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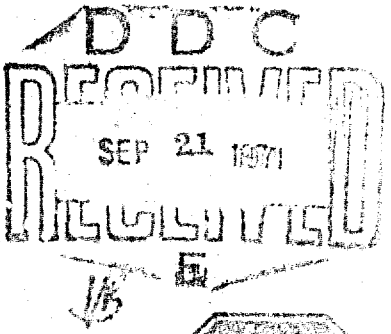
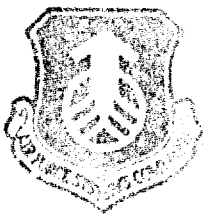
AFCRL-71-0247
1 APRIL 1971
SPECIAL REPORTS, NO. 118

AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

Bibliography, With Abstracts, of AFCRL Publications From 1 January to 31 March 1971



AIR FORCE SYSTEMS COMMAND
United States Air Force



14. KEY WORDS	LINK A		LINK B		LINK C	
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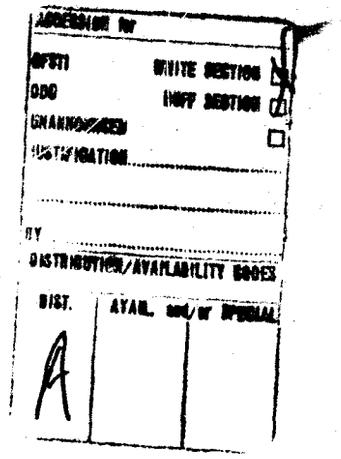

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3. REPORT TITLE

BIBLIOGRAPHY, WITH ABSTRACTS, OF AFCRL PUBLICATIONS FROM 1 JANUARY TO 31 MARCH 1971

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

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5. AUTHOR(S) *(First name, middle initial, last name)*

6. REPORT DATE April 1971	7a. TOTAL NO. OF PAGES 156	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

1—This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued from 1 January to 31 March 1971. Abstracts are included.

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AFCRL-71-0247
1 APRIL 1971
SPECIAL REPORTS, NO. 118

AIR FORCE CAMBRIDGE RESEARCH LABORATORIES
L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

Bibliography, With Abstracts, of AFCRL Publications From 1 January to 31 March 1971

AIR FORCE SYSTEMS COMMAND
United States Air Force

Abstract

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued from 1 January to 31 March 1971. Abstracts are included.

Contents

Bibliography, With Abstracts, of AFCRL Publications From 1 January to 31 March 1971

INTRODUCTION

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued during the reporting period. The DD Form 1473 (Document Control Data - R&D) for each publication is included.

In Part I, the 1473's for in-house reports are arranged numerically by the series in which they were issued; in Part II, the 1473's for journal articles are arranged alphabetically by author; in Part III, the 1473's for contractor reports are arranged alphabetically by corporate author. For cross-reference purposes, an index is included, listing the publications numerically by the AFCRL document number.

Types of AFCRL Reports

AFCRL technical reports include those prepared in-house and those prepared by contractors. The in-house reports are issued in six series, and the contractor reports are of two types. The in-house series and the types of contractor reports are described below.

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This series is utilized for two types of environmental research information: (a) research results that are directly applicable to design, developmental, or

operational problems of the Air Force, and (b) survey or state-of-the-art papers in a specific area of the environmental sciences.

INSTRUMENTATION PAPERS

Instrumentation Papers present information about new techniques, procedures, instrumentation, components, or vehicles utilized in AFCRL research efforts.

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In general, these papers report results of AFCRL research in the information and mathematical sciences, microwave physics, laser physics, solid state sciences, and spectroscopy.

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Papers reporting results of AFCRL research in the environmental sciences, including space physics, upper atmosphere physics, optical physics, meteorology, and the terrestrial sciences are published in this series.

SPECIAL REPORTS

The Special Reports series provides a publication medium for (a) papers that do not report specific research results, such as bibliographies and proceedings of symposia, (b) papers by special employees of AFCRL, such as summer employees or cooperative students, (c) theses written by AFCRL employees, and (d) significant management and administrative reports. Other special categories may be accommodated in this series as the need arises.

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Scientific Reports are normally prepared when a definable phase of the research has been completed, when the research effort reaches a point where it is natural and logical to summarize the results, or if no other scientific report was issued during the contract year. Scientific Reports cover all phases of work undertaken during the period of the report, including the contents of papers published in scientific journals or presented at scientific meetings.

FINAL REPORTS

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Cameron Station
Alexandria, Virginia 22314

All other persons and organizations desiring copies of AFCRL technical reports should apply to the:

National Technical Information Service (NTIS)
Springfield, Virginia 22151

Part I
AFCRL In-House Reports by Series

Air Force Surveys in Geophysics

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Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LK)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
OPTICAL OBSERVATIONS OF CHEMICAL RELEASES IN THE UPPER ATMOSPHERE DURING 1969, WITH DESCRIPTION OF INSTRUMENT USED FOR DAYTIME VAPOR-TRAIL TRACKING

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Gordon T. Best

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
26 October 1970	30	28

8a. CONTRACT OR GRANT NO. LDF
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b. PROJECT, TASK, WORK UNIT NOS. 7635-13, 14-01
c. DOD ELEMENT 62101F
d. DOD SUBELEMENT 681000

9a. ORIGINATOR'S REPORT NUMBER(S)
AFCRL-70-0692

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
AFSG No. 227

10. DISTRIBUTION STATEMENT
1. This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES
This research was partially supported by the AFCRL Laboratory Director's Fund.

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LK)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

During 1969, a number of rocket payloads flown by AFCRL released clouds of chemical vapor, which were measured by triangulation and spectroscopy. This report discusses the results of spectroscopic measurements made on barium clouds and the spectrum of the luminous cloud produced by a release of diborane. A tracking instrument for detecting high-altitude vapor trails during the day is also described, together with the results of a successful field test.

The results of these studies are relevant to current Air Force needs in the areas of electromagnetic wave propagation through a disturbed medium, accurate prediction of satellite orbits, and prediction of motion of nuclear debris.

KEYWORDS: Upper atmosphere dynamics, Chemical releases, Optical instrumentation, Spectroscopy

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DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LKC)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
A HYDROSTATIC APPROXIMATION FOR THE FLATTENING OF THE PLANETS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Harry E. Moses
Antonio F. Quesada

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
2 December 1970	13	14

8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)
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c. DOD ELEMENT	62101F	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
d. DOD SUBELEMENT	681000	AFSG, No. 228

10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LKC) LG Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Geodesy plays an important role in determining satellite orbits and paths of chemical releases. A simple hydrostatic model gives the correct flattening ratio of the six oblate planets within a factor of 2.05. A conjecture is hazarded as to why the agreement is not even better.

KEYWORDS: Geodesy, Planets, Flattening ration, Oblateness

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1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LYS)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE

STUDIES OF CLOUDS AND WEATHER OVER SOUTHEAST ASIA

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

John H. Conover

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
21 January 1971	45	11

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-71-0078
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c. DOD ELEMENT 62101F	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* AFSG No. 229
d. DOD SUBELEMENT 681000	

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LY) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT A radar weather index forecast was used to provide a measure of precipitation coverage which in turn would serve as a guide to more detailed forecasts of ceiling, visibility, etc. The index equals the percent coverage by radar echoes within a 50-nmi radius of the station. Hourly indices were computed for Tan Son Nhut, Pleiku, Ubon, and Udorn.

From the analysis of cloudiness, winds, and pressure distributions it was found that weather over the three southernmost stations is best related to prior conditions to the east. Activity at the northernmost station also relates to prior conditions to the east, but weak pressure correlations are also found over the Tibetian Highlands and western Indochina, suggesting an influence from the northwest and west.

Using a stepwise multiple regression program, equations were developed for forecasting 1, 2, and 3 days in advance the probability that the radar index in the afternoon, 1230 to 2330 LT, would be low, average, or high. Variables of cloudiness, sea level pressure, and pressure gradients were found most useful. Nomograms were made to simplify calculations of the forecasts.

Independent test forecasts over the 1969 season showed no skill over recurrence when scored by the Heidke method. Forecasts for 1970 showed skills of +0.18 and +0.14 for days +1 and +2, or about the same as those found with the dependent data. Scores for the day +3 forecasts were near zero. These scores, although low, are considered important because forecasts for these periods are usually based on recurrence or persistence. KEYWORDS: Forecasting weather Southeast Asia, Southwest monsoon Southeast Asia, Satellite cloudiness Southeast Asia, Radar index Southeast Asia

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Environmental Research Papers

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1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LII)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
AREAL MAPPING: A PRELIMINARY ASSESSMENT OF ITS APPLICABILITY TO THE IONOSPHERE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Charles M. Rush
Robert E. Cookingham, 1/Lt, USAF

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
2 December 1970	13	none

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b. PROJECT, TASK, WORK UNIT NOS. ILIR	
c. DOD ELEMENT 61101F	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* ERP No. 338
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
This research was fully supported by the AFCRL Laboratory Director's Fund.	Air Force Cambridge Research Laboratories (LII) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The mapping of ionospheric parameters for the purpose of extending and extrapolating observations is studied. It is found that a relatively simple contouring program can be used to specify the ionosphere in the lower regions that are under strict solar control. Using electron density data representative of various ionospheric stations in North America, it is seen that the shape of the generated contours for the F region depend upon the location of the various stations. These results seem to imply the need for more sophisticated methods of synoptic representation of the upper level ionosphere.

KEYWORDS: Areal mapping, Ionospheric forecasting, Specification, Electron density

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Air Force Cambridge Research Laboratories (LI)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
GLOBAL MORPHOLOGY OF IONOSPHERIC SCINTILLATIONS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Jules Aarons
Herbert E. Whitney
Richard S. Allen

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
16 October 1970	39	27

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Amplitude fluctuations produced by small irregularities in electron density in the F-layer of the ionosphere (at 300 to 400 km height) can be a problem to communication and navigation systems in the VHF-UHF range. Recent measurements, primarily by AFCRL, are shown with emphasis on results at high and equatorial latitudes. At high latitudes an irregularity region exists whose lower boundary reaches 57° invariant latitude near midnight. During magnetic storms the boundary descends to lower latitudes and the fading becomes deeper. Over the polar cap scintillations are somewhat diminished. When observing synchronous satellites through the irregularity region, deep and fast fading is frequently seen, with fade rates to one per second.

Irregularities produce deep scintillations in the VHF range ±15° from the geomagnetic equator. In equatorial regions maximum occurrence of high level scintillations takes place between 2100 and 2400 local time during the equinoxes; a minimum occurrence is observed during the solstices. When the sunspot numbe decreases, the equatorial irregularity region spreads and becomes larger. The data for various latitudes has been placed in statistical form, that is, distribution of amplitudes for 15-min samples as well as for periods of 1 yr and longer. To minimize the effect of this ionospheric phenomenon on satellite transmissions, the system designer can utilize amplitude distributions, fading rates, depths, and other aspects of scintillation observations in designing his modulation.

KEYWORDS: Global morphology, Ionospheric scintillations, Satellite communications, Navigation systems

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1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LKC) L. G. Hanscom Field Bedford, Mass. 01730	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE
FORWARD AND BACK SCATTER CHARACTERISTICS OF SPHERICALLY SYMMETRIC OVERDENSE CLOUDS FOR SEVERAL ELECTRON DENSITY DISTRIBUTIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
Milton M. Klein

6. REPORT DATE 23 November 1970		7a. TOTAL NO. OF PAGES 16	7b. NO. OF REFS 4
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11. SUPPLEMENTARY NOTES TECH. OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKC) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT Knowledge and understanding of the propagation of electromagnetic waves through the ionosphere, ionospheric irregularities, and artificial electron clouds, provide the information and criteria needed to solve Air Force problems of discrimination, detection, and communication. Because the electron density distribution changes during expansion of a cloud, it is desirable to know how the change affects the scattering characteristics of the cloud.

A determination, in geometric optics approximation, of the forward and back scatter characteristics of spherical overdense clouds having: (1) a gaussian decrease with distance from the center, (2) a $sech^2$, or exponential, decay, and (3) an inverse-square decrease, showed that the back scatter cross section for the inverse square distribution is always larger than for the other two distributions. As the center point density increases, the back scatter cross section obtained with the gaussian sphere most rapidly takes on the characteristics of a conducting sphere, that of the $sech^2$ distribution lags slightly behind, but that of the inverse-square sphere never gets close to the result for a conducting sphere. In forward scatter, the inverse-square distribution shows the largest cross section and a fairly rapid increase with center point density, the $sech^2$ distribution has an essentially constant cross section, and the gaussian, which has the lowest forward scatter cross section, shows a slight decrease with center point density.

KEYWORDS: Scattering, Geometric optics, Radio frequency, Overdense plasma, Spherically symmetric distribution

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1. ORIGINATING ACTIVITY *(Corporate author)*
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L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
PHOTOGRAPHIC STUDIES OF BARIUM RELEASES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
G. T. Best
C. A. Forsberg
T. M. Noel
N. W. Rosenberg

6. REPORT DATE
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9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
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11. SUPPLEMENTARY NOTES
This research was partially supported by the AFCRL Laboratory Director's Fund

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LKC)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Photography of barium releases was performed by AFCRL from two sites, the primary purposes being to obtain quantitative data on peak and integrated intensities and to study the spatial structure and dynamics of the releases by means of stereo techniques. High-speed photography of the release phase was also performed, and a preliminary analysis of the initial expansion mechanism is given. Sample photographs of the releases showing several features of interest are presented.

KEYWORDS: Barium, Chemical release, Plasma, Ion clouds, Radial expansion

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1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LII)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
RADIO PROPAGATION EFFECTS DUE TO IONOSPHERIC WAVES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Kurt Toman

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3 December 1970	24	22

8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S)
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d. DOD SUBELEMENT	681310	

10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LII) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Acoustic-gravity waves in the ionosphere create moving, undulating, reflecting surfaces. Overhead passage of such surfaces causes variations of amplitude, phase, and frequency of reflected radio waves. The patterns of these variations change with the characteristics of the reflecting surface. For the study and prediction of these patterns, computer experiments were carried out ot simulate the effects of sinusoidal reflecting surfaces on propagating radio waves. The simulated parameters included field strength and path length and its derivative. The results are compared with high-frequency measurements made over an oblique, ionospheric transmission between Ottawa, Canada, and Bedford, Mass.

KEYWORDS: Ionosphere, Acoustic-gravity waves, Radio propagation, Doppler effect, Focusing, Simulation, Phase height, Group height,

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Air Force Cambridge Research Laboratories (LII)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE

RIOMETRY AS AN AID TO IONOSPHERIC FORECASTING

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*

Raymond J. Cormier

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LII) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

This paper deals with the use of riometers as an aid in ionospheric forecasting during both disturbed and undistrubed conditions at various geographical regions of the earth. Both the physical and technical aspects of riometry are discussed. Riometer observations during special solar geophysical events such as polar cap absorptions, auroral absorptions, and solar flare effects are presented and discussed. Suggestions for the improvement of riometer output and a description of experiments to be performed using riometers as as integral part of forecasting systems are presented.

KEYWORDS: Riometry, Ionospheric absorption, Polar cap absorption events, Auroral absorption, Solar flare effects

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Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

POLAR RIOMETER OBSERVATIONS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*

Raymond J. Cormier

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TECH, OTHER	Air Force Cambridge Research Laboratories (LII) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Qualitative descriptions of the morphology of PCA events are given, using data from the following riometer stations: Thule and Godhavn, Greenland; Churchill Range, Manitoba, Canada; and Reykjavik (Leirvogur), Iceland. The dependence of commencement time on solar zenith angle and subsequent daily variations in absorption following the initial day are described. The morphology of PCA events is very important for forecasting the behavior of ionospheric absorption during a PCA event. It is shown that besides information concerning the energy spectrum of the proton flux, the season and time of day must also be considered for forecasting the expected absorption.

KEYWORDS: Riometers, Polar cap absorption events, Ionospheric absorption, Morphological development, Auroral absorption events

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3. REPORT TITLE
SPECTROSCOPIC STUDIES OF BARIUM RELEASES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Gordon T. Best
Norman W. Rosenberg

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Air Force Cambridge Research Laboratories, (LKC)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Optical observations following the release of barium vapor at high altitudes can be described in terms of three phases. The first, lasting of the order of a second, is the initial release and expansion of a neutral barium cloud. The second is the ionization phase that can take from 3 to 100 sec, depending on release altitude and size. The remaining history is characterized by the development of striations in the ion cloud and of a tail joining the ion and neutral clouds.

Observations of each of the above phases with various optical instruments showed the ionization mechanism to be via metastable levels, and experiments were conducted which led to a more detailed description of the processes involved.

KEYWORDS: Barium, Chemical release, Plasma, Ion clouds, Spectroscopy

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3. REPORT TITLE
A NUMERICAL STUDY OF THE SEASONAL AND SOLAR CYCLE CHANGES OF THE MID-LATITUDE NEUTRAL AIR WINDS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Charles M. Rush
John A. Pustaver

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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LII) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The coupled equations representing the horizontal neutral air winds arising from the diurnal variation of atmospheric pressure, are solved numerically. Taking full account of the diurnal and seasonal variation of electron density, meridional and zonal winds have been computed at mid-latitudes for both solar maximum and solar minimum conditions. The daily variation of both the meridional and zonal wind can be well represented by a daily mean plus a 24- and 12-hour oscillation and tabular values of the winds for each season are given for the height of the F2 maximum and for every 100 km interval from 200 to 500 km. These values can be used to readily compute the associated vertical drift velocity at any middle latitude location when account is taken of the local geomagnetic field.

KEYWORDS: Neutral winds, Ionospheric winds, Drift velocity, Ionization distribution, Coupled equations

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LOW FREQUENCY GROUND-WIRE ANTENNA

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Gary S. Sales
Alma Ganio

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TECH, OTHER	Air Force Cambridge Research Laboratories (LII) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The impedance and radiation properties of a ground-wire antenna are analyzed using transmission line theory. For the purpose of computing these properties, considering the large number of parameters necessary to describe the antenna, a computer program was developed. Several sample calculations are described, directed towards the design of an antenna for use with a low frequency stepped ionosonde.

KEYWORDS: Antenna, Low frequency, Transmission line, Impedance, Ionosonde

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

DIELECTRIC MATTER AND THE VECTOR D

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*

Leonard J. Eyges

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TECH, OTHER	Air Force Cambridge Research Laboratories (LQ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The purpose of this report is to provide a new clarity of insight into concepts that are involved in the design and understanding of devices which have importance in a wide variety of Air Force applications. The formulas derived herein provide new tools for clarifying the mode operation and optimizing the performance of devices that involve dielectric components. The standard theory of dielectrics that involves the vector D is clarified by expressing its basic but implicity assumption as an explicit postulate. For a dielectric sample with polarization density P(r), a discussion is presented concerning the approximation involved in calculating the external field of the sample from the surface and volume polarization charge densities $\sigma_P = P \cdot n$ and $\rho_P = -\nabla \cdot P$. If E_s is the field generated by the surface density σ_P, it is shown that the usual theory of dielectrics is equivalent to the postulate that for a homogeneous dielectric in an applied field E_a, the polarization is related to the field by $P = \chi_e \bar{E}$, where the mean field $\bar{E}$ is the sum of E_a and E_s, and χ_e is the electric susceptibility. The vector D is defined by $D = \bar{E} + 4\pi P$, and this definition is shown to be the one implicit in the conventional but sometimes ambiguous treatment. The field of conductors embedded in dielectric matter is discussed in terms of the present formalism, as is the force on, and energy density of, a dielectric body in an applied field. The standard expression $w = -\frac{1}{2} P \cdot E_a$ for the energy density w of polarized matter is derived from a microscopic viewpoint, without invoking the vector D.

KEYWORDS: Dielectric, Polarization, Internal fields, Vector D, Susceptibility

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INVESTIGATION OF THE SYNTHESIS OF DIAMONDS

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5. AUTHOR(S) *(First name, middle initial, last name)*

Stanley Key Dickinson, Jr.

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13. ABSTRACT

Crystals of high chemical and mechanical perfection are required for research in electronic devices. The purpose of the research reported here was to produce diamonds for use in the fabrication of semiconducting devices. This was one portion of a laboratory-wide program investigating the utilization of diamond as a high temperature semiconductor.

Diamond synthesis is explained in terms of crystallization from a supersaturated liquid. The major driving force is thermodynamic. The primary condition for synthesis is a stable diamond-liquid equilibrium in which the liquid is composed of carbon and certain metal solvents.

Thermodynamic expressions are developed for describing the pertinent portions of the nickel-, cobalt-, manganese-, and iron-carbon binary systems. Temperature-composition diagrams at high pressures are drawn to show stability relationships and the allowed limits for synthesis. The theoretical model is verified by an extensive ultra-high pressure-temperature experimental investigation. Theoretical and empirical results are employed in predicting conditions for producing high quality single crystals.

KEYWORDS: Diamond synthesis, High pressure thermodynamics, Metal-carbon systems, Semiconducting diamond, Boron active impurity

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3 REPORT TITLE

A METHOD FOR FILTERING METEOROLOGICAL DATA

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5 AUTHOR(S) *(First name, middle initial, last name)*

Rosemary M. Dyer

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TECH, OTHER	Air Force Cambridge Research Laboratories (LY) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A mathematical filter for eliminating persistence in meteorological data is proposed and discussed. This filter takes the form

$$Z_t = X_t - \rho_1 X_{t-1} .$$

Relationships between statistical parameters of the filtered and the original data are derived and found to depend only on the value of ρ_1. Examples of the effect of the filter on the power spectrum of various types of input data are also given.

KEYWORDS: Persistence, Meteorological data analysis, Mathematical filters, Markov processes

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
A TECHNIQUE FOR MEASURING PHASE AT MILLIMETER WAVELENGTHS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
Frederick H. Cleveland, Major, USAF
Nicholas P. Kernweis

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13. ABSTRACT

A technique that utilizes a reference signal of varying phase for measuring the phase of millimeter signals in free space is described. The phase of the reference signal is measured independently and subtracted from the total phase measured to determine the desired phase. The use of a varying reference phase is necessary because flexible or movable waveguides whose phase characteristics can readily be measured are not available at millimeter wavelengths. The theory of the technique described is based upon the interference pattern of slowly varying electric fields.

KEYWORDS: Millimeter wavelengths, Phase measurements, Interference pattern

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3. REPORT TITLE

PREPARATION AND ELECTRICAL PROPERTIES OF SOME CERAMIC MATERIALS AT MICROWAVE FREQUENCIES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
Martin R. Stiglitz

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13. ABSTRACT

The need for high-dielectric constant, low-loss, temperature-stable ceramic materials for microwave-device application has given impetus to the study of various titanate and oxide mixtures. In the course of this research we have developed a material which has a temperature frequency coefficient of 530 ppm/°C and a dielectric constant of 106, comparable to the American Lava T-96 Ceramic, but has a higher dielectric constant. Methods for mixing, firing, and aging of ceramic materials, as well as microwave measurement techniques, are presented and results are given in graphic form and tables. These results may be valuable to workers wishing to pursue the development of zero temperature coefficient materials further.

KEYWORDS: Dielectric resonators, High dielectric constant ceramics, Temperature coefficient, Temperature stability

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

SELF-ORTHOGONAL CODES OF HALF DIMENSION OVER GF(2)

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

Vera S. Pless

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TECH, OTHER	Air Force Cambridge Research Laboratories (LRA) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Self-orthogonal codes have been used on many occasions due to their added ease of decoding. In particular, moderate length self-orthogonal codes are often needed. This paper gives a complete listing of all self-orthogonal codes of rate one-half whose length is between 2 and 18, and also lists all their properties. Someone who wants to use such a code can see what is available from the list and then select one based on the characteristics listed.

KEYWORDS: Self-orthogonal codes over GS(2), Complete group of codes, Equivalent classes, Weight distribution

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

FINAL REPORT ON HOBBS' FAILSAFE DECODER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Final Report.

5. AUTHOR(S) *(First name, middle initial, last name)*
Charles F. Hobbs Joseph P. Brazy, Capt, USAF
Stanwood Ayer Lawrence V. Kriger

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LR) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

To improve the reliability of digital communications systems, an encoder/decoder was designed, constructed, and evaluated for failsafe and error correction capabilities under stationary gaussian noise conditions. It employs a random error-correcting (73,45) cyclic code in a binary erasure channel. The code is in the class of difference set cyclic codes. Discussed are trade-offs between failsafe communication and efficiency of transmission rate. Also discussed is a special threshold detection technique for error correction purposes. Included is a brief description of the experimental system and the procedures used for computer evaluation. The work is an extension of that originated and first reported by C. F. Hobbs (now deceased) in a 1969 Air Force Cambridge Research Laboratory Summary Report.

KEYWORDS: Failsafe decoder, Cyclic codes, Difference-set codes, (73, 45) code

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
COMPENSATION OF INTERPOLATION BY LINEAR FILTER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

5. AUTHOR(S) *(First name, middle initial, last name)*
Ralph Shapiro

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Air Force Cambridge Research Laboratories
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

A new method for counteracting the damping effects of interpolation makes use of simple symmetric linear filters. Specifically for use in numerical integrations involving multiple mappings of a grid network on a sphere, it has been designed to take advantage of the relative simplicity of map representations in numerical integrations and at the same time avoid the instability that is due to incompatible solutions in the overlap region. Whether or not the method will actually succeed in this purpose can only be determined from specific experiments. The method makes use of linear filtering to produce a maximum restoration of damped amplitude, and may therefore also be useful in generating initial grid point data from irregularly spaced station data as part of some general objective analysis procedure. The procedures are general and may find application in such diverse problems as that of incorporating nonsynoptic data into an objective analysis procedure or in limited-area nesting problems.

KEYWORDS: Interpolation, Filter, Amplitude restoration, Damping, Stability, Phase displacement

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3. REPORT TITLE
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4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Sara Regina Murphy

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13. ABSTRACT

There are many potential applications of computers in which it would be desirable for the user to be able to communicate with the machine in English. A number of experimental computer programs have been written which were intended to have the capability of accepting input in at least a restricted subset of English. Some of these programs have been fairly successful at understanding and answering simply phrased questions on some specific topic. None, however, can deal with more than one type of data base, and none can deal with sentences of very great syntactic complexity.

The theory of transformational grammars represents the linguists' most elaborate attempt to date to formalize the syntactic structure of English. The result of analyzing a sentence according to a transformational grammer is a so-called "deep structure," which expresses various information about the constituent portions of the sentence in a treelike form. In view of the relatively high state of development of the transformational theory, it is natural to use it as the basis for the "front end" of an English-understanding program.

The system discussed in this report provides a general method of interpretation of transformationally parsed sentences for use in question-answering. It is based on a general scheme for using the information contained in the deep structures to interrogate a data base. The primary effort is aimed at handling a wide variety of complex syntactic structures, with particular concern for the problem of embedded structures.

The system provides a general facility for handling syntactic structures, to which a user can add routines corresponding to the specific nouns, verbs, and adjectives he wants to use. The present implementation includes a vocabulary suitable for dealing with sets; the noun, verb, and adjective routines for this area of discourse constitute about 10% of the entire program. KEYWORDS: Transformational grammar, Computers, Man-machine interaction, Semantics, Natural language

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5. AUTHOR(S) *(First name, middle initial, last name)*
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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (PHS)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This Bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. The first four issues, which encompassed 1964 data, constitute Volume I. Volume II (numbers 1-4) contains quarterly data for 1965 with Volume III (1966), Volume IV (1967), Volume V (1968), Volume VI (1969), and Volume VII (1970).

Program descriptions for all data sections are updated annually or as required, and are presented in Number 1 of each volume.

The following types of data are contained within each issue: magnetometer, cosmic ray, ELF noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for July, August, and September 1970.

KEYWORDS: Magnetometer, Neutron monitor, ELF noise, Riometer, Solar optical observations, Solar radio emission, Vertical incidence ionospheric soundings

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Air Force Cambridge Research Laboratories (CA)
L. G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3 REPORT TITLE
PROCEEDINGS OF THE L. G. HANSCOM FIELD SCIENCE AND ENGINEERING AWARDS MEETING, 3 NOVEMBER 1970

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5 AUTHOR(S) *(First name, middle initial, last name)*
Henry Novak, Compiler

6 REPORT DATE	7a TOTAL NO. OF PAGES	7b NO. OF REFS
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d DOD SUBELEMENT	N/A	Special Reports, No. 112

10 DISTRIBUTION STATEMENT
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11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (CA) L. G. Hanscom Field Bedford, Massachusetts 01730

13 ABSTRACT

The L. G. Hanscom Field S&E Awards Meeting, held in the Base Theatre on 3 November 1970, served as the vehicle for recognizing selected outstanding research performed by scientists of the Air Force Cambridge Research Laboratories and those of the Electronic Systems Division. This volume is the collection of eight AFCRL papers (three were jointly authored), and two papers prepared by researchers of the ESD, given at this Meeting. The S&E Awards Meeting was also the forum for informing the RDT&E communities at L. G. Hanscom Field of the significant research completed or continuing in a number of disciplines by scientists of the AFCRL/ESD organizations.

KEYWORDS: Science and engineering awards meeting

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3. REPORT TITLE
AIR FORCE CAMBRIDGE RESEARCH LABORATORIES REPORT ON RESEARCH

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
LaVerne Woods, Editor

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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (CA) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

This is the fifth in a series of reports on research at the Air Force Cambridge Research Laboratories. The report covers a three-year interval. This report was written primarily for Air Force and DOD managers of research development—and more specifically, for the managers in our Headquarters office, the Air Force Systems Command. But it is hoped that it will be of interest and value to a much broader audience. To encompass this broader audience and to make the content more meaningful, the report attempts to relate, by means of survey discussion, the programs to the larger scientific field of which they are a part. The work of each of the eleven laboratories is discussed separately in chapters with an overall introductory chapter on AFCRL management and logistic activities during the reporting period.

KEYWORDS: Upper atmosphere physics, Radio astronomy, Solar astronomy, Optical physics, Meteorology, Information processes, Electronic solid state, Communication, Ionospheric physics, Plasma physics, Geodesy, Gravity, Seismology, Geology, Crystallography, Electronic devices, Radiation damage, Microwave acoustics, MM wave propagation, Lasers, Balloon technology, Rocket instrumentation, Signal processing

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Air Force Cambridge Research Laboratories (CA)
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Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
ON THE FOUNDATIONS OF CRYSTAL OPTICS
Part I – Dispersion Theory Part II – Theory of Reflection and Refraction

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific Interim

5. AUTHOR(S) *(First name, middle initial, last name)*
P.P. Ewald

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11. SUPPLEMENTARY NOTES
Translation: From Annalen der Physik, 49, 1916, No. 1 and No. 2. Postscript 1970 by P.P. Ewald

KEYWORDS: Dispersion theory, Reflection, Refraction

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (CA)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This two part paper investigates the propagation of light in the visible region through a crystalline medium.

In Part I, which is a slightly shortened version of the author's doctoral thesis of 1912, the objective is to determine if the anisotropic arrangement of ordinary (isotropic) dipoles at the nodal points of an orthorhombic lattice would account for the existence of double refraction. The value of the computed birefringence is found to be comparable to the observed value. Additionally some features of the traditional "theory of dispersion" are disclosed and clarified. In the older theories the "incident optical wave" plays a role but it is shown that in a medium which extends to infinity in all directions no such wave should be assumed: The refractivity is shown to arise as an internal property of the medium.

In Part II, a crystalline medium is considered as filling a half-space and having a plane boundary at $z = 0$. A plane optical wave is incident on this medium. Because of the linearity of the equations it has to be superimposed on the field originating in the crystal. It is shown that this incident optical wave is actually prevented from entering the crystal because of the modification produced in the field of the crystal by the introduction of a boundary. Boundary waves are found to exist on both sides of the boundary. The higher their order, the more rapidly they attenuate as a function of distance away from the boundary but the zero order waves are ordinary undampted plane waves of vacuum velocity c. The fields outside and inside the medium are connected by the Fresnel formulae: These follow from the condition that the optical field inside the medium and the oscillations generated there form a self-consistent system.

Material Added 1970. The conclusion that the incident optical field cannot penetrate the crystal boundary, together with a similar conclusion in a paper by Oseen, is the basis of the Ewald-Oseen Extinction Theorem.

The same methods and field transformations developed in this two part paper were applied in two later papers which were published as Parts III and IV. These extend the treatment to the passage of X-rays through crystals. "Postscript 1970" published here indicates the relationship of these four parts and further developments of the subject as well as referencing the papers noted above.

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
DISSOCIATIVE CHARGE TRANSFER REACTIONS OF He^+ AND Ne^+ IONS WITH N_2, O_2, AND CO_2 MOLECULES AT COLLISION ENERGIES OF 3 TO 200 eV FROM

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
H. Schlumbohm

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Translated from Zeitschrift für Naturforschung, 24a, 1720 (1969)	Air Force Cambridge Research Laboratories (LKB) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Cross sections for the dissociative charge transfer reactions $He^+ + N_2$, O_2 and $Ne^+ + N_2$, O_2, CO_2 have been measured over an energy range from 3 to 200 eV and are compared with values given by other authors. The values were determined from measurements of the current of the slow charge exchange ions formed with a collision chamber.

KEYWORDS: Ion-molecule reactions, Bimolecular reactions, Charge transfer reaction

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Air Force Cambridge Research Laboratories (LQ)
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2a. REPORT SECURITY CLASSIFICATION

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3. REPORT TITLE
GROWTH AND PROPERTIES OF SINGLE-CRYSTAL MATERIALS FOR OPTO-ELECTRONICS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Special Scientific.

5. AUTHOR(S) *(First name, middle initial, last name)*
Nobukazu Niizeki

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9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
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11. SUPPLEMENTARY NOTES
Translation: Applied Physics (OYO BUTSURI), Japan, 38(9):812-824, 1969.

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LQ)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Single-crystal materials currently in the use in various fields of opto-electronics are reviewed from the viewpoint of materials science. The characteristics of crystal-line laser hosts, nonlinear optic crystals, electro-optic crystals, and ultrasonic light diffraction solid media are described. The present status of crystal growth by the pulling method is discussed, and relations between the growth conditions and defects in the obtained crystals are stressed. The necessary steps in the process of device fabrication are analyzed, and some important factors such as phase diagram information, domain structure in oxide ferro-electrics, and laser damage susceptibility are pointed out. Some theoretical treatments of oxide ferroelectric crystals useful for materials scientists are reviewed.

KEYWORDS: Single crystal, Opto-electronics, Crystal growth

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2a. REPORT SECURITY CLASSIFICATION
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AN ON-BOARD INFRARED FOURIER SPECTROMETER

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5. AUTHOR(S) (First name, middle initial, last name)
M. N. Markov A. V. Kartacheb
V. I. Vedernikov V. S. Petrov
V. V. Ivanob

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11. SUPPLEMENTARY NOTES
Translation: Akademiia Nauk SSSR.
Ordena Lenina Fizicheskii Institut.
Preprint No. 189, pp. 1-31, 1969.

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (OP)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This report describes the theory, details and performance of the laboratory prototype of a small-scale Fourier spectrometer to measure the absolute spectral intensity of the radiation from the Earth or other planets in the 10 to 40 μ range from aircraft, balloons, rockets or satellites.

KEYWORDS: Infrared, Fourier spectrometer

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3. REPORT TITLE

SCINTILLATION BOUNDARY DURING QUIET AND DISTURBED MAGNETIC CONDITIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Jules Aarons
Richard S. Allen

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11. SUPPLEMENTARY NOTES Reprinted from Journal of Geophysical Research, Vol.76, No.1, pp.170-177, January 1, 1971.	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LIR) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT Earlier studies of ionospheric scintillations outlined the lower boundary of the high-latitude region where intense scintillations at 40 MHz were observed. The quiet-day scintillation boundary reached a lower position of 57° invariant latitude at 2200 LT. Dyson's (1969) recent observations with a Langmuir probe have verified the existence of a lower latitude boundary of small-scale irregularities. The boundary concept has been extended to include the effects of magnetic storms. Observations of satellite beacon signals at 40 and 54 MHz during 1961 to 1966 indicate that the mean change in the lower boundary latitude of the irregularity region is a decrease of approximately 1.6° per unit change in local K index. This is quite similar to the change of 1.8° per unit change in K_p noted for the trough position by Rycroft and Thomas (1970). In examining the data available from high-inclination and synchronous satellites, it was noted that the change in latitude with K index is a function of time. The maximum change of latitude as a function of K index, approximately 2° to 3° per unit K, occurred between 0300 and 0600 LT; the minimum change, about 1° per unit K, occurred over a broad interval from 1600 to 0200 LT. If the irregularity structure is produced by an interaction of the plasmapause with the ionosphere, the morphologic behavior of this region of the magnetosphere can be studied by reviewing the large inventory of scintillation and spread F data that has been amassed in the course of ionospheric research.

KEYWORDS: Sub-auroral ionosphere, Ionospheric irregularities, Irregularity boundary, Magnetic activity, UHF/VHF fading

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
OPTICAL INSTRUMENTATION FOR TRACKING HIGH ALTITUDE VAPOR RELEASES BY DAY

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
G.T. Best

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Applied Optics, Vol. 9, No. 12, pp. 2666-2672, December 1970.	Air Force Cambridge Research Laboratories (LKC) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

High altitude chemical vapor trails may not be photographed by day because of the intense background light of the sky. A comparison of several possible emission line detectors is given. An instrument incorporating an ultra-narrow interference filter in a differential radiometer is described and the results of a successful field test are given.

KEYWORDS: Atmosphere, Choppers, Filters, Optical systems, Tracking

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3. REPORT TITLE

ON THE CONTINUITY OF THE AURORAL OVAL

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Jurgen Buchau
James A. Whalen
S.-I. Akasofu

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13. ABSTRACT

The Flying Ionospheric Laboratory, a NKC-135 jet aircraft of the Air Force Cambridge Research Laboratories, made during the winter of 1969-1970 four flights which examined the continuity of the auroral oval. Two passed completely around the oval; two covered the afternoon-evening half of the oval. The all-sky camera photographs taken during these flights strongly suggest that the auroral oval, defined as the band of visible auroral arcs, is under moderately disturbed magnetic conditions ($\Sigma K_p > 10$) a continuous band around the geomagnetic pole. Under quiet conditions ($\Sigma K_p < 10$) discontinuities in the occurrence of auroras in the oval were observed in the morning, noon, and evening sector. Discontinuities in the morning sector were of temporal nature, the discontinuities in the noon and evening sector could be either temporal or spatial.

KEYWORDS: Auroral oval, Continuity of auroral forms, Magnetospheric model

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3. REPORT TITLE

19-GIGAHERTZ (1.58-CENTIMETER) SOLAR RADIO BURSTS AS INDICATORS OF PROTON EVENTS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

D.L. Croom

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Geophysical Research, Space Physics, Vol.75, No.34, pp.6940-6949, December 1, 1970	Air Force Cambridge Research Laboratories (LIR) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A study of 19-GHz (1.58-cm) solar radio bursts recorded at the Slough Solar Radio Observatory from July 1967 to June 1969 suggests that they can be used as reliable indicators of proton events and of PCA's provided that (a) the peak flux increase during the burst is >50% of the pre-burst values, and (b) that the flux enhancement is >10% for longer than 5 min. The warning period, from the time of the burst to the arrival of the first detectable protons in the vicinity of the earth, ranges from tens of minutes to several hours. There is a further delay of three or more hours to the time of maximum proton flux. Since only one frequency is involved, a proton warning solar radiometer could be fitted to any aeroplane, satellite, or spacecraft to supplement ground observations.

KEYWORDS: 19 GHz, Solar radio bursts, Proton event indicators, Burst duration

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
SOLAR MICROWAVE BURSTS AS INDICATORS OF THE INTENSITY OF SOLAR PROTON EMISSIONS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
D.L. Croom

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Astrophysical Letters, Vol. 7, pp. 133-135.	Air Force Cambridge Research Laboratories (LIR) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The total energy in fixed-frequency solar microwave bursts that exceed certain threshold values, when normalized in terms of the peak intensity of the burst, is a much better guide to the intensity of associated solar proton fluxes than either the peak burst intensity itself or the total, un-normalized, energy produced in the burst.

KEYWORDS: Solar microwave bursts, Solar protons, Solar forecasting, Solar radio spectra

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1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LYW)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

MAPPING A THUNDERSTORM ANVIL FLOW BY DOPPLER RADAR

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*

Ralph J. Donaldson, Jr.

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Applied Meteorology, Vol. 9, No. 6, pp. 911-915, December 1970.	Air Force Cambridge Research Laboratories (LYW) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The mean motion of particles in a thunderstorm anvil has been measured at various heights and elevation angles by Doppler radar, using the velocity-azimuth scanning mode of Lhermitte and Atlas with the harmonic analysis scheme of Browning and Wexler. An error analysis indicated that the measurement accuracy, even at elevation angles as high as 80°, is comparable to the inherent radar resolution of 0.9° in direction and 0.6 m sec^{-1} in speed. The scale of temporal and spatial variability of wind at anvil height was more than an order of magnitude greater than the errors; consequently, the measurements of anvil winds obtained by Doppler radar are considered to be significantly informative. Estimates of divergence, on the other hand, were quite unreliable at elevation angles >50° and not especially trustworthy at any of the smaller elevation angles. All measurements of divergence, however, showed a trend of increase with greater height in the anvil. Pronounced anomalies in the measured wind components, with respect to the components required by the mean anvil flow, provide a rough map of the intense, upper level outflow of the thunderstorm.

KEYWORDS: Doppler radar, Thunderstorm anvil, Wind measurement, Divergence measurement

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3. REPORT TITLE

BAND STRENGTHS IN FORBIDDEN TRANSITIONS:
THE CAMERON BANDS OF CO

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

A.R. Fairbairn

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13. ABSTRACT

The band strengths of the Cameron system of CO, $a^3\Pi \rightarrow X^1\Sigma$, have been measured. The data yield an electronic oscillator strength of $1.7 \times 10^{-4} \pm 10$ percent. The radiative lifetime depends on the rotational quantum number and estimates are made of these from published line strength formulae.

KEYWORDS: Spectroscopy, Oscillator-strength, Carbon monoxide, absorption

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3. REPORT TITLE
ATMOSPHERIC EMISSION AND ABSORPTION AT MILLIMETER WAVELENGTHS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Vincent J. Falcone, Jr.
Karl N. Wulfsberg
Samuel Citelson

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Reprinted from Radio Science, Vol. 6, No. 3, pp. 347-355, March 1971.	Air Force Cambridge Research Laboratories (LZN) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

We simultaneously measured atmospheric emission and absorption under clear sky conditions at frequencies of 15 and 35 GHz and compared the values with those calculated from the radiative transfer equation. The measurements show that atmospheric attenuation determined from emission and absorption measurements agree within experimental error and that the calculated values of attenuation agree with the measurements on a statistical basis when the Gross form factor is used with the model of a plane stratified atmosphere.

KEYWORDS: Millimeter waves, Atmospheric attenuation

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3. REPORT TITLE
IMPURITY EFFECTS ON ANNEALING OF RADIATION DEFECTS IN p-TYPE SILICON

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
P.H. Fang P.J. Drevinsky
Tarko P. Iles

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13. ABSTRACT

A study of p-type silicon shows that (1) the annealing temperature of electron-irradiation damage increases as the acceptor concentration increases and (2) the isochronal annealing behavior of damage in samples with gallium and aluminum impurities is different from that in boron-containing samples, which show a higher annealing temperature.

KEYWORDS: Radiation effects, p-type silicon, Annealing, isochronal Electron irradiations

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Bedford, Massachusetts 01730

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3. REPORT TITLE

EFFECT OF AXIAL RATIO CHANGES ON THE ELASTIC MODULI AND GRUNEISEN γ FOR LOWER SYMMETRY CRYSTALS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*

E.S. Fisher
M.H. Manghnani

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Reprinted from Journal of Applied Physics, Vol. 41, No. 13, pp. 5059-5062, December 1970.	Air Force Cambridge Research Laboratories (LWW) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Gerlich has shown that Sheard's model for calculating mode γ's from hydrostatic pressure derivatives of the elastic moduli of hcp Mg and Cd yields Gruneisen γ's at both high and low temperatures that are in good agreement with the γ's derived from thermal-expansion measurements. For hcp Ti and Zr, however, large differences arise, primarily from very small values for dC_{44}/dP. It is proposed that these small values are caused by the changes in c/a ratio with hydrostatic pressure because of a large dependence of C_{41} on the c/a ratio. The disagreement with thermal-expansion data can be removed by taking into account the difference in $d(c/a)/dV$ between hydrostatic-pressure and thermal-expansion conditions. The effect of $\Delta(c/a)$ is not found in tetragonal TiO_2, rutile, where $\bar{\gamma}H$ is in excellent agreement with the thermal expansion γ_∞.

KEYWORDS: Elasticity, Gruneisen parameter, Thermal expansion

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
pH-INDUCED REVERSIBLE CHANGES IN THE ABSORPTION SPECTRUM AND PHOTOACTIVITY OF BACTERIOCHLOROPHYLL IN PHOTOSYNTHETIC BACTERIA CHROMATOPHORES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Eiji Fumimori

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Biochimica et Biophysica Acta, Vol. 223, pp. 444-446, 1970.	Air Force Cambridge Research Laboratories (PHF) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The photoactivity of active bacteriochlorophyll and the absorption spectrum of bacteriochlorophyll absorbing at 800 nm are temporarily lost at low pH but partially regenerated by increasing the pH within a certain time limit. This pH-induced modification and regeneration of these bacteriochlorophyll molecules indicate the contribution of protein conformation in their environment to their spectral and photoactivity characteristics.

KEYWORDS: Absorption spectrum, Photoactivity, Bacteriochlorophyll, Bacteriopheophytin, Protein convermation

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THE H-NO CHEMILUMINESCENCE USING ADIABATICALLY EXPANDED NO

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
D. Golomb
G. L. Dyer
D. F. Kitrosser

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Chemical Physics Letters, Vol. 5, No. 2, pp. 101-104, 1 March 1970.	Air Force Cambridge Research Laboratories (LKC) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Nitric oxide has been expanded from a high-pressure reservoir against a supersonic stream of hydrogen atoms in an inert carrier. A chemiluminous headglow was observed in which the emission intensity exceeded by three orders of magnitude the intensity of the afterglow. The spectrum consists of the vibronic bands of the $^1A'' - {}^1A'$ transition.

KEYWORDS: Chemiluminescence, HNO, Atomic oxygen, Nitric oxide

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
SOLAR RADIATION IN THE EXTREME ULTRAVIOLET AND ITS VARIATION WITH SOLAR ROTATION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
L.A. Hall
H.E. Hinteregger

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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LKO)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Measurements of solar extreme ultraviolet radiation in the wavelength range 1310-270 A have been made from the satellite Oso 3. The flux variation over a solar rotation period was obtained for emission lines representing elements in various stages of ionization. Since no correction need be made for atmospheric absorption, the accuracy of these results is superior to the accuracy of the results we previously obtained with similar instrumentation aboard rocket vehicles.

KEYWORDS: Solar extreme ultraviolet, Solar activity

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Air Force Cambridge Research Laboratories (LZP)
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2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
MEANING OF KATO'S FORMULAS FOR UPPER AND LOWER BOUNDS TO EIGENVALUES OF HERMITIAN OPERATORS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Dallas T. Hayes

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Reprinted from Canadian Journal of Physics, Vol. 49, No. 2, pp. 218-223, 1971.	Air Force Cambridge Research Laboratories (LZP) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Using an independent derivation by Kohn, the full meaning of Kato's formulas for upper and lower bounds to eigenvalues of a Hermitian operator is shown. These bounds are the best possible when the only information available on a particular eigenvalue problem is a suitable trial function and an estimate of the neighboring eigenvalues to the one in question. This was asserted by Kato but not proved. A comparison is made of Kato's bounds with those derived in papers by Stevenson and Crawford and by Cohen and Feldmann. Under the conditions which result in Kato's bounds it is shown that the Stevenson-Crawford and Cohen-Feldmann bounds reduce to those of Kato. When more information is available these bounds are an improvement upon Kato's. This makes more precise the recent work of Walmsley and Cohen-Feldmann, whose results appear to prove in general the greater accuracy of the Stevenson-Crawford and Cohen-Feldmann bounds over those of Kato. A general discussion of all three sets of bounds is given in terms of the parameter λ appearing in the Stevenson-Crawford formulation.

KEYWORDS: Gas voltage breakdown, Upper and lower rounds on eigenvalues of Hermitian operators

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L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
DISSOCIATION ENERGY OF NaO(g) AND THE HEAT OF ATOMIZATION OF Na_2O(g)

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Donald L. Hildenbrand
Edmond Murad

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Reprinted from The Journal of Chemical Physics, Vol. 53, No. 9, pp. 3403-3408, 1 November 1970.	Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The vaporization of Na_2O(c) has been studied mass spectrometrically. It was found that the vaporization yields primarily Na(g) and O_2(g), with NaO(g) and Na_2O(g) being minor vapor constituents. From equilibria involving Na_2O(c), Na_2O(g), Na(g), NaO(g), and O_2(g), it was possible to measure $\Delta Hf_{298}^{\circ}[NaO(g)]$ = 24.3±4 kcal/mol and $\Delta Hf_{298}^{\circ}[Na_2O(g)]$ = -9.9±3 kcal/mol. These values yield $D_0^{\circ}(NaO)$ = 60.3±4 kcal/mol (2.61±0.20 eV) and $D_0^{\circ}(Na_2O)$ = 119.8±3 kcal/mol (5.20±0.15 eV). The appearance potentials of NaO^+ and Na_2O^+ were measured and found to be 6.5±0.7 and 5.5±0.5 eV, respectively. These appearance potentials are suggested to be close to the true ionization potentials of the molecules. Implications of these results regarding some recent beam experiments are briefly discussed.

KEYWORDS: Dissociation energies, Mass spectrometry, Ionization potentials, Sodium oxide, Thermochemistry

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
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4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Herbert S. Hoffman

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Reprinted from The Astrophysical Journal, Vol.163, pp.393-403, January 15, 1971.	Air Force Cambridge Research Laboratories (LKC) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A Two-step ionization and excitation model is proposed as an alternative mechanism to the commonly accepted direct-excitation one for the generation of ionic meteor spectra. A near-resonance criterion is invoked to indicate when this mechanism is expected to predominate. The implications of the model are calculated in a slip-flow "threshold" approximation. That is, first and second collisions of atmospheric molecules as well as first collisions of vapor atoms are taken into account. Qualitative agreement with observations is obtained. The model is then applied specifically to the example of the bright Ca II spectra, which are enhanced by this mechanism over the direct-excitation mode.

KEYWORDS: Ion spectra, Collision dynamics, Atmosphere, Meteors

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L.G. Hanscom Field
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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

POLARIZATION OF LIGHT SCATTERED BY ICE CRYSTALS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

Paul Huffman

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Atmospheric Sciences, Vol. 27, No. 8, pp. 1207-1208, November 1970.	Air Force Cambridge Research Laboratories (OPA) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The spectral dependency and polarization were measured for visible light scattered from polydisperse distributions of ice crystals grown in a laboratory cold chamber.

Within the limits of experiment accuracy, there was no discernable spectral variation in the shape of the scattering diagram. The polarization was small but discernable, having a negative value in the region of the 22° halo and a broad positive peak near 115°.

KEYWORDS: Polarization, Ice crystal, Light scattered ice crystals, Nephelometer

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1. ORIGINATING ACTIVITY *(Corporate author)*
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Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
FORMATION AND GROWTH OF ICE FOG PARTICLES AT FAIRBANKS, ALASKA

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
P.J. Huffman
T. Ohtake

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13. ABSTRACT

A mechanism is proposed for the formation of ice fog particles in the city and environs of Fairbanks, Alaska. Equations are developed for calculating the size distribution resulting from growth by deposition of water vapor. The equations are numerically solved with a computer for three major types of ice fog sources: (1) automobile exhaust, (2) exhaust from heating plants, and (3) open water. The size distribution produced by an individual source is determined by the cooling rate of water vapor injected into the environment. The cooling rate is a function of the source characteristics and the ambient temperature. The proposed mechanism adequately represents the observed size distribution if the cooling rate of the water vapor injected into the environment is not too large (source types 2 and 3). Because of the large cooling rate of the water vapor injected into the atmosphere by source type 1, the size distribution from this source is not adequately represented by the model. In agreement with observations, the computational results predict a decrease in the size of ice fog particles with decreasing ambient temperature for source types 2 and 3.

KEYWORDS: Ice fog, Visibility, Nucleation, Condensation, Freezing

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Air Force Cambridge Research Laboratories (LKS)
L.G. Hanscom Field
Bedford, Massachusetts 01730

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3. REPORT TITLE
DECREASE IN D-REGION O_2 ($^1\Delta_g$) PHOTOIONIZATION RATES RESULTING FROM CO_2 ABSORPTION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
R.E. Huffman J.C. Larrabee
D.E. Paulsen R.B. Cairns

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Geophysical Research, Vol. 76, No. 2, pp. 1028-1038, February 1, 1971.	Air Force Cambridge Research Laboratories (LKS) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Photoionization of the metastable O_2 ($^1\Delta_g$) molecule has been proposed as an important source of ionization in the D region. The wavelength region of interest is from 1027 to 1118 A, where ground state O_2 is the primary absorber of the incident solar flux but is not ionized itself. This paper presents improved ion production rates based on new laboratory data, including new O_2 ($^1\Delta_g$) photoionization cross sections and more detailed curves in several ground state O_2 windows. Recent solar flux measurements reduce the continum intensity by about a factor of 5. This reduction is partly compensated by including in the calculations the Si III multiplet, which is at the deepest O_2 window (1108.2 A, minimum cross section = 4.4×10^{-21} cm^2) and by the new ionization cross sections, which are generally larger than the previously assumed values. An important factor not previously considered is absorption by carbon dioxide, which has a much larger absorption cross section than ground state O_2 throughout this region. The ground level mixing ratio has been assumed. The ion production rates are somewhat less than Hunten and McElroy's [1968] curves if CO_2 is not included. With CO_2, a production rate of 1 ion cm^{-3} sec^{-1} is reached at approximately 80, 84, and 86 km for zenith angles of 0°, 45°, and 60°, respectively. Hunten and McElroy find this rate to be 10 to 15 km lower. Concentrations of O_2^+ are calculated for a zenith angle of 45° for a variety of conditions, including a dry atmosphere and an atmosphere with 5 ppm H_2O.

KEYWORDS: Photoionization, Ionosphere, Metastable oxygen, Carbon dioxide, D-region

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L.G. Hanscom Field
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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
AN IMAGE SELECTION DEVICE FOR USE WITH A TELESCOPE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
G.R. Hunt
L.M. Logan

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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13. ABSTRACT

A device for selecting any two small areas in a telescope image plane, and alternately focussing them on the same detector element by means of an optical mechanical chopper is described.

KEYWORDS: Two-spot-comparator, Image-selection-device, Celestial-targets, Two-beam photometer, Infrared radiometry

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Air Force Cambridge Research Laboratories (LM)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
STRONG CORONAL SHOCKS AND 'THERMAL' SOLAR X-RAY BURSTS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Charles L. Hyder

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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LM)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

I find that a one-dimensional strong coronal shock ($M_S \geq 3$) will grow outward until the Mach number (M_S) ceases to increase with height ($dM_S/dh=0$). The shock is driven by the pressure gradient and it is damped by gravity and by energy losses (radiative and conductive). The driving and damping terms reach equilibrium for $M_S \simeq 4$.

Standard shock jump conditions for $M_S \simeq 4$ lead to post-shock temperatures in the corona in the range 10^7 to 1.8×10^7K and emission measures from 3.8×10^{47} to 3.8×10^{48} cm^{-3}. For isolated simple events, I predict an exponential decay of the emission measure with decay times in the range $1 \leq \tau \leq 6.5$ min.

In a detailed study of over 4000 X-ray bursts, Drake (1970) compares 1 to 6 keV X-ray data with 7.7 to 12.5 keV X-ray data (the 'thermal' component) and finds ranges for the temperatures of 1.2×10^7 to 1.8×10^7K, for the emission measures of 5.1×10^{47} to 3.8×10^{48} cm^{-3} and for the decay times $0.5 \leq \tau \leq 20$ min. He also finds that the emission measure varies "...both from event to event and within the event, by more than a factor of two".

The agreement between the predictions and the observations makes it appear that a strong shock in the corona will produce a post-shock state that yields the observed characteristics of the soft component of X-ray bursts (the 'thermal' X-rays).

I give several examples where sprays and fast eruptive prominences($M \simeq 1$), that are not associated with solar flares, are associated with 'thermal' X-ray bursts. There were two slow eruptive prominences ($M \ll 1$) in the sample, and neither of them yielded a detectable X-ray burst.

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1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

Hα DOPPLER BRIGHTENING AND LYMAN-α DOPPLER DIMMING IN MOVING Hα PROMINENCES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
Charles L. Hyder
Bruce W. Lites

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13. ABSTRACT

We consider the effect that coherent motion has on the observed brightness of moving clouds above the photosphere. We find that steady state clouds (constant N_e and T_e) that are moving perpendicular to the line of sight will appear brighter in Hα for speeds between 8 and 100 km/sec and dimmer for speeds greater than 135 km/sec. The brightening and dimming are due to apparent Doppler shifts of the respective Hα absorption and the Lyman-α emission profiles 'seen' by the absorption profile of the moving cloud.

We apply this analysis, along with optical depth and geometrical considerations, to the observed brightness variations of the 1 March 1969 limb eruptive prominence. We find that all of the observed brightening and dimming can be explained by the motions, and that no significant change in the prominence N_e or T_e was necessary during the observed Hα event. This conclusion is significant in interpreting and X-ray burst that began as the prominence velocity increased abruptly at the time of maximum Hα intensity. The 'thermal X-ray' peak occurred 150 sec later when the prominence had become faint again. There was no associated flare that was visible in Hα. We discuss the relative brightness of Hα and D_3 in a specific moving prominence knot.

We note that the observed range of limb speeds (30-150 km/sec) may be due to the combined Hα Doppler brightening and Lyman-α dimming effects. We also discuss generally the Hα brightness of disk surges (bright and dark) and flares, and sprays and puffs that occur at or near the limb.

KEYWORDS: Solar spectroscopy, Solar physics, Solar chromosphere

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Air Force Cambridge Research Laboratories (OPL)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
SPECTRAL ANOMALIES DUE TO INHOMOGENEOUS OPTICAL PUMPING IN THE RUBY LASER

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
Jerald R. Izatt

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

The output of a ruby laser operated near threhold at liquid-nitrogen temperature normally consists of one or more longitudinal cavity modes near the center of each member of the R_1 doublet. The nominal doublet spacing is 0.38 cm^{-1}, but by masking a portion of the ruby rod from the pump radiation the separation of the laser components can be reduced significantly below that value. For example, masking 1/4 of the length of a 5.08×0.64-cm ruby rod has been observed to result in a laser component separation of only 0.20 cm^{-1}. This paper presents typical laser spectra for masked rubies and also presents and discusses time-resolved laser spectra and fluorescence spectra observed under the same masking conditions. The latter provide insight into the mechanisms responsible for the observed anomalies, and a theoretical model is developed to explain the principal features of the observations.

KEYWORDS: Lasers, Inhomogeneous optical pumping, Ruby laser

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Air Force Cambridge Research Laboratories (LYB)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
WIND SPEEDS AS MEASURED BY CUP AND SONIC ANEMOMETERS AND INFLUENCED BY TOWER STRUCTURE

4. DESCRIPTIVE NOTE: *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S): *(First name, middle initial, last name)*
Yutaka Izumi
Morton L. Barad

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Reprinted from Journal of Applied Meteorology, Vol. 9, No. 6, pp. 851-856, December 1970.	Air Force Cambridge Research Laboratories (LYB) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Wind tunnel and field experiments have shown that the fast-response three-component sonic anemometer is a highly accurate wind speed sensor. When sonic anemometers were used as reference sensors for wind speed, slower response cup anemometers were found to consistently overestimate the wind speed. Despite measures taken during a field program in Kansas to minimize tower influence on wind measurements, the errors due to the tower effect on the windward side are inferred to be about ±5% of the observed wind speed ratios of cup to sonic anemometers. When the observed speed ratios are compared with the errors due to tower influence, the overspeeding of the cup anemometer is estimated to be about 10% of the reference wind speed.

KEYWORDS: Cup anemometers, Sonic anemometers

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
THE DISCOVERY OF A 2H-3C SOLID STATE TRANSFORMATION IN SILICON CARBIDE SINGLE CRYSTALS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
P. Krishna
R.C. Marshall
C.E. Ryan

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Reprinted from Journal of Crystal Growth, Vol. 8, pp. 129-131, 1971.	Air Force Cambridge Research Laboratories (LQS) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Needle-shaped single crystals of 2H (wurtzite type) SiC, grown by a vapour-liquid-solid mechanism, are transformed to the 3C (sphalerite type) structure on annealing in argon at temperatures above 1400°C. The temperature at which the structural transformation is induced varies from one crystal to another ranging from 1400°C to 1800°C. The structure of the crystals before and after the heat-treatment was identified by X-ray diffraction photographs. The discovery of this transformation explains the absence of the ABAB... packing in the structure of SiC polytypes formed at high temperatures above 2000°C and suggests that cubic SiC is the stable modification, at least over a temperature-range from 1400°C to about 1800°C.

KEYWORDS: Silicon carbide, Polytype, Crystallography, Transformation, Annealing

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L.G. Hanscom Field
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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE

EMISSION SPECTRA OF PARTICULATE SILICATES UNDER SIMULATED LUNAR CONDITIONS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*

Lloyd M. Logan
Graham R. Hunt

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Reprinted from Journal of Geophysical Research, Vol. 75, No. 32, pp. 6539-6548, November 10, 1970.	Air Force Cambridge Research Laboratories (PHL) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Infrared spectra have been acquired under simulated lunar conditions that demonstrate that, contrary to popular belief, features of high spectral contrast are available for small-particle-size samples. The spectral information occurs in the form of emission maxima that are associated with the principal Christiansen frequencies, and these maxima are diagnostic of gross composition. The features represent a 5 to 30% effect, depending on particle size and composition. The effect is explained in terms of the sharp thermal gradients produced close to the surface under lunar conditions.

KEYWORDS: Emission spectra, Silicates, Lunar

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
JAMES FRANCK AT GÖTTINGEN

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
O. Oldenberg

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Reprinted from American Journal of Physics, Vol. 39/1, pp. 41-43, January 1971.	Air Force Cambridge Research Laboratories L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

These recollections were written at the request of the Project on the History of Recent Physics of the American Institute of Physics. The author was "head assistant" to James Franck from 1922 to 1930. Discussion of Franck's methods of thought centers around Klein-Rosseland processes (impacts of the second kind) and the Franck-Condon principle.

KEYWORDS: History of physical science, James Franck and atomic and molecular theory, Franck-Condon principle, Ionization and dissociation processes in molecules, James Franck and Otto Oldenberg at Göttingen

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3. REPORT TITLE
STUDY OF ION-NEUTRAL REACTIONS WITH A TIME-OF-FLIGHT DOUBLE MASS SPECTROMETER

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
John F. Paulson
Fred Dale
Stanley A. Studniarz

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13. ABSTRACT

The times-of-flight of reactant and product ions from some low energy ion-neutral reactions are measured using a longitudinal double mass spectrometer system. This system consists of a 2.54 cm 90 degree magnetic sector ion beam selector, a collision chamber and grid system, and a 46 cm quadrupole mass filter, together with a multichannel scaler, operated at dwell times of 50 nanosec per channel, that serves as a flight-time recorder. Reactant ions are produced as a pulsed beam by applying 0.1 to 1.0 microsec pulses to an electron control grid. The time-of-flight of these ions to the collision chamber is obtained by measuring the delay between the pulse on the electron control grid and pulse applied to a grid close to the collision chamber used to stop the reactant ion beam. Times-of-flight of the reactant and product ions through the collision chamber, grid system, and mass filter are then obtained by difference. The apparatus has been used to study ion-neutral reactions in the range of reactant ion energies from 0.3 to 250 eV and of product ion energies from thermal to about 150 eV. Consideration of the sources of error indicates that the system is most useful for the range of ion energies from thermal to a few tens of eV. Results obtained in the study of three ion-neutral reactions are presented. These are $Ar^+ + Ar \rightarrow Ar + Ar^+$, $CO_2^+ + CO_2 \rightarrow CO_2 + CO_2^+$, and $CO^+ + CO_2 \rightarrow CO + CO_2^+$.

KEYWORDS: Ion-molecule, Mass spectrometer, Time-of-flight

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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
CHARACTERISTIC SPECTRA OF ENERGY ABSORPTION FOR DIELECTRIC SOLIDS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
J.N. Plendl

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
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13. ABSTRACT

A method has been developed of deriving the fundamental absorption spectra of solids directly from experimental infrared data without having to resort to computational evaluation. These characteristic lattice absorption spectra represent the true energy absorption spectra of solids. As opposed to the traditional absorption coefficient (k) vs frequency curve, which is regarded as the absorption spectrum for solids in the region of anomalous dispersion, the spectra, as derived by the proposed method, clearly resolve the transverse and longitudinal modes of vibration. They also exhibit the characteristics of anharmonicity and damping. The method uses the combined reflection and transmission data on single-crystal and thin-film specimens. Its validity has been verified on a wide variety of solids. The most recent data obtained from emission, laser-Raman, or cold neutron scattering techniques, is in complete agreement with the derived values. A method of calculating the various modes of vibration of solids, directly from elastic constants, is also advanced. It is simultaneously used to render further support for the developed characteristic energy absorption spectra. The importance of these spectra is discussed with regard to some problems in solid state physics.

KEYWORDS: Lattice spectra, Infrared spectra, Raman spectra, Cold neutron spectra, Binding forces in solids

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3. REPORT TITLE
DAMPING OF LATTICE VIBRATIONS IN SOLIDS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
J.N. Plendl

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Applied Optics, Vol. 10, pp. 87-97, January 1971.	Air Force Cambridge Research Laboratories (LQD) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The damping of lattice vibrations in solid compounds is treated using kinetic theory analogous to damping in gases. It is based on the collision frequency of atoms, taking into consideration the atomic coordination due to the crystalline structure, the cross section of collision, the radius ratio of the component atoms (atomic size factor), as well as an anharmonic factor which is an expression for the anharmonicity of lattice vibrations. A semiempirical formulation is derived without need for constants fitted to experimental data. This formulation of damping is shown valid for more than eighty solids, mostly binary compounds, also some ternary compounds and elements. They may have either ionic or covalent or metallic binding. They cover ten different structures and valencies from one through four. In addition, a close relationship is shown between damping and thermal expansion as a function of temperatures. Based on this relationship, the temperature dependence is empirically expressed by an exponential function of the coefficient of thermal expansion. This function agrees with the variation of ir energy absorption vs temperatures. The complete damping formulation is shown valid for the entire temperature range of solids, from absolute zero to the melting point, for a variety of solids for which all pertinent data were on hand.

KEYWORDS: Lattice spectra, Infrared spectra, Raman spectra, Cold neutron spectra, Binding forces in solids

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Air Force Cambridge Research Laboratories (PH)
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2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
NONLINEAR COLLISIONLESS PLASMA WAVES AND INTENSITY OF THE ELECTRIC FIELD OF THE IONOSPHERIC IRREGULARITIES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
B. Prasad G. Kalman
Hari K. Sen
P. Bakshi

6. REPORT DATE
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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (PH)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

An exact longitudinal wave solution of nonlinear equations for a cold and collisionless one-fluid magneto plasma has been obtained. The wave is found to be anharmonic (non-sinusoidal) in form and its amplitude involves an arbitrary parameter. By means of a pseudopotential well, the domain of nonlinear oscillations is defined and the maximum amplitude up to which a nonlinear wave can grow is determined. Intensity of the equatorial sporadic-E irregularities is computed and the coherent energy density is found to be of the order of 10^{-9} erg/cm^3.

KEYWORDS: Nonlinear plasma waves, Ionospheric irregularity

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3. REPORT TITLE
THE RESONANCE BARRIER THEORY OF HYDROMAGNETIC WAVES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Henry Robert Radoski

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11. SUPPLEMENTARY NOTES Reprinted from Journal of Geomagnetism and Geoelectricity, Vol.22, No.3, pp.361-379, 1970.	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PHG) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A theory of hydromagnetic propagation is developed for the case in which the isotropic and guided modes are coupled. The hydromagnetic wave equation, including ioncyclotron terms, is derived and is applied to the cylindrical geometry of the MHD wedge. The low frequency, axisymmetric case, which corresponds to weak coupling is considered in detail. A steady state solution is obtained which involves the formation of a period-dependent, reflecting barrier. This barrier, a direct result of the toroidal resonance, confines the wave energy to definite regions within the magnetized plasma. The numerical results obtained for this particularly tractable model are applied by analogy to the plasmasphere. The anticipated spectra and the associated latitude effects are displayed for both bounded and open systems.

KEYWORDS: Hydromagnetic waves, Magneto sphere, Resonances

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Air Force Cambridge Research Laboratories (LII)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
A UNIFIED DESCRIPTION OF THE TIDAL EFFECTS IN f_0F_2

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
C.M. Rush
D.E. St. John
S.V. Venkateswaran

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Radio Science, Vol. 5, No. 12, pp. 1413-1428, December 1970.	Air Force Cambridge Research Laboratories (LII) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The ionospheric spectrum of the critical frequency of the F_2 region, f_0F_2, is studied in detail at 35 locations during solar maximum and at 21 stations during solar minimum. The spectra contain prominent lines superposed on background continua. The most prominent lines correspond to solar periods of 24, 12, and 8 hours. Lines at half a lunar day (period of 12.48 solar hours) and at two lunisolar periods have also been detected in all the spectra investigated. The lunisolar lines have statistically significant amplitudes only at the low-latitude stations. Our analysis indicates the influence in the F region of plasma transport processes such as E×B drift, ambipolar diffusion, and iondrag effects of the neutral air wind generated by the thermospheric diurnal density variations. An assessment of the roles of some of these processes is attempted in terms of the results obtained from our analysis.

KEYWORDS: Tidal effects (F region), f_0F_2, Spectrum analysis, Ionospheric dynamics, Solar cycle variations

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3. REPORT TITLE

A NOTE ON ERRORS IN UPPER AIR HUMIDITY CLIMATOLOGY

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

H.A. Salmela
N. Sissenwine

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11. SUPPLEMENTARY NOTES Reprinted from Journal of Applied Meteorology, Vol.9, No.6, pp.954-955, December 1970.	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKI) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Their findings are discussed in this note and average dew point corrections are suggested for selected constant pressure levels.

KEYWORDS: Climatology, Humidity, Humidity sensor

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1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LZM) L.G. Hanscom Field Bedford, Massachusetts 01730	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE
MICROWAVE FREQUENCY ACOUSTIC SURFACE-WAVE LOSS MECHANISMS ON $LiNbO_3$

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
A.J. Slobodnik, Jr.
P.H. Carr
A.J. Budreau

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Applied Physics, Vol. 41, No. 11, pp. 4380-4387, October 1970.	Air Force Cambridge Research Laboratories (LZM) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The temperature and frequency dependence of the attenuation of 0.5–5-GHz acoustic surface waves on $LiNbO_3$ has been measured. For propagation in vacuum a frequency-squared dependence of the total attenuation is obtained with a value at 1 GHz of 0.9 dB/μsec. Temperature-dependence measurements using a novel three-transducer technique show the dominant loss (0.7 dB/μsec at 1 GHz) mechanism to be the interaction with thermally excited elastic waves. Propagation in air results in an additional loss linearly proportional to frequency with a value of 0.2 dB/μsec at 1 GHz. The effects of beam steering and diffraction losses are also investigated both theoretically and experimentally. Both misalignment of transducers with respect to pure mode propagation axes and misalignment of the propagation-plane perpendicular can add significantly to delay line insertion loss. This beam steering loss on Y-cut Z-propagating $LiNbO_3$ is considerably higher than on the 41.5° rotated-cut X-propagating orientation. The loss mechanisms measured in this paper are sufficient to completely account for the insertion loss of surface-wave delay lines.

KEYWORDS: Three transducer method, Temperature dependence of attenuation, Air loading of microwave acoustic surface waves, Frequency dependence of attenuation, Loss mechanisms in microwave acoustic surface waves

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1. ORIGINATING ACTIVITY *(Corporate author)*
Air Force Cambridge Research Laboratories (LIR)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
OBSERVATIONS AT THE SAGAMORE HILL SOLAR RADIO OBSERVATORY

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Ronald M. Straka
John P. Castelli

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Reprinted from Nature, Vol. 226, No. 5251, pp. 1149-1152, June 20, 1970).	Air Force Cambridge Research Laboratories (LIR) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Measurements of the 7 March 1970 solar eclipse were made by AFCRL at the Sagamore Hill radio observatory on the frequencies of 35 GHz, 15 GHz, 8800 MHz, 4995 MHz, 2695 MHz, 1415 MHz, 606 MHz, 245 MHz and 114 MHz. The brightness temperature spectral index, γ, derived from $T_b = af\gamma$ showed that the residual temperatures at maximum obscuration ($m = 0.96$) had an index of -1.5, which indicated a flatter temperature spectrum than was associated with the 12 November 1966 eclipse where $\gamma = -1.9$. A similar flattening of spectrum occurs with daily total sun values during periods of high solar activity.

The flux spectrum of the radio source associated with McMath plage 10607 is illustrated and shows a peaking of 10.9 flux units to occur near 6.0 CM wavelength. Brightness, temperatures of the region as well as its associated optical development are described.

KEYWORDS: Solar eclipse, Radio astronomy, Active regions, Source spectrum

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Air Force Cambridge Research Laboratories (LKB)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE

SOURCES FOR $H_3O^+ \cdot (H_2O)_n$ IONS IN THE D REGION

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

W. Swider

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Journal of Geophysical Research, Space Physics, Vol. 75, No. 34, pp. 7299-7302, 1 December 1970.	Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Difficulties concerning the creation of $H_3O^+ \cdot (H_2O)_n$ ions in the D-region are discussed. It is suggested that the formation of these ions may be related to the chemistry of methane.

KEYWORDS: Ionosphere, D-region, Mesosphere, Atmospheric ionization, Ionospheric chemistry

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Air Force Cambridge Research Laboratories (PHP)
L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
ELECTRONIC ENHANCEMENT OF PHOTODETECTOR PERFORMANCE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific, Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
C. Tsacoyeanes
M.A. Levine

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Applied Optics, Vol. 9, No. 11, pp. 2597-2598, November 1970.	Air Force Cambridge Research Laboratories (PHP) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A significant gain in signal-to-noise ratio for photodiodes and avalanche photodiodes is realized by bootstrapping the device capacitance. A specific example is detailed for the detection of 6328 Å light modulated at 30 MHertz. The signal-to-noise ratio gain in this example is 9 db and 3 db for the photodiode and avalanche photodiode respectively, so that, the signal-to-noise ratios for the photodiodes are superior to that of a photomultiplier when the light intensity is greater than .05 microwatts for the avalanche photodiode and 1 microwatt for the photodiode.

KEYWORDS: Photomultipliers, Photodiodes, High speed light detection

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3. REPORT TITLE
SHOCK-TUBE MEASUREMENTS OF ABSOLUTE gf-VALUES FOR Fe I

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
S. J. Wolnik
R. O. Berthel
G. W. Wares

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13. ABSTRACT

Absolute gf-values for 118 Fe I lines in the visible region of the spectrum have been measured by shock-tube emission spectroscopy. Special attention was given to choosing relatively faint lines in a region of reasonably well-defined solar photospheric continuum and to eliminating systematic errors. For the latter purpose, the gas kinetic temperature was measured accurately by an ultrasonic technique for every shock, and a special study was made in which the various experimental parameters were varied over extreme ranges and in which the validity of the assumptions of local thermodynamic equilibrium (LTE) and of optical thinness were verified. Our results are in fairly good agreement with Corliss and Tech's free-burning-arc measurements for low-excitation lines but show large disagreements for lines having high-excitation potentials. The magnitude of the discrepancies is largely dependent upon upper excitation potential and to a lesser extent upon wavelength. Our measurements for low-excitation and high-excitation lines agree to within a factor of about 2 with values obtained by other independent investigations, which include shock-tube, wall-stabilized-arc, atomic-beam, and beam-foil measurements. These results suggest that the solar photospheric abundance of iron may need to be revised upward in the light of the various recent measurements of gf-values for high-excitation lines, which are consistently smaller than reported free-burning-arc values by nearly 1 order of magnitude. These free-burning-arc f-values and the furnace-absorption f-values upon which they are based have repeatedly led to the paradox of solar photospheric iron abundance about an order of magnitude lower than coronal. According to a line-profile fitting analysis by Ross (1970), our Fe I gf-values correspond to an increased photospheric abundance by a factor of about 5.

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L.G. Hanscom Field
Bedford, Massachusetts 01730

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
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4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
N. Ben-Yosef
A.G. Rubin

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Physics Letters, Vol. 33A, No. 4, pp. 222-223, 2 November 1970.	Air Force Cambridge Research Laboratories (PHP) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A new method of measuring turbulent electric fields and electron temperatures from broadening of hydrogen Balmer lines is presented.

KEYWORDS: Turbulent, Stark, Broadening, Lines, Balmer

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Accumetrics Corporation
344 Rindge Avenue
Cambridge, Massachusetts 02140

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
FLIGHT DATA ANALYSIS AND ELECTROMECHANICAL SIMULATION OF SOUNDING ROCKET STABILITY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific, Final, 25 August 1969 - 24 January 1971 approved 5 Feb 71

5. AUTHOR(S) (First name, middle initial, last name)
Donald H. Fryklund
Oiva R. Anderson

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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LC)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The post-burnout angular motions of three divergent NIRO sounding rocket flights have been examined using rigid body energy techniques previously developed under contract F19628-69-C-0029, Report AFCRL-69-0222. Two of these flights exhibited roll-pitch lock-in through burnout and for several seconds after. All exhibited a rapid initial increase in coning angle followed by an actual decrease and a later more gradual divergence consistent with increased altitude. The rigid body kinetic energy histories show a double peaked character which implies that energy is temporarily stored internally such as in structural deformation. The magnitude of the energy in transverse motion is small enough so that de-spun damping of reasonable weight penalty is feasible.

The previous study indicated that coning divergence of a spin-stabilized sounding rocket could be eliminated by the use of a passive de-spun rotor stabilization system. In an effort to effectively and economically verify the performance of this system in hardware form an electromechanical simulator was designed and fabricated. A passive rotor stabilizer, included in the system, was tested with positive results. Performance of this system checked closely with predicted results.

A logical next step in this program is the design, fabrication and flight testing of several rotor stabilizer systems.

KEYWORDS: Sounding rocket, Stability, Dual-spin stabilization

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3. REPORT TITLE

THE GROWTH OF SINGLE CRYSTALS OF THE CHARGE TRANSFER COMPLEXES.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final, 1 August 1967 - 31 July 1970	Approved: 13 January 1971

5. AUTHOR(S) (First name, middle initial, last name)

Carolus M. Cobb
Elbridge B. Wallis

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13. ABSTRACT

Conditions for the single crystal preparation of the perylene-iodine charge transfer compounds and the nitro-derivatives of fluoren - $\Delta^{9\alpha}$ - malononitrile have been investigated. Ternary phase relationships for the perylene-iodine carbon disulfide system have been obtained at 25°C and 35°C. Smoothed solubility curves for the $P_7(I_2)_{10}$, $P_2(I_2)_3$, and $P(I_2)_2$ species are presented for both 25°C and 35°C. The solubility curves for 9 - dicyano methylene - 2,4,7 trinitrofluorene and 9 - dicyano-methylene 2.7 dinitrofluorene in acetonitrile have been determined and the conditions for crystal growth of these materials are presented.

The free energies of formation, heats of formation and entropies of formation have been deduced for the $P_7(I_2)_{10}$, $P_2(I_2)_3$ and $P(I_2)_3$ species from the solubility data and previous gas-solid reaction studies.

The factors which hinder the crystal growth of the perylene-iodine compounds have been identified as extremely small solubilities coupled with large changes of the solubility with temperature. The requirements for isothermal and temperature gradient techniques for growing single crystals of these materials are stated. These include specifications on the allowed temperature gradients and concentration changes which will prohibit the onset of dendritic growth through constitutional supersaturation.

Results from the program indicate that the solution growth of good single crystals of both the perylene-iodine compounds and the nitro-derivatives of fluoren - $\Delta^{9\alpha}$ - malononitrile will require extremely close control of solution temperatures and temperature gradients and use of growth solutions of six liters or more in size.

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Donald J. Armstrong Edward D. Conway Carolyne M. Mandell
John A. Carbone Peter W. Lindstrom

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (SUM) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

This report is the concluding scientific report to record the status and progress of Scientific Analytical Investigations, the preparation of Computer Programs, Data Reduction, and the development of mathematical and computer techniques in support of Environmental Research and other various aspects of the physical sciences concerning the upper atmosphere.

During the year covered by this report, the 50 completed programs ranged in complexity and size from conversion of programs from one language or computer system to another, to analysis and development of a large system of analytical programs.

KEYWORDS: Climatology, Trafficability, Areal precipitation

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113 Terrace Hall Avenue
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4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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3 February 1971

5. AUTHOR(S) *(First name, middle initial, last name)*
Leonard L. Dalton
Richard H. Desrochers
Arthur J. Markey
David T. Williams

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11. SUPPLEMENTARY NOTES
TECH, OTHER.

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (SU)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

In an effort to circumvent the difficulties and effort involved in reducing and processing the telemetry data from a broad class of differing space vehicles, and Analysis and Simulation Branch (SUYA) of the Air Force Cambridge Research Laboratories (AFCRL) at L. G. Hanscom Field, Bedford, Massachusetts, has been engaged in the development of a Satellite Data Reduction Processor System (SADAR) (as described in AFCRL-67-0561) to provide a general and flexible computer programming system capable of handling the raw data from diverse vehicles.

This report describes a system to process raw telemetry data from the OV3-6 Satellite and the display of the various experimental results.

KEYWORDS: Commutator, Computer program, Computer programing system

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3. REPORT TITLE

CONSIDERATIONS FOR NON-LINEAR MICROWAVE BREAKDOWN & PROPAGATION

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Scientific Interim

5. AUTHOR(S) *(First name, middle initial, last name)*

Ronald L. Fante

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Approximations have been considered which lead to a simplified model for non-linear microwave breakdown. Using the simplified model we have then analytically considered the propagation of a high power plane wave into a steady state ( ) gaseous half-space. We have also presented numerical results for the non-steady state case ( ).

KEYWORDS: Non-linear propagation, Microwave breakdown

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Clarkson College of Technology
Department of Physics
Potsdam, New York 13676

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
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4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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Approved
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5. AUTHOR(S) *(First name, middle initial, last name)*
Richard Madey
G. Thomas Huetter
Stephen M. Yushak

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Multiple Reprints included	Air Force Cambridge Research Laboratories (PH) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Advances in instrumentation based on the spark-chamber technique for making charged particle studies of the aerospace environment have included the development of (1) spark-discharge modules that are sealed against the space environment, (2) a high-voltage generator with a long lifetime for use with spark chambers in space, (3) a passive readout technique for spark-discharge counters, and (4) a method of applying a clearing field that consumes no power. Analytical expressions have been derived for the flux of protons within cylindrical shell and slab disk shields exposed to protons in space. Reported also are studies in space radiation dosimetry.

KEY WORDS: Spark Chamber Spectrometry, Proton Spectrometer, Spark-Discharge Modules

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1 ORIGINATING ACTIVITY (Corporate author)
Colorado School of Mines
Department of Geophysics
Golden, Colorado, 80401

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3 REPORT TITLE
EVALUATION OF AIRBORNE ELECTROMAGNETIC SURVEYING FOR MAPPING VARIATIONS IN ROCK STRENGTH

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Final 1 March 1969-1 July 1970 approved 30 December 1970

5 AUTHOR(S) (First name, middle initial, last name)
George V. Keller
Andre B. Lebel
Evan L. Ausman, Jr.

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11 SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field, Bedford, Mass. 01730

13 ABSTRACT

The objective of the study that is the subject of this report was to determine the feasibility of estimating variations in ground strength on the basis of electrical conductivities measured from the air. A review of the literature indicates that for a wide variety of crystalline igneous rocks, a reasonably unique relationship should exist between resistivity and strength. Three airborne electromagnetic surveying techniques hold promise for measuring ground conductivity in the desired range. These are, in order of the ease with which surveys might be made with existing or modified systems, the wave-tilt method, the long-grounded-wire method and the INPUT method. The wave-tilt method makes use of waves radiated by VLF broadcast stations in the frequency range from 15 to 30 KHz, and is useful with no modification of commercially available equipment, as field tests described in this report indicate. The long-grounded-wire method makes use of fields from a current-carrying cable installed specifically for a survey. The INPUT method makes use of a transmitter carried on the aircraft with the receiver. However, in order to measure conductivities in the range of interest with the existing commercial INPUT system, major modifications would be required.

KEYWORDS: Rock strength, Strength variations, Wave tilt

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Colorado State University
Department of Electrical Engineering
Fort Collins, Colorado 80521

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE

CAUSES, EFFECTS AND DIAGNOSTIC MEASUREMENTS OF THE REENTRY PLASMA SHEATH

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)

James P. Rybak

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH., OTHER	Air Force Cambridge Research Laboratories L. G. Hanscom Field (LZ) Bedford, Massachusetts 01730

13. ABSTRACT

During entry into the earth's atmosphere of a manned or unmanned space vehicle, a plasma sheath envelops the vehicle because of shock heating of the ambient gases and ablation of the heat shield material. This plasma sheath causes the interruption of radio communications between the space vehicle and ground based stations commonly referred to as the reentry communications blackout. To solve the blackout problem, a knowledge of the reentry plasma sheath properties (electron density, electron collision frequency, electron temperature and plasma stand-off distance) is required. A summary of the causes and effects of the reentry plasma sheath is presented in this report together with a discussion of reentry plasma diagnostic techniques and review of the flight experiments performed to determine the properties of the reentry plasma.

KEYWORDS: Reentry, Plasma sheath, Plasma diagnostics, Reentry vehicles

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Colorado State University
Department of Electrical Engineering
Fort Collins, Colorado 80521

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
ANTENNAS IN COMPRESSIBLE PLASMAS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
James P. Rybak

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11. SUPPLEMENTARY NOTES
TECH., OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories
L. G. Hanscom Field (LZ)
Bedford, Massachusetts 01730

13. ABSTRACT

Measurements of antenna impedance are frequently used to determine the properties of plasmas which occur in the ionosphere and during the atmospheric reentry of space vehicles. An accurate understanding of the performance of antennas in plasmas is required for these purposes as well as for determining ways to minimize the reentry communications blackout problem. The results of the ionospheric rocket experiments have indicated the necessity, when analyzing antenna performance, of using a "warm" or "compressible" plasma theory which takes into a account the thermal motion of the plasma particles. The classical derivation of the hydrodynamic, compressible plasma theory equations is included in this report together with a discussion of appropriate boundary conditions. A review of the antenna analyses which have been performed using this compressible plasma theory is presented to illustrate the present "state of the art" of antenna-plasma analysis.

KEYWORDS: Antennas, Antenna theory, Compressible plasmas, Plasma diagnostics

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1 ORIGINATING ACTIVITY (Corporate author) Colorado State University Department of Electrical Engineering Fort Collins, Colorado 80521	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3 REPORT TITLE

MICROWAVE REENTRY PLASMA DIAGNOSTICS

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5 AUTHOR(S) (First name, middle initial, last name)

James P. Rybak

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11 SUPPLEMENTARY NOTES TECH., OTHER	12 SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories L. G. Hanscom Field (LZ) Bedford, Massachusetts 01730

13 ABSTRACT

An analysis of surface-mounted aperture antenna admittance has been performed in this study to determine the conditions under which admittance measurements can be used for reentry plasma diagnostics. The primary contribution of the present work is the determination that the admittance of a thin, microwave aperture antenna, located on the surface of a reentry vehicle, can be used to obtain the values of the electron density, electron collision frequency, ion sheath thickness and electron temperature of the reentry plasma. It is further demonstrated, by using admittance measurements made during a reentry test flight as reported by Mayhan et al. (1968 IEEE Trans. Antennas and Propagation, AP-17, 573), that open-ended-waveguide antenna admittances can be used to determine the plasma electron density, electron collision frequency and plasma stand-off distance when the reentry plasma is separated, due to aerodynamic boundary layer effects, from the surface of the reentry vehicle.

KEYWORDS: Reentry, Plasma sheath, Plasma diagnostics, Microwave antennas, Reentry vehicles

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PALISADES, NEW YORK 10964

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
SEISMICITY MAP OF THE ARCTIC COMPILED FROM ESSA, COAST AND GEODETIC SURVEY, EPICENTER DATA JANUARY 1961 THROUGH SEPTEMBER 1969

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (Last name, first name, initial)
Muawia Barazangi
James Dorman

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11. SUPPLEMENTARY NOTES Reprinted from the Bull. of the Seismological Soc. of Amer., Vol. 60, No. 5, pp.1741-1743, 1970. This research was supported by the Advanced Research Projects Agency.

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LW)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

A seismicity map of the Arctic region north of latitude 70°N containing 310 epicenters has been compiled from data tabulated by ESSA, Coast and Geodetic Survey, for the interval January 1, 1961 through September 30, 1969. All of the hypocenters are less than 100 km deep. The main feature is the continuation of the Mid-Atlantic seismic belt through the Arctic, which follows a complicated pattern of non-linear segments between Iceland and northern Greenland and follows a remarkably straight line across the Arctic Basin between Greenland and the Siberian shelf.

KEYWORDS: Seismicity map of Arctic

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2a. REPORT SECURITY CLASSIFICATION

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2b. GROUP

3. REPORT TITLE

THREE-DIMENSIONAL SEISMIC RAY TRACING IN A LATERALLY HETEROGENEOUS SPHERICAL EARTH

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

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5. AUTHOR(S) *(Last name, first name, initial)*

Klaus H. Jacob

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11. SUPPLEMENTARY NOTES Reprinted from the Journal of Geophysical Research, Vol. 75, No. 32, November 10, 1970, pages 6675-6689. This research was supported by the Advanced Research Projects Agency.

12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research Laboratories (LW)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Recent seismological studies suggest lateral inhomogeneities in P and S velocities of the mantle that are associated with slabs of mobile lithosphere descending into the mantle beneath island arcs. In special cases, travel times of P traversing such zones can differ by as much as 5 sec and of S by up to 10 sec from standard travel times. In addition, such zones are characterized by relatively low attenuation of S-wave energy compared with high attenuation in a broad zone on the landward side of the active volcanoes. To explain the observed anomalous travel times and attenuation phenomena, it is necessary to trace the path of body waves through laterally heterogeneous earth models. The technique of ray tracing developed here uses Fermat's principle to obtain the differential equation of a ray in spherical coordinates. The position, direction, and travel time of the seismic wave front at any point along the curved ray path are obtained by numerical integration of the differential equation for an assumed three-dimensional, continuous velocity distribution. The problem of representing a realistic three-dimensional velocity structure in the earth is solved in a way that is especially suitable for use on computers. Some examples for rays traversing an island-arc structure are presented. The implications of this method of tracing rays in a laterally heterogeneous earth are discussed with respect to seismic travel-time studies, interpretation of residuals in terms of tectonic heterogeneities, source bias, and the precise location of earthquakes and nuclear explosions; $dT/d\Delta$ measurements from large seismic arrays and their inversion to obtain details of the velocity structure in the upper mantle are also discussed.

KEYWORDS: Three dimensional seismic ray tracing, Heterogeneous spherical earth

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3. REPORT TITLE
STRUCTURE AND EVOLUTION OF THE MOBILE SEISMIC BELTS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific, Interim

5. AUTHOR(S) (First name, middle initial, last name)
Jack Oliver

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13. ABSTRACT

This is a review paper that was presented orally at the IUGG meeting in Madrid in the fall of 1969. The basic theme of the paper is that plate tectonics, or the new global tectonics, is undergoing widespread testing and development. Evidence from a number of disciplines, including seismology, gravity, sub-bottom profiling, geomagnetism, and various branches of geology, supports the moving plate model of plate tectonics. While observations of geophysics have been outstanding during the development of plate tectonics and will no doubt continue to be important in the future, it appears that the observations of geology will play an increasingly important role.

KEYWORDS: Mobile seismic belts, New global tectonics

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3. REPORT TITLE

ROCKET-BORNE PHOTOMETER INVESTIGATION OF NOCTILUCENT CLOUDS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific | Final (1 June 1968 - 1 February 1971 ; Approved 14 January 1971

5. AUTHOR(S) (First name, middle initial, last name)
Leslie G. Smith

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11. SUPPLEMENTARY NOTES Tech, other	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PH), L.G. Hanscom Field, Bedford, Massachusetts 01730

13. ABSTRACT

The design, construction, testing and flight performance of a rocket-borne dual-photometer system for investigation of the aerosol particle distribution in a noctilucent cloud is described. One photometer is mounted with the axis of the field of view parallel to the spin axis of the rocket. This photometer is equipped with a polarizer and observes the degree of polarization of the cloud at a particular scattering angle and at a specified wavelength (3750Å). The second photometer is oriented at 60 degrees to the spin axis. The intensity of the scattered light is observed over a wide range of scattering angle at a wavelength of 5750Å.

KEYWORDS: Noctilucent clouds, Photometer, Rocket instrumentation

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1. ORIGINATING ACTIVITY (Corporate author) General Electric Co. Re-Entry & Environmental Division Valley Forge, Pennsylvania 19101	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

SHOCK LAYER IONIZATION AT HIGH ALTITUDES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific, Final (Nov. 1968-Jan. 1971) approved Feb. 2, 1971

5. AUTHOR(S) (First name, middle initial, last name)

Henry G. Lew

6. REPORT DATE November 1970	7a. TOTAL NO. OF PAGES 116	7b. NO. OF REFS 6
8a. CONTRACT OR GRANT NO. F19628-69-C-0112 b. PROJECT, TASK, AND WORK UNIT NO. 4642-02-01 c. DOD ELEMENT 62101F d. DOD SUBELEMENT 681000	9a. ORIGINATOR'S REPORT NUMBER(S) GE TIS 70SD782 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-70-0702 AD719,750	

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11. SUPPLEMENTARY NOTES TECH., OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Electron production from the high temperature shock layer of blunt re-entry bodies are considered at high altitudes. The dissociation and subsequent ionization of air species due to the high flight speeds are predicted by analytical techniques with the consideration of the prevalent viscous effects at low density throughout the flow and with chemical relaxation of these species. The effect of vibrational nonequilibrium is also determined. Finally the spatial distributions of air species, temperature, velocity, and electron concentrations over a sphere-cone body, the Trailblazer, is mapped in detail for several altitude velocity conditions.

KEYWORDS: Ionized bow, Viscous shock layer, Boundary layer, Electron density

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1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Division of Engineering and Applied Physics Harvard University, Cambridge, Massachusetts 02138	Unclassified
	2b. GROUP

3. REPORT TITLE

STRUCTURAL PROPERTIES OF GRAMMARS AND LANGUAGES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final. Period covered: November 1, 1967 - October 31, 1970 Approved 1 Dec 70

5. AUTHOR(S) (First name, middle initial, last name)

Ronald V. Book

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Tech, OTHER	Air Force Cambridge Research Laboratories (LR) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The purpose of this report is to review and summarize the results obtained by this project during the total contract period.

KEY WORDS: Grammars, Language, Structure of grammars, Complexity of grammars

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1. ORIGINATING ACTIVITY (Corporate author)
Harvard University
Div. of Engineering and Applied Physics, Cruft Lab.
Cambridge, Massachusetts 02138

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
EXPERIMENTAL STUDY OF COUPLED LINEAR ANTENNAS IN AN INHOMOGENEOUS DISSIPATIVE MEDIUM

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
Thomas Sugimoto

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO.
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b. PROJECT NO Task, Work Uni' Nos.
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c. Dod Element: 61102F

d. Dod Subelement: 681305

9a. ORIGINATOR'S REPORT NUMBER(S)
Scientific Report No. 10

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LZ)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

An experimental investigation of a pair of coupled linear antennas in an inhomogeneous dissipative medium has been made. The medium was obtained by diffusing a water solution of NaCl into a large block of agar agar gel contained in a wooden tank. The relative dielectric constant was approximately 78 while the loss tangent could be varied from 0.13 to 3.0 at 114 MHz, the frequency used throughout the investigation.

Driving point admittances and current distributions were measured with the medium inhomogeneity oriented parallel to the axes of the antennas. Self and mutual input admittances were measured as a function of the antenna length (βh = 0.3 to 2π in steps of 0.1). Symmetric and antisymmetric current distributions were measured for four different antenna lengths (h/λ = 0.25, 0.50, 0.75, and 1.0). Each measurement was repeated for three antenna separations (b/λ=0.125, 0.25, and 0.50).

Self and mutual driving-point admittances were measured as a function of base separation (b/λ=0.25 to 1.5 in steps of 0.125) for four antenna lengths (h/λ=0.25, 0.50, 0.75, and 1.0) with the medium inhomogeneity direction perpendicular to the antenna axes.

Also studied were the effects of a medium discontinuity at the input, non-identical elements, and input aperture size on the measured input admittance.

KEYWORDS: Coupled linear antennas, Inhomogeneous dissipative medium, Driving-point admittances

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1. ORIGINATING ACTIVITY *(Corporate author)*
Harvard University
Harvard College Observatory
Cambridge, Massachusetts 02138

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
FINE STRUCTURE IN CaII ON THE SOLAR DISC

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific, Interim

5. AUTHOR(S) *(First name, middle initial, last name)*
Jay M. Pasachoff

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 1970	16	61

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F19628-69-C-0077	Scientific Report 4
b. PROJECT, TASK, WORK UNIT NOS. 7649-06-01	
c. DOD ELEMENT 62101F	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
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10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Solar Physics 12 (1970), pp. 202-215.	Air Force Cambridge Research Laboratories (CRK) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

High-dispersion spectra of the core of the K line of CaII as seen at the center of the solar disc have been reduced. Resolution on the spectra approach 1 arc sec. Line profiles of individual elements are very asymmetric and often are peaked on only one side of the line center. Variations of the line profiles and the emission peaks are discussed. The doubly reversed mean profile of the K line is explained as a spatial average of individual profiles, and it is suggested that single peaks may be caused by Doppler-shifted discrete elements in the chromosphere.

KEYWORDS: Solar disc, High-resolution spectrograms

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1. ORIGINATING ACTIVITY (Corporate author)
International Business Machines Corporation
Components Division, East Fishkill Facility
Hopewell Junction, New York 12533

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
CRYSTAL PROPERTIES AS INFLUENCED BY CRYSTALLOGRAPHIC IMPERFECTIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Final: March 1968 to November 1970 Approved: 21 Jan. 1971

5. AUTHOR(S) (Last name, first name, initial)
Guenter H. Schwuttke

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
December 1970	17	49

8a. CONTRACT OR GRANT NO.
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b. Project, Task, Work Unit Nos.
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9a. ORIGINATOR'S REPORT NUMBER(S)
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9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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10. AVAILABILITY/LIMITATION NOTICES
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11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LQ)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

A short summary is presented of the major results obtained under Contract F 19628-68-C-0196. Reference is made to the previous technical reports and scientific publications in which detailed discussion of the various phenomena is presented.

KEYWORDS: Defects in silicon, Semiconductor device performance, X-ray diffraction topography

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1. ORIGINATING ACTIVITY *(Corporate author)*
Lowell Technological Institute Research Foundation
450 Aiken Street, Lowell, Massachusetts 01854

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE

DESIGN AND FABRICATION OF SOUNDING ROCKET PAYLOADS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*
Richard E. Kenyon

6. REPORT DATE
March 1971

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7b. NO. OF REFS
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b. PROJECT, TASK, WORK UNIT NOS.
8692-09-01

c. DOD ELEMENT 62101F

d. DOD SUBELEMENT 681000

9a. ORIGINATOR'S REPORT NUMBER(S)
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Scientific Report No. 1

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
AFCRL-71-0072

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11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LC)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This report reviews work accomplished from February 1970 through January 1971 on design, integration and launch support of various sounding rocket payloads. A synopsis of each payload states the basic experimental objectives of the payload; the support electronics and instrumentation supplied; and the results of launch support efforts. Additional material presents a versatile battery charger; a squib power monitor assembly; and the results of evaluation of magnetic detection techniques for motion and position monitoring.

KEYWORDS: Payloads, Rockets, Design, Sounding rockets

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1. ORIGINATING ACTIVITY (Corporate author) Massachusetts Institute of Technology Aerophysics Laboratory Cambridge, Massachusetts 02139	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

ALLEVIATION OF THE PLASMA BOUNDARY LAYER BY CHEMICAL INJECTION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
Charles W. Haldeman
James P. McGuirk

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F19628-69-C-0043 b. [redacted] Project, Task, Work Unit Nos. 4642-02-01 c. DoD Element: 62101F d. DoD Subelement: 681000	TR 172 Scientific Report No. 5 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-71-0016 AD718,976

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LZ) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Work performed during 1970 on the transmission and radiation characteristics of antennas on the surface of a plasma-covered wind tunnel model is reported. The model used is a blunted cone-cylinder operated in a supersonic wind tunnel at M = 4, T_o = 80 → 100°F and P_o = 1.2 → 3 psi. The plasma sheath is obtained by injecting nitrogen plasma from a DC arc jet located in the model nose.

A new chemical injection system was used to inject a number of halogenated hydrocarbons into the plasma layer through .0012 and .0006 inch diameter orifices at rates between .3 and 6 gm per minute (additive mass fractions from 5 to 100 percent). It was found that nearly complete restoration of free space antenna impedance and transmitted power could be achieved from 25 mw S-Band signals at 50 percent or less additive mass fraction.

Data from electrostatic probes is presented which indicates that the mechanism of alleviation is electron attachment to form heavy negative species.

Teflon and carbon phenolic ablative plasmas were also studied and the effects of these ablative materials on the plasma sheath are presented.

The effect of ultrasonic energy on small fluid jets was also studied, as was the penetration of these jets into the wind stream.

KEYWORDS: Plasma sheath, Microwave antenna, Plasma alleviation

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1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
Department of Meteorology Massachusetts Institute of Technology 02139	Unclassified 2b. GROUP

3. REPORT TITLE

THE MEASUREMENT OF SMALL SCALE VELOCITY STRUCTURE IN THE 30-60 KM. REGION BY THE SMOKE TRAIL METHOD

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Final. 1 August 1968-31 August 1970 approved 13 October 1970

5. AUTHOR(S) (First name, middle initial, last name)

George J. Boer

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 31, 1970	63	9

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F 19628-69-C-0039 b. PROJECT, Task, Work Unit Nos. 8624-02-01, ILIR-49-01 c. DoD Element: 62101F, 61101F d. DoD Subelement: 681000, 680100	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-70-0513 AD715,923

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
This research was supported, in part, by the Air Force In-House Laboratory Independent Research Fund.	Air Force Cambridge Research Laboratories (LKI) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The measurement of small scale wind motions in the 30-60 km region of the atmosphere by means of the smoke trail method is described. This method obtains wind motions by photographing the deformation of a trail of smoke with time. The experiment consists of the analysis of four such trails deposited by two rockets which were fired simultaneously from different positions and which deposited a trail on both the upward and downward trajectories.

The method of reduction of the photographic data to obtain the position in space of the smoke trails with time and subsequent velocities is discussed and an estimate of the error in the resulting smoothed wind profiles is obtained.

The wind profiles obtained by this experiment are compared with an independent measurement which was made some 90 minutes later by a STARUTE sonde.

The wind profiles are analysed in terms of the spectrum of vertical wavelengths, the phase orientation and wavelength in the horizontal and the distribution of vertical shears.

A temperature profile obtained in the region is also analysed and an attempt is made to relate the wind and temperature profiles in terms of simple gravity wave theory.

The results of gravity wave theory are discussed and the measurements are shown to be compatible with the theory although a complete identification of the motions is not feasible.

KEYWORDS: Winds in stratosphere and mesosphere, Smoke trail measurements

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1. ORIGINATING ACTIVITY (Corporate author)
McDonnell Douglas Astronautics Company
P.O. Box 516, St. Louis, Missouri 63166

2a. REPORT SECURITY CLASSIFICATION
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2b GROUP

3. REPORT TITLE
A POTENTIAL HIGH ENERGY RESOLUTION IODINE NEGATIVE ION SOURCE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (Last name, first name, initial)
Ronald L. Cowperthwaite
Howard Myers

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO.
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b. PROJECT NO. Task, Work Unit Nos. 4642-02-01
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9a. ORIGINATOR'S REPORT NUMBER(S)
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9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LZ)
L. G. Hanscom Field, Bedford, Mass. 01730

13. ABSTRACT

The dissociative attachment reaction $e + HI \rightarrow H + I^-$ is suggested as a source of I^- ions. The desirable characteristics of the source are: (1) large attachment cross section, (2) small value of the H/I mass ratio, (3) nearly thermoneutral attachment, and (4) insensitive to the electron beam energy spread. When formed from stationary HI, these factors combine to give an I^- energy spread of 2-3 millivolts. The dominant I^- spread results from the thermal motion of HI, and is estimated to be 0.03 - 0.06 eV, FWHM. By using the heavy I^- ion to bombard a stationary light target molecule, a large difference in laboratory and center-of-mass (CM) energy scales further improves energy resolution and calibration. The reaction $I^- + H_2 \rightarrow H_2^- + I$ is suggested for measuring the electron affinity of H_2. For this case, the energy scale compression factor is 64.5 and the energy spread in the CM system, due to the I^- spread, is estimated to be the order of one millivolt.

KEYWORDS: High energy resolution I^- source

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1 ORIGINATING ACTIVITY *(Corporate author)*
Solid State Spectroscopy Laboratory
Physics Department, Northeastern University
Boston, Mass. 02115

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3 REPORT TITLE
THE STUDY OF THE REFLECTIVITY OF INORGANIC MATERIALS IMPORTANT FOR REMOTE SENSING APPLICATIONS

4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific. Final. 15 September 1968-15 September 1970. Approved 18 Dec. 1970.

5. AUTHOR(S) *(First name, middle initial, last name)*
Clive H. Perry
Robert P. Lowndes

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (PH) L.G. Hanscom Field Bedford, Mass. 01730

13. ABSTRACT

The influence of phase angle, compactness of material and particle size on the total reflectivity in the frequency range 10-10,000 cm^{-1} on a variety of inorganic materials is presented.

The determination of the $k \approx 0$ longitudinal optic frequencies and lifetimes from the dielectric and inverse dielectric response functions of simple cubic solids is discussed. The results of the temperature dependence over the range 5-400°K of the $k \approx 0$ LO frequencies and lifetimes of 18 alkali and thallium halides are given as determined from Kramers-Kronig analyses of near normal incidence single-crystal reflectance data and from small grazing angle reflectance data from thin films on conducting substrates. In addition, the pressure dependence up to 5 kilobars at 290°K of the LO frequencies of RbI, CsBr and CsI is reported.

Far infrared transmittance and reflection spectroscopic measurements at near normal incidence and Raman spectroscopic measurements are reported for polycrystalline thallous iodide in the temperature range 5-550°K.

The results of reflectivity measurements as a function of phase angle for fused quartz and calcite single crystals are presented together with the reflectivities as a function of particle size, packing fraction and phase angle for powdered samples of quartz and calcite.

Infrared and Raman measurements of a number of minerals are used to determine their characteristic lattice and Christianson frequencies and are directly applicable to the interpretation of remote sensing data.

A measurement and a discussion of the far infrared Stark and Zeeman splittings of Er^{3+} in the rare earth fluorides is given. The occurrence of silicon monoxide bands in some low temperature stars is also discussed.

KEYWORDS: Infrared, Raman, Remote sensing, Reflection

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1. ORIGINATING ACTIVITY (Corporate author)
Northeastern University
Boston, Massachusetts

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
INVESTIGATION OF SOLID STATE DEVICES AND DESIGN OF ELECTRONICS AND ELECTRO-OPTICAL MEASURING EQUIPMENT

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific, Final 1 October 1967 to 30 September 1970 Approved Jan. 15, 1971

5. AUTHOR(S) (First name, middle initial, last name)
Basil L. Cochrun

6. REPORT DATE
30 September 1970

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b. PROJECT NO. Task, Work Unit Nos. 4608-05-01

c. DoD Element 6240527F

d. DoD Supplement 634608

9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Lab. LG
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT
The investigations carried out under the terms of this contract consist of an attempt to find unique applications for the SCAD-Small Current Amplifying Device -, a new semiconductor device and the design of low noise preamplifiers suitable for new solid state sensors, a study of electrolumenescence in Ge and a study of the anomalous behavior of Schottky junctions.

KEYWORDS: Active devices, Junctions, Electroluminescence, Semiconductor noise, Preamplifiers

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1. ORIGINATING ACTIVITY *(Corporate author)*
Parke Mathematical Laboratories, Incorporated
One River Road
Carlisle, Massachusetts 01741

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP
- - - - -

3. REPORT TITLE

RESEARCH ON RADIATION EFFECTS IN SOLIDS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific Final. January 1968 - December 1970, approved 9 February 1971

5. AUTHOR(S) *(First name, middle initial, last name)*

PML Staff

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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8a. CONTRACT OR GRANT NO. F19628-68-C-0188
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9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)*
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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LQ)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This final report gives a summary of the principal topics of study and the main accomplishments of Contract No. F19628-68-C-0188. It also contains a complete list of publications issued under the contract and some specific recommendations for extension of the work.

KEY WORDS: Radiation effects, Electron slowing down, Secondary electron emission, Radiation dosimetry

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Materials Research Laboratory
The Pennsylvania State University
University Park, Pennsylvania 16802

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
INVESTIGATION OF NUCLEATION SITES IN GELS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final. 6 November 1967 - 30 November 1970 Approved: 12 Feb. 1971

5. AUTHOR(S) (First name, middle initial, last name)
Heinz K. Henisch

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TECH, OTHER	Air Force Cambridge Research Laboratories (LQ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The report gives a survey of work on the mechanism of crystal nucleation in gels and the various factors which influence it: heterogeneous nuclei and gel structure. It shows how both factors can in principle be controlled, through the use of so-called hybrid growth systems and a recently devised process known as "gel gettering". The report also describes research on seeding and re[illegible]nucleation processes, their problems and potentialities, and discusses the special role of cusps in controlling crystal growth in the gel medium. It concludes that the method is inherently capable of further development and makes three proposals for future research.

KEYWORDS: Crystal growth, Gels; gelling process; Nucleation, Diffusion

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Perkin-Elmer Corporation, Research Department
50 Danbury Road
Wilton, Connecticut 06897

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
TRANSIENT AND STEADY-STATE ELECTROSTRICTIVE LASER BEAM TRAPPING

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific Interim

5. AUTHOR(S) *(First name, middle initial, last name)*
Edwin L. Kerr

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Reprinted from IEEE Journal of Quantum Electronics, Vol. QE-6, No. 10, October 1970, pp 616-621	Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Electrostriction is a cause of laser beam self-trapping and damage in transparent glass. It predominates over other self-focusing mechanisms, such as Kerr effect or thermal self-focusing, under certain conditions. This paper shows that self-focusing can occur even if the laser pulse is so short that no steady state is achieved, provided the pulse power is large enough. In the steady state, the threshold power for self-focusing is independent of beam size. In the transient region, the threshold power increases and becomes proportional to the square of the initial beam radius, in the limit of large radius beams or short pulses. The theoretical trapping threshold derived here is less than typical experimental thresholds for track formation in glass.

KEYWORDS: Laser, Electrostriction, Self-focusing, Glass damage

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3. REPORT TITLE
INVESTIGATION OF SOLID STATE COLD CATHODES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)
Elliott S. Kohn

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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Labs. (LQ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Silicon cold cathodes were successfully operated for the first time. Planar structures were operated at efficiencies as high as 5×10^{-4} while $Si:SiO_2$ structures had efficiecies as high as 0.3%. Pulsed currents as large as 0.6 mA were drawn, corresponding to current densities in excess of 100 mA/cm^2. The silicon cold cathodes were also operated continuously, and it was found that tens of microamperes could be drawn for several hours, an encouraging result from the viewpoint of practical devices. The procedure for fabricating and testing $Si:SiO_2$ cold cathodes is discussed, an methods are proposed for achieving more efficient operation.

KEY WORDS: Electron emission, Cold cathodes, Photoemission

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Raytheon Missile Systems Division Radar Laboratory Bedford, Massachusetts 01730	Unclassified 2b. GROUP

3. REPORT TITLE

ANALYSIS AND ELEMENT PATTERN DESIGN OF PERIODIC ARRAYS OF CIRCULAR APERTURES ON CONDUCTING CYLINDERS.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)

Giorgio V. Borgiotti
Quirino Balzano

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH. OTHER	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The analysis and the design of the elements of a large array of circular apertures on a triangular grid is approached by modeling the antenna as an infinite structure rotationally symmetric and periodic along the cylinder axis. Because of this particular symmetry every possible excitation is the superposition, with suitable weights, of a set of fundamental excitations having uniform magnitude and linear phase progression in the azimuthal direction and in the direction of the cylinder axis ("eigenexcitations"). Thus, by invoking superposition the electromagnetic analysis of the array is reduced to the solutions of the simpler boundary value problems pertinent to the set of eigenexcitations. This is done by expanding the field in normal modes in the region exterior to the cylinder and in the waveguides feeding the apertures, followed by a field matching at the cylinder surface (obtained approximately through Galerkin's method). The realized gain pattern of the radiators can be modified to a considerable extent by using an "element pattern shaping network" (in the radiator waveguides), serving the purpose of matching the array for a selected eigenexcitation. Criteria for the network design are given. A series of numerical examples illustrates the technique and shows that a "flat" element pattern can be thus obtained with a gain fall off with respect to the peak of less than 6 db at 80 degrees.

KEYWORDS: Conformal arrays, Element pattern design, Wide angle coverage

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1. ORIGINATING ACTIVITY *(Corporate author)*
The Royal Institute of Technology
Physics Department
S-100 44
Stockholm 70, Sweden

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
CONSECUTIVF ION-MOLECULE REACTIONS IN ACETYLENE INVESTIGATED BY CHARGE EXCHANGE MASS SPECTROMETRY

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
I. Szabo
P. J. Derrick

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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LK)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The consecutive ion-molecule reactions in acetylene within the pressure limits of 10^{-5} and 10^{-2} torr have been investigated as a function of the energy transferred to the acetylene molecule during the initial ionization by charge exchange with incident positive ions of low kinetic energy. The reactions of the molecular ion in the ground electronic state (π_u^{-1}) are distinguished from those of the molecular ion in an excited electronic state (σ_g^{-1}). The various chain sequences of reaction, including those involving ions with uneven numbers of carbon atoms, are elucidated, and numerous reactions proposed by earlier workers are shown to be unimportant in the pressure range investigated. Rate constants are calculated for the various ion-molecule reactions.

KEYWORDS: Acetylene, Charge exchange, Mass spectrometer, Ion-molecule reactions

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Univac Division of Sperry Rand Corp., Defense Systems Div.
Univac Park, P. O. Box 3525
St. Paul, Minnesota 55101

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
GALOIS LOGIC DESIGN

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
James T. Ellison
Bernard Kolman

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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LR)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This report discusses the problems of logic design by means of finite field theory, their interrelationship and some approaches to their solution, with emphasis on logic networks whose function is externally determined. Galois theory is the study of finite fields and can be viewed as a generalization of the two-element Boolean algebra traditionally used in logic design. As a mathematical foundation for logic design, Galois theory offers far greater flexibility in the choice of basic primitive logic gates, an arbitrarily great increase in economy of thought and the possibility of choosing a mathematical structure which is best suited to each stage of technological development. Various basic decisions are made with regard to field size, Boolean encoding of field elements and primitives for the context of design; actual logic design is then carried out in the familiar language of polynomials. Reasoning processes are identical to those of elementary algebra with further simplification frequently possible. This report attempts to give an introduction to those topics of Galois field theory most relevant to hardware vendor and logic designer and develops the theory of universal Galois functions and its categorical implications. There is a detailed discussion of Boolean encoding procedures which lead to highly efficient Galois multiplication gates and optimal Galois addition gates. Various single-primitive systems are considered, capable of utilizing a single LSI chip-type throughout any network to be designed. One especially natural primitive offers the additional potential of maximizing effective LSI-yield. Methods are suggested for the design of general and universal Galois functions in two-primitive and one-primitive systems. In conclusion, a variety of areas is identified for further research in Galois logic design.

KEYWORDS: MSI/LSI, Logic Design, Cellular arrays, Finite fields

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Sperry Rand Research Center
100 North Road
Sudbury, Massachusetts 01776

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
EXPERIMENTAL AND THEORETICAL STUDIES INTO PULSE AND WAVE PHENOMENA IN PLASMAS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
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5. AUTHOR(S) *(First name, middle initial, last name)*
Albert W. Baird
Claude D. Lustig

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT This report describes an investigation of methods for measuring the electron density in a reentry shaft. The methods include excitation of electroacoustic resonances and the observation of enhanced microwave breakdown. Good agreement is obtained between electron density profiles determined from electroacoustic resonance frequencies measured for a laboratory plasma and those calculated theoretically. If higher order resonances can be observed, departures of the profile from linearity can be obtained. Measurements of enhanced breakdown in a laboratory plasma under simulated reentry conditions suggest that this method should be feasible for some reentry plasmas. A hollow cathode plasma source was constructed in an attempt to simulate low altitude reentry plasmas.

KEYWORDS: Electroacoustic resonance, Reentry plasma sheath, Hollow cathode plasma source

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3. REPORT TITLE

VISIBILITY MEASUREMENT FOR AIRCRAFT LANDING OPERATIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final. 26 September 1969-30 September 1970	Approved: 19 November 1970

5. AUTHOR(S) (First name, middle initial, last name)

Ronald T. H. Collis Edward E. Uthe
William Viezee John Oblanas

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13. ABSTRACT

An experimental pulsed neodymium lidar system was modified and calibrated to obtain accurate data on atmospheric extinction properties in fog and low cloud conditions. The objective was to establish the theoretical and practical basis of a system for measuring slant visibility conditions for aircraft landing operations. To operate in conditions of fog and low cloud the lidar system's dynamic range was extended to 50 dB by using a two-stage receiver system. In addition, the transmitter and receiver beams were made coaxial to make close-range observations.

Field trials were carried out at a temporary site at Half Moon Bay, California, and at the National Bureau of Standards site at Arcata, California, in May/June and August 1970, respectively. At Arcata, data were collected in conjunction with measurements by an array of up to five AN/GMQ-10 transmissometers. Observations were made in clear weather and in conditions of fog and low cloud using arrays of passive targets to provide information on atmospheric extinction. The correlation between atmospheric transmittance derived from lidar/target data and from AN/GMQ-10 transmissometers equalled that found between the data from individual transmissometers. Thus, a lidar with the support of passive targets could replace a transmissometer system with comparable accuracy in determining atmospheric transmittance.

Single-ended lidar data were obtained along horizontal paths adjacent to the passive targets and to a 500-ft base line transmissometer. Atmospheric transmittances were computed from these lidar data using analytical methods (which are discussed in detail) of evaluating atmospheric extinction coefficients from a consideration of the "slope" of the lidar trace. A correlation coefficient of 0.97 was found between the lidar data and the transmissometer data for comparable path transmittances in a variety of low-visibility conditions.

The concept of remotely deriving extinction coefficients aloft from observations by a ground-based lidar was applied to the aircraft landing problem. Using values of extinction coefficient for atmospheric layers above the surface derived from series of lidar observations at different angles of elevation, examples are given of the calculation of transmittance over the line-of-sight path from which a pilot would look (at a cockpit cut-off angle) from the critical height to the surface to acquire visual reference. No corroboration of these evaluations of slant path transmittance was available. Possible means of deriving and presenting such data for operational purposes are outlined, and the potential use of lidar for revealing the general conditions of cloud and fog conditions in the airfield approach are described.

The problem of realizing an operational system in an ultimate form is considered and some potential approaches to this end are noted.

KEYWORDS: Lidar measurements of visibility, Lidar measurements of atmospheric transmittance

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3. REPORT TITLE

LINE-OF-SIGHT PROPAGATION OF MILLIMETER RADIO WAVES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific, Final. 1 December 1967 - 30 November 1970. Approved: 25 January 1971.

5. AUTHOR(S) (First name, middle initial, last name)
Alan T. Waterman, Jr.
Robert W. Lee
Jeffrey C. Harp

6. REPORT DATE December 1970	7a. TOTAL NO. OF PAGES 27	7b. NO. OF REFS 10
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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field; Bedford, Mass. 01730

13. ABSTRACT

The effects of atmospheric irregularities on line-of-sight propagation are studied both experimentally and theoretically. The experimental measurements utilize a pair of 35 GHz transmitting antennas, time shared through a rapid switching arrangement, and an array of receiving antennas at each of which amplitude and relative phase of the arriving wave are measured separately. This configuration is coordinated with 11 GHz transmissions propagated over the same 28 km path. The entire set-up is highly versatile and permits a variety of different types of propagation measurements to be made in near simultaneity.

Among the types of measurements made are some aimed at inferring the extent of atmospheric inhomogeneity, as described by the refractivity structure constant C_n^2, its distribution along the path, and the cross-path wind. Measured data are combined with specific applications of the theory to achieve these aims.

KEYWORDS: Tropospheric propagation

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3. REPORT TITLE

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
Edward F. Assmus, Jr.
Harold F. Mattson, Jr.

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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LR) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The resultant is applied to the problem of weights in cyclic codes. The binary code arising from the projective plane of order 10 (if it exists) is examined. T-design decoding is discussed in general, and the special case of the (48, 24) binary extended quadratic residue code is worked out in detail. The (60, 30) ternary extended quadratic residue code is proved to yield new 5-designs. Miscellaneous results include study of the question whether Steiner triple systems support linear codes.

KEYWORDS: Cyclic codes, Weights, Majority logic decoding

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Syracuse University Electrical Engineering Department Syracuse, New York 13210	UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

THEORY AND COMPUTATION OF CHARACTERISTIC MODES FOR CONDUCTING BODIES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific, Interim

5. AUTHOR(S) (First name, middle initial, last name)

Roger F. Harrington
Joseph R. Mautz

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TECH, OTHER	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A theory of characteristic modes for conducting bodies is developed starting from the operator formulation for the current. The mode currents form a weighted orthogonal set over the conductor surface, and the mode fields form an orthogonal set over the sphere at infinity. It is shown that the modes are the same ones introduced by Garbacz to diagonalize the scattering matrix of the body. Formulas for the use of these modes in antenna and scatterer problems are given. A procedure for computing the characteristic modes for bodies of arbitrary shape is developed, and applied to conducting bodies of revolution and to wire objects. Illustrative examples of the computation of characteristic currents and characteristic fields are given for a cone-sphere, a disk, and a wire arrow. Modal solutions using these modes are computed for representative antenna and scattering problems to illustrate convergence of the solution as the number of modes is increased. For electrically small and intermediate size bodies, only a few modes are needed to characterize the electromagnetic behavior of the body.

KEYWORDS: Bodies of revolution, Characteristic currents, Characteristic fields

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3. REPORT TITLE

COMPUTER PROGRAMS FOR CHARACTERISTIC MODES OF BODIES OF REVOLUTION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Joseph R. Mautz
Roger F. Harrington

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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Computer programs are given for calculating the characteristic currents and characteristic gain patterns of conducting bodies of revolution. Also given are computer programs for using these characteristic currents in aperture radiation and plane-wave scattering problems. Plot programs for use with a Calcomp plotter are included. Operating procedures and program details are discussed, and sample input-output data are given.

KEY WORDS: Bodies of revolution, Characteristic currents, Characteristic fields, Computer programs, Modal solutions

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1. ORIGINATING ACTIVITY (Corporate author)
The Technical University of Denmark
Laboratory of Electromagnetic Theory
Lyngby, Denmark

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
INFLUENCE OF VARIATION OF BACKFIRE ANTENNA PARAMETERS.
II: SHORT-BACKFIRE ANTENNA

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
Erik Drago Nielsen

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A large number of numerical and experimental results showing the influence of a variation of the antenna parameters on the radiation properties of a short-backfire antenna are presented. These results may be very useful for the design of such antennas.

The numerical results have been calculated on a digital computer using a previously published theory for backfire antennas with dipole elements. The experimental results have been measured in a radio anechoic chamber.

Other numerical results have been obtained, which show that the radiation properties of the short-backfire antenna correspond to those of open resonators. Finally, a number of computations have been carried out in order to investigate the possibility of applying the short-backfire antenna as the excitation system of a Yagi antenna.

KEYWORDS: Dipole structure, Backfire antenna, Parameter variation, Short-backfire

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Tyco Laboratories, Inc.
Waltham, Massachusetts 02154

2a. REPORT SECURITY CLASSIFICATION
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3. REPORT TITLE
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)
James N. Butler, Raymond J. Jasinski, David R. Cogley, H. Lloyd Jones, John C. Synnott, Susan Carroll

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11. SUPPLEMENTARY NOTES
Included is one reprint from Analytical Chemistry, Vol. 40, pp 1908-1910, October 1968

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (PH) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

In order to make possible a rigorous program of research and development of high energy battery systems based on aprotic organic electrolytes and lithium anodes, a literature survey and a number of experimental studies have been conducted on the purification and analysis of relevant solvents: acetonitrile, butyrolactone, dimethyl sulfoxide, dimethyl formamide, formamide, hexamethyl phosphoramide, N-methyl pyrrolidone, propylene carbonate, and tetrahydrofuran. In all cases, methods have been developed (where not already available) for purification to a level of less than 10 ppm water or organic impurities, and for analysis of the solvents at that purity level. Purification methods employed include vacuum fractional distillation, dehydration with molecular sieves, chemical reaction to remove specific impurities, and preparative gas chromatography. Analytical methods include gas chromatography, ultraviolet and infrared spectroscopy, conductance, polarography, and solid electrode voltammetry. Stability of the pure solvents, particularly in contact with lithium electrodes, has been examined critically. For the solvents propylene carbonate, dimethyl sulfoxide, dimethyl formamide, and hexamethyl phosphoramide, the exchange current of a solid lithium electrode has been determined and the effect of added water on this kinetic parameter has been studied.

KEYWORDS: Nonaqueous solvents, High energy batteries, Lithium electrode

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1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
University College London Department of Physics Gower Street, London, W.C. 1	Unclassified 2b. GROUP

3. REPORT TITLE

UPPER ATMOSPHERE NEUTRAL TEMPERATURE PROFILES IN THE AURORAL ZONE 1968-1970

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim.

5. AUTHOR(S) (First name, middle initial, last name)
David Rees

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
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10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LK) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT Neutral temperatures have been measured above 120 km altitude from observations of the fluorescent emission of aluminium oxide and barium oxide clouds released from rockets launched at ESRANGE, Kiruna. The temperature observations showed a strong correlation with the C9 daily magnetic character rather than with the 3-hour Kp index, expressed approximately by the following equations at morning twilight for 140 and 165 km altitude (average rocket apogee):

$$T(140) = 420 + 25 \times C9 \quad (^{o}K)$$

$$T(165) = 450 + 50 \times C9 \quad (^{o}K)$$

A small diurnal variation appeared from the data, the temperature at 165 km being on average 100 ^{o}K higher during evening twilight than morning twilight. No clear seasonal or longer term variations were apparent from the data. The results indicate a strong auroral zone enhancement of the heating associated with geomagnetic activity.

KEYWORDS: Ionosphere, Ionospheric temperatures, Ionospheric probe

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1. ORIGINATING ACTIVITY *(Corporate author)*
University College London
Department of Physics
Gower Street, London, W. C. 1

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE

IONOSPHERIC WINDS IN THE AURORAL ZONE

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific Interim.

5. AUTHOR(S) *(First name, middle initial, last name)*

David Rees

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LK) L. G. Hanscom Field Bedford, Massachusetts 01730
KEYWORDS: Ionosphere, Ionospheric winds, Ionospheric probe	

13. ABSTRACT Observations of the drift velocity of rocket-borne chemical releases have been used to determine neutral wind velocity and ion velocity in the altitude range 90-230 km at ESRANGE, Kiruna.

The ion cloud drift measurements have demonstrated the orthogonality of the simultaneous magnetic perturbation vector at ground level and the ion drift vector in the F region of the ionosphere. This result implies that in the auroral zone Hall currents are predominantly responsible for that part of the total magnetic perturbation seen at ground level due to ionospheric currents.

A comparison of neutral wind velocity profiles obtained under quiet and disturbed geomagnetic conditions has shown that in the auroral zone the observed west-east neutral wind component above about 120 km altitude is directly correlated with the mean south-north magnetic perturbation vector over a period of two-three hours prior to the observations. This correlation is due to acceleration of the neutral atmosphere above 120 km by ions drifting in a meridional electric field. Both the ground magnetic perturbation and the neutral acceleration are direct functions of the locally enhanced electric field and of the electron (and hence ion) density. After a positive bay disturbance of 200γ of three hours duration, a neutral wind velocity of nearly 500 m/s was observed near 150 km altitude. In general, in the auroral zone the west-east neutral wind speed (V_{NY}, m/s) following disturbed conditions has been found to be related to ΔX, the two-hour mean of the south-north magnetometer disturbance in gammas (from a quiet ionospheric level), by $V_{NY} = 2.5\Delta X$. The sense is such that positive disturbances produce westward winds and vice versa. These disturbances in the auroral zone may be related to the anomalously high wind velocities which have been observed at times about 120 km altitude at lower latitudes.

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1. ORIGINATING ACTIVITY (Corporate author)
School of Engineering
University of California, Irvine
Irvine, California 92664

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
Investigation of Spectral and Statistical Properties of Single-Mode CW Lasers.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final. 1 July 1969 - 30 June 1970.

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28 September 1970

5. AUTHOR(S) (First name, middle initial, last name)
Hideya Gamo
Shih Shung Chuang

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Tech., other.	Air Force Cambridge Research Laboratories (CRO) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Variance and power spectrum of intensity fluctuations of a single mode CW CO_2 10.6 micron gas laser have been measured by using a copper-doped Germaniun detector and analog instrumentation. RMS intensity fluctuations above the oscillation threshold was smaller than 0.3% of the average intensity. The measurements near the oscillation threshold, however, were not accurate, because the acoustic disturbance due to acoustical noise, bubbles in the cooling water and temperature fluctuations in the plasma tube were predominant over the fluctuations due to spontaneous emission. The power spectrum observed at frequencies above 10KHz showed features characteristic to the laser model of Van der Pol oscillator driven by the random noise. Improvements of CO_2 gas laser desirable for further investigation are discussed.

KEYWORDS: CO_2 gas laser, CW single mode laser, Intensity flucuations

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1. ORIGINATING ACTIVITY *(Corporate author)*
University of Cincinnati
Cincinnati, Ohio 45221

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
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5. AUTHOR(S) *(First name, middle initial, last name)*
Tai-Fu Tuan

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LK) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

This report is divided into three parts

(1) The presence of large scale time-dependent dynamic disturbance in the ionosphere may be treated by using an inhomogeneous linear integral equation with Green's function satisfying homogeneous boundary conditions. For the special case where there is no disturbance, the theory reduces to the well known results for a quiet ionosphere.

(2) The disturbance of the ionosphere by a long period travelling wave originating in the northern hemisphere has been detected in the southern hemisphere with the accompanying expected phase change as the wave crosses the magnetic equation.

(3) A comprehensive survey has been made into the question of anomalous sounds from auroras. Preliminary results seem to show that the theory of brush discharge can properly explain all the observed phenomena without inconsistency.

KEY WORDS: Treatment of dynamic disturbance in the ionosphere with integral equation and Green's functions

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1. ORIGINATING ACTIVITY *(Corporate author)*
The University of Connecticut
Storrs, Connecticut 06268

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
THE ANALYSIS OF HYDROGEN - CARBON RATIOS IN CARBONACEOUS RESIDUES

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific Final. 1 February 1964 - 1 May 1968.

Approved
25 January 1971

5. AUTHOR(S) *(First name, middle initial, last name)*
Sidney R. Smith

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LQ) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT I. Several methods for the analysis of the hydrogen content of carbonaceous material resulting from hydrocarbon pyrolysis are examined. The method of sample combustion is an oxygen atmosphere and analysis of the hydrogen content by mass spectrometry and carbon dioxide by manometry gives results on a series of replicate runs with a standard deviation 3.5% on samples in the 1.5-8 mgm range.

II. The pyrolysis of naphthalene has been studied by the flow system and static methods. Analysis of the products show that there is no splitting of the C-C bond and that hydrogen and polymers of naphthalene are the products of the reaction. The naphthalene polymers are characterized by mass spectrometer and gas chromatographic methods.

The rate constant for hydrogen formation in the initial stages of the pyrolysis can be expressed by $k_{H_2} = 2.3 \times 10^{15} \exp. - \frac{71800}{RT}$ $\frac{\text{litre - mole}}{\text{sec}}$ in the range temperature 650-700°C. The kinetics data and reaction products can be explained by either a bimolecular or free-radical predominantly homogeneous reaction mechanism.

KEYWORDS: Carbonaceous material, Carbon hydrogen analysis, Mass spectrometry, Gas chromatography, Pyrolysis of naphthalene

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1. ORIGINATING ACTIVITY (Corporate author) University of Hawaii Hawaii Institute of Geophysics Honolulu, Hawaii 96822	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

THE MEAN TROPOSPHERIC CIRCULATION AND CLOUDINESS OVER SOUTHEAST ASIA AND NEIGHBORING AREAS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim.

5. AUTHOR(S) (First name, middle initial, last name)
James C. Sadler
Barry E. Harris Lt. Col. USAF

6. REPORT DATE August 1970	7a. TOTAL NO. OF PAGES 37	7b. NO. OF REFS 34
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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYS) L.G.Hanscom Field, Bedford Massachusetts 01730

13. ABSTRACT

Mean monthly wind analyses for the 3,000 ft, 850 mb, 700 mb, 500 mb, 300 mb, and 200 mb levels are discussed in terms of major features and their change from month to month. The mean monthly cloudiness, compiled from five years of daily meteorological satellite data, and the change in mean cloudiness from month to month are related to the flow patterns and their changes. Longitudinal sections of monthly cloudiness and month-to-month changes in cloudiness are presented for eight selected longitudes between 70E and 140E.

KEYWORDS: Southeast Asia, India, Burma, Philippines

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1. ORIGINATING ACTIVITY (Corporate author)
Department of Physics and Astronomy
University of Hawaii
Honolulu, Hawaii 96822

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
STUDY OF SCATTERING AND FLUORESCENCE OF GASES IN THE VACUUM ULTRAVIOLET

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Final: 1 April 1965 to 30 September 1970. Approved: 16 November 1970

5. AUTHOR(S) (First name, middle initial, last name)
Frederick M. Matsunaga
Kenichi Watanabe
William Pong (PI)

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LK) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Measurements of spectral absorption and photoionization cross sections of CO_2, NH_3, O_2, COS, NO, N_2, and vinyl chloride in the region 580 - 1650 Å were made. A number of new Rydberg series were found and the convergence limits were compared with the photoionization values.

In the study of dispersed fluorescence from molecules, particular attention was given to the emissions from CO, NH_3, N_2, and NO in the spectral region 1800 to 6000 Å. The experimental Franck-Condon factors for CO and N_2 were found to be in good agreement with the theoretical values. The threshold for the NH $c^1\Pi \rightarrow a^1\Delta$ transition was observed at (1245 ± 10) Å. On the basis of the observed threshold of the NH emission, the calculated energy separation of the $a^1\Delta$ state from the ground state of NH is (2.2 ± 0.1) eV which is somewhat higher than the value previously reported. The excitation spectra of NO show many overlapping states. However, the $B' \rightarrow X$ transitions of NO were identified, and the experimental Franck-Condon factors are in agreement with the calculated values. The results suggest that the γ' band contribution in NO emission is negligible. The excitation spectra of other molecules such as H_2, O_2, and SO_2 were studied, and certain features of the emission spectra can be related to the spectral absorption.

The effect of molecular collisions on the fluorescence of NO was investigated. Quenching of the B', D, E, and F states with the enhancement of the γ band emission was observed.

KEYWORDS: Absorption coefficients, Photoionization yields

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1. ORIGINATING ACTIVITY (Corporate author)
Department of Electrical ENgineering
University of Hawaii
~~Honolulu, Hawaii 96822~~

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific, Final, 1 November 1969 - 31 October 1970(appvd. Dec. 1970)

5. AUTHOR(S) (First name, middle initial, last name)
Tadao Kasami
Shu Lin

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9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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11. SUPPLEMENTARY NOTES
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12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (LR)
~~L. G. Hanscom Field~~
Bedford, Massachusetts 01730

13. ABSTRACT

This final report summarizes research for a one-year project. Abstracts for the two scientific reports are given, and some new results are included on reduction of context-free grammars, decoding binary block codes on Q-ary output channels, a procedure for decoding binary product codes, on the minimum weight code words of a certain class of cyclic codes, distance property of the dual codes of polynomial codes and on shortened Reed-Muller codes.

KEYWORDS: Context-free grammar, K-structural-equivalence, Hard binary decision, W-weight

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3. REPORT TITLE
EFFECTS OF A DYNAMO ELECTRIC FIELD ON THE THERMOSPHERIC WINDS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim.

5. AUTHOR(S) (First name, middle initial, last name)
Han R. Cho
Kung C. Yeh

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8a. CONTRACT OR GRANT NO. F19628-70-C-0001 b. PROJECT, TASK, WORK UNIT NOS. 4643-01-01 c. DOD ELEMENT 62101F d. DOD SUBELEMENT 681000	9a. ORIGINATOR'S REPORT NUMBER(S) Reprint 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-71-0117 AD720,185

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from Ann. Geophys., Vol. 26, No. 3, pp 801-803, 1970	Air Force Cambridge Research Laboratories (LI) L.G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Ion drag is one of the dominant forces which affect the motion of the neutral air in the thermosphere. As a result, the neutral winds are modified bythe presence of ar electric field. Improved agreement between theoretical wind velocities and experimental data has been obtained by including the effects of the dynamo field. Comparison with Thomson scatter data shows that the reversal of the theoretically computed meridional wind occurs at the same time as the experimental data.

KEYWORDS: Dynamo electric field, Thermospheric winds, Ion drag, Incoherent scatter radar

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1. ORIGINATING ACTIVITY (Corporate author)
Department of Geology
University of Kansas
~~Lawrence, Kansas 66044~~

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
RADIATION DAMAGE AND CHEMICAL REACTIONS INDUCED IN CRYSTALLINE SOLIDS BY HIGH-ENERGY PROTON BOMBARDMENT

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Final.1 July 1968-1 July 1970 Approved 9 Dec. 70.

5. AUTHOR(S) (First name, middle initial, last name)
Edward J. Zeller — John D. Zimbrick
Gisela Dreschhoff — Yash P. Virmani

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8a. CONTRACT OR GRANT NO.
F19628-69-C-0009

b. PROJECT, TASK, AND WORK UNIT NO.
8602-02-01

c. DOD ELEMENT
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d. DOD SUBELEMENT
681311

9a. ORIGINATOR'S REPORT NUMBER(S)

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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10. DISTRIBUTION STATEMENT
1-This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES
TECH, Other

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (PHL)
~~L. G. Hanscom Field~~
Bedford, Mass. 01730

13. ABSTRACT

The primary objective of the research conducted under U.S.Air Force contract F19628-69-C-0009 was to determine the extent and nature of chemical changes produced in solid targets by fast heavy particle irradiation. The major portion of the work involved proton irradiation of solids using energy ranges from 0.7 to 2.5 MeV. Alpha particles and deuterons were also available and were used for special studies. In general, the results of the bombardments were evaluated with either electron spin resonance [ESR] or differential thermal thermal analysis [DTA] techniques.

The data provided by the ESR analytical methods tends to substantiate the conclusion that proton bombardment of diamond results in the formation of CH radicals. Furthermore, there is no doubt that H atoms can be trapped in the diamond lattice and will remain uncombined at liquid nitrogen temperature.

KEYWORDS: Radiation damage, Diamonds, Protons

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) University of Leeds Department of Electrical and Electronic Engineering Leeds 2, England	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE
MAXIMIZATION OF ARGON-HYDROCARBON PENNING MIXTURES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
A. E. D. Heylen

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
1970	8	9

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F61(052)-68-C-0013 b. PROJECT, TASK, WORK UNIT NOS. 4642-02-01 c. DOD ELEMENT 6240538F d. DOD SUBELEMENT 681000	Scientific Report No. 3 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-71-0108

10. DISTRIBUTION STATEMENT
1-This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from J. Phys. D: Appl. Phys., 1970, Vol. 3, pp 789-796	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Townsend's primary and secondary ionization coefficients have been measured in 0·003, 0·03, 0·3 and 3% of n-pentane, ethylene and acetylene mixed in argon for a total pressure in the range of 0·5 to 500 torr and for a uniform field gap up to 1 cm. For n-pentane, a concentration of 15% was also employed. A marked Penning effect is again observed and is greatest in about 0·1% of acetylene in argon; the enhancement of Townsend's primary ionization coefficient in this mixture exceeds that previously observed in the classical rare gas mixtures. As usual, the hydrocarbons are observed to be efficient quenching agents, acetylene in this respect being the less efficient. At an optimum concentration of 0·03% for all the mixtures the sparking voltage is lowered considerably below that for pure argon, the lowering being the most — and amounting to a factor somewhat greater than 4 — in argon-acetylene mixtures.

KEYWORDS: Measurement of Townsend's primary and secondary ionization coefficients. Hydrocarbon-argon mixtures. Penning effect

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* University of Leeds Department of Electrical and Electronic Engineering Leeds 2, England	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

ASPECT OF ELECTRIC STRENGTH OF A MOVING GAS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Scientific Interim

5. AUTHOR(S) *(First name, middle initial, last name)*

A. E. D. Heylen

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
December 1969	4	15

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F61(052)-68-C-0013 b. PROJECT, TASK, WORK UNIT NOS. 4642-02-01 c. DOD ELEMENT 6240538F d. DOD SUBELEMENT 681000	Scientific Report No. 4 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* AFCRL-71-0109

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
Reprinted from PROC. IEE, Vol. 116, No. 12, December 1969, pp 2101-2104	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The influence on the prebreakdown processes and the sparking voltage of a gas moving at an angle to an electric field across a uniformly stressed gap is considered quantitatively by invoking the equivalent-pressure concept. The velocity with which a moving gas displaces the charged particles taking part in the processes leading to a spark is found, and the variation of the gap strength with the gas flow is calculated. With a pure cross gas flow, no change in the electric strength is predicted, and this is in agreement with experiment where gas speeds up to 2 X 10^3 m/s have been attained. With axial gas flow, the moving gas can either increase or decrease the gap strength depending on the direction of the gas flow relative to the field due to the direct applied voltage, and provided the gas speed is comparable in magnitude with the electron drift velocity (under a.c. conditions, a reduction in strength always occurs). A novel method for obtaining the electron drift velocity, and hence the electron-molecule-collision frequency, by the use of a moving gas is evolved. The analogy between a moving gas and an applied crossed magnetic field is pointed out. This leads to a second method for obtaining the electron drift by the simultaneous application of a moving gas and a crossed magnetic field. Possible relevance to compressed-air-blast circuit breakers is considered.

KEYWORDS: Theory prebreakdown, Processes and sparking, Voltage of a moving gas

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Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)*
University of Leeds
Department of Electrical and Electronic Engineering
Leeds, 2, Yorkshire, England

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
GASEOUS TOWNSEND DISCHARGES IN GAS MIXTURES, IN A CROSSED MAGNETIC FIELD AND IN A MOVING GAS

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
Scientific Final, 1 October 1969 - 30 September 1970.

5. AUTHOR(S) *(First name, middle initial, last name)*
A. E. D. Heylen
M. P. Watts

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
9 October 1970	30	22

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F61(052)-68-C-0013	
b. PROJECT, TASK, WORK UNIT NOS. 4642-02-01	
c. DOD ELEMENT 6240538F	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* AFCRL-71-0110
d. DOD SUBELEMENT 681000	

10. DISTRIBUTION STATEMENT

1-This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

The final results of a three-part experimental and theoretical research program on gaseous Townsend discharge are contained in this report. Firstly, the influence on the prebreakdown processes and the sparking voltage of a gas moving at an angle to an electric field across a uniformly stressed gap was considered quantitatively by invoking the equivalent pressure concept. The velocity with which a moving gas displaces the charged particles taking part in the processes leading to a spark is found, and the variation of the gap strength with gas flow was calculated.

Secondly, Townsend's primary and secondary ionization coefficients have been measured in .003, .03, and 3% n-pentane, ethylene and acetylene mixed in argon for a total pressure in the range 0.5 to 500 Torr and for a uniform field gap up to 1 cm. For n-pentane, a concentration of 15% was also employed.

Thirdly, further work on the dynamic Townsend discharge in a crossed magnetic field is presented. This work includes both experimental and theoretical results on pulsed discharge propagation and measurement of the E/P and other avalanche parameters using the balanced pulse technique.

KEYWORDS: Townsend's primary and secondary ionization coefficients, Sparking voltage, Argon-hydrocarbon Penning mixtures

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DOCUMENT CONTROL DATA - R & D
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1. ORIGINATING ACTIVITY (Corporate author)
University of Miami, School of Marine and Atmospheric Science, Div. of Atmos. Science
Coral Gables, Florida 33124

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE
SEASONAL VARIATIONS OF THE INTER-TROPICAL CONVERGENCE ZONE STUDIED WITH AN INTERACTING ATMOSPHERE AND OCEAN MODEL

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final, November 1967 - January 1971 Approved 18 February 1971

5. AUTHOR(S) (First name, middle initial, last name)
Arthur C. Pike

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
January 1971	48	30

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F19628-68-C-0144	
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c. DOD ELEMENT 62101F	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d. DOD SUBELEMENT 681000	AFCRL-71-0067 AD720,266

10. DISTRIBUTION STATEMENT
1 - This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories (LY) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A simple, four-level primitive-equation model of a zonally-symmetric tropical atmosphere has been combined with a two-layer model of the upper tropical ocean in order to predict three years of inter-tropical convergence zone (ITCZ) behavior under the influence of seasonally-variable solar heating of the sea. A cold equatorial surface develops on account of oceanic upwelling and vertical mixing; a single ITCZ establishes itself, off the equator, over the surface temperature maximum in the warmer hemisphere. This convergence zone migrates quickly between hemispheres, with only a minor lag, when the progress of the seasons causes the hemispheric surface temperature asymmetry to reverse every half year. Such behavior is qualitatively in accord with that of the updraft branch of the mean tropical Hadley circulation in the real atmosphere. The lag of maximum sub-equatorial sea surface temperature behind the overhead sun of late summer is computed to be about nine weeks, a reasonable value.

KEYWORDS: Numerical model, Seasonal variations, Tropical atmosphere

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1. ORIGINATING ACTIVITY (Corporate author) Institute of Physical Sciences University of Milan Via Celoria 16, 20133 Milan, Italy	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

ALBEDO NEUTRON COMPONENT OF THE EARTH'S RADIATION ENVIRONMENT

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final. 1 May 1968 - 30 April 1970.

5. AUTHOR(S) (First name, middle initial, last name)

Giuseppe Occhialini

6. REPORT DATE 23 December 1970	7a. TOTAL NO. OF PAGES 18	7b. NO. OF REFS 12
8a. CONTRACT OR GRANT NO. F61(052)-68-C-0050 b. PROJECT, TASK, WORK UNIT NOS. 8600-06-01 c. DOD ELEMENT 6144501F d. DOD SUBELEMENT 681311	9a. ORIGINATOR'S REPORT NUMBER(S) 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-71-0133	

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PH) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

A high energy neutron detector has been constructed to measure the solar neutron flux, under quiet or active Sun conditions over the energy range 10 MeV to 200 MeV. The detector consists of a plastic scintillator (the central detector) with anticoincidence shield. The central detector is surrounded by an aluminium sheath, whose purpose is to bring to rest the recoil protons, thus diminishing the "self-gating" effects and keeping the detection efficiency high enough at high energies. No finite flux has been however detected and an upper limit 5.5×10^{-3} n/cm^2 sec has been established for the continuous flux, which is comparable (although somewhat lower) with other upper limits obtained over the same energy range. A time integrated upper limit of 30 n/cm^2 is established for a 1N importance optical flare. Also the omnidirectional intensity of atmospheric gamma rays, converted in the aluminium sheath, has been measured at balloon altitudes at three energy levels. A value of 0.33/cm^2 sec has been found for energies greater than 20 MeV. The results are in good agreement with those obtained by Fichtel et al. (1969).

KEYWORDS: Solar corpuscular radiation, Solar neutron flux, Neutron albedo

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Unclassified
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1. ORIGINATING ACTIVITY (Corporate author) University of New Hampshire Antenna Systems Laboratory Durham, New Hampshire 03824	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

AN INTERFEROMETER SYSTEM FOR THE MEASUREMENT OF THE AZIMUTH OF RADAR ECHOES FROM METEOR TRAILS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
Ronald R. Rudman, Filson H. Glanz
Albert D. Frost, Ronald R. Clark

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
August 15,1970	66	11

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F19628-67-C-0230	ASL - 70 - 1 Scientific Report No. 1
b. PROJECT, TASK, AND WORK UNIT NO. 8628-08-01	
c. DOD ELEMENT 62101 F	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AD717,776
d. DOD SUBELEMENT 681000	AFCRL - 70 - 0588

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Laboratories [LYU] L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

To improve the measurement of the azimuth direction of arrival of radar echoes at 36.8 MHz a digitally controlled phase sequence interferometer technique has been developed for incorporation into the UNH/AFCRL meteor trails radar system. Phase measurements are made with respect to a common calibration pulse inserted between sucessive echoes. Preliminary tests indicate an azimuth measurement capability of better than ± 2° when used in conjunction with an elevation measurement system of comparable accuracy.

KEYWORDS: Meteor trails, Interferometer, Meteor radar, Digital switching, Direction finding

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Security Classification

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1. ORIGINATING ACTIVITY (Corporate author) University of New Hampshire Antenna Systems Laboratory Durham, New Hampshire 03824	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE
COMPUTER PROCESSING OF DATA FROM THE UNH/AFCRL METEOR TRAILS RADAR

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
Filson H. Glanz
Ronald R. Clark

6. REPORT DATE August 20, 1970	7a. TOTAL NO. OF PAGES 46	7b. NO. OF REFS 10
8a. CONTRACT OR GRANT NO. F19628-67-C-0230 b. PROJECT, TASK, AND WORK UNIT NO. 8628-08-01 c. DOD ELEMENT 62101F d. DOD SUBELEMENT 681000	9a. ORIGINATOR'S REPORT NUMBER(S) ASL-70-4 Scientific Report No. 4 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-70-0717 AD718,105	

10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES TECH, OTHER	12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LY) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

This report is a description of the UNH Meteor Trails Radar Main Off-Line Computer Program. The report consists of a summary of the program and a complete listing and flowgraph of the program. The main contribution is the method of determining azimuth and elevation angles from the UNH/AFCRL Meteor Trails Interferometric azimuth-elevation system.

KEYWORDS: Meteor trails radar, Upper atmosphere winds, Interferometer direction finder, Data processing

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(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* University of Tennessee Knoxville, Tennessee 37916	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

EVALUATION OF REMOTE SENSOR IMAGES, ASHEVILLE BASIN AREA, NORTH CAROLINA

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Scientific Interim

5. AUTHOR(S) *(First name, middle initial, last name)*

Lyman O. Williams

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
December 1970	147	8

8a. CONTRACT OR GRANT NO. F19628-69-C-0116 b. PROJECT, TASK, WORK UNIT NOS. 7259 (THEMIS) c. DOD ELEMENT 61102F d. DOD SUBELEMENT 681309	9a. ORIGINATOR'S REPORT NUMBER(S) Scientific Report No. 1 9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* AFCRL-71-0015 AD719, 761

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER KEYWORDS: Remote sensors, Water, Vegetation, Soil, Rock, Topography	Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT Isopleth mapping, computation of Pierson's Correlation Coefficient, and multiple linear regression analysis have been employed to analyze the system: water-vegetation-soil-rock-topography in a 50 mile long, 12 mile wide area centered on Asheville, North Carolina. Comparison of data suggests that analysis of the 100 random samples give results which are comparible to isopleth mapping of 196 sample sites for variables which have relative abundance and which have relatively contrasting properties of weathering, erodability and water retention. These variables are clay and silt in soils, quarts in soils, potassium feldspar in soils and bedrock, garnet in soils, biotite in both soils and bedrock, and muscovite in bedrock, and they appear to be dependent on a unique combination of independent variables. Accordingly it appears that lowlands (Case A) will be more likely to have clay rich soils, with relatively longer channel lengths per square mile, and to have soils which have low color values and relatively more soil moisture. The subsurface is likely to have abundant muscovite or biotite in both soils and bedrock, and garnet will be associated. Quartz will probably be essentially absent in the shallow subsurface. Conversely uplands (Case B) will probably have abundant silt and sand in soils, have shorter channel lengths per square mile, and have soils which have high color values and low soil moisture contents. The subsurface will probably have moderate to abundant quartz, and relatively great proportions of potassium feldspar. It appears that different steady states exist for these two different bedrock conditions. The flow of matter and energy in the system implies that surface phenomena will evolve in response to each condition of bedrock so as to develop a unique combination of topography, water and vegetation conditions. If enough measurements are made under enough varying climcatic geologic, and topographic conditions, then a catalog could be developed which would allow useful inferences to be made from measurements of surface phenomena on remote sensor images.

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1. ORIGINATING ACTIVITY (Corporate author)
University of Utah
Upper Air Research Laboratory
Salt Lake City, Utah 84112

2a. REPORT SECURITY CLASSIFICATION
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2b. GROUP

3. REPORT TITLE
ROCKET INSTRUMENTATION FOR AURORAL MEASUREMENTS--
AEROBEES 3.756 and 3.759

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final 1 August 1968 - 30 October 1970 Approved - 29 December 1970

5. AUTHOR(S) (First name, middle initial, last name)
David A. Burt
Glenn D. Allred

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
November 1970	193	18

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
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c. DoD Element: 61102H, 62101F	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
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10. DISTRIBUTION STATEMENT
1. This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
This research was partially supported by the Defense Atomic Support Agency.	Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

Two Aerobee rockets, instrumented with payloads for measuring auroral parameters, were launched from the Churchill Research Range, Manitoba, Canada in late March 1969. Ejected nosetip payloads and main payloads were utilized to obtain simultaneous measurements at separate locations within the aurora. The instrumentation included electron and proton counters, electron density and temperature probes, X-ray counters and auroral light photometers. Details of instrumentation are presented.

KEYWORDS: Auroral measurements, Rocket instrumentation, Ionospheric measurements, Instruments for auroral measurements

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1. ORIGINATING ACTIVITY (Corporate author)	2a. REPORT SECURITY CLASSIFICATION
University of Washington Department of Electrical Engineering Seattle, Washington 98105	Unclassified 2b. GROUP

3. REPORT TITLE

TEMPORAL FREQUENCY SPECTRA OF MULTIFREQUENCY WAVES IN A TURBULENT ATMOSPHERE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)
Akira Ishimaru

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
November 1970	43	11

8a. CONTRACT OR GRANT NO.	9a. ORIGINATOR'S REPORT NUMBER(S)
F 19(628)-69-C-0123 b. PROJECT NO. 8682-02-01 c. DoD Element 62101F d. DoD Subelement 681000	Technical Report No. 141 Scientific Report No. 2 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-70-0696

10. DISTRIBUTION STATEMENT

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
TECH, OTHER	Air Force Cambridge Research Labs. (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730

13. ABSTRACT

General formulations for temporal frequency spectra of the fluctuations of plane, spherical and beam waves operating at two frequencies are given based on weak turbulence and frozen-in assumptions. The cross spectra and the coherence are obtained for the amplitude at two frequencies, the phase at two frequencies, and the amplitude at one frequency and the phase at another frequency. The results are examined in detail for a plane wave case. For the spectrum of the index of refraction κ^{-n} in the inertial subrange, the amplitude spectrum behaves as $k^{(5-n)/2}$ for $\omega \to 0$ and $k^2\omega^{1-n}$ for $\omega \to \infty$. The phase spectrum for $\omega \to 0$ and for $\omega \to \infty$ behaves as $k^2\omega^{1-n}$ with different constants. These results agree well with the experimental work of Janes, Thompson, Smith, and Kirkpatrick at 9.6 GHz and 34.5 GHz, and explains the ratio of the spectra at two frequencies. Also noted is the experimental slope of -2.6 as $\omega \to \infty$ which may be compared with $1 - n = -2.66$ using the Kolmogorov spectrum of $n = 11/3$. The amplitude and phase coherence are calculated and the results agree well with the experimental data. This agreement is indicative of the general validity of the theory for frequencies as low as 10 ∿ 30 GHz and the path length as long as 60 km. It is also shown that using the above theory, the wind velocity and the structure constant C_n can be deduced from the experimental data.

KEYWORDS: Temporal frequency spectra, Multifrequency waves, Turbulent atmosphere, Fluctuations

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Security Classification

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)
EMR-Photoelectric
EMR Division of Weston Instr., Inc.
Box 44, Princeton, New Jersey 08540

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP

3. REPORT TITLE

NEW CHARGED PARTICLE DETECTORS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final. 1 Nov.1966 - 1 Jan. 1970 Approved 31 Aug.1970

5. AUTHOR(S) (First name, middle initial, last name)

Victor J. Belanger

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
17 March 1970	74	0

8a. CONTRACT OR GRANT NO.
F19628-67-C-0024

b. PROJECT, TASK, AND WORK UNIT NO.
7601-07-01

c. DOD ELEMENT 6240539F

d. DOD SUBELEMENT 681000

9a. ORIGINATOR'S REPORT NUMBER(S)
POA 4662

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
AFCRL-70-0482 AD718,110

10. DISTRIBUTION STATEMENT
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11. SUPPLEMENTARY NOTES
TECH, OTHER

12. SPONSORING MILITARY ACTIVITY
Air Force Cambridge Research Laboratories (CRF)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The objectives of this program were to perform experimental investigations directed toward the design and fabrication of new charged particle detectors. The particle detectors are to be used in satellite, rocket, and laboratory experiments to study the magnetospheric boundary regions of space and must be capable of detecting particles with energies of 1 keV or less maintaining high counting efficiency. To attain these goals it was necessary to do extensive field plotting of entry dynode structures in order to arrive at a design configuration that would insure good collection and counting efficiencies, also it was necessary to devise equipment, fixturing, and testing techniques for accurately determining spatially, these efficiencies.

KEYWORDS: Experimental investigations, Design, Fabrication, Particle

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Unclassified

Security Classification

Index

In-House Reports

AFCRL-70-0187 (Schlumbohm, H.) Dissociative Charge Transfer Reactions of He^+ and Ne^+ Ions With N_2, and CO_2 Molecules at Collision Energies from 3 to 200 eV, Translations, No. 85.

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