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SUMMARY OF RESEARCH ACTIVITIES, ACADEMIC DEPARTMENTS, 1979-1980--ETC (11)

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SUMMARY  
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1979 - 1980

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COMPILED AND EDITED  
BY  
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ENGLISH DEPARTMENT

OCTOBER 1980

UNITED STATES NAVAL ACADEMY  
ANNAPOLIS, MARYLAND  
21402

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## FOREWORD


The academic excellence of an educational institution is measured by the achievements of its faculty in teaching, research, and related scholarly endeavors. It is the policy of the Naval Academy to provide and maintain an environment in which research activities that contribute to the professional growth of the faculty and outstanding midshipmen may flourish.

The research activities of the faculty range from very applied cooperative studies with the Navy research and development community to very fundamental investigations concerned with extending the frontiers of knowledge. The broad scope of research described in this annual report reflects the interests and expertise of the participating faculty and midshipmen, as well as the availability of laboratory, library and computer facilities.

This publication was compiled to acquaint the reader with faculty and midshipmen research efforts being done behind the classroom scene. Research results are published in manuscripts, reports, and prestigious journals as well as presented at important professional meetings and conferences. In addition to their teaching and research, the faculty contribute to their profession through participation in professional societies and consulting activities. This publication contains summaries of completed and on-going faculty projects, midshipmen research course projects including the Trident Scholar Program, and lists of presentations and publications. The work reported on was conducted during the period 1 July 1979 through 30 June 1980.

External support continues to increase significantly. This is undoubtedly due to the additional opportunities provided by new laboratories in the Engineering Studies Complex and the initiative of the well-qualified civilian and military members of the faculty. It is important to acknowledge the strong and continuous support provided by the Chief of Naval Research, Chief of Naval Development, Director of Navy Laboratories and the numerous activities of the Naval Material Command, without which such progress could not be possible.

Comments and suggests related to the research efforts will be gratefully received and sincerely appreciated.

  
BRUCE M. DAVIDSON  
Academic Dean


  
RICHARD D. MATHIEU  
Director of Research

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DIVISION OF  
ENGINEERING AND WEAPONS



## AEROSPACE ENGINEERING DEPARTMENT

*Lieutenant Commander Paul B. Schlein, USN, Chairman*



It is the objective of the Aerospace Engineering Department to continually develop its educational process. This report of the research performed in this period is a very important part of that development. The projects span engineering and depart widely from the stricture of well-trodden curricula. Midshipmen are more heavily involved than before. The researchers are required not merely to fill the gaps in the body of knowledge, but also to expand their grasp.

Measurement of the effectiveness of the educational process is always difficult. However, this year, at the Naval Academy-hosted American Institute of Aeronautics and Astronautics Mid-Atlantic Regional Student Conference, six of twenty papers accepted were authored by midshipmen. Further, Midshipman Botero won first place and Midshipman Brastauskas, honorable mention. These tangible indications of midshipmen academic acumen are very good measures of the educational process here.

Not reported herein, but important to note, was the support provided to Sir Frank Whittle in boundary layer control, to Dr. Joseph Sladky in cryptosteady thrust augmentation, and to the Office of Naval Research in flow field measurements in the lee of inclined cones and cylinders.

Research was a large and continuing effort in the Aerospace Engineering Department.

\*\*\*\*\*

XR-5 REFURBISHMENT AND TESTING

Researcher: Assistant Professor William J. Bagaria

Sponsor: Naval Sea Systems Command

The objectives of this project were 1) to complete the refurbishment of the XR-5 testcraft; 2) to conduct sea trials; 3) to install and check out testcraft instrumentation; 4) to develop and conduct a training/demonstration program for midshipmen enrolled in EX 437 (Principles of Surface Effect Vehicles); and 5) to prepare plans for the XR-5 research program.

The Naval Academy completed the refurbishment of the craft to its material condition during the craft's last operational period. This included hull repairs, machinery installation, electrical installation, sub-system checkout, safety equipment installation, and communications equipment installation.

The David W. Taylor Naval Ship Research and Development Center provided and installed all recording instrumentation, including reactive wind velocity/direction, engine RPM/thrust, craft speed, and plenum and seal pressures.

A training program for midshipmen enrolled in EX 437, Principles of Surface Effect Vehicles, was developed. This program included a static on-cushion demonstration, runs on and off cushion, maneuvering demonstrations, and midshipman-conducted experiments to determine optimum performance.

In cooperation with PMS-304 and DTNSRDC, plans were prepared for the research program to be conducted in FY'80 and subsequent years. The following possibilities are being considered:

- (1) confirmation of existing drag and powering data;
- (2) evaluation of scaling data with five degrees of freedom models and two tank models;
- (3) determination of drag characteristics as related to fan flow rate and craft velocity;
- (4) tests of new components proposed to improve operational characteristics;
- (5) development of stability and control data base information in conjunction with DTNSRDC;
- (6) determination of heave acceleration for various sea-states as related to cushion pressure control devices, seal heights and craft velocity; and
- (7) determination of roll characteristics over a range of velocities, headings and wave heights.

\*\*\*\*\*



## EXPERIMENTAL INVESTIGATION OF INITIAL BUCKLING AND COLLAPSE OF STIFFENED THIN CYLINDRICAL SHELLS

Researcher: Assistant Professor William J. Bagaria

Sponsor: Naval Air Systems Command

Although the thin cylindrical shell in compression has been an extensively studied theoretical and experimental research problem for over sixty years, it still cannot be concluded that the initial buckling process is a purely elastic-deformation phenomena. Relatively recent kinematically and constitutively nonlinear analysis indicates that elasto-plastic material effects can be significant, the degree being dependent on both the magnitude of the effective radius-to-thickness ratio of the structure and the material of which the shell is fabricated. Unfortunately, in attempts to correlate experimental data with the classical or linear-theory predictions, published results for unstiffened shells omit any test data falling outside the linear-elastic material range. For stiffened shells, the structure of design interest, the experimental programs undertaken either classify as unreliable, too restricted in scope, or valid but devoid of sufficient information to use for correlation purposes (for example, the stress-strain curve of the material).

The fabrication and structural test facilities of the Naval Academy are being used to conduct an experimental program involving identical geometry ring- and stringer-stiffened shells representing four different flight-structure materials (two aluminums, one titanium, and a stainless steel). The stiffened cylinders consist of integral stringer-stiffened skins adhesively bonded to the rings. A special manufacturing process has been devised which uses the computer-controlled N/C mill to fabricate the integrally stiffened skins. The 200,000 pound hydraulic testing machine is currently being modified to test the cylinders and to automatically acquire and display the load vs. end-shortening curves. The tests are scheduled to be conducted during the spring and summer of 1980.

\*\*\*\*\*

## POSTBUCKLING STIFFNESS OF ADVANCED COMPOSITE PLATES--PREDICTION AND EXPERIMENT

Researcher: Assistant Professor William J. Bagaria

Sponsor: Naval Air Systems Command

A common misconception concerning anisotropic advanced composite materials (for example, boron/epoxy and graphite/epoxy) is that, unlike isotropic conventional metals, they are characterized by mostly linear stress-strain relationships to failure. Recent theoretical study and computational analysis at Stanford University has established that non-linear material behavior of angle-ply boron/epoxy laminates significantly reduces the post-buckling stiffness of edge-supported thin plates in axial compression. The same phenomenon has been observed in tests conducted at General Dynamics with edge-stiffened plates fabricated of angle-ply graphite/epoxy. Such plate structure and compressive loading conditions are found in the skin surface of aircraft (for example, F-14 stabilator with boron/epoxy and F-18 wings, fuselage, and empennage with a significant portion being graphite/epoxy). This surprising behavior of advanced composites could limit the freedom to arbitrarily tailor composite lay-ups to the extent desired for cost-effective weight-savings and maintain the conventional metals, such as aluminum, competitive as gains in specific strength and stiffness are achieved.

To establish the validity of the theoretical work and justify its use as an engineering tool, a series of experiments has been designed to buckle and postbuckle eight different plate lay-ups of angle-ply graphite/epoxy. The basic plates, fabricated at Grumman Aerospace, have adhesively-bonded edge stiffeners added to provide proper boundary conditions along the unloaded edges; the loaded-edges are to be potted into specially designed and fabricated fixtures. Axial compression loading is to be provided by a hydraulic testing machine. Currently, a computerized data-acquisition system is being developed for the purpose of automatically recording and displaying the load versus end-shortening data, the information from which the postbuckling stiffness is derived. Tests are scheduled to take place in the summer of 1980.

\*\*\*\*\*

## MEASUREMENT OF SUPERSONIC SKIN FRICTION

Researcher: Professor Bernard H. Carson

Sponsor: Defense Nuclear Agency

This work is an extension of work begun in 1978. The purpose of this research is to develop a method for the direct measurement of skin friction on roughened specimens in supersonic flow. The first phase consisted of developing an apparatus compatible with the USNA 6" x 6" supersonic wind tunnel. Considerable development was required in this phase, due to the low level of forces measured in the presence of intense mechanical vibration of the wind tunnel. During the forthcoming summer, tests will be conducted on artificially-roughened surfaces of known friction coefficients, as a means of moving the validity of the present apparatus. Following this, it is intended to determine the skin friction coefficients of ablated reentry vehicle nose cone material.

\*\*\*\*\*

## NAVAL ACADEMY HEAT BALANCED ENGINE (NAHBE) PROJECT

Researchers: Professor Andrew A. Pouring, Associate Professor Eugene L. Keating (Mechanical Engineering Department), Associate Professor Dennis Hasson (Mechanical Engineering Department), Commander Charles Failla, USN (Mechanical Engineering Department), and Captain John E. Allen, USMC (Mechanical Engineering Department)

Sponsor: Office of Naval Research

The following tasks were undertaken this year in connection with the continuing research on the Naval Academy Heat Balanced Engine:

1. Parametric Variations, CFR Engine. Performance of a CFR engine over a wide range of experimental conditions is reported in detail for standard spark ignition operation and for heat balanced configurations. Operating conditions were mapped for primary combustion chamber and balancing chamber volumes giving nearly constant balancing ratios for three selected compression ratios; edge gap clearance was also varied. Three secondary air modes were investigated during optimization of performance giving more than a 30% increase in output over standard S.I. operation, an improvement in ISFC of 10% at best economy,

30% at best power with CO emission decreased to less than 0.1% and UHC to less than 100 ppm.

A new method of engine performance analysis, the Run Quality Index (RQI) is proposed to help evaluate the heat balanced engine and compare it to other engines.

2. Heat Transfer. Heat transfer to and from the NAHBE piston cap and its effect as a regenerator were studied analytically. The current report is an extension of the previous E&W Report EW-11-77 dated September 1977. The effect of thermal radiation on the transient temperature distribution within the NAHBE cap is included by modifying the previous numerical model. The results showed that little cooling of the cap could be accomplished by cooling the cylinder walls to increase the radiation loss from the cap.

A study was made to show the effect of changing the convective heat transfer coefficients ( $h$ ) during each part of the cycle. As expected, the value of  $h$  during the expansion stroke clearly dominated the temperature of the cap. An addition of a second fin does not appear to present a cooling advantage.

Comparison of the mean temperature for caps of various materials is also given.

3. Materials Analysis. A materials selection analysis to determine suitable materials for the NAHBE pressure exchange cap was performed. The analysis consisted of a metallographic and scanning electron microscope fractographic investigation of cast and extruded aluminum material caps from design testing programs on an air cooled engine, and a materials selection study of several metallic alloys and a ceramic coating. Cast aluminum or non-heat treatable 5000 series aluminum and titanium alloys in the form of plate were proposed for the cap material. Studies of welding of the 5000 series aluminum and titanium materials to cast aluminum, and fuel/material compatibility with blended fuels were proposed.

4. Fuel-Air Heat Balanced Cycle Analysis. The quasi-equilibrium thermodynamic model of the Naval Academy Heat Balanced Engine (NAHBE) has been modified to include the influence of fuel-air chemistry on predicted indicated engine performance. Heat addition to the Air Standard Heat Balanced Cycle was expressed in terms of an appropriate fuel-air ratio and heating value for a standard fuel. Indicated parameters including mean effective pressure, peak pressure, specific fuel consumption and thermal efficiency for compatible Otto and Heat Balanced cycles were calculated and compared. Performance parameters for both cycles

were obtained at equal compression ratios, fuel-air ratios, fuel type, and engine rpm. Results show that for overall stoichiometric heat addition the Heat Balanced cycle can produce greater indicated engine power, higher indicated thermal efficiency and lower indicated specific fuel consumption than the corresponding Otto Cycle. Further analysis indicated that the optimum heat balancing conditions occur for constant volume heat addition with rich mixture composition followed by constant pressure heat addition with lean composition.

5. Testing of Two-Dimensional Transparent Engine. A one cylinder research engine incorporating a square cylinder and piston with the NAHBE modification is now fully operational. Optical studies of the operating engine in a quasi-two-dimensional environment have been conducted with a FASTEX high speed movie camera at speeds over 1000 frames per second. Schlieren, and color film have been taken and spectacular holographic interferograms showing the combustion driven wave interaction between chambers in the engine. The results are now being documented.

6. Combustion Kinetics. Dr. E. R. Buckle of Sheffield University has been examining the feasibility of extending the kinetic cluster theory developed under previous ONR support to combustion. Work on the first increment is 80% complete and is now being documented.

7. Two-Stroke NAHBE Application. Under a series of student projects the feasibility of two stroke operation has been examined on a single cylinder engine. An engine is now operating with encouraging results but inadequate test equipment (dynamometer), continually delays technical development.

8. Related Research. A proposal for testing and evaluation on existing GM 2-71 diesel modified to NAHBE configuration has been submitted to DOE. Standard diesel fuel and SRCII middlecut distillate (coal derived synfuel) will be evaluated.

\*\*\*\*\*

CADCAM SYSTEM FOR SHIP HULL DESIGN AND TOWING TANK MODEL PRODUCTION

Researcher: Professor David F. Rogers

Sponsor: U. S. Coast Guard

This project continued the development of a Computer Aided Design/Interactive Graphics-Computer Aided Manufacturing System for ship hull design and towing-tank model production.

\*\*\*\*\*

## FLIGHT EVALUATION OF THE TERMINAL GUIDANCE SYSTEM

Researcher: Research Professor Doral Sandlin

Sponsor: National Aeronautics and Space Administration

The use of steep descent curved approaches to a landing reduces noise pollution and permits more efficient utilization of existing air space. The Dryden Flight Research Center of NASA has conceived and fabricated an avionics system called the Terminal Guidance System (TGS) which gives guidance along a curved descending flight path to a landing. The TGS was installed in a general aviation aircraft and flight tested at the Naval Academy. A data recording system which records on magnetic tape all inputs and outputs to the TGS was developed and installed for several flight tests. The recorder permitted the plotting of the actual aircraft position. A comparison with the desired position and the determination of the system's shortcomings was made. The system does not adequately compensate for wind drift. The result of the study was the development of a new algorithm which eliminated this defect.

\*\*\*\*\*



## FUEL EFFICIENCY OF SMALL AIRCRAFT

Researcher: Professor Bernard H. Carson

There is a basic mismatch between the amount of power installed in small propeller-driven aircraft and that required for efficient cruising, which results from climb performance requirements. It is shown in this paper that there is a way of using excess power for most efficient cruise, the resulting airspeed coming closest to the Gabrielli-von Karman limit line of vehicular performance. A survey of 111 light aircraft was conducted, and it is found that many are operated at this optimum, while many more are not. A figure of merit is developed that measures cruise performance. Rationale is presented that is directly applicable to design for cruise efficiency.

\*\*\*\*\*



## PNEUMATIC END-PLATES

Researcher: Midshipman 1/C Russell Averill

Adviser: Associate Professor Vadym V. Utgoff

This project involves the experimental determination of the effectiveness of pneumatic end-plates on a wing. High pressure air is ducted internally to the wing tips and is constrained to issue in a flat jet to establish a pneumatic end-plate. The effect on the lift curve slope,  $C_{L_{max}}$ , the drag polar, and the pitching moment will be evaluated by wind tunnel tests.

\*\*\*\*\*

## JET WINGLETS

Researcher: Midshipman 1/C Russell Averill

Adviser: Associate Professor Vadym V. Utgoff

The purpose of this project was to determine the efficacy of jet winglets in improving the performance of a wing. A test wing was built incorporating an internal duct leading to tip planes designed so that air flowing in the wing would be emitted in the form of a jet sheet. Lift and drag coefficients were determined with the jet sheet acting as a winglet, and as a wing extension, for various values of jet mass flow. The results indicate that jet winglets and jet wing extension increase the lift coefficient and reduce the drag coefficient.

\*\*\*\*\*

## A COMPUTERIZED STUDY OF WAVE CHARACTERISTICS IN A TIME-DEPENDENT COMPRESSIBLE FLOW

Researcher: Midshipman 1/C Frederick W. Botero

Adviser: Professor Andrew A. Pouring

Non-dimensional wave characteristic plots are drawn by hand due to the complexities of a given time-dependent flow problem. The graphical process requires numerous calculations and tedious drawing for even a small number of points. Human drafting error and limited mathematical capabilities produce inaccuracies which accumulate, making long-term analysis extremely



difficult. This research project selects simple, common flow-situations and develops a computer analysis to produce accurate graphical and digital data for long term (terminal) analysis. The computer's accuracy and speed enable studies to be made of wave behavior for several flow situations. System qualities of terminal oscillatory or damped behavior are sought. Several interesting circumstances are observed and system qualities of velocity, pressure, and period are examined for each particular situation. Practical application of the closed tube non-steady flow machine can be made to a pulse jet engine. Modeling of the pulse jet is performed, and results show that the computerized method produces surprisingly accurate data. The computerized method proves to be a useful tool capable of realistic modeling and increased future development.

\*\*\*\*\*

A TIME-DEPENDENT FILM ANALYSIS OF THE NAHBE COMBUSTION PROCESS  
UTILIZING SCHLIEREN TECHNIQUES

Researcher: Midshipman 1/C James P. Brastauskas

Adviser: Professor Andrew A. Pouring

Limited fuel resources have brought about an increased demand for fuel efficient engines. In an effort to meet this demand, research is being conducted by the United States Naval Academy on internal combustion engines. As a student at the Academy, Midshipman Brastauskas' research efforts have been focused on the Naval Academy Heat Balanced Engine (NAHBE), a design currently being investigated. The NAHBE is a new type of engine that obtains improved performance and efficiency when compared to present reciprocating engines. This improvement is obtained by the introduction of a new piston geometry, which effectively utilizes the steady and non-steady gasdynamic interactions that occur during the combustion process. The research specifically deals with a high-speed film analysis, which was first conducted on piston models in a shock tube, and further extended to a glass internal combustion engine. This film analysis was conducted to obtain a better understanding of the combustion process, and to provide evidence which was used to confirm theoretical calculations. These films were further utilized by applying them to practical design problems in an effort to optimize the piston geometry and obtain the optimum utilization of the gasdynamic interactions involved.

\*\*\*\*\*

DETERMINATION OF DRAG CHARACTERISTIC TRENDS FOR GENERAL AVIATION AIRCRAFT

Researcher: Midshipman 1/C Jon Buttram

Adviser: Professor Bernard H. Carson

This is a "paper" study which will result in a compilation of drag characteristics and other performance parameters of approximately 100 light aircraft. No support except computer usage is required.

\*\*\*\*\*

MOTION SENSOR DESIGN FOR XR-5A

Researcher: Midshipman 1/C Ronald P. Colvin

Adviser: Assistant Professor William J. Bagaria

The purposes of this project were to review current methods for the measurement of roll, pitch, and yaw motions of moving vehicles; to select or design a system for the XR-5A that will measure roll, pitch and yaw rates and also measure pitch, roll and sideslip angles during steady and unsteady maneuvers; and to install and test system on XR-5A. This was a two-semester project.

\*\*\*\*\*

FLIGHT TEST OF HOMEBUILT AIRPLANE

Researchers: Midshipmen 1/C Richard Donofrio and Peter S. Jerome

Adviser: Associate Professor Vadym V. Utgoff

This project involves determining the performance and flying qualities of a homebuilt airplane by flight test.

\*\*\*\*\*

IMPROVED BULLET CONFIGURATIONS

Researcher: Midshipman 1/C Eric Heidhausen

Adviser: Professor Andrew A. Pouring

A thin plate was adapted to the wad of a shotgun shell as a means of increasing the velocity of the slug fired from the round. All other parameters were held constant. The thin plate, placed on the aft end of the plastic wad, was separated by a small distance from the actual wad. The diameter of the plate was somewhat less than the wad and an initial sizing was purely arbitrary. Subsequent alterations were made to improve the effectiveness of the plate. Pressure-time curves were plotted for the various types of rounds used. Velocity computations were made and compared to a control round(s) without a plate. The experiment suggests that a secondary pressure chamber could be designed which more accurately and efficiently controlled the pressure vs. time trace within the barrel. By controlling the peak pressure and the normally rapid decline in pressure as the bullet travels the barrel's length, the bullet's exit velocity, and kinetic energy could be increased.

\*\*\*\*\*

JET PUMP-THRUSTER

Researcher: Midshipman 1/C Hugh Henry

Adviser: Professor Mairo Saarlax

The purpose of this project was to design and construct a small 5-pound thrust water-jet thruster operating at 8000 RPM.

\*\*\*\*\*

CONSTRUCTION OF BENSEN GYROCOPTER

Researcher: Midshipmen 1/C Thomas J. Goebel and R. A. Pickering

Adviser: Associate Professor Vadym V. Utgoff

A Bensen Gyrocopter has been donated to the U. S. Naval Academy and a second one is being purchased. The plan of this project was to assist in its construction, in order to get practical experience in airframe construction.

\*\*\*\*\*

FREE-WING, FREE-TRIMMER WIND TUNNEL TEST

Researchers: Midshipmen 1/C Robert V. Huffman, Edward B. Martin,  
and Joseph Giaquinto

Adviser: Professor Doral R. Sandlin

The Free-Wing, Free-Trimmer Aircraft is a NASA-conceived configuration to alleviate gust loads on aircraft with low wing loading. The objective of this study is to determine the longitudinal modes of motion of a model with a freely-rotating wing and attached freely-rotating trimmer in a wind tunnel and compare with the modes predicted by the equations of motion of this system.

In addition, the flowfield in the vicinity of the trimmer was investigated using a laser doppler velocimeter. A wind tunnel model was fabricated, assembled and tested. The data have been collected and are being analyzed.

\*\*\*\*\*

GRAPHIC DISPLAY OF SIMULATED FLIGHT PATHS

Researcher: Midshipman 2/C Brent W. Jett, Jr.

Adviser: Professor David F. Rogers

Using the Tektronics 4051 and the GAT-IV5 Flight Simulator, the researcher proposed the development of a series of computer programs to acquire flight data and to graphically display the flight path of runway-vicinity simulated flight. Once developed, this system will be used to test new procedures for emergency flight situations such as loss of power on takeoff.

\*\*\*\*\*

RAGALLO HANG GLIDER WITH VARIABLE SWEEP

Researcher: Midshipmen 1/C David L. Kennedy and Carlos Miller

Adviser: Associate Professor Vadym V. Utgoff

The purpose of this project was to determine the effect of variable sweep on the performance of a typical Ragallo-wing. A small scale wind tunnel model of a Ragallo-wing incorporating a mechanism for varying the sweep was constructed and tested.

Results indicate that an optimum sweep angle exists, but that allowances must be made for stability and control. A small sweep angle delivers the best performances, that is, the best lift-to-drag ratio and the smallest sink rate. A larger sweep angle gives a more controllable, stabler ride.

\*\*\*\*\*

APPLICATION OF THE NAVAL ACADEMY HEAT BALANCED ENGINE CONCEPT  
TO A TWO-STROKE ENGINE

Researcher: Midshipman 1/C Richard C. Locke

Adviser: Professor Andrew A. Pouring

This project is the research work related to the Naval Academy Heat Balanced Engine (NAHBE). The NAHBE was developed by Naval Academy scientists and is a new type of engine based on a unique configuration which gives it superior efficiency and performance over a conventional engine. This particular project involves the operation and testing of a two-stroke motorcycle engine in the NAHBE configuration. Objectives for this work are to collect performance data from a conventional two-stroke engine to act as baseline data; convert the engine to the NAHBE concept; and collect performance figures for this engine and compare the results to baseline data. Work will also involve the adapting of a fuel-injector system to the NAHBE and the use of fuels other than gasoline, specifically JP-5, a military jet fuel. The culmination of this research is to determine the feasibility of converting existing portable firepumps in the Navy to the NAHBE concept. Results at this point include the collection of baseline data, NAHBE performance data and a successful operation of the NAHBE engine on JP-5.

\*\*\*\*\*

V/STOL SUCKDOWN ALLEVIATION

Researchers: Midshipmen 1/C S. D. Martin and Kenneth Neubauer

Adviser: Professor Maida Saarlas

The purpose of this project is to design and build a V/STOL aircraft model, not to scale; to establish pressure distribution on the bottom side of the fuselage and wing to approximately determine the loss of lift (suckdown) during in-ground effect; and to determine if suckdown effect can be partially or fully alleviated by directing the jet thrust along the bottom of the wing surface.

\*\*\*\*\*

FLIGHT EVALUATION OF THE TERMINAL GUIDANCE SYSTEM (TGS)

Researchers: Midshipmen 1/C Gregory A. Miller and Jonathan W. Hults

Adviser: Professor Doral R. Sandlin

The TGS is an avionics system used to guide the aircraft along a curved descending flight path to a landing. This system was installed in a General Aviation single engine aircraft and flight evaluated. The objectives of the program were to evaluate the capabilities of the system and determine the effect of pilot experience on system operation. Numerous approaches have been flown using many different glide slopes, turn radius, and angles turned through. Several pilots with different amounts of flying time flew the approaches. One of the results of the program was the development of a new concept for presenting flight data and accomplishing curved approaches.

\*\*\*\*\*

LIST FAN PARAMETER STUDY ON XR-5A

Researcher: Midshipman 1/C Robert Oxborrow

Adviser: Assistant Professor William J. Bagaria

The purposes of this project are to measure the cushion air mass flow rate and pressure requirements of the XR-5A; to determine the flow rate parameters of the current XR-5A lift fans; to conduct a survey of available fans that would be compatible with the XR-5A but require less horsepower. If suitable fans are not available commercially, design and build a suitable prototype fan. This is a two-semester project.

\*\*\*\*\*

NAHBE MULTI-FUELS TEST ETHANOL AND METHANOL

Researcher: Midshipman 1/C Charles Preston

Adviser: Professor Andrew A. Pouring

Objectives of this project were to run a fuel test on the NAHBE-CFR using 200 proof Ethanol and 190 proof Methanol; to find the best operating conditions for both fuels; to make a theoretical comparison with each fuel; to make an actual comparison with Octane; and to make any recommendations for further testing.

It was found that Ethanol on an A/F to A/F basis had lower %CO and UBHC while peak IHP was slightly higher than octane. ISFC was nearly twice as high as that for octane on an A/F to A/F basis. EGT was marginally down as was ITE and RQI. However, BMEP was up.

Methanol was about the same as octane for IHP but had a much smaller range. %CO was lower than gas but higher than that for Ethanol. For UBHC Methanol was higher than that for Ethanol, but since Methanol did not have the operating range of gasoline, no comparison could be made on air fuel basis. However, UBHC is higher than that for gasoline for the entire operating range. EGT was much lower than that for gasoline for the entire operating range. EGT was much lower than that for both Ethanol and Octane. ITE was down by 10 to 11.8% as was RQI. EMEP was higher than that for Octane but was lower than that for Ethanol.

\*\*\*\*\*

AN EXAMINATION OF THE FANNO PROCESS IN PRESSURE-SPECIFIC VOLUME COORDINATES

Researcher: Midshipman 1/C David M. Schlagel

Adviser: Professor Andrew A. Pouring

This paper presents the plot of a steady Fanno process in p-v coordinates. The basic equations of motion for a Fanno flow are first manipulated so as to allow application of a computer-prepared numerical evaluation technique. Using this computer method, a graphical display of the Fanno process is generated. Experimental data obtained from a subsonic Fanno flow was then compared with the numerically determined results. A final consideration is presented concerning the possible development of a polytropic-like process describing the pressure-specific volume behavior of the Fanno process.

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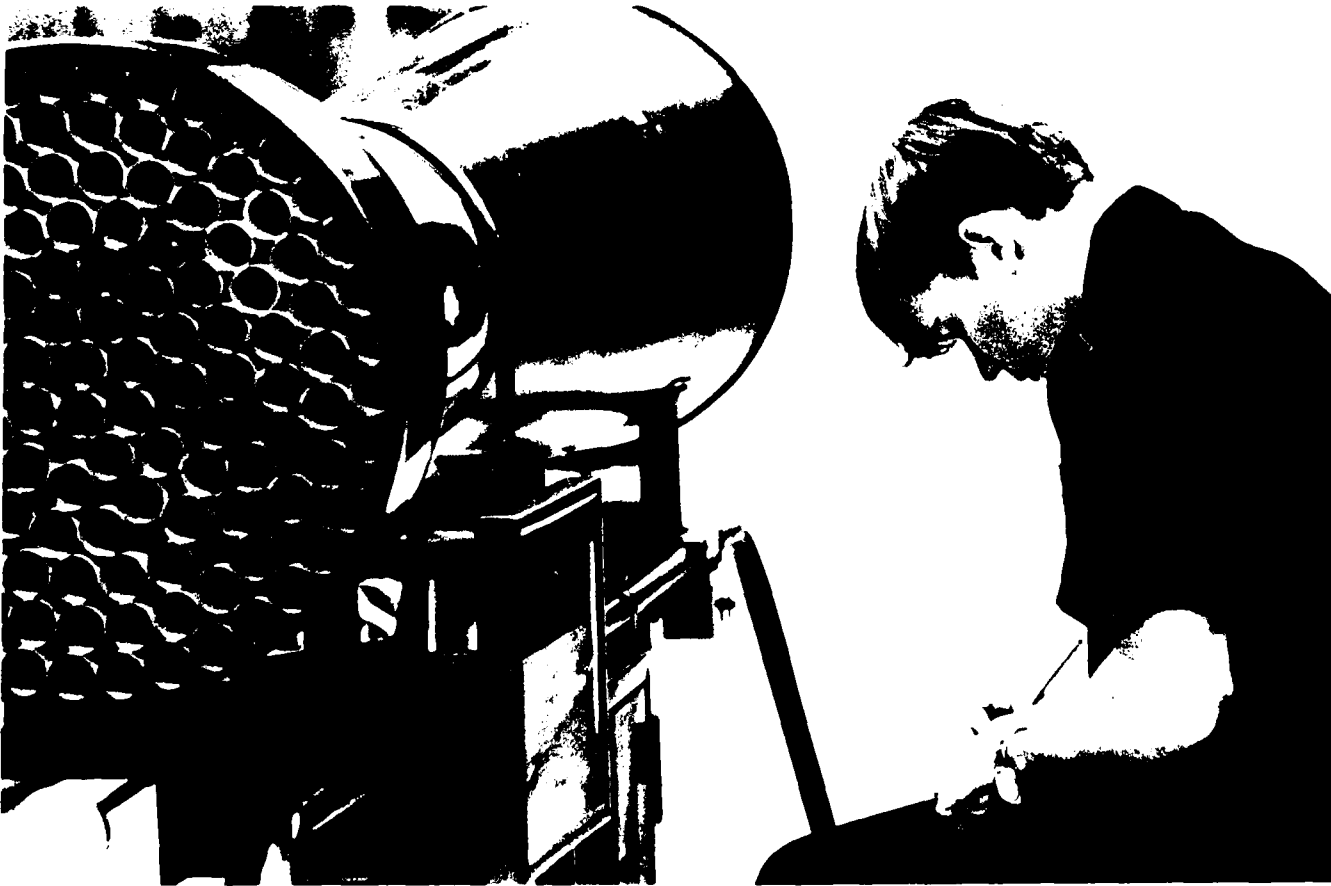
## CONSTRUCTION AND TESTING OF UFM "EASY RISER"

Researcher: Midshipman 1/C Lawrence R. Smith

Adviser: Associate Professor Vadym V. Utgoff

The objective of this project was to construct an "Easy Riser" Biplane Hang Glider, the glider to be purchased from Ultralight Flying Machines, Santa Clara, California. Before construction, a small model was built to run wind tunnel tests on. Estimated construction time was 100+ hours. The researcher took lessons (hang gliding) during the semester to aid in gaining the knowledge to fly the glider once constructed in actual manned and unmanned flight. He tested and compared the performance of the glider versus manufacturers' specifications.

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POURING, Andrew A., Professor, Charles C. FAILLA, LCDR, USN (Mechanical Engineering Department), Bruce H. RANKIN, Professor (Naval Systems Engineering Department), and Eugene L. KEATING, Associate Professor (Mechanical Engineering Department) "Parametric Variations of a Heat Balanced Engine," E&W Report 12-79, September 1979.

Performance of a CFR engine over a wide range of experimental conditions is reported in detail for standard spark ignition operation and for heat balanced configurations. Operating conditions were mapped for primary combustion-chamber and balancing-chamber volumes giving nearly constant balancing ratios for three selected compression ratios; edge gap clearance was also varied. Three secondary air modes were investigated during optimization of performance, giving more than a 30% increase in output over standard S.I. operation, an improvement in ISFC of 10% at best economy, 30% at best power with CO-emission decreased to less than 0.1% and UHC to less than 100 ppm.

A new method of engine performance analysis, the Run Quality Index (RQI) is proposed to help evaluate the heat balanced engine and compare it to other engines.

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POURING, Andrew A., Professor Eugene L. KEATING, Associate Professor (Mechanical Engineering Department), "Quasi-Equilibrium Fuel-Air Heat Balanced Cycle Analysis," E&W Report 14-79, November 1979.

The quasi-equilibrium thermodynamic model of the Naval Academy Heat Balanced Engine (NAHBE) has been modified to include the influence of fuel-air chemistry on predicted indicated engine performance. Heat addition to the Air Standard Heat Balanced Cycle was expressed in terms of an appropriate fuel-air ratio and heating value for a standard fuel. Indicated parameters including mean effective pressure, peak pressure, specific fuel consumption and thermal efficiency for compatible Otto and Heat Balanced cycles were calculated and compared. Performance parameters for both cycles were obtained at equal compression ratios, fuel-air ratios, fuel type, and engine rpm. Results show that for overall stoichiometric heat addition, the Heat Balanced cycle can produce greater indicated engine power, higher indicated thermal efficiency and lower indicated specific fuel consumption than the corresponding Otto cycle. Further analysis indicates that the optimum heat balancing conditions occur for constant volume heat addition with rich mixture composition followed by constant pressure heat addition with lean composition.

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PRESENTATIONS

AEROSPACE ENGINEERING DEPARTMENT

ROGERS, David F., Professor, "Interactive Graphics and the Uniform Beam in Engineering Education," Second Conference on Computing in Civil Engineering, Baltimore, Maryland, 10-13 June 1980.

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ROGERS, David F., Professor, "A Sample CAD/CAM System for the Design and Construction of Towing Tank Models," 17th Annual Meeting of the Numerical Society, Hartford, Connecticut, 27-30 April 1980.

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## ELECTRICAL ENGINEERING DEPARTMENT

*Professor Francis Joseph Eberhardt, Chairman*



Research activities of the Department continue to span a wide range of areas, with particular emphasis on digital signal processing. The on-line acoustic signal processor designed for the Naval Ship Research and Development Center has been completed and tested and follow-on work continues. Student and faculty projects, such as computer control for a video tape player, and a microprocessor-controlled robot are doing well.

A new development this year is a cooperative venture with the Naval Surface Weapons Center, White Oak, to bring real world engineering problems to the midshipmen. Naval Academy faculty members and NSWC engineers have been identifying small parts of systems under development, for which the design can be undertaken by midshipmen in the EE423, Design Lab Course, or in the FE49X, Research Studies Courses. This approach gives the student the opportunity to apply his recent course work to a part of an on-going development. It is hoped that some of the First Classmen who do work on these projects will be assigned TDY to NSWC while awaiting entry to their specialty schools.

Research in the Department of Electrical Engineering serves three purposes: it supports continuing development of the faculty; it provides the important element of applied engineering for midshipmen who participate in projects; and it contributes new knowledge to the disciplines. The second of these purposes is most important at the Naval Academy. Research must provide the basis for a strong undergraduate program, one in which faculty members are committed to maintaining dynamic and challenging projects for midshipmen who specialize in electrical engineering. Participating midshipmen have the opportunity to engage in unstructured scientific efforts of a wide variety. Thus, they are exposed to some of the techniques applied to the solution of practical engineering problems.

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## DESIGN OF MULTICHANNEL MATCHED NOTCH FILTERS

Researchers: Midshipman 1/C David Flores and Professor Francis J. Eberhardt

Sponsor: Naval Surface Weapons Center, White Oak

The objective is to design and construct three notch filters with the following characteristics: -50dB or more attenuation in the notch at 600 Hz; no more than -5dB at 100 Hz either side of the center frequency; flat pass band outside the region. Additionally, the phase characteristics of all three filters must be similar. Several types of filters were examined and the second-order notch filter was selected. Three similar units were designed and constructed by Midshipman Flores and delivered to NSWC on 22 May 1980.

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## A HIGH-SPEED DATA ACQUISITION AND HARDWARE SIGNAL PROCESSOR FOR THE TM990/101 MICROCOMPUTER

Researchers: Ensign John Ford, USN, and Associate Professor Antal A. Sarkady

Sponsor: David W. Taylor Naval Ship Research and Development Center

The researchers designed and built a hardware signal processor board for the TM990/101 microcomputer. The instrument performs high-speed pulse-height analysis and periodic averaging. The pulse-height analysis mode is used to compute probability density functions of acoustical value leakage-signals in submarines while the periodic averaging mode is used to extract repetitive signals "buried" in noise and useful in ship surveillance.

The instrument was designed and lab tested during the period July - December 1979. The applications of this instrument in submarine signals are currently being investigated.

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## COMPUTER-AIDED EXTRA INSTRUCTION IN ELECTRICAL ENGINEERING

Researchers: Major Michael W. Hagee, USMC, Professor Francis J. Eberhardt, Major Marvin H. Floom, USMC, Associate Professor Wesley K. Kay, Lieutenant Commander Peter S. Pierpont, USN, Lieutenant Commander David C. Steere, USN, Assistant Professor Tian S. Lim, and Lieutenant Commander John C. Garske, USN

Sponsor: Academic Dean - Instructional Development Program

The subject project implemented a computer-augmented video extra-instruction package in the Electrical Engineering Department at the United States Naval Academy. The extra-instruction package consists of a series of fifteen different and independent modules involving computer graphics display and integrated computer-controlled television to help non-electrical engineering as well as non-engineering students assimilate the essentials of the electrical engineering core courses. Each module is keyed to one of the recurrent stumbling blocks by the majority of the non-technical students each year. The subject areas covered are: voltage division, current division, network reduction, phasor manipulation (three levels), Thevenin/Norton Theorems, superposition, current and voltage sources, RC transients (5 levels), and RL transients. Each of the listed modules contain a quick recap of theory and basic sample problems, followed by exercises to build the students' experience and confidence.

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## A DIRECT MEMORY-ACCESS INTERFACE UNIT

Researchers: Midshipman 1/C Charles Kanewske and Associate Professor Antal A. Sarkady

Sponsor: Naval Surface Weapons Center, White Oak

A direct memory-access (DMA) controller was designed and built for the TI TM990/101M microcomputer. The controller provides a high speed (500KHz) analog data-acquisition and display for the SP-16 microcomputer based signal processor.

The project was completed on 14 May 1980 and is currently being used in signal processing research.

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## PROGRAMMABLE AMPLIFIER SYSTEM FOR A TAPE RECORDER

Researchers: Midshipman 1/C Jeffrey S. Kunkel and Associate  
Professor Antal A. Sarkady

Sponsor: Naval Surface Weapons Center, White Oak

A programmable gain amplifier was designed and constructed to be used in sonar signal-processing and recording applications. The amplifier compresses strong signals and expands weak echoes to reduce tape recorder noise.

The project was completed on 12 May 1980 and was delivered to NSWC on 26 May 1980.

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## RADIATION TESTING OF RECENT VINTAGE MICROPROCESSORS

Researcher: Associate Professor Richard L. Martin

Sponsor: Naval Research Laboratory, Washington, D. C.

A novel radiation experiment was performed using a total of 39 recent-vintage 8080A microprocessors from five different manufacturers. The purposes of the experiment were to determine whether processing changes had influenced the radiation hardness of the devices and to determine whether total dose failure levels were dependent on dose rates.

Functional self-tests were performed both before and after the irradiations. During the irradiations, the microprocessors were operating a simple program, exercising all of the working registers in the device. Degree of failure and apparent recovery due to room-temperatures annealing were noted.

No apparent change was found in the failure levels of the devices from any manufacturer. Due to the varied range of total dose-failure levels, no dose-rate dependency was discernible. No area of the microprocessors exhibited particular sensitivity to the radiation, implying that improvement to radiation hardness would be accomplished by introduction of processing steps applied to the entire device.

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AN INVESTIGATION OF A FREQUENCY-MODULATED UNDERWATER  
COMMUNICATION SYSTEM

Researchers: Lieutenant Commanders Peter S. Pierpont, USN and  
David C. Steere, USN

Sponsor: Naval Academy Research Council

The project is a continuation of two related Master of Science theses by the authors. Investigation into the choice of carrier frequency and modulation mode has dictated the use of 40KHz frequency-modulated ultrasonic transmission. Utilization of modern micropower phase locked-loop technology for modulation and demodulation is anticipated. Two working prototype acoustic transceivers are to be designed and constructed. Preliminary testing is also to be accomplished. Concepts and prototypes developed will ultimately lend to a reliable, self-contained underwater communications system for free swimming divers.

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## MISSILE DATA-ACQUISITION SYSTEM USING 24K of CMOS 12-BIT RAM

Researchers: Associate Professors Antal A. Sarkady and  
Herbert M. Neustadt

Sponsor: Naval Surface Weapons Center, White Oak

A high speed internal data-acquisition and CMOS RAM data-storage system was designed to measure and record the dynamic behavior of missiles and torpedos during the air-water interface. The system is internal to the missile and, on recovery, the stored data is preprocessed by a microcomputer-based ground support system. The design of this system was completed during the period January 1980 - May 1980 and it will be constructed and tested during this summer.

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## DEVELOPMENT OF A MICROCOMPUTER-BASED SIGNAL PROCESSOR AND ITS APPLICATION TO NAVAL SHIPBOARD SENSORS

Researcher: Associate Professor Antal A. Sarkady

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

A versatile microcomputer-based signal processor was designed, constructed and delivered to NSRDC. The instrument is used to compute cross-correlation, cross-spectrum, auto-correlation and power spectrum of shipboard sensor signals used in machinery monitoring. The instrument is currently being used at NSRDC to measure leakage rates in submarine valves and rams.

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## A NONINVASIVE ASSESSMENT OF THE SEVERITY OF AORTIC STENOSIS IN CHILDREN

Researcher: Associate Professor Antal A. Sarkady

Sponsor: Department of Cardiology, Children's Hospital, National Medical Center, Washington, D. C.

This is a joint research project between Children's Hospital, National Medical Center, Washington, D. C., and the U.S. Naval Academy. The objective is to develop a safe, noninvasive method of assessing the severity of congenital aortic stenosis in children by utilizing computer analysis of phonocardiograms.

The phonocardiogram data are recorded on magnetic tapes during cardiac catheterization at Children's Hospital and analyzed on the USNA TSS computer system. The first spectral movement ( $S$ ) of the averaged power-spectrum of a quasi-stationary segment of the aortic murmur is correlated with the peak systolic pressure gradient and the aortic valve area. The research will be meaningful if significant correlation between ( $S$ ) and the aortic valve-gradient can be established, thus providing an estimation of the gradient in patients with aortic stenosis, without the need for cardiac catheterization. Eight aortic stenosis patients have been processed during this year.

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## UNIVERSAL MOTOR CONTROL IGNORES LINE RESISTANCE

Researcher: Professor Stephen H. Burns

The purpose of this motor control circuit is to keep the motor voltage independent of a varying resistance in the ac line while allowing, nevertheless, the ac source voltage to exercise control over the motor's speed.

The rectifier and power stage of this electronic control disconnect the load from the line near the zero crossings of the sine wave on the line, and Thevenin's theorem suggests that one can then deduce the (open circuit) ac source voltage. This deduction is made by timing the intervals during which the absolute value of the line voltage  $V_0 \sin \omega t$  is between zero and some reference voltage  $V_r$ . The duration of these intervals equals  $2V_r / V_0$ .

A control voltage is developed across a capacitor, which is charged by a constant current source. The capacitor is discharged by a bleeder circuit and also by a second current-source that is gated on during the intervals measured above. The average value of the control voltage depends only upon the (open circuit) ac source voltage.

The average value of the motor voltage is set by a differential amplifier and a power transistor to be a constant multiple of the control voltage. The power transistor operates efficiently in a switching mode at twice the line frequency.

Three realizations of these ideas were tested and found to work. The first consisted primarily of discrete transistors. In the second, an IC operational amplifier replaced several discrete devices for better performance at a lower cost. In the third, a different IC yielded a wider dynamic range.

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## ELECTROMAGNETIC ASPECTS OF WILLIAMS' DYNAMIC THEORY

Researcher: Associate Professor Dan C. Ross

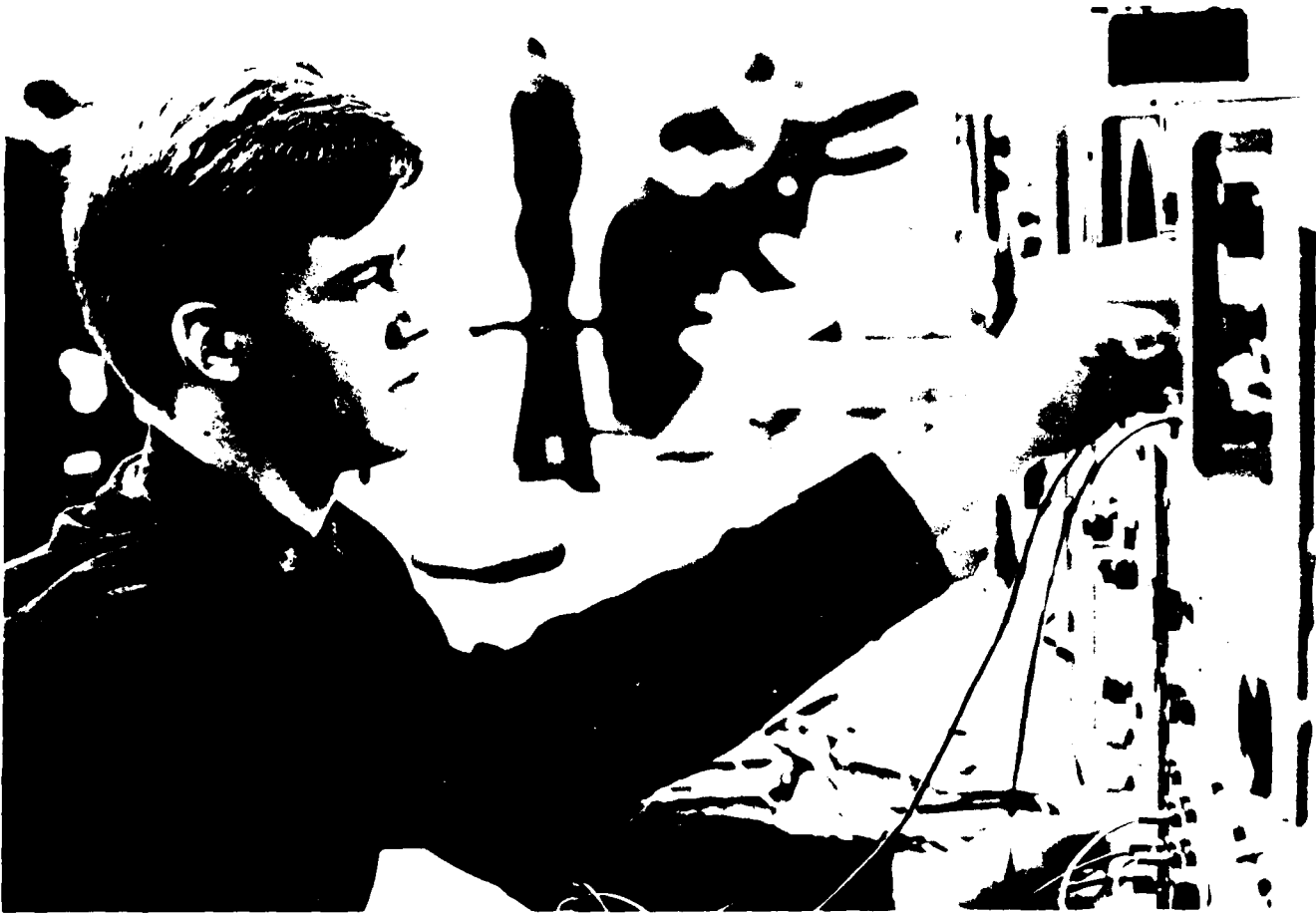
A new theory unifying thermodynamics, mechanics, gravitation, and electromagnetics has been proposed by Lieutenant Commander P. E. Williams, USN, in four papers completed in 1976-1979 at Naval Postgraduate School, U.S. Naval Academy and Los Alamos Scientific Laboratory. The theory is stated in a five-dimensional tensor form from which the classical theories can be derived.

Williams' theory makes predictions not possible in previous theories, most notably a limit on the rate of conversion of matter into energy.

The objective of the present research project is to consider the electromagnetic aspects of Williams' theory and to find situations where different results are predicted, as compared to previous theory (Einstein) and where these differences could be measured.

Work to date has been limited to part-time study of Williams' papers and to preliminary discussions with him on specific cases to be analyzed mathematically and/or by computer simulation during academic year 1980-1981--for example, a planar EM transient wave impinging on a planar sheet of charge.

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A KIM-1 TO USNA/DTSS COMMUNICATION LINK

Researcher: Midshipman I/C Isaac R. Clark, Jr.

Adviser: Professor Ralph P. Santoro

Efforts have begun on the hardware and software design of a system that will allow data interchange between the USNA time-share computer and a KIM-1 microcomputer located in the Electrical Engineering Department laboratories. This link greatly extends the power of the KIM-1 microcomputer and enhances its laboratory value. The project is about 95% complete in hardware and 75% complete in software.

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AUTO-SWITCHING OF DATA PLAYBACK

Researcher: Midshipman I/C Lawrence M. Ingeneri

Adviser: Professor Ralph P. Santoro

This project was a software refinement task. An existing control program written for the KIM-1 microcomputer would not execute rapidly enough to carry out the auto-switching of pre-recorded oceanographic data in real time; the existing software provided a 767  $\mu$ sec period which was 127  $\mu$ sec longer than real time. The critical segments of machine-language code were rewritten and achieved a 508  $\mu$ sec period, well below the 640  $\mu$ sec real time value. The arithmetic accuracy of several routines was also improved in the process.

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A CASSETTE TAPE SYSTEM FOR THE ELECTRICAL ENGINEERING DEPARTMENT'S 8080 MICROPROCESSOR DEVELOPMENT SYSTEM

Researcher: Midshipman I/C Richard A. Medley

Adviser: Professor Ralph P. Santoro

Hardware and software to interface a standard auto cassette-recorder to the Department's 8080 microprocessor development system was designed and implemented. This achievement greatly improves the bulk storage capabilities of this development system. A primary feature of Midshipman Medley's design is compatibility with the KIM-1 microcomputer tape format. Data transportability between the KIM-1 and the 8080 development system is therefore assured.

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## FILTER DESIGN USING MICROCOMPUTERS

Researcher: Midshipman 1/C Richard A. Modley

Advisor: Assistant Professor Tian S. Lim

The purpose of this project is to study the use of computer in the design of double-terminated optimal filters, containing an RC-ladder network with the maximum possible gain and minimum total series capacitance. Synthesis of these types of filters has become more and more important due to our increasing dependence on integrated circuit technology. The size of the chip is directly proportional to the amount of resistance and capacitance contained within. Thus by minimizing these values, one can minimize the cost of each chip. The project has been completed.

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LIM, Tian S., Assistant Professor, co-author, "Microcomputer-Aided Design of Double-Terminated Butterworth Filters," Proceedings of 13th Annual Asilomar Conference on Circuits, Systems, and Computers (November 1979), 298-301.

In this paper double-terminated ladder networks, consisting of a cascade of LC two-ports with a load resistor and a source resistor, are investigated. The chain-parameters technique is used. This method is based upon a useful property of an LC network and the chain parameters. This property relates the even part of a Butterworth polynomial to  $\Lambda(s)$  and  $D(s)$  of the chain parameters and the odd part to  $B(s)$  and  $C(s)$ . The entire synthesis process is accomplished using a simple algorithm and a microcomputer that has some form of extended-BASIC. Based on the equations derived in this paper, a microcomputer program has been written which is so automated that all the user has to do is to input the number  $N$ , the order of the desired Butterworth filter. The computer printout shows the Butterworth polynomial as well as the value of filter elements.

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LIM, Tian S., Assistant Professor, co-author, "Microcomputer-Aided Design of Optimal Filters," IEEE Circuits and Systems Magazine, 2 (March 1980), 14-18.

Due to our increasing dependence on integrated circuit technology, optimal synthesis of filters has become more and more important. The size of the chip is directly proportional to the amount of resistance and capacitance contained within. Thus, by minimizing these values, one can minimize the cost of each chip. This method, however, does not necessarily reduce the overall cost of production. The man-hours involved in arriving at these optimal values may more than offset the savings realized by smaller chips. This is especially true as the complexity of the filter increases. To alleviate this problem, one can use a microcomputer to aid in design. This reduction in man-hours makes optimal synthesis economically desirable.

The optimal synthesis of a double-terminated high-pass RC filter is very tedious if done by hand. The whole process, however, can be done in only a fraction of the time using a microcomputer which has some form of BASIC. The program is limited only by the storage capacity and accuracy of the microcomputer.

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LIM, Tian S., Assistant Professor, co-author, "Optimal Filter Design Using New Formulas," IEEE Circuits and Systems Magazine, 2 (March 1980), 19-22.

Optimal synthesis of RC-ladder networks with given terminations was first introduced by Kuh in 1958. He realized a grounded RC two-port from a given transfer function. He used the Lagrange multipliers-method to obtain the optimization and the resulting optimal network has maximum gain and minimum total capacitance. Integrated circuit technology spurred a revival of interest in optimal synthesis of RC-ladders nearly two decades after Kuh's discovery. Optimal synthesis of RC-ladder networks using various techniques has been advanced in recent years. However, all these methods require the formation of impedance or admittance function from a given transfer function using various techniques and, invariably, a continued fraction expansion of the resulting function. The complexity of such a procedure increases rapidly with the number of ladder sections. In this paper, a simple and fast method using new formulas is introduced. These new formulas enable the designer to find optimal networks identical to those obtainable from existing techniques at a fraction of the time.

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LIM, Tian S., Assistant Professor, co-author, "Realization of Some Orthogonal Polynomials Assisted by Microcomputers," Proceedings of 14th Annual Conference on Information Science and Systems, Princeton University (March 1980).

This paper deals with a method of realizing orthogonal polynomials such as Butterworth, Chebyshev, and Bessel polynomials. The Butterworth filters (also called maximally flat filters) are widely used due to their simple network configuration and good phase response. The Butterworth amplitude response, because of its maximally-flat property, is excellent near  $\omega=0$ . The Chebyshev filter is superior to the Butterworth at cutoff and in the stopband. If phase response is important, as well as amplitude response, and the phase response is the primary concern, neither Butterworth nor Chebyshev filters should be used. A much better approximation than is the Bessel filter. In this paper, transmission parameter is used to derive the realization procedures for both single-terminated and double-terminated networks. The entire realization process is accomplished by means of an algorithm and a microcomputer which has some form of extended BASIC.

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LIM, Tian S., Assistant Professor, co-author, "Microcomputer-Aided Design of Single-Terminated Bessel Filters," IEEE SOUTHEASTCON Proceedings (April 1980).

In filter design, the phase response and the time delay are important if it is desired that the signal pass through the filter with very little distortion. In fact, if the phase response is linear (in which case the time delay is constant), then there is no distortion in the signal. Bessel filter is a realizable approximation to the ideal constant time delay function  $e^s = \cosh s + \sinh s$ . This paper deals with single-terminated Bessel filters, consisting of a cascade of LC-ladders terminated in a one-ohm resistor. The method is based on the property which associates the even part of the Bessel polynomial to  $A(s)$  of the transmission parameters and the odd part to  $B(s)$ . The solution is obtained using a simple algorithm implemented by a microcomputer which is equipped to process a short BASIC program.

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LIM, Tian S., Assistant Professor, co-author, "Computer-Augmented Video Education in Electrical Engineering at the U. S. Naval Academy," Proceedings of National Education Computing Conference (June 1980).

This paper describes a computer-augmented video education (CAVE) project being undertaken in the Electrical Engineering Department at the United States Naval Academy. The project is designed to produce a series of modules involving computer graphics display and integrated computer-controlled television to help engineering students (non-electrical) as well as non-engineering students learn the essentials of electrical engineering. Each module contains a quick recap of the theory and basic sample problems, followed by an exercise to test student proficiency. The student can use the system to increase basic electrical engineering skills through drill and practice. The instructor can anticipate to spend less time on EI-sessions and therefore can devote more time to students with more serious difficulties. This customization of instruction has the added benefit of diagnosing a student's specific problems in given concept areas as well as a tool in measuring various teaching methods, since one can monitor the responses/comments of students to the given material.

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MARTIN, Richard L., Associate Professor, "Some Alternate Applications of Microprocessor Trainers in Support of Undergraduate Laboratories," Transactions, CoEd Division of ASEE, 11 (December 1979).

A variety of ways in which a microprocessor trainer has been used to support undergraduate laboratories is presented. Provision of signals and demonstrations for experiments unrelated to microprocessors is the primary consideration. Signal generation is of two forms. Direct generation of low frequency waveforms of arbitrary shape is accomplished by the addition of only a simple digital-to-analog converter to the basic microcomputer. Higher frequencies with a restricted variety of waveshapes are generated by the further addition of a voltage-controlled oscillator.

As a demonstration of the computational capabilities of an eight-bit microprocessor, a second order differential equation simulation is presented. An X-Y plotter subroutine is included to allow the microcomputer to properly output the simulation results. Complete flow diagrams and machine language listings are provided for all programs.

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SARKADY, Antal A., Associate Professor, co-author, "A Low Cost Versatile  $\mu$ -Computer Based Pulse Height Analyser," Proceedings of the 32nd Annual Conference on Engineering in Medicine and Biology, Denver, Colorado (October 1979), 3.

A pulse-height analyser was developed for random signals using a 16-bit microcomputer. This instrument is very useful for nuclear biomedical applications where Gamma and X-ray pulse-height spectrum are observed with nuclear scintillation and solid-state detectors and studied by pulse-height analysis. The instrument is designed around an inexpensive commercially available 16-bit microcomputer which requires only added I/O and programs. The complete hardware and software design is presented in the paper, which enables a user to build this instrument. The computer performs a multifunction role of data acquisition, data acquisition timing, data processing and control of the display of a pulse-height spectrum. The spectrum is refreshed continuously by a foreground display program which is interrupted for each pulse-height data acquisition. The incoming data at maximum rate of 40 KHz is digitized to one of 256 different amplitude levels and is used to update the display counts. Pulse-height display scale from 256 to 65,536 counts in powers of two are continuously available to the operator via user-controlled switches. The microcomputer checks the status of these switches accordingly. Data acquisition time-durations in the range of 10 ms. to 8 hrs. is provided by a software controlled programmable



interval timer. The microprocessor is readily available to perform other more sophisticated signal processing applications such as feature extraction, pattern identification, correlation or data smoothing.

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SARKADY, Antal A., Associate Professor, co-author, "A 16-Bit Microcomputer Based Biomedical Signal Processor," Proceedings of the Third Annual Symposium on Computer Application in Medical Care, Washington, D. C., (October 1979), 464-468.

A versatile low-cost, two-channel signal processor was developed using a 16-bit microcomputer. The instrument can process biomedical signals in the time and frequency domains using a fast, fixed-point FFT algorithm. Many averaged signal processing functions and their estimates are computed efficiently on-line and in near real-time using look-up tables and directives.

The signal processing techniques were applied to phonocardiograms to develop a non-invasive technique to assess the severity of valvar aortic stenosis in children. A murmur-power spectral analysis is presented which yields a statistically reliable spectrum. Envelopograms are defined and found to be useful for timing cardiac events.

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SARKADY, Antal A., Associate Professor, co-author, "A Quantitative Description of the Aortic Ejection Click and First Heart Sound," Proceedings of the Third Annual Symposium on Computer Application in Medical Care, Washington, D.C., (October 1979), 660-665.

The aortic ejection click and first heart sound (S1) are described in the time and frequency domains from computer processed phonocardiogram data obtained from 13 aortic stenosis patients and 6 normal ones. The analysis procedure described was done separately for inspiration and expiration and consisted of the following steps: (1) determination of the click onset times; (2) generation of aligned average cardiocycles with alignment done separately on the click and S1; (3) calculation of power spectra for selected segments of the click and S1. Tabulated results typically show 2 frequencies in S1 (means at 40 and 75 Hz) and 3 in the click (means at 45, 95, and 195 Hz). The high frequency content of the click is compared to that of S1, and the power spectra of the early and late parts of the click are compared.

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SARKADY, Antal A., Associate Professor, co-author, "A High-Speed Data Acquisition and Hardware Signal Processor for the TM 99C/101 Microcomputer," Proceedings of the IECI 80 Spring Conference on Application of Mini- and Microcomputer, IEEE Industrial Electronics & Control Instrumentation Society, (March 1980), 313-318.

A hardware direct memory access (DMA) controller was designed and build for the Texas Instruments TM 990/101 microcomputer which performs high speed data acquisition, as well as dedicated hardware signal processing. The controller uses a dual DMA LSI Chip (TI TMS 9911) which allows data acquisition or hardware processing in the foreground and data display in the background. The system performs three basic functions: those of data acquisition, pulse height analysis, and periodic averaging. System flexibility is provided by using software selectable modes, parameters, and a programmable timer. A complete description of the hardware and software is presented in the paper.

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SARKADY, Antal A., Associate Professor, co-author, "A Biomedical Tape Recorder Adapter with Common-Mode Noise Suppression," Proceedings of the Seventh Annual Rocky Mountain Bioengineering Symposium and Seventeenth International ISA Biomedical Sciences Instrumentation Symposium, U.S. Air Force Academy, Colorado Springs, Colorado, (April 1980), 33-37.

The signal-to-noise ratio in biomedical signal recordings has been improved by more than 6dB by using a two-channel adapter which subtracts common-mode noise due to the tape recorder. The two channels are FM multiplexed on a single track and each channel has a frequency response from 0 to 120 Hz.

The adapter consists of a pair of matched FM modulators, demodulators and subtracting circuits. A FM modulator is comprised of a low-pass filter, a VCO, and a summing network. The VCO center-frequencies are 4.5 KHz and 10.6 KHz. These were chosen to be consistent with the required input signal bandwidth and frequency response of a typical high fidelity AM stereo tape recorder (i.e., the UHER model CR135 with a recording range of 50-15 KHz). Each FM signal has a modulation index of 21, and a frequency deviation of  $\pm 2.5$  KHz. The two wideband FM signals are summed with a 1.1 KHz guard band and recorded on a single track of a commercial AM cassette tape recorder.

Each demodulator consists of an input high or low-pass filter, a phase-locked loop demodulator, an output low-pass filter, and a subtracting circuit. The input low-pass filter in channel one and the input high-pass filter in channel two have

cutoff frequencies of 7 KHz and 8.1 KHz respectively. The free running frequencies of the phase-locked loops are tuned to 4.5 KHz and 10.6 KHz respectively. The demodulated output is then low-pass filtered to attenuate any residual carrier frequencies or high frequency noise. The adapter can be used in two modes. If two signals are to be recorded, the subtracting circuit is bypassed. However, if only one signal is to be used, the remaining channel input is shorted and used as a reference signal. Inverting the reference output and summing it with the demodulated signal results in a subtraction of common noise signals due to tape speed and position variations.

Complete circuit diagrams and performance of the adapter is presented in the paper. This instrument is currently being used for ECG recordings but can be used in many signal processing applications.

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PRESENTATIONS

ELECTRICAL ENGINEERING DEPARTMENT

ALLEY, Reuben E., Jr., Professor, "Physics and Art," Southeastern Section of American Physical Society, Chattanooga, Tennessee, 9 November 1979.

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ALLEY, Reuben E., Jr., Professor, "Physics and Art," Annual Meeting of American Association of Physics Teachers, Chicago, Illinois, 24 January 1980.

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ALLEY, Reuben E., Jr., Professor, "Physics and Art," Joint Colloquium of Physics and Art History Departments, University of Delaware, Newark, Delaware, 19 March 1980.

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HAGEE, Michael W., Major, USMC, co-author, "Computer-Augmented Video Education at the U. S. Naval Academy," National Educational Computing Conference, Norfolk, Virginia, June 1980.

LIM, Tian S., Assistant Professor, "New Formulas for a Class of Optimal Filters," Allerton Conference on Communication, Control and Computing, University of Illinois, Champaign, Illinois, October 1979.

\*\*\*\*\*

LIM, Tian S., Assistant Professor, "Microcomputer-Aided Design of Double Terminated Butterworth Filters," Asilomar Conference on Circuits, Systems and Computer, Monterey, California, December 1979.

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LIM, Tian S., Assistant Professor, co-author, "Computer-Augmented Video Education at the U. S. Naval Academy," National Educational Computing Conference, Norfolk, Virginia, June 1980.

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LIM, Tian S., Assistant Professor, co-author, "Computer-Generated Graphics in Computer-Controlled Audio-Visual Interactive Programs for Electrical Engineering at the U. S. Naval Academy," American Society for Engineering Education Conference, Amherst, Massachusetts, June 1980.

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PRESENTATIONS

ELECTRICAL ENGINEERING DEPARTMENT

MARTIN, Richard L., Associate Professor, "Some Alternate Applications of Microprocessor Trainers in Support of Undergraduate Laboratories," ASEE Annual Conference, Louisiana State University, Baton Rouge, Louisiana, 24-26 June 1979.

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MARTIN, Richard L., Associate Professor, co-author, "Microcomputer Workshop: Introduction to Control Applications," Annapolis Subsection of IEEE, U. S. Naval Academy, Annapolis, 13 November 1979.

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MARTIN, Richard L., Associate Professor, co-author, "A One-Day Microcomputer Workshop," Maryland Association for Educational Use of Computers, U. S. Naval Academy, Annapolis, 17 November 1979.

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SANTORO, Ralph P., Professor, co-author, "Microcomputer Workshop: Introduction to Control Applications," Annapolis Subsection of IEEE, U. S. Naval Academy, Annapolis, 13 November 1979.

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SANTORO, Ralph P., Professor, co-author, "A One-Day Microcomputer Workshop," Maryland Association for Educational Use of Computers, U. S. Naval Academy, Annapolis, 17 November 1979.

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SANTORO, Ralph P., Professor, co-author, "Controlling for the Computer Video Environment: A Computer-Augmented Video Education Experience," Conference of the Association for the Development of Computer-Based Instructional Systems, Washington, D. C., 31 March - 3 April 1980.

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SAREADY, Antal A., Association Professor, "A Low Cost Versatile Microcomputer Based Pulse Height Analyzer," 32nd Annual Conference on Engineering in Medicine and Biology, Denver, Colorado, 6-10 October 1979.

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PRESENTATIONS

ELECTRICAL ENGINEERING DEPARTMENT

SARKADY, Antal A., Associate Professor, co-author, "A 16-Bit Microcomputer Based Biomedical Signal Processor," 3rd Annual Symposium on Computer Application in Medical Care, Washington, D. C., 14-17 October 1979.

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SARKADY, Antal A., Associate Professor, co-author, "A Quantitative Description of the Aortic Flow Click and First Heart Sound," 3rd Annual Symposium on Computer Application in Medical Care, Washington, D. C., 14-17 October 1979.

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SARKADY, Antal A., Associate Professor, co-author, "Microcomputer Workshop: Introduction to Control Applications," Annapolis Subsection of IEEE, U. S. Naval Academy, Annapolis, 13 November 1979.

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## MECHANICAL ENGINEERING DEPARTMENT

*Professor Vincent J. Loydale, Chairman*



Faculty and midshipmen research in the Mechanical Engineering Department covers many of the areas of specialization in mechanical engineering. These include research in direct energy conversion, fluid mechanics, heat transfer, shaft seals, acoustics, dynamic effects, stress corrosion cracking, fracture mechanics, composite materials, welding technology, design, and computer-aided graphics.

Research is supported through funds from six different government agencies with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, providing opportunities for several faculty members to work on projects during the intersessional period. Additionally, some faculty members have undertaken independent research in their areas of expertise. Including all levels of research, 14 civilian and two military faculty members have been active in the research of the Department this year.

An important part of the Department's research effort during the year has been the involvement of midshipmen in independent research, design, and development projects. Current midshipmen interests include the Naval Academy Heat Balanced Engine, computer graphics, corrosion, impact, and many aspects of fluid mechanics.

Supporting the research effort in mechanical engineering are the sophisticated laboratory facilities located in the Rickover Hall complex. The Department maintains facilities for performing experimental research in several areas: fluid mechanics, solid mechanics, materials science, experimental-stress analysis, control systems, mechanical vibrations, heat transfer, and thermodynamics.

The primary driving force behind the Department's research is the real need for the faculty to stay abreast of technological developments in the many diversified areas of mechanical engineering, thereby enabling them to be more effective classroom teachers.

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COMPARISON OF THE PERFORMANCE OF METAL AND HYBRID SHAFT SEAL SYSTEMS  
 DRIVEN BY DD-963 SUBMARINE MAIN SHAFTS - METAL AND HYBRID  
 COMPONENTS

Researcher: Associate Professor Elliott E. Leifer

Project: Submarine Main Shaft Seal Shock Testing Program  
 (DD-963 Main Shaft Seal Shock Testing Program)

The purpose of this report is to compare the performance of metal and hybrid shaft seal systems driven by DD-963 submarine main shafts. The report is divided into two parts. The first part describes the test program and the results of the tests. The second part discusses the results of the tests and compares the performance of the metal and hybrid shaft seal systems. The tests were conducted on a test rig that simulates the operating conditions of a submarine main shaft seal. The test rig consists of a motor-driven shaft, a seal, and a housing. The motor is a DD-963 submarine main shaft motor. The seal is a metal or hybrid seal. The housing is a metal housing. The test rig is driven at 1000 RPM. The test results show that the hybrid shaft seal system performed better than the metal shaft seal system. The hybrid shaft seal system had a longer life and a lower failure rate than the metal shaft seal system. The hybrid shaft seal system also had a lower torque and a lower power consumption than the metal shaft seal system.

For each of the two shaft seal systems, two shaft seal units would be tested. One shaft seal unit would be tested in a non-metallic hybrid component. The two shaft seal units would be tested side-by-side and would be tested at all possible shaft seal bearing positions. Scaled one-third and one-half scale shaft seal bearings would also be tested. All testing would be conducted in the (non-rotating) modes of DD-963 shafts with a rotating, non-rotating controller mass.

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STATUS REPORT OF SUBMARINE SHAFT SEAL PROGRAM, ELEMENTAL DESIGN AND TESTING - A 1979 UPDATING

Researcher: Associate Professor Elliott E. Leifer

Project: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

Since the August 1978 Status Report, there appears to be greatly increased interest and a far more optimistic attitude for the shock testing of submarine shaft-seal systems. This is exemplified by the concluding statement of DONSPOC report, SSN Main Shaft Seal Shock Analysis Report No. B4R0403-1 (Final), April, 1979: "Shaft Seal requirements for most combat situations have not been determined due to the uniqueness of shaft-seal systems and lack of full scale experimental data. In order to fully evaluate the combat performance of a shaft-seal system and develop validated design guides, it is recommended that an experimental investigation be conducted on full scale."



Further reflecting the sentiment for shock testing has been the implementation of NDCP:8-9971 - which, in progressing rapidly, has been well well placed into Tasks A, B, and C, with considerable effort being put, particularly B. The major effort in Task B is NDCP:8-9971 (Advanced Equipment Shock Evaluation Program) controlled by General Services, Electric Boat Division.

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#### ANALYSIS OF THE EFFECTS OF STRESS ON INTERACTIONS

Directed by the staff of the Dr. Joseph B. Hillerlain, Jr.

Research Center, General Motors, Warren, Michigan, White Oak Laboratory, National Aeronautics and Space Administration

The objective of this program is to develop predictive methods for the analysis of interactions of materials and aircraft components under various environments and conditions. Detailed analytical and experimental studies of the flow field, as determined by experimental methods, is required in order to develop predictive methods for the analysis of interactions and to develop predictive methods.

The experimental program will be made in the U. S. Naval Ordnance Research Laboratory and also in Naval Air Station, Naval Air Station, Naval Air Station, Naval Air Station. A model of a component with a cylindrical leading edge has been built. The model is available for use in the laboratory.

The analytical methods, measurements and flow visualization techniques will be used to analyze three-dimensional flow fields and geometries. The analytical methods will be used to obtain the flow field data which will be integrated to obtain the aerodynamic forces which will be compared with force balance data. The analytical methods and methods of wind tunnel analysis will be used to determine aerodynamic loads.

The present method of analysis of interaction data have been obtained from the present method with the use of the stress distribution, the flow field, the stream function, and the force function of the flow field. The measurements were obtained upstream of the fan and downstream of the fan. The measurements on the fan on both the upstream and downstream of the fan are used to analyze the interaction.

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## HYDRODYNAMICS OF TOWED VEHICLES

Researcher: Professor Robert Granger

Sponsor: Naval Coastal Systems Center, Panama City, Florida

The plan of investigation is to experimentally analyze a towed environmental-sensing system: to examine the characteristics which best meet the depth keeping and stability requirements, to determine the effect of the tow cable, depressor and tow ship, to study the lateral and longitudinal stability and relate to the vehicle's neutral buoyancy the effect of heave on the towed configuration.

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## MATERIALS ANALYSIS FOR ALLOY SELECTION FOR THE NAHBE PRESSURE EXCHANGE CAP

Researcher: Associate Professor Dennis F. Hasson

Sponsor: Office of Naval Research (Code 483)

The pressure exchange cap is a key element in the Naval Academy Heat Balanced Engine (NAHBE) concept. During the development of NAHBE hardware on an air-cooled single cylinder engine, some evaporation/erosion of the cap occurred. In order to avoid this difficulty, a materials analysis was initiated to determine suitable metallic alloys. The analysis consisted of a metallographic and scanning electron-microscope fractographic investigation of cast and extruded aluminum material caps from design testing programs on an air-cooled engine, and a materials selection study of several metallic alloys and a ceramic coating. Cast aluminum or non-heat treatable 5000-series aluminum and titanium alloys in the form of plate were proposed for the cap material. Studies of welding of the 5000-series aluminum and titanium materials to cast aluminum, and fuel/material compatibility with blended fuels were proposed.

The important element in materials selection is the temperature profile in the pressure exchange cap. Preliminary experimental studies were performed utilizing temperature-sensitive markers on a cast aluminum cap, a titanium cap, and cast aluminum caps spray-coated with zirconia and titanium. Some information was obtained, but the temperature sensitive markers are not completely useable for internal temperatures. Temperature plugs appear to be more suitable to obtain this type of data.

The austenitic or modular cast-iron for the pressure exchange caps were determined to be attractive materials from studies of the literature. In order to accomplish a more scientific materials selection utilization of temperature plugs for a more definite temperature distribution on titanium, cast aluminum, spray-coated cast aluminum, modular cast-iron and austenitic cast-iron will be performed in the 1980 summer intersessional period.

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#### INVESTIGATION OF FRACTURE PHENOMENA IN WELDS

Researcher: Associate Professor Dennis F. Hasson

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The objective of the study is to conduct laboratory investigations of fracture phenomena in two-and four-inch thick titanium weldments. Additional efforts included the evaluation of mechanical properties and microstructures of base plate, weld and heat-affected-zone (HAZ) of out-of-position weldments produced by the gas-metal-arc (GMA) spray and pulsed-current welding modes.

Scanning electron microscope (SEM) fractography was performed on fracture surfaces from mechanical tests. Stereomicrograph pairs were taken to provide information for the determination of the model of fracture (e.g., ductile or brittle). Metallography was also performed to assist in the interpretation of the fractographic morphology.

Major and interstitial chemical-element analyses, dynamic tear-tests, weldability tests, mechanical properties tests and fracture toughness test (e.g. Charpy V notch) were also performed to evaluate the effects of welding process and variables on the integrity of welds. The results of the out-of-position weld process program have been prepared for a report. The report is currently being reviewed.

Current activity is on the evaluation of other weld techniques for titanium (e.g. electron beam welding) and a comparison of this technique with GMA welding. A similar investigation to that performed on the out-of-position weldments will be performed during the 1980 summer intersessional period.

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FATIGUE LIFE CHARACTERISTICS OF ANODIZED ALUMINUM IN A SALT  
WATER ATMOSPHERE

Researcher: Associate Professor Dennis P. Hasson

Sponsor: Naval Surface Weapons Center, White Oak Laboratory

The objective of the research is to obtain information leading to an understanding of the corrosion-fatigue life characteristics of anodized aluminum in a moisture laden atmosphere with a condensed salt film on the specimen.

Corrosion-fatigue tests in reversed bending were run on salt-bleed Al 7075-T73 aluminum alloy specimens in (1) non-anodized condition, (2) sulfuric acid anodized with a 0.2 micron thick coating and (3) ammonium tartrate anodized with a 0.2 micron coating.

Tests were conducted in a 100% sea humidity environment at stress levels of 37.1, 33.1, 18.7 and 14.0 ksi which represented stresses of 67, 59, 33, and 25% of the yield stress. Scanning electron microscope (SEM) investigations of the fracture surfaces were performed.

Results of the investigation to date showed that the ammonium tartrate had the best characteristics in the 33% to 59% yield stress region, while unanodized specimens have the best corrosion fatigue resistance at the 25% and 67% yield stress regions. The results, however, were not completely conclusive.

More tests to build a better statistical base for more definitive conclusions, the study of another anodization treatment, and a study of the effect of the thickness of the anodized layer will be performed during the summer of 1980 intersessional period.

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## DUST DEVIL SIMULATION

Researcher: Professor Robert Granger

Sponsor: Funds from Saudia Arabia

An analysis is made of the special type of atmospheric vortex frequently encountered in Saudia Arabia. Starting with Lamb's equation and the energy equation, the potential temperature is expressed in terms of altitude and lapse rate, and the centerline vorticity distribution is expressed in terms of altitude and vorticity strength. After considerable transformations, a non-homogeneous second-order nonlinear partial differential equation is obtained subject to boundary conditions on the radial, circumferential, and axial velocity components. Considering the special case of an adiabatic lapse rate, the governing equation is transformed by a similarity transformation into a form whereby a closed-form analytic solution is obtained. Comparisons are made with other solutions in the literature.

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## RADIOGRAPHIC CURVE EVALUATION USING A KEY CURVE FORMULATION

Researcher: Assistant Professor James A. Joyce

Sponsor: Nuclear Regulatory Commission

The objective of this research was to develop a J-R curve for A533B using the "Key Curve" technique developed at USNA during the past two years. The basic methodology is to test a series of small specimens of various crack lengths at a loading rate of 2.5 in/sec and assembling the load displacement records into a specially formulated "Key Curve" computer file. This file can then be used to obtain J-R curves directly from the load displacement records of larger scale specimens of the identical material loaded at a proportionately scaled-up test speed.

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## TEARING INSTABILITY CRITERIA WITH NAVY ALLOYS

Researcher: Assistant Professor James A. Joyce

Sponsor: David W. Taylor Naval Ship Research & Development  
Center, Annapolis Laboratory

The objective is to evaluate the validity and applicability of the  $J_I$ -R curve-tearing modulus instability criteria with Navy alloys. The first step was to determine the validity of tearing modulus as a material property for steels, titanium, and aluminum alloys using laboratory scale tests. This has been accomplished for five different materials, using a specially modified high-compliance test machine. Tests are now in preparation to duplicate these results for high-toughness materials. Preparations are also being made for instability tests on piping geometries and wide plates with center and edge cracks.

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## DESIGN OF WAVE TURBINE POWER TRAIN

Researcher: Associate Professor William M. Lee

Sponsor: David W. Taylor Naval Ship Research & Development  
Center, Annapolis Laboratory

A power train was designed for the wave-driven air turbine sponsored by the Department of Energy. All but the turbine blades were purchased or manufactured at DTNSRDC, Annapolis Laboratory. The project is scheduled to be tested in the sea of Japan on a barge financed by the International Energy Agency.

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DYNAMIC  $J_{IC}$  FRACTURE TOUGHNESS MEASUREMENTS

Researchers: Assistant Professor James A. Joyce and Associate Professor Dennis F. Hasson

The objective of this work is to evaluate the elastic-plastic fracture toughness parameter  $J_{IC}$  from high rate tests. In elastic-fracture mechanics, higher rates of testing produce dramatic reductions of crack resistance properties. It is not likely that this same effect will result in the elastic-plastic situation, since higher loading rates would be expected that will spread damage over a greater area and produce, in fact, a tougher material behavior.

Tests to date have been conducted on HY-130 and HY-80 steels at rates up to 5 in/sec, which is 6 orders of magnitude faster than standard tests, without showing a marked change in the fracture toughness. Both high and low rate tests have been run on these steels at temperatures from  $-192^{\circ}\text{C}$  to  $150^{\circ}\text{C}$ . The major result has been to show that the transition temperature for HY-80 is rate-sensitive while that of HY-130 is not.

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## BOUNDARY LAYER FLOW ON A MOVING FLAT PLATE

Researcher: Professor Robert Granger

The classical Prandtl boundary-layer equation subject to the boundary conditions of Blasius, but modified such that  $u = U_w$  at  $y = 0$ , where  $U_w$  is the velocity of the moving wall, was examined. The equation was transformed by a similarity transform into a nonlinear ordinary differential equation similar to that obtained by Blasius but with a different set of boundary conditions. Solutions were obtained that indicated the presence of a standing vortex over the moving plate.

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## WIND ENERGY

Researcher: Midshipman 1/C G. W. Buck

Adviser: Professor Chih Wu

The objective of this project is to set up a wind-driven generator plant. The plant is a 6-volt heavy duty model 622 manufactured by Winco, Division of Dyna Technology, Inc. The plant includes a tower, a generator, a tail vane, a propeller, a governor, a brake drum, a propeller track, connecting generator wires to collector ring cover and a battery. Wire connections, lightning protection, installation check are complete and data is presently being taken and evaluated.

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## IMPACT OF CONCRETE RODS

Researcher: Midshipman 1/C Daryl L. Chen

Adviser: Professor Thomas W. Butler

In order to examine and understand one-dimensional wave propagation in rods, an apparatus was constructed in which a swinging weight impacts the end of a slender, supported-by-wires, concrete rod. Resistance strain gages sensed axial strains and the location of tensile impact failure (after wave reflection from opposite end) was determined as a function of weight being dropped and impact velocity.

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## CORROSION FATIGUE OF ANODIZED Al 7075-T73 MATERIAL

Researcher: Midshipman 1/C Alexander T. Funke

Adviser: Associate Professor Dennis F. Hasson

Several methods for anodizing the Al 7075-T73 material to enhance the corrosion fatigue resistance needed for carrier aircraft applications have been achieved. Different methods of anodization affect the material's fatigue strength differently. The effect of three of these methods on the fatigue strength properties were determined and then the fractures were examined using the scanning electron microscope.

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## TEMPERATURE VARIATIONS OF A NAHBE PRESSURE EXCHANGE CAP

Researcher: Midshipman 1/C Michael Long

Advisers: Associate Professor Dennis F. Hasson and Lieutenant  
Commander Charles C. Failla

It was proposed that a Briggs and Stratton engine, already modified with a titanium pressure exchange cap and secondary air carburetion, be used to determine the temperature gradients of the cap under various operating conditions. Heat sensitive temperature sticks (already on order), were used to obtain the temperature gradients. A three-dimensional plot comparing maximum pressure exchange cap temperature cap radius and exhaust gas temperature were the goal of this research.

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## DYNAMIC SIMULATION WITH REFRESH DISPLAY

Researcher: Midshipman 1/C Douglas L. Williams

Adviser: Professor J. Alan Adams

Basic computer programs were rewritten in FORTRAN for use on the DEC PDP-11/45, RT-11 systems and modified to obtain a dynamic refresh display of various mechanisms. The E&S Picture System was used for the output hardware. Experimental sub-routines were written to determine the most effective way to create mechanical simulation in real time. A 16-mm camera was available, and the type of interface which allows movies to be made directly from the screen, without flicker, was investigated. Mechanisms were chosen which will have potential instructional values for courses concerned with kinematics and dynamics.

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FAILLA, Charles C., Lieutenant Commander, USNR, co-author, "Parametric Variations of a Heat Balanced Engine," Engineering and Weapons Division Report EW-14-79, 1979.

Performance of a CFR engine over a wide range of experimental conditions is reported in detail for standard spark-ignition operation and for heat-balanced configurations. Operating conditions were mapped for primary combustion chamber and balancing chamber volumes giving nearly constant balancing ratios for three selected compression ratios; edge gap clearance was also varied. Three secondary air modes were investigated during optimization of performance giving more than a 30% increase in output over standard S.I. operation, an improvement in ISRC of 10% at best economy, 30% at best power with CO emission decreased to less than 0.1% and UHC to less than 100 ppm.

A new method of engine performance analysis, the Run Quality Index (RQI) is proposed to help evaluate the heat-balanced engine and compare it to other engines.

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GILLERLAIN, Joseph D. Jr., Associate Professor, "Vortex-Fin Interaction Flow Field Measurements," co-author, in Proceedings of the 4th U.S.-German Data Exchange Agreement meeting on Viscous and Interacting Flow Field Effects, held in Meersburg, 24-26 April 1979; published by The German Ministry of Defense in Forschungsbericht aus Der Wehrtechnik, BMVg-FBWT 79-31, Part II (1979),408-417.

Accurate prediction of the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces becomes more essential as high angle-of-attack maneuvering requirements increase. Detailed knowledge of the three-dimensional viscous flow field, as determined from wind tunnel experiments, is required in order to develop predictive methods based on the vortex-fin interaction. Tests were conducted in the U. S. Naval Academy Aerodynamics Laboratory subsonic wind tunnel using a pressure distribution model and a flow visualization model. Both consisted of a rectangular fin with cylindrical leading and trailing edges, and both were adjustable for angle-of-attack. The impinging vortex was generated upstream of the fin at the juncture of two adjacent airfoils set at equal but opposite angles-of-attack. The vortex velocity field was surveyed using a laser Doppler velocimeter. The flow visualization tests utilized the fluorescent mini-tuft technique. Surface pressure distribution data were obtained along with force balance data. Results from preliminary tests are presented, and future work is outlined.

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GRANGER, Robert A., Professor, "Dust Devil Simulation,"  
Engineering and Weapons Division Report EW-1-80.

An analysis is made of the special type of atmospheric vortex frequently encountered in Saudi Arabia. Starting with Lamb's equation and the energy equation, the potential temperature is expressed in terms of altitude and lapse rate, and the centerline vorticity distribution is expressed in terms of altitude and sink strength. After considerable transformations, a non-homogeneous second-order nonlinear partial differential equation is obtained subject to boundary conditions on the radial, circumferential and axial velocity components. Considering the special case of an adiabatic lapse rate, the governing equation is transformed by a similarity transformation into a form whereby a closed-form analytic solution is obtained. Comparison are made with other solutions in the literature.

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GRANGER, Robert A., Professor, "Boundary Layer Flow on a Moving Flat Plate," Engineering and Weapons Division Report EW-2-80.

The classical Prandtl boundary layer equation subject to the boundary conditions of Blasius, best modified such that  $u = U_w$  at  $y = 0$ , where  $U_w$  is the velocity of the moving wall, was examined. The equation was transformed by a similarity transform into a nonlinear ordinary differential similar to that obtained by Blasius but with a different set of boundary conditions. Solutions were obtained that indicated the pressure of a standing vortex over the moving plate.

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GRANGER, Robert A., Professor, "On the Divergence of SOR Applied to the Unsteady Transonic Problem," Engineering and Weapons Division Report EW-3-80.

Linearizing the nonlinear partial differential equations of unsteady transonic flow for application in aeroelastic analyses of thick elastic aircraft wings results in the Helmholtz equation. In examining the discretization of this differential equation, one can study the convergence properties. The discretized problem becomes

$$\bar{B}' = \bar{R}$$

where  $\bar{R}$  contains the boundary conditions. Applying a well-known theorem, the SOR converges if and only if  $B$  is position definite. One can show from the properties of the Helmholtz

equation conditions on the aerodynamic parameter when the above equation will not converge, and thus the dimensions of the grid can be uniquely determined. Hence, an upper bound on the reduced frequency of the oscillating wing can be found. Attempting to calculate aerodynamic unsteady forces above this upper limit will result in computer solutions diverging.

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HASSON, Dennis F., Associate Professor, "Materials Analysis for Selection of Alloys for the NAHBE Pressure Exchange Cap," Engineering and Weapons Division Report EW-3-79, May, 1979.

A materials selection analysis to determine suitable materials for the NAHBE pressure exchange cap was performed. The analysis consisted of a metallographic and scanning electron microscope fractographic investigation of cast and extruded aluminum material caps from design testing programs on an air-cooled engine, and a materials selection study of several metallic alloys and a ceramic coating. Cast aluminum or non-heat treatable 5000 series aluminum and titanium alloys in the form of plate were proposed for the cap material. Studies of welding of the 5000 series aluminum and titanium materials to cast aluminum, and fuel material compatibility with blended fuels were proposed.

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HASSON, Dennis F., Associate Professor, "Laboratory Determination of Hot Forming Limits for Ti-621/0.8Mo," co-author, Ship Materials Engineering Department Research and Development Report DTNSRDC/SME 79-30, October 1979.

Intergranular tensile fractures have been observed in the laboratory when tensile specimens were subjected to thermal cycling above the beta transus temperature and subsequently tested below the beta transus temperature. All testing was performed in a vacuum chamber. Suitable hot forming limits were determined from the results of these elevated temperature tensile tests.

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HASSON, Dennis F., Associate Professor, co-author, "Effect of Heat Input on the Heat-Affected Zone of Ti-6Al-2Cb-1Ta-0.8 Mo Weldments," Ship Materials Engineering Department Research and Development Report DTNSRDC/SME 78-103, January, 1980.

Ti-6Al-2Cb-1Ta-0.8 Mo titanium alloy weldments were fabricated to determine the effects of heat input on the mechanical properties of the heat-affected-zone. Three weldments were made, one utilizing only weld beads of 11.7 kilojoules per inch (0.46 megajoule per meter), a second utilizing only weld beads of 54.7 kilojoules per inch (2.15 megajoules per meter), and a third utilizing only weld beads of 126.0 kilojoules per inch (4.96 megajoules per meter). Welding of beta processed plate was shown to result in a solidified weld-bead which grows epitaxially from the base plate with no heat-affected-zone visible in the macrostructure. Bend specimens of the weld metal/base plate interface for all three heat inputs passed a 6T-180° bend test, and none of the tensile specimens failed at the weld metal/base plate interface. Variations of heat input showed no effect on either the compressive yield strength or the Rockwell-C hardness.

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JOYCE, James A., Assistant Professor, co-author, "Issues in Developing a Plane Strain  $J_I$ -Curve Test Procedure," in NUREG/CP-0010 Nuclear Regulatory Commission, Washington, D.C., January, 1980, pp. 270-292.

Currently, a working group of ASTM Committee E-24.08 is developing a test procedure for determining the plane strain  $J_I$ -Curve. A review of technical issues impacting this effort has been developed with emphasis on recent data which relates to these issues. The method of computation of  $J_I$ , measurement of crack-extension and influences of slip-mode and specimen constraint are discussed. The progress in test and analysis procedures for developing the complete R-curve is discussed. Requirements for additional experimentation, particularly in the areas of minimum  $J_I$  requirement and limits of allowable crack extension are identified.

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JOYCE, James A., Assistant Professor, co-author, "Computer Interactive  $J_{Ic}$  Testing of Navy Alloys," American Society for Testing and Materials, STP 668, 1979.

A computer interactive unloading compliance single-specimen  $J_{Ic}$  test procedure has been developed. This procedure utilizes an on-line minicomputer to analyze digitized load-displacement data during testing. Unique values of  $J_I$  and crack length are determined from compliance measurement on short unloadings along the load displacement record. The test procedure is presented in detail and analysis procedures are discussed.

Three tasks which demonstrate the validity and utility of the computer interactive test method are discussed. Results for single-specimen and multiple-specimen tests are presented for HY130, 10Ni steel, 17-4PH steel, Ti-7Al-2Cb-1Ta, and Ti-6Al-4V which show close correspondence between the two methods. Tests on 17-4PH steel compact tension specimens with various thicknesses and crack lengths are summarized and dimensional effects on  $J_{Ic}$  and the  $J$ - $R$  resistance curve slopes are discussed. Finally, tests on HY130 specimens with various notch root radii demonstrate effects of notch acuity on  $J_{Ic}$ .

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JOYCE, James A., Assistant Professor, "Application of the Key Curve Method to Determining  $J$ - $R$  Curves for A533B Steel," U.S. Nuclear Regulatory Commission, NRC FIN No. B7026, February 1980.

This report describes the experimental development of a key curve for compact specimens of A533B steel and the use of this experimental key curve to generate the  $J$ -Resistance curve directly from the load displacement records, without obtaining crack length estimates from unloading compliance, ultrasonics, electric potential or other techniques. In fact two complete key curve functions were developed, the first using subsized fatigue precracked specimens, the second using subsized but machine-notched specimens. In each case eight  $\frac{1}{2}$  T compact specimens with crack lengths from  $a/W = 0.5$  to  $0.9$  were used to generate a series of digital load displacement records which were assembled in a computer file as the key curve for geometrically similar compact specimens of this material for similar loading conditions if no crack extension were to take place. Deviations between the key curve function and the load displacement record for a particular specimen can then be attributed to crack extension and a calculation for the amount of crack extension can be made. The key curve also allows corrections to be made to  $J$  values to account for effects of this crack extension.

In this work J-Resistance curves (J-R curves) were obtained for HY compact specimens directly from load-displacement curves using the key curve formulation and compared with unloading compliance J-R curves obtained previously for the same specimens. Close agreement was found between the critical J values for crack initiation between the two methods. For each specimen the final crack length estimate obtained by the key curve method was found to agree well with the final value obtained by the unloading compliance result, but to fall short of a nine-point average measurement for those specimens in which large crack tunneling occurred.

The crack-growth correction to J determined by the key curve method agreed well with an approximate analysis for short cracked specimens but disagreed markedly for the deeper cracked specimens.

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DAWID, James A., Assistant Professor, co-author, "Investigation of Specimen Geometry Modifications to Determine the Conservative J-R Curve Tearing Modulus Using the HY-130 Steel System," American Society for Testing and Materials, STP 677, 1979.

The objective of this work was to investigate the effects of face-groove and crack-length variations of  $J_{1c}$  and the tearing modulus of HY-130 steel. Compact specimen geometries (1TCT) with crack-length ratios of 0.55, 0.65, and 0.8, and groove area of 12.5 percent and 25 percent total gross section reduction were tested using a computer interactive unloading compliance test technique. Results of these tests showed that for this material,  $J_{1c}$  was independent of specimen geometry for the range of geometries evaluated. The tearing modulus, however, was higher in surface grooved specimens, in which crack tunneling occurred, and the tearing modulus was found to increase by a factor of two as crack-length ratios increased from 0.55 to 0.8. In face-grooved specimens, the tearing modulus was found to be constant for the various crack-length ratios tested, at the lower end of values developed with nonface grooved specimens.

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DAWID, James A., Associate Professor, co-author, "Quasi-Equilibrium Fuel-Air Heat Balanced Cycle Analysis," Engineering and Research Division, Report EW-12-79.

The quasi-equilibrium thermodynamic model of the Naval Academy Heat Balanced Engine (NAHBE) has been modified to include the influence of fuel-air chemistry on predicted indicated engine performance. Heat addition to the Air Standard Heat Balanced

Cycle was expressed in terms of an appropriate fuel-air ratio and heating value for a standard fuel. Indicated parameters including mean-effective pressure, peak pressure, specific fuel consumption and thermal efficiency for compatible Otto and Heat Balanced cycles were calculated and compared. Performance parameters for both cycles were obtained at equal compression ratios, fuel-air ratios, fuel type, and engine rpm. Results show that for overall stoichiometric heat addition, the Heat Balanced cycle can produce greater indicated engine power, higher indicated thermal efficiency, and lower indicated specific fuel consumption than the corresponding Otto cycle. Further analysis indicates that the optimum heat balancing conditions occur for constant volume heat addition with rich mixture composition followed by constant pressure heat addition with lean composition.

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WU, Chih, Professor, "Teaching Energy Awareness by Computer Simulation," *Computers and Education, an International Journal*, 4 (April 1980), 213-224.

Energy awareness simulations are developed to demonstrate how rapidly our energy reserve is depleted, how quickly and enormously our demand for energy grows, and how important energy conservation is to us. The students find the computer simulation very interesting and innovative throughout. An understanding of the current and future limitations is therefore achieved. Further, this demonstration stimulates students' interest in the energy-conversion field.

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WU, Chih, Professor, "An Educational Passive Solar Energy Collector," *The International Association of Science and Technology for Development of Energy, Symposia, Montreal, Canada, May 28-30, 1980.*

A flat plate solar energy collector which uses air as the heat exchanging medium is designed to teach the basic components of air collectors in passive mode. The 3' x 4' x 4" collector wooden box includes glazing, insulation, collector-absorber plates, and fan. Two sheets of steel painted flat black are used as collector surfaces. The upper sheet is lapped and is mounted two inches above the lower plate. Two ports of 2" x 5" size, one at the bottom and one at the top, allow air to flow by either natural convection or forced draft provided by the fan at the bottom. The collector plate can be covered by a single pane or multi-pane of glass. Design consideration, performance and analysis of the collector are given in this paper.



Laboratory experiments include determining solar intensity at different times, different seasons and different weather conditions, determining solar energy transmitted through glazing materials, determining solar energy output, and determining solar collector efficiency.

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WU, Chih, Professor, "Energy Awareness Demonstration Device,"  
The International Journal of Mechanical Engineering Education,  
7 (July 1979), 127-129.

An energy-awareness demonstration device has been built to demonstrate how rapidly our energy reserve can be depleted, how quickly and enormously our demand for energy grows, and how important energy conservation is to us.

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## PRESENTATIONS

## MECHANICAL ENGINEERING DEPARTMENT

ADAMS, J. Alan, Professor, "Kinematics and Computer Graphics,"  
VFISU, Blacksburg, Virginia, 17 January 1980.

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ADAMS, J. Alan, Professor, "Kinematics and Computer Graphics,"  
University of Arkansas, Fayetteville, Arkansas, 22 January  
1980.

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ADAMS, J. Alan, Professor, "Kinematics and Computer Graphics,"  
University of Kansas, Lawrence, Kansas, 16 April 1980.

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FAILLA, Charles C., Lieutenant Commander, USNR, "Naval Academy  
Heat Balanced Engine Parametric Tests," U. S. Naval Academy,  
Annapolis, Maryland, 14 August 1980.

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FAILLA, Charles C., Lieutenant Commander, USNR, "Naval Academy  
Heat Balanced Engine Parametric Tests," ASME Chapter,  
Baltimore, Maryland, 22 April 1980.

\*\*\*\*\*

GILLERLAIN, Joseph D., Jr., Associate Professor, "Experiments  
on Vortex Impingement on Control Fins," 5th U.S.--German Data  
Exchange Agreement Meeting on Viscous and Interaction Flow  
Field Effects, U. S. Naval Academy, 16-18 April 1980.

\*\*\*\*\*

HIPSCH, Richard A., Associate Professor, "An Innovative Design  
Course for Marine and Ocean Engineering Students," ASME  
Meeting, Amherst, Massachusetts.

\*\*\*\*\*

JOYCE, James A., Assistant Professor, "Issues in Developing a  
Plane Strain  $J_1$ -Curve Test Procedure," CSNI Specialist  
Meeting on "Plastic Tearing Instability," Washington Univer-  
sity, St. Louis, Missouri, 25 - 27 September 1979.

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PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

JOYCE, James A., Assistant Professor, "Computer Data Acquisition Applications in the Materials Science Laboratory," 87th Annual Conference of American Society for Engineering Education, Louisiana State University, Baton Rouge, Louisiana, 25 - 28 June 1979.

\*\*\*\*\*

JOYCE, James A., Assistant Professor, "Key Curve Analysis of Ductile Shelf Fracture Toughness," Seventh Water Reactor Safety Research Information Meeting, Gaithersburg, Maryland, 5 November 1979.

\*\*\*\*\*

JOYCE, James A., Assistant Professor, "J Integral Elastic-Plastic Fracture Mechanics Technology in the U.S. Navy," at the Third International Conference on Mechanical Behavior of Materials, Cambridge, England, 20-24 August 1979.

\*\*\*\*\*

JOYCE, James A., Assistant Professor, "The Direct Evaluation of J Resistance Curves from Load Displacement Records," 12th National Symposium on Fracture, ASTM, Washington University, St. Louis, Missouri, June 1979.

\*\*\*\*\*

JOYCE, James A., Assistant Professor, "Effects of Specimen Geometry on the  $J_I$ -R Curve for ASTM A533B Steel," 12th National Symposium on Fracture, ASTM, Washington University, St. Louis, June 1979.

\*\*\*\*\*

BEAD, Kenneth F., Assistant Professor, DOE Program Manager Summary Presentation During the National OTEC Integration Meeting, 25 January 1979.

\*\*\*\*\*

BEAD, Kenneth F., Assistant Professor, "OTEC Power Systems Development Status Report," Technical Congress for the Investigation and Conservation of Energy Resources, San Juan, Puerto Rico, 7-9 November 1979.

\*\*\*\*\*

PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

READ, Kenneth F., Assistant Professor, "Power System Development Program Overview," 7th Ocean Energy Conference, Washington, D. C., 3 June 1980.

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## NAVAL SYSTEMS ENGINEERING DEPARTMENT

*Professor Peter F. Waggoners, Chairman*



Research in the Naval Systems Engineering Department plays a vital role in the professional enrichment of both midshipmen and faculty. During Academic Year 1979-1980, faculty members and midshipmen participated in numerous and varied projects in the fields of marine engineering, ocean engineering, and naval architecture.

A variety of projects were undertaken, both funded and unfunded. These include faculty research in the areas of ship-arrangement studies, ship-resistance studies, ship-mooring dynamic analysis, sea floor dynamics, large amplitude ship motions, oil-spill recovery systems, computer-aided ship design, sediment-transport measurements, neutron-activation studies, condenser studies, ocean thermal-energy conversion, environmental protection programs, and faculty sponsored midshipman projects in the areas of ship damage stability, wave forces and structural responses, wave-energy-conversion turbine studies, irregular wave tests of a destroyer model, and ship-motion studies.

Support for research was found in many sources, from departmental operating funds to contracts and grants from such diverse organizations as the Naval Academy Research Council, the Naval Sea Systems Command, the Naval Civil Engineering Laboratory, the U. S. Coast Guard, the David W. Taylor Naval Ship Research and Development Center, the Office of Naval Research, and the U.S. Army Coastal Engineering Research Center.

Research and design projects, as in the past, have continued to display the originality and variety typical of the Naval Systems Engineering Department faculty and undergraduate majors. The Department will continue to pursue an aggressive commitment for research for the midshipmen and faculty that provides the needed scholarly activity to maintain an outstanding undergraduate program. Many of the faculty members of the Department are internationally known for contributions in their respective fields.

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## SEA-FLOOR DYNAMICS

Researcher: Associate Professor Thomas H. Dawson

Sponsor: Office of Naval Research

The objective of this research is to determine the degree to which an elastic model can describe sea-floor response to overhead water surface waves. The work is continuing under ONR sponsorship and involves collaboration with personnel of the Coastal Studies Institute of Louisiana State University.

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## ELECTRICAL RESISTIVITY TECHNIQUES AS A MEANS FOR DETERMINING SEA-FLOOR ENGINEERING AND ACOUSTIC PARAMETERS

Researcher: Commander Ronald A. Erchul, USN

Sponsor: Office of Naval Research

The proposed research involves analytical and experimental studies using an electrical resistivity measuring technique to determine acoustic and engineering properties of marine sediments. Electrical resistivity, acoustic, and shear-resistance measurements will be made on sediment samples in the laboratory and numerical studies will be made in order to gain a better understanding of the mechanics involved and to develop in situ resistivity devices to better predict sediment and acoustic properties of marine sediments.

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## SEDIMENT TRANSPORT MEASURING DEVICES, A STATE-OF-THE-ART REVIEW

Researcher: Assistant Professor Ronald C. Gularte

Sponsor: U. S. Army Coastal Engineering Research Center

For verification and subsequent improvement of predictive sediment-transport models, actual measurements of sediment loads are highly desirable. With continually changing environmental boundary conditions, the magnitude, direction, and size-distribution of the material transported is continually changing. The prediction of sediment transport in the nearshore area will require the determination of the net amounts and predominant directions of material transported past selected points.

The objective of this work was to determine what methods of measuring sediment are available or are being developed, with particular emphasis on those systems capable of measuring the magnitude and direction of material transported (suspended and bedload) in the nearshore environment seaward of the breaker zone. The approach was first to search the literature to determine who was involved in the measurement of sediment transport. Those so identified were then sent questionnaires pertaining to their equipment. Additionally, those individuals whose systems appeared particularly attractive were contacted by phone for further information.

The advantages and disadvantages of those approaches, which included acoustic, optical, nuclear, and electrical techniques, which were believed suitable for possible further development, are discussed in some detail in the text. The results of the literature search, questionnaires and personal communication are presented in tabular form for those 49 approaches that were thought to be potentially useful in measuring sediment transport. The summary includes 12 acoustic, 20 optical, 6 nuclear and 2 electrical indirect approaches in addition to 9 direct techniques for measuring sediment transport.

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#### FEASIBILITY STUDY OF AN OIL SPILL RECOVERY SEPARATOR

Researcher: Assistant Professor William B. Huckenpoehler

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, and U. S. Coast Guard

The purpose of the study is to determine the technical, economic, and operational feasibility of an oil/water separator system to reduce the concentration of water in recovered oil at oil-spill sites. The separator must operate within certain constraints and must also interface with existing U.S.C.G. equipment. The study is structured to evaluate oil/water separation techniques/systems using a constraint matrix.

A literature search was conducted to accumulate data and various manufacturers were contacted and consulted. All data collected was evaluated against the constraint matrix and recommendations were presented dealing with various systems which were deemed to be feasible under certain conditions. The project is about 80% complete and awaits action by the Coast Guard on recommendations.

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## SHIP MOORING DYNAMIC ANALYSIS

Researchers: Professor Michael E. McCormick, Professor  
Rameswar Bhattacharyya, and Assistant Professor  
Sander M. Calisal

Sponsor: Naval Civil Engineering Laboratory

A computer program is developed at the U. S. Naval Academy for the Naval Civil Engineering Laboratory to estimate the size of moorings for ships at different configurations. A static and dynamic load and motion analysis is done in the spectral sense. Linearized theories are used. The program was tested for known ships so far and additional applications planned for new ship geometries. The assumptions used were presented at C.E.L. at the Ship Mooring Dynamics Symposium in January 1980.

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## CAS. AC ARRANGEMENT SUBSYSTEM INTERFACES

Researcher: Assistant Professor Bruce C. Nehrling

Sponsor: Naval Ship Engineering Center

The complexity and interdisciplinary nature of naval ship design mandates that the engineers involved in this process be fully aware of what has and is being done in terms of design decisions. In this context, it is sufficient to say that the efficient and reliable communication of technical decisions and information is critical to a successful design effort. This communication link can be highly strengthened by the judicious application of computer technology.

This report addresses how one group of engineers, namely those involved in ship compartmentation and arrangements, can benefit by using computer interfaces to communicate technical data to other engineering groups engaged in pre-contract design.

Methods for storing and passing technical information between arrangement, hull, combat systems, and machinery specialists are discussed. The type of information required to be transmitted during pre-contract design is also analyzed.

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ANALYSIS OF DYNAMIC RESPONSE OF SSN-688 CLASS SUBMARINE

Researcher: Associate Professor Martin E. Nelson

Sponsor: David W. Taylor Naval Ship Research & Development  
Center, Annapolis Laboratory

This report describes a dynamic model of the propulsion plant of an SSN-688 Class submarine. The model simulates the transient response of the primary and secondary systems of the SSN-688 power plant to the opening and closing of the throttle to the propulsion turbine.

The model has been constructed by representing the performance of critical components in the primary and secondary systems through unsteady-state heat and mass-transfer differential equations. The resulting system of equations has been solved by the use of a computer code, developed using well-known numerical techniques and SSN-688 design information. The details of the computer code are described in the report.

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LARGE AMPLITUDE SHIP MOTIONS

Researcher: Research Professor Nils Salvesen

Sponsor: Naval Sea Systems Command

The existing computational methods for predicting the sea-keeping performance characteristics of naval ships are all based on linear mathematical models. For severe sea conditions, these linearized approaches are inadequate for analyzing most of the important naval ship seakeeping problems. A new time-domain simulation method is being developed for predicting the large nonlinear responses of naval ships in severe sea conditions. A new nonlinear theory has been formulated and a computer program based on this theory is being developed. Results obtained by this new computer code will be compared with experimental results obtained in the Naval Academy towing tank.

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WAVE FORCE AND RESPONSE OF OFFSHORE STRUCTURES

Researcher: Midshipman 1/C Marc H. Rolfes

Adviser: Associate Professor Thomas H. Dawson

Sponsor: Trident Scholar Program

Wave forces and response of offshore structures were examined experimentally by subjecting an 18-foot-tall test-structure to wave action in the Naval Academy's 330-foot Towing Tank. Both regular and random waves of up to 2.5 feet in height were used to simulate representative design sea-states, which, for a scale-factor of 24, correspond to waves up to 60 feet striking a 430-foot structure.

Computer models were developed for comparison of measurements with presently accepted engineering methods for calculating the forces and structural responses.

Major accomplishments from the research are the following:

(1) For the first time, a reasonably realistic ocean structure has been tested in a controlled laboratory environment and measurements compared with predictions from presently accepted methods of engineering analysis.

(2) For regular (design-type) waves, a relatively wide range of hydrodynamic coefficients are allowed in current engineering practice. For the most part, this range is shown to be conservative. The theory and measurements also open up the possibility of further refinement of the coefficient selection, based on wave characteristics.

(3) For irregular waves, the currently accepted method of linearizing the governing equations for purposes of analysis was found reasonable. This was the first time that such a check was made on the theory using a structural model that allowed realistic representation of both drag- and inertia-force contributions.

(4) For the structural response, it was shown that the standard assumption of rigid structural joints is overly restrictive and that more work is needed on the analytical description of the joints.

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USER'S GUIDE FOR THE INTERACTIVE COMPUTING SYSTEM NAVARCH

Researcher: Assistant Professor Bruce C. Nehrling

NAVARCH is an interactive computing system intended for students studying naval architecture and marine engineering. It consists of three parts, a design executive (DEX), a set of database management routines, and a library of computational programs known as "modules". The design executive provokes decisions by requiring the user to select commands from a list of options known as a "menu". DEX also provides the user with a format-free input environment. If the user enters illegal input, DEX will interrupt the user with an appropriate error message and recover procedure. In addition, DEX provides easy access to sources of auxiliary information (EXPLAIN files) as well as editorial support for the database.

The database management routines provide for the transfer of data between system modules and the database. The information contained in the database represents computed results and/or input for subsequent modules. This information was developed and stored either directly by the user or indirectly by means of a previous module.

The third part of the NAVARCH system is a library of computational modules. All modules of the system library are written to standards specified by the system developers. In this way, each module confronts the user in a consistent manner. Therefore, the user will be able to gain progressive and meaningful experience as he or she works with the system.

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MODULE PROGRAMMER'S GUIDE TO THE INTERACTIVE COMPUTING SYSTEM  
NAVARCH

Researcher: Assistant Professor Bruce C. Nehrling

NAVARCH is an interactive computing system for students studying naval architecture and marine engineering. It consists of a design executive (DEX), a set of database management routines and a number of computational programs known as "modules".

This manual is intended to provide guidance to programmers preparing modules for the NAVARCH system. Programmers are required to adhere to the methods and styles postulated in this manual.

It is believed that this structure will provide an efficient flexibility to the programmer while still offering a consistent interface to system users. It is assumed that the module programmer has a prior working knowledge of Algol68, and it is an interactive programming. A novice NAVAPCII programmer will benefit by studying existing modules as well as by gaining some first-hand experience as a user of the NAVAPCII system.

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#### ABSTRACTED WATER EFFECTS ON A HEAVING CYLINDER

Keywords: Professor Michael E. McWhorter and Mr. John Hoyt

A heaving, vertical, circular cylinder was studied in the 12-foot towing tank to determine the effects of draft, length, wavelength, and wall position on the damping and added-mass. It was found that both the damping and added-mass have minimum values for certain combinations of the parameters studied. The minimum values mean that more than 50% of the wave energy in the tank can be converted into mechanical energy. This value exceeds the 50% theoretical limit in deep water.

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RESEARCH COURSE PROJECTS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

THE EFFECTS OF LONGITUDINAL GYRADIUS ON SHIP MOTIONS IN HEAD SEAS

Researcher: Midshipman 1/C Michael Ales and Joseph McGettigan

Advisor: Associate Professor Roger H. Compton

This was an experimental analysis of the effects of longitudinal wave distribution on the vertical plane motions of pitch, roll, and relative flow motion. Longitudinal gyradius was varied from 20 feet to 30 feet on a 5' model of USCG Cutter Itasca. The model was run at three discrete speeds into both regular and irregular head seas.

The experimental trends obtained were then compared to analytical strip theory predictions for the same hull obtained from the DENSPAC 31-17 digital computer program.

Conclusions were made and discussed.

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TRANSVERSE SHIP MOTION COMPUTATION

Researcher: Midshipman 1/C Jordan Cassell

Advisor: Assistant Professor Gander M. Calisal

The main objective of this project was to develop a computer program which will calculate the bending moment amidships for different hull geometries. Different hull geometries were input via the keyboard. The hull was balanced on a given wave profile and acceleration effects were taken into account.

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WAVE ANALYSIS OF AN EIGHT-ANGLED SHELL

Researcher: Midshipman 1/C Charles Everett

Advisor: Assistant Professor Gander M. Calisal

The project is centered about a hypothesis that a conventional shaped eight-angled shell deflects and generates a foil type effect. After testing the shell with conventional rigging, the shell was re-rigged with a "ferris" rigging and the results of acceleration data compared.

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RESEARCH COURSE PROJECTS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

INVESTIGATION OF THE BEHAVIOR OF A SUBMERGE FALL CONE DEVICE

Researcher: Midshipman 1/C Robert Hennegan

Adviser: Assistant Professor Ronald C. Gularte

A specially designed fall cone device has been tested submerged on kaolinite with varying water contents. Calibration curves have been obtained and will allow use of the device in the field. The results were compared with those obtained in air and buoyancy and added mass effects appear to be unimportant.

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LENS FOCUSING OF OCEAN WAVES

Researcher: Midshipman 1/C Robert Kastner

Adviser: Professor Michael E. McCormick

An experimental study of the focusing of water waves by a submerged lens-shaped structure was conducted in the Coastal Engineering Tank. Results of the study show that a circular arc lens will augment the wave height at a focal point up to 1.7 times. The augmentation depends on the wavelength, depth, and height of the lens. For a clearance above the lens of 25% of the wavelength, significant wave energy is transmitted with minor reflection. Thus this would be the design criterion in wave energy conversion.

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THE USE OF USNA WASTE TO SUPPLY ENERGY TO THE ACADEMY BOILER

Researchers: Midshipmen 1/C Mel Meinhardt, John Link, Alex Schawn, and Tracy Fisher

Adviser: Assistant Professor Clyde C. Richard

The U. S. Naval Academy produces tons per year of solid waste which is presently tracked to local landfill areas. The heat content of such waste is approximately 6000 BTU/lbm and if recovered could add a sizeable amount of energy to the Academy's boiler house.

A project was undertaken to study the feasibility of utilizing a fluidized bed combustor to burn this waste and produce steam at the Academy. This project was carried into the second semester as an EN-460 design project.

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#### UNDERWATER NUCLEAR POWER PLANT: ANALYSIS OF A CONCEPT

Researcher: Midshipman I/C Kevin C. Mulloy

Adviser: Associate Professor Martin E. Nelson

As the energy needs of the United States become more critical, and the continued supply of foreign sources becomes more uncertain, America is forced to look inward for solutions to her energy crises. During this period, substantial hope lies with nuclear power.

In the realm of nuclear power, greater restrictions and demands upon safety and sizing make it no longer prudent to rely solely on established ideas and concepts. The needs of the future demand an evaluation of new and different concepts and proposals for nuclear power plants. An underwater nuclear power plant is one such proposal.

This presentation will describe the underwater plant concept as follows: first, the concept will be discussed and explained. Then the advantages and disadvantages will be presented. Thirdly, the engineering considerations associated with making such a plant a reality will be discussed. Finally, the alternate uses of this energy proposal will be presented.

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#### DAMAGE STABILITY

Researcher: Midshipman I/C Joseph W. Osborne

Adviser: Professor Ramensar Bhattacharyya

A comparison of the importance of survivable fire power to fire damage stability and reserve buoyancy are examined at length in this report. The Naval Shipyard Institute conducted a study on the damage stability of a ship. The study was conducted in a laboratory setting. The study was conducted in a laboratory setting. The study was conducted in a laboratory setting.

The purpose of this project is to develop a realistic method of calculating the stability of a ship when damaged, even in a seaway. The second part of the project includes further calculation and develops criteria based on the calculations.

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#### IRREGULAR WAVE TESTS OF A DESTROYER MODEL

Researchers: Midshipman 1/C Mike Serafin and Steve Southard

Adviser: Professor Bruce Johnson

This project is a continuation of the cooperative model test program with the National Research Council of Canada. It involves the use of a Canadian built self-propelled model on loan from the Ottawa Towing Tank. The Canadians performed extensive seakeeping tests in regular waves on this model and the Naval Academy portion of the project is to perform the irregular wave tests and compare the results for identical model speeds. Some preliminary results were obtained last year, but tank and wavemaker problems combined with an underpowered propulsion system on the model left much work to be accomplished.

This project will involve the installation of a larger propulsion system, reballasting the model, and testing it in constant slope irregular waves at Froude Numbers of 0.2, 0.3, 0.4, and 0.5. The results will be compared with the regular wave tests. The instrumentation for slamming and deck-wetness measurement will then be installed, and the model will be run in various sea states at the same set of Froude Numbers. These results will again be compared to the previous data to determine the influence of significant wave height on measure response amplitude operators in pitch and heave.

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#### DETECTION OF LEAKS IN CONDENSER TUBES

Researchers: Midshipman 1/C Tom Sullivan and Alan Wellesley

Adviser: Assistant Professor Clyde C. Richard

The inability to rapidly determine the leaking tube in a large tube bundle costs the electric power industry millions of dollars each year. In an effort to reduce this problem, a



project was undertaken to determine the size of holes that result in a leak rate of .001 to .01 gpm in a condenser tube operating under vacuum.

An apparatus was constructed and various configurations of hole sizes and differential pressures were tested. The result was a family of curves showing leak rates as a function of hole size and differential pressure.

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#### WAVE ENERGY CONVERSION TURBINE STUDY

Researchers: Midshipman 1/C Bryon Trop and Thomas Casey

Advisor: Professor Michael E. McCormick

The Wave Energy Conversion Turbine to be used in the Sea of Japan was modeled and studied. The quarter-scale model was tested in the 10-foot towing tank to determine the power produced at regular and irregular seas. Also studied was the wave-focusing ability of the system in the neighborhood of the cavity resonance frequency. The device acts as an antenna by radiating waves which interact with the incident waves and focus wave energy on the body; thus, enhancing the wave energy conversion of the system.

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#### WAVE DATA ANALYSIS

Researcher: Midshipman 1/C Paul Zohorsky

Advisor: Professor Michael E. McCormick

Forty-two tapes containing wave data, wave-power-conversion data, ship motion data and mooring data have been received from the Fukuoka wave energy conversion study. This study is being conducted in the Sea of Japan by the International Energy Agency. The tapes are to be analyzed using USNA computer facilities by spectral methods. This involves writing programs to couple the data and computers, analyze the data, and provide graphic displays. Results of this effort will allow comparisons of the various energy conversion turbine efficiencies to be made, and to assess the full scale potential of pneumatic wave energy conversion.

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BHATTACHARYYA, Rameswar, "Ship Mooring Dynamics," Ship Mooring Dynamics Symposium Proceedings, California, 1980.

The usefulness of the strip theory approach, especially for longitudinal motions and associated predictions, has surpassed the imagination of many theorists and engineers. Predictions for the transverse motions and the associated predictions, however, are not as good because of the difficulty in determining the motion coefficients of the lateral motions.

The present paper enumerates the inherent assumptions in the present theory and attempts to establish how far the transverse motions can be estimated, if not improved, by determining the coefficients more accurately after incorporating the appendage as well as hull circulation effects.

\*\*\*\*\*

CALISAL, Sander M., Assistant Professor, "Wave Resistance Computation by Numerical Far Field Wave Survey Data," DTNSRDC Report, 1980.

Experimental wave survey methods give a wave spectrum which provides an insight into the calculations of wave resistance. As the experimental wave spectrum is relatively easy to obtain, a numerical wave-survey method appears to offer a better comparison of experimental and numerical calculations. The present program can be extended to a higher-order study.

\*\*\*\*\*

CALISAL, Sander M., Assistant Professor, "An Attempt to Detect the Importance of Turbulent Boundary Layer in Ship Wave Resistance," U. S. Naval Academy Report EW-4-79, June 1979.

The Reynolds number of a ship model is increased artificially by using a flat plate leading the model. The turbulence level of the flat plate boundary layer is also altered. A decrease in the calculated wave resistance and measured residual resistance is observed within the Froude number range  $2 < Fr < 4$ . The results indicate a viscous wave interaction which can be formulated in terms of the visco-elastic properties of turbulent flow. A possible formulation using this procedure is also indicated.

\*\*\*\*\*

CALISAL, Sander M., Assistant Professor, "Some Experimental Results with Ship Model Acceleration Waves," U. S. Naval Academy Report EW-4-80, February 1980.

The wave resistance of a ship moving at a constant speed can be calculated using information obtained from its wave pattern. One of the basic assumptions in wave survey methods is the existence of a time-independent model speed.

In towing tanks initial acceleration is unavoidable. Wehausen (1964) showed that the effect of initial acceleration on wave resistance has a decaying and oscillating character. Calisal (1977) gave the general form of the initial acceleration potential and showed the existence of a two-dimensional wave of the form:

$$\zeta_T = \frac{A}{cT} \sin (\frac{1}{2} k_0 (x-cT) + \phi(t)) + O(cT)^{-2}.$$

To study the validity of the theoretical results some experiments were performed. The variation of the measured spectra and the frequencies within the recorded total resistance pitching moment are of interest. Results indicate that models should travel a distance proportional to the square of the Froude number before wave-data collection can be begun, that the predicted encounter frequency exists in the recorded total resistance and pitching moment signals, and that special effort is required to avoid initial acceleration waves due to wall effects.

\*\*\*\*\*

DAWSON, Thomas H., Associate Professor, Co-author, "Determination of Elastic Shear Modulus of Marine Sediments from Wave Theory and Field Measurements," Offshore Technology Conference Proceedings, Houston, 1980.

A method is described for determining the elastic shear modulus of marine sediments from field measurements of wave-induced bottom acceleration and water pressure. The procedure relies on results from a wave theory that assumes a linearly-elastic sea-floor response. The method is thus limited to wave-induced pressures which are sufficiently small to allow this simple idealization. Specific application is made to field data taken in the Mississippi Delta region during winter storm conditions where wave heights ranging up to about 6 feet were observed, corresponding to wave-induced bottom pressures ranging up to about 40 lb/ft<sup>2</sup>. Results show that the assumption of a linear-

elastic sea-floor response is reasonable for these pressure levels and that the elastic shear modulus is approximately 50 kips/ft<sup>2</sup>.

\*\*\*\*\*

SHAWNS, Peter F., Professor, co-author, "Equipment Designs for Neutron Capture Gamma Experiments with <sup>252</sup>Cf," Neutron Capture Gamma-Ray Spectroscopy, New York: Plenum Publishing Corporation, 1979, 696-608.

Several laboratory assemblies for research with neutron capture gamma rays have been built with from a few to 3000 micro Ci of <sup>252</sup>Cf with the gamma detector, e.g., Ge(Li), only far enough away to limit neutron damage.

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PRESENTATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

ERCHUL, Ronald A., Commander, USN, "Innovative Design for Marine and Ocean Engineering Senior Students," ASEE Annual Conference, Amherst, Massachusetts, June 1980.

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ERCHUL, Ronald A., Commander, USN, "Navy's Underwater Tower Inspection," Marine Technology Exposition and International Conference, New Orleans, Louisiana, 10-12 October 1979.

\*\*\*\*\*

GULARTE, Ronald C., Assistant Professor, co-author, "Scouring of Cohesive Material as a Rate Process," ASCE Civil Engineering in the Ocean IV, San Francisco, California, 10-12 September 1979.

\*\*\*\*\*

GULARTE, Ronald C., Assistant Professor, co-author, "Rheological Methods for Predicting Cohesive Erosion," Marine Technology Exposition & International Conference, New Orleans, 10-12 October 1979.

\*\*\*\*\*

JOHNSON, Bruce, Professor, Karel MONTOR, Associate Professor (Applied Science), and Douglas L. AFDAHL (Computer Center), "Instrumentation for Brain Wave Signal Processing," 5th International Conference on Medical & Biological Engineering, Jerusalem, Israel, 20 August 1979.

\*\*\*\*\*

NEHRLING, Bruce C., Assistant Professor, "Measuring the Impact of Alternative Ship Arrangements," NAVSEA Workshop on General Arrangement Evaluation Criteria, Washington, D.C., 22-23 January 1980.

\*\*\*\*\*

RICHARD, Clyde C., Assistant Professor, co-author, "The Design and Analysis of a Vertical Axis Ocean Current Power Plant," International Conference on Alternate Energy Sources, Miami, Florida, December 1979.

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PRESENTATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

RICHARD, Clyde C., Assistant Professor, Richard A. HIRSCH, Associate Professor (Mechanical Engineering) and Ronald A. ERCHUL, Commander, USN, "Innovative Design for Marine and Ocean Engineering Senior Students," ASEE Conference, Amherst, Massachusetts, July 1980.

\*\*\*\*\*

RICHARD, Clyde C., Assistant Professor, and Richard I. LATHAM, Associate Professor, "The Classroom Design of a COGAS Plant by Naval Systems Engineering Students," Annual International Gas Turbine Conference, New Orleans, March 1980.

\*\*\*\*\*

RICHARD, Clyde C., Assistant Professor and Bruce H. RANKIN, Professor, "A One Semester Design Course for Marine and Ocean Engineering Students," ASME Winter Annual Meeting, New York City, December 1979.

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## WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

*Professor Charles F. Olsen, Chairman*



The Weapons and Systems Engineering Department provides and maintains an environment in which research activities contributing to the professional growth of the faculty and outstanding midshipmen flourish. Such research, in addition to keeping both faculty and midshipmen abreast of today's rapidly advancing technology, ultimately improves the academic environment by providing examples of, and solutions to, existing problems. Where research is based on problems posed by the U. S. Navy, the association causes the academic environment to be more relevant to the professional development of midshipmen.

Faculty research is regularly undertaken by nearly all civilian members of the Weapons and Systems Engineering Department and on occasion by some military members as well. Funding for research activities is available from several sources, including grants or contracts from various federal agencies as well as funding support from within the Naval Academy. Current contracts have been made by faculty members with both the Naval Surface Weapons Center, the Naval Air Development Center and the Naval Research Laboratory. Excellent faculty and midshipmen research relations have additionally been established with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory.

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## RESOURCE SHARING FOR MICROCOMPUTERS

Researcher: Assistant Professor C. George Proskur

Sponsor: Naval Academy Research Council

Several microcomputer systems are available for use in the Department. These systems are available to users with a wide variety of facilities for application in many diverse project areas. It is not economically feasible to provide mass storage and sophisticated peripherals for each single system. Conversely, to allow the systems to be used easily by the novice, there must be access to mass storage for program development and for access to the existing library of utility software routines.

The solution is to connect the simple systems in a common communications network with a master system, the latter having the required mass storage, sophisticated peripherals and sophisticated operating system software. The overall design philosophy has been established for the project: to connect the master system to several communications nodes via serial asynchronous interfaces; and to establish at each node a parallel communications bus interconnecting several simple systems.

At present, and for the early portion of the next fiscal year, attention will be focused on the communications bus at the node. The hardware must be developed for the parallel bus; the communications protocol must be established for the system; and the means of monitoring and controlling bus traffic must be formulated. Three midshipmen have registered to work on these problems for ES495, in Fall 1980.

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## LASER-TRIGGERED SWITCH FOR VEDA

Researcher: Major Jerry R. Bettis, USAF

Sponsor: Naval Research Laboratory, Washington, D.C.

A high current, relativistic electron accelerator, designed and constructed at NRL several years ago has been modified to permit command output switching. As originally designed, the generator pulse forming network had an unbalanced water blumron with the output switching provided by a self-clearing water switch with a laser triggered gas switch. The switch assembly not only provides a command triggered output capability but also results in significant improvements in the output waveform.



Substantial improvement in the voltage fluctuation during the constant portion of the output waveform and in the shot-to-shot reproducibility of the output voltage were necessitated by the requirements of the free electron laser experimentation.

Switching was accomplished by a Q-switched ruby laser-pulse introduced into the spark gap along a radius. Portions of the beam were diverted by partial reflection along two additional radial paths, from the center outward, in order to provide up to three simultaneous switch channels. The radial introduction provides a fail-safe, single channel irradiation along the opposite radius regardless of optical component alignment. Simultaneous discharge of all channels will result in a reduction of switch inductance which will reduce output voltage risetime by as much as 2/3. The designed command triggering jitter of less than 5 nsec has been achieved by single channel discharge.

Successful operation of the switch will improve output waveform and allow simultaneous initiation of separate, high-voltage, high-peak power events.

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#### APPLICATION OF MICROPROCESSORS TO CONTROL SYSTEMS

Researchers: Assistant Professor Robert DeMoyer, Jr. and  
Associate Professor E. Eugene Mitchell

Sponsor: Naval Academy Research Council

While control system compensation has been implemented by analog components in the past, recent developments in digital control have yielded superior controllers. Extremely flexible control is attainable by use of a state observer/state variable feedback controller. It is the objective of this work to investigate and develop related control algorithms, to perform parametric design studies, and to implement the controllers with inexpensive microcomputers.

Controller design has been reduced to the computation of two z-transfer functions. Discrete simulations have shown control accuracy as a function of internal microprocessor word-lengths and sample-time.

Ongoing parametric studies are expanding to various implementations and to higher order plants. Microprocessor implementation will follow.

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CPR PROPELLER PITCH SCHEDULING-CONTROL ASPECTS

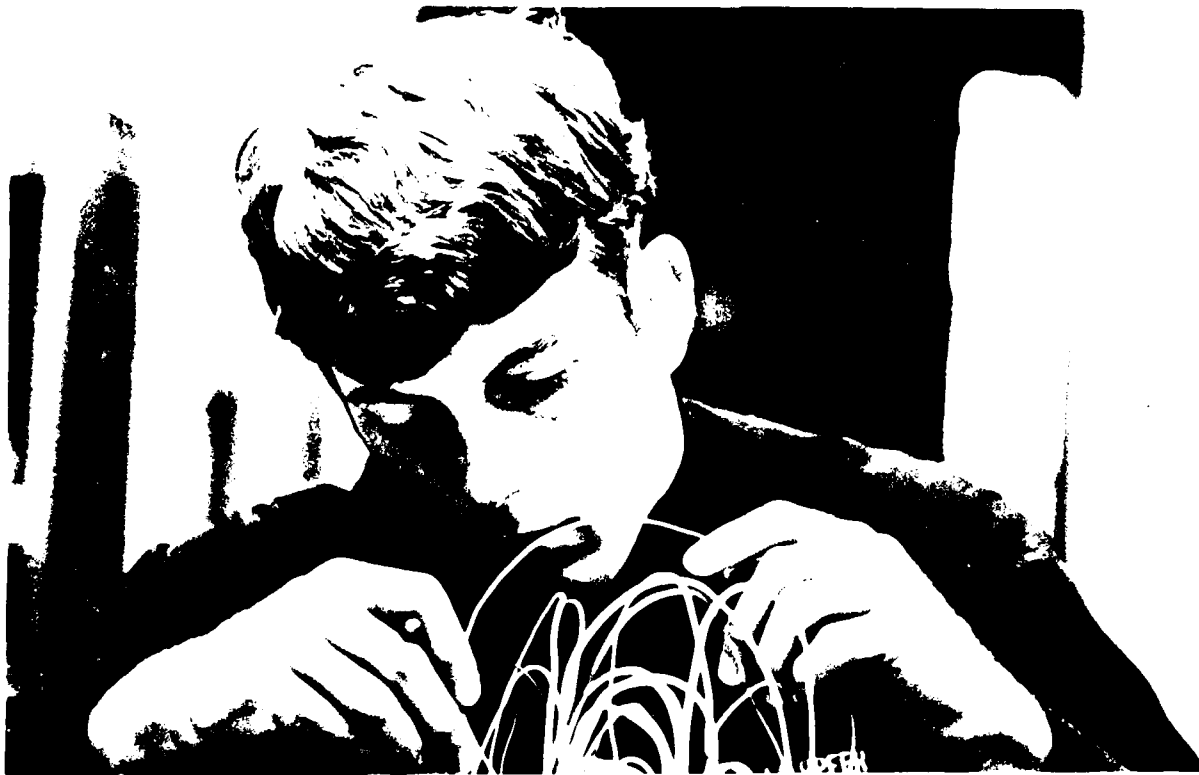
Researcher: Assistant Professor Jerry W. Watts

Sponsor: David W. Taylor Naval Ship Research and Development  
Center, Annapolis Laboratory

The Annapolis Laboratory of DTNSRDC is involved in a project to improve fuel economy on DD-963 class ships. The pitch of the gas-turbine-driven CRP propeller is reduced when operating in the trail shaft mode to give better fuel economy. Prior to sea trials, an analysis of the control system was presented by this researcher in a memorandum dated 31 July 1979. Sea trials have been conducted on two different DD-963 class destroyers with positive results; fuel saving by pitch scheduling looks probable.

This summer a request for proposal will be written by this author and T. L. Bowen for control development and retrofit of economy pitch scheduling to existing, DD-963 class ships.

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## MICROPROCESSOR SIMULATION OF A TIME DELAY

Researcher: Midshipman 1/C Jon C. Kubo

Adviser: Associate Professor E. Eugene Mitchell

The occurrence of a pure time-delay or a transportation lag arises in many practical systems. A time-delay is a linear phenomena; in the time domain it produces terms of the form  $x(t-T_d)$ , which are transcendental terms in the frequency domain.

There exist very few analytical methods for the analysis of systems with time-delays, and these are generally unmanageable for complex, high-order problems. If the time-delay is itself a variable, the methods fail. Consequently, the common tactic is to study the problem through simulation.

In the past, considerable effort was invested in the approximation and simulation of time-delays. The better methods used a tape recorder with variable speed tape and a tape loop. In most cases, the hardware problems were so complex as to require implementation of the simplest mathematical approximation.

The introduction of the hybrid computer provided a ready means of simulating time delays and is widely used in this task. A time-delay simulation is an integral part of many hybrid hardware packages.

The purpose of this study was to implement a time-delay in the form of a microprocessor. There are several advantages to using a microprocessor, but the primary motivation is that of creating an inexpensive means of accomplishing a task which is normally possible without a hybrid computer environment.

It was assumed that the student would wish to have a means of simulating a time delay, one which would be able to handle a variable time delay, and which would be able to handle a variable time delay, and which would be able to handle a variable time delay. For the problem of a variable time delay, the time delay would have to be implemented by a computer.

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## MICROPROCESSOR-BASED DIGITAL CONTROLLER

Commander: Midshipman LCD Steven E. Mizell

Advisor: Associate Professor B. Eugene Mitchell

The basic theory of digital control has been in existence for some time; however, the application has been severely limited. Primarily this is because a digital computer in a relatively expensive phase of development to use as a control element in small applications.

The advent of the microprocessor has begun to revitalize the field area of digital control. Currently, the hardware exists to develop an advanced digital-controller scheme on a microprocessor for under a thousand dollars.

However, there are three basic difficulties with the application of microprocessors to digital control systems, and the three are interrelated. First, there is very little useful software in existence. Second, the microprocessor is relatively slow in execution speeds, and as to be really useful, the programs must be written in machine language. Since machine language is quite machine-dependent, software is not very portable. Finally, the question of accuracy is not sufficiently understood.

If a microprocessor is programmed and used in the same manner as a large computer, then it will perform much as the large machine does, except for speed of computation. But a primary question is the one of the lower limit, i.e. how far can one reduce the quality and quantity, and of course cost, and still achieve an acceptable or useful control effort? The purpose of this study was to answer some of these questions.

The problem of concern in the paper was to design a digital controller which operated in the error channel of a feedback control loop. Functioning in the same manner as a series compensator would function. The controller was to work with 8-bit numbers, 7-bit magnitude plus sign. Under this scheme the total range of usable numbers lie between -127, and only integers are used.

The conclusion reached was that an 8-bit controller will work. The output tends to dither around the least significant bit, that is 0.08 volts. This is far from a high accuracy controller, but would certainly suffice in many non-critical applications. At current prices the controller could be implemented with off-the-shelf components for approximately four hundred dollars.

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THE DESIGN AND CONSTRUCTION OF A HYBRID COMPUTER INTERFACE

Instructor: Midshipman LCD Paul L. Zelder

Advisor: Associate Professor Kenneth A. Fowler

An interface was developed and built to help solve the flight control problem. The completed interface used the two low-trim lines of the MiniAC which were available via a standard connection to the rear of the machine. Eight of these channels were used for the control of the machine, and four were used for digital-to-analog conversion. The MiniAC connection for an analog interface was used for mode control. Digitally, the interface was connected to the I/O ports of the IBM 360 computer system via a parallel digital board. Some speed was sacrificed, but the interface was able to work with virtually all standard digital computers.

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DESIGN AND CONSTRUCTION OF A DIGITALLY-CONTROLLED MECHANICAL MANIPULATOR

Instructor: Midshipman LCD Daniel A. Tanner

Advisor: Associate Professor Kenneth A. Fowler

The present study was a cooperative work between a mechanical engineer and a computer scientist. The objective was to design and construct a mechanically-operated manipulator which could be controlled by a digital computer. The design of the manipulator was based on the principle of a parallel-link mechanism. The digital computer was used to generate the control signals for the manipulator. The digital computer was also used to generate the control signals for the manipulator. The digital computer was also used to generate the control signals for the manipulator.

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SUMMARY OF RESEARCH ACTIVITIES, ACADEMIC DEPARTMENTS, 1979-1980--ETC(11)

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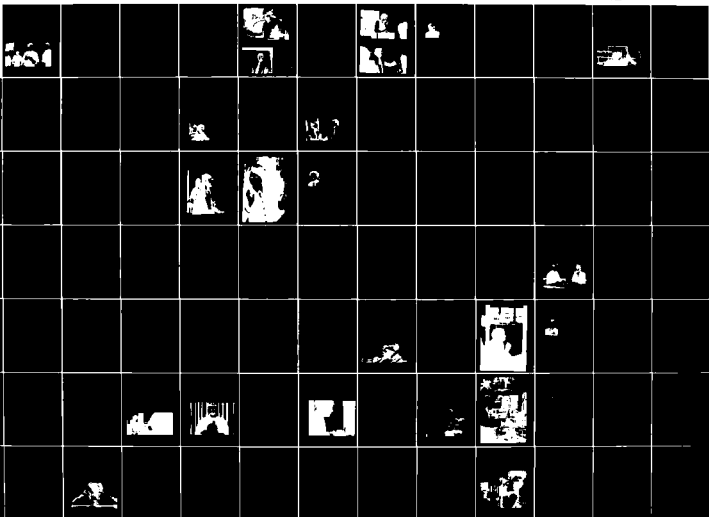
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effect on the economy (which itself could be hypothetically varied) could be observed in macroeconomic terms (such as Gross National Product, rate of inflation, the unemployment rate, and so forth). This effect must then be included with the other benefits and costs of pollution abatement as benefit cost analysis is used to optimize the pollution abatement policy. Other benefits of pollution control include improved health (lowered medical bills), increased equipment and material life, higher property values, and many other intangibles. New jobs may be created by the new pollution control industry, and there will be other macroeconomic benefits. The cost of the pollution-abatement equipment is felt directly by the manufacturer and the automobile owner who must now buy and use pollution emission controls. Additionally, the manufacturer's customers will pay a higher price for his goods when he pays for pollution-abatement equipment (depending upon price elasticity); some of his employees may be laid off as a result; and other macroeconomic strains may occur.

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BETTIS, Jerry R., Major, USAF, et al., "Refractive-Index Dependence of Pulsed-Laser-Induced Damage." Journal of Optics Letters, 4 (August 1979), 256-258.

A parametric study of the threshold for pulsed-laser-induced damage with refractive index for surfaces and thin films of several transparent optical materials is reported. An empirical analysis of the experimental results obtained using 1.06  $\mu\text{m}$  radiation in 40-nsec pulses, together with other published data, yields, to first order, a  $1/(n^2-1)$  dependence for the threshold optical electric field. The proposed scaling law describes quite well the variation of damage threshold for optical surfaces ranging in refractive index from 1.38 to 2.49. Similar agreement is noted for homogeneous thin films deposited on a fused silica substrate; however, deviations are noted for inhomogeneous films.

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BETTIS, Jerry R. Major, USAF, et al., "Low Jitter, Low Inductance Solid Dielectric Switches." Review of Scientific Instrumentation, 50 (November 1979), 1487-1489.

It has been shown that the use of graded solid dielectric sandwiches in laser-triggered spark gaps (LTS) can lead to highly desirable multi-channel operations while maintaining the low delay and jitter performance characteristics of LTS. As many as ten separate breakdown channels were observed when small circular or hexagonal aluminum inserts were inserted between two Mylar dielectric sheets stressed at 4.1 kV/mil. A reduction in rise time was noted for these multichannel switching events.

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BETTIS, Jerry R. Major, USAF, et al., "Low Power Laser Trigger Switching of a Solid Insulated Spark Gap." Review of Scientific Instrumentation, 50 (November 1979), 1486-1487.

The feasibility of reliably triggering solid dielectric insulated spark gaps by low power ( $\sim 6$  MW) lasers has been demonstrated. Breakdown of 10-mil Lexan dielectric sheets stressed to 70 kV was initiated by a focused 6 MW, Nd in YAG laser emitting 40 mJ in a pulse 6 ns wide at the half-peak intensity height. Delays achieved were in the tens of ns. Slight increases in laser power or electrical stress should produce shorter delays ( $< 10$  ns) and subnanosecond jitter.

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KNOWLES, Kenneth A., Associate Professor, "Trident Towed Buoy Simulation Algorithm (u)." Confidential report to U. S. Navy.

This report contains a detailed description of a simulation of TRIDENT Towed Buoy depth, cable tension and scope during reel out, reel in, and deployed operation. The fidelity of this simulation is sufficient for purposes of Ship Control Station operator training on the TRIDENT Device 21010.

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KNOWLES, Kenneth A., Associate Professor, "Algorithm to Simulate the Operation of a Shipboard Cavitation Indicator Display (u)." Confidential Report to U. S. Navy, 9 November 1979.

The Ship Control Operator Trainer, located at the TRIDENT Training Facility, Bangor, Washington, is to incorporate a cavitation indicator display. The purpose of this document is to describe an algorithm for minicomputer implementation which will determine in real time the status of the various displays on the cavitation indicator display unit. These indications will be used in conjunction with other simulation modules which will provide the necessary ship's environmental parameters. It is further assumed that the logical variables which are generated by this algorithm will be used to set or reset appropriate latches, which will, in turn, control the status of the various displays on the cavitation indicator unit.

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OLSEN, Charles F., Professor, Abstract of "Compensator Design Using the Frequency Domain Approach," Simulation, May 1979, written and published in ZENTRALBLATT FUR MATHEMATIK at the request of Professor Doctor Bernd Wegner, Editor-in-Chief.

The original abstract appeared in Summary of Research Activities, 1978-1979, p. 100.

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PRESENTATIONS

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

BETTIS, Jerry R., Major, USAF, "Laser-Triggered Switch Modification to VEBA." Pulse Power Conference, Orlando, Florida, 3 June 1980.

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BROCKUS, C. George, Assistant Professor, "Magnitude and Time-Scaling for State-Space Description of Systems." ASEE 88th Annual Conference Amherst, Massachusetts, 24 June 1980.

\*\*\*\*\*

KNOWLES, Kenneth A., Associate Professor, "Pushy Parents, Professional Apathy and Positive Approaches to the Education of Gifted Students." 26th Annual Convention National Association for Gifted Children, Baltimore, October 1979.

\*\*\*\*\*

MITCHELL, E. Eugene, Associate Professor, Robert DEMOYER, Jr., Assistant Professor, and C. George BROCKUS, Assistant Professor, "A Course in Microcomputers for Control Applications." Session 2221, ASEE 88th Annual Conference, Amherst, Massachusetts, 24 June 1980.

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MITCHELL, E. Eugene, Associate Professor and Robert DEMOYER, Jr. Assistant Professor. "Study of the Discrete Controller Problem With Application to the Single Board Microprocessors." ASME Annual Conference, Chicago, Winter 1979.

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Brian Peace Pact



DIVISION OF  
ENGLISH AND HISTORY



## ENGLISH DEPARTMENT

*Associate Professor Fred M. Fetrow, Chairman*



For faculty members of the English Department, Academic Year 1979-1980 was a most active and productive time for literary research and scholarly publication. Three sponsored projects, with support from the Naval Academy Research Council, were underway: a study of play and game structure inherent in much recent American fiction; analysis of the prose style of E. M. Forster; and completion of an annotated bibliography of writings in a journal devoted to the work of James Joyce. Two faculty members on sabbatical leave were engaged in research, one investigating the University of Virginia Writer-in-Residence Program, and the other preparing a bibliographical study of writings by and about the nineteenth-century Maryland author John Pendleton Kennedy. Independent (non-funded) research, with 15 projects in progress, included critical and biographical studies of classical, British, and American writers.

Two books by members of the English faculty were published: a study of Aaron Burr and the American literary imagination, and a volume of poems. One article appeared in a collected volume of critical essays, and 14 articles were published in literary journals. Eight faculty members made 11 presentations at meetings of professional organizations.

Research, critical investigation, and creative writing by members of the English faculty enhance the quality and vitality of instruction in the classroom as well as the scholarly reputations of those involved and the Naval Academy they represent.

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MISCHIEVOUS GAMES: PLAYFUL ARTISTRY IN CONTEMPORARY  
AMERICAN FICTION

Researcher: Assistant Professor Neil Berman

Sponsor: Naval Academy Research Council

This project will attempt to evaluate the play and game structures inherent in so much recent American fiction. Although definitions of "play" are as varied as the writers on the subject, several characteristics are almost universally accepted. These include joy, freedom, and creativity. As a tool of literary criticism, play theory will take account of "play" and "game" as among the largest metaphors of human experience. Most play theorists therefore also see that dualisms such as play/seriousness, play/work, play/reality are naive and must be collapsed to fully understand that experience.

The play-element in recent American fiction embraces a number of very different kinds of stories. Some writers, like Thomas Berger and John Barth, adopt a narrative point of view which establishes a game between writer (and his persona) and reader. Others, like Jerzy Kosinski and Don DeLillo, embed into their novels a wide variety of play-forms, such as sports, rituals, simulations, and both explicit and implicit games. A ludic criticism of contemporary fiction is badly needed to help elucidate some of our most problematic fictions and to expand the parameters of literary criticism. Using the resources of play theory, which include the psychology, anthropology, and philosophy of play and games, this project will attempt to differentiate and clarify the game structures inherent in the narrative strategies of much recent American fiction.

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JAMES JOYCE QUARTERLY: AN ANNOTATED BIBLIOGRAPHY

Researcher: Lieutenant Commander John Harty, USNR

Sponsor: Naval Academy Research Council

The purpose of this project is to create an annotated bibliography of Dr. Thomas Staley's periodical James Joyce Quarterly (published in Tulsa, Oklahoma) which contains criticism and other material on James Joyce and his works. The Quarterly has been issued four times a year since its inception in 1963. No such annotated bibliography exists at this time. Last year a similar project on A Wake Newslitter, a newsletter devoted to the study of Joyce's Finnegans Wake was completed. The researcher is attempting to get both projects published in one volume.

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## THE UNIVERSITY OF VIRGINIA WRITER-IN-RESIDENCE PROGRAM

Researcher: Associate Professor Philip K. Jason

Sponsor: Sabbatical Leave

This investigation focuses on the relationships between the host institution and the guest writers with the aim of discovering the advantages to each of the writer-in-residence arrangement. Attention is given to the obligations undertaken by the writers and to the degree of support, financial and otherwise, provided by the university. The University of Virginia program, which was financed by a bequest from Emily Balch, funded two semester-long visits by William Faulkner (spring 1957 and spring 1958); a visit by Katherine Anne Porter during the fall 1958 term; a two-month residency by Stephen Spender during the spring of 1962; and a three-week visit by John Dos Passos in February 1963. Though none of these writers had teaching responsibilities, each gave public lectures, visited classes, and met with student groups. The full-term residencies allowed the writers to give most of their attention to their own work, thereby serving as subsidies for literary achievement. The program faded when writers began to be hired as regular faculty members (Peter Taylor was so hired in 1967). This latter situation coincided with the growth of creative writing as an academic subject.

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## THE PROSE STYLE OF E. M. FORSTER

Researcher: Assistant Professor Molly B. Tinsley

Sponsor: Naval Academy Research Council

The researcher has felt it necessary to redefine the parameters of this project, expanding them to include Forster's non-fiction as well as his novels. The study thus is able to offer a more solid account of those stylistic characteristics (such as antithesis, positive negation) which are constants to the Forsterian voice as well as to show variations in that voice according to the different demands of his subject matter.

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THREE STUDIES IN AMERICAN LITERATURE

Researcher: Associate Professor David O. Tomlinson

Sponsor: Sabbatical Leave

A semester's sabbatical leave in the fall of 1979 allowed substantial progress on three academic projects:

(a) A survey on the teaching of American literature in colleges and universities was completed. The data were analyzed using programs of the Statistical Package for the Social Sciences (SPSS); and a report utilizing this computer analysis was presented at the annual meeting of the South Atlantic Modern Language Association in Atlanta, Georgia on November 2, 1979.

(b) An edition of Sidney Lanier's Tiger-Lilies was prepared. The book written in 1867, shows a blending of romantic and local color writing and therefore preserves a rather valuable record of the changes being introduced into American fiction after the Civil War.

(c) A survey of the writing by and about John Pendleton Kennedy, a nineteenth century Baltimore writer and politician and a Secretary of the Navy, led to a rather lengthy article, "John Pendleton Kennedy: An Essay in Bibliography."

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THE HARVEST DEATH OF THE ANCIENT CORN-SPIRIT AS REFLECTED IN  
BURNS' "JOHN BARLEYCORN" AND KEATS' "TO AUTUMN"

Researcher: Associate Professor John P. Boatman

Most researchers have ignored the reflection of an ancient harvest ritual that ceremoniously celebrates the annual killing of the corn (or grain) spirit in the autumnal activities of reaping or threshing or pressing grapes, activities and folklore described by Sir James Frazer in his monumental Golden Bough, Chapter XLVII ("Lityerses"). The present researcher has merely pointed out that the basic images of Burns' poem "John Barleycorn" and Keats' "To Autumn" (Stanza 2) very closely reflect images of the folk tradition of this ancient harvest death. In both poems the death is a sacrifice for mankind: in Burns' poem the outcome is whiskey that warms the cockles of man's convivial heart; in Keats' poem the sleepy or sleeping autumnal workers symbolize, not a mere abstraction for Autumn, but the very "spirit" of the season--the corn-spirit--all of whose life has been drained out in the activities of harvest until sleep (an old common symbol for death) falls upon them all, a sacrifice for man's annual benefit through the death of the hidden benefactor, the spirit of the season.

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THE FAERIE QUEENE: SPENSER'S QUEST FOR POETIC TRUTH

Researcher: Assistant Professor Mallory Young Clifford

Spenser introduced every book of The Faerie Queene with an explicit defense of poetry. Many of his proems are devoted entirely to self-justification. In addition, the epic is traditionally accompanied by an external apology, the letter to Raleigh. Truth, Spenser claims, is a matter of morality--and allegory is the means for presenting moral truth. Few readers, however, are convinced by the Spenserian statement of moral truth; and a close look at the numerous and contradictory points in his argument reveals that Spenser himself was equally troubled. His epic finally reveals the limits of the moral justification and indicates a much more profound understanding of the ambivalence of story, reality, and truth itself.

The problematic of Spenserian storytelling proves to be the danger of the loss of innocence--the bite of the Beast, as Serena and Timias learn, is an internal and not an external ailment. The storyteller, like his knights, must face the dilemma of innocence and action, virtue and knowledge. The telling of the story, like all great human deeds, is mediated in the Christian world by sin. There is always sin--and danger--in the knowledge of good and evil. It is this ambivalence that The Faerie Queene reflects and attempts to mediate.

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## THE PHAEACIANS: PLEASURE, POETRY, AND TRAGIC CHOICE

Researcher: Assistant Professor Mallory Young Clifford

The decision of the Phaeacians to convey Odysseus to his home in Ithaca is one of the most problematical events in the Odyssey. The Phaeacians are well aware of the conflict between Poseidon and Odysseus: their guest has revealed it in his own story. They also know the dangerous consequences of aiding and abetting this wanderer. Numerous explanations have been offered to justify their action--forgetfulness, hospitality, even cowardice. But a better answer may appear in a consideration of the Phaeacians' own position and culture.

The Phaeacians live in a world of unflinching abundance, free from effort and toil. Their play-oriented culture represents the height of civilization. They live the life of the gods, separated from all men. Their view of story-telling corresponds: the bard Demodocus provides them with pleasure. But the Phaeacians are not gods; they are mortal. Odysseus' story forces them to a recognition of their own humanity. No one can stand disinterested between gods and men; the Phaeacians enter the struggle on the side of man, choosing their own mortality--much as had Odysseus himself on the island of Calypso. The Odyssey reveals that men are not gods--and that poetry is not solely an instrument of pleasure.

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## YET DOES HE MARVEL: THE POETRY OF ROBERT HAYDEN

Researcher: Associate Professor Fred M. Fetrow

This project will culminate in a monograph-length study of the works of Robert Hayden, an important contemporary American poet. Prefaced with an initial chapter which chronologically summarizes Hayden's biography and career, the ensuing study concentrates on the poetry through sustained critical analysis of Hayden's major themes and techniques. As a Depression era ghetto-dweller whose youthful work was first published in 1931, Robert Hayden developed a distinctive poetic voice as he gradually gained in prominence until his importance was recognized in 1976, as he became the first black poet appointed to serve as the Consultant in Poetry at the Library of Congress. Hayden's career was characterized by his consistent commitment to his art; while he frequently wrote on themes of black history in expressing the hopes and frustrations of his race, he adamantly insisted upon being judged by the universal standards of artistic achievement. His work thus subsumed, yet transcended the "black experience", as he addressed the human condition rather than a

racial situation. He pursued the truths to be found beneath superficial or mundane realities, and he constantly sought new themes and untried poetic techniques in that pursuit. Because of the timelessness of his thematic concerns and his intriguing innovations in poetic style, Hayden's work has a permanence of challenge to readers and scholars. Both groups have now begun to give Hayden the attention he has long deserved, and this study will be the first full-length critical treatment of his canon.

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PILATE'S BELLY AND THE NARRATIVE STRUCTURE OF SONG OF SOLOMON

Researcher: Associate Professor Fred M. Fetrow

As one of the central characters in Toni Morrison's Song of Solomon (1977), Pilate is as intriguing as the narrative structure of the novel. Pilate's lack of navel initially makes her seem rather strange, mysterious and somehow frightening. The narrator refers frequently to how smooth Pilate's belly is, almost as if that smoothness itself is mysterious. People in the novel are mystified by Pilate's smoothness of belly, but as they and we learn more about her, we can see that her "fine difference" is a good, not a bad difference. In retrospect, the entire novel can be viewed and better understood in terms of a narrative texture of mysterious smoothness. While the evocative appeal of the novel derives partially from Morrison's use of sensuous detail (color and tactile imagery and motifs), the narrative structure, which is initially confusing because the reader discerns connections among characters and events only gradually, can therefore also be apprehended as a texture we must come to understand. As Morrison brings together the narrative strands of the novel to form a beautifully woven tapestry, we more fully realize and appreciate its "smoothness" of texture. In a sense, the texture of Pilate's belly serves as a metaphor for the entire novel: initially mysterious, but when fully understood, both thematically enlightening and esthetically gratifying.

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## HERMAN MELVILLE'S FIRST SIGHTING OF NANTUCKET ISLAND

Researcher: Professor Wilson L. Heflin

It has generally been assumed that Herman Melville first saw Nantucket Island during a visit there with his father-in-law Chief Justice Lemuel Shaw in 1852, a year after the publication of Moby-Dick. An entry in a midshipman's journal reveals, however, that Melville, as an enlisted man in the U. S. Navy, must have seen the island from the sea on 3 November 1844, when his ship, the frigate United States, was returning from the Pacific Ocean to Boston. The remainder of this study is concerned with the influence of Nantucket on Moby-Dick and Melville's relationships with Nantucketers during the two and one-quarter years that he was a whalerman in the South Seas.

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AARON BURR (1716-1757)

Researcher: Assistant Professor Charles J. Nolan, Jr.

Father of an infamous son, son-in-law of the celebrated Jonathan Edwards, the Reverend Aaron Burr achieved prominence in his own right as both minister and civil leader. As might be expected, his literary works reflect his dual function. A Sermon Preached at the Ordination of . . . David Bostwick, for example, typifies the standard three-part structure and the common spiritual concerns of the Puritan sermon, whereas A Discourse Delivered at New-Ark has a public theme. Preached before the synod of New York, The Watchman's Answer, another sermon, depicts the Puritan minister's function of reading the hand of God in all visible things; The Supreme Deity . . . Maintained, on the other hand, an elaborate refutation of Emlyn's Inquiry, represents a classic example of the kind of theological debate so prevalent in the eighteenth century. In A Servant of God Dismissed, the funeral sermon for Governor Belcher and the minister's final work, Burr again reflects both spiritual and public concerns.

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## ANNUAL BIBLIOGRAPHY OF ENGLISH LANGUAGE AND LITERATURE

Researcher: Assistant Professor Charles J. Nolan, Jr.

Contributions to the Annual Bibliography come from a careful review of the many issues of fourteen journals ranging from Anthropological Linguistics to the International Philosophical Quarterly. The contributor examines and notes any article, edition, book, or thesis, published in any language, that has an important link to English or American language or literature and any ancillary work that bears significantly on those fields. Using a specialized format, he then prepares bibliography cards for such items and forwards them to the American editor, who in turn sends the American contribution to Leeds, England, where the Annual Bibliography is published. The result each year is one of the two major bibliographies in English studies.

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## HEMINGWAY: THE WRITER AS RESEARCHER

Researcher: Assistant Professor Charles J. Nolan, Jr.

When Hemingway published A Farewell to Arms in 1929, he asked Scribner's to downplay the autobiographical element. Early reviewers and later critics, however, insisted upon making the connection between Frederic Henry's experience and Hemingway's life. Now Michael Reynolds has shown that Hemingway drew as much from books as he did from life. Reynolds suggests that Hemingway used a variety of sources; he also ferrets out biographical material that informed Farewell and provides other valuable information as well. Reviewers have had mixed reaction to Reynolds' work, all praising him for his diligent research but some raising questions about his critical judgments and omissions. The present writer agrees with Jeffrey Meyers that "Reynolds' scholarship is superior to his criticism" and provides full support for that judgment, while still recognizing Reynolds' research as a needed corrective to past Hemingway scholarship.

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## A SOURCE FOR THOMAS CAREW'S "EPILOGUE TO A PLAY PRESENTED BEFORE THE KING AND QUEENE"

Researcher: Assistant Professor Michael P. Parker

Rhodes Dunlap, Carew's most recent editor, remarks that the "Epilogue to a Play" echoes "the Platonic doctrine of the alteration of opposites developed in the Phaedo." The immediate source for the theory of pleasure expounded in the piece, however, is the opening dialogue of Giordano Bruno's Spaccio de la bestia trionfante. While the epilogue has long been ascribed to Carew on stylistic grounds, the indebtedness to Bruno strengthens the attribution, since Carew made extensive use of the Spaccio in his masque Coelum Britannicum, first performed in February 1634. More noteworthy than the mere fact of the borrowing is Carew's careful editing of his source to suit the tastes of his royal audience. Bruno's frank references to sexual pleasure are deleted, perhaps in deference to the supersensual theories of love espoused by Henrietta Maria and the Caroline court. The borrowing from Bruno in the "Epilogue to a Play" testifies to the range of Carew's intellectual interests, as well as to his ability to employ the fruits of his philosophical reading in a courtly, predominantly lyric, poetic mode.

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"TO MY FRIEND G. N. FROM WREST": CAREW'S SECULAR MASQUE

Researcher: Assistant Professor Michael P. Parker

Despite current interest in the English country-house poem, Thomas Carew's major contribution to the genre, "To G.N. From Wrest," has largely been ignored. This neglect is unfortunate because Carew's poem represents the crucial middle term between Johnson's initial essays in the English country-house poem and Marvell's transformation of the genre in the 1640's and 1650's. Due to a scholarly blunder in the early twentieth century, critics have been unaware of the lively cultural and literary activities that focused on Wrest Park, seat of Henry de Grey, the eighth Earl of Kent, in the 1620's and '30's: John Selden, Samuel Butler, Samuel Cooper, Sir John Suckling, and Thomas Carew were all intimates of the family. The identification of Henry de Grey as proprietor of the estate illumines many of the iconographic and historical details of the poem whose significance has eluded earlier researchers. Carew celebrates the de Grey family through the use of a structure and techniques borrowed from the court masque; oblique criticisms of the king's Scottish Campaign of 1639 suggest that the poet has abandoned the court to pursue his aesthetic ideals in a narrower, more practicable sphere.

"To G. N. from Wrest" culminates Carew's poetic career, tying together the themes that govern his hundred-odd lyrics. More importantly, the piece marks the end of the Caroline period in poetry and anticipates the concerns of Interregnum writers.

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#### A THEORY OF NARRATIVE VOICE

Researcher: Assistant Professor Stephen M. Ross

The term "voice" as applied to works of literature has become an important concept in recent American and English criticism" (so writes Professor Gregory Polletta, in *Issues in Contemporary Literary Criticism*). Originally employed as little more than a variant for terms such as "style" or "tone", "voice" has come to be treated as a literary concept in its own right. The term has been used, however, so inconsistently that no precise definition has heretofore been possible. Voice seems to offer a conceptual bridge between contemporary critical concerns with their increased emphasis on abstract analysis, and more traditional concerns with biography, literary history, and the interpretation of works.

The first step in this project has been completed: the researcher has circulated a long article defining the varied uses of voices in the history of criticism. The second, and larger, step will be to complete refinement of his own theory of narrative voice.

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THE EMPTY LOCUS OF DESIRE: WOMAN AS FAMILIAL CENTER IN  
MODERN AMERICAN FICTION

Researcher: Assistant Professor Stephen M. Ross, Co-Researcher

In an article on the "family novel," Robert Boyers suggests that the power of the family is redemptive; to celebrate life is to celebrate the family. Modern American fiction, however, has not generally been so sanguine about the family, either in its reality or its ideal potential. The traditional redemptive promise of the family, usually embodied as the mother/wife or as some more abstract symbol of feminine innocence, has not been kept. Where once the holy female--the "True Woman" of 19th-century domestic handbooks, the bloodless heroine of popular fiction, the plausibly sturdy moral advisor in Howells--devoted her life to redeeming her man, today that feminine family center is empty. To affirm the family is no longer, in fiction to celebrate life.

In an article submitted for publication in March, the researchers explore various versions of the American family and the female "centers" of those families. Works included are by Faulkner, Heller, Sherwood Anderson, and various contemporary American woman writers.

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## A TENDENCY TO CLIMB

Researcher: Assistant Professor Molly B. Tinsley

A Tendency to Climb is the tentative title of a novel completed this year. Told in the first person, it is a linear narrative concerning the journey of a young woman, Anna Ryder, back to the town where, at the age of five, she lost her parents when a small airplane crashed into their house. As might be expected, she learns about herself and the world along the way.

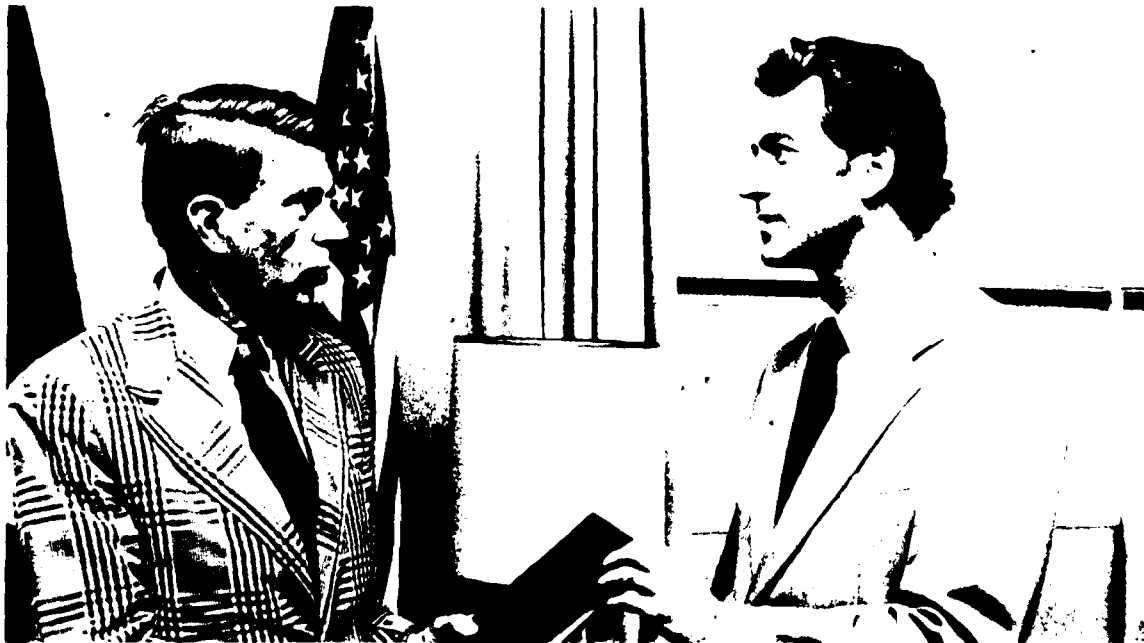
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A FREUDIAN PSYCHOLOGICAL STUDY OF FORD MADOX FORD'S THE GOOD SOLDIER

Researcher: Assistant Professor John Wooten

Critics of Ford Madox Ford's novel The Good Soldier can be divided into two main groups: one group accepts the first-person narrator of the novel as a basically reliable reporter of the events described in the novel; the other group finds the narrator to be a highly unreliable witness to the novel's tragic action. The narrator, John Dowell, is seen by the first group as Ford's trustworthy surrogate; the second group believes that Dowell is the main object of Ford's fiercely ironic attack on Western Civilization just before World War I. The best way to resolve these conflicting views, and it is a way that Ford's text encourages, is to use Freudian psychological theory of human behavior. The psychological complexity of Ford's characterization of Dowell demands a thorough study that can, once and for all, lay to rest the myth of Dowell's reliability. No critic has employed this approach sufficiently well, and, as a result, a convincing interpretation remains to be made. Freud's views on desire and guilt as those things impinge on the problems of civilization in general help to explain both the narrator's erratic behavior and the larger cultural significance of the novel's complicated action.

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BOATMAN, John P., Associate Professor, "After Elea: Burns' 'John Anderson My Jo, John' and Milton's Lost Paradise," Caledonia, 2 (Spring 1980), 17-20.

This article attempts to point out Burns' indebtedness to the details of Milton's Paradise Lost, Book XII, by noting parallels between the two poems in the situation of Burns' and Milton's chief characters as they leave the Garden of Eden on a hill to descend to the plain below, noting common imagery and phraseology heretofore unnoted by critics.

An attempt is made, also, to note the influence of Milton's style and tone upon the poem by Burns that differs so much from Burns' other poetry in its calm, controlled, and balanced simplicity of tone and statement.

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BOATMAN, John P., Associate Professor, "A Burns Bookshelf," Caledonia, 1 (Fall 1979), 3-4.

This article gives a brief, annotated list of five books on Burns' life; criticism and evaluation of his poetry; and an analysis of the three-volume edition of Burns' poetry. The intent is to direct readers toward a critical first study of Burns' poems.

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BOATMAN, John P., Associate Professor, "Burns' 'Hallowe'en' and the Ancient Rituals of Fertility," Caledonia, 1 (Winter 1979-80), 15-19.

An attempt is made to trace the ancient European and Mediterranean backgrounds of the folk customs cited by Burns in his poem "Hallowe'en." The essay alludes to the concept of the ancient ritual death of the tanist king, the concept of tragic sacrifice of the lovers of the ancient queen of love and death for the good of the community, the concept of ritual resurrection of a savior, the concern of ancient people for life in the face of death--as described in Frazer's Golden Bough, Jessie L. Weston's From Ritual to Romance, Robert Graves' The White Goddess, classical drama, and other sources.

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FETROW, Fred M., Associate Professor, "Chapman's Stoic Hero in The Revenge of Bussy D'Ambois," Studies in English Literature, 19 (Spring 1979), 229-237.

The standard interpretation of George Chapman's The Revenge of Bussy D'Ambois (1613) continues to sustain modern critical response. Modern critics, bound to the notion that Chapman's tragic hero is as self-sufficient as he is stoical, generally conclude that the play is didactically effective, "poetically successful but dramatically disappointing," largely because they discern no inner conflict in Clermont. However, re-examination of Clermont's characterization indicates that Chapman deliberately and carefully exhibits a tragic hero who continually struggles to accommodate belief and behavior. Thus Chapman does present a viable tragic hero, but Clermont comes to life not so much through his repeated demonstration of stoic principles, as in behavior which is contrary to his philosophy. So those critics of The Revenge who claim that Chapman sacrifices tragic effect for didacticism are simply mistaken, and the defenders of Chapman's dramatic skills are right, but for the wrong reasons.

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FETROW, Fred M., Associate Professor, "'Middle Passage': Robert Hayden's Anti-Epic," College Language Association Journal, 22 (June 1979), 304-318.

Robert Hayden's "Middle Passage" is especially intriguing for its resistance to generic classification. Hayden himself remained rather ambivalent on this point. While his original plan for the poem seems explicit, he claimed a sort of mystic vision as the source of his ultimate format. However, another oblique authorial reference suggests an epic intention. And when one approaches the poem as a miniature epic, both generic mode and heightened meaning emerge. Hayden includes and yet inverts most of the traditional epic conventions and devices. This technique of ironic inversion extends the moral implications of the ostensible subject, slave trade during the late seventeenth and early eighteenth centuries. More importantly, the technique embodies an epic structure which allows the poet to ennoble an epic "anti-hero" and to speak in a mythic voice in the creation of a folk epic which glorifies the real subjects of the poem, the Black victims of "Middle Passage" in their struggle for personal and spiritual freedom then and since. (This article resulted from NARC funding.)

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PETROW, Fred M., Associate Professor, "Robert Hayden's 'The Rag Man' and the Metaphysics of the Mundane," Research Studies, 47 (September 1979), 188-190.

Robert Hayden's brief poem, "The Rag Man," which appears in his recently published American Journal (1978), is a prime example of this poet's ability to recreate a common event as an occasion for posing complex psychological and moral questions. Through the device of guilt-inducing projection, Hayden gives the beggarly rag picker attributes which make him seem physically and morally superior to the speaker-narrator of the poem. Because the reader identifies with the speaker's response and values, the poem subtly forces us to ponder our own attitudes and priorities. Ultimately, the rag man is not so much the subject of the poem as the catalyst for the reported incident, an event which the poet uses to heighten self-awareness and to provoke moral reassessment. Thus with deceptive simplicity of narrative, Robert Hayden evokes a vicarious sharing of the social and moral implications of "The Rag Man."

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PETROW, Fred M., Associate Professor, "The Function of Geography in The Power and the Glory," Descant, 23 (Spring 1979), 40-48.

Modern critics frequently cite Graham Greene's The Power and the Glory (1940) as the work which marks that author's growth as a novelist, and some scholars treat in detail those aspects of the novel which evidence the artistry of Greene's early effort, as well as the seriousness of his intent. None of these aspects is more clearly the work of an accomplished artist than the technique with which Greene makes his geographical setting so diversely and organically functional. He merges the physical setting and geographic landscape with the characterization, thematic motifs, allegorical implications, and indeed, with the very ideology of the novel. Through symbolic use of climate (meteorological conditions) and a hitherto unnoticed manipulation of the compass directions, Graham Greene creates the psychological and spiritual atmosphere of the book, and consequently extends the allegory of God's pursuit of man into the reader's mind.

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HEBLIN, Wilson L., Professor, "Researching in New Bedford, Circa 1947," *Melville Society EXTRACTS*, 42 (May 1980), 1-4.

This is a retrospective article about the problems, pleasures, and rewards of seeking, in New Bedford, Massachusetts, more than thirty years ago, the facts of Herman Melville's whaling career. It considers the researching at this time of Jay Leyda, Leon Howard, Harrison Hayford, and the author. In contrast to the well-kept and thoroughly indexed documents in New Bedford repositories at the present time, many official papers were then in disordered and dusty piles. Special attention is given to the important, resourceful work of Pierce D. Brown of Fairhaven, a WPA field-worker in the 1930's. When officials of the New Bedford Custom House were planning to dispose of many old whaling records, Mr. Brown had them transferred to the New Bedford Free Public Library. Among these records are many important papers that are relevant to Melville's first whaling voyage in the ship Acushnet of Fairhaven.

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BILL, John M., Assistant Professor, "Pepper's Contextualism and the Reader's Values," *Paunch*, 53-54 (1980), 122-134.

Stephen C. Pepper offers a powerful aesthetic in contextualism. As a world hypothesis (a fundamental orientation toward phenomena that emphasizes the on-going event, vivid in its context) contextualism is fairly new and most closely allied to organicism, least allied to formalism and to mechanism. But as an aesthetic orientation it does not help the reader sort through literature or art for particular values. Vividness is unquantifiable; but more importantly what it portends may well vary from reader to reader. Unlike adherents to other aesthetic orientations, a contextualist necessarily imports values into his criticism, even while remaining a pure contextualist. This is because the competing aesthetic orientations offer familiar values on their face, as it were (such as organic integration and wholeness, for example). And the strands or events they organize into particular wholes do not portend anything beyond themselves. Only contextualism has an aesthetically rooted concern for revelation and meaning in events--which makes it an especially powerful aesthetic for literary art.

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JASON, Philip K., Associate Professor, Thawing Out, Washington, D.C.: Dryad Press, 1979.

This book contains twenty-four poems ranging from strict verse forms (such as terza rima) to free verse. Many of the poems appeared first in such periodicals as Commonweal, Greenfield Review, Hampden-Sydney Poetry Review, Kansas Quarterly, Poet and Critic, and West Coast Poetry Review.

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JASON, Philip K., Associate Professor, "Modern Versions of the Villanelle," College Literature, 7 (Spring 1980), 136-45.

The formal characteristics of the villanelle provide a range of opportunities that modern poets have exploited in various ways. The essential features--a narrow rhyme range and the patterned repetition of two refrains--demand a strategy that releases the power residing in the interplay of constant and variable elements. Schemes of classification, progression, and polarity have been handled effectively in this structure. Other formal features include a three-part structure that overrides the six stanzas of the villanelle and that exaggerates the natural positional emphasis of short stanzaic poems. A dominant theme in modern villanelles is that of obsession: the formula of repetition is manipulated to the end of reproducing or dramatizing a monomaniacal vision. Typical villanelle variations include punctuation shifts in the repeating lines that alter syntax and meaning, and small-scale verbal substitutions that relax the strict rules of the form without losing its essential expressive trains. The attraction of the villanelle form suggests that its pattern corresponds to basic experiential patterns of thought, emotion, and action.

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JASON, Philip K., Associate Professor, "The Writer in the University After World War II: Overview of Controversy," JGE: The Journal of General Education, 31 (Spring 1979), 45-64.

A survey of opinions published during the period 1947-1976 reveals a wide range of attitudes about the relationship between the creative writer and the university. As more and more writers made the university either their place of employment or the benevolent sponsor of their writing careers, controversy developed over whether or not this growing alliance was advantageous to the parties concerned. Some observers felt that the writer's independence would suffer. They feared an institutionalization

of the world of letters from which a timid, insular, and conformist "academic" writing would result. Others argued that the presence of exemplars of the creative process would open new channels of knowledge that universities had not promoted in the past. Still others felt that the writer was a "natural" educator, and that his practice and experience could be of great benefit to the essential university task of maintaining and enhancing a literate society. Further dialogues arose over the ideal format for the writer-university relationship. How should it be structured so as to maximize benefits and minimize risks? In spite of the controversy, the alliance has continued to gain strength and to modify itself according to the perceived needs of the institutions and the writers.

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NOLAN, Charles J., Jr., Assistant Professor, "Going Back to School," JGE: The Journal of General Education, 31 (1979), 129-40.

This article traces the author's progress from initial decision to return to graduate school at age 31 to securing the Ph.D. and a job. The long foreground of decision-making and preparation for the return are set in the context of both national and personal history; one complicated the other. All the usual hurdles are discussed--course work, candidacy examination, comprehensives, dissertation, job-hunting--but always there is an attempt to make the idiosyncratic representative. The article speaks to those contemplating a similar return to school in these difficult times and to those who teach in or direct graduate programs.

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NOLAN, Charles J., Jr., Assistant Professor, Aaron Burr and the American Literary Imagination. Westport, Conn.: Greenwood Press, 1980.

American writers have used the figure of Aaron Burr to express several of society's deepest fears. Though Burr was a complex personality, the popular conception of him as the cold-hearted murderer of Hamilton or as the detestable conspirator who tried to destroy the Union prevails. Such a view becomes commonplace after Burr's political enemies attack him as a Catiline, Cain, and sexual predator. Influenced by these perjorative images, American dramatists often repeat them in their works and add depictions of their own. But as the distance from the historical events in which Burr figured increases, the dramatic treatment of him becomes more positive. Overall, three



images predominate--those of traitor, predator, and victim--the first two in the nineteenth century, the last in our time. Like the playwrights, American novelists and short story writers present a mixed picture of Burr. Here are the same three principal images of him along with equally appropriate analogues for them--those of Catiline, Lovelace, and Warwick. And once more the way in which Burr is portrayed shifts with time.

The Aaron Burr emerging from our literature, then is a complex figure whom American authors employ for reasons not immediately apparent. In choosing to highlight the three major aspects of him that they did, they seem to use him as a vehicle to express society's fears and therefore in some way to purge them. Thus in a nineteenth-century world that is apprehensive about both the dismemberment of the Union and the ruination of its women, the views our writers naturally emphasize are those of conspirator-traitor and predator. And in a twentieth-century society that feel threatened by the various forces that act to crush the individual, it is perhaps not unexpected that our authors also turn to the portrayal of Burr as victim. By choosing to focus upon these particular roles and by selecting for them the appropriate analogues of Catiline, Lovelace, and Warwick, they raise Burr to the level of an American symbol. Thus he comes to represent aspects of American life that are profoundly disturbing--touches, that is upon our most terrifying nightmares of societal chaos, of phallic plundering of our women, and of helpless victimization.

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NOLAN, Charles J., Jr., Assistant Professor, "Lewis' 'Objective Room': Key to Aesthetics," The Bulletin of the New York C. S. Lewis Society, 10 (1979), 5-6.

One of the more important thematic passages in That Hideous Strength is the five-page discussion of Frost's "Objective Room." Aside from its general significance, the section also provides a key to understanding Lewis' sense of the beautiful. Perhaps the most fundamental of the author's aesthetic beliefs is that man has an innate predilection for beauty. Other elements of Lewis' credo of beauty emerge by implication: the beautiful possesses total congruity, is pleasantly colorful, and conveys emotional warmth; it involves an exact sense of symmetry and proportion and exhibits careful regularity; it demands balance and a correspondence between subject matter and manner of realization; and it is linked inextricably with morality. For Lewis, all that the word "normal" implies is the beautiful.

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NOLAN, Charles J., Jr., Assistant Professor, "Structural Sophistication in 'The Complaint unto Pity,'" Chaucer Review, 13 (1979), 363-72.

Critics have often regarded "The Complaint unto Pity" as just an early poem in which Chaucer makes use of a standard form. But perhaps the best way to read the poem is to see it as a rather sophisticated if problematic attempt to blend the amorous and the legal complaints and to note some of the advantageous effects that such a mixture has upon representative aspects of the poem. There can be no doubt that the piece is a standard lover's plea because all of the elements of that form manifest themselves in the work. What has not been generally recognized is that Chaucer also employs the structure of the legal bill in the second half of the poem, a structure consisting of an address, a statement of grievance, and a prayer for remedy. Such recognition resolves several of the problems that critics have raised and also makes clear the advantages that Chaucer gains from the merger of the two complaint forms, particularly an intensified language and an enriched personification. Thus "The Complaint unto Pity" demonstrates Chaucer's already highly developed skill and foreshadows the kind of technical brilliance he will later so fully display.

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ROSS, Stephen M., Assistant Professor, "Faulkner's Absalom, Absalom! and the David Story: A Speculative Contemplation," In The David Myth. West Lafayette, Indiana: Purdue University Press, 1980, pp. 136-155.

William Faulkner valued the Old Testament for its stories and characters more than for its philosophy. In exploring how the biblical David story comes to be renewed in Absalom, Absalom!, we must examine the ways in which Faulkner rearranges the story and the relationships among the characters. The novel's main character, Thomas Sutpen, should be seen as more than a morally inadequate David figure, but also as a "king" and "father" figure in a more general sense. Like David, Sutpen succeeds in the terms demanded by his culture, and like David he has qualities of boyishness and naivety which separate him from the other cotton barons of the South. But Sutpen is like Saul, too, in his superior stature and prowess, and in his attempt to use his own son to prevent another son's rightful inheritance. Faulkner also makes use of the relationships between Saul, Jonathan, and David, and between David, Amnon, and Absalom in portraying Sutpen, Charles Bon, and Henry Sutpen. Each of these familial struggles grows out of the conflicting demands of love and authority. This article analyzes Faulkner's use of the David story.

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STEINBAUGH, Eric N., Major, USMC, "Will the Real Winston Churchill . . .," New Hampshire Profiles, (July 1979), 36-37.

In December of 1900, the American Winston Churchill held a dinner party in Boston in honor of the English Winston Spencer Churchill. The American was an 1894 graduate of the U. S. Naval Academy, an extremely popular novelist, and could boast that he had first rights to his name since he was three years older than his British namesake. The English Churchill was in America lecturing on the Boer War after his dramatic escape from Pretoria. He had written to the American in 1899 that he would henceforth sign his name "Winston Spencer Churchill" in order to avoid confusion. This did not seem to solve the problem, however, for in the Englishman's autobiography he says that while in Boston "all my mails were sent to his address while the bill for the dinner came in to me. I need not say that both these errors were speedily redressed."

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TINSLEY, Molly B., Assistant Professor, "Muddle et Cetera: Syntax in A Passage to India," Journal of Narrative Technique, (Fall 1979), 191-198.

This article illustrates the ways in which Forster disrupts the orderly subordination of the complex sentence in order to render verbally the muddle that was India. Sentences in A Passage to India undermine climax and fight closure as consistently as does the structure of that novel. Comma splice sentences and burgeoning catalogues further assert the irrepressibility of chaotic experience against the tidiness of sentences.

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TOMLINSON, David O., Associate Professor, "William Cullen Bryant," Dictionary of Literary Biography: Volume 3: Antebellum Writers in New York and the South. Ed. Joel Meyerson, Gale: Detroit, Michigan, 1979, pp. 30-43.

Bryant became America's first poet to win international acclaim. He learned to write with an easy style, expressing a viewpoint not common to artists in his era. Until the 1830's he was seen as being in the forefront of experimental poetry.

Realizing that poetry could never provide him with a steady income, Bryant never depended on it for his livelihood. Indeed, by 1829, he had a lucrative position as editor of the New York Evening Post, a position he held until his death in 1878.

As he matured, he wrote less and less poetry; but the work of his youth became popular; and the small body of work he produced later in life received the acclaim of the masses if not of the critics.

He also earned a wide reputation as an editor and, in part because of his editorial prominence, was a real celebrity in New York until the time of his death.

The article is a biographical and critical estimate of Bryant.

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WOOTEN, John, Assistant Professor, "The Metaphysics of Milton's Epic Burlesque Humor," Milton Studies, 13 (1979), 255-273.

There are two worlds in Paradise Lost--a tragic, fallen world and a comic universe of ultimate Christian promise. The comic obviously supersedes the tragic in the theological sense, but in the poem's narrative drama the two are held in an uneasy and tension-filled balance. This balance is the source of the poem's burlesque vision of absurdity. In the first part of this essay burlesque is defined, using the Paradise of Fools episode. Then burlesque's affinities to modern black humor is considered. The psychological and metaphysical aspects of Milton's burlesque are illuminated by a comparison to twentieth-century black humor, and important analogies between the two can be made. After establishing initial definitions, key passages are examined which show the involvement of Satan, Sin and Death, Chaos, and even Milton's God in unmistakable burlesque activity.

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PRESENTATIONS

ENGLISH DEPARTMENT

BERGMANN, Harriet, Assistant Professor, "Henry Adams' Esther: No Faith in the Patriarchy," Chesapeake American Studies Association, 2 November 1979.

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BERMAN, Neil, Assistant Professor, "Workshops or Playshops? Game Strategies in the Teaching of Writing," Conference on College Composition and Communication, Washington, D. C., 13-15 March 1980.

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HILL, John M., Assistant Professor, and Allan LEFCOWITZ, Professor, "Science Among the Sages: Or, Mind and Matter Doesn't Matter," Victorians Institute Conference, Richmond, Virginia, October 1979.

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JASON, Philip K., Associate Professor, Poetry Readings, The Writer's Center, November 1979; The Folger Shakespeare Library, April 1980; Georgetown University, April 1980; Montpelier Arts Center, April 1980.

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LEFCOWITZ, Allan, Professor, Panelist, "Influences of Science and Technology on Literature," Library of Congress, May 1979.

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LEFCOWITZ, Allan, Professor, "Editing and the Writer," Northern Virginia Society of P.E.N., Northern Virginia Community College, October 1979.

NOLAN, Charles J., Jr., Assistant Professor, Chairman, Panel on American Romanticism, Northeast Modern Language Association, North Dartmouth, Massachusetts, 21 March 1980.

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TINSLEY, Molly B., Assistant Professor, Fiction Reading, Greater Reston Arts Center, October 1979.

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TINSLEY, Molly B., Assistant Professor, "Writing Fiction: Get Started," McKendree College Writers' Conference, Lebanon, Illinois, 2-3 May 1980.

PRESENTATIONS

ENGLISH DEPARTMENT

TOMLINSON, David O., Associate Professor, "American Literature as It is Taught," South Atlantic Modern Language Association, Atlanta, Georgia, 2 November 1979.

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## HISTORY DEPARTMENT

*Professor Larry V. Thompson, Chairman*



For the History Department, 1979-1980 was a banner year in both publication and research. Four books appeared and a fifth was revised. All were in the field of naval history. Of the new publications, one provides a revisionist view of the naval policy debate in the young republic; two are biographies of important naval officers of the post-Civil War era; and the fourth provides the first narrative history of the Naval Academy since 1900. The faculty also published a total of sixteen articles, papers, and encyclopedia entries. Finally, two department members collaborated with the Educational Resources Center to produce two videotape

historical documentaries, both approximately a half-hour in length.

The wide-ranging research interests of the History Department faculty ensure that this scholarly productivity will continue. Six other books are currently in press, numerous articles have been accepted for publication, and many other works are in progress. Two projects were sponsored by Naval Academy Research Council grants.

Throughout the year, the History Department continued to participate actively in professional conferences across the country. At nine of these conferences, faculty members presented papers. Other historical presentations were made to military and civic audiences.

The results of the History Department's deep involvement in research are reflected in the ongoing enrichment of its students' classroom experience as well as in the production of scholarly publications and papers.

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THE PAPERS OF JOHN PAUL JONES

Researcher: Assistant Professor James C. Bradford

Sponsor: National Historical Publications and Records Commission

This project will produce a complete, scholarly edition of the papers of John Paul Jones. The first phase of the project involves the collection of all Jones materials. To date copies have been obtained from 65 repositories. Over 2000 items have been accessioned and filed; targets have been prepared for future photographing; and transcribing of documents has begun. This phase of the project should be completed by June 1981. Documents will then be selected for the letter-press edition, all documents prepared for publication, and a subject index and finding guide will be prepared. The entire project should be completed by August of 1983.

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DYNAMIC MILITARY ENGAGEMENTS THROUGH COMPUTER GRAPHICS

Researcher: Associate Professor William M. Darden

Sponsor: Naval Academy (Academic Dean)

The object of this project is to present a classroom demonstration by means of computer graphics of the background, development, and results of selected battles. Complete statistics of the opposing forces, as well as pictures of important commanders, the battlefield terrain, and weapons used, are made available.

The Battle of Chancellorsville, the greatest victory of the Army of Northern Virginia (May 1863), was put on line this year.

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HISTORY OF MARINE AMPHIBIOUS OPERATIONS IN WORLD WAR II

Researcher: Associate Professor William M. Darden

Sponsor: Academic Dean - Instructional Development Program

In reference to the preceding project, the decision was made to put amphibious operations on videotape rather than the computer.

A 25-minute documentary of Guadalcanal, the first amphibious operation of the war, reviews the course and assesses the significance of the struggle. It is hoped that this is the first tape in a series which will show the history and development of Marine amphibious operations in World War Two.

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#### INVESTIGATION OF ACCIDENTS ABOARD U. S. NAVAL VESSELS

Researcher: Associate Professor William N. Darden

Sponsor: Academic Dean - Instructional Deveopment Program

An investigation was conducted into shipboard accidents to prove or disprove the necessity for an acoustic egress system aboard ships. The investigation showed that such a system should be available.

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#### INTELLIGENCE AND VALUES

Researcher: Associate Professor David E. Johnson

Sponsor: Naval Academy Research Council

The purpose of this project is to assess the implications in the evolution of our concept of human intelligence for changes in our value concepts. The objectives are: (1) to clarify one significant shift in our conceptual framework; (2) to write about the conclusions of the research so that others can understand what is written; (3) to publish some of these writings. The researcher plans to read several books and articles dealing with artificial intelligence as an adequate model for human intelligence, comparing them with more traditional notions of the nature of man. Then he will analyze the implications of these changes in our culture's view of man for our values. This project is in preliminary stages.

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MEMBER COUNTRY INFLUENCING OF ORGANIZATIONAL DECISION-MAKING:  
THE CASE OF THE WORLD BANK GROUP

Researcher: Lieutenant Commander Robert W. Stuart, USN

Sponsor: Arleigh Burke Scholarship

This dissertation is intended to meet the final outstanding requirement for the doctorate in International Economics at the Fletcher School of Law and Diplomacy, Tufts University.

The completed study met three research objectives. First, a review of functional, structural, and behavioral literature was conducted to identify the key elements to be included in a comprehensive decision-making model equally applicable at the three levels of analysis. Second, this decision-making model was constructed and functional, structural, and behavioral overviews of the model developed. Then finally, the model was tested considering one particular international development organization, the World Bank Group.

The in-depth analysis of the decision-making processes of the World Bank Group uncovered the existence of precise influence-avenues or "influence pressure points" by which or along which a member country can exert significant influence and subsequently direct the nature of organizational output.

In short, the dissertation becomes a prescription for developmental organization member countries to maximize the return from their organizational investment.

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SOLVING THE ENERGY PROBLEM IN THE COAL-BURNING NAVY

Researcher: Assistant Professor Craig L. Symonds

Sponsor: Naval Academy Energy Awareness Committee

In this project, the researcher studied the problems of coal availability to the nineteenth century navy. The poor engine efficiency of early steamers, and the lack of U.S. government coal plantations created a general recession British and other foreign powers' lanes when U.S. ships were deployed. The solution, not found to the 1880's, was increased fuel efficiency with triple expansion engines, and increased horsepower, greater U.S. windmill of the 1890's and the retrieval of the 19th century engine. The research included the utilization of statistical analysis, evaluation, efficiency, and price from the 1940's to the 1960's.

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## THE CZECH LEGION IN ITALY

Researcher: Associate Professor Rowan A. Williams

Sponsor: Naval Academy Research Council

There is no known publication in English that treats the history of the Czech prisoners of war in Italy in World War One. Thanks to the political activities of Czech nationalists in the allied nations, the prisoners were mustered into the 6th Division of the Czechoslovak National Army. The division was committed against the Austrians at the Battle of the Piave in June 1918, held a crucial sector of the Alpine front in August, and participated in the Final Vittorio-Veneto Offensive. The legionnaires then accompanied Thomas Masaryk to Czechoslovakia, where they occupied the province of Slovakia in defiance of the Hungarian Communist Government. A preliminary study of the legion has been completed.

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## THE U. S. NAVY AND CHINA, 1945-1950

Researcher: Midshipman I/C Samuel J. Cox

Advisor: Assistant Professor Robert William Love, Jr.

Sponsor: Trident Scholar Program

American foreign policy on the Chinese Civil War went through four phases from 1945 to 1950: support of the Nationalist government, mediation of the conflict, noninvolvement, and resumed attachment to Chiang Kai-shek and the Kwomintang. Throughout these critical five years in Sino-American history, the U.S. Navy maintained a major command in China and attempted to play a significant role in the shaping of American foreign policy in Asia.

Using for the first time recently declassified documents, this study discovered that American admirals in China continuously advocated unwavering support for the Nationalist regime despite its reactionary and corrupt characters. Advocacy of this policy persisted throughout the conflict even after it was apparent that the Nationalists had lost the Civil War. The study showed that these admirals received only lukewarm sympathy in the Navy Department and seldom influenced the major decisions in America's postwar foreign policy. On the other hand, by their relentless friendship for the Nationalists these admirals stiffened the resolve of Chiang Kai-shek not to negotiate with the Communists on the grounds that the United States would not allow his government to fall.

\*\*\*\*\*

METAPHYSICS AND POETRY

Researcher: Assistant Professor P. Robert Artigiani

Defining consciousness as a function of metaphysics in Western terms, Heidegger's definition of poetry as a distinct mode of learning intended to overcome all alienation is discussed. The shared ambition and methodology of the poet Wallace Stevens is also examined. Stevens, however, found that his poems never achieved Heidegger's goal. Rather than establishing a metaphysical union subsuming the condition of alienation, Stevens found that each poem established a new realm of consciousness.

\*\*\*\*\*

THE RELIEF OF MAJOR GENERAL COMMANDANT BARNETT

Researcher: Major Merrill M. Bartlett, USMC

The reason for the dramatic and unexpected relief of Major General George Barnett as Commandant of the U. S. Marine Corps in 1920, following his extremely effective conduct of that office during World War One, has never been satisfactorily explained. This study, based upon extensive archival research, provides the first complete account of the incident.

\*\*\*\*\*

GEORGE BARNETT, 1859-1930: A REGISTER OF HIS PERSONAL PAPERS

Researcher: Major Merrill L. Bartlett, USMC

As Major General Commandant, 1914-1920, George Barnett headed the Marine Corps at an important, transitional state of its history. This register of his papers, covering the entire span of his career, 1881-1923, should be valuable for students of the naval service.

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## CRUISE OF THE IROQUOIS

Researcher: Major Merrill L. Bartlett, USMC

In 1889 the screw-sloop U.S.S. Iroquois broke her propeller shaft while proceeding from Honolulu to Samoa. Her propeller was jammed in a position that made it impossible to steer her under sail and eventually she drifted across the Pacific to the coast of Washington. This account of the incident, during which her crew endured considerable privations and which could easily have ended in disaster, is based on original, archival research.

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## A HISTORY OF THE FIRST MARINE DIVISION, 1941-1979

Researcher: Professor William M. Belote, co-author

The objective of this project is to present a balanced, illustrated, chronological account of the entire history to date of the First Division of the U. S. Marine Corps. The book will consist of approximately 60,000 words, will be profusely illustrated, and will cover all campaigns in which the division has participated.

\*\*\*\*\*

RURAL ENTREPRENEURSHIP IN THE EARLY REPUBLIC: HENRY LEE'S  
MATTLEDAVILLE

Researcher: Assistant Professor James C. Bradford

This project will provide an analytical examination of the way in which a leading political figure of Virginia's early years as a state used his network of friends, his governmental positions, and his social position in the local community to further the development of property he owned as a town and manufacturing site. "Light Horse Harry" Lee was a war hero, served as governor of Virginia, and invested in real estate in an effort to establish a firm financial base for his family. Many of his methods would be considered questionable under today's conflict of interest standards but were acceptable in his time. This project will examine those methods and explain why Lee failed in his venture and wound up in debtors' prison.

\*\*\*\*\*

THE INTERSTATE SLAVE TRADE IN VIRGINIA: THE OLD VIEW VS.  
THE NEW

Researcher: Professor William L. Calderhead

This project is a follow-up of research conducted several years ago that analyzed Maryland archival records dealing with interstate slave-trading activities in Maryland before the Civil War. That paper showed that the interstate slave trade, at least for Maryland, was far less significant than authorities had assumed it to be. Since Maryland was not necessarily a representative slave state, the findings were considered to be interesting but not necessarily revolutionary in nature.

The new study stressing Virginia, a typical slave state, should determine conclusively how significant the interstate slave trade really was. An analysis of bills of sale, traders' records, shipment manifests list, and other pertinent material is being made of the major Virginia counties selling slaves. Thus far, the statistics show that the intensity of the trade in Virginia was higher than in Maryland, but the total extent of the trade--as the Maryland study had earlier implied--was clearly far less than the old propagandists would have us believe.

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## AMERICAN SECRETARIES OF THE NAVY

Researcher: Professor Paolo E. Coletta, co-author

The careers and contributions of sixty-two Secretaries of the Navy are described in a two-volume work to be published by the Naval Institute Press in 1980. The researcher wrote five of the individual biographical essays, edited and proof-read the remainder, and prepared the index.

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## A BIBLIOGRAPHY IN AMERICAN NAVAL HISTORY

Researcher: Professor Paolo E. Coletta

A collection has been prepared of 4,900 books, articles, documents, dissertations, and works of fiction that are deemed important in teaching American naval history. An index of authors and a subject index are included.

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GENERAL CLIFTON CATES, USMC

Researcher: Professor Paolo E. Coletta

A biographical essay is being prepared for Commandants of the Marine Corps, edited by Assistant Professor Robert W. Love, Jr., and Major Merrill M. Bartlett, USMC.

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ADMIRAL LOUIS E. DENFELD

Researcher: Professor Paolo E. Coletta

A biographical essay has been prepared for The Chiefs of Naval Operations, edited by Assistant Professor Robert W. Love, Jr., and currently in press.

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THE NAVAL WAR IN THE WEST IN WORLD WAR ONE

Researcher: Professor Paolo E. Coletta

The history of the naval war between Germany and the Western powers, 1914-1918, is to be related in light of recent research. Particular attention will be paid to naval warfare in the Adriatic.

\*\*\*\*\*

CYRUS VANCE

Researcher: Professor Paolo E. Coletta

An eminent attorney and former secretary of the navy, as secretary of state, Cyrus Vance was for three years one of the leading figures of the Carter administration. Research for a full-scale biography is well underway.

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CURATORES VIARUM: HIGHWAY MAINTENANCE IN ITALY IN THE ROMAN EMPIRE

Researcher: Assistant Professor Phyllis Culham

This study examines the history of the organization of attempts to build and maintain Italian highways under the Roman Empire. It provides a detailed examination of the imperial bureau devoted to highway maintenance. All personnel known to have been attached to the bureau are discussed in an effort to compare it to other bureaus and to gain new insights into Roman social history.

\*\*\*\*\*

THE LEX OPPIA

Researcher: Assistant Professor Phyllis Culham

It is argued that the Lex Oppia has been misunderstood by all major authorities, including Livy. Actually, it was not an economic measure, nor did it have any but the most indirect economic impact. The law was, rather, directed at women with the aim of reducing the new status they had attained in the period of the Punic Wars.

\*\*\*\*\*

RESOLUTION BY TRIAL IN THE ORESTIA

Researcher: Assistant Professor Phyllis Culham

The significance of resolution by trial in The Orestia trilogy is reassessed. The contention is that, in addition to the formal trial which ends the last play, both of the other plays end with scenes that are really disguised trials. These are instrumental in resolving on stage the issues of conflict.

\*\*\*\*\*

VLADIMIR KOROLENKO

Researcher: Assistant Professor Jane Good

The career of the Russian radical, populist, and writer Korolenko (1853-1921) is traced in a 2,000-word study. It has been accepted for publication.

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SERGEI KRAVCHINSKY

Researcher: Assistant Professor Jane Good

The radical writer Sergei Kravchinsky (Stepniak) was one of the most active members of the Russian emigré community in London during the last two decades of the nineteenth century. His career is related in an article that includes a detailed bibliography.

\*\*\*\*\*

PAUL MILIUKOV

Researcher: Assistant Professor Jane Good

The biography of Paul Miliukov (1859-1943), historian and leader of the Constitutional Democratic (Cadet) Party, is presented in a 3,000-word article that has been accepted for publication.

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SOLZHENITSYN'S PRECURSOR: V. G. KOROLENKO'S VISIT TO THE UNITED STATES, 1893

Researcher: Assistant Professor Jane Good

This study compares the written impressions of America by the nineteenth century Russian radical author V. G. Korolenko with Alexander Solzhenitsyn's recent critique of the United States. It concludes that certain features of their criticisms are remarkably similar. Both find Americans to be excessively materialistic and caught up in transitory problems. They also regard the press as irresponsible. Both believe that America has great potential, but that, as yet, it has been unfulfilled.

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## THE ENCLYCLOPEDIA OF U. S. NAVY AND MARINE CORPS HISTORY

Researchers: Associate Professor Kenneth J. Hagan and  
Assistant Professor Jack Sweetman

This work has been conceived to remedy the lack of a single, "one-stop" reference to which the student or researcher can turn for coverage of all important aspects of U. S. Navy and Marine Corps history. Alphabetically organized, it will consist of approximately 1,500-2,000 entries, combining the operational, administrative, biographical, and technological threads of American naval history. In terms of content, the entries will be of two types: brief, purely factual entries on specific subjects (individuals, battles, aircraft types, etc.) and longer, analytical entries on topical areas (amphibious operations, anti-submarine warfare, gunboat diplomacy, etc.). The work should prove an invaluable aid to anyone involved in naval history, whether student, teacher, historian, or buff.

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## OVER THE RAMPARTS: INTERPRETATIONS OF AMERICAN MILITARY HISTORY

Researchers: Associate Professor Kenneth J. Hagan, co-author

The history and evolution of the U. S. Army will be analyzed by a collection of seventeen interpretative essays. Accounts of the army at war are balanced by considerations of civil-military relations and the institutional development--organization, structure, policy, doctrine, and ideology--of the army at peace.

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## NATIVISM, ETHNICITY, AND THE ENLISTED FORCE OF THE NAVY AND MARINE CORPS, 1870-1910

Researcher: Assistant Professor Frederick S. Harrod

During the late nineteenth century, growing nativist sentiment throughout the nation had its counterpart in efforts to "Americanize" the enlisted force. Although the Navy had traditionally accepted large numbers of foreigners, it became increasingly displeased with what Secretary Benjamin Tracy characterized as its "mongrel crews." In Manning the New Navy

I have considered some new aspects of this subject. Yet many important avenues of research relating to the attitudes of Navy officials and civilians toward foreigners in the service remain to be explored. In addition, the Marine Corps aspects of this subject is completely unstudied.

The project is continuing along three main lines of research. One avenue is additional searching for writings by nativists on the Navy and Marine Corps and writings by officers expressing nativist sentiments to establish personal and ideological links between the two groups. The second area of concentration is further archival research into Navy and Marine policies regarding aliens. The third major line of study concerns the enlisted force of the Marine Corps. There is a need to investigate all aspects of marine enlisted policy as well as particular questions relating to noncitizens in the force. In this way it will be possible to understand the specific policies of the Marines and to compare these policies to those of the Navy.

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THE AMBIGUOUS REFORMATION IN THE TERRITORIAL CITIES OF UPPER AUSTRIA, 1520-1576: ENNS, FREISTADT, GMUNDEN, LINZ, STEYER, VOCKLABRUCK, AND WELS

Researcher: Assistant Professor Corina M. Herrera

This study explores the responses to the Protestant Reformation of the sixteenth century in a selected group of small cities. While much of the previous and current literature in this field has concentrated on major urban centers in which the Reformation gained early and formal acceptance, this study analyzed a region in which incremental change provided the key to religious conviction. Because the critical obstacle to a formal Reformation was the lack of strong and consistent leadership, this research surveyed the role of local elites, including the clergy, lay students and later magistrates, and the school teachers.

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## UNIVERSITIES AND SOCIETY IN AUSTRIA: THE FORMATION OF SOCIAL AND POLITICAL ELITES AND THEIR RESPONSE TO THE REFORMATION

Researcher: Assistant Professor Corina M. Herrera

The purpose of this study, planned as a monograph, will be to continue with promising areas of research indicated during the writing of a dissertation. The project will demonstrate that the German-speaking universities of the sixteenth century played a distinct and essential role in the formation and preservation of the newly consolidated and centralized governmental units. By educating future administrators and politicians, the universities sustained and promoted the emergence of new bases for social and political power. The universities provided an incubator for the religious and political protests of the early modern period, but they also served as cradles for the emergence of the approach to government and social policies developed by the politiques. The monograph will be developed with data culled from unpublished local archival sources, university archives, and published matriculation rosters. Nearly all the archival material (and thus the vast majority of the data needed) is available only in European archives. This study requires data gathering at the universities of Wittenberg and Leipzig (German Democratic Republic), and Ingolstadt, Freiburg im Breisgau, and Tübingen (Federal Republic of Germany).

Active archival research will begin either in June of 1980 or June 1981, depending on the availability of a grant from the Federal Republic of Germany. Preliminary research to consolidate data already gathered is already underway.

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## THE SERMON AS CHALLENGE TO AUTHORITY: THE REFORM PREACHING OF MARTIN LUTHER AND JOHN CALVIN

Researcher: Assistant Professor Corina M. Herrera

This paper will attempt to present the sixteenth century clergy as publicists. Reformation scholars have surveyed extant sermonic literature in order to assess the development of theological positions or homiletic techniques. This study, however, aims to explicate the general function of Reformation sermons as political statements and exhortations. Did the early reform preaching of Luther and Calvin provide conscious or

unconscious models for later political tracts which became increasingly radical? The paper will base its conclusions on a comparative analysis of sermons by these two leaders as well as other Protestant and Catholic reformers of the sixteenth century.

\*\*\*\*\*

#### VISIONS OF HISTORY IN REFORMATION EUROPE

Researcher: Assistant Professor Corina M. Herrera

The aim of this project is to assess the impact of the Reformation on sixteenth century writers of history. Renaissance Italy witnessed bold new techniques and approaches to historiography and the dramatic division in the Western Church during the sixteenth century offered challenging topics for contemporary observers. The project will survey assumptions about history and its patterns as well as judgments and evaluations of contemporary assaults on established tradition and authority in the Reformation histories written by two men, Jörg Vögeli, city secretary of Constance (southern Germany) and Wolfgang Waldner, former Catholic monk and later Protestant minister in Austria and southern Germany.

This project will be based on earlier research involving the History of the Reformation by Jörg Vögeli and on a newly-encountered manuscript by Waldner in the state archive in Munich, Germany.

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#### PERSONAL AUTONOMY AND MORAL EDUCATION

Researcher: Associate Professor David E. Johnson

Moral education involves the assumption that virtue can be taught. An absolutist in this area holds that there is one best set of values to be inculcated and that he/she knows what set that is. Absolutism is shared by some theorists of education (like Lawrence Kohlberg) and by many school administrators. One significant value that is overlooked on this view is personal autonomy (in the sense of being able to make decisions on the basis of standards devised by and/or adopted by oneself after careful reflection). The researcher proposes to show that absolutism in moral education is untenable, and that personal autonomy must be enhanced by the schools (although it may be that moral education is not possible).

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## CHANGING INTERPRETATIONS AND NEW SOURCES OF NAVAL HISTORY

Researcher: Assistant Professor Robert W. Love, Jr., Chief  
Editor, et alia

The papers presented at the Third Naval History Symposium (1977) sponsored by the History Department, USNA, have been edited and prepared for publication. The book is scheduled to appear in summer 1980. Twelve other department members participated in the project.

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## THE CHIEFS OF NAVAL OPERATIONS

Researcher: Assistant Professor Robert W. Love, Jr.

This is a collection of biographical essays on each of the first nineteen chiefs of naval operations, from Admiral William S. Benson to Admiral Elmo Zumwalt. Each author has attempted to explain why the admiral he is researching became CNO, what his major policies were in office, and how he succeeded or failed in implementing them. Since not all of the CNO's have been equally important, greater attention has been paid to those whose contributions have been most significant: Fleet Admiral King, and Admirals Benson, Pratt, Stark, Sherman, and Burke. Each essay closes with an evaluation of the CNO from an historical perspective. In addition, the study includes an introductory essay on the origins of the office and the major changes in statutory and practical authority of the CNO's from 1915 to 1974.

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FROM PEARL HARBOR TO TOKYO BAY: ERNEST J. KING AND THE  
AMERICAN NAVY IN THE SECOND WORLD WAR

Researcher: Assistant Professor Robert W. Love, Jr.

This project is a major study of American naval policy and strategy under the leadership of Fleet Admiral King during the second World War. Research on the first portion of the study, which concerns the period from the Japanese attack on Pearl Harbor to the victory on Guadalcanal, has been completed and the manuscript is being readied for publication. The major theme of the study is the significance of individual leadership

in the formulation of national policies, as exemplified by the activities of Admiral King during the first year of the global war. Additionally, the study attempts to explain the close connections between theater strategies, arms transfers, institutional imperatives, military construction, and perceptions by leaders of national interests.

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THE CHANGING FOCUS OF ANTI-IMPERIALISM: APRISMO AND THE UNITED STATES DURING THE WORLD WAR

Researcher: Assistant Professor Daniel M. Masterson

During World War Two, the outlawed Aprista Party attempted to gain political legality in Peru through the intercession of the U. S. State Department. In exchange for American assistance, the party promised to secretly provide intelligence of Axis activities in the country.

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POLITICS AND MILITARY PROFESSIONALISM IN PERU, 1939-1963

Researcher: Assistant Professor Daniel M. Masterson

The process of military professional development in Peru in the mid-twentieth century is reviewed in the context of civil-military relations, including political affairs, and of the evolution of institutional ideology within the armed forces themselves. Special attention is paid to the reformist orientation (structural, economic, and agrarian) of the Peruvian military. Field research, including extensive personal interviews, has been conducted in Peru, as well as in relevant American archives.

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PROFESSIONAL DEVELOPMENT IN THE PERUVIAN ARMED FORCES, 1895-1940

Researcher: Assistant Professor Daniel M. Masterson

The purpose of this study, which is being conducted in conjunction with the project described above, is to define and assess the influence of French military theory upon the development of professional ideology in the Peruvian armed forces.

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of the German U-BOAT (1941-44); 341-344. He is also the author of the book "Journal of Baron Bernhard von Müllemberg" (1944) and the book "Assistant Professor Jack Sweetman."

Baron Bernhard von Müllemberg-Becher is the author of the history of the German U-boat fleet in Bismarck, which is the name of the U-boat cruiser Becher in the battle of the Atlantic in 1941 and was himself sunk by pursuing British ships. The name "later" Becher led the German Navy to obtain the first U-boat production cruiser warfare in the Atlantic with the U-boat fleet and reported to the passing of the battle of the Atlantic. Baron Müllemberg, who had earlier served as a staff officer in the U-boat command, Captain Ernst Lindemann, was the senior staff officer after the control situation at the time of the attack. Baron Müllemberg's history and memoir of the U-boat fleet contains much new material and sheds important light on the U-boat fleet and the operations, particularly the general operations of the German Fleet Command, Admiral Günther Lütjens. The English translation of the work is now published, simultaneously with the German and German editions.

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#### A GENTLEMEN'S AGREEMENT (THE HOLLOWAY BOARD)

Researcher: Assistant Professor Jack Sweetman, in collaboration with Admiral James H. Holloway, Jr., USN, Retired.

At the end of World War II, it was apparent that the Naval Academy, as traditionally constituted, could not supply the annual output of junior officers who would be needed by the greatly enlarged, postwar navy. Secretary of the Navy Forrestal convened a board, headed by Admiral Holloway, to review the navy's program of officer education and procurement. Its recommendations resulted in the Regular NROTC program established by law in 1946. The history of the Board is related in an informal, "as-told-to" memoir by Admiral Holloway.

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CONFIDENTIAL - SECURITY INFORMATION

Approved for Release by NSA on 05-08-2014 pursuant to E.O. 13526

The following information was obtained from the narrative prepared by the author, Mr. James H. Brown, Jr., in connection with the study of the operations and to provide for the study of the operations of the United States in World War I. The information is of a general nature and is not of a confidential character.

The information has been carried out by research in the Department of the Navy, the Admiralty, and Cabinet in London. Also, the information has been carried out by British officials in the French Ministry of the Interior in Paris has been investigated. The information is being carried out in the process of digesting the information and cooperation into the study. The information is not to be determined at this time.

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ARTIGIANI, P. Robert, Assistant Professor, "Order and Openness," in Kishore Gandhi (ed.), Adventures in the Evolution of Consciousness. London: Oxford University Press, 1979.

Defining history epistemologically by analogy to the theory of evolution, game/systems theory is applied to the dynamics of culture. By this device an opportunity is developed to reconcile two competing theories of the evolution of consciousness. Cultures are shown to be systems of negative entropy, as essentially stable states. However, the incapacity of cultures, like life-systems, to permanently resist change is emphasized. Thus, culture necessarily evolves. By a detailed analysis of the second scientific revolution, however, it is maintained that evolution proceeds most effectively through the mechanisms of the established cultural system.

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ARTIGIANI, P. Robert, Assistant Professor, "Education and Culture Shock," in Proceedings of the Fifth International Conference on Improving University Teaching. London: 1979. I, 279-306.

Learning is conventionally understood to involve a process of change variously defined as growth, development, or improvement. Educators rightly take pride in the extent to which their efforts lead to these changes. What is usually forgotten, however, is that these changes often lead to a reshaping of student lifestyles. In the case of many contemporary college students these changes are dramatic enough to be compared to a "cultural revolution." The trauma of cultural revolution, as social scientists since Durkheim have been pointing out, can lead to an anomic state popularized by Toffler as "future shock." In this condition, many students feel threatened, so threatened that they may, at least unconsciously, "turn off" intellectually--or, worse yet, turn back towards various primitive patterns of behavior and anti-intellectual patterns of belief. Thus, to improve university teaching, we must be sensitive to the subjective problems certain students experience as a result of the learning process and develop teaching strategies that transcend the normal professional demand for effective classroom performance.

\*\*\*\*\*

ARTIGIANI, P. Robert, Assistant Professor, "Technology and Human Values," in Proceedings Odyssey '79, Maryland Conference on the Humanities, 1979, 1-15.

Surveying the literary responses to technological change, one establishes a pattern of hostile criticism in which technology is described as "dehumanizing." Upon analysis these criticisms are shown to be fairly typical of human responses to eras of transition and not legitimate critiques of technology. It is then argued that technology required cultural developments which seem more likely to expand the concept of humanism and that writers like Saint-Exupéry have clearly demonstrated the potential benefits arising from appropriate responses.

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BARTLETT, Major Merrill L., USMC, "Mother of Marines," Fortitude, 9 (Winter 1979-80), 8-9.

During World War One, the wife of Major General Commandant George Barnett, USMC, took a keen personal interest in the welfare of enlisted Marines. Hundreds of men wrote her regarding their personal problems. Every letter was answered, and the records of the correspondence, deposited at the Washington Navy Yard, reveal that at times Mrs. Barnett intervened with effect.

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BARTLETT, Major Merrill L., USMC, "Reflections on a New Tradition," Marine Corps Gazette, 63 (June 1979), 33-40.

The Mess Night is an important tradition in the Marine Corps. Over time, the origins of this event have been lost or distorted historically; worse, the refinements necessary for a successful evolution have deteriorated markedly. Both the history of the Mess Night and the mechanics of conducting such an event have been brought into perspective.

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COLETTA, Paolo E., Professor, Bowman Hendry McCalla: A Fighting Sailor. Washington, D.C.: University Press of America, 1979.

This is the biography of a controversial and capable naval officer. A graduate of the USNA Class of 1864, McCalla early saw the need of promotion by selection, the merging of the line and engineer corps, and the need of a naval general staff.

Before the age of 20, he had served two tours as executive officer of ships. He then served for six years as detail officer and finally chosen for Rear Admiral John G. Grimes, head of the Bureau of Navigation. While in this billet he was chosen in 1875 to lead an expedition to keep the Panama Railroad open during a revolt. He served two tours as a Bureau of Equipment representative. With his first command of the sloop Enterprise, he served on the Isthmian Station. One day he struck an unruly crewman with his sword. In consequence he was given a court-martial which detached him from duty at half pay for three years. While in command of the light cruiser Marblehead during the Spanish-American War, he commanded the joint Navy-Marine Corps operation that seized Guantanamo Bay. He then put his knowledge of amphibious warfare to work in subduing insurgent Filipinos, and, as commander of the American contingent, in leading the Seymour Expedition during the Boxer Rebellion. After a tour as captain of the battleship Kearsarge and also as chief of staff to Commander, North Atlantic Station, he finished his active duty as Commandant of the Mare Island Navy Yard. In the latter capacity he helped mitigate the suffering of those caught in the San Francisco earthquake and fire of 1906.

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COLETTA, Paolo E., Professor, The American Naval Heritage in Brief. Second edition. Washington, D.C.: University Press of America, 1979.

This edition differs from the first in that the naval bibliography has been greatly reduced. Added have been a section entitled Notable Naval Books, a bibliography on the U. S. Marine Corps, and 100 pages of maps, battle charts, and Navy Department and Department of Defense organization charts. The coverage has been extended through August 1979.

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COLETTA, Paolo E., Professor, Admiral French Ensor Chadwick: Scholarly Warrior. Washington, D. C.: University Press of America, 1980.

Graduating in the Naval Academy Class of 1864, Chadwick served on ships as a junior officer before being selected to be sent abroad as the first U.S. naval attaché. His record of six years in London remains unchallenged. His reports helped in the design and building of the ships of the New Navy. In time he served as Chief of the Bureau of Equipment, head of the Office of Naval Intelligence, and both as commanding officer of the

cruiser New York and the chief-of-staff to Admiral William T. Sampson during the Caribbean phase of the Spanish-American War. After the war he served as President of the Naval War College and as commander of the South Atlantic Squadron. Following his retirement he wrote three volumes on Spanish-American diplomatic relations; a book on the causes of the Civil War; a history of the U. S. Navy; and numerous articles.

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COLLETTA, Paolo E., Professor. "John T. Raulston," in Dictionary of American Biography, Supplement 1945-55, New York: Scribners.

Raulston was a lawyer who specialized in land and railroad law, and served in the Tennessee legislature before being appointed as circuit county judge. His fame lay in the fact that he presided at the famous Scopes "monkey" trial in 1925.

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WILLIAM, Phyllis, Assistant Professor, "The Delian League: Unicameral or Bicameral?" American Journal of Ancient History, 3 (1978), 27-31.

This article argues that N. G. L. Hammond and G. E. M. de Ste. Croix are mistaken in their recent books saying that the Delian League was bicameral. A close reading of the text of Thucydides shows that it was unicameral. Bicameralism was an innovation of the Second Athenian Confederacy.

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WATSON, William M., Associate Professor, "Guadalcanal," Educational Resources Center, USNA 1980.

The Marine Corps' battle for Guadalcanal, August 1942 - February 1943, involved the fiercest and most grueling fighting in which American ground forces were involved in the Southwest Pacific campaign. The hard lessons learned there proved of inestimable value in the conduct of subsequent amphibious operations in the war against Japan. This 25-minute, videotape documentary, prepared in collaboration with the Educational Resources Center, reviews the course and assesses the significance of the struggle.

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GOOD, Jane, Assistant Professor, co-author, "Duma," Modern Encyclopedia of Russian and Soviet History, 10 (1979), 39-50.

This article is a detailed, narrative account of the Russian Duma (1905-1917) and includes electoral process charts and a full bibliography of both Russian and English language sources.

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HARROD, Frederick S., Assistant Professor, "Jim Crow in the Navy (1798-1941)," U. S. Naval Institute Proceedings, 105 (September 1979), 46-53.

The United States Navy has always included some black enlisted men, but their numbers and the opportunities afforded them have varied dramatically over the years. Policies towards blacks in the service have ranged from the integration of work, messing, and berthing assignments in the early nineteenth century to segregation and even exclusion from the service in the early twentieth. During World War Two, the Navy yielded to outside pressure and ended official barriers to black service throughout the Navy. Yet the elimination of segregation did not by itself increase black enlistment in the service, and in the 1960's the Navy experimented with additional racial programs.

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JOHNSON, David E., Associate Professor, co-author, "The Brain, Evolution and the Purposes of Education," in the Proceedings of the Fifth International Conference on Improving University Teaching.

Interdisciplinary learning theory requires us to consider the biological and social evolutionary endowments of the human brain as they relate to the educational purpose of developing personal autonomy. We begin with a review of the most probable account of behaviors which led to the rapid growth of the human cortex during pre-history. Next, the brain's functioning is described by means of Alexandr Luria's model. The final body of knowledge referred to is the developmental psychology of Jean Piaget. A cybernetic learning theory is established in which Luria's neurological model is integrated with Piaget's psychological model to obtain a single theory that shows the parallel structure of the two views. The preceding theoretical structures are used to examine existing educational practices, i.e., grading, credits, majors, etc., so critically assailed by many recent studies. These studies indicate the institutional constraints

placed on the student which undermine those behaviors thought to be responsible for the evolved potential of the human brain. In particular it is argued that the development of those behaviors governed by the functions of the frontal lobes are inhibited as a result of some present university teaching practices. The philosophical conclusion is that the educational goal of personal autonomy can be attained only if university teaching is based on the processes of learning and not conversely, as is commonly the case. If positive change is to occur, future action must be grounded in common social values supported by recent interdisciplinary knowledge. This paper is a theoretical attempt to identify such values and knowledge in an integrated manner so as to advance the quality of higher education for all concerned.

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LOVE, Robert W., Jr., Assistant Professor, co-author, "Will am Daniel Leahy," Dictionary of American Biography: 1950-59 supplement. New York: Scribners, 1980.

\*\*\*\*\*

SWEETMAN, Jack, Assistant Professor, The U. S. Naval Academy. An Illustrated History. Annapolis, Maryland: Naval Institute Press, 1979.

The work narrates the history of the U. S. Naval Academy from its foundation to the present. It is the first such history to be published since 1900. The text, of approximately 60,000 words, is complemented by some 200 illustrations and three maps. The structure is basically chronological. Enough background material is supplied to enable the reader to appreciate the relationship between the Academy, the Navy it serves, and the national policies both uphold. Recurrent themes include: the Academy's contribution to the rise and maintenance of American sea power; the development of Academy activities and traditions; evolution of the curriculum; the balance between education and training; buildings and monuments; academy athletics; and profiles of outstanding superintendents, famous graduates, and colorful characters.

\*\*\*\*\*



SWEETMAN, Jack, Assistant Professor, "Lord Jim to the Rescue,"  
Shipmate, 42 (September 1979), 17-18.

The article consists of an excerpt from The U. S. Naval Academy: An Illustrated History. It describes the superintendency of Rear Admiral James L. Holloway, Jr. (1947-1950) and his activities as president of the Holloway Board and as a member of the Stearns-Eisenhower (Service Academies) Board.

\*\*\*\*\*

SWEETMAN, Jack, Assistant Professor, "The U. S. Naval Academy:  
A History, 1845-1979," Educational Resources Center, USNA, 1979.

The history of the Naval Academy is reviewed in a 30-minute, videotape documentary prepared in collaboration with the Educational Resources Center.

\*\*\*\*\*

SWEETMAN, Jack, Assistant Professor, "Notable Naval Books of 1979,"  
U. S. Naval Institute Proceedings, 106 (January 1980).

An annual review article discusses the outstanding works published in the fields of naval and maritime history and affairs in the course of the preceding year. Foreign publications are included.

\*\*\*\*\*

SYMONDS, Craig L., Assistant Professor, "Admiral William Pratt and American Naval Policy," in Selected Papers from the Citadel Conference on War and Diplomacy. Charleston, South Carolina: The Citadel, 1979, pp. 66-75.

This essay evaluates the contributions of America's fifth Chief of Naval Operations, who presided over the Navy during a time of decreasing budgets due to the depression and increased responsibilities due to the outbreak of war in the Far East. It concludes with a sympathetic portrait that casts Pratt as a moderate between conflicting groups of radicals and conservatives. The paper was one of eight (out of forty) selected for publication from the Citadel Conference on War and Diplomacy, 1978.

\*\*\*\*\*

SYMONDS, Craig L., Assistant Professor, "War, Politics, and Grand Strategy in the Pacific, 1941-1945," Air University Review, 31 (November-December 1979), 93-97.

This essay reviews the recent literature on the War in the Pacific, focusing on a comparison of Japanese, American, and British historians whose views differ greatly from one another. It concludes that the Japanese and British have been more introspective about that war largely because it brought about the demise of both their Pacific empires.

\*\*\*\*\*

SYMONDS, Craig L., Assistant Professor. Navalists and Anti-navalists: The Naval Policy Debate in the United States, 1785-1827. Newark, Delaware: University of Delaware Press, 1980.

A scholarly study based upon extensive archival research reinterprets the naval policy debate, centering on Congress and the Navy Department, concerning the construction of ships-of-the-line, frigates, or gunboats with relevance to America's role in world affairs in the early years of the republic. It concludes that the opponents of naval expansion were rational, well-meaning statesmen rather than philosophical ideologues, as previously presented.

\*\*\*\*\*

WILLIAMS, Rowan A., Associate Professor, "The Czech Legion Revisited," East Central Europe, 6 (December 1979), 20-39.

During World War One, the many Czechoslovak settlers in Russia organized an all-volunteer Czech unit that was under the operational control of the Russian high command. Following the first Russian revolution, this unit was expanded to around 65,000 men. They fought brilliantly in the July (Kerensky) offensive. After the Bolshevik revolution, Thomas G. Masaryk persuaded the Soviet government to send them to France via Vladivostok. There followed delays, misunderstandings, and finally armed struggle with the Red Army. The Czechs seized most of the Trans-Siberian Railway. They were finally evacuated in 1920.

This article draws together most of the recent work on the subject.

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PRESENTATIONS

HISTORY DEPARTMENT

ARTIGIANI, P. Robert, Assistant Professor, "Education and Culture Shock," Fifth International Conference on Improving University Teaching, London, England, 8 July 1979.

\*\*\*\*\*

ARTIGIANI, P. Robert, Assistant Professor, "Metaphysics and Poetry," International Seminar on Literature and the Evolution of Consciousness, New Delhi, India, 12 February 1980.

\*\*\*\*\*

ARTIGIANI, P. Robert, Assistant Professor, "On the Origins and Function of Science in the West," Indian National Science Conference, Calcutta, India, 5 February 1980.

\*\*\*\*\*

ARTIGIANI, P. Robert, Assistant Professor, "The Two Cultures," United States Naval Reserve Research Group, Annapolis, Maryland, 16 June 1979.

\*\*\*\*\*

ARTIGIANI, P. Robert, Assistant Professor, "Technology and Human Values," Maryland Committee for Humanities, Baltimore, Maryland, 16 November 1979.

\*\*\*\*\*

BRADFORD, James C., Assistant Professor, "Francis Nicholson and the Early Chesapeake," Conference on Chesapeake History and Culture, St. John's College, Annapolis, Maryland, 20 November 1979.

\*\*\*\*\*

BREEDEN, George L., Lieutenant Commander, USN, "The Maryland State Navy," Old Line Chapter, Daughters of the American Revolution, Monckton, Maryland, 14 November 1979.

\*\*\*\*\*

COLETTA, Paolo E., Professor, "Sea Power in the War of 1812," Calvert Maritime Museum, Solomons, Maryland, 7 November 1979.

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PRESENTATIONS

HISTORY DEPARTMENT

COLETTA, Paolo E., Professor, "The Adjustment of the Navy to the National Security Act of 1947: Secretaries of the Navy Forrestal through Anderson," American Historical Society, New York, New York, 29 December 1979.

\*\*\*\*\*

DARDEN, William M., Associate Professor, "The Civil War," College Women's Club, Annapolis, Maryland, 10 April 1979.

\*\*\*\*\*

JOHNSON, David E., Associate Professor, "Rethinking Moral Education," American Philosophy of Education Society, San Francisco, California, 28 April 1980.

\*\*\*\*\*

LOVE, Robert W., Jr., Assistant Professor, "Two-Ocean War," Air War College, Maxwell Air Force Base, Alabama, 6 September 1979.

\*\*\*\*\*

LOVE, Robert W., Jr., Assistant Professor, "The Adjustment of the Navy to the National Security Act of 1947: Chiefs of Naval Operations Denfeld through Carney," American Historical Society, New York, New York, 29 December 1979.

\*\*\*\*\*

LOVE, Robert W., Jr., Assistant Professor, "Strategy and the Lessons of World War Two," Naval War College Extension Course, Arlington, Virginia, March 1980.

\*\*\*\*\*

MASTERSON, Daniel M., Assistant Professor, "Caudillismo and Institutional Change: Manuel Odria and the Peruvian Armed Forces, 1948-1956." Conference on Latin America, Western Illinois University, Macomb, Illinois, 21 March 1980.

\*\*\*\*\*

SWEETMAN, Jack, Assistant Professor, "National Socialism and Monarchism: August Wilhelm of Prussia--The Nazi Prince," The Citadel Symposium on Hitler and the National Socialist Era, Charleston, South Carolina, 24 April 1980.

\*\*\*\*\*

SWEETMAN, Jack, Assistant Professor, "The Naval Academy since 1935," USNA Class of 1935 Reunion, Annapolis, Maryland, 10 May 1980.

\*\*\*\*\*

THOMPSON, Larry V., Professor, "Eichmann in Jerusalem: A Reconsideration," USNA History Club, Annapolis, Maryland, January 1980.

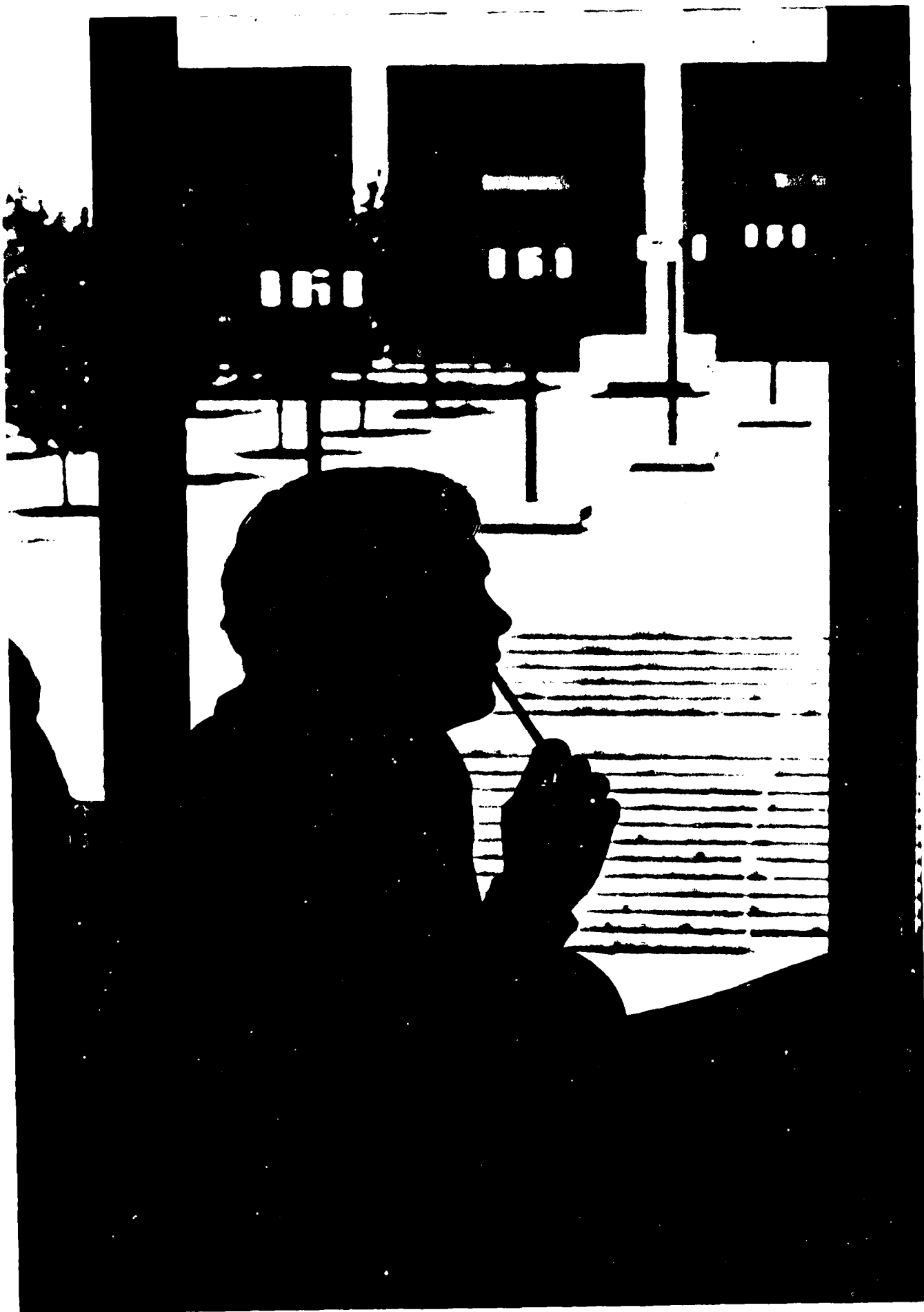
\*\*\*\*\*

WILLIAMS, Rowan A., Associate Professor, "The Czech Legion in Italy," International Colloquium on War and Society in Eastern Europe, Brooklyn College (University College of New York), New York City, 3 December 1979.

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DIVISION OF  
MATHEMATICS AND SCIENCE



## APPLIED SCIENCE DEPARTMENT

*Commander Neel L. Kozlowski, USN, Chairman*



The research performed within the Applied Science Department reflects the wide range of expertise present in the Department's three disciplines: Resources Management, Operations Analysis, and Computer Science. The Operations Analysis Study Group was supported by an annual grant from the Chief of Naval Operations (OP-95). The funds provided assisted the Study Group in conducting joint faculty-midshipmen research in areas of missile targeting, antisubmarine warfare, minefield countermeasures and clearing, air-to-air

missile data analysis, and Marine Corps aviator retention.

Another category of research by the Operations Analysis Study Group is "in-house" analysis, in support of Naval Academy operations or programs on an as-requested basis. The Graduate Performance Evaluation System (GRAPES) is a continuous activity in this category.

One member of the faculty continued his independent research on the human body by aiding a civilian employee of the Naval Academy to reduce his dependency for drugs to control his systolic blood pressure levels. Another member of the faculty continues his research on the effect of recreational boating on aquatic vegetation and has developed a predictive model for the transparency of estuarine waters.

In the area of Computer Science, a set of programs was developed to predict the electromagnetic field strengths due to a submerged horizontal electro-dipole (HED).

The large number of midshipmen projects reflects the Department's belief that student research under the supervision of an interested and dedicated faculty is a broadening and educational experience. The opportunity to utilize the knowledge and skill gained during the prior three intensive years of work gives First Class midshipmen an appreciation and understanding of the usefulness and importance of their education.

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## ELECTROMAGNETIC FIELDS FROM AN HED SOURCE

Author(s): Assistant Professor Franklin L. F. Chi

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The object of the project is to predict the electromagnetic field strength for the standard HED. Various approximate methods for the electromagnetic field at different distances, frequencies, and geometries, and a set of computer programs in FORTRAN are available for the experiments.

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## THE EFFECT OF REMANENT EVALUATION OF AIRMEN (REARME)

Author(s): Lieutenant Commander Owen D. Moore, USN

Sponsor: Naval Academy (Operational Development)

The REARME study was designed to provide an objective evaluation of the operational value of Naval Academy graduates who were in the United States Navy performing their duties during the Vietnam War. The study was designed to determine the operational value of graduates that are in the United States Navy, based on the results of the REARME study, which was conducted in 1967, 1968, 1969, and 1970.

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## METHOD FOR THE TRANSPARENT OF INSULATING WALLS

Author(s): Dr. Robert A. Hoadley, President, H. H. Hoadley & Associates, Inc., 1000 North 17th Street, Arlington, VA 22209

Sponsor: Naval Academy (Operational Development)

The purpose of this study was to develop a method for the transparent of insulating walls. The study was conducted in 1967, 1968, 1969, and 1970. The study was designed to determine the operational value of graduates that are in the United States Navy, based on the results of the REARME study, which was conducted in 1967, 1968, 1969, and 1970.

with settling and transport out of the estuary as sinks. These sources and sinks are described in terms of measurable parameters such as salinity, rainfall, population density, gross national product per capita, local environmental protection effort, nature of watershed, boat traffic, wind, bottom characteristics, and nutrient inflow.

The resulting model specifies turbidity in terms of the near attenuation coefficient, with each of the sources and sinks either adding to or subtracting from some ambient level of alga determined primarily from the local salinity. A total of eight constants are included, many of which are location specific. The effect of a typical summer storm is shown by computer simulation for various assumed values of the eight constants.

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#### EFFECTS OF RECREATIONAL BOATING ON TURBIDITY AND SEDIMENTATION RATES IN RELATION TO SUBMERGED AQUATIC VEGETATION

Researchers: Assistant Professor Frederick A. Skove and  
Professor Jerome Williams (Oceanography)

Sponsor: U. S. Army Corps of Engineers

This report describes a project undertaken to study the role of recreational power boating in resuspension of bottom sediments. Suspended sediments were measured at frequent time intervals at selected stations and these values were compared with tidal currents, precipitation amounts, and boat traffic. Small (no larger than 0.4) correlation coefficients were found between each of the three possible causes of increased turbidity and the suspended sediment level. Equivalent Secchi Disc Readings were calculated for water which would limit light penetration to half that required for maximum photosynthesis at a depth of one meter, and these calculated Disc Readings were found to be close to those measured in the study area. This was interpreted to mean that a small increase in turbidity may be important in SAV survival. A mechanism involving wake associated waves rather than propeller induced turbulence was also suggested as being primarily responsible for bottom sediment resuspension.

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OPTIMAL ALLOCATION OF EFFORT AMONG SUBAREAS OF A MINEFIELD  
IN A MINE COUNTERMEASURES OPERATION

Researchers: Midshipmen I/C James V. Adams and Edward M.  
Connolly

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations (OP-95)

An optimal allocation of mine-countermeasures effort to the subareas of a minefield yields the minimum expected loss for the mine clearing operation. This study develops algorithms in the form of computer programs which utilize the data describing the minefield as input in order to produce an optimal allocation situation. The relationship between mine-countermeasures effort and expected loss is investigated, with the result that the optimal solution to any question of countermeasures effort/expected loss in a subarea of the minefield is determined by the computer programs.

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AN ANALYSIS OF SURVEY OPINIONS ON JOB SATISFACTION AND RETENTION  
OF MARINE CORPS PILOTS AND FLIGHT OFFICERS

Researchers: Midshipmen I/C John C. Aguero and Jeffrey H.  
Tuset

Adviser: Major R. L. Spooner, USMC

Sponsor: Chief of Naval Operations (OP-95)

The declining retention of aviators and flight officers is presently one of the major concerns of HQMC. This study analyzes survey responses from approximately 4000 active and recently separated Marine Corps pilots and flight officers concerning retention and job satisfaction.

\*\*\*\*\*

SUBMARINE REACTION TO AN ASW TORPEDO IN A FREEPLAY ENVIRONMENT

Researchers: Midshipmen 1/C William S. Buchanan and Stephen D. Matts

Adviser: Commander Phillip S. Marsden, USN

Sponsor: Chief of Naval Operations (OP-95)

This project utilized data from instrumented fleet anti-submarine warfare exercises to find patterns in submarine evasion from ASW torpedoes and to make recommendations for reattack procedures.

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DEVELOPMENT OF A SURFACE REPLENISHMENT SCHEDULE

Researchers: Midshipmen 1/C T. J. Donovan and E. A. Sternaman

Adviser: Lieutenant Commander Robert L. Peck, USN

Sponsor: Chief of Naval Operations (OP-95)

The Mobile Logistics Support Force is the major source for surface replenishment in the U. S. Navy. This highly efficient support fleet is crucial in maintaining the superiority of our naval forces. Therefore, it would be highly beneficial to have a systematic scheduling procedure in order to minimize the time and cost necessary for underway replenishments. At present, scheduling is accomplished by manually examining available replenishment assets and requirements, and determining a schedule for replenishment. This project reports the development of a computer assisted algorithm which determines a highly efficient replenishment schedule, which is extremely fast, and which takes into account a large variety of interrelated variables.

\*\*\*\*\*

## DETERMINING NAVIGATIONAL ERRORS IN MINEHUNTING OPERATIONS

Researchers: Midshipmen 1/C David M. Harris and Charles D. Behrle

Adviser: Lieutenant Commander Robert L. Peck, USN

Sponsor: Chief of Naval Operations (OP-95)

The first and one of the most critical steps in any mine countermeasures-effort is minehunting. One primary asset available in minehunting is the surface ship. In order to achieve the desired level of minehunting effort, it is necessary that the minehunting forces sweep the mine area by following a prescribed series of tracks. Deviation from this prescribed pattern could result in mines being undetected or improperly located. This report describes an analysis of 152 trial minehunting runs. In the analysis, the nature and magnitude of navigational errors was established. As a result of this report, it will be possible to more accurately assess current minehunting tactics, and to modify existing minehunting doctrine if necessary.

\*\*\*\*\*

## COST OF OWNING AND OPERATING AN AUTOMOBILE

Researcher: Midshipman 1/C Arcelio H. Josiah

Adviser: Commander Phillip S. Marsden, USN

Sponsor: Brigade of Midshipmen

Automobile owners are often unaware of the magnitude of the expenses they often incur as a result of owning and operating an automobile. Because of the increase in the costs of fuel, repairs and maintenance, insurance, and other automobile-related costs, it becomes advantageous for a prospective car owner to anticipate the future operational and ownership costs, and decide if he can afford an automobile and its accompanying costs. This report describes the development of an interactive computer program for estimating the operational and ownership costs of eight 1980 automobiles. The costs studied and estimated in this project were: Depreciation, Insurance, Finance Charges, License Fees, Gasoline, Repairs and Maintenance, and Replacement Tires.

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SPONSORED RESEARCH

APPLIED SCIENCE DEPARTMENT

STATISTICAL ANALYSIS OF AIM-7F TEST FIRINGS

Researcher: Midshipman I/C Michael J. Kane

Adviser: Lieutenant Commander Kevin T. Moore, USN

Sponsor: Chief of Naval Operations (OP-95)

This project analyzes the data provided from 326 firings of the AIM-7F air-to-air missile over a one-year period. The data include numerous variables which are widely recognized as being critical in the determination of successful missile performance. The effect of these variables, individually and in combination, is investigated and documented.

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THE ANALYSIS OF MINEFIELD RECONNAISSANCE DATA

Researcher: Midshipman I/C Michael T. Maliniak

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations (OP-95)

This study develops methodology for obtaining ninety-five percent confidence intervals on minefield density in mines per square mile for minefields of known and unknown dimension with the probability of detecting a mine, given it is in the searched area, is equal to one or is less than one.

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ANALYSIS OF CONVERGENT ZONE LOCATIONS AND WIDTHS

Researcher: Midshipman I/C Drew P. Meyer

Adviser: Associate Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations (OP-95)

The purpose of this report is to formalize an analysis of the convergent zone location and width for a particular submarine group in the North Atlantic. The convergent zone is defined as the location and width from the

data used by Fleet Numeric Weather Centers to produce propagation-loss profiles. When this occurs, an accurate and simple on-station estimation of convergent zone range and width is a viable alternative for using the invalid propagation-loss profiles.

\*\*\*\*\*

ESTIMATING THE PROBABILITY OF TARGET ACQUISITION BY A SURFACE-LAUNCHED HARPOON MISSILE

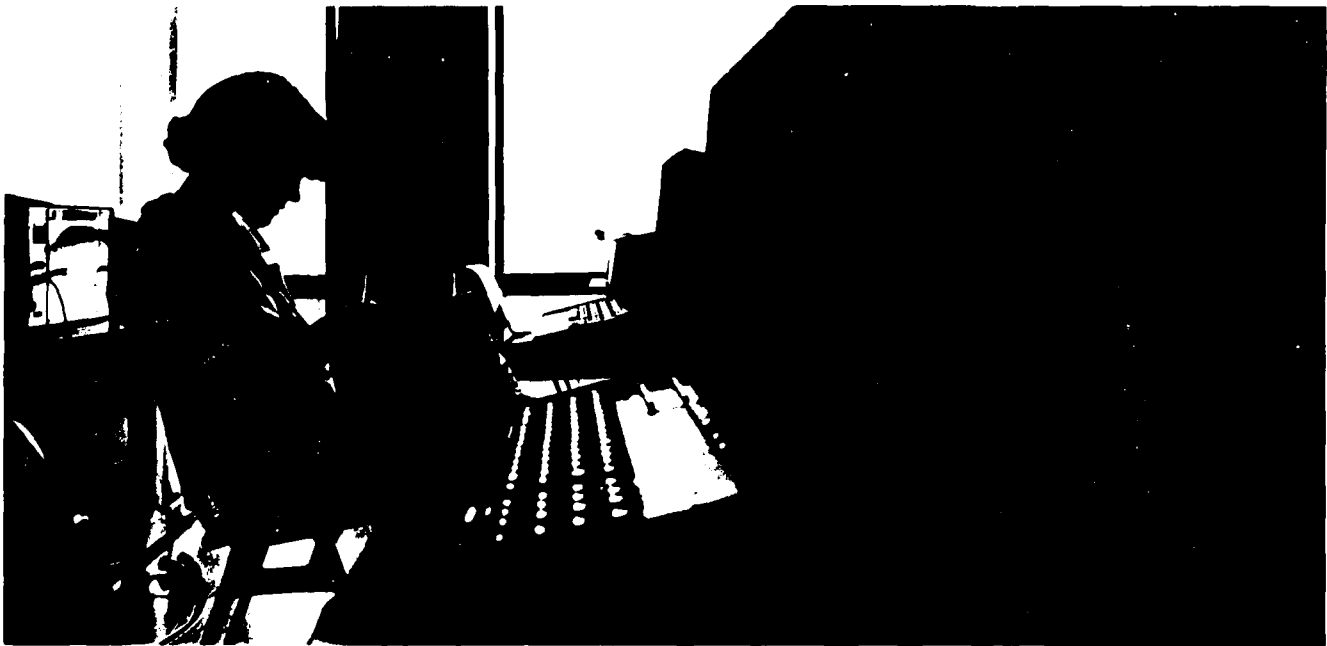
Researchers: Midshipmen 1/C Gregory Mislick and David D. Foy

Adviser: Commander Phillip S. Marsden, USN

Sponsor: Chief of Naval Operations (OP-95)

A computer simulation of the HARPOON targeting process is used to investigate the effect of missile, sensor, and environmental errors on the probability of target acquisition by the missile. The results are compared to probability estimates in recent HARPOON employment publications.

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## REDUCTION OF SYSTOLIC BLOOD-PRESSURE LEVELS

Researcher: Associate Professor Earel Monton

A civilian employee at the Academy with a 145-systolic level at start of training, was provided visual and auditory feedback as to his blood pressure levels at an update rate of three to five second intervals. Over a three week period, using three one-hour training periods three times per week the individual learned to reduce his resting systolic from 145 to 129, with the added advantage that his doctor indicated that drugs, for control, would no longer be required.

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## A MANUAL WARGAME DEVELOPED FOR USE IN A CLASSROOM ENVIRONMENT

Researcher: Midshipman 1/C John F. Herlocker

Adviser: Commander Phillip S. Marsden, USN

Although manual wargames exist which cover operational situations, at present there are no noncomputerized simulations covering antisubmarine warfare (ASW) for use in the classroom. The game ASW was designed to provide a simulation that could be learned by the average student and played within one laboratory period. The game is flexible enough to allow for the substitution of new or classified data.

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## THE INTERRELATIONSHIP OF AUDITING, BUSINESS LAW, AND ACCOUNTING

Researcher: Midshipman 1/C Jeffrey S. Reed

Adviser: Associate Professor Karel Montor

In addition to completing all required courses in the Resources Management Major, Midshipman Reed completed the following courses at the Anne Arundel Community College: Intermediate Accounting I & II, Advanced Accounting, Business Law I & II, Tax Accounting, and Auditing. For the work involved in these seven courses, Midshipman Reed was given three hours of SR496 credit. The total course completion at the Academy and the Anne Arundel Community College qualifies Mr. Reed to sit for the national CPA exam, the first midshipman ever so certified. The research aspect of this course was the studying by Mr. Reed, and the tying together of all aspects of administration, business, and management into a single framework of understanding, which will allow him to sit for and pass the CPA exam.

\*\*\*\*\*

CHI, Franklin L. K., Assistant Professor, co-author, "Solutions to Higher-order Boundary Layer Equations for Flow over a Semi-infinite Plate," The AIAA Journal, 17, (August 1979), 915-916.

The first, second, and third order solutions of the boundary layer flow past a semi-infinite plate have been found. The third order solution is new, and it predicts a larger value for the coefficient of skin friction than that which was previously calculated.

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PRESENTATIONS

APPLIED SCIENCE DEPARTMENT

HEBERT, John E., Visiting Assistant Professor, co-author,  
"Alternative Approaches to Scheduling Officials," 15th  
Annual Meeting of the Institute of Management Science -  
Southeastern Chapter, Myrtle Beach, South Carolina, 3-5  
October 1979.

\*\*\*\*\*

HEBERT, John E., Visiting Assistant Professor, "Stochastic  
Network Models and Analysis for R&D Program Management,"  
1979 IEEE Engineering Management Conference, Washington,  
D. C., 5-7 November 1979.

\*\*\*\*\*

HEBERT, John E., Visiting Assistant Professor, "Applications  
of Simulation in Project Management," 1979 Winter Simulation  
Conference, San Diego, California, 3-5 December 1979.

\*\*\*\*\*

HEBERT, John E., Visiting Assistant Professor, "A Time/Cost  
Trade-off Procedure for Projects Modelled on Stochastic  
Networks," 10th Annual Meeting of the American Institute for  
Decision Sciences - Southeastern Section, Orlando, Florida,  
20-22 February 1980.

\*\*\*\*\*

HEBERT, John E., Visiting Assistant Professor, co-author,  
"A Decomposition Approach to Project Scheduling," Joint  
National ORSA/TIMS Meeting, Washington, D. C., 5-7 May 1980.

\*\*\*\*\*

MONTOR, Karel, Associate Professor, "Instrumentation for Brain  
Wave Signal Processing," combined V International Conference  
on Medical Physics and XII International Conference on  
Medical and Biological Engineering, Jerusalem, 20 August 1979.

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PRESENTATIONS

APPLIED SCIENCE DEPARTMENT

MARTIN, David, Associate Professor, "Instrumentation for Brain Wave Signal Processing," 26th Annual Technical Meeting of the Institute of Environmental Sciences, Philadelphia, Pennsylvania, 14 May 1980.

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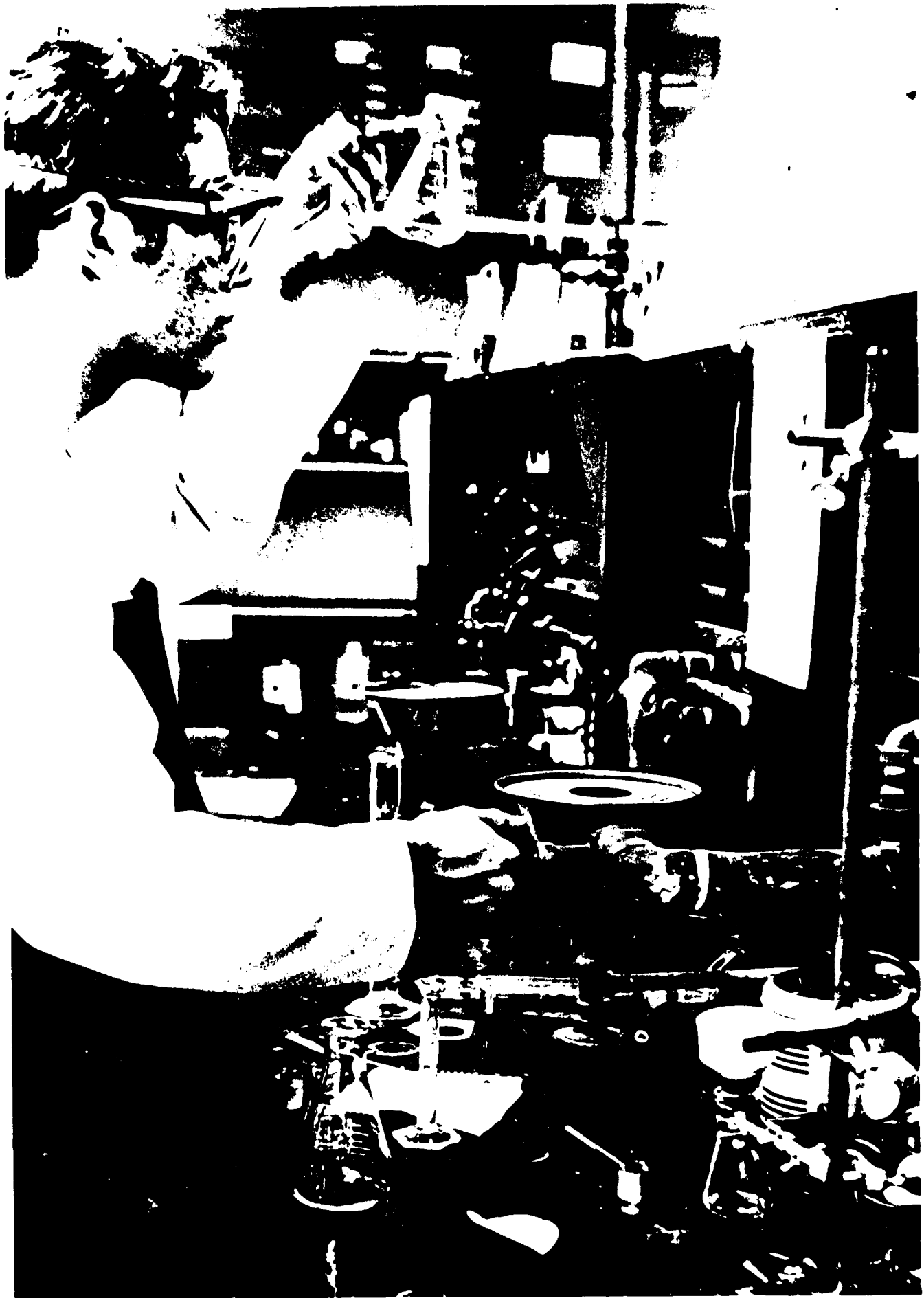
NOBLO, Anthony F., Assistant Professor, "Documentation and Indentation Effects on Memory Organization of Computer Programs," Annual Meeting of the American Psychological Association, New York, New York, September 1979.

\*\*\*\*\*

NOBLO, Anthony F., Assistant Professor, "Factors Affecting the Comprehension of Computer Programs," Annual Meeting of the National Computer Conference, New York, New York, July 1979.

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## CHEMISTRY DEPARTMENT

*Professor Samuel P. Massey, Chairman*



The research reported on in the following pages underscores two aspects of the Chemistry Department's operation.

It demonstrates the intimate interaction of faculty members and students in the list of student research projects. The establishment of a "junior-senior colleague" relationship is an important part of the maturation of our students.

The large number of publications in the biochemical field are largely fruits of research done by the officers assigned to our department. The continued demonstration of the high professional quality of our military instructions is a matter of satisfaction.

As in the past, there is a sustained relationship between the "real world" of military needs and a significant part of the department's effort. Of course, research into improved instruction continues.

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## PROTONATION PHENOMENA FOR BRIDGED FERROCENES IN "SUPER ACIDS"

Researcher: Lieutenant Thomas E. Bitterwolf, USN

Sponsor: Naval Academy Research Council

In metallocene chemistry, the effect of metal identity and oxidation state is of major significance but is obscured oftentimes by the fact that the pi systems of the cyclopentadiene rings can carry the impact to sites remote from the metal atom. The use of alkyl bridges between the rings offers an opportunity to discover the geometric changes that occur when a proton is accepted, because nuclear magnetic resonance measurements give clear-cut and reliable indication of conformational changes. From these changes, the site of proton attack can be determined. Deuteration of the starting materials provides further confirmation of the assignments.

Preparation of systems with 2-, 3-, 4- and 5-carbon bridges, as well as use of some multiple bridged materials, permitted study of protonation site, electrophilic substitution mechanism, and oxidation mechanism on both ring and metal. The studies utilized variable temperature techniques for nmr, mass spectra, ir, thin layer and column chromatography etc. for both compound identification and process study.

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## PHOTODISSOCIATION DYNAMICS OF POLYATOMIC MOLECULES

Researcher: Assistant Professor Mark L. Elert

Sponsor: Chemistry Division, Naval Research Laboratory

Preliminary work was begun to develop the capability to perform semi-empirical and ab initio electronic structure calculations using the Advanced Scientific Computer at the Naval Research Laboratory. To date, the integral evaluation portion of a CNDO computational scheme has been completed and tested. When complete, these programs will be used to generate wavefunctions and potential energy hypersurfaces for small polyatomic molecules. This information is a prerequisite for successful prediction of fluorescence lifetimes and dissociation rates of molecules in the gas phase in the presence of intense laser radiation. The photodissociation dynamics of hydrogen cyanide (HCN) will be studied in detail as a prototype of such calculations.

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## TITANIUM USE IN CONDENSER TUBE SYSTEMS

Researcher: Associate Professor Frank J. Gonda

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

A survey of recent literature was undertaken and coupled with communications with persons involved in the utilization of titanium and titanium alloys for the construction of condenser-tube systems to be used aboard submarines and surface ships for the Navy. The intent was to assess the possible performance of titanium under operating conditions with regards to the various types of corrosion.

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## THE EFFECT OF PROPYLENE GLYCOL DINITRATE ON SEVERAL TEMPERATURE SENSITIVE PHYSIOLOGIC FUNCTIONS

Researchers: Ensign Stephanie A. Pluskota, USNR and Captain Gerald Tozzi, USA

Sponsor: Naval Academy Research Council

The purpose of this ongoing project was to use a chemical reagent to lower the core body-temperature of experimental animals so that the effect of a sustained temperature drop on spermatogenesis, basal metabolic rate, and glycogenolysis might be studied.

The chemical chosen was propylene glycol dinitrate (PGDN), a major component of torpedo fuel as well as of other fuels used by the Navy. Researchers at the Naval Medical Research Institute (NMRI), Bethesda, Maryland, had previously determined that PGDN was capable of depressing core body-temperature in mice.

The first series of injections, using dosages previously tested at NMRI showed that PGDN was much more lethal for rats than for mice. Rats develop cyanosis a short period of time after injection of small amounts of pure PGDN. All but one of 25 experimental animals died following PGDN injection.



The PBN was dissolved first in an ethyl-alcohol carrier and injected into the next group of rats. A much reduced response was noted at this time. No effect was noticed. Using the same dilution factor, responses were increased until the original lethal range of response was reached. The alcohol seems to mitigate the lethal dose effects of PBN without destroying its temperature-lowering qualities.

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#### INVESTIGATION OF UTILITY FOR A CONTINUOUS ACTIVE-CHLORINE MONITOR TO BE USED IN HEAT EXCHANGER SYSTEMS USING SEAWATER

Investigator: Associate Professor Robert R. Kemler

Organization: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

A commercially-available, amperometric probe for the continuous monitoring of "active chlorine" present in water is used to monitor effluent coolant water from the heat exchangers in many power plants located on sites where fresh or perhaps slightly brackish water is available. Attempts to utilize the same probe in setups using seawater as coolant have been hampered. This work sought the cause of the difficulty.

The problem was attacked by making up standard hypochlorite solutions, and titrating with a Fischer Titrimeter after measuring the chlorine content with the recalibrated Delta probe. These experiments showed that the probe gave good results under the experimental conditions.

When, however, a synthetic seawater was used instead of distilled water for making up the standard hypochlorite and from the probe was a failure. Two factors entered heavily into this result. The probe actually responds significantly only to HOCl. The concentration of  $\text{POCl}^-$  vs.  $\text{OCl}^-$  is very pH-sensitive, so that at pHs greater than ca. 4 - most of the "Cl" is present as the ion. Since seawater normally has a pH greater than 8, the probe is blind to the "Cl". Furthermore, seawater contains ca. 65 ppm  $\text{Br}^-$  which is immediately oxidized by HOCl producing HOBr which itself can be measured by a suitably-designed probe but not one calibrated for HOCl.

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STUDY OF SOLVENT INDUCED SHIFTS IN THE UV ABSORPTION MAXIMUM  
AS A MODE OF QUANTIFYING HYDROGEN BONDING

Researcher: Professor Charles F. Rowell

Sponsor: Naval Surface Weapons Center, White Oak Laboratory

In the continuing search for reliable ways to measure the forces between molecules, such as components of a solid propellant system, several inorganic complexes and a couple of organic dyes were prepared.

Measurement of the uv or visible spectrum of these materials in a variety of solvents with a range of hydrogen-bonding characteristics permitted the solvent dependence to be measured. This information was then included in the basic set used to establish the quantitative equation for hydrogen bonding as proposed by Kamlet and Taft.

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RELIABLE TEST MATERIALS

Researcher: Associate Professor John W. Schultz

Sponsor: National Security Agency

The researcher produced X-ray fluorescence standards for use in calibrating and cross-checking laboratory equipment.

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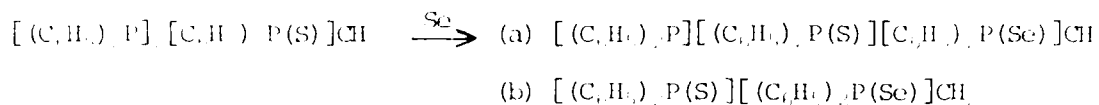
TRIS(DIPHENYLPHOSPHINO)METHANE: CHEMISTRY

Researcher: Instructor Edward D. Walton

Sponsor: Naval Academy Research Council

The tris(diphenylphosphino)methane adducts with the halogens (O, S, Se) are a new class of organophosphorus compounds which show some unique chemical properties and serve as models for investigation of nuclear magnetic resonance (NMR)

parameters. The chemistry of these compounds is of interest because some show a rather facile cleavage of a carbon-phosphorus bond to yield bis(diphenylphosphino) methanes.




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(a) TrisSSe                      (b) BisSSe

Preliminary studies show that the percent breakdown of the Tris compound is increased significantly by a change in solvent from benzene to toluene. This suggests that the availability and ease of hydrogen abstraction from the solvent is important. A study of this reaction in a deuterated solvent,  $C_6D_6$ , for example, can provide necessary verification of solvent participation in this decomposition. The preparation of a series of tris adducts with oxygen, sulfur, and selenium (needed for NMR studies) requires the control of this cleavage.

Work towards the preparation of the TrisS is underway. All the "Tris" compounds are somewhat difficult to prepare being both air sensitive and prone to cleave. All starting materials have been prepared at this point and some mass spectral studies are undertaken prior to the kinetics.

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#### COMPOSITION AND PROPERTIES OF FUELS IMPORTANT FOR COMPARISON OF FUELS FROM DIFFERENT SOURCES

Researcher: Professor John G. Zimmerman

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

A critical literature search was conducted in order to prepare a chapter for the Annual Technical Report for Fiscal 1979 for Synthetic Fuel Characterization and Crude Assay Program, David W. Taylor Naval Ship Research and Development Center.

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COMPUTER APPLICATIONS TO GENERAL CHEMISTRY

Researcher: Professor Don G. Sheets

In an ongoing program to develop tutorial, laboratory data-reduction, and random-quiz-generating programs, a large number have been written. Seventeen tutorial programs, of which 15 have been validated by midshipmen use and opinion survey, have been completed. Fifteen laboratory-data-reduction programs for use in grading laboratory performance have been validated with a portion of the plebe class.

The quiz-generating programs permit the development of short quizzes, hour exams or computer-terminal quizzes.

Data collected from the midshipmen support the concept of greatest need and use among the less well-prepared students.

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## PREPARATION OF COBALTOCENE AND ITS PROTONATION

Researcher: Midshipman 1/C Jeffrey Abel

Adviser: Lieutenant Thomas E. Bitterwolf, USN

Cobaltocene is a well-known transition metal complex that is easily oxidized to the cobalticinium ion, which is isoelectronic with ferrocene. As much of our work has been in the area of ferrocene protonation, it was of interest to determine if cobaltocene is susceptible to protonation under similar conditions. Preparation of the compound was hindered by its extreme sensitivity to oxidation.

\*\*\*\*\*

## SOME SUBSTITUTION REACTIONS OF A PLANAR COBALT(III) COMPLEX

Researchers: Midshipmen 1/C Larry E. Arkley and Douglas J. Fuse

Adviser: Professor John G. Zimmerman

Cobalt(III) normally forms stronger bonds to ligands containing nitrogen or oxygen rather than sulfur. It is known that planar-forcing ligands such as dimethylglyoxime reverse this preference.

Syntheses of  $H[Co(DH)Cl_2]$ ,  $[Co(DH)(H_2O)(Cl)]$  and  $Co(DH)(H_2O)^+$  ion were performed and characterization completed. Three substituted thioureas were screened as ligands. Thiourea and diethylthiourea were used to carry out kinetic runs at pH 5 and unit ionic strength. Two discrete rates were observed for the substituted thiourea, indicating differences in the 1st and 2nd substitution process.

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## PREPARATION OF ORTHOHEXAPHENYLENE AND SUBSEQUENT METAL INSERTION

Researchers: Midshipmen I/C Joseph Doyle and James Brinkman

Adviser: Lieutenant Thomas E. Bitterwolf, USN

Orthohexaphenylene is a unique compound first prepared by Wittig in 1971. It features six benzene rings connected in a ring which assume a conformation in which three of the rings pucker upward while the remaining three pucker downward. The cavities formed by these rings are seemingly ideal for introduction of a transition metal atom such as Chromium. Preparation of the orthohexaphenylene is a seven-step procedure yielding only small amounts of the desired products.

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## HETEROCYCLIC THIOSEMICARBAZONES AS POTENTIAL ANTIMALARIALS

Researchers: Midshipmen I/C Joseph Doyle, James Gerding,  
Kurt Schmidt, Stephen Johnson

Adviser: Professor Samuel P. Massie, Jr.

As part of an ongoing program in connection with Walter Reed Army Institute, a series of thiosemicarbazones was prepared.

All members of the series were derived from 2-acetylquino-  
line, an intermediate which offered some difficulty in  
preparation. The variation of the series was produced by  
substitution of various secondary amines on a common xanthate  
intermediate.

Six new compounds were made and characterized spectrally.  
They will be submitted for biological screening. An early  
member of the series has been found to have unusual anti-  
bacterial properties.

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## KINETICS OF THE DECOMPOSITION OF TRIS(DIPHENYLPHOSPHINO)METHANES

Researchers: Midshipmen 1/C James B. Ervin and Manuel R. Rivera

Adviser: Instructor Edward D. Walton

It is known that compounds of the type  $[(C_6H_5)_2P]_3CHP(X)(C_6H_5)_2$ ;  $X = O, S, Se$ , easily break down to form compound  $(C_6H_5)_2P-CH_2-P(X)(C_6H_5)_2$ . The mechanism of this decomposition of tris(diphenylphosphino) compounds to their "bis" analogs is of interest in order to avoid this breakdown in the preparation of "tris" compounds. The purpose of this study is to determine what factor affects the decomposition reaction and how it can be prevented. One tris compound in particular, tris S, was found to break down to varying extents in different solvents, when it was allowed to react with Se to produce Tris SSe and Bis SSe. The study of this reaction in a deuterated solvent  $C_6D_6$  could yield information concerning the need for having hydrogen atoms available for abstraction from the solvent.

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## PREPARATION OF BRIDGED FERROCENES

Researcher: Midshipman 1/C James Fenton

Adviser: Lieutenant Thomas E. Bitterwolf, USN

Bridged ferrocenes in which two ferrocenyl moieties are held side by side have been prepared by several groups in very low yields, typically 1-5%. Observations of hydrogen evolution from acid solutions of these compounds by Bitterwolf have recently been confirmed and these compounds are actively studied as possible electrode-coating for solar generation of hydrogen. This work is severely limited by the difficulty of obtaining practical quantities of the required compounds.

Midshipman Fenton's research was directed toward improvement of existing procedures and development of new synthetic routes for the preparation of bridged compounds. His work clarified ambiguities existent in the literature dealing with the preparation of ferrocenyl carboxylic acid chlorides and provided initial evidence for the feasibility of a synthetic route via dilithioferrocene and pressure. This work is continuing as an integral part of Lieutenant Bitterwolf's NARC project.

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## METAL COMPLEXES OF TRIS ORGANOPHOSPHORUS CHALCOGENIDES

Researcher: Mishipman 1/C James E. Denton

Advisor: Instructor Edward D. Walton

Bis-(diphenylthio)pheno(diphenylthiophosphoryl)methane [ $(C_6H_5)_2P(SPh)_2CH(Ph)_2$ ] is one of a new class of organophosphorus ligands and has three potential coordination sites. This ligand, however, acts as a bidentate due to steric constraints. As a bidentate this compound offers two possible linkage isomers in complexes with either metal carbonyls or metal halides: (A) linkage to the metal via the two phosphorus atoms forming a four-membered chelate ring; or, (B) linkage via one phosphorus atom and the sulfur atom, forming a five-membered ring. The purpose of this study was to see if, indeed, both isomers are formed and to note the ratio of these isomers. Also, if the sulfur atom is changed to oxygen, or selenium "in the same family," this ratio may reflect the stability of the strained four-membered ring isomer relative to the five-membered ring isomers, considering the differences in coordination strengths of oxygen, sulfur, and selenium. Some complexes with metal carbonyls should prove more soluble so that conformational studies can be more easily carried out. In the present study the preparation of the ligands was undertaken.

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## THE POTASSIUM CONTENT OF ORANGE JUICES

Researcher: Mishipman 2/C Mary Hewitt and Kimlynn Jones

Advisor: Professor Orville W. Rollins

The potassium content of several varieties of commercially available frozen orange juice was determined by flame photometry. Samples of fresh orange juice were also studied. All samples after filtration showed a decided decrease in their potassium level. Overall, the potassium content of frozen orange juice is approximately 1.5 times that of the fresh variety.

This study is significant because many people who are being treated for cardiovascular ailments are directed to supplement their potassium intake by drinking orange juice. Some (perhaps all) physicians are unaware of the difference and will recommend fresh juice strongly over frozen.

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INSTRUMENTAL STUDY OF EQUILIBRIA FOR A DYE MOLECULE USED TO  
PROBE HYDROGEN BONDING

Researcher: Midshipman I/C Roger K. Ishii

Adviser: Professor Charles F. Rowell

One of the dyes that was prepared to study hydrogen-bonding phenomena was found not to produce linear wave-length shifts with variation of the usual parameters. Exploration of the system found that the material was two isomers in equilibrium with each other. The color shift observed was not due to simple solvent effects on the molecule but on the shifting equilibrium.

The use of instrumental techniques permitted the assignment of probable structures to the species in solution.

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SYNTHESES OF MODEL COMPOUNDS FOR STUDY OF PHOTODECOMPOSITION  
OF NITRAMINE EXPLOSIVES

Researcher: Midshipman I/C Roger K. Ishii

Adviser: Professor Charles F. Rowell

In earlier work in this laboratory, it has been established that nitramine explosives undergo decomposition under the influence of ultra-violet light. A central compound in the proposed mechanism of such decomposition is a hydroxylamine intermediate.

Two separate routes to synthesis of this intermediate were undertaken with promising results but purification of the product led to decomposition.

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## METAL COMPLEXES OF TRIFLUOROACETYL-ACETONEATE

Researcher: Midshipman I/C Wyatt B. Pratt

Advisor: Lieutenant Thomas E. Bitterwolf, USN

Acetylacetonates of numerous metals are known and have been used as reaction intermediates as well as research compounds in their own right. Generally, these complexes are octahedral with three acetylacetonate ligands complexed to the central metal atom. When substituent atoms are added to the acetylacetonate, structural isomerization can occur. Under favorable circumstances these isomers can be separated and studied by instrumental techniques such as NMR. Eight compounds were prepared and the isomers of one pair separated.

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## METAL ATOM REACTOR CHEMISTRY

Researcher: Midshipmen I/C Mark Russell and P. Dimitrow

Advisor: Lieutenant Thomas E. Bitterwolf, USN

Metal atom chemistry is a new field in which metal atoms from a metal source are reacted directly with a liquid material on the surface of a very cold reactor vessel. This technique allows the preparation of numerous compounds which have not been possible before. Installation and tuning up of the reactor was followed by preparation of bis(benzene)chromium as a check on the successful operation.

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## CYTOLOGICAL STUDIES OF ORCHID CHROMOSOMES

Researcher: Midshipman I/C Edward L. Spear

Advisor: Assistant Professor D. Lawrence Weingartner

The study consisted of a literature search followed by laboratory experiments; published techniques for the histological identification of the mitotic chromosomes of plants were applied to phalaenopsis orchid root-tips.

The study included most phases of microscopical technique, including fixation, staining, and both section and non-section methods of tissue preparation. Comparisons of the various techniques were made in an attempt to develop a method suitable for making chromosome counts of phalaenopsis hybrids. The project, still in a preliminary stage of investigation, is required for the establishment of a scientifically-based phalaenopsis-breeding program.

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EMERSON, Mauna A., English, USNR, co-author, "Effects of *Acholeplasma laidlawii* and an unidentified mycoplasma on selected fish cell cultures and the replication of fish viruses," *Journal of Fish Diseases*, 2 (1979), 227-238.

An unidentified mycoplasma was isolated from cultures of Atlantic salmon (AS) cells and implicated as the cause of cytopathic effects (CPE). The agent did not visibly affect HEp-2 cells. Experimental infection of HEp-2 cells with *Acholeplasma laidlawii* resulted in increased cellular granularity and destruction. Scanning electron microscopy (SEM) examination of infected HEp-2 and AS cultures revealed typical mycoplasma filamentous cell surfaces and a marked effect on the cell-membrane topology, characterized by a loss of microvilli and cellular processes. SEM also revealed mycoplasma contamination that was not detected by culture. Contaminated, contaminated and contaminated HEp-2 cells showed enhanced 10-100 fold replication of infectious pancreatic necrosis virus (IPNV) and infectious haematopoietic necrosis virus (IHNV) in the presence of *A. laidlawii*.

\*\*\*\*\*

EMERSON, Mauna A., English, USNR, co-author, "Effect of Particulation on the Inactivation of Bacteria and Viruses in Water," Report to Environmental Protection Agency, January 1979. (Grant # R-804527)

This program was to determine the effect of particulates on ozone inactivation of enteric bacteria and viruses adsorbed to or incorporated into these materials. The particulate materials were fecal material, HEp-2 cells, aluminum oxide flake and bentonite clay. Fecal coliforms, poliovirus (Sabin Type 1), Coxsackievirus A9, porcine picorna-virus type 3 (PPV-3), and a bacteriophage were used in this study. The concentration of particulates to which the bacteria or viruses were adsorbed to or incorporated into before ozonation was 1 or 5 Nephelometric Turbidity Units (NTU).

Results of the ozonation study indicate that the encasement or adsorption of enteric bacteria and viruses in fecal material, both human and porcine, and HEp-2 cells protects these microorganisms from a concentration of ozone and contact-time that would normally inactivate the bacteria and viruses in an unadsorbed or free state. It was necessary to maintain a concentration of 5.13 to 4.81 mg/L ozone to inactivate the cell-associated coxsackievirus in 5 to 10 minutes. The ozone

concentration and the time required to inactivate the virus was determined in terms of the volume percentage of low molecular weight polyethylene glycol present in the medium. Hydrated aluminum oxide, bentonite clay, attapulgite, feldspar, and kaolin were found to be more effective than other polymeric and inorganic materials in terms of particle size over that of the microorganisms in the test system. The 10 percent phosphate adsorbed to bentonite clay particles was inactivated at a lower rate than the free phosphate in the medium.

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WADA, Masao, Associate Professor, "Search for the Body of a Japanese Soldier Lost in Vietnam with Army West Pointers," *Japan's Foreign News*, vol. 1 (1971), 34-35.

WADA, Masao, Associate Professor, "Body of John Paul Jones Located in Vietnam," *Hereward Journal to United States*, vol. 3, (1973), 11, 12-13.

WADA, Masao, Associate Professor, "Body of John Paul Jones Located in Vietnam," *United States Naval Academy in Annals*, vol. 1 (1971), 53, 54.

WADA, Masao, Associate Professor, "The Search for the Body of John Paul Jones," *Hereward Journal to the United States*; and "The Search for the Body of John Paul Jones," *United States Naval Academy*.

\*\*\*\*\*

WELLS, William Norman, M.A., "War and Morality," *The Social Contract Review*, vol. 19 (1973), 110-112; 143-147.

This two-part study traces the use of force and violence in world history and offers a moral perspective on the moral dilemmas throughout history.

\*\*\*\*\*

WILKINSON, Laura, Associate Professor, "Qualitative Analysis of the Ethical Dimensions of Business Decisions," *Journal of Business Ethics*, vol. 1 (1982), 267.

A sequential program to obtain the teaching methods of participants in a study which administered the *Business Ethics* survey is reported.

\*\*\*\*\*

HOLLINS, Orville W., Professor, co-author, "A new 115-116-117-  
sulfate(III)," Journal of Inorganic and Nuclear Chemistry,  
41 (1979), 1797-1800.

A method has been developed for preparation of a new 115-  
116-117-sulfate(III) heteropoly anion, tentatively formulated as  
[ $(SO_4)_3W_3O_{12}$ ]. Both ammonium and sodium salts have  
been studied. Potentiometric titrations were run with  
the anionic charge and they showed that neither of these anions  
contain acidic hydrogen ions. They also establish the  
NaOH demutation plateau for this heteropoly sulfatate  
series at the unusually high pH of 8. X-ray fluorescence and  
an saturated sodium sulfate solution reveal, respectively,  
that the anion is a dimeric species. The sodium salt is  
extremely soluble in water producing high clarity, colorless,  
and very stable solutions.

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HOLLINS, Orville W., Professor, co-author, "Demutation of  
115-116-117-sulfate(II) Anion, Cupro(II) and Manganic(II)  
115-116-117-sulfate(II) Preparation, Properties, Structure  
and Salts," Journal of Inorganic and Nuclear Chemistry, 41  
(1979), 371-376.

A method has been developed for the preparation of both  
115-116-117-sulfate(II) of cupro(II) - and manganic(II) 115-  
116-117-sulfate(II).

X-ray structural studies are in agreement with a "tetra-  
mer" structure for both of these heteropoly sulfatate anions.

Thermogravimetric studies showed that the Cu(II) form is  
thermally demutated in its anion.

By contrast when the saturated sodium sulfate (saturated  
with both heteropoly anions) are precipitated by  
ethanol, demutation is almost absent at 33°C.

Potentiometric titrations showed that cupro(II) - and  
manganic(II) 115-116-117-sulfate(II) anions react with 4,  
4'-di-2,6-dimethylphenylpyridine to form a complex, respectively.

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SUMMARY OF RESEARCH ACTIVITIES, ACADEMIC DEPARTMENTS, 1979-1980--ETC

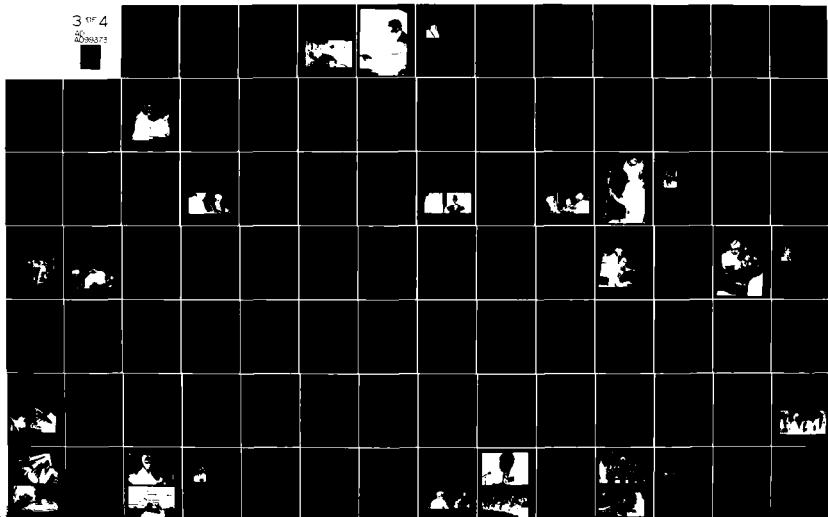
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SCHULTZ, Warren W., Lieutenant Commander, co-author, "Demonstration of specific antibodies to a coxsackie-like virus in patients of a hepatitis outbreak," American Journal of Epidemiology, 110 (July 1979), 124-131.

Lynchburg fecal virus (LFV), originally isolated from the stool of an infectious hepatitis patient, was passaged 15 times in WI-38 cells and partially characterized. Its properties are as follows: RNA virus; 27 nm in diameter, picornavirus-like morphology; inactivated at 56 C for 60 min; resistant to treatment with hydrochloric acid (pH 3.0), chloroform (33%), and diethyl ether (20%). Neutralization studies indicated that LFV is sero-related to Coxsackievirus A-24 but not to prototype hepatitis A virus (HAV). An epidemiological relationship between LFV and HAV, however, was found when examining by enzyme immunoassay (EIA) the sera of infectious hepatitis patients of the Lynchburg outbreak. Absence of anti-LFV in patient sera was accompanied by an absence of anti-HAV and, conversely, an increased titer in anti-LFV was accompanied by an increased titer in anti-HAV. Each antibody type was shown to be elicited independently indicating simultaneous infections with LFV and HAV. The contribution, if any, of LFV to disease in the outbreak remains unknown.

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SNYDER, Stephen L., Lieutenant Commander, co-author, "Release of  $\beta$ -glucuronidase from Peritoneal Macrophages of Normal and Endotoxin-tolerant mice," Canadian Journal of Microbiology, 25(1979), 1245-1251.

Lysosomal enzyme release from cells involved in inflammatory response could play a central role in the pathogenesis of endotoxin shock. Therefore we have studied the release of the lysosomal enzyme,  $\beta$ -glucuronidase, from peritoneal macrophages obtained from normal and endotoxin-tolerant B6CBF1 mice both before and after challenge with lethal doses of endotoxin. Unstimulated cells from tolerant mice spontaneously released a smaller percentage of their total  $\beta$ -glucuronidase content in culture than cells from normal mice during a 5-h incubation period. In support of the lysosomal-enzyme release hypothesis, it was found that the in vitro release of  $\beta$ -glucuronidase was accelerated when cells were collected from the mouse peritoneum 3 h after i.v. challenge with a lethal dose (1.0 mg) of endotoxin. The increased in vitro "leakiness" of peritoneal macrophages following endotoxin challenge was less marked when tolerance was induced in mice by prior repeated injections of endotoxin. Furthermore, measurements of the total enzyme activities of



peritoneal cells revealed a significant reduction in the  $\beta$ -glucuronidase content of cells from normal mice 3 h after endotoxin challenge but no such decrease for cells from tolerant mice. These results suggest that macrophages in endotoxin-sensitive mice release their lysosomal enzymes in vivo during endotoxemia, whereas cells found in tolerant mice do not.

In related experiments, the phagocytosis of latex particles and inhibition of bacterial growth by macrophages from normal and tolerant mice were compared. These studies suggest that cells from tolerant mice may also release a smaller percentage of their lysosomal enzymes during phagocytosis.

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SOPER, John W., Instructor, co-author, "Mitochondrial ATPase Complex, A dispersed, cytochrome-deficient, oligomycin-sensitive preparation from rat liver containing molecules with a tripartite structural arrangement," Journal of Biological Chemistry, 254 (1979), 11170-11176.

A stable, oligomycin-sensitive, ATPase preparation can be isolated from rat liver mitochondria by refinement of the deoxycholate-solubilization procedure (Soper, J.W., and Pederson, P.L. (1976) Biochemistry 15, 2682). NADH dehydrogenase, succinic dehydrogenase, and cytochrome oxidase activities cannot be detected by enzymatic assay. Spectral measurements reveal that the content of individual cytochromes is less than 0.05 nmol x mg<sup>-1</sup> protein. ATPase activity of the preparation (~13  $\mu$ mol ATP hydrolyzed/min/mg) is inhibited more than 80% by oligomycin. Electron microscopy of the freshly isolated preparation reveals it to be highly dispersed and membrane-free, and to contain molecules exhibiting a tripartite structural arrangement consisting of the F<sub>1</sub>-ATPase headpiece, a basepiece, and a stalk connecting these two units. The thickness of the basepiece (~60 A) is sufficient to span the hydrophobic phase of the inner mitochondrial membrane. Two types of F<sub>1</sub>-headpieces are present, one of which exhibits the typical spherical structure of membrane-bound F<sub>1</sub>, and a second of which is more compact and elliptical in appearance. Polyacrylamide gel electrophoresis in sodium dodecyl sulfate reveals the presence of all sub-units of F<sub>1</sub>-ATPase, the oligomycin sensitivity-conferring protein, and several additional polypeptides which are candidates for the basepiece. When bound to soy bean phospholipid vesicles, the preparation catalyzes an oligomycin-sensitive ATP-P<sub>i</sub> exchange reaction in the absence of other protein-coupling factors. This report summarizes the first description of the properties of an oligomycin-sensitive

ATPase preparation from rat liver, and the first description of an energy-transducing ATPase preparation in which individual molecules in dispersed form are seen to exhibit clearly a tripartite headpiece-stalk-basepiece arrangement.

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ZIMMERMAN, John, Professor, "Composition and Properties of Fuels Important for Comparison of Fuels from Different Sources," Annual Technical Report for Fiscal 1979 for Synthetic Fuel Characterization and Crude Assay Program, David W. Taylor Naval Ship Research and Development Center, October 1979.

In examining new or alternate fuels, tests must be performed to assure compatibility with use. Those considerations of importance are: elemental composition, especially sulfur, nitrogen and metals; aromaticity; and, physical properties such as boiling range, storage stability, thermal stability, luminosity, and general burning characteristics.

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SCHULTZ, W. W., Lieutenant Commander, co-author, "An Enzyme-Linked Immunosorbent Assay (ELISA) for Pseudomonas aeruginosa exotoxin A.," Journal of Clinical Microbiology, 9 (July 1979), 705-708.

An enzyme-linked immunosorbent assay (ELISA) is described for Pseudomonas aeruginosa exotoxin A. A double antibody-sandwich method was used employing polyvinyl microtiter plates as the solid phase, a primary coat of monospecific rabbit antitoxin serum, an outer layer composed of a horse radish peroxidase-sheep antitoxin IgG conjugate, and an ortho-phenylene-diamine substrate. Absorbance of hydrolyzed endproduct was read spectrophotometrically at OD<sub>492</sub>. ELISA detected as little as 30 pg (0.3 ng/ml) of purified toxin and absorbance was linear over a 20-fold or greater concentration range. Toxin was demonstrated in culture filtrates from 42 of 48 (88%) consecutive clinical P. aeruginosa isolates compared with 37 of 48 (77%) positive by hemagglutination inhibition. Results of the two assays correlated closely ( $r=0.82$ ,  $p<0.001$ ). Specificity was confirmed by neutralizability of ELISA activity with monospecific antitoxin. ELISA was thus a sensitive, specific, and quantifiable technique for the assay of P. aeruginosa exotoxin A in both purified and crude culture materials.

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PRESENTATIONS

CHEMISTRY DEPARTMENT

MASSIE, Samuel P., Professor, "Heterocyclic Thiosemicarbazones as Antimalarial and Antibacterial Agents," Northeastern Regional Meeting, American Chemical Society, Syracuse, New York, October 1979.

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WALTON, Edward D., Instructor, "The Nature of the Phosphoryl Bond: NMR Studies of Phosphine Calogcogens," Howard University Colloquium Series, Washington, D.C., October 1979.

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WALTON, Edward D., Instructor, "The Properties and Uses of Polymers," 7th Annual Meeting of the National Organization of Black Chemists and Chemical Engineers, Washington, D.C., May 1980.

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## MATHEMATICS DEPARTMENT

*Professor Theodore J. Benac, Chairman*



Research is an integral part of the professional activities of the members of the Mathematics Department. Areas of research reflect a wide range of interest. Present activity includes research in algebra, group theory, algebraic geometry, topology, shape theory, non-standard analysis, partial differential equations, analytic functions theory, combinatorics, graph theory, probability and statistics, and lattice theory.

The research activity of the staff has produced a considerable number of scholarly papers and presentations. Sources of funding have included the Naval Academy Research Council, the National Science Foundation, and the David Taylor Naval Ship Research and Development Center.

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## INHOMOGENEOUS CAUCHY-RIEMANN EQUATIONS OF SEVERAL COMPLEX VARIABLES

Researcher: Assistant Professor James Buchanan

Sponsor: Naval Academy Research Council

Certain systems of first-order elliptic partial differential equations can be written as inhomogeneous Cauchy-Riemann equations. The case of one complex variable has been studied at length. Concerning the case of several complex variables, which is distinguished from the one-variable case by the presence of consistency conditions on the inhomogeneous terms, much less is known. W. Tutschke has developed an existence-theory when underlying domain is a polydisk. Also A. Koohora has proved a similarity principle when the inhomogeneous term is real-linear in the unknown functions.

The investigator is seeking to extend results such as these. For instance, an existence-theory may be possible for domains other than polydisks for which there are analogues of the Cauchy integral formula. Also, the real-linear case should be studied in greater detail when the coefficient functions are analytic functions of their real arguments by employing the complex Volterra equation methods introduced by I. N. Vekna for the one-variable case.

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## DEFORMATION OF ALGEBRAS

Researcher: Assistant Professor Jane P. Coffee

Sponsor: Naval Academy Research Council

The goal of this project is the determination of analogues of results obtained by Nijenhuis and Richardson in the analytic deformation theory by using the tools of algebraic deformation-theory. In their joint paper, Corwin, Neeman and Sternberg describe a construction which associated a graded Lie algebra structure to a filtered associative algebra satisfying certain conditions. When this construction is applied to the ring of differential operators on a manifold, the algebra of Poisson brackets is obtained. The following result has been established: under the Corwin-Neeman-Sternberg construction the rigidity of the graded Lie algebra is equivalent to the rigidity of the filtered associative algebra.

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## NIPOTENT PRODUCTS OF CYCLIC GROUPS

Researcher: Assistant Professor Anthony M. Gaglione

Sponsor: Naval Academy Research Council

Let  $G$  be a free product,  $G = G(1) * G(2) * \dots * G(s)$  where  $G(i)$ ,  $1 \leq i \leq s$ , is a cyclic group and for at least one  $i$   $G(i)$  is finite ( $s$  is finite). Let  $G_n$  denote the  $n$ th subgroup of the lower central series of  $G$ . The main objective of this investigation is to study the groups of the form  $G_n = G/G_{n+1}$  ( $n=1,2,3,\dots$ ), called the  $n$ th nilpotent product of the groups  $G(i)$ . In collaboration with H. V. Waldinger, the investigator has found presentations for the Groups  $G_n$  where  $1 \leq n \leq 2p - 1$  ( $p$  being the smallest prime which divides the orders of any of the generators of  $G$ ). This was done by reexamining a previous joint-paper from the point of view of commutator calculus. The continuation of this work will be geared towards refining these proofs and extending them to a larger class of groups.

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## A STUDY OF COVERING PROPERTIES OF SCATTERED TOPOLOGICAL SPACES

Researcher: Assistant Professor Marlene E. Gewand

Sponsor: Naval Academy Research Council

The object of this project is to characterize scattered spaces which are compact, Lindelöf or paracompact and to determine properties of these spaces. From these characterizations, the covering properties of the cartesian product of  $\alpha$  factors will be investigated, where  $\alpha$  is finite, countable or a limit cardinal and where  $\beta$  of the factors ( $\beta$  less than or equal to  $\alpha$ ) are scattered spaces with a given property.

On the question of product-spaces, preliminary research has yielded results for finite products with different and simpler methods than previously published results by others. It can be shown, for example, that a product of a Lindelöf-scattered space with any other Lindelöf space is Lindelöf. However, to date these methods have not been extendable to countable products. Rather, it has been necessary to use a more involved technique, by means of the Cantor-Bendixon decomposition and a modification of Kunen's tree-type method, to investigate

countable products. So, for example, by this technique it has been shown that the  $G_\delta$  - topology on a countable product of compact scattered spaces is Lindelöf. It appears that these techniques will again have to be modified and expanded to consider uncountable products as well as countable products of Lindelöf scattered spaces.

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#### GRADED MODULES AND PROJECTIVE ALGEBRAIC GEOMETRY

Researcher: Assistant Professor Charles C. Hanna

Sponsor: Naval Academy Research Council

This project is a continuation of an earlier Naval Academy Research Council project "Basic Elements in Graded Rings." That project resulted in a generalization to graded modules of the Eisenbud-Evans theorem on basic elements.

The primary objective of this research is to extend that result and investigate its consequences, particularly as applied to projective and quasi-projective schemes. A paper, prepared by the researcher, contains the theorem mentioned and an application to locally-free sheaves on quasi-projective schemes. Further generalizations are being sought, especially along the lines of Plumstead's recent solution of the Eisenbud-Evans conjectures.

A second objective of this research is to investigate a number of related questions which arose during the earlier research. Among these is a possible generalization to graded rings of standard local ring results on systems of parameters, superficial elements, and R-sequences.

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#### COMPUTER MODELING OF ALKALI METAL AND RARE-EARTH DOPED ALKALINE EARTH FLUORIDES

Researcher: Captain Robert J. Kimble, Jr., USMC

Sponsor: Naval Academy Research Council

The objective of this project is to develop a computer program capable of determining activation energies for doped-



alkaline earth-fluorides, as well as computing the relative energies associated with various defect configurations.

A computer program capable of calculating the energies associated with a finite portion of a  $RF_2$  crystal lattice has been produced ( $R = Ca, Sr, \text{ or } Ba$ ). Using multidimensional Newton-Raphson techniques, the lattice ions are moved about in order to find a position of least energy. By varying the parameters associated with the rare-earth dopant, experimental results in  $Sr F_2$  have been duplicated. Work is now in progress in  $CaF_2$ .

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C\* - ALGEBRA COMPACTIFICATIONS OF SEMIDIRECT PRODUCTS OF SEMIGROUPS

Researcher: Assistant Professor Bao Ting Lerner

Sponsor: Naval Academy Research Council

The purpose of this research is to determine the structure of semigroup compactifications of semidirect products of semitopological semigroups.

The proposer has analyzed the semigroup  $F$ -compactification of the semidirect product  $W$  of  $S$  and  $T$ , where  $S, T$  are semitopological semigroups, and  $F$  is an admissible sub- $C^*$ -algebra of bounded, complex-valued functions on  $(W)$ . The main result gives necessary and sufficient conditions to insure that  $F$ -compactification of  $(W)$  could be decomposed (up to isomorphism) into a semidirect product of the corresponding compactifications of  $S$  and  $T$ . As corollaries, applications of the decompositions were made to the almost periodic, strongly almost periodic and left - uniformly continuous cases under the hypotheses that  $T$  contain a dense subgroup and  $S$  be a compact topological group.

The proposer is investigating which of the above mentioned conditions on  $S, T$  may be weakened. An analogous result for the weakly almost periodic case is also under study.

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## INTERPLAY BETWEEN TOPOLOGY AND GEOMETRY

Researcher: Assistant Professor Mark D. Meyerson

Sponsor: Naval Academy Research Council

The objective is to study, unify, and solve several problems which are of special interest because they are simultaneously topological and geometrical, and to consider geometric approaches to topological problems. Examples of results in these areas include a geometric proof of the Borsuk-Ulam Theorem, an example showing that some tame knots cannot be linked by a straight line, Roger Fenn's Table Theorem, and results on dilations.

It is hoped that the methods used by the investigator in a paper with Richard Jerrard and a paper with Alden Wright can be combined to attack several of these problems.

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## SOME CLASSES OF FUNCTIONS RELATED TO THE ROBERTSON FUNCTIONS

Researcher: Assistant Professor Edward J. Moulis, Jr.

Sponsor: Naval Academy Research Council

The objective of this project is to study certain analytic and geometric properties of some large classes of functions regular in the unit disc. Since the early part of this century, useful information such as distortion and rotation bounds, coefficient bounds and bounds on the modulus of the schwarzian derivative have been obtained for the class of functions mapping the unit disk onto a convex domain. By a suitable selection of real parameters, it is possible to define larger classes of functions involving these parameters, with each parameter referring to a specific geometric property. The researcher has been investigating how and in what natural setting the information mentioned above can be extended to these larger classes of functions.

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WAR-AT-SEA TACTICAL EVALUATOR

Researcher: Lieutenant Commander Robert E. Rinker, USN and  
Lieutenant Commander Roger G. Lerseth, USN  
(Applied Science)

Sponsor: Naval Academy Research Council

The objective is the development of a comprehensive, computer-based decision-aid to be used in evaluating attack tactics by Naval aircraft against surface combatants. The model will be transportable, easy to use, and as flexible as possible with regard to ship types and numbers and aircraft types and numbers. Weapons-system parameters will be easily modified by parameterizing as many hardware characteristics as possible so that the model will not necessarily become obsolete with introduction of a new weapon. The basic model should remain unclassified once parameters are set. The model will use Monte-Carlo simulation techniques to return to the user the effectiveness of the particular tactic as measured both by the probability of a target kill and probability estimates of the loss to the attacking force. At present, literature searches are about 60% complete, and contact has been made with Navy operational commands. Preliminary work on the model has started, and two unpromising lines of approach have been discarded.

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THE CONSTRUCTION AND STUDY OF COSPECTRAL GRAPHS

Researcher: Assistant Professor Allen J. Schwenk

Sponsor: National Science Foundation

Several researchers have been studying the spectrum of a graph, particularly, graphs with cospectral adjacency matrices. This theory is of interest both for its graphical consequences as well as its chemical implications. The concept of a removal cospectral set was recently introduced by the researcher in an attempt to unify several diverse results about cospectral graphs. It is proposed to continue the study of this concept. One problem of interest is to find an eigenvector characterization of removal-cospectral sets. Another problem is to determine when sets are removal-cospectral both in a pair of graphs and in their complements.

Recently, several authors have used the spectrum to obtain results on reconstruction. This area may be ripe for extension by studying the spectral properties of nonreconstructable tournaments and digraphs. It is becoming increasingly clear that some pair of cospectral graphs may be found to be nonreconstructable.

The attempt to develop the properties of removal cospectral sets continues. Particular attention is given to try to extend known results on cospectral points. Opportunities to digress into related problems are seized.

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#### COMPOSITION OF QUADRATIC FORMS

Researcher: Assistant Professor JoAnn S. Turisco

Sponsor: Naval Academy Research Council

The object of this research is the study of a generalized version of the problem of composition of quadratic forms. This problem is that of determining the conditions which guarantee the existence of a bilinear map which maps two quadratic spaces into a third quadratic space and "preserves" the corresponding quadratic forms. That is, the quadratic form applied to the image of this map is equal to the product of the corresponding quadratic forms on each variable. Of particular interest is the case in which the dimension of the image space is not equal to the dimension of either of the other spaces. The investigator is currently studying this problem using Pierce-decompositions of Jordan-pairs. The investigator is also studying a "Hasse Principle" for these maps; i.e. whether or not it is true that such a bilinear map exists over a global field  $K$  if and only if it exists over the completion  $K_v$ , for each place  $v$ . Some results of this kind have been obtained in cases where Clifford algebra representations are applicable. The general case is now under study. A further area of interest is the study of the role of these maps in the theory of stable homotopy groups of spheres.

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## REGRESSION ANALYSIS OF SSBN PRESSURE MODEL DATA

Researcher: Assistant Professor John C. Turner with Professors  
John Geremia and Chih Wu (both, Mechanical  
Engineering)

Sponsor: David W. Taylor Naval Ship Research and Development  
Center, Annapolis Laboratory

This project, essentially completed, involved the analysis of data from submarine model tests. It involved the creation of an interactive multiple-linear regression program and its application to the data. It also involved interpretation of the results in light of the physics of the situation and statement of suitability to goals of the project. This work is classified.

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## THE COORDINATIZATION OF ORTHOMODULAR GEOMETRIES

Researcher: Assistant Professor Karen E. Zak

Sponsor: Naval Academy Research Council

The primary objective of this research is to determine conditions on an orthomodular geometry which guarantee the existence of a coordinatizing dimension  $*$ -semigroup. Several secondary questions will also be considered, e.g., if  $l$  is finite, can the geometry be coordinatized by a semigroup of this type in which all elements are partially unitary?

All similar coordinatization theorems have been established by constructing the coordinatizing object from suitable endomorphisms of the object to be coordinatized. It is, therefore, reasonable to consider the dimension-reducing maps in  $S(L)$ . Moreover, in this case, it is known that an orthomodular geometry can be coordinatized by a Baer  $*$ -semigroup if and only if whenever  $e$  and  $f$  are dimension equivalent, the intervals  $(o,e)$  and  $(o,f)$  are isomorphic orthomodular geometries.

To date, it has been established that an orthomodular geometry in which  $l$  is finite and which satisfies the criteria above can be coordinatized by a  $*$ -regular weak dimension  $*$ -semigroup. This object is universal in the sense that any other coordinatizing weak dimension  $*$ -semigroup maps homomorphically into it. Work on this project continues.

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## AXISYMMETRIC GREEN'S FUNCTIONS

Researcher: Assistant Professor Allen J. Fryant

The properties of Green's function for axially-symmetric solutions of Laplace's equation in three dimensions were investigated. New representations for such Green's functions for axiconvex regions were obtained, and these were used to obtain integral representations for solutions of the corresponding Dirichlet problems. It was found that axially-symmetric Green's functions can be expressed as Bergman  $B_3$  transforms of symmetric analytic functions of two complex variables. Application was made to solving the Dirichlet problem by interpolation to boundary values using symmetric potential functions whose definition was suggested by the symmetric Green's function. This development led to an explicit, constructive solution of the Dirichlet problem on an ellipsoid. Several possible definitions of a symmetric Green's function in three dimensions with pole at infinity were considered, and their relation to transfinite diameter of the region involved were investigated. The objective of this latter investigation was the development of potential theoretical results which are classical in two dimensions, and a corresponding theory of polynomial approximation analogous to that which has been obtained for analytic functions of a single complex variable.

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## CONVERGENCE SPACES

Researcher: Assistant Professor Robert A. Herrmann

This project continues the investigation of the uses of non-standard analysis and its application to convergence spaces. In particular, the main thrust of this project is mapping theory.

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## ON SOME CYCLIC CONFIGURATIONS

Researcher: Assistant Professor Donald E. Keenan

The objective of this project is to study configurations similar to finite projective planes. Let  $S_1, \dots, S_n$  be  $n$  subsets of an  $n$ -set  $S$  with the properties  $|S_i| = K \geq 3$ , each element of  $S$  belongs to exactly  $K$  subsets, and  $|S_i \cap S_j| \leq 1$ . Suppose further that each subset has non-empty intersection with exactly  $n-3$  of the remaining subsets.

If  $A$  is the incidence matrix of such a configuration, the rows and columns of  $A$  may be partitioned into cycles in a natural way. The investigator has shown that  $A$  then has a cyclic sub-structure and the length of any cycle divides the length of the longest cycle; also, after the rows and columns have been suitable permuted,  $AA^T = A^TA$ . Those configurations in which all the cycles are of equal length are related to interdependent difference sets, and a non-existence condition for these configurations has been established.

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## SHAPE SPECTRAL SEQUENCES

Researcher: Associate Professor Thomas J. Sanders

The objective of this project is to develop the spectral sequence which arose in the investigator's research in shape-theory and to show that the spectral sequence or its homology is an invariant of the shape classification of a topological space. The present plan is to base the investigation on a classified paper on spectral sequences by W. S. Massey. The spectral sequence arose naturally in the investigator's research on a Whitehead Theorem in CG-shape and should prove useful in shape theory.

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## A VIDEO EXTENSION FOR STRONG TUBE GRAPHICS TERMINAL

Researcher: Assistant Professor John C. Turner and Steven G. Satterfield (Computer Aided Design and Interactive Graphics Group)

A microprocessor-based graphics device is described that emulates the display of the Tektronix 4000 series terminals. It is implemented as a data-line monitor rather than a terminal. It is not intended to replace the terminal but instead to generate a composite video signal in addition to the storage-tube display.

This approach has numerous advantages. Graphics output can be shown to larger groups than is possible with storage tube displays. The device does not hamper the inexperienced user because it behaves just like the familiar Tektronix terminal. All existing software designed for use on Tektronix terminals may be used without modification. The graphics emulator is built from commercially available inexpensive hardware and thus is within the budget of many potential users.

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MICROPROCESSOR INTERFACE TO XYNETICS FLATBED PLOTTER

Researcher: Assistant Professor John C. Turner

The purpose of this project is to allow data generated in NATS or any other computer system to be transferred to the Xynetics flatbed-plotter via telephone lines rather than magnetic tape. A terminal is attached to a microprocessor which is connected to NATS via telephone lines. Provision is made for connection to as many as four other systems as well. The microprocessor is connected to the paper-tape interface of the Xynetics plotter. During normal operation, the terminal appears to be connected directly to NATS, allowing programs to be run, etc. Upon command, the microprocessor begins relaying data from NATS to the paper-tape interface which results in the data being plotted. Software had to be developed on NATS to send the data in the correct format. In addition, modification of the local software of the Xynetics plotter was required.

This completed project is now operating as a turnkey system in Pickover Hall, Room 117.

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SEASONAL TRENDS IN UNEQUALLY SPACED DATA

Researcher: Assistant Professor John C. Turner, co-investigator

The purpose of this project is to develop methods for estimating and removing seasonal trends from time-series data with unequally spaced or missing values. The method developed was a modification of a Buys-Ballot filter combined with an iterating procedure to account for missing values. This was shown to be effective and to have good filtering characteristics.

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## STATISTICAL PROPERTIES OF TREND REMOVAL

Researcher: Assistant Professor John C. Turner, co-researcher

This work is a follow-up of the work on trend-removal with missing data. Confidence intervals and other statistical properties of the trend-removal process are obtained for a number of cases of seasonal trend, underlying spectrum and data-deletion process.

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## n-ASSOCIATIVE ALGEBRAS

Researcher: Assistant Professor William P. Wardlaw

An algebra  $A$  over a field  $K$  is n-associative if the product of any  $n$  elements of  $A$  is independent of the way in which the factors are associated. An algebra is finitely associative if it is  $n$ -associative for some positive integer  $n$ .

This work parallels a previous study of  $n$ -associativity in groupoids, and is motivated by the fact that for  $n$  greater than 2,  $n$ -associativity implies  $(n + 1)$ -associativity. Modification of the methods used for finite groupoids to treat finite dimensional algebras yields the following theorem: If  $A$  is a finitely associative algebra of dimension  $n$ , then  $A$  is  $(2^{n-1} + 1)$ -associative.

Examples have been found of  $n$  dimensional algebras which are  $(2^{n-1} + 1)$ -associative but not  $2^{n-1}$ -associative, showing that the above bound is as good as possible.

The investigator is continuing the study of the structure and cardinality of strictly  $n$ -associative groupoids.

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## APPLICATIONS OF SYMMETRIC PRODUCT SPECTRA

Researcher: Assistant Professor Peter J. Welcher

One of the basic problems in Algebraic Topology is that it is almost impossible to calculate the generalized homology of a topological space or its generalization, a spectrum. Yet the homology is supposed to provide an invariant of the space, for use in comparing it with other spaces.

The objective of this project is to compute the Brown-Peterson homology of the symmetric-product spectra. Good evidence for the answer is available, and the investigator is currently seeking a tidier method of proving his answer correct. There should be further applications to computations with the Adams spectral-sequence for several examples of interest to the investigator in connection with his thesis.

The ultimate objective is full or partial explanation of a hard result, the Kahn-Priddy theorem, by means of an alternative, conceptual (as opposed to calculation-based) proof.

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## COMPUTER MODELLING OF RARE EARTH DOPED ALKALINE EARTH FLUORIDES

Researcher: Assistant Professor Peter J. Welcher

The goal is to provide computer support for the work of Professors Fontanella, Wintersgill, and Treacy when Captain R. J. Kimble, USMC, leaves for his next duty assignment. To date the investigator has written a number of computer programs which take Kimble's output data and turn it into various kinds of pictures on the Tektronix terminals. The output of the latest version is readily understood as representing deformations of the crystalline lattice by deformations visible in a perspective drawing of a cubical lattice. This greatly enhances understanding of both the results of Kimble's program and of the underlying molecular mechanisms due to the ease with which they may be "viewed." The picture, once set up, may be easily transferred to the Evans and Sutherland Picture System for simulated 3-D viewing and/or may be plotted on the Xynetics plotter. The details of programming the PDP-11 computer in FORTRAN (the language Kimble's model is in) are now being learned, with a goal of programming "moving pictures", i.e. by twisting a dial the viewer will see the deformation resulting from a change in dopant size. Movies may result from this work.

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CHAMBERLAIN, Michael W., Assistant Professor, "Coin - Tossing Problem Revisited," The Two-Year College Mathematics Journal, 10 (1979), 349-350.

Most probability textbooks investigate the waiting time until the first success occurs in an unending sequence of independent Bernoulli trials (the geometric distribution). Many consider the waiting time until the  $k$ th success (the negative binomial). The purpose of this article was to show that using only standard undergraduate mathematics, satisfactory answers to the following questions could be derived: What is the waiting time distribution until  $k$  consecutive successes occur? How long would one expect to wait for this first "success run"?

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COFFEE, Jane P., Assistant Professor, "On the Rigidity of Graded Algebras," Proceedings of the American Mathematical Society, 76 (1979), 219-222.

In deformation theory -- whether algebraic or analytic -- it is critical to determine when a non-isomorphic object is obtained. The following has been proved: If  $G$  is a graded algebra (separated and complete) over a field  $k$  of characteristic zero and  $G$  is rigid in the category of algebras, then  $G$  is rigid in the category of filtered algebras and hence isomorphic, as a filtered algebra, to any  $F$  whose (complete) associated graded algebra is  $G$ . Thus if a graded algebra is rigid in its operational structure, then it must also be rigid in its filtration structure.

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GAGLIONE, Anthony M., Assistant Professor, "A Commutator Identity Proved by Means of the Magnus Algebra," Houston Journal of Mathematics, 5 (1979), 199-207.

Let  $F$  be the free group generated by  $a$  and  $b$ . Let  $F(n)$  be the  $n$ th subgroup of the lower central series of  $F$ . Let  $p$  be a fixed prime. Let  $C(1), C(2), \dots, C(q)$  be the basic commutators in  $F$  of dimension  $\leq p^2$  in their respective order. Let  $P(1) = (a, b)$  and  $P(n) = (P(n-1), b)$  for  $n > 1$ . Then  $(a, b^{p^i}) \prod_{i=1}^q C(i)^{e_i} \pmod{F(p+1)}$ , where  $i \geq 1$ . Moreover, it is shown that the exponents of the basic commutators of dimension  $\leq p+1$  are divisible by  $p^i$  except for the exponent of  $P(p)$  which is congruent to  $p^{i-1}$  module  $p^i$ .

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HERRMANN, Robert A., Assistant Professor, "A Non-standard Approach to S-closed Spaces," Topology Proceedings, 3 (1978), 123-138.

The major purpose of this paper is to introduce a new monad, the S-monad, which is nuclear but not filter-base determined and which is capable of characterizing Thompson's concept of the S-closed space, as well as improving many of his results. In particular, it is shown that  $(X, \tau)$  is extremally disconnected if and only if for each  $p \in X$  either  $\mu_\alpha(p) \subset \mu S(p)$  or  $\mu\theta(p)$  or  $\mu\phi(p) = \mu S(p)$  or  $\mu(p) \subset \mu S(p)$ . Moreover,  $X$  is S-closed if and only if  $*X = U\{\mu S(x) \mid x \in X\}$ . Using these results yields some improvement in various theorems of Thompson.

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HERRMANN, Robert A., Assistant Professor, "Convergence Spaces and Extensions of Maps," Mathematical Reports of the Academy of Sciences of Canada, 1 (1979), 265-268.

This is the third paper in a series of investigations answering various unsolved problems relative to convergence spaces. The major goal of this present research is to investigate the extendibility of maps defined on "preconvergence spaces."

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HERRMANN, Robert A., Assistant Professor, "Convergence Spaces and Nonstandard Compactifications," Mathematical Reports of the Academy of Science of Canada, 1 (1979), 187-190.

One of the major problems in the theory of convergence spaces has been to determine a meaningful characterization for the concept of the projective maximum or projective minimum object in various classes of convergence space compactification. The goal of this present research is to obtain, from the non-standard viewpoint, such characterizations for pseudotopological and pretopological spaces as defined by Kent.

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HERRMANN, Robert A., Assistant Professor, "Maximum One Point Near-Compactifications," Bollettino U.M.I. 5 (1979), 284-290.

The major purpose for this paper is to show that the one-point near-compactifications  $(Y, \tau)$  and  $(Y, \tau^*)$  for a non-nearly-compact locally nearly-compact Hausdorff space  $(X, T)$  are isomorphic to Obreanu's one point H-closure  $(Y, T^+)$  and that Obreanu's projective maximum  $(Y, T')$  in the class of all point H-closures of  $(X, T)$  is also the projective maximum in the class of all one point near-compactifications of  $X$ . Consequently, many of the results in Obreanu's and Porter's papers may now be applied to non-nearly-compact locally nearly-compact Hausdorff spaces. On investigating unique one-point near-compactifications, it is shown that  $(Y, T')$  for the real numbers is a natural and easily obtained non-semiregular near-compactification (i.e. H-closed Urysohn) space which is thus not minimal Hausdorff. Moreover, the identity map  $I: (Y, T^+) \rightarrow (Y, T')$  is a non-trivial almost-continuous non-continuous map.

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HERRMANN, Robert A., Assistant Professor, "Nonstandard Implication Algebras," Matematicki Vesnik, 2 (1978/79), 351-358.

In this paper, meet (join) semi-lattices, implication algebras, generalized Boolean algebras, Boolean algebras are embedded into an enlargement. The nonstandard algebras obtained tend to contain bounding elements, among others, which are not present in the basic generating algebra which has now become a subalgebra of its enlargement. The relations between these generating sub-algebras and their enlargements is investigated. After investigating the nonstandard properties of ideals in these structures, a major result shows that each disjunctive algebra is isomorphic to a set-theoretic algebra composed of subsets of the nonstandard extension of the carrier. For implication algebras, and hence generalized Boolean algebras or Boolean algebras, the isomorphism between the operations is shown to be unique. The Stone representation theorem, among others, follows from this result and in particular yields a new uniqueness property for Boolean algebra representations.

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HERRMANN, Robert A., Assistant Professor, "Perfect Maps on Convergence Spaces," Bulletin Australian Mathematical Society, 20 (1979), 447-466.

The concept of the perfect map on a convergence space  $(X, q)$  where  $q$  is a convergence function, is introduced and investigated. Such maps are not assumed to be either continuous or surjective. Some nontrivial examples of well-known mappings between topological spaces, nontopological pretopological spaces and nonpseudotopological convergence spaces are shown to be perfect in this new sense. Among the numerous results obtained is a covering property for perfectness and the result that such maps are closed, compact, and for surjections almost-compact. Sufficient conditions are given for a compact (respectively almost-compact) map to be perfect. In the final section, a major result shows that if  $f: (X, q) \rightarrow (Y, p)$  is perfect and  $g: (X, q) \rightarrow (Z, s)$  is weakly-continuous into Hausdorff  $Z$ , then  $(f, g): (X, q) \rightarrow (\forall xZ, pxs)$  is perfect. This result is given numerous applications.

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HERRMANN, Robert A., Assistant Professor, "RC-Convergence," Proceedings of the American Mathematical Society, 75 (1979), 311-317.

The rc-convergence structure is introduced and used to characterize S-closed spaces in terms of regular-closed (rc) or regular-open sets. S-closed spaces are compared with nearly-compact, quasi-H-closed spaces and compact semiregularizations. Weakly- $T_2$  extremally disconnected spaces are embedded into the Fomin S-closed extension. For any discrete space,  $\beta(X)$  is shown to be S-closed and the category of nearly-compact Hausdorff spaces and  $\theta$ -continuous mappings has the S-closed spaces as its projective objects. An explicit example of noncompact Hausdorff S-closed space is constructed. Finally, various mappings which preserve S-closedness are investigated.

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KEENAN, Donald E., Assistant Professor, "A Fisher Type Inequality," Discrete Mathematics, 29 (1980), 205-208.

Subsets of a finite set are studied that intersect each other in at most one element. Each subset intersects most of the other subsets in exactly one element. The following theorem is one of our main conclusions:

Let  $S_1, \dots, S_m$  be  $m$  subsets of a  $n$ -set  $S$  with  $|S_i| \geq 2$  ( $i=1, \dots, m$ ) and  $|S_i \cap S_j| \leq 1$  ( $i \neq j; i, j = 1, \dots, m$ ). Suppose further that for some fixed positive integer  $c$  each  $S_i$  has non-empty intersection with at least  $m - c$  of the remaining subsets. Then there is a least positive integer  $M(c)$  depending only on  $c$  such that either  $m \leq n$  or  $m \leq M(c)$ .

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LEE, Rebecca, Assistant Professor, "Covers and Associated Primes in Noetherian Lattice Modules," Houston Journal of Mathematics, 5 (1979), 219-239.

Covers have previously proved to be a useful tool in establishing results for  $L$ -modules. In particular, they naturally arise whenever lattices of finite dimension are considered. The main purpose of this research is to study the covering relationship itself and to prove a number of interesting and useful properties of this relationship. Then, due to the very close connection between covers and associated primes, a number of new results concerning associated primes are proved for  $L$ -modules.

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LERNER, Bao Ting, Assistant Professor, "Trimis Radiology Systems Test and Certification Requirements," The Johns Hopkins University Applied Physics Laboratory Reports, 30 July 1979.

This report provides information relating to the test and certification of the Radiology Trimis System. Presented in Section A are descriptions and definitions pertaining to the test and certification process as well as to development and change processes. Also included in Section A is a detailed listing of Vendor/Government responsibilities as they relate to the various



stages of the test-certification Process. Section B presents the Radiology Functional Requirements. Section C describes the methods and criteria by which vendor-supplied test information will be evaluated. Section D presents a description of the total test database.

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McCOY, Peter A., Associate Professor, "Approximation and Harmonic Continuation of Axially Symmetric Potentials in  $E^3$ ," Pacific Journal of Mathematics, 81 (1979), 481-491.

A complex-valued axially symmetric potential that is regular on the closed unit sphere is approximated by Newtonian potentials whose singular circles are located in the complement of the sphere. The rate of convergence of optimal approximates on the sphere is used to locate and classify the singularities of the harmonic continuation of the potential from the sphere.

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McCOY, Peter A., Associate Professor, "Mean Boundary Value Problems for a Class of Elliptic Equations in  $E^3$ ," Proceedings of American Mathematical Society, 76 (1979), 123-128.

An interior Dirichlet problem for generalized axisymmetric potentials is solved constructively by means of a Riemann series expansion determined from the arithmetic means of the boundary values. The problem is generalized to a class of axisymmetric elliptic partial differential equations in  $E^3$ . The Bergman and Gilbert integral operator method is used along with the method of ascent.

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McCoy, Peter A., Associate Professor, "Polynomial Approximation of Generalized Biasymmetric Potentials," Journal of Approximation Theory, 25 (1979), 153-168.

Let the real-valued generalized biaxially symmetric potential  $F$  be regular in the open unit hypersphere and continuous on the closure. The minimum errors in the Chebyshev approximation of  $F$  on the closed hypersphere are taken over classes of real-valued generalized biaxially symmetric harmonic polynomials. The growth of the error sequence determines those  $F$  that harmonically continue

as biaxisymmetric potentials that are entire functions. The growth of the sequence is used to compute the growth of  $F$  as defined by order and type. These may be zero, infinite, or logarithmic. The Bergman and Gilbert Integral Operator Method is used to extend results of A. R. Reddy which consider similar characterizations of analytic functions of one complex-variable.

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MEYERSON, Mark D., Assistant Professor, co-author, "Homotopy with M-Functions," Pacific Journal of Mathematics, 84 (1979), 305-318.

M-functions were introduced by G. Darbo and R. Jerrard as a generalization of continuous functions. They are weighted, finitely-valued functions with a property corresponding to that of usual continuity. Earlier papers have shown that ordinary singular homology groups for compact polyhedra are actually m-homotopy type invariants and that this is a stronger invariance than homotopy type. R. Schultz used m-homology as an example of a "good" homology theory and noted that it differs from singular homology on some compact metric spaces. Here the concept of m-homotopy groups (actually R-modules) is defined and some of their properties are given. In particular, it is shown that for a compact polyhedron, the n-th singular homology group and the n-th m-homotopy group are actually isomorphic.

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MOULIS, Edward J. Jr., Assistant Professor, "Generalizations of the Robertson Functions," Pacific Journal of Mathematics, 81 (1979), 167-174.

A class of analytic functions is studied which unifies a number of classes previously studied, including functions with boundary rotation at most  $K$ , functions convex of order  $\alpha$ , and the Robertson functions, i.e., functions  $f$  for which  $af'(z)$  is  $\alpha$ -spirallike. Representation theorems are obtained for this general class, and, using a simple variational formula, sharp bounds are also obtained on the modulus of the second coefficient of the series expansion of these functions. Using a univalence criterion due to Ahlfors, a condition on the parameters  $k, \alpha, \beta$ , is determined which will ensure that a function in this class is univalent. This result improves previously published results for various subclasses and is sharp for the class of functions  $f$  for which  $zf'$  is  $\alpha$ -spirallike of order  $\alpha$ .

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SCHWENK, Allen J., Assistant Professor, co-author, "Integral Starlike Trees," Journal Australian Mathematical Society, A, 28 (1979), 120-128.

In this note, the trees homeomorphic to a star are determined which have a spectrum consisting entirely of integers. The integral double stars are also specified and the problem of trees with more complicated structure is considered.

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SCHWENK, Allen J., Assistant Professor, co-author, "On the Number of Trees in a Random Forest," Journal Combinatorial Theory, B, 27 (1979), 109-121.

The analytic methods of Polya are used to determine the asymptotic behavior of the expected number of (unlabeled) trees in a random forest of order  $p$ . Our results can be expressed in terms of  $\alpha = .338321856899208\dots$ , the radius of convergence of  $t(x)$ , which is the ordinary generating function for trees. We have found that the expected number of trees in a random forest approaches  $1 + \frac{1}{k} \sum_{k=1}^{\infty} t(\alpha^k) = 1.755510\dots$  and the form of this result is the same for other species of trees.

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SCHWENK, Allen J., Assistant Professor, "Removal-Cospectral Sets of Vertices in a Graph," Proceedings Tenth South-East Conference Combinatorics, Graph Theory, and Computing, Utilitas Mathematica, Winnipeg, 1979, 849-860.

The concept of cospectrally-rooted graphs (also called graphs with cospectral points) was introduced by the author in an earlier work. This concept is now extended to allow subsets of vertices containing more than one vertex. In this new view, cospectrally-rooted graphs are graphs containing removal-cospectral sets of vertices which happen to be singletons - namely, the roots of the respective graphs.

This extension yields numerous constructions of cospectral graphs, including one discovered by Godsil and McKay. It also provides an explanation of the phenomenon of unrestricted substitution vertices discovered by Herndon and Ellzey. Finally, there are some interesting examples using graphs first studied in connection with the reconstruction conjecture.

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SCHWENK, Allen J., Assistant Professor, co-author, "The Construction of Cospectral Composite Graphs," Annals of New York Academy of Science, (1979), 460-496.

An operation loosely described as a type of composition of graphs is studied. Under rather flexible conditions, the resulting composite graphs must be cospectral. This operation is sufficiently powerful to generate 81 cospectral pairs with at most nine vertices. These pairs include the unique smallest cospectral pair, the smallest cospectral connected pair, and one pair of trees with nine vertices. It is felt that this operation provides a unified explanation of cospectrality in several cases that were previously viewed as coincidental.

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SCHWENK, Allen J., Assistant Professor, co-author, "The Spectral Approach to Determining the Number of Walks in a Graph," Pacific Journal of Mathematics, 80 (1979), 443-449.

It is well-known that the number of closed walks of length  $n$  is simply the  $n$ 'th moment of the adjacency matrix. Similar spectral expressions are found for unrestricted (either open or closed) walks, and also for walks from any specified starting set of points to another set of terminal points. Knowledge of the number of walks in  $G$  may be applied to find the spectrum of the complement of  $G$ . In conclusion, cyclic and dihedral equivalence relations are defined for closed walks, and Burnside's Lemma is used to enumerate the number of equivalence classes of both types.

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TURNER, John C., Assistant Professor, "Pattern Recognition Using Nonparametric Density Estimation," with C. P. Tsokos, Metron, 35 (1979), 89-104.

Pattern recognition is the process of assigning random samples to one of several populations from which it might have come. Regardless of the loss structure used and whether or not a Bayesian approach is taken, it is necessary to know the probability density function (p.d.f.) of the sample. A parametric approach assumes a form for the p.d.f. and then estimates associated parameters. The approach used here is to estimate

the p.d.f. itself using a maximum-likelihood method developed by David W. Scott. This method is shown to perform nearly as well as the parametric method. It has the advantage of being simple to use, since it does not require the validation of any one parametric form.

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TURNER, John C., Assistant Professor, "Sensitivity Analysis of An Inventory Management Scheme," Decision Information, Academic Press, 1979.

A two-echelon inventory management scheme developed by S. Zacks is investigated for sensitivity to the underlying probabilistic assumptions. A submarine supply ship services several submarines. Their demands for some item are random with some associated probability function. The supply ship must reorder items in advance of the demand. Zacks derived the optimal reordering procedure under certain assumptions for the demand function. In this paper, other demand functions were considered, and the behaviors of the resupply algorithm were examined. The algorithm is found to be fairly robust but some oscillatory problems are noted.

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FRYANT, Allan J., Assistant Professor, "Rotations and the Bergman  $B_3$  Integral Operator," Regional Meeting of American Mathematical Society, Philadelphia, 18 April 1980.

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GAGLIONE, Anthony M., Assistant Professor, "A Theorem on Nilpotent Products of Cyclic Groups," Regional Meeting of American Mathematical Society, Philadelphia, 18 April 1980.

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GAGLIONE, Anthony M., Assistant Professor, "Nilpotent Products Investigated by the Magnus Algebra and Generalized Bracketing," Annual Summer Meeting of American Mathematical Society, Duluth, Minnesota, 23 August 1979.

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GEWAND, Marlene E., Assistant Professor, "Equivalence Relations on Linearly Ordered Topological Spaces," Spring Topology Conference, Birmingham, Alabama, 21 March 1980.

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HERRMANN, Robert A., Assistant Professor, "Perfect Maps on Convergence Spaces," Annual Summer Meeting of American Mathematical Society, Duluth, Minnesota, 23 August 1980.

\*\*\*\*\*

KIMBLE, Robert J. Jr., Captain, USMC, "Almost Every Edge of a Graph Can Be Pseudo Similar," International Graph Theory Conference, Kalamazoo, Michigan, 7 May 1980.

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LERNER, Bao Ting, Assistant Professor, "Compactifications of Semidirect Products of Semigroups," Regional Meeting of American Mathematical Society, Davis, California, 25 April 1980.

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## PRESENTATIONS

## MATHEMATICS DEPARTMENT

MCCOY, Peter A., Associate Professor, "Approximation of Solutions of an Elliptic Partial Differential Equation in Three Dimensions," Regional Meeting of American Mathematical Society, Washington, D. C., 21 October 1979.

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MCCOY, Peter A., Associate Professor, "Bernstein Theorem for a Parabolic Equation in One Space Variable," International Conference in Honor of G. G. Lorentz, Austin, Texas, 11 January 1980.

\*\*\*\*\*

MCCOY, Peter A., Associate Professor, "Approximation Theory in Partial Differential Equations by Function Theoretic Methods," Seminar, Applied Mathematics Institute, University of Delaware, Newark, Delaware, 9 May 1980.

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MEYERSON, Mark D., Assistant Professor, "UMAP - A Math Modules Project," Regional Meeting of Mathematical Association of America, Largo, Maryland, 10 November 1979.

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PENN, Howard L., Assistant Professor, "Computer Generated Polar Coordinate Graphs," Sectional Meeting of Mathematical Association of America, Largo, Maryland, 10 November 1979.

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PENN, Howard L., Assistant Professor, "The Graphs of the Solutions of the Heat Equation in a Metal Bar," National Meeting of American Society for Engineering Education, Baton Rouge, Louisiana, 25 June 1979.

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SANDERS, Thomas J., Associate Professor, "A Characterization of Approximate  $n$ -connectedness," Spring Topology Conference, Birmingham, Alabama, 21 March 1980.

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SCHWENK, Allen J., Assistant Professor, "Pseudosimilar Vertices in a Graph," British Combinatorial Conference, Cambridge, England, 15 August 1979.

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SCHWENK, Allen J., Assistant Professor, "An Introduction to Co-spectral Graphs," Research Summer School in Problems on Applicable Graph Theory, University of Essex, Colchester, England, 21 August 1979.

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SCHWENK, Allen J., Assistant Professor, "Integral Starlike Trees," Regional Meeting of American Mathematical Society, Kent, Ohio, 3 November 1979.

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SCHWENK, Allen J., Assistant Professor, "On Universal Caterpillars," International Graph Theory Conference, Kalamazoo, Michigan, 7 May 1980.

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TURISCO, JoAnn S., Assistant Professor, "Composition of Quadratic Forms and Jordan Triple Systems," Regional Meeting of American Mathematical Society, Philadelphia, 17 April 1980.

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TURNER, John C., Assistant Professor, "Seasonal Trends in Unequally-Spaced Data," National Meeting of American Statistical Association, Washington, D.C., August 1978.

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WARDLAW, William P., Assistant Professor, "n-Associative Groupoids and Algebras," Regional Meeting of Mathematical Association of America, Richmond, Virginia, 12 April 1980.

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WELCHER, Peter J., Assistant Professor, "Symmetric Fibre Spectra and  $K(n)$ -Homology Acyclicity," Regional Meeting of American Mathematical Society, Kent, Ohio, 2 November 1979.

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ZAK, Karen E., Assistant Professor, "Compact and Fredholm Objects in Polar Dimension  $*$ -Semigroups," Regional Meeting of American Mathematical Society, Philadelphia, 17 April 1980.

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ZAK, Karen E., Assistant Professor, "Dimension  $*$ -Semigroups," Colloquium, Kansas State University, Manhattan, Kansas, 8 May 1980.

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The following papers were presented by members of the Mathematics Department at the Annual Meeting of the American Mathematical Society, San Antonio, Texas, 3-6 January 1980:

BUCHANAN, James, Assistant Professor, "The Eilenberg-Hilbert Problem for Partial Systems."

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COFFEE, Jane P., Assistant Professor, "A Rigidity Theorem for Filtered Algebras."

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HANNA, Charles C., Assistant Professor, "Basic Elements in Graded Modules."

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HEERMANN, Robert A., Assistant Professor, "Extensions of Maps Defined on Convergence Spaces."

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KAPLAN, Gail, Assistant Professor, "Joint Quasi-Triangularity of 2 - Tuples of Essentially Normal Essentially Commuting Operators on Infinite Dimensional Hilbert Spaces."

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KEENAN, Donald E., Assistant Professor, "Cyclic Configurations With Constant Cycle Sizes."

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MCCOY, Peter A., Associate Professor, "Optimal Approximation and Analytic Continuation of Solutions to an Elliptic Partial Differential Equation."

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MEYERSON, Mark D., Assistant Professor, "Local Dilations."

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SANDERS, Thomas J., Associate Professor, "A Whitehead Theorem  
in CG-shape."

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SCHWENK, Allen J., Assistant Professor, "Pseudosimilar Vertices  
in a Graph."

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WARDLAW, William P., Assistant Professor, "n-Associative Algebras."

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ZAK, Karen E., Assistant Professor, "Semigroups Coordinatizing  
Orthomodular Geometries."

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## OCEANOGRAPHY DEPARTMENT

*Commander Richard A. Anawalt, USN, Chairman*



During the 1979-1980 academic year, faculty research (in a broad range of atmospheric and oceanographic areas) was regularly undertaken by both civilian and military members of the Oceanography Department. Not only does this research provide the opportunity for the faculty to keep abreast of current technology and theory, but it also serves as a basis for qualified midshipmen to undertake related research projects, particularly those dealing with the Chesapeake Bay, where their work can be supported by the Departmental research vessel.

Funding for these research activities has been available from a number of sources, including grants from or contracts with the David Taylor Naval Ship Research and Development Center, Defense Mapping Agency, Naval Air Systems Command, National Oceanic and Atmospheric Administration, Department of Commerce, Naval Facilities Engineering Command, National Ocean Survey, Office of Naval Research, the Environmental Protection Agency, and the Naval Academy Research Council.

Specific areas of research activity with the Department include but were not limited to sedimentation processes and properties, submarine geology, oceanic eddy processes, estuarine pollution and circulation, estuarine ecology, marine biofouling, dredging, environmental planning for Naval operations, climatology, geomagnetic, and electric and electromagnetic fields in the ocean.

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## STUDIES OF WHALES IN ICELANDIC WATERS

Researcher: Assistant Professor John W. Foerster

Sponsor: National Oceanic and Atmospheric Administration -  
National Environmental Satellite Service

In reviewing data from the Denmark Straits, factors such as wind stress and sea surface temperatures are clues to hydrographic conditions in the whale feeding grounds. It is conjectured that as an arctic frontal system passes, winds from the north drive cold arctic water into the warmer Irmiger Current creating a mixing zone. During the early arctic summer, these arctic waters are fertilizing the slightly warmer more saline, less fertile Atlantic waters. However, it is hypothesized that the barriers to mixing created by density differentials are insignificant at this time and the wind force significant. Since day length is increasing in combination with this, fertilization production begins. As the front passes, the winds cycle to the south pushing more warm water into the area so that mixing continues from these two gross compass locations.

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## PHYTOPLANKTON PRODUCTION IN THE SARGASSO SEA

Researcher: Assistant Professor John W. Foerster

Sponsor: Sea Education Association

The Sargasso Sea is reputed to be an area of low biological activity. Presumably isolated from surrounding waters because of physical characteristics, the area has been defined by oceanographers as a biological desert. However, deserts have active areas of production.

In an effort to determine if the Sargasso Sea has active biological regions, a study was performed to test the hypothesis that spatial heterogeneity existed. Data developed from sampling two parallel cruise tracks running northwest to southeast across the persion for phytoplankton have been analyzed. From these data six patches of activity were delineated. The algal relationships are emphasized at this time, though zooplankton and physical oceanographic forces are under study.

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## ATTENUATION COEFFICIENT FOR TURBID WATER

Researcher: Assistant Professor John W. Foerster

Sponsor: Defense Mapping Agency

A relationship between the beam-attenuation coefficient ( $\alpha$ ) and the diffuse-light-attenuation coefficient ( $k$ ) has been determined for relatively clear oceanic water (Shannon, 1975). However, very little if any, work has been done to extend this relationship into more turbid inshore waters.

This is of some interest since a large portion of the anticipated laser-bathymetry load will be experienced in these more turbid waters. The existence of such a relationship will allow the use of additional data sets for the prediction of laser-bathymetry operating characteristics and limitations in strange waters.

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## THE INFLUENCE OF STANDING WAVES VS. PROGRESSIVE WAVES ON THE TIDAL CURRENT VELOCITIES IN THE SEVERN RIVER

Researcher: Commander Joseph J. Spigai, USN

Sponsor: Naval Academy Research Council

Tidal currents are the horizontal movements caused by changes in elevation of the water surface through tidal changes. The diurnal tides which move up Chesapeake Bay twice in every 24.8 hours produce a moderate range of tide, averaging 1-2 feet, and a correspondingly moderate range of tidal currents, averaging 0.5 knots or less at the Bay mouth to 1.5 knots or more in the upper reaches of the Bay. Measured tidal current velocities may vary widely, however, depending on location, depth and local weather (wind) conditions. Measurements taken near the surface, for example, may reflect more the river runoff velocity than the velocity of the ebbing tide.

Given that location and depth can be controlled, and that wind velocities can be recorded and accounted for, there is another factor which must be considered in order to fully understand the nature of the tidal currents. As the tide moves up the bay, it moves as a progressive wave. When the tide encounters the natural boundaries of the bay, a standing tidal wave is set up, the nature of which depends on the naturally

resonating characteristics of the bay. Therefore, the tidal heights, and the tidal currents, are results of the progressive and standing tidal wave superimposed on one another.

The separate contribution of the progressive wave versus the standing wave to the tidal current velocity must be fully understood before more advanced analyses can be made of turbulence and diffusion in the bay, or the separate effect of topography on the tide can be studied. Finally, when the contribution of each of the several factors can be isolated and understood, a more accurate estimate of flushing time can be obtained. If the separation between progressive and standing wave contributions and other factors can be done in the Severn River, it may be possible to extrapolate to other rivers within Chesapeake Bay.

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1. TITLE AND SYNOPSIS: (Include title, author, date, and a brief synopsis of the report.)

2. AUTHOR: (Name and address of the author.)

3. SUMMARY: (A brief summary of the report, including the objectives, methods, results, and conclusions. This section should be written in a clear, concise, and factual manner. One would expect that the heat flux would be directed from the equator to the poles. However, as demonstrated by Wyrtki (1965), Telford (1967), and Whitford (1970), certain oceanic areas are in the equatorial flux. This equatorward oceanic heat flux may be a result of an excessive poleward atmospheric circulation.

4. PROJECT PURPOSE: (To determine the direction and amount of the Indian Ocean heat flux by conducting an oceanic mass, salt, and heat-transport analysis from a calculation of geostrophic currents. The heat flux of the Atlantic and Pacific Oceans has been previously analyzed; however, the Indian Ocean's heat flux has not been analyzed. Therefore, this project would represent the first investigation of this kind in this particular ocean. These computer-derived determinations would also reveal a detailed analysis of the oceanic circulation patterns. The results of this project would be available for combination with Indian Ocean atmospheric heat fluxes at a later time.

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## VALUE ANALYSIS OF ENVIRONMENTAL FORECASTS BY WARFARE AREAS

Researcher: Midshipmen 1/C Eric J. Bayler and Michael Whiting

Adviser: Commander Richard A. Anawalt, USN

Sponsor: Naval Air Systems Command (AIR-370)

The main purpose of this project is to attempt to quantify the benefits which accrue to various warfare areas as a result of environmental forecasts which are prepared and disseminated by the Naval Oceanography Command. The areas investigated to date include surface warfare, with emphasis on Optimum Track Ship Routing, and Naval Aviation, with an emphasis on a statistical evaluation of aircraft damage reports. The principal goal of the project is to develop a comprehensive report which can be easily supplemented in future years. The main purpose of the report would be in the prioritization process of the Planning, Programming, and Budgeting System.

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## DYNAMIC TOPOGRAPHY OF EASTERN PACIFIC COASTAL WATERS

Researcher: Midshipman 1/C Catherine-Mary Carlin

Adviser: Professor Jerome Williams

Sponsor: National Oceanic and Atmospheric Administration

Using data supplied by National Oceanic and Atmospheric Administration, Midshipman Carlin plotted the dynamic topography of waters off the western U. S. coast. Using the 500-decibar level as a reference, both vertical sections and surface contours were plotted. The plots showed reasonably regular contours for the major portion of the area with some eddies present in the region around San Francisco Bay. Due to data limitation, only spring conditions were represented.

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WASTE DISPOSAL IN BALTIMORE COUNTY AND THE COASTAL PLAIN AREAS  
AS COMPARED TO THAT IN NEW YORK CITY AND LONG ISLAND

Researcher: Midshipman I/C Catherine-Mary Carlin

Adviser: Associate Professor Douglas W. Edsall

Population growth and the advent of disposable containers has caused an increase in waste. This increase must be accompanied by a more efficient waste disposal system. Developing and putting into operation an improved system is expensive and time consuming. Baltimore County and the Coastal Plain areas of Maryland can reduce much of the time and expense by adopting the waste disposal systems of New York City and Long Island. This can be done because of the similarity in these areas. Maryland, however, will not be able to use exactly the same systems, because of the lack of experience and different land.

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## WATER RESOURCES IN THE BALTIMORE AREA

Researcher: Midshipman I/C Catherine-Mary Carlin

Adviser: Associate Professor Douglas W. Edsall

Many activities depend on water. There is, however, a limited amount of usable water. Baltimore County happens to be an area that has more than its share of water. The County has numerous water sources, many of which are basically untouched.

Baltimore County has done little to secure an adequate water supply for the future. The county's officials must begin to investigate and find solutions for an upcoming shortage. Attention must be paid to improving industrial usage, increasing recharge, increasing reuse, improving waste treatment, developing storage areas and building water treatment and purification facilities.

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EXPERIMENTAL PROCEDURE

Two groups of rainbow trout, 20 fish per group, were held in aerated water at 10°C. The water was changed daily. The fish were held in aerated water for 48 hours before being used in the tests. The water in the tanks was aerated continuously during the entire test period.

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EXPERIMENTAL PROCEDURE ON THE EFFECT OF HEATED WATER ON RAINBOW TROUT

Two groups of rainbow trout, 20 fish per group,

were held in aerated water at 10°C.

The water in the tanks was aerated continuously during the test period. The water was changed daily. The fish were held in aerated water for 48 hours before being used in the tests. The water in the tanks was aerated continuously during the entire test period. A 48-hour test was run to evaluate the lethal effects of heated water.

Two groups of rainbow trout were run to compare the effect of heating the water on the  $LD_{50}$ . Two runs were conducted in aerated water and an  $LD_{50}$  was obtained. Another two runs were conducted with aeration provided, and the  $LD_{50}$  from the aerated tanks was compared to the  $LD_{50}$  from the un-aerated tanks. The aerated  $LD_{50}$  was nearly 2°C higher than that of the un-aerated tanks.

Two runs were conducted in an acidic, un-aerated environment. Higher fish mortalities occurred during these tests and the  $LD_{50}$  obtained from the mortality curves was nearly 3°C lower than the aerated, un-polluted  $LD_{50}$ . An exact pH level was difficult to maintain, and the results from the acidic portion of the test may be questionable.

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RESEARCH REPORT ON THE ENVIRONMENTAL IMPACTS OF OIL SPILLS

Volume 1: Environmental Impacts of Oil Spills

Chapter 1: Introduction to Environmental Impacts

The purpose of this report is to provide a comprehensive overview of the environmental impacts of oil spills. This includes a discussion of the physical, chemical, and biological processes involved in the transport and fate of oil in the marine environment. The report also examines the potential for oil to enter and contaminate coastal and estuarine ecosystems, and the resulting impacts on wildlife, fisheries, and human health. Finally, the report discusses the importance of monitoring and assessment in understanding and managing the environmental impacts of oil spills.

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ENVIRONMENTAL IMPACTS - ARE THEY GEOLOGICALLY FEASIBLE OFFSHORE OIL SPILLS?

Author: Mr. Shipman L.C. Perry, A. Feldmann

Editor: Associate Professor Douglas W. Edmull

The origin and development of passive continental margins such as the east coast of the United States, as understood from current geological theories, suggests that it is an area well-suited for natural accumulations of oil and gas. Current drilling results in the Baltimore Canyon Trough region off the New Jersey coast have supported the conclusions of these theories and have increased the prospects for large new discoveries of oil and gas. Assuming commercial quantities are available, this research has shown that this continental margin is more adaptable to the placement of drilling platforms and the laying of pipelines than other coastal regions of the United States. Atlantic City can effectively serve as a transition point from the offshore to onshore transportation of the oil and gas.

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## AN ECONOMIC ANALYSIS OF MANGANESE NODULE MINING ON THE DEEP OCEAN FLOOR

Researcher: Midshipman I/C Peter A. Fyles

Adviser: Associate Professor Douglas W. Edsall

It is clearly evident that the marine manganese-nodule deposits represent a vast reserve of such elements as cobalt, nickel, manganese, and copper. If political and legal debates can be resolved, the technology for mining and processing is ready. Mining will initially require a large capital investment, a large drawback. However, soon after full-scale mining commences there will be a large potential for profit.

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## A COMPARATIVE ANALYSIS OF LABORATORY METHODS FOR DETERMINING VIABILITY OF SELECTED BACTERIA

Researcher: Midshipman I/C Melissa L. Harrington

Adviser: Commander Joseph J. Spigai, USN

The cooling efficiency of submarine piping systems is rapidly reduced by the growth of bacterial slime and macroscopic organisms which affix to the metal surfaces. Both the Chlorinator and the Cathelco systems are studied and their anti-fouling abilities are compared. Titanium and Copper Nickel are compared as to their erosive/corrosive resistances. Initial qualitative approximations have determined that the chlorinator system used with Titanium appears to be the best combination for preventing bacterial sliming. Three quantitative lab methods for determining bacteria viability on submarine pipings are examined to evaluate which is most accurate within the scope of the Deep Components project. The oxygen probe and glucose method both are not sensitive enough to detect changes in quantities of bacteria unless unrealistically concentrated levels of organisms are used. The ATP Photometer is a highly sensitive instrument; the predicted linearity between concentration and luminescence was obtained. The Photometer appears to be the most suitable instrument for determining bacteria viability.

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THE MECHANISM BY WHICH SWAMPS PRODUCE CARBON MONOXIDE - A  
LITERATURE SEARCH

Researcher: Midshipman 1/C Michael A. Matson

Adviser: Professor John F. Hoffman

A search of the current literature indicated there are many studies dealing with the production of methane and the sources and sinks of carbon monoxide. Little is known however concerning the relationship between methane ( $\text{CH}_4$ ) and carbon monoxide (CO). The mechanism by which CO is produced may be the oxidation of  $\text{CH}_4$  by hydroxyl radicals, or by a reaction between  $\text{CH}_4$  and metastable oxygen below eighty kilometers. Above eighty kilometers, there is some indication that CO is produced from the photolysis of  $\text{CH}_4$  by direct solar radiation. Considerable research is still required to determine the interrelationship between  $\text{CH}_4$  and CO, especially in swamp waters that produce methane and the atmospheric layer immediately above the swamp area.

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## WATER QUALITY IN THE CHESAPEAKE BAY

Researcher: Midshipman 1/C William W. Metzgar

Adviser: Associate Professor Douglas W. Edsall

Existing physical, chemical, biological, and environmental conditions in the Chesapeake Bay were analyzed. At present, the water quality in the Bay may go either way. It is imperative that proper planning and implementation of advanced wastewater policies and procedures be enacted, that waste treatment capabilities are expanded, and strict enforcement of present laws and regulations is maintained.

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1. NAME OF REPORT:

2. DATE OF REPORT:

3. TITLE OF WORK OR PROJECT:

Researcher: Midshipman I/C Perry T. Tuetz

Adviser: Associate Professor J. Hoffman

The barrier islands of Maryland are being eroded at an amount of erosion. Wind, storm waves, and littoral currents are causing the amount of 150,000 cubic yards of sand to be lost each year. Because of these erosion impacts on the area, there has been an interest in the construction of a barrier. The most prominent of the methods of barrier construction is suggested to be in the construction of an eddy current system which would use the energy already in the waves. Sand replenishment will also be necessary because an unusually severe storm will erode the beach in spite of man's efforts to stop the damage. To date, there is no plan, however, that will maintain the coast of Maryland without destroying another portion, such as the northern tip of Assateague Island.

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THE USE OF THE CHESAPEAKE BAY HYDRAULIC MODEL IN DETERMINING THE TRANSPORT OF SEDIMENT AND HYDROIDS WITHIN HAMPTON ROADS, VIRGINIA

Researcher: Midshipman I/C Perry T. Tuetz

Adviser: Professor John F. Hoffman

Hydroids and shoaling in pier berths has been a problem at the Naval Station in Norfolk, Virginia for many years. The hydroid, Sertularia argentea, is causing a serious fouling problem at the Navy pier areas as is the settlement of silt. Costs for maintenance dredging are escalating. Any solution to these problems requires a knowledge of the source and bottom circulation patterns of both the sediment and the hydroid.

Initially, a large scale study of the Hampton Roads area to determine bottom circulation patterns is not necessarily the most economical. As a preliminary step, flow patterns in the Hampton Roads area have been studied and tests carried out in a scale model of Chesapeake Bay (owned and supervised by the Army Corps of Engineers, Baltimore District). This report concerns the preliminary results of the program.

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ANAWALT, Richard A., Commander USN, "A Survey of University Weather Games," Bulletin of the American Meteorological Society, 61 (1980), 197-201.

A survey was performed to gather data on all weather forecasting games that exist in the undergraduate and graduate institutions in the United States. Of 50 schools surveyed, 34 had weather forecasting games as a part of the meteorology program, and 16 did not participate in any game at all. A tabulation of each institution's forecasting-game highlights some of the unique aspects of the various games and shows the various scoring methods that are being used. It is hoped the survey and distribution of the results will aid other institutions in developing a forecasting game or help to improve existing forecasting games across the country.

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HOFFMAN, John F., Professor, Investigation Into Deep-Draft Vessel Berthing Problems at Selected U. S. Naval Facilities. Report prepared for the Naval Facilities Engineering Command and the Office of Naval Research, 1980.

An investigation of serious problems of shoaling of pier berths and turning basins and biofouling of aircraft carriers is described in this report. Seven harbors where U. S. Navy deep-draft vessels are berthed were examined. These are Alameda Naval Air Station; Charleston Naval Station; Mayport Naval Air Station; Norfolk Naval Station; Pensacola Naval Air Training Station; North Island Naval Air Station, Coronado, California; and King's Bay, Georgia.

Included were investigations of current velocities, shoaling patterns, submarine sediments, ship movement, dredging, spoil disposal, and berthing problems. Recommendations were made for specific installations as well as for the overall Navy dredging program.

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WILLIAMS, Jerome, Professor, co-author, *Science Puzzles*.  
New York: Franklin Watts, Inc., 1979.

This is a book of science puzzles aimed at upper elementary school students.

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PRESENTATIONS

OFFICE OF THE CHIEF OF BUREAU

ANAWALT, Richard A., Commander, USN, "The Naval Academy Oceanography Major," 30-minute slide presentation, Naval Postgraduate School, Monterey, California, 13 May 1980. (Part of the bi-annual curriculum review.)

\*\*\*\*\*

EDSALL, Douglas W., Associate Professor, "Laboratory Instruction Using Computer Augmented Video Education (CAVE)," 1979 Frontiers in Education Conference, Niagara Falls, Canada, October 1979.

\*\*\*\*\*

EDSALL, DOUGLAS W., Associate Professor, "Cultural Resources in the St. Francis River Basin," Annual Meetings of The Geological Society of America, San Diego, California, November 1979.

\*\*\*\*\*

HOFFMAN, John F., Professor, "Current Aspects of Dredging," Symposium on Dredge Sedimentation and Marine Organism Control, Alexandria, Virginia, 22-23 April 1980.

\*\*\*\*\*

WILLIAMS, Jerome, Professor, "A Comparison of Three Measures of Turbidity," Spring Meeting of the Atlantic Estuarine Research Society, U. S. Naval Academy, 11-12 April 1980.

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WILLIAMS, Jerome, Professor, "Does Recreational Boating Need Regulation?" Meeting of the Institute of Environmental Sciences, Philadelphia, Pennsylvania, May 1980.

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## PHYSICS DEPARTMENT

*Professor Gerald P. Calame, Chairman*



The research effort in the Physics Department reflects the wide range of expertise in the Department's faculty. Present activities include research in Acoustics, Computer-Assisted Education, Electric and Magnetic Properties of Materials, Fiber Optics, Laser Optics and Technology, Magnetic Signatures of Ships, Radiation Effects in Solids, Solar-Energy Studies, Solar System Astronomy, and Solid-State Physics, with the Solid-State Physics group being especially active.

This year, the Department's research efforts were supported by the David Taylor Naval Ship Research and Development Center, the Department of Energy, the National Aeronautics and Space Administration, the National Bureau of Standards, the Naval Research Laboratory, and the Naval Academy Research Council.

Midshipmen majoring in physics are encouraged to participate in the Department's research program, either through the 490-series or through the Trident Scholar Program. It should be noted that four of the six Trident Scholars for the year were Physics Majors.

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## THE RESPONSE SURFACE IN ELASTIC WAVE SCATTERING

Researcher: Associate Professor Donald W. Brill

Sponsor: David W. Taylor Naval Ship Research and Development  
Center, Annapolis Laboratory

A study was made of the normal-mode amplitudes for the scattering of elastic waves returned by a fluid-filled spherical cavity in an elastic solid. The moduli of the resonance portions of these amplitudes are exhibited in the form of a two-dimensional "response surface" in a three-dimensional graph, where the two independent variables are frequency and mode order. An explanation is made of the various distinctive features of the response surface, namely: (a) the loci of the zeroes; (b) the series of ridges that give rise to modal resonances and to the Regge poles (circumferential waves); and (c) the series of spikes along each ridge, which are shown to correspond to resonances in the circumferential waves. These informative features, graphically displayed at a glance in the plots of the response function, are quite useful in the interpretation of the scattering process taking place around fluid-filled cavities in solids, and in the identification of the material composition of the cavity contents, if the fillers were not known.

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## INVESTIGATION OF TONE GENERATION BY FLOW OVER WALL-MOUNTED CAVITIES

Researcher: Professor Samuel A. Elder

Sponsor: David W. Taylor Naval Ship Research and Development  
Center, Bethesda, Maryland

The prevention of self-sustained acoustic oscillations associated with cavities exposed to external flow is a recurrent problem in ship design. Under earlier contract, methods were developed for investigating free shear-layer oscillations in a cavity noath. The increased understanding of the phenomenon derived from these studies has been documented in a series of journal articles, under GHR sponsorship. The most significant result so far has been the development of a theory of driven shear-layers, on the basis of which it has been possible to account for observed cavity tone Strouhal numbers both in air and under water. Following this approach a feedback model, emphasizing trailing edge influence, has been developed. The

model is able to account qualitatively for many of the observed characteristics of cavity tones such as threshold flow-speed, spectral cutoff, and frequency lock-in (for resonator situations). When supplemented by an empirical formula for shear-layer nonlinearity, a rough estimate of the radiated sound amplitude is possible. Current work involves experimental investigations being conducted in the USNA Tow Tank Facility, using an instrumented towed model. A proposal to extend the present contract until September of 1981 has been submitted.

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#### ANALYSIS OF MAGNETIC MODEL TEST DATA

Researcher: Associate Professor William E. Fasnacht

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The magnetic field of a ship may be characterized by the magnetic scalar potential, which in turn may be expanded in a series of prolate spherical harmonics. D. A. Nixon of David W. Taylor Naval Ship Research and Development Center has shown that such an expansion is appropriate, has done extensive calculations determining the coefficients of such an expansion from measured values of the magnetic field, and has developed some preliminary explanations of the physical significance of various terms.

The problem under study is the selection of the optimum sample of data from the magnetic field of a model, and through analysis of the selected data to characterize the magnetic state of the model. Work is continuing.

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## DIELECTRIC PROPERTIES OF POLAR FLUIDS IN THE SUPERPRESSED STATE

Researchers: Associate Professor John J. Fontanella and  
Assistant Professor Mary C. Wintersgill

Sponsor: National Bureau of Standards (NBS)

A three-terminal cylindrical cell has been constructed for making complex impedance measurements in liquids and plastic crystals at audio frequencies. Pressures up to 15 kbar can be obtained over the temperature range 200-400K. In addition, the cell contains a thermocouple for differential thermal analysis studies.

Some preliminary measurements have been performed on carbon tetrachloride. The cell is obviously capable of producing excellent data on liquids. Consequently, one of the goals of the project can now be achieved since a careful study of liquids in the superpressed state can be made. The preliminary results do not indicate any dramatic dielectric anomalies in the superpressed state. However, there appears to be a decrease in the curvature in that region. More careful studies are now being carried out.

The results in the solid region are also very interesting in that a sharp transition is not observed. The most obvious explanation is that this is due to the cell design. One check is currently being made by using an alternative cell with a different geometry. This cell is the one constructed at NBS, and it will also be used to study phase transition in other fluids.

Finally, the cylindrical cell appears to give very good data for the dielectric properties of the plastic phase far above the phase transitions and will be used to study other materials.

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RADIATION EFFECTS IN FIBER OPTIC MATERIALS

Researcher: Associate Professor John J. Fontanella

Sponsor: Naval Research Laboratory

The primary purpose is to perform optical and dielectric absorption and electron spin resonance measurements on various samples of fused silica in order to further characterize and properly identify the radiation-sensitive defect center found dielectrically during the past year. Specifically, it is felt that the observed relaxation is due to an aluminum-alkali center, and an attempt will be made to correlate the dielectric signal to the well-known aluminum-associated electron spin resonance spectrum. The correlation will be attempted by varying radiation dose and carrying out isochronal annealing studies. In addition, studies of the effect of radiation on the low temperature hydroxyl associated relaxation may be carried out. Finally, a wide selection of silicate glasses may be studied dielectrically.

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TRANSMISSION LOSS IN OPTICAL FIBERS DUE TO NEUTRON IRRADIATION

Researcher: Associate Professor Richard L. Johnston

Sponsor: Naval Research Laboratory

This is a continuation of a project investigating the transmission properties of optical fibers, provided by NRL, when irradiated with 14.7MeV neutrons. About 20 meters of fiber are coiled and placed as close to the source as possible and the light output is monitored during irradiation at 820 nm. A pre- and post-irradiation wavelength spectrum is also taken to determine effects at other wavelengths.

A germanium detector has been constructed so that data can be extended into the 1100- to 1500-nm wavelength region.

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## COMPUTER TUTORIALS IN BASIC MECHANICS

Researcher: Associate Professor Bruce H. Morgan

Sponsor: United States Naval Academy, Office of the Academic Dean

The purpose of this project was to generate physics tutorials in basic mechanics using interactive computer graphics, with the objective of helping students to learn to translate real world problems into the conceptual terms of physics with emphasis on the value of the free-body diagram.

The plan was to develop learning hierarchies and flow charts as guides to logical development of a sequence of frames and switching points for each tutorial lesson.

Three tutorial programs were completed, two on operations with vectors and one on static equilibrium.

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## STRESS-INDUCED MAGNETIZATION BEYOND THE RAYLEIGH REGION

Researcher: Associate Professor Carl S. Schneider

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory (Project Linear Chair)

Lord Rayleigh's semi-empirical description of the changes in magnetization with changes in applied magnetic field was extended to stress-induced changes by Brown in 1949. In the present work we have experimentally verified a theoretical extrapolation of the Rayleigh-Brown model using the differential susceptibility curve as a response-function and maintaining the assumed thermodynamic equivalence of field and stress. Moreover, the development of stress-induced parabolic hysteresis loops is further derived as associated with the reversible stress coefficient of susceptibility,  $d\chi/d\sigma$ , and is experimentally confirmed.

Present efforts are to complete the final measurements on sample rods of HY80 and HY100, common Navy ship steels, of length to diameter ratio sufficiently large to make demagnetization effects negligible. The theory developed and confirmed in this work is constrained to the Rayleigh region of magnetic field, as exists for ships in the Earth's field, and up to the coercive stress, which our ships experience in their natural operations.

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## RADIATION INDUCED DEFECTS IN III-V SEMICONDUCTORS

Researcher: Professor Robert N. Shelby

Sponsor: Naval Research Laboratory

The purpose of this research is to identify and characterize defects in III-V semiconductors. The emphasis is on defects that have been created by radiation damage due to external sources or by radiation damage suffered during ion implantation.

This project uses Deep Level Transient Spectroscopy (DLTS) to determine the energy, capture cross-section, and concentration of the defect states. In addition, DLTS allows one to identify the defect or trapping states as majority or minority carrier-traps.

Results on electron-irradiated GaP have been reported and current work is concentrated on ion-implanted GaAs.

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## GENERATION OF COHERENT TUNABLE VACUUM ULTRA-VIOLET RADIATION

Researcher: Assistant Professor Lawrence L. Tankersley

Sponsor: Naval Research Laboratory

The purpose of the project is to develop a widely tunable coherent radiation source in the VUV. Rare gas-halide excimer lasers are being utilized as primary radiation sources. The primary radiation will be used to pump a dye laser producing a tunable secondary beam. Finally, the primary and secondary beams will be mixed, using non-linear techniques to produce coherent VUV radiation. A source of the type described would have wide-ranging spectroscopic applications.

At present, we have tunable output around the Lyman- $\beta$  transition. We are studying the use of this radiation as a probe of neutral hydrogen densities. A good probe of neutral hydrogen densities would aid the fusion-plasma research programs.

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## PHOTOSTRUCTURAL CHANGES IN CHALCOGENIDE GLASSES

Researcher: Associate Professor Donald J. Treacy

Sponsor: Naval Research Laboratory

The nuclear quadrupole resonance (NQR) spectra of  $^{75}\text{As}$  in  $\text{As}_2\text{Se}_3$  and  $\text{As}_2\text{O}_3$  were examined. In the  $\text{As}_2\text{Se}_3$  melt, quenched glass and films deposited on high and low temperature substrates were examined. The purpose of this investigation was to determine if there were any differences in structure of the bulk glass and films. The bulk glass was found to be similar to the crystal, but in the films deposited on low temperature substrates, substantial evidence for  $\text{As}_2\text{Se}_4$  structural units was found.

The films deposited on low temperature substrates were then irradiated with laser light in the electronic absorption edge ( $\lambda > 200$  to  $3000 \text{ cm}^{-1}$ ). This irradiation changed the structure of the film as determined by NQR, Raman scattering, and IR absorption.

In the  $\text{As}_2\text{O}_3$  two crystalline modifications exist, each with a different NQR spectrum. A lineshape of the NQR as a function of frequency showed evidence for some traces of a arsenolite-based glass, but the predominant glass form seems to resemble claudetite. This glass is unstable at room temperature and devitrifies to the arsenolite crystal. The relaxation of two samples stored at liquid nitrogen temperature was followed as the glass devitrified.

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## THE EFFECTS OF VOYAGING ON THE MAGNETIZATION OF SHIP MODELS

Researcher: Midshipman 1/C Elizabeth A. Belzer

Adviser: Associate Professor Carl S. Schneider

Sponsors: Naval Ship Research and Development Center, Annapolis Laboratory and Trident Scholar Program

The effects of cyclic stress on induced and remanent magnetization in rods of HY100 and HY130 ship steel were measured using a newly designed and fabricated apparatus to simultaneously apply variable magnetic field and cyclic stress. Circuits were built to monitor the strain levels in the samples (roughly fifty and one hundred microstrains) using a resistance strain-gage bridge, and to measure changes in magnetic induction using an

induction coil and a magnetometer probe. Results showed a uniform increase in susceptibility with cyclic stress for both rods. The HY130 sample's susceptibility was higher than that of the HY100 in all cases. The slope of the normal susceptibility with field, or Rayleigh coefficient, was measured for each steel, and these were compared with the slope of the normal initial susceptibility with strain amplitude to determine the fraction of domains responsive to stress. The calculated value of this fraction was 0.55.

In addition, long-term effects of cyclic stress on magnetization were studied. An increase in magnetization in the presence of a field, related to the log of the number of cycles, was observed. The change of the magnetization with the first cycle of stress was found to be large in comparison to changes which occurred through subsequent cycles. Continuation of vibration for several months is now seen as adequate to produce comparable first-cycle and long-term effects. Thus, a model for changes in magnetization of Navy ships with time has been established.

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#### BASIC STUDIES OF A FLUORINE ANION SUPERIONIC CONDUCTOR

Researcher: Midshipman 1/C John R. Igel

Advisers: Associate Professor John J. Fontanella and Associate Professor Donald J. Treacy

Sponsor: Trident Scholar Program

Audio frequency conductivity and capacitance measurements in the temperature range of 5.4-310K have been used to study the conductivity and dipolar relaxation phenomena in calcium-doped lanthanum trifluoride. Measurements have been taken at five frequencies from 100Hz to 10kHz on samples varying in concentration from 0.01% to 0.3%. One strong dipolar dielectric relaxation and several weaker relaxations have been observed both parallel and perpendicular to the c-axis. The strong dipolar relaxation has been attributed to the realignment of a charge-compensating fluorine ion vacancy about a substitutional alkaline-earth ion. The weaker relaxations have been attributed to trace impurities because of the lack of any regular progression in either concentration or direction of applied field. Measurements indicate that, for samples of similar concentrations, the strength of the dipolar dielectric relaxation perpendicular to the c-axis is

from 1.5-1.9 times the strength parallel to the c-axis. This has been attributed to a dipole moment perpendicular to the c-axis which is significantly greater than that parallel to the c-axis. An activation enthalpy in the dipolar region of  $.31 \pm .03$  eV has been observed. At higher temperatures, a thermally-activated or association region has been observed. An activation enthalpy for this region of  $.49 \pm .03$  eV and an association energy of  $.38 \pm .03$  eV is reported.

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#### RADIATION EFFECTS IN FIBER OPTICS

Researcher: Midshipman 1/C Mark J. Marshfield

Advisers: Associate Professor Richard L. Johnston and Assistant Professor Mary C. Wintersgill

Sponsor: Trident Scholar Program

The damage produced in optical fibers by fast neutrons has been studied with reference to the recovery of the fibers tested. The fibers were subjected to varying doses of neutrons. Individual wavelengths were monitored during the irradiation and post irradiation recovery processes. Recovery rates for each particular wavelength were studied to measure the bleaching effect of the monitoring light at that wavelength. The wavelength was varied over the lower operating range of the fibers, 700 to 950 nm in increments of 50 nm.

Further measurements were taken to determine the bleaching effect of ultraviolet light. Theory suggest that damage caused by high energy neutrons, known to create absorption bands in the ultraviolet range, should show bleaching effects when high intensity ultraviolet light is transmitted through the fiber. Neutral density filters were utilized to determine the dependence of recovery on the intensity of ultraviolet light used.

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## RADIATION INDUCED TRAPPING STATES IN SEMICONDUCTORS

Researcher: Midshipman 1/C Stephen L. Spehn

Adviser: Professor Robert N. Shelby

Sponsor: Trident Scholar Program

All semiconductor devices contain impurities and defects of the crystalline structure which produce energy levels in the mid-band gap range. These energy-states provide the mechanisms for the generation and recombination of conduction electrons and holes. In addition, these states act as "trapping states" for electrons and holes observable in the transient response of the device. One of the most effective techniques for investigating the presence and properties of these trapping states is called Deep-Level Transient Spectroscopy (DLTS). Midshipman Spehn's research consisted of a careful mathematical modeling of the DLTS system and an application of the modeling results to measurements on Silicon and GaAs samples.

The results of the modeling study yielded the most complete response functions currently available for DLTS systems using lock-in amplifiers. Calculations based on this response-function allow one to calculate more accurate values for trapping state parameters for a much wider range of DLTS system parameters than was previously available. Graphical displays of the response-function were generated to guide experimenters in DLTS set-up procedures.

In addition, DLTS measurements were made on Silicon and GaAs samples, and the response function developed was proved by comparing results with known results.

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## THE DEVELOPMENT OF THE DOUBLE PARABOLIC-CONCENTRATOR

Researcher: Midshipman 1/C Dean J. Cottle

Adviser: Professor Billie J. Graham

The efficiency of solar collectors can be improved by collecting more of the incident radiation and by decreasing the heat losses from the absorber element. The double parabolic concentrator utilizes the geometric properties of the reflector to increase the acceptance angle of the incident radiation. In contrast to conventional focusing collectors which accept only direct radiation parallel to the optic axes, these nonimaging concentrators (a) eliminate the need for continual tracking, requiring only an occasional tilt adjustment; (b) accept diffuse radiation as well as direct radiation; (c) collect more radiation with a wider acceptance angle; and (d) return by reflection some reradiation by the absorber.

A computer program was written to analyze by ray-tracing the path of radiation reflected from the double parabolic-concentrator to the absorber region. A prototype concentrator was constructed and tested for efficiency.

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## AN INVESTIGATION OF STABILITY MODELS FOR DRIVEN PLANE LAMINAR JET

Researcher: Midshipman 1/C Edward J. Fischer

Adviser: Professor Samuel A. Elder

By means of hot-wire technique, the growth of driven instability waves along a plane laminar jet was investigated. The plan was to measure both ac and dc velocity-profiles at a number of stations downstream of the jet orifice, as a function of driving frequency. From these data, average values of instability-gain were computed. When the results were displayed in the form of a plot of nondimensional imaginary propagation constant versus Strouhal number, they were found to support some of the theoretical predictions of Drazin and Howard, which are based on a temporally-growing Bickley-type jet. It appears, however, that better agreement could be obtained with a model based on spatial rather than temporal growth.

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## NEUTRON-INDUCED ATTENUATION IN THE NEAR INFRA-RED IN OPTICAL FIBERS

Researcher: Midshipman 2/C William H. Hilarides

Adviser: Associate Professor Richard L. Johnston

The circuitry for a germanium detector has been constructed so that data in the 1100- to 1500-nm wavelength region can be obtained.

Fibers provided by the Naval Research Laboratory will be irradiated with 14.7 MeV neutrons, and any observable attenuation will be monitored.

A wavelength spectrum over the range 1100- to 1500-nm will be taken prior to and after each irradiation to determine effects over the band. Recovery will also be monitored.

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## MICROPROCESSOR CONTROL OF OPTICAL EXPERIMENTS

Researcher: Midshipman 1/C J. Kenyon Hiser

Adviser: Associate Professor Donald J. Treacy

The purpose of this project was to develop the necessary software and hardware to interface an H-8 microprocessor with a Cary Spectrophotometer and allow the microprocessor to control the acquisition and handling of data.

The difficult part of this project was to develop a set of instructions for the microprocessor to physically perform input/output routines.

The project essentially is completed. The microprocessor will completely control the Spectrophotometer.

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## TRAPPING-STATES IN SEMICONDUCTORS

Researcher: Midshipman 2/C Harvey S. Hopkins

Advisor: Professor Robert N. Shelby

Trapping-states in semiconductors are important to the transient-response characteristics of semiconductor devices. The purpose of this project was to familiarize Midshipman Hopkins with the theory and techniques of deep-level transient spectroscopy, a method of measuring trapping parameters, and to perform the necessary preliminary measurements on samples to allow interpretation of system results. The work will continue as a Trident Project in 1980-1981.

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## COMPUTER-MODELING OF IONIC SOLIDS

Researcher: Midshipman 2/C Louis D. Marquet

Advisor: Associate Professor John J. Fontanella

The primary objectives of the project were to evaluate the stability of various dimers (defect site containing two impurity atoms) in rare-earth doped alkaline earth fluorides and to propose and evaluate new dimers which would be consistent with recent, new experimental results. Computer calculations were performed using a shell-model HADES-type program written by Captain Robert J. Finkle, USMC, of the Mathematics Department. It was found that of previously proposed dimers, the 2-2-2 is indeed the most stable. In addition, the researchers have thus far been unable to find a more stable dimer. However, different configurations containing vacancies have not yet been tried, and thus further work is necessary. One important result was that the only electrical relaxation possible for the 2-2-2 must take place with a well-inequivalency of 0.6 eV. This inequivalency is not observed experimentally and thus rules out the 2-2-2 as the dimer responsible for the RIV relaxation.

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## THE USE OF PLASTIC CRYSTALS AS PRESSURE-CALIBRATION DEVICES

Researcher: Midshipman 1/C Mark E. Middleton

Adviser: Assistant Professor Mary C. Wintersgill

It is proposed to study liquid-solid and solid-solid phase transitions in compounds using differential thermal analysis (DTA) and dielectric (DR) techniques. In DTA studies, a temperature difference caused by heat flow in phase transitions is measured, and in DR techniques, the changes in capacitance and conductance due to the phase change are measured. Special attention will be given to compounds in which one of the solid phases is "plastic." In a plastic crystal, the molecules maintain a high degree of rotational freedom.

The objectives of this project are of both a basic and an applied nature. First, there have been many recent papers on the effects of temperature on the dielectric properties of plastic crystals, but very few consider the effects of high pressure. By combining dielectric and DTA data with known data from temperature experiments, it is hoped that a better understanding of phase-transitions can be developed.

The applied interest in such data lies in the possible use of phase transitions of plastic crystals as pressure fixed points. If a plastic crystal is found which has a well-defined phase transition with little temperature dependence, such a material could be used to accurately determine pressure in confined spaces.

The construction of the new sample-holder and additional equipment associated with the pressure-bomb has been completed. Several data runs have been made and the preliminary results appear to be very interesting, including a distinct region of supercompressed fluid and a characteristic curved transition to the solid state.

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## DETERMINATION OF THE MEAN LIFE OF COSMIC RAY MUONS AT PERT

Researcher: Midshipman 1ZC Stephen Struble

Adviser: Professor Robert H. Shelby

A scintillation-detector system was assembled to record the stopping and decay of cosmic ray muons. The time between the muon's stopping and decay was measured electronically and recorded in a multichannel analyzer. After correction for accidental events and nuclear capture in the detector, a value for the muon mean life of 2.145  $\mu$ sec was obtained. This value is within 1.5% of the accepted value of 2.115  $\mu$ sec. The experimental procedure was carefully documented to allow possible use of this experiment as an experiment for the Nuclear Physics Laboratory.

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BRILL, Donald W., Associate Professor, co-author, "Resonance Theory of Elastic Shear-Wave Scattering from Spherical Fluid Obstacles in Solids," Journal of the Acoustical Society of America, 67 (1980), 414.

The vector potential for an arbitrarily polarized shear-wave in an elastic (lossless) medium incident on, and scattered by, a spherical fluid occlusion is expanded in vector spherical harmonics. The boundary conditions are dealt with for this incident vector-potential in terms of two (scalar) Debye shear potentials  $s$  and  $t$ , giving rise to what we have termed "s and t waves," respectively. The s wave scatters into both another s wave and also mode-converts into a compressional p wave. The t wave scatters only into another t wave with no mode conversion. Scattering amplitudes are cast in a series of resonance terms. The scattered p and s waves exhibit resonances; however, the t wave does not. We exhibit monostatic and bistatic plots of the first few partial-wave amplitudes ( $n = 1, 2, 3, \dots$ ) for the sp, ss, and tt scattering modes. When the background amplitude corresponding to scattering from an *evacuated* spherical cavity is removed from each partial-wave contribution, the remaining portion of the amplitudes is a clear series of liquid sphere resonances. We display these resonances as functions of the acoustic size  $k_0 a$  of the cavity, and of the order  $n$  of each mode. This work completes the determination of the scattering matrix elements for a fluid sphere in an elastic medium which was commenced earlier with the study of resonance effects in pp and ps scattering.

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ELDER, Samuel A., Professor, "Some Physical Mechanisms Underlying the Pipe Voicing Art," Journal of the Acoustical Society of America, 66 (1979), S67.

This paper examines underlying mechanisms for changes in the flue pipe spectra caused by selective changes in mouth cutup, pipe length, languid position, etc. The physics of the problem involves the mechanics of jet waves, and the subtleties of their interaction with sound waves. Special interest centers at lower lip, where jet waves originate, and at upper lip, where sound is produced by collision of jet and pipe fluid. The necessities of feedback amplification require jet and sound motions to act in a reciprocal way so that, for example, delay in impulse transmission along the jet is exactly matched by acoustic transmission delay in pipe. Actually, jet waves and their associated sound waves behave

in remarkably self-consistent and complementary ways. Just as sound waves travel up and down pipe to form discrete modes, jet waves also appear in discrete pairs, which travel up and downstream. One of the principal acoustic factors in voicing is the natural "stretching" of pipe mode frequencies, which tends to give pipes voiced to oscillate above resonance a different character from those voiced to oscillate below. An analogous property of jet is thickness Strouhal-number, or nondimensional frequency. Since cutoff occurs at a critical Strouhal-number, harmonic development on the jet is not possible unless  $S > 0.05 S_c$ . High and low Strouhal-number jets, therefore, exhibit opposing spectral tendencies. Thus, voicing is seen as adjustment toward optimum complementarity between jet and resonant cavity, consistent with a desired spectral output.

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MOHR, Samuel A., Professor, "Forced Oscillations of a Separated Shear Layer with Application to Cavity Flow-Tone Effects," Journal of the Acoustical Society of America, 67 (1980), 774-781.

Wave-boundary conditions near the point of separation at a sharp edge are carefully examined, with new insights being derived for some common flow-tone situations. Application of the continuity-of-velocity principle enables the amplitude and phase of the instability wave to be related to the acoustic driving wave-amplitude. Likewise, continuity of shear stress leads to a mathematical linkage of shear layer dynamics on upstream wall boundary-layer parameters. Some surprising results: (1) An instability wave origin near the point of separation is found to move initially at half the velocity expected from linear theory. (2) Although resonator-controlled flow tones operate at levels above the nonlinear saturation point for shear layer instability, they can exist only for shear layers that would otherwise be highly unstable. Some longstanding mysteries cleared up: (1) Why unlabeled resonators (e.g., coke bottles) resist excitation by flow at grazing incidence. (2) Why flow-tone spectra are nearly pure sine waves, even for multimode cavity systems.

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ENGLE, Irene M., Assistant Professor, co-author, "Idealized Jovian Magnetosphere Shape and Field," Journal of Geophysical Research, 85 (1980), 579-592.

An equatorial sheet-current deduced from Pioneer 10 magnetic field observations has been added to a planetary dipole-field to construct a model of magnetic field due to sources inside the magnetopause. This internal field has then been used to calculate the magnetopause surface in a cyclic process to a fifth order, in cycles, at which the calculation converges. The resulting magnetopause is considerably flatter in shape than one resulting from a primarily dipole internal field-source. The field internal and external to the magnetopause surface due to the currents on the surface has been computed by integrating over the entire magnetopause. A model for the total magnetospheric field of the inflated magnetosphere has been constructed by adding this latter contribution to the internal source-fields to obtain a global model of an inflated Jovianlike magnetospheric field.

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FONTANELLA, John J., Associate Professor, and Michael K. SMITH, Ensign, USN, "Electric Dipole Relaxation of Mixed Clusters in Double Doped CaF<sub>2</sub>," Physical Review, B19 (1979), 5293-5298.

Audio frequency dielectric relaxation measurements from 150-400K and ionic thermocurrent measurements from 90-290K have been used to study the relaxation of dipolar defects in several calcium fluoride samples doped with two rare-earth species. In particular, the region containing the R<sub>IV</sub> relaxation for the corresponding singly-doped samples has been investigated. The R<sub>IV</sub> relaxation is distinguished by an activation energy that is a strong function of the ionic radius of the rare-earth dopant, varying from about 0.5eV (for CaF<sub>2</sub>:Tm) to about 0.9 eV (for CaF<sub>2</sub>:Pr). In each doubly-doped sample, relaxations are observed similar to those observed in the singly-doped samples. In addition, a new relaxation is found which falls between the R<sub>IV</sub> relaxation peaks of the two constituents. This suggests that the R<sub>IV</sub> relaxation is associated with a cluster including two rare-earths (a dimer) and that the new peak is associated with a cluster including two different rare-earths (a mixed dimer). Since the existence of an electrical relaxation requires that the dimer be dipolar, the results cannot be explained by the usual dimer models. In addition, the data indicates that the rare-earth ions do not share equally in the reorientation process.

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FONTANELLA, John J., Associate Professor, and Richard L. JOHNSTON, Associate Professor, "The Dielectric Properties of As-Received and Gamma Irradiated Fused Silica," Journal of Non-Crystalline Solids, 31 (1979), 401-414.

Audio-frequency capacitance and conductance measurements have been carried out on 15 kinds of fused silica over the temperature range 5.5-380K. The results are used to arrive at corresponding values for the complex dielectric constant. It is shown that the relative strengths of the three relaxations observed in as-received fused silica are characteristic of the Type of fused silica. In addition, it is found that one of the relaxations can be destroyed by gamma rays and that the destruction is accompanied by the creation of a lower activation energy-relaxation. A corresponding growth of optical absorption-bands in the visible portion of the spectrum is observed. The gamma ray sensitive relaxation is attributed to an aluminum-alkali center, and the gamma ray induced relaxation is attributed either to an aluminum-oxygen-hole center or to a "nonlocal" alkali ion. Finally, accurate values for the real part of the dielectric constant at various temperatures are presented.

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FONTANELLA, John J., Associate Professor, Robert J. KIMBLE, Jr., Captain, USMC, and Mary C. WINTERSGILL, Assistant Professor, "Electrical Relaxation in Double Doped Calcium Fluoride and Activation Volume for the R1 Relaxation," Journal de Physique, 40 (1979), 65-65.

Audio-frequency dielectric relaxation measurements are reported over a temperature range 150-250 K for various samples of calcium fluoride doped with two different rare-earths. Consequently, the R1 relaxation region has been studied. It is found that the R1 relaxation region in the double-doped samples is composed only of the R1 relaxations found in the singly-doped materials. This is consistent with the usual association of the R1 relaxation with a simple point defect consisting of a substitutional rare-earth and a nearest-neighbor interstitial fluorine ion (tetrahedral site).



In addition, the complex dielectric constant for calcium fluoride doped with either erbium or terbium has been measured at pressures up to 0.4 GPa at 195K. The activation volume for the motion is found to be  $2.9 \pm 0.1$  cm<sup>3</sup>/mol. For comparison, a theoretical value of 2.5 cm<sup>3</sup>/mol is calculated using Flynn's dynamical diffusion model. In addition, the results are compared with recent activation volume data for Type I and Type II dipoles in strontium fluoride and impurity-vacancy dipoles in calcium fluoride.

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FONTANELLA, John J., Associate Professor, and Donald J. TREACY, Associate Professor, "The Effect of Quenching on the Defect Structure of Calcium Fluoride Doped with Erbium," Journal of Chemical Physics, 72 (1980), 2235-2245.

Audio-frequency dielectric relaxation measurements over the temperature range 5.5-390K and optical absorption studies at 8K have been performed on various samples of rare-earth doped calcium fluoride. Erbium was the principal dopant and the studies were carried out for a series of concentrations before and after vacuum anneal at 1125K followed by a quick quench. Strong effects were observed on all spectra. A similar anneal followed by a slow cool returned the samples to their initial state. It is shown that RI and RII correlate with optical signals associated with the A and B sites of Tallant and Wright. The annealing results are consistent with the identification of these sites as monomer (single rare-earth) sites of C<sub>4v</sub> and C<sub>3v</sub> symmetry, respectively. It is pointed out that while the assignment of the former site to a T<sub>q</sub>(f<sub>1</sub><sup>-</sup>) complex is justified, the assignment of the latter to a Tr(F<sub>1</sub><sup>-</sup>) complex is not supported by current ESR or ENDOR data.

RIV, which has recently been shown to be associated with a dimer (two rare-earths), correlates with optical signals associated with the C site of Tallant and Wright. This suggests that at least one of the rare-earths in the dimer exhibits approximately trigonal symmetry. In addition, RIII is found to be associated with optical signals which correlate with the D-sites of Tallant and Wright. The annealing results suggest that RIII may be due to a higher-order cluster. Finally, the annealing results suggest that RV is associated with a monomer site. This result is significant in that this is the first observation of a non-cluster-associated relaxation for which the activation energy depends strongly upon the nature of the rare-earth.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Activation Volume for Vacancy Motion in Calcium Fluoride," Physica Status Solidi, B97 (1980), 303-309.

The audio-frequency complex dielectric constant for sodium-doped calcium fluoride has been measured at pressures up to 0.4 GPa over the temperature range 240-270K and at zero pressure over the temperature range 5.5-400K. Consequently, the reorientation of a nearest-neighbor vacancy around a substitutional sodium ion has been studied. The activation volume for the motion is found to be  $1.73 \pm 0.05$  cm<sup>3</sup>/mol. It is argued that this value should be similar to the migration volume for "free" vacancies. The compressibility of the activation volume is found to be forty times the compressibility of the host lattice. Finally, a large negative thermal expansion coefficient is found for the activation volume for vacancy motion.

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FONTANELLA, John J., Associate Professor, and L. Michael HAYDEN, Ensign, USN, "Activation Volume for Interstitial Motion in Strontium Fluoride," Physical Review, B21 (1980), 794-798.

The complex dielectric constant for erbium-doped strontium fluoride has been measured at pressures up to 0.4 GPa over the temperature range 300-360K. Consequently, the reorientation of a Type II dipole (substitutional rare-earth and next-nearest neighbor interstitial fluorine charge compensator) has been studied. The activation volume for the motion is found to be  $4.73 \pm 0.1$  cm<sup>3</sup>/mol. It is argued that this value should be similar to the migration volume for "free" interstitials. Excellent agreement is found between a value for the migration-volume calculated from Flynn's dynamical diffusion model and the experimental value for bound interstitials. Finally, the compressibility of the activation volume is found to be more than an order of magnitude greater than the compressibility of the host-lattice, and the thermal-expansion coefficient for the activation volume is found to be negative.

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GRAHAM, Billie J., Professor, "A Survey and Evaluation of Current Design of Evacuated Collectors," Report for DOE Contract No. DE-AC04-78CN05350, (September 1979).

This report describes the state of the art of evacuated solar-collectors, and identifies all of this type of collectors from those which have been extensively tested to others which are just in the state of laboratory development. Where the information is available, the collectors are compared in performance with a flat-plate collector. A list of the sites using these collectors was compiled to show the variety and extent of application of evacuated collectors.

Some 30 evacuated-collectors were described in the report in detail which depended upon the information available and the stage of development. Recent developments in evacuated-collectors include utilization of CPC reflectors, both externally and internally with respect to the tube, use of air as a heat-transfer medium, and the introduction of the heat pipe as a heat-transfer device.

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GRAHAM, Billie J., Professor, "Evacuated Tube Collectors," Solar Age Magazine, 4 (1979), 12.

Evacuated tube-collectors reduce heat losses by conduction and convection by placing an insulating vacuum-jacket about the absorber, and they reduce radiation losses by using selective coatings on the absorber surface. As a consequence of the reduced heat losses, the minimum solar energy required for useful collection of energy for an evaluated tube-collector at 50°C about ambient temperature will be on the order of 0.14 kW m<sup>-2</sup>. For a typical flat-plate collector this minimum incident solar energy is 0.25 to 0.30 kW m<sup>-2</sup>. This improvement in performance means that, compared with flat-plate collectors, evacuated collectors (a) start collecting energy earlier in the morning and extend this collection until later in the day; (b) collect energy under less favorable operating conditions; (c) collect energy more days per year; and (d) show substantial improvement in average daily collector efficiencies in regions of marginal availability of insolation.

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IGEL, John R., Midshipman 1/C, USN, John J. FONTANELLA, Associate Professor, Donald J. TREACY, Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Defect Structure of Calcium Doped Lanthanum Fluoride," Bulletin of the American Physical Society, 25 (1980), 414.

Complex impedance-measurements have been performed on samples of lanthanum fluoride doped with calcium at various concentrations over the range 0.01 - 1.0 mol-%. Measurements have been made both parallel and perpendicular to the optic axis and over the temperature range 5.5 - 310K at audio frequencies. The effect of the impurities on the DC-conductivity, in the vicinity of room temperature is reported. In addition, a strong electric relaxation is observed at lower temperatures and is attributed to reorientation of a substitutional calcium-fluorine vacancy pair. Activation parameters for both types of processes are reported.

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SHELBY, Robert N., Professor, and John J. FONTANELLA, Associate Professor, "The Low Temperature Electrical Properties of Some Anisotropic Crystals," Journal of Physics and Chemistry of Solids, 41 (1980), 69-74.

The principal complex dielectric constants have been studied at audio frequencies over the temperature range 5.5-380K for  $\alpha$ -quartz, sapphire, magnesium fluoride, and calcite. For some samples, the imaginary part of the dielectric constant revealed the presence of dipolar or thermally-activated loss mechanisms which are attributed to trace impurities. The effects of these impurities are considered in arriving at values of the real part of the dielectric constants for each of the materials.

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TANKERSLEY, Lawrence L., Assistant Professor, "Can the  $^3\text{He-A}$  Texture Be Electrically Oriented?", Journal of Low Temperature Physics, 37 (1979), 141-147.

The polarization-contribution to the  $^1\text{He}$ - $^3\text{He}$  interaction affects the dielectric anisotropy in superfluid  $^3\text{He-A}$ . An improved molecular model of the polarization-contribution verifies the results of previous atomic models. Design criteria are discussed for a feasible  $^3\text{He-A}$  electrical orientation experiment.

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TREACY, Donald J., Associate Professor, co-author, "Photodarkening and Photostructural Effects in Glassy  $As_2Se_3$ ," Solid State Communications, 32 (1979), 423.

A systematic study of one-phonon Raman, two-phonon infrared and  $^{77}As$  nuclear quadrupole-resonance measurements on bulk and thin film samples of  $As_2Se_3$  has separated the photodarkening and photostructural effects. Photodarkening occurs in all samples but photostructural effects are not observed in bulk or well-annealed films of  $As_2Se_3$ .

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TREACY, Donald J., Associate Professor, co-author, "Photostructural Effects in Glassy  $As_2Se_3$  and  $As_2S_3$ ," Journal of Non-Crystalline Solids, 35 and 36 (1980), 1035.

Photostructural effects are investigated in 300K substrate evaporated films of  $As_2S_3$  and  $As_2Se_3$  using nuclear quadrupole-resonance (NQR) techniques. NQR results confirm the existence of  $As_2S_3$  (or  $As_2Se_3$ ) molecular units in the films and suggest the presence of  $AsS_3$  (or  $AsSe_3$ ) pyramidal units which lack the longer range (two-dimensional) correlations present in the bulk. Structural differences between films and bulk are greater (and photostructural changes are easier to induce) in  $As_2S_3$  than in  $As_2Se_3$ .

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WINTERSGILL, Mary C., Assistant Professor, co-author, "Explanation of the Anomalously High Activation Energies of TL in  $LiF(TLD100)$ ," Radiation Effects, 41 (1979), 11.

Previous analyses of the high temperature glow-peaks in  $LiF(TLD100)$  have suggested that the peaks may be described by classical "first order" kinetics for the thermoluminescence. However, the pre-exponential factor  $S$  and the activation energy  $E$  are anomalously high (e.g., for peak 5,  $E = 2.06$  eV and  $S = 5 \times 10^{10} s^{-1}$ ). A reappraisal of the paths of the charge movements between the complex defect-aggregates which exist within the  $LiF:Mg:Ti$  suggests that the simple classical analysis may be inappropriate, and while one predicts the same curve shapes, the measured parameters are  $S^x$  and  $xE$  where  $1 < x < 2$ . Hence, the energy required for the primary step of charge-release is quite normal for the temperature range at

which the glow peaks are observed (e.g.,  $S = 10^{11}$ ,  $E = 1$  eV,  $T = 200$  C). The apparent difference between glow-curve values of  $E$  and  $S$  and those from isochronal anneals are satisfactorily explained, and the two methods are seen to be in agreement.

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WINTERSGILL, Mary C., Assistant Professor, co-author, "The Effect of Radiation on the  $\text{OH}^-$  Infrared Absorption of Quartz Crystals," Journal of Applied Physics, 50 (1979), 5449.

The effect of 1.6 MeV electron irradiation on the infrared properties of high-purity quartz crystals has been studied. The infrared bands associated with  $\text{OH}^-$  impurities in  $\text{SiO}_2$  crystals are strongly temperature dependent and must be studied at 77K or below. Prolonged electron irradiation at low temperature suppresses all of the  $\text{OH}^-$  bands, but these bands recover when the crystals are annealed to approximately 740K. If "as-grown" crystals are irradiated at 300K, the intensity of the  $\text{OH}^-$  bands decreases, and two new bands appear at  $3367\text{cm}^{-1}$  and  $3306\text{cm}^{-1}$ . The relative absorption intensity of these two bands depends on radiation temperature and dose.

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WINTERSGILL, Mary C., Assistant Professor, and John J. FONTANELLA, Associate Professor, "The Temperature Variation of the Dielectric Constant of 'Pure'  $\text{CaF}_2$ ,  $\text{SrF}_2$ ,  $\text{BaF}_2$ , and  $\text{MgO}$ ," Journal of Applied Physics, 50 (1979), 8259-8261.

Improved values of the real part of the low-frequency dielectric constant are presented for "pure"  $\text{CaF}_2$ ,  $\text{BaF}_2$ ,  $\text{SrF}_2$  and  $\text{MgO}$  over the temperature range 5.5-400K. Accurate measurements of both the real and imaginary parts of the dielectric constant were made so that corrections could be made to allow for dipolar impurities. The final results are thought to be accurate to better than 0.1% over the full range of temperatures.

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WINTERSGILL, Mary C., Assistant Professor, co-author, "EPR Study of the  $E_1^1$  Center in Alpha-Quartz," Solid State Communications, 30 (1979), 575.

Electron paramagnetic resonance measurements of the  $E_1^1$  center in alpha quartz have now proven that this species contains one unpaired electron ( $S = 1/2$ ), with hyperfine splitting from one proton ( $I = 1/2$ ). The spin-Hamiltonian matrices  $g$  and  $A(HI)$  have been measured at room temperature.

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WINTERSGILL, Mary C., Assistant Professor, John J. FONTANELLA, Associate Professor, Robert J. KIMBLE, Captain, USMC, and Louis D. MARQUET, Midshipman 2/C, USN, "Activation Volume for Dimer Reorientation in Rare Earth Doped Calcium Fluoride," Bulletin of the American Physical Society, 25 (1980), 186.

The audio-frequency complex dielectric constant for rare-earth doped calcium fluoride has been measured at pressures up to 0.4 GPa over the temperature range 250-350K. Consequently, the activation volume for RIV has been determined. RIV has recently been associated with a defect-site containing two rare-earths. The characteristic features of RIV are that the activation energy depends strongly upon the size of the rare earth and is larger than for most other dipolar complexes. However, the activation volume is found to be smaller than for bound- or free-vacancy or interstitial motion in calcium fluoride. Various models for the dimer are discussed. The stability of the various models is evaluated using a HADES-like computer calculation.

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PRESENTATIONS

PHYSICS DEPARTMENT

BRILL, Donald J., Associate Professor, co-author, "'Zeros,' 'Ridges,' and Poles in the Scattering Amplitudes of Elastic Waves Echoing from Resonating Fluid Spheres in Solids and Liquids," 98th Meeting of the Acoustical Society of America, Salt Lake City, Utah, 30 November 1979.

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ELDER, Samuel A., Professor, "Wave Boundary Conditions for a Driven, Separated Shear Layer," 99th Meeting of the Acoustical Society of America, Atlanta, Georgia, 21-25 April 1980.

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FONTANELLA, John J. Associate Professor, Robert J. KIMBLE, Jr., Captain, USMC, Mary C. WINTERSGILL, Assistant Professor, Carl ANDEEN, and Michael K. SMITH, "Electrical Relaxation in Double Doped Calcium Fluoride and Activation Volume for the EI Relaxation," Third Europhysics Topical Conference on Lattice Defects in Ionic Crystals, Canterbury, England, 17-21 September 1979.

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FONTANELLA, John J., Associate Professor, Mary C. WINTERSGILL, Assistant Professor, Robert J. KIMBLE, Jr., Captain, USMC, Louis D. MARQUET, Midshipman 2/C, and Carl G. ANDEEN, "Activation Volume for Dimer Reorientation in Rare Earth Doped Calcium Fluoride," 1980 March Meeting of the American Physical Society, New York City, 24-28 March 1980.

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FONTANELLA, John J., Associate Professor, John R. IGEL, Midshipman 1/C, Donald J. TREACY, Associate Professor, Mary C. WINTERSGILL, Assistant Professor, and Carl G. ANDEEN, "Defect Structure of Calcium Doped Lanthanum Fluoride," 1980 March Meeting of the American Physical Society, New York City, 24-28 March 1980.

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BAHLM, Billie J., Professor, "A Survey and Evaluation of Current Design of Evacuated Collectors," Annual DOE Active Solar Heating and Cooling Contractor's Review Meeting, Lake Tahoe, Nevada, March 1980.

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MARSHFIELD, Mark J., Midshipman 1/C, USN, Mary C. WINTERSGILL, Assistant Professor, and Richard L. JOHNSTON, Associate Professor, "Photobleaching of Fast Neutron-Induced Radiation Damage in Optical Fibers," Eastern ANS Student Conference, Knoxville, Tennessee, 20-22 March 1980.

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WINTERSGILL, Mary C., Assistant Professor, "Thermoluminescent Dosimetry or How to Make Light of Pottery," Naval Academy Chapter, Society of the Sigma Xi, 20 February 1980.

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DIVISION OF  
PROFESSIONAL DEVELOPMENT



## LEADERSHIP AND LAW DEPARTMENT

*Commander John M. McGrath, USN, Chairman*



Research programs conducted by the Leadership and Law Department are typically applied to and directly support institutional objectives. Currently members of this Department conduct research to support, through program development or program validation, the integration of the women program, officer career development and midshipmen professional development. Associate Professor Harrison acts as Division Research Coordinator.

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## EXPERIMENTAL SIMULATION OF BEHAVIORAL RESEARCH PROBLEMS

Researcher: Associate Professor Patrick R. Harrison

Sponsor: Academic Dean - Instructional Development Program

This project develops a large-scale interactive computer simulation of behavioral research problems that span the topic areas of the Military Psychology Course including motivation, perception, learning, memory, personality, and physiology. The students conduct experiments in simulation mode developing research strategies, formulating meaningful results and conclusions. The simulator also provides a 'build' simulator which teaches staff members how to program their own simulations into the system.

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## A DEVELOPMENT MODEL FOR EVALUATING THE PERFORMANCE OF SERVICE ACADEMY GRADUATES

Researcher: Associate Professor Patrick R. Harrison

Sponsor: Division of Professional Development

Owen's developmental-integrative model is used to bring together diverse sources of data to provide for the ongoing evaluation of the performance of Naval Academy graduates. Based on biographical data that summarizes experience prior to entry at the Naval Academy, midshipmen are classified into homogeneous subsets. The subsets are then evaluated relative to independent performance measures during the midshipmen's four years at the Academy and at three points in their active duty career. The model provides a basis for defining career patterns and feeding information back for program validation and career analysis at different points.

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## CAREER DEVELOPMENT AND ORGANIZATIONAL DEVELOPMENT

Researcher: Associate Professor Patrick R. Harrison

Sponsor: Division of Professional Development

This research describes a model for the analysis of behavior in organizations. The model provides convergence between developmental and organizational theory. We restrict our focus to systems or subsystems whose product is people, though the model is intended to be of value as a general scheme for organizational research. The model is tailored to organizations that have a definable set of objectives and a control and evaluation system to measure system process. This does not imply that we neglect other ecological units but only that they are referenced according to their impacts and interactions with the organization. The model is cast into the language set of general-systems theory. Both organism (usually a defined collective for system development) and environment are viewed as hierarchically organized systems with inclusive levels. The unit of analysis which represents interaction between organism and environment is the operation. Operation is defined as the rules, procedures, and equipment used to measure behavior and generate behavioral concepts. Operations describe structure in the reciprocal interactions of organism and environment. The classes of operations considered in this model are, selection, setting, maintenance, process, probe, and measurement. Review of the career development literature is used to introduce the model.

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## OUTCOMES AND PROCESS IN DEVELOPING MEN AND WOMEN NAVAL AND MARINE CORPS OFFICERS AT THE U.S. NAVAL ACADEMY

Researcher: Associate Professor Patrick R. Harrison

Sponsor: Division of Professional Development

Naturally occurring probes that represent traditional unobtrusive measures provide the basis for describing outcomes and process. Areas of analysis include policy, admissions and attrition, academic and military performance, physical standards, conduct and authority, leadership performance, and dating and fraternization.

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POINTER, H. S., Lieutenant Commander, JAGC, USN, "Status of Forces Agreement, Due Process and Fair Trial: The Japanese Experience," University of Maryland School of Law Contemporary Asian Studies Series, No. 7 (1979), 31-47.

This is an exhaustive study, with special attention to the experience in Japan, of the history, legal precedents, and legal implications of the question as to who has the primary right to exercise criminal jurisdiction over offenses committed by American military personnel in a foreign receiving state. It traces the administrative agreements that preceded acceptance by Japan of the NATO Status of Forces Agreement (SOFA) and discusses the deliberations on this issue by the United States Senate, the Department of Defense, and the Supreme Court of the United States. The practical experience in Japan with all aspects of the SOFA agreement is analyzed in detail, and two applicable cases, one in the experience of the author, are cited. One section of the article considers the development of a new court system after the Constitution of 1946 created a constitutional democracy and made drastic changes in the political and legal structure of Japan. In recent years, the author observes, "waivers of jurisdiction by Japanese authorities have far exceeded the number of trials of American service members in Japanese courts..." It is concluded that "the Japanese SOFA seems to have reached an acceptable balance of Japanese sovereignty and American concerns for discipline within the bounds of due process of law."

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HARRISON, Patrick R., Associate Professor, and R. C. USTICK, Captain, USN, "The First Three Years of Integration: A Developmental Perspective," Invited Symposium at American Psychological Association Convention, New York City, September 1979.

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HARRISON, Patrick R., Associate Professor, "A Developmental Model for Evaluating the Performance of Service Academy Graduates," Seventh Psychology in the Department of Defense Symposium, United States Air Force Academy, April 1980.

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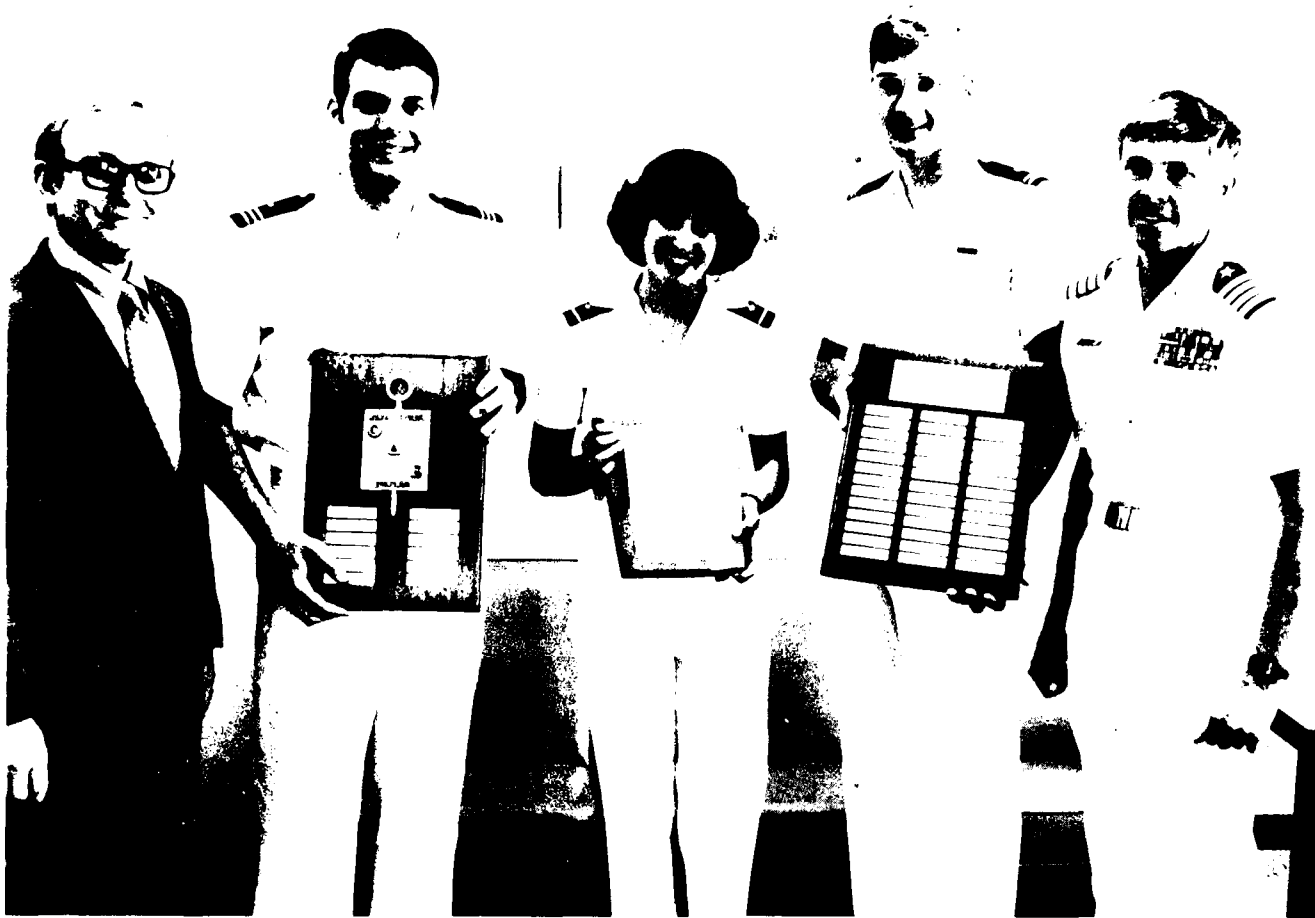
HARRISON, Patrick R. and Patricia C. Garvin, Lieutenant, MSC, USNR, "Navy Men and Women in the Workplace," Seminar under joint sponsorship of Commander of Naval Military Personnel Command and Director of Human Resources Management Division (OP-15) of the Office of the Chief of Naval Operations, October 1979.

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DIVISION OF  
U. S. AND INTERNATIONAL STUDIES



## ECONOMICS DEPARTMENT

*Associate Professor Clair L. Morris, Chairman*



Research activity within the Economics Department produced an impressive number of scholarly articles and many presentations at professional meetings during academic year 1979-1980. Economic analysis was applied to a broad spectrum of topics: financial institutions, arms sales abroad, manpower training programs, recreational projects, vocational education in the military, and religious institutions. Midshipmen have also participated in some of the studies.

The Academy's policy of sponsoring and fostering meaningful research is in no small sense an important contribution to maintaining lively and informed instruction in the classroom.

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SOCIOECONOMIC CHARACTERISTICS OF THE ALL-VOLUNTEER FORCE:  
EVIDENCE FROM THE NATIONAL LONGITUDINAL SURVEY, 1979

Researchers: Associate Professors J. Eric Fredland and  
Roger D. Little

Sponsor: Office of Naval Research

The objectives of this project involve using the 1979 National Longitudinal Survey young male cohort (1) to investigate socioeconomic characteristics of young men in the military in comparison with young men in the civilian labor market; (2) to examine transferability of military training to subsequent civilian occupations; (3) to use results to forecast the propensity to volunteer by those presently too young to serve and subsequently to test those predictions; and (4) to assess changes in (1) and (2) between the 1960's and the 1980's.

Only the first phase of the project has been outlined in detail. Methodology includes (1) discriminant and/or logit analysis of socioeconomic characteristics of the civilian and military samples; (2) specification of earnings regressions for these two groups using variables identified in (1) for purposes of measuring differences in magnitudes of coefficients, estimating earnings potential of military personnel in civilian labor markets, establishing earnings paths of those entering the military, those entering civilian labor markets directly, and those entering civilian training programs.

Analytical framework has been developed. Analysis of data will begin as soon as data are available, which is imminent. The project is on-going.

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## HOW MANPOWER TRAINING PROGRAMS AFFECT ENROLLEE EARNINGS

Researcher: Assistant Professor William B. Bowman

Since the early 1960's, the government has become increasingly involved in the training of individuals, directly and indirectly in the private sector, in hopes that unemployment could be reduced to an acceptable level. Early manpower programs attempted to retrain individuals temporarily displaced, but since the mid-1960's an increasing proportion of resources have been directed toward improving the skills of low-income workers. Even though billions of dollars have been spent in these efforts, prior manpower evaluations have told us little about the long-run effectiveness of manpower programs (or employment and training programs as they are now called). In addition, research has not been directed toward explaining how these programs affect enrollee earnings and employment. The study represents an attempt to explain the latter problem. Accordingly, a cost-effective approach to manpower training is developed in the process of identifying the ways manpower programs affect enrollee work histories.

Results may be condensed into two major points. (1) The relative effect of manpower program characteristics on enrollee earnings change significantly over an observed five year post-MDTA (Manpower Development and Training Act) period. Program evaluations must consider both the average effect and the trend effect to program variables if meaningful results are to be obtained. (2) The majority of the relative effects of employment and training programs operate indirectly through affecting enrollees' opportunities for different quantities and/or qualities of post-training work experience. This study has been completed.

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## BRANCHING AND COMPETITION IN THE SAVINGS AND LOAN INDUSTRY

Researcher: Assistant Professor Kristine L. Chase

The purpose of this study is to construct a model explaining branching activity in the savings and loan industry, concentrating on the impact of deposit rate regulation on the amount of branching that has occurred. The main premise is that the average savings and loan has increased branching activity as a form of non-price competition, i.e., as a response to its inability to compete for deposits through deposit rate variations. Using time-series data from the 1950's through the present for selected states and SMSA's, the factors influencing the establishment of branches will be regressed upon the actual amount of branches established, and the coefficients thus obtained will be used to forecast the amount of branching that would otherwise have occurred without government regulation of competition.

From this approach it may be possible to see the impact that deposit rate regulation has had on the degree of concentration and competition in the savings and loan industry, as well as on the costs of operation, based on the premise that branching is a more costly method of competing. Work continues on the project.

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## RESERVED-BASED TAX SYSTEM: FEDERAL INSURANCE RESERVE AND AN ASSET COMPOSITION RESERVE

Researcher: Assistant Professor Rae Jean B. Goodman

This project is to investigate the implications of two alternative reserve-based tax systems--the Federal Insurance Reserve (FIR) and an Asset Composition Reserve. Various tax burden measures are being used to compare the current tax system with the two proposed systems. The impact on savings and loan associations by asset size, by income size, by type, and by location will also be included in the analysis which is continuing.

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## FURTHER ANALYSIS OF SAVINGS AND LOAN ASSOCIATION TAXATION

Researcher: Assistant Professor Rae Jean B. Goodman

This study analyzes four tax policies: The current tax system, the mortgage interest tax credit (MITC), the mortgage investment tax credit (TCMI), and a reserve-based tax system. The tax policies are examined at a level such that the total tax revenue effects are constant.

Six major issues are addressed with respect to the four tax policies: (1) Family Financial Centers vs. Mortgage Originators; (2) "Warehousing" vs. Secondary Market Usage; (3) Types of Mortgages Affected; (4) Cyclical Impact; (5) Reserve Impact; and (6) Administrative Issues. Several minor issues are raised where appropriate. The study is virtually completed.

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## ANALYSIS OF THE 1977 NATIONWIDE OUTDOOR RECREATION SURVEY

Researcher: Assistant Professor F. Reed Johnson

Current evaluation of recreation benefits for federal-water-project planning relies primarily on arbitrary visitor daily-use values. Because available activities and access costs vary widely, actual social value of facilities may diverge strongly from these assumed averages. Using the 1977 Nationwide Outdoor Recreation Survey, the determinants of participation in various outdoor recreation activities are being analyzed. Using data on time and travel costs, demand-functions for various activities are being derived using linear regression and probit techniques. It is expected that the results of this study will be useful for evaluating recreation benefits for relatively small projects where a site-specific demand-study would not be cost effective. Preliminary econometric results have been obtained and are currently being analyzed.

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PERSONAL INVESTMENT ALTERNATIVES FOR THE SMALL INVESTOR

Researcher: Midshipman 1/C Eric P. Grubman

Adviser: Lieutenant Commander Jimmie D. Emerson, USN

An economic analysis of potential financial investments is beneficial to the small investor as well as to large institutional investors. With the numerous investment possibilities available, the objective of this study was to systematically evaluate the expected rate of return and risk of each category of investment opportunity. Since all alternatives are not suitable to meeting the goals of every investor, careful research of investments permits selection of those best-suited for the individual concerned. Research requires some knowledge in the areas of economic forecasting and economic policy, in addition to familiarity with various types of financial investment.

This examination was limited to study of the desirability of the following alternatives given the current economic situation: (1) Bonds; (2) Common stocks; (3) Commodities; and (4) Real estate, including home ownership.

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OPTIMIZATION OF POLLUTION ABATEMENT COSTS AND BENEFITS

Researcher: Midshipman 1/C Bradley D. Taylor

Advisers: Associate Professor J. Eric Fredland and  
Associate Professor Olaf N. Rask (Weapons and  
Systems Engineering Department)

The purpose of this project was to model impacts of federal pollution control policy on the U. S. economy and to describe optimum policy in light of certain benefit-cost criteria. The approach used was to develop a pollution control model which was in turn interfaced with a small macroeconomic model. The macro model was adopted from Pindyck and Rubinfeld, Economic Models and Economic Forecasts and reestimated. The pollution control model, developed by the researcher, is disaggregated by industry.

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THE THIRD WORLD ARMS MARKET IN THE 1980s

Researcher: Midshipman 2/C Eugene B. Rex

Adviser: Assistant Professor Arthur Gibb, Jr.

The purpose of this research is to investigate the magnitude and characteristics of the Third World nations as an arms market and consider the questions which changes in this market may raise from the United States.

Initially the central element of the research will be an analysis of the composition of the Free World arms market to date. Subsequent analysis will make projections for the 1980s by varying the projected size of defense establishments in Third World nations. Further analysis will investigate the implications of assuming, first, major co-production schemes in the Third World and, second, the evolution of an integrated European arms industry competitive with that of the United States.

The project will conclude with an analysis of the policy options facing the U. S. in the following areas: the magnitude of U. S. arms credits; the terms of such credits; implicit subsidies to the arms industry; and the present policy opposing co-production in Third World nations.

Work undertaken during this reporting period has been limited to preparation of the project proposal. Midshipman Rex intends to begin research work in Washington, D.C. during June 1980.

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ENTRY LEVEL PAY OF VETERANS  
MILITARY VOCATIONAL TRAINING IN THE CIVILIAN WORK PLACE

Researchers: Mark Hess and Phil Bolin

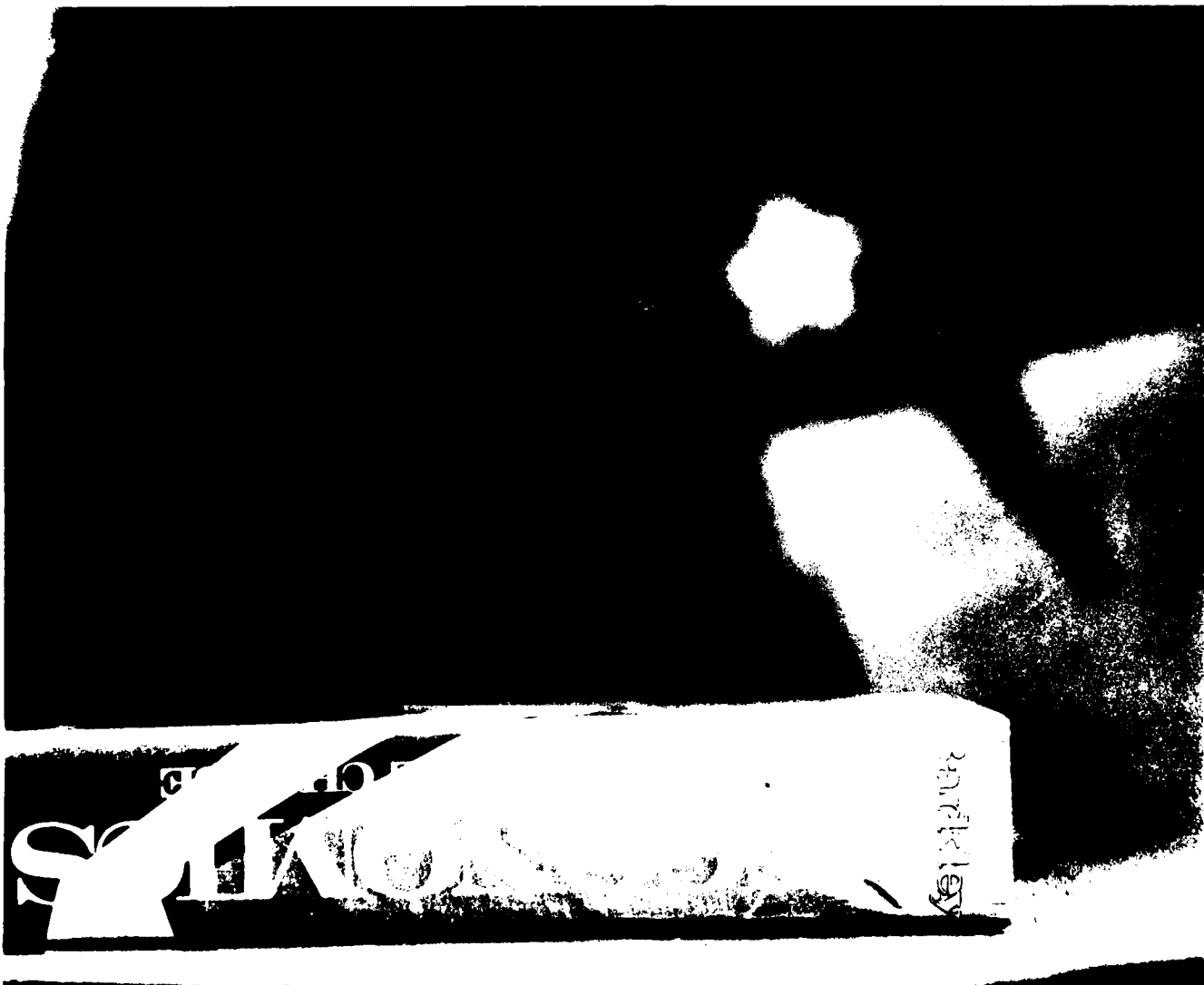
Adviser: Associate Professor Roger D. Little (Visiting at  
Naval Postgraduate School, 1979-1980)

These two masters theses use the National Longitudinal Survey Young Men Sample to assess (1) the entry level wages of new veterans and (2) the return to using skills acquired in the military in one's civilian occupation. Several recent studies suggest that veterans may earn more than non-veterans.

These studies are attempts to identify particular advantages that young veterans may have over a comparison group who has not served.

Both studies use a sample of veterans who served in the late 1960's and rely heavily on comparing the labor force characteristics of veterans and non-veterans within five years of the veteran's leaving the military. This research is incomplete at this time.

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FREDLAND, J. Eric, Associate Professor, and Associate Professor Roger D. LITTLE, "Human Capital Returns to Self-Employed Workers," Papers and Proceedings of the Southwestern Society of Economists, Lamar University, Beaumont, Texas, 1980, Hi K. Kim (ed.), pp. 48-53.

This paper reports on an empirical investigation of long-term capital returns, particularly returns from post-secondary vocational training to self-employed men. The research compares returns to employees with those to self-employed and is a complement to studies of vocational training which focus on earnings shortly after labor force entry or reentry. Several regression equations are presented and the results are compared with those which would be expected if education and training benefited self-employed workers as the "screening" hypothesis would predict.

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FREDLAND, J. Eric, Associate Professor, and Associate Professor Roger D. LITTLE, "Long-Term Returns to Vocational Training: Evidence from Military Sources," Journal of Human Resources, 15 (Winter 1980), 49-66.

Although several studies have examined the effects of vocational training on earnings, little empirical attention has been devoted to long-run returns. This paper reports on an investigation of returns to a sample, drawn from the National Longitudinal Survey data, of mid-career white male workers who received military vocational training in World War II and immediately thereafter. In contrast to the largely ambiguous regressions from short-run studies, the cross-section earnings regressions reported here strongly suggest that those who use their vocational training receive long-term premiums. Those who took training but report not using it appear to earn no premiums, indicating that the training effects are job-specific.

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GOODMAN, Rae Jean B., Assistant Professor, "Savings and Loan Association Taxation: History, Issues and Options," Invited Working Paper No. 32, Federal Home Loan Bank Board, Washington, D. C., February 1980.

This paper reviews the history of the taxation of savings and loan associations, mutual savings banks and commercial banks for the period 1950-1979. Discussions of the methods of loss reserve calculations, the minimum tax, the tax implications of conversions, commercial bank leasing operations, and the impact of tax-exempt securities are included. The relative average tax rates for different industries are used as a comparative for financial institutions with other industries. Various S&L issues--impact on housing, capital adequacy, etc.--are discussed in relation to the degree of taxation. The last section of the paper presents an analysis of various tax proposals--mortgage interest tax credit, mortgage investment tax credit, reserve-based tax system, tax incentives for savings and mortgage revenue bonds. For each tax proposal, the advantages and disadvantages are discussed and estimates of the tax expenditures are presented. The impact of the tax systems on S&Ls by asset size are also presented for the mortgage interest tax credit, mortgage investment tax credit, and the reserve based tax system.

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JOHNSON, F. Reed, Assistant Professor, "Recreation Benefit Estimation in Theory and Practice: A Comment on Imperfect Methods," Journal of Forestry, 78, (January 1980), 24-25.

While some of the criticism of the travel-cost method of estimating benefits of outdoor recreation is without basis, serious problems of utility or disutility of travel, joint visitation, and data deficiencies do limit accuracy of the estimates. This method is nevertheless a considerable improvement over the current practice of using arbitrary unit-day values as approximations of users' average willingness to pay. Replacement of unit-day values with travel-cost and survey-valuation techniques will yield more accurate estimates and encourage needed refinements in data and methodology.

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JOHNSON, F. Reed, Assistant Professor, "Congruence Between Economic and Biological Objectives: The Case of Tellico," in Proceedings of the Multiple Objectives Planning Workshop, Russell L. Gum and William E. Martin (eds.), Tucson, Arizona: U.S.D.A. Report #7, College of Agriculture, University of Arizona, 1979, pp. 147-159.

This paper examines some important valuation issues in the recent case of the Tellico Dam in eastern Tennessee. A procedure is outlined for estimating recreation benefits when substitutes are present generalizing on a procedure used for Hells Canyon as a unique resource. Two alternatives are examined for the Little Tennessee Valley: completion of the dam as planned, and development of the river for agriculture and recreation. An important difference between the two alternatives is the relative abundance of similar reservoir facilities compared to the relative paucity of riverine recreation in the region. This difference, together with relatively high demand growth rates and high quality adjusted capacity for the river implies that expected recreation benefits for that option will be greater than those for the reservoir. The difference is probably not large enough to make the river clearly superior to the reservoir on the basis of quantifiable measures alone.

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JOHNSON, F. Reed, Assistant Professor, "Measuring Recreation Values: A Status Report," in Proceedings of the Multiple Objectives Planning Workshop, Russell L. Gum and William E. Martin (eds.), Tucson, Arizona: U.S.D.A. Report #7, College of Agriculture, University of Arizona, 1979, pp. 80-93.

Recreation-valuation procedures are designed to provide objective and useful information on project benefits to decision-makers responsible for allocating limited public investment funds among alternative projects. Net benefits of a project in the National Economic Development (NED) account are the increases in foregone opportunities. In order to provide objective and comparable measures of these values, procedures must relate as accurately and directly as possible to observed consumer demand for the specific goods and services produced, used, and displaced by the project.

This paper surveys current methods available for recreation-valuation, existing agency practices in this area, and the prospects for change stimulated by the renewed interest in this subject.

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LITTLE, Roger D., Associate Professor, "Technology and Warship Design: Comment, Overview, and Bibliography of the Economics of Transience," Naval War College Review, 32, (September-October 1979), 85-92.

This piece is a response to an article which won the Admiral Richard G. Colbert Memorial Prize at the Naval War College in 1978. The purpose is to provide a brief introduction to the economics of technological change and apply the material to the narrower question of the effect of technological change on capital/labor trade-offs in future weapons system development. A bibliography of nearly sixty references is included in the hopes of interesting more officers to pursue this area of dynamic interaction between society and change.

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LITTLE, Roger D., Associate Professor, co-author, "Analysis of Changing Employment Opportunity by Occupational Group," Growth and Change, 1 (January 1980), 2-10.

This paper assesses the capabilities and limitation of three techniques used to identify labor force convergence among racial groups. Emphasis is also placed on the interpretation of empirical results for policy making with respect to a particular employment situation. Algebraic formulations of each technique are presented and their applicability for making regional comparisons are discussed. The characteristics of the alternative techniques--proportionality, exogeneous base and shift-share--are analyzed by study of a particular labor force situation, black school teachers in the South before and after integration. The third technique, above, is specifically formulated to accomplish this comparison.

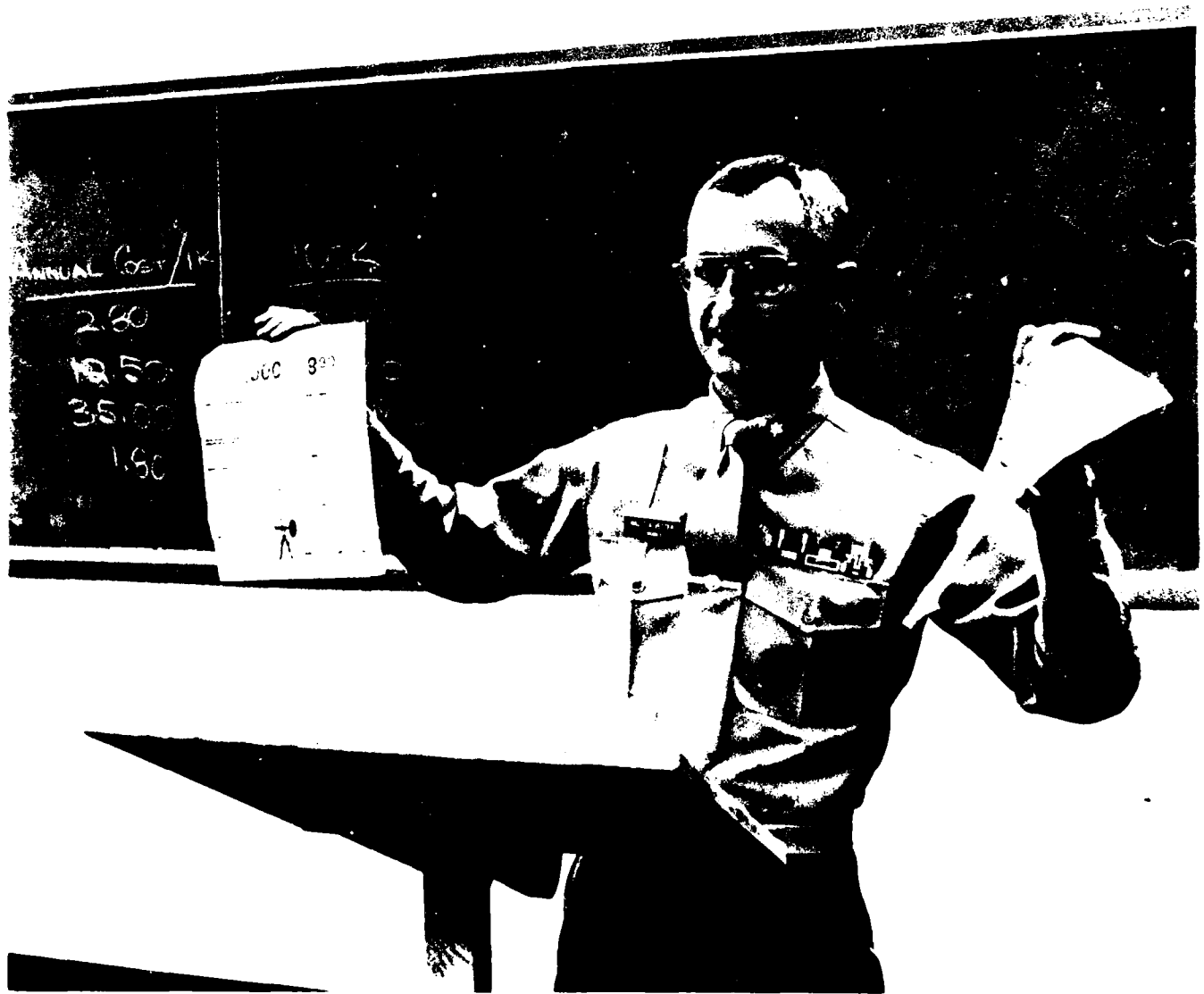
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MORRIS, Clair E., Associate Professor, "The Economics of First-Class Mail," (Comment), Atlantic Economic Journal, 8 (March 1980) 63-64.

This comment represents an assessment of a paper of the same title by Professor Babu Nahata and William A. Donnelly. The paper is criticized for needing a review of the literature in order to be able to put this study in proper perspective. Other considerations needing attention include: (1) the high probability that elasticity of demand for first class mail is likely to change rapidly and dramatically over time because of

the technological advances in communications and the changing costs of alternatives; (2) telephone rates to be included as a variable in the demand function (it might be that increases in per capita real income lead to a much greater demand for telephone service as a substitute for first class postal service); (3) changes in the occupational composition of the population on the demand for mail service.

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BOWMAN, William R., Assistant Professor, "How Manpower Training Programs Affect Enrollee Earnings," Eastern Economic Association, Montreal, Canada, 8-10 May 1980.

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FREDLAND, J. Eric, Associate Professor and Roger D. LITTLE, Associate Professor, "Characteristics of Mature Men Who Enter and Leave Self-Employment," 58th Annual Meeting of the Southwestern Social Science Association, Houston, Texas, 2-5 April 1980.

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GOODMAN, Rae Jean B., Assistant Professor, "Tax Incentives for Savings Deposits," Western Economic Association, San Diego, California, 17 June 1980.

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JOHNSON, F. Reed, Assistant Professor, "The Economics of Church Activity: Money and Time Donations of Mormon Households," Seminar on Economics and Mormon Culture, Brigham Young University, Provo, Utah, 4 April 1980.

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JOHNSON, F. Reed, Assistant Professor, "Federal Project Evaluation and Intangible Resources: The Case of Tellico," Western Economic Association, San Diego, California, 15 June 1980.

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LITTLE, Roger D., Associate Professor, and J. Eric FREDLAND, Associate Professor, "Income Determinants of Self-Employed Workers," 49th Annual Southern Economic Association Meetings, Atlanta, Georgia, 7-9 November 1979.

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LITTLE, Roger D., Associate Professor, and J. Eric FREDLAND, Associate Professor, "World War II Veterans: Pecuniary and Non-Pecuniary Returns to Service," 54th Annual Western Economic Association Conference, San Diego, California, 15-19 June 1980.

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## LANGUAGE STUDIES DEPARTMENT

*Professor John D. Yarbrow, Chairman*

CHINESE  
FRENCH  
GERMAN  
ITALIAN  
JAPANESE  
PORTUGUESE



During the past year, those Department faculty members engaged in research have mainly developed new phases of projects begun earlier. Their interests include Russian lexicography, military leadership in the People's Republic of China, religious-political events in Russia, 17th century German literature, and computer analysis of Navy military-personnel occupational standards.

Funding has come from the Defense Intelligence Agency, the Naval Intelligence Support Center, the Naval Military Personnel Command, and the Naval Academy.

In their projects, faculty members have relied heavily on the facilities and services of the Academic Computer Center, which has become an invaluable asset for research and analysis.

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## FAVOROV ENGLISH-RUSSIAN SHIPBUILDING DICTIONARY

Researchers: Associate Professor Michael C. Halbig, project director; Professor Claude P. Lemieux (Retired)

Sponsor: Naval Intelligence Support Center and U. S. Naval Academy

The purpose of this project is to produce a useful Russian-English dictionary of Russian shipbuilding terminology through computer reversal of an existing English-Russian shipbuilding dictionary (Favorov). Work has continued during the past academic year, and the original Favorov material has now been edited and stored in the USNA computer. After proofreading by NISC-62 personnel, the reversed Russian-English entries will be alphabetized to complete the new version of the dictionary.

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## AN AUTOMATED BIOGRAPHICAL FILE ON CHINESE MILITARY LEADERSHIP

Researcher: Associate Professor Daniel T. Y. Lee

Sponsor: Defense Intelligence Agency

During the past year, Associate Professor Lee carried out another phase of this project, which was supported originally by the Naval Academy Research Council and later by the Defense Intelligence Agency. Its purpose has been to develop automated analytical biographies of military leaders in the People's Republic of China.

Following a three-week period of research in Hong Kong and Beijing during the summer of 1979, the researcher was able to collect, update, translate, and input some 70 additional individual histories. This brings to some 300 the total number of biographies now on file.

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ANALYSIS OF OCCUPATIONAL STANDARDS OF USN ENLISTED PERSONNEL

Researcher: Professor John A. Hutchins

Consultant: Associate Professor Mahlon F. Stilwell (Retired)

Sponsor: Naval Military Personnel Command

The purpose of this continuing project has been to review, analyze, and standardize the job descriptions and requirements for advancement of all USN enlisted ratings, by means of the USNA computer facilities. The method has involved inputting present job-description elements and then using the computer to compare and analyze them.

An important related benefit has been the application of programming developed for this project to other research and studies conducted by Professor Hutchins and other Department faculty members.

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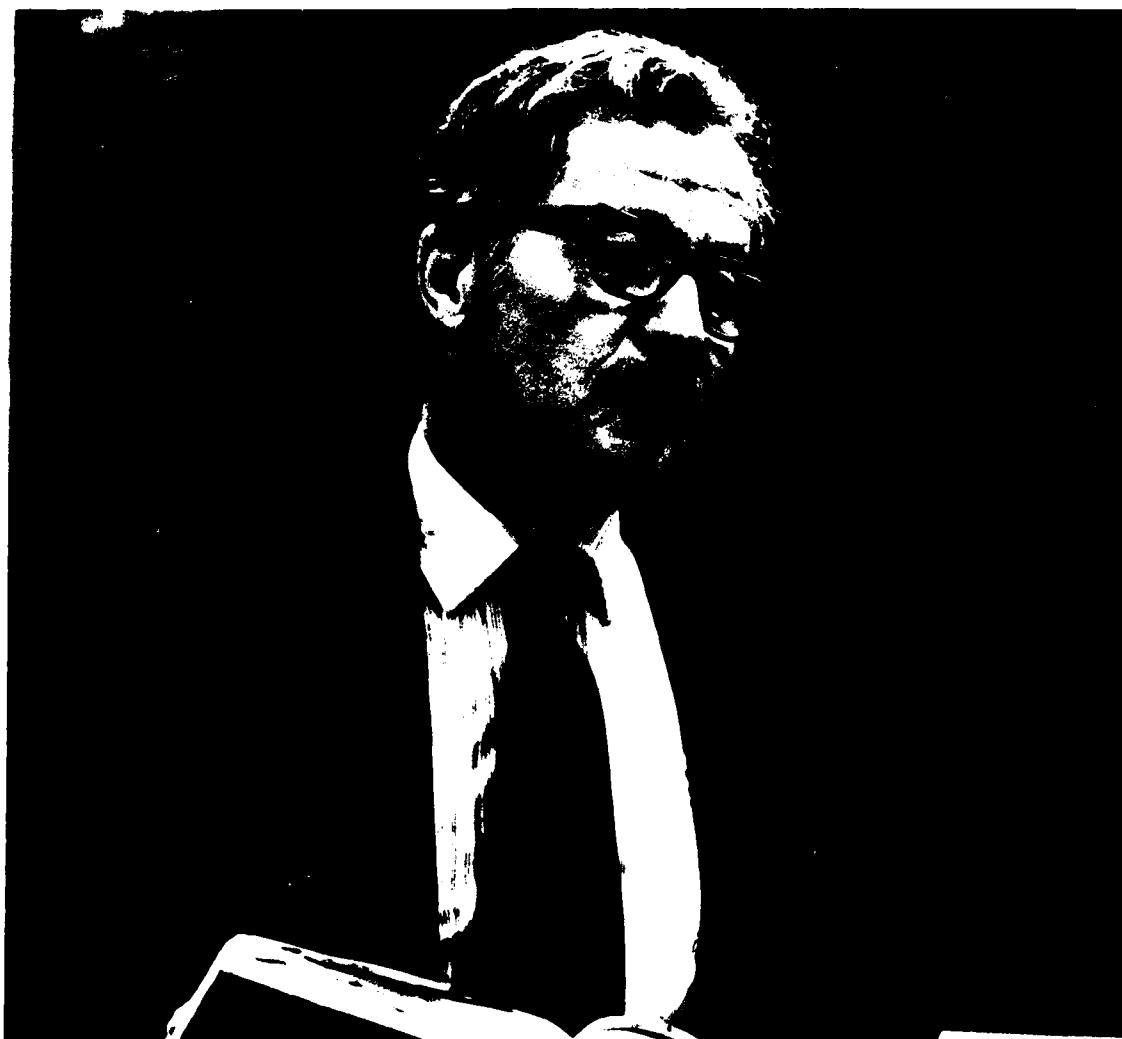
CHURCH AND STATE IN STALIN SOVIET UNION

Researcher: Midshipman 1/C R. Stefanovic

Adviser: Assistant Professor V. S. Tolstoy

For summary, see entries for the Political Science Department. This was an interdisciplinary project, directed by Assistant Professor Tolstoy.

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## POLITICAL SCIENCE DEPARTMENT

*Professor G. Pope Atkins, Chairman*



The Political Science Department continued to maintain a research environment that encouraged professional growth of the faculty, allowed outstanding midshipmen to pursue specialized investigations, and supported teaching excellence. Research conducted in this Department reflected a wide range of faculty expertise covering the entire discipline of Political Science. Projects were pursued in various aspects of the fields of American politics (including foreign policy), comparative politics (including geographic regions and individual states), international politics, and political theory and methodology. Research related to student conferences and classroom instruction also was conducted. Projects were supported by funds from four different sources. Including all levels of research, twelve faculty members and eight midshipmen pursued thirty-two different projects. Among the published results were a book, a set of edited lectures, three monographs, and four articles. Two extensive reports were submitted, and four papers were presented at scholarly conferences. Another book was accepted for publication. In addition, numerous faculty members lectured at war colleges, other academic institutions, and civic associations, served as panelists at professional meetings, and participated in scholarly seminars. In sum, Academic Year 1979-80 was a productive period for political science research at the Naval Academy.

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NAFAC: TWO DECADES LATER

Researcher: Assistant Professor Stephen E. Frantzich

Sponsor: Exxon Educational Foundation

Over the last twenty years, over two thousand students have been delegates to the annual Naval Academy Foreign Affairs Conference. In this project, an attempt was made to contact all former participants to assess their accomplishments and attitudes, and their evaluation of NAFAC. Results based on almost 1300 respondents (over 60% of delegates for whom addresses were available) indicated that former delegates gave the conference high marks and that they had gone on to impressive levels of personal accomplishment. NAFAC delegates are very active in politics and tend to hold internationalist attitudes. The research reports general trends as well as differences between sub-groups of participants. The results of this research will contribute to the improvement of NAFAC as well as shed some light on the political orientations of a unique group of college graduates.

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CRISIS MONITORING AND FORECASTING: THE SOUTHERN AFRICAN SUBSYSTEM

Researcher: Assistant Professor Helen E. Purkitt

Sponsor: Naval Academy Research Council

The purpose of this project is to develop a computer-based information system and quantitative indicators of changes in the Southern African subsystem that may escalate into regional and/or international crises. The current specific task is to complete a series of case studies of local crises during the 1970s in an effort to develop more general computer-based indicators of regional crises. Immediate outputs from this project will be two papers, one surveying integrative and dis-integrative trends in the region during the 1970s, and the other evaluating the forecasting utility of general indicators of international crises at the regional subsystem level of analysis.

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BIOGRAPHIC ANALYSIS OF CHINESE LEADERSHIP

Researchers: Associate Professor Rodney G. Tomlinson and  
Associate Professor Daniel T. Y. Lee, Language  
Studies Department

Sponsor: Defense Intelligence Agency

This study is an analysis of 18 characteristics of the leadership of the People's Republic of China. It develops English-text summaries prepared according to strict syntactical rules with imbedded computer flags to enable automated searching for names and locations, linking the same, and presenting concise summaries in response to ad hoc questions. Research includes automated linkages of "who knows whom," identifying rising stars in the Chinese hierarchy. Research is on a continuing basis, with a comprehensive report delivered to sponsor in November 1979. Additional research is developing a public-appearance file detailing who appeared where and in company with whom. These files, when linked to biographical files, allow the researcher to develop seniority lists and study patterns in behavior of Chinese leaders.

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WORLD ARMS TRANSFERS

Researcher: Associate Professor Rodney G. Tomlinson

Sponsor: U. S. Arms Control and Disarmament Agency

Major world powers like the United States, the Soviet Union, France, Great Britain, Canada, and some lesser powers, derive considerable international influence through the transfers of weapons to smaller nations. The initial perpetration of a nation might begin with lower-level weapons such as infantry pieces. Later more sophisticated weapons might appear: armored vehicles and military aircraft. As the amount and complexity of weapons grows, so too does the influence that the donor-country exerts over the recipient nation.

This research examined information related to arms transfers and cast it into an automated structure that would allow analysts at the U. S. Arms Control Agency to detect trends in the transfer of arms to selected nations. Tentative findings indicate that very little analysis of trends has been done in the past. It also appears that once a nation is "entrapped" by

a donor-nation, it falls into a web that grows ever tighter until it approaches becoming a client-state. A client-state might have large numbers of "advisors" from the donor-state. These advisors spread their influence from the strictly military role into other areas of government, including national police forces and even defense policy and economic planning.

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ARMS AND POLITICS IN THE DOMINICAN REPUBLIC: CIVIL-MILITARY  
RELATIONS SINCE THE CRISIS OF 1965

Researcher: Professor G. Pope Atkins

This book-length manuscript is a chronicle and interpretation of recent military-political events in the Dominican Republic. It analyzes the political behavior of armed forces and national police since the civil war and U. S. intervention of 1965. The Dominican experience with arms and politics is a case of noninstitutionalized civil-military relations. That is, relations revolved around personal interactions among the president or his key associates and important military officers, as well as among the officers themselves, rather than depending on processes involving a bureaucratically well-organized "presidency" and "military establishment." The period encompasses the course of Joaquín Balaguer's lengthy presidency (1966-78) and the remarkable events surrounding the 1978 election of president Antonio Guzmán and the subsequent first months of his administration. The most important political dynamics had to do with the role of armed forces in political processes. Under Balaguer, the key factor was the president's personal manipulation of numerous officers employing a variety of techniques. Guzmán's principal goal was to "depoliticize" the armed forces; it was realized to a remarkable degree within the first six months of his administration. The author made extended visits to the Dominican Republic to conduct interviews, observe events, and review materials difficult to obtain outside the country.

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DEMOGRAPHIC EVOLUTION IN THE CHARACTER OF THE BRIGADE OF  
MIDSHIPMEN, 1970-1979

Researchers: Professor Charles L. Cochran, Professor John A.  
Fitzgerald, and Associate Professor Rodney G.  
Tomlinson

The demographic composition of the Brigade of Midshipmen has changed since 1970. More and more minorities are entering the Naval Academy, and more entering candidates have more diverse backgrounds than previously. This study intends to compare Naval Academy midshipmen with students at civilian institutions, and to examine changes in the composition of the Brigade of Midshipmen itself. The primary data source is the American Council on Education annual surveys. These data are available on tapes and currently are being converted to the Naval Academy Time-Sharing system by Tomlinson. The project is currently identifying concepts and variables to be used in the research.

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THE "PERKING UP" OF ELECTORAL FORTUNES: THE USE OF OFFICIAL  
PERQUISITES BY CONGRESSMEN

Researcher: Assistant Professor Stephen E. Frantzich

Members of Congress have designed a system in which it is often difficult to distinguish between constituent communications activities (trips to the district, franked mail, etc.) and re-election tactics. This research looks at the use of perquisites for re-election purposes and concludes that congressmen most in need of enhancing their election strength use perquisites most often, and that the use of perquisites has a definite positive impact on electoral strength.

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WHO MAKES OUR LAWS?: THE LEGISLATIVE EFFECTIVENESS OF MEMBERS OF THE U. S. SENATE

Researcher: Assistant Professor Stephen E. Frantzich

This is a companion-piece to a previously published study on the U. S. House of Representatives, attempting to analyze actual power in the Senate. Power is defined as the ability to get legislation through the congressional labyrinth. The different levels of effectiveness are related to political and social background characteristics to determine the degree to which conventional wisdom on Senatorial power matches empirical reality.

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POLAND IN THE 1980s

Researcher: Assistant Professor Arthur R. Rachwald

This research is leading to an article on the current socio-political and economic situation in Poland. It is an attempt to project and analyze possible alternative patterns of domestic and international policies of Poland in the 1980s.

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MONITORING INTERNATIONAL POLITICAL BEHAVIOR THROUGH MODELS BASED ON CATASTROPHE THEORY

Researcher: Associate Professor Rodney G. Tomlinson

International political behavior is characterized by irregular behavior wherein nations suddenly alter their behavior in response to probes and feelers from other nations. In many instances, what was expected to be a consistent line of behavior abruptly changes, leading to a discontinuous pattern. This study attempts to apply some mathematical concepts regarding discontinuous systems to systems of international behavior. The notion here is that there are times and circumstances when forces are at work that indicate sudden change will occur if these forces are applied to a set of models based on catastrophe theory. If all the forces are in attendance in the amounts critical to the system, a large and disproportionate change in one or more national behaviors will occur (for example, a transition from peace to war or war to

peace.) The present research seeks to identify cases of international behavior in which changes have occurred and then observe the presence or absence of the forces thought to provoke the change. Once identified, the model will be tested to see if it would have predicted the sudden change.

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TRENDS IN MIDSHIPMEN OPINION ON THE INTEGRATION OF WOMEN INTO THE BRIGADE

Researcher: Associate Professor Rodney G. Tomlinson

In July 1976, women entered the three major service academies. The integration of women led to changes in the Naval Academy program that have not always led to favorable responses from males. Kathleen Durning reported in *Armed Forces and Society* (1977) on the results of a series of surveys taken when the Class of 1980 first entered. This research reports on the results of a poll of 224 midshipmen in November 1979. Tentative findings indicate that male midshipmen have not yet adjusted to the integration of women into the Naval Academy. This research is meant as a followup to the Durning study to indicate if the prognosis of the effects of association with females is borne out. Findings so far indicate that this hypothesis is not operable in the Naval Academy environment. It appears that other influences are at work that lead to the formation of negative attitudes towards women.

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SOCIALIZATION OF WOMEN AT THE NAVAL ACADEMY

Researcher: Midshipman 1/C Janice L. Buxbaum

Adviser: Professor Charles L. Cochran

Admission of women to the Naval Academy has received considerable attention in popular journalism. The goal of this research was to establish the magnitude and significance of the changing role of women in the military. The researcher developed the evolution of female involvement in the U. S. military with particular attention to the images of females as being unable to cope successfully, either physically or psychologically, with the rigors of combat. Some studies performed by the military suggest that women actually outperform men in certain military skills. Various studies are examined to test myths concerning the emotional stability of females in stress situations. Of major importance to the role of women in the military, and the Naval Academy in particular, is the negative cultural bias toward acceptance of women in the military. The result is rejection of women at the Naval Academy by a large proportion of males. Analysis is made of peer-pressures that unify males in rejection of females at the Academy, and the female experience and reaction.

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THE SOVIET UNION IN AFGHANISTAN

Researcher: Midshipman 1/C Robert Cotterell

Adviser: Lieutenant Thomas E. Eckert, USN

This project analyzes the Soviet military intervention in Afghanistan, focusing on the following aspects: (a) the political and military background that led the Soviet Union to invade Afghanistan, including the overall strategic implications for the Soviets; (b) the various problems that the Soviets will encounter in attempting to subdue the Afghani rebels and control the Afghani government; (c) the regional implications of the invasion, particularly for Iran and Pakistan; (d) the United States' policy towards the situation in Afghanistan and the future direction of that policy.

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CHANGING RELATIONS BETWEEN THE UNITED STATES AND BRAZIL

Researcher: Midshipman I/C Kenneth Flack

Adviser: Professor G. Pope Atkins

Relations between the United States and Brazil are in a state of flux. U. S. policy has proven ineffective and sometimes counterproductive in dealing with Brazil, its traditional Latin American ally. As the world's newest "developed" state, Brazil is expanding its economic, military, and diplomatic influence within the international system. U. S. disregard for Brazil's new status and its new problems has caused a deterioration in the past "special relationship." The United States must shape a new policy reflecting Brazil's increased stature and unique problems, changing the tutelary relationship of the past to one of cooperation between peers.

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A SURVEY OF MIDSHIPMEN ATTITUDES RELATING TO SATISFACTION AT THE U. S. NAVAL ACADEMY

Researchers: Midshipmen I/C Dale A. Lumme and Terry S. White

Adviser: Professor John A. Fitzgerald

This preliminary qualitative survey is designed to explore the feasibility of developing a quantitative survey-instrument for the analysis of midshipmen satisfaction with various aspects of the Academy experience. The major findings were these: (1) the majority of midshipmen perceive themselves as accomplishing the Naval Academy's basic purpose of preparing them to be professional naval officers; and (2) a majority of midshipmen express dissatisfaction regarding (a) peer-pressure to perform at minimal levels, and (b) an overprotective environment that they feel fosters immaturity.

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OPTIONS-ANALYSIS AND THE OPEC PROBLEM

Researcher: Midshipman 1/C Robert K. Morris

Adviser: Assistant Professor Helen E. Purkitt

This study examines the applicability of options-analysis for short-term (less than one year) and long-term forecasts of future OPEC policies. Interviews with energy experts at the State Department, Department of Energy and Department of Defense provided judgmental data. The likelihood of three future scenarios--another Egyptian-Israeli war, the Sovietization of Iran, and the radicalization of the Saudi Arabian regime--were analyzed in detail. The report concludes with an evaluation of options-analysis as a forecasting technique in international relations research.

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SUBLIMINAL COMMUNICATIONS AND THE FIRST AMENDMENT

Researcher: Midshipman 1/C Bruce A. Ross

Adviser: Professor John A. Fitzgerald

This research examines the use of subliminal communication-techniques in the mass media. Attention is directed to three dimensions of the phenomenon: (1) the theory and practice of subliminal communication in the mass media; (2) the case for federal regulation of subliminal advertising; (3) the constitutional implication of prohibiting this communication technique. The research concludes that despite certain practical, administrative problems, subliminal communications should be prohibited because of its subversive impact on rational decision-making. Such a prohibition would raise a First Amendment problem.

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CHURCH AND THE STATE IN STALIN'S SOVIET UNION

Researcher: Midshipman 1/C R. Stefanovic

Adviser: Assistant Professor Vladimir S. Tolstoy (Language  
Studies Department)

This project analyzed church-state relations in the Soviet Union during the Stalin period. It concentrated on the interaction of the Russian Orthodox Church and the Communist Party of the Soviet Union (CPSU) and their mutual impact. It explored the unique position the Church held in Stalin's ideology and practice. Most of the research was done with Russian language sources.

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DUE PROCESS OF LAW IN ACADEMY HONOR CODE HEARINGS

Researcher: Midshipman 1/C James M. Wilson

Adviser: Lieutenant Commander William R. Drukker, JAGC, USN

The project entailed intensive research of the honor systems of the three service academies, the hearings held, and the current case law precedent on due process requirements at an administrative hearing for disenrollment. Comparison of honor systems followed by highlighted differences in the honor hearings precedes a careful review of the Federal and relevant state laws regarding hearing rights of accused. Principal areas of research were: right to notice, right to counsel, public (open) hearing, challenge to board/committee members, standards of proof and voting, right to transcript and appeal. A model system synthesized from all three academies is proposed in conclusion. The hope was not only to present an academically accurate comparison of the Army, Navy and Air Force academies, but also to propose a system that was fair to both an Academy and the accused. Avoidance of litigation (which currently faces the Naval Academy) is seen as a potential result if portions of this model were adopted.

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COCHRAN, Charles L., Professor, editor and co-author, U. S. Status of Force Agreements with Asian Countries: Selected Studies. University of Maryland, School of Law, Occasional Papers in Contemporary Asian Studies No. 7, 1979.

The purpose of the study was to examine the experience of the United States in negotiating Status of Force Agreements (SOFA) with Asian nations. This study reveals the trends in this area of the law and the interface between culture, socio-economic conditions, and the political system and the SOFAs.

The relationship between the visiting force and the host state is usually governed by a SOFA which tends to result in Executive Agreements rather than treaties. The North Atlantic Treaty Organizations' SOFA is the standard by which all other agreements are measured in the United States. The study reveals interesting variations in Asia. For example, the United States - Japanese agreement is modeled directly on the NATO-SOFA, while the U. S. agreements with the Philippines, the Republic of Korea and the Republic of China have several significant variations.

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FRANTZICH, Stephen E., Assistant Professor, "Political Science Emerges From the C.A.V.E. (Computer Augmented Video Education)," Proceedings of the Association for the Development of Computerized Instruction, Bellingham, Washington: ADCIS, 1980, pp. 14-26.

This article gives a description of a computerized system for combining video-tape and computerized programmed-learning for the teaching of political science.

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FRANTZICH, Stephen E., Assistant Professor, Presidential Popularity in America. Washington, D. C.: American Political Science Association, 1979.

This is a research monograph published as part of the American Political Science Association's S.E.T.U.P.S. series (Supplementary Empirical Teaching Units in Political Science). It summarizes research on the causes and consequences of popular support for U. S. presidents, outlines some conflicting models, and provides students with exercises and original data-packages with which students can test hypotheses.

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FRANTZICH, Stephen E., Assistant Professor, "Who Makes Our Laws?: Legislative Effectiveness of Individual Congressmen," Legislative Studies Quarterly, (August, 1979), 409-428.

Using empirical data on the ability of individual members of Congress to get their own bills passed through Congress, this paper challenges some of the conventional wisdom concerning who has real power in Congress.

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PAONE, Rocco M., Professor, Japan (Vol. III in Energy Policies of the World series). New York: Elsevier Press, 1979.

The energy policy of Japan is crucial to the third most industrialized society in the world. About 98% of its oil must be imported, and a declining coal industry has impelled the Japanese to import certain grades of coal as well. In this study, the geographic and physical setting of Japan as well as its natural resources, impoverished by a lack of minerals, is carefully described and analyzed. Only five of thirty metals commonly used in manufacturing are found in Japan.

Development of Japan's energy policy since 1973 is illuminated through making the public aware of the problem, choosing major priorities, such as nuclear power development, conservation measures, and so forth. The promotion of alternate sources of energy has its problems with environmental groups as in the United States.

The book lays great emphasis on the country's current national energy conservation plans and their likely effect on petroleum, coal, and nuclear power, and then views Japan's long-range energy planning with forecasts through 1990. Stockpiling, development of new sources of energy, such as solar, geothermal flows, hydrogen, and synthetic natural gas are also carefully examined. The book concludes with an assessment of obstacles Japan must overcome to achieve its energy goals and maintain its phenomenal economic growth without violent domestic inflation and intolerable foreign deficits.

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PAONE, Rocco M., Professor, (editor), "The Military and Energy Awareness: Some Developments," Lectures on Energy Conservation. Annapolis, Maryland: U. S. Naval Academy, 1979.

This presentation is part of a booklet on energy, an edited compilation of the Energy Seminar-Lecture Series which was sponsored by the Naval Academy Energy section of the Energy-Environment Research Group. The article stresses the energy direction of the Department of Defense, the organization of DOD Energy Office, the Navy's response to the energy crisis, and the current (1979) energy resources program of the Navy.

The article also emphasizes that the Navy has close liaison with the Army and Air Force, as well as with other government and non-government agencies and universities, so as to reap benefits from their research and share progress gained through Navy-sponsored research in energy related matters with people of the country. The Navy's energy-awareness program, initiated before the National energy "crisis," is firmly organized and fully implemented. It reflects a deep-seated recognition of fuel shortages possibly facing the Navy and other services and the threat to the national security of this nation that is involved. Thus energy limitation will constitute for a number of years a problem vital to the security interests of the United States and the Western Alliance. It could also impede the U. S. Navy in its attempt to achieve a high-level combat efficiency.

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PURKITT, Helen E., Assistant Professor, co-author, Demystifying "National Character" in Black Africa: A Comparative Study of Culture and Foreign Policy Behavior. University of Denver, Monograph Series in World Affairs, 17 (1978-80), 1-76.

This study is an exploratory and comparative analysis of the relationship between six national attributes of 32 Black African states and seven patterns of their foreign policy in the mid-1960s. Hypotheses related to the importance of culture for understanding patterns of foreign policy behavior are empirically tested and discussed.

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This article outlines the complex nature of problems created by the seizure of hostages at the American Embassy in Tehran, Iran. It deals with the nature of possible remedies and the impact of hostage-taking on international politics.

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STEMPEL, John D., FSO-4, "Terror Comes Home," Foreign Service Journal, 57 (May 1980), 33-35.

This is a brief review of the problems caused by terrorist attacks for democratic societies. Particular emphasis is given to questions of terrorism against diplomatic personnel and officials abroad.

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POLITICAL SCIENCE DEPARTMENT

ATKINS, G. Pope, Professor, "Arms and Politics in the Dominican Republic Since the Crisis of 1965," Conference on the Caribbean, Howard University, 15 April 1980.

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FRANTZICH, Stephen E., Assistant Professor, "The Over-Time Pattern of Innovation Among Members of the House of Representatives," Midwest Political Science Association, Chicago, Illinois, 1980.

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