0010	1956		0120	435
	0011	593		0121	436
	0013	1102		0122	437
	0015	543		0129	1845
	0020	1572		0130	2534
	0021	1573		0132	735
	0022	1574		0133	736
	0025	1575		0134	2253
	0027	676		0135	2254
	0028	677		0136	2567
	0029	2502		0137	122
	0031	2118		0139	1221
	0033	1862		0140	85
	0034	615		0141	3087
	0035	769		0143	3088
	0036	1656		0144	440
	0037	1657		0145	1134
	0038	1658		0147	1135
	0039	2091		0148	1136
	0040	1316		0150	1137
	0042	2475		0151	1138
	0046	2510		0153	1644
	0047	350		0156	1292
	0048	351		0157	1119
	0056	1325		0159	1874
	0057	2491		0161	1875
	0058	2203		0162	1903
	0060	1997		0163	3045
	0070	2652		0164	64
	0071	678		0165	1527
	0072	936		0166	1528
	0073	1650		0167	1529
	0074	1651		0171	544
	0078	1480		0172	630
	0089	2030		0174	2042
	0091	1881		0175	2445
	0092	919		0176	2446
	0093	81		0177	525
	0096	1684		0180	34
	0097	744		0181	1070
	0098	745		0182	1690
	0099	2372		0184	1386
	0101	2373		0185	470
	0103	1941		0186	2986
	0104	651		0187	1741
	0105	652		0188	1742
	0106	653		0189	322
	0107	2524		0191	325
	0108	662		0193	2204
	0109	3105		0194	2205
	0110	694		0203	1873
	0111	695		0207	2960
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	0232	480
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	0234	482
	0235	1207
	0236	1208
	0237	1725
	0238	1726
	0244	2304
	0245	538
	0248	2849
	0249	2682
	0250	2628
	0251	1043
	0254	1576
	0255	1577
	0256	1007
	0257	1008
	0258	1009
	0260	2149
	0261	2882
	0262	2653
	0263	2654
	0264	262
	0266	274
	0267	1578
	0268	1579
	0269	1580
	0270	1581
	0275, Pt. 1	861
	0275, Pt. 2	862
	0276	1842
	0277	2503
	0278	108
	0279	2023
	0280	2024
	0281	3003
	0282	3040
	0288	2608
	0290	2401
	0291	2750
	0292	2751
	0293	1329
	0294	790
	0295	2739
	0297	1907
	0298	489
	0299	2511
	0300	2512
	0301	3041
	0302	3042
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	0310	1317
	0317	867
	0318	868
	0319	2336
	0320	682
	0321	2731
	0323	2157
	0324	1463
	0326	2290
	0327	1437
	0328	1493
	0329	2310
	0330	2311
	0331	358
	0332	2732
	0333	1863
	0334	275
	0341	389
	0342	2316
	0343	874
	0344	1177
	0345	1481
	0349	2726
	0350	914
	0352	2955
	0355	98
	0359	655
	0360	1582
	0361	1583
	0362	1584
	0363	1585
	0364	2655
	0365	1730
	0366	1273
	0367	1669
	0368	1670
	0369	52
	0371	1773
	0372	1209
	0373	656
	0374	731
	0376	365
	0377	200
	0378	2818
	0379	2819
	0380	96
	0382	2305
	0383	2306
	0384	2307
	0385	1381
	0389	1861
	0390	2452
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		2375		0486	2271
	0404	2376		0487	2272
	0406	2720		0488	463
	0407	654		0489	464
	0410	696		0490	29
	0411	697		0493	241
	0412	1184		0494	2273
	0413	1185		0495	2274
	0414	1186		0496	2275
	0415	1187		0497	2276
	0416	3094		0498	2277
	0417	1994		0499	2278
	0418	746		0500	1418
	0419	747		0501	1419
	0422	130		0502	1420
	0432	18		0503	1417
	0436	2360		0504	1421
	0438	1075		0505	1422
	0439	1076		0506	1423
	0440	1077		0507	1424
	0441	644; 1835		0508	3089
	0442	2361		0509	515
	0443	2377		0510	516
	0444	2374		0511	2600
	0445	1943		0513	410
	0446	1219		0514	1345
	0448	1084		0516	1341
	0449	1085		0517	2440
	0450	2721		0518	190
	0451	1944		0519	191
	0453	1967		0520	192
	0454	1968		0521	193
	0455	201		0522	194
	0456	202		0523	195
	0457	203		0524	1234
	0460	1919		0525	1235
	0461	1365		0526	1236
	0462	1312		0527	1237
	0463	504		0528	1238
	0464	505		0530	1239
	0465	929		0531	2962
	0466	2535		0532	3061
	0467	2536		0534	3062
	0468	510		0535	2929
	0469	511		0536	2930
	0470	512		0539	537
	0471	513		0540	1678
	0472	514		0544	1586
	0473	548		0545	1587
	0474	549		0546	1588
	0475	550		0547	1589
	0476	551		0548	2683
	0477	552		0552	1905
	0478	1126		0554	15
	0479	1127		0555	2206
	0480	1883		0558	1918
	0481	1884		0559	2715

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	0562	2844		0696	422
	0563	2845		0698	1087
	0564	1229		0699	2740
	0565	2138		0700	2741
	0568	1870		0701	2742
	0569	1871		0702	2743
	0570	2331		0703	2744
	0571	2332		0704	2745
	0572	616		0705	2746
	0573	2137		0706	2747
	0578	1220		0707	2748
	0577	120		0708	2749
	0578	828		0712	1718
	0582	1081		0717	1989
	0586	1898		0728	37
	0587	3034		0729	937
	0588	3035		0731	1530
	0589	3038		0732	1531
	0593	967		0735	1532
	0594	2402		0736	1533
	0595	873		0737	1534
	0597	2485		0740	1414
	0598	2488		0742	1398
	0602	1442		0743	1399
	0603	869		0744	1797
	0605	1540		0745	1120
	0606	1541		0746	2922
	0609	2279		0747	2923
	0610	1590		0748	2795
	0611	1727		0751	1191
	0612	1591		0752	1192
	0614	1679		0755	2934
	0615	2576		0782	415
	0618	2337		0783	1189
	0617	817		0785	2794
	0618	1351		0786	88
	0621	2158		0789	3081
	0622	2159		0770	2055
	0624	385		0771	3046
	0626	2591		0772	1062
	0627	1914		0773	2812
	0628	2312		0774	2143
	0629	2993		0778	2046
	0632	278		0780	2047
	0633	2577		0733	598
	0634	2578		0784	103
	0635	2579		0785	1904
	0638	2580		0791	326
	0638	2180		0792	327
	0648	1403		0793	328
	0647	1404		0794	329
	0651	1405		0797	1054
	0656	1413		0798	1057
	0664	707		0799	2724
	0687	1978		0800	1084
	0687	1838		0802	399
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	0809	1310		0943	846
	0815	553		0944	1264
	0817	465		0945	1265
	0818	94		0946	1320
	0819	466		0947	1321
	0820	737		0948	1322
	0822	86		0949	1323
	0823	87		0950	1324
	0825	1313		0951	2888
	0826	1425		0953	1318
	0827	517		0954	2426
	0828	1311		0955	1202
	0829	2007		0964	349
	0830	2008		0966	1146
	0831	2009		0967	499
	0832	438		0968	500
	0833	439		0980	2226
	0836	506		1001	380
	0837	507		1002	381
	0839	2236		1003	502
	0840	2237		1004	684
	0841	2238		1005	1464
	0842	2239		1008	2781
	0843	2240		1011	273
	0844	2537		1012	1897
	0860	1188		1017	2840
	0864	30		1018	2841
	0865	204		1019	2842
	0866	2727		1020	2821
	0867	1402		1021	1443
	0868	1749		1023	1161
	0869	1750		1025	2785
	0870	1751		1029	2880
	0873	2011		1030	859
	0885	2225		1031	2067
	0886	453		1032	941
	0890	2823		1033	942
	0898	1719		1036	1743
	0903	1592		1037	382
	0910	263		1039	386
	0911	264		1040	1128
	0914	2453		1041	1129
	0918	2131		1045	1113
	0919	2140		1046	2829
	0920	2507		1047	2839
	0921	2135		1048	768
	0923	1441		1053	2862
	0925	2860		1055	39
	0926	1910		1056	2901
	0927	1105		1059	752
	0928	1106		1062	2241
	0929	1107		1066	2538
	0930	1108		1075	159
	0931	1109		1077	2613
	0932	1110		1078	2614
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	1088	3023		1290	1971
	1089	3024		1292	857
	1090	3025		1293	492
	1091	3026		1294	493
	1093	3027		1295	1979
	1094	3028		1296	1357
	1097	1822		1297	1992
	1098	1823		1299	3001
	1099	1824		1300	3009
	1100	1825		1301	3010
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