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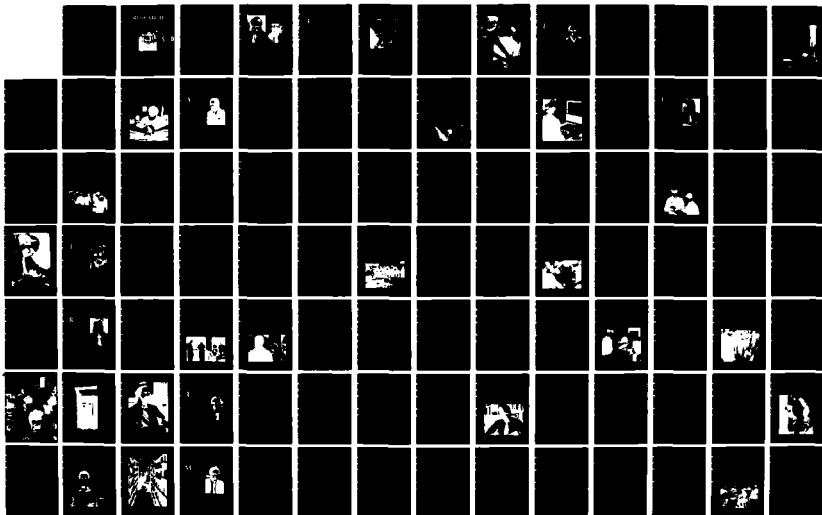
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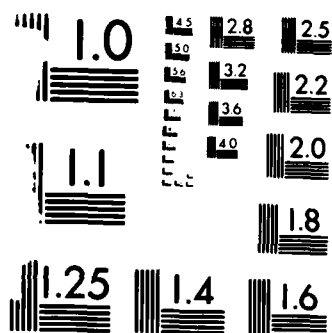
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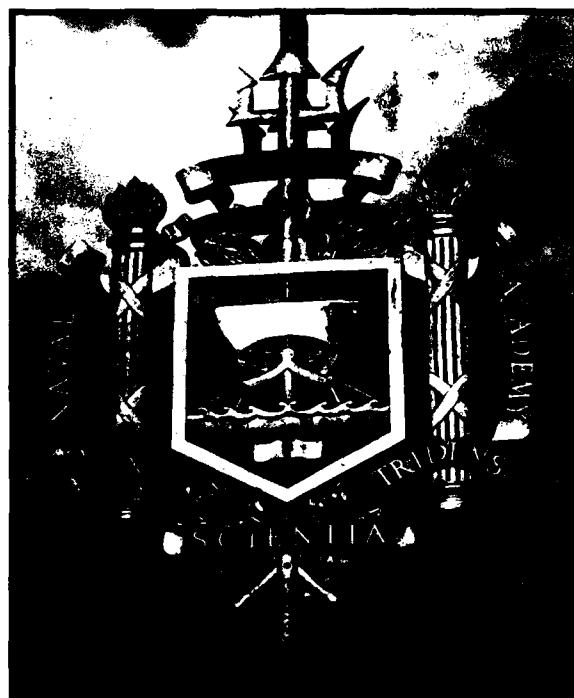
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SUMMARY OF RESEARCH

ACADEMIC DEPARTMENTS

1984 - 1985



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SUMMARY OF RESEARCH

1984 - 1985

COMPILED AND EDITED

BY

PROFESSOR WILSON L. HEFLIN

ASSISTANT EDITOR

PROFESSOR FRED M. FETROW

ENGLISH DEPARTMENT

OCTOBER 1985

UNITED STATES NAVAL ACADEMY

ANNAPOLIS, MARYLAND

21402



KARL A. LAMB
Academic Dean



RICHARD D. MATHIEU
Vice Academic Dean

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 July 1984 through June 1985.

External support continues to increase significantly. This is undoubtedly due to the additional opportunities provided by new laboratory facilities 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 Office of Naval Research and Office of Naval Technology, without which such progress could not be possible.

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

Karl A. Lamb

KARL A. LAMB
Academic Dean

Richard D. Mathieu

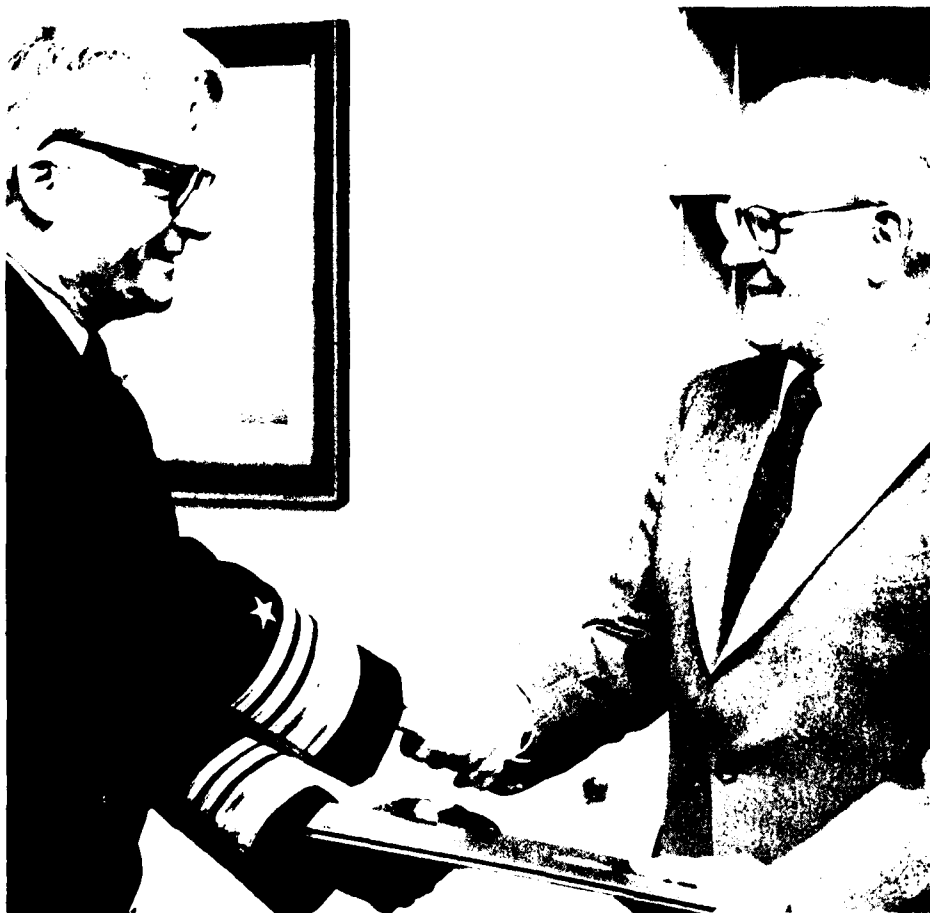
RICHARD D. MATHIEU
Vice Academic Dean



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PROFESSOR WILSON L. HEFLIN

1913-1985



The annual *Summary of Research* is dedicated to the memory of the teacher-scholar who compiled and edited this and all previous editions over the past decade. Professor Heflin's contributions in founding, sustaining, and improving the *Summary* have been of inestimable value to the Naval Academy's development as an institution of teaching excellence, staffed by a faculty of dedicated research scholars. By his own worthy example, in his encouragement to his colleagues, and through his careful and elegant work as editor, Professor Heflin has made the high quality of that faculty and its research a known quantity throughout the Naval community and the larger world of academe. This and subsequent editions of the annual *Summary* will stand as monuments to his service and memory.

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Division of Engineering and Weapons



Aerospace Engineering

COMMANDER WILLIAM L. McCracken, USN
CHAIRMAN

Faculty and midshipmen research in the Aerospace Engineering Department covers many diverse areas of advanced investigations. This broad spectrum of disciplines includes research in computer-aided design and manufacturing, structural analysis including advanced composite materials, computer simulation of aircraft performance, and both high and low speed aerodynamics. The primary impetus of the Department's research is both to pursue contemporary topics and to develop the laboratory by a continual up-grading of the facility. A balance is sought in these two critical areas to enhance the student's education through his academic environment and the quality of the physical facilities.

Research is supported predominantly by the Naval Air Systems Command and its field laboratories as well as the Office of Naval Research and the U.S. Coast Guard. This year the Naval Space Command established a Research professorship with the Department with the objective of involving midshipmen and faculty in scientific activities related to space systems. Two midshipmen completed research projects related to space. Faculty members also pursue independent research in their own areas of expertise, supported by the Department's operational funds.

An important facet of this year's research is an effort to expand Navy laboratory sponsorship for midshipmen projects. This association, based on problems posed by the Navy, provides a more relevant academic environment for their professional development. The midshipmen are urged to present their scholarly paper before student and professional organizations. This year, six



midshipmen presented papers at the American Institute of Aeronautics and Astronautics Middle Atlantic Region Student Conference. Two teams of four midshipmen each did comprehensive design studies for the Naval Air Systems Command on the VMX project proposed by NAVAIR. The midshipmen also entered both the team and individual design competitions sponsored by the AIAA.

Sponsored Research

Flow Structure and Performance of a Radial Diffuser

RESEARCHER: ASSISTANT PROFESSOR JOHN E. ALLEN

SPONSOR: OFFICE OF NAVAL RESEARCH

The air flow characteristics in a vortex-controlled radial diffuser have been investigated using non-orthogonal, two-component LDV measurements in the entrance region of the diffuser. The velocity components and turbulence parameters in a plane of the axisymmetric flow field were mapped for four geometric configurations, with and without suction. These detailed measurements, supported by overall performance parameters, yielded considerable insight into the interaction between the forced recirculation region and the core flow. A particularly

difficult environment required a series of tradeoffs to maintain a flow field which was representative of that encountered in the practical application of such a device. The application of suction emerged as the dominant parameter, increasing the turbulent mixing between the core flow and the vortex region, thereby permitting the core stream-tube to negotiate the adverse pressure gradient downstream. This significant result is strongly supported by both the performance measurements and the flow-field structure presentation.

Modified Lockheed P-3C Wing-Tip Flutter

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM J. BAGARIA

SPONSOR: NAVAL AIR DEVELOPMENT CENTER

This investigation evaluated the change in the wing-tip flutter of the Lockheed P-3C aircraft with the addition of AIL ESM antennas to each wing tip.

The wings are being modified in order to place the AIL ESM antenna arrays in each wing tip. This adds an additional 150 pounds to each wing tip, thereby changing the wing-

flutter characteristics. It was determined that, with various stores and fuel load configurations, the lowest flutter speed was $1.15 V_L$. This analytical result was based on the Lockheed Aeroelastic model. Since this is at the minimum specified speed, it was recommended that ground vibration testing be conducted.

Full-Scale Wind Tunnel Tests in the GTR-18 "Smokey Sam" Surface-to-Air Missile

RESEARCHER: PROFESSOR BERNARD H. CARSON

SPONSOR: NAVAL ORDNANCE STATION

Tests were conducted in the USNA 54" x 38" subsonic windtunnel on the GTR-18 ("Smokey Sam") practice surface-to-air missile. Included were the variations with angle of attack of the lift, drag, and base drag coefficients, and center

of pressure in the Reynolds Number range of $7 \times 10^5 - 1.4 \times 10^6$, for angles of attack varying from -5 to 30 degrees. Results were presented in both graphical form and in empirical formulae amenable to flight performance calculations.

Timeliness and New Directions of Aircraft Design

RESEARCHER: VISITING RESEARCH PROFESSOR ARNOLD GOLDBURG

SPONSOR: NAVAL AIR SYSTEMS COMMAND

This investigation was concerned with the following problems:

- a) The impact of computer-oriented design procedures in the industry on the aerospace educational design courses;
- b) The timeliness and the level of USNA aerospace design courses;
- c) The requirements and the Navy (NAVAIR) and their impact on USNA aerospace design courses; and

- d) Interaction with the professional societies, AIAA, SAE, ABET, etc.

Among the many interesting and beneficial conclusions and results were the strong affirmation of the need to teach fundamentals, and to participate in as many as possible external meetings and design competitions-events. Several groups of midshipmen did participate in the AIAA-Bendix design competition. The results are not yet available.

An Initial Comparison of Helicopter Rotor Flight Test Data with a Two-Dimensional Airfoil Performance Prediction Method

RESEARCHER: ASSOCIATE PROFESSOR GERALD F. HALL

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Flight test data from the Tim Aero Acoustics Test (TAAT) are compared with a transonic 2-D theory. The data are in pressure coefficient form, derived from absolute pressure transducer measurements. The theory, TRADES, obtains the inviscid flow field by solving the full perturbation-potential flow equation, given two-dimensional airfoils in

free air. Chordwise pressure distributions at six radial locations are compared at azimuth angle of 90° . The results show the effect of the tip on the blade pressures by a reduction in magnitude of the minimum pressure and a forward motion and increase in strength of the shock wave when compared with a two-dimensional model.

Hull-Superstructure Interaction

RESEARCHER: ASSISTANT PROFESSOR MICHAEL D. A. MACKNEY

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The researcher initiated the project with literature search and early formulation of a

simple model of hull-superstructure interaction. Little progress has been made to date.

Computer-Aided Hull Design and Model System

RESEARCHER: PROFESSOR DAVID F. ROGERS

SPONSOR: UNITED STATES COAST GUARD

A Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) system for the design of ship hulls and the production of towing tank models is being developed. The design portion of the system is implemented on and supported by a three-dimensional interactive graphics device and a microcomputer-based color real-time interactive graphics workstation minicomputer. A microprocessor-based stand-alone graphics device simply, directly, and

inexpensively interfaced to the CNC controller on the shop floor is used to provide support for the manufacturing portion of the system. A program running in the microprocessor-based graphics system provides all post-processing, a graphical display for the machine operator, and drives the machining center. All functions are accomplished on-the-fly in real time. All hardware components of the system are off-the-shelf items.

Effect of Modified P-3C Wing Tips on Range

RESEARCHER: PROFESSOR MAIDO SAARLAS

SPONSOR: NAVAL AIR DEVELOPMENT CENTER

This investigation evaluated the change of range due to modifying the Lockheed P-3C aircraft wing tips with the addition of AIL ESM antennas to each wing tip.

The wings are being modified in order to place the AIL ESM antenna arrays in each wing tip. This adds additional weight to each wing tip and increases the wing area and thickness near the tips. As a consequence, the aircraft drag is increased. The increase in the area and the aspect ratio tend to increase the range, but weight and drag increases will bring about a decrease in the range.

A brief theoretical analysis was conducted and compared with the existing Lockheed experimental wind tunnel data, which indicated a smaller drag rise than would be expected. This anomaly seems to be caused by the particular three-dimensional shape of the new wing tips, which tends to cause a wake drag relief due to tip vortex rollup and a strong spanwise flow component at the tip trailing edge.

It is intended to further study this problem experimentally as a midshipman research project.

Independent Research

Bagasse Solar Drying System

RESEARCHER: PROFESSOR MAIDO SAARLAS

An hybrid (passive-active) solar-powered collector system was designed and installed for the State Sugar Council in the Dominican Republic. The purpose of the system is to partially dry the bagasse which is used

as boiler fuel, thus enhancing its energy content and improving its combustion characteristics. The system was designed in 1981-82 and started operating in February 1984.



Research Course Projects

Aircraft Ground Propulsion System

RESEARCHER: MIDSHIPMAN 1/C DAVID A. BAILEY

ADVISER: PROFESSOR MAIDO SAARLAS

The purpose of this project is to determine if the braking energy of a landing aircraft can be converted and stored for use in the taxiing phase of the ground operations, thus saving

fuel. The results show that there are some practical trade-offs possible concerning accumulator size and weight versus the operating pressure of the system.

Computer-Graphics Display System for the Planetary Orbits

RESEARCHER: MIDSHIPMAN 1/C LISA M. CAPUTO

ADVISER: ASSOCIATE PROFESSOR WILLIAM J. BAGARIA

This project involved a dynamic computer-graphics display of the solar system. Computer programs were developed to determine the positions of the nine planets and to orient them in space relative to an inertial coordinate system centered on the sun. The calculations were based on the theoretical principles of orbital mechanics. Some difficulties were

encountered in the actual display concerning scaling and resolution limitations; however, they were resolved by experimentation. The final product was a display of the planetary orbits with the planets moving along the orbits. This display could be interactively scaled and rotated in three dimensions in real time to select a view from any angle.

Shock Propagation as the Cause of Helicopter "Blade-Slap"

RESEARCHER: MIDSHIPMAN 1/C KURT S. COLLOM

ADVISER: ASSOCIATE PROFESSOR GERALD F. HALL

Helicopter blade-slap is a significant problem particularly to the military since surprise attack is made extremely difficult due to high-intensity sound being generated by the helicopter rotor blade and propagating far ahead of the aircraft. Before steps can be taken to solve this problem, the source of the sound must be discerned. The primary theory concerning blade-slap

involves Blade-Vortex Interactions (BVI) creating local supersonic velocities on the blade resulting in the formation of shock waves which propagate off the blade and are heard as sound. The purpose of this project is to prove this theory through the use of computer simulation. To date the project is incomplete because of computational logistics problems.

The Effects of Computer-Aided Machining on the Drag Characteristics of Aerodynamic Bodies

RESEARCHER: MIDSHIPMAN 1/C RICHARD J. GOFFI
 ADVISER: ASSOCIATE PROFESSOR THOMAS J. LANGAN

This project studies the effects of computer-aided machining on the aerodynamic characteristics of axis symmetric bodies. In particular, the

drag characteristics are determined as they vary with the number of cuts made on a numerical lathe while cutting the body.

Economic and Performance Analysis on Gas-Alcohol Fuels

RESEARCHER: MIDSHIPMAN 1/C JEROME T. MARR
 ADVISER: ASSOCIATE PROFESSOR EUGENE L. KEATING

This study observed the trends in engine performance of a theoretical light aircraft engine due to the effects of gas-alcohol fuels. The computer program, L.EM***:ASICEA, was used to measure brake horsepower and specific fuel consumption as functions of percentage of ethanol to aviation gasoline. The theoretical engine was run as an ideal Otto cycle. It was discovered that BHP increased by +2.03% from 0% to 100% ethanol,

while SFC as a function of $lb_m/HP-hr$ increased by a factor of +39.5%. However, this study was conducted from an economical viewpoint. In this sense, it was discovered that the SFC as a function of cost, $$/HP-hr$, increased by a factor of +16.25%. This study was designed to promote the economic viewpoint of engine performance as well as show the basic effects of gas-alcohol fuels on light-weight aircraft engines.

Venting Analysis of the Standard Electrical Box for the Naval Research Laboratory Shuttle Launch Dispenser

RESEARCHER: MIDSHIPMAN 1/C MICHAEL E. MERREN
 ADVISER: COMMANDER WILLIAM L. MCCrackEN, USN

The purpose of this project was to determine the adequacy of the venting of the Standard Electronics Box for the Shuttle Launch Dispenser as it de-pressurizes after launch of the NASA Space Shuttle. The box must be vented so that the stresses on the box are kept within tolerable limits. The venting of the box after launch was simulated with a

BASIC 7 venting program from which graphs of pressure differential-vs-time were produced. Using the value of the maximum pressure differential (-000978 psia), the stresses imposed on the hex screws holding the box together were determined. It was found that these stresses were insignificant; hence, the venting of the box was more than adequate.

Whittle Wing 8

RESEARCHER: MIDSHIPMAN 1/C GLENN S. ROSEN

ADVISER: SIR FRANK WHITTLE

The purpose of this research was to determine the effect on lift and drag of the tangential blowing used on the Whittle Wing 8. Also, the effect of ground proximity was investigated. It was determined that the wind tunnel setup did not provide a good two-dimensional effect because of endplate boundary layer growth and airflow separation at the junction of the airfoil and the endplates. Also, a Venturi formed in the test section, further complicating the flow. When blowing was in effect, the lift curve slope increased, but a separation of flow before the tangential slots led to an early stall. Moving the airfoil closer to the ground

resulted in an increase in lift-curve slope, a delay in stall, and a higher $C_{L_{max}}$. Previous research has determined that, in this type of setup, drag results from the balance are not considered accurate. The drag results determined using the Momentum Theorem are questionable since a constant spanwise distribution is not achieved. The lift results have led to the possibility of using the Whittle Wing 8 on a ground-effect vehicle. A setup with a longer airfoil section is presently being constructed to better simulate the two-dimensional effect, providing more accurate drag results.



Electrical Engineering

LIEUTENANT COLONEL GEORGE D. PETERSON, USAF
CHAIRMAN

A key ingredient to sustaining a high-quality undergraduate program is an enthusiastic faculty who are professionally active and contributing to the general body of knowledge in their field. Students sense the faculty's enthusiasm and are themselves motivated by the faculty's experiences. This response is particularly true in the rapidly changing field of electrical engineering. The research program serves to keep the faculty involved in development of the discipline and therefore contributes directly to the quality of education for midshipmen. A related benefit is the opportunity for some midshipmen to participate directly in research projects under faculty guidance.

The general character of research currently being investigated by the faculty is related to existing fleet problems. The results of these efforts benefit our operating forces and introduce midshipmen to relevant topics which enhance their professional as well as academic growth.



Sponsored Research

Development of Wire Antennas for Tactical Communications

RESEARCHER: CAPTAIN WARREN P. AVERILL, USMC

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL AND MARINE CORPS DEVELOPMENT CENTER

As fast-moving offenses become the rule, field communicators today must communicate over ever greater distances and through electronic countermeasures. The radios and stock antennas now available are not always adequate to meet these challenges. An immediate improvement to a radio system is the addition of wire antennas. These can be cheaply made and very often they can be made from material readily available in the field.

The objective of this project is to develop and publish a handbook for construction of wire antennas in a tactical environment. The researcher initially explored existing information on tactical antennas through a

publication review and through queries to the various government agencies to develop a list of practical wire antennas and approximate design parameters. Later, at the Naval Postgraduate School, the researcher analyzed the antennas using the Numerical Electromagnetics Code (NEC). A set of instructions was drafted in handbook form. The draft is in distribution for comments while a field test at a major command is being conducted to determine the handbook's readability by the operator and practicality of construction methods. A final product handbook will be written and submitted for publication.

Transducer Performance Evaluation

RESEARCHER: ASSISTANT PROFESSOR WILLIAM E. BENNETT

SPONSOR: NAVAL RESEARCH LABORATORY

This is an ongoing project to evaluate the performance of transducers by analyzing the impedance characteristics. Particular research

requirements have included high speed A/D implementations and a negative impedance converter for transducer compensation.

Interactive Computer Program Development for the Root Locus Analysis and Design of Systems

RESEARCHER: VISITING RESEARCH PROFESSOR M. BLYTHE BROUGHTON

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The cycloconverter described in the final report on the simulation of variable-speed, constant-frequency generators showed unsatisfactory stability under transient conditions. A stability analysis of a normalized cycloconverter model was carried out on the

digital computer using root locus methods. Satisfactory stability was obtained by means of derivative feedback while maintaining adequate insensitivity to load variations and adequate supply frequency harmonic rejection.

Sonar Transducer Parameter Estimation

RESEARCHER: VISITING RESEARCH PROFESSOR M. BLYTHE BROUGHTON
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The simplex method for the computer-aided solution of non-constrained optimization problems is described and applied to the least-squares

estimation of the parameters of a linear equivalent circuit model for a sonar transducer derived from measurements of its frequency response.

Computer Program Development for the Time-Domain Analysis of Piece-Wise Linear Systems

RESEARCHER: VISITING RESEARCH PROFESSOR M. BLYTHE BROUGHTON
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

After summarizing the system theory required for modelling piece-wise linear systems whose state is a continuous function of time, and in which each subsystem is described by linear ordinary differential equations with constant

coefficients, a computer program for simulating such systems is described and listed in the appendix. Six example systems from the field to power electronics are presented to demonstrate the simulation method.

Digital Packet Radio Networking of Personal Computers: Terrestrial Experiments in Support of PASCAT 1986

RESEARCHER: COMMANDER ROBERT E. BRUNINGA, USN
SPONSOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Volunteers in Technical Action, a major non-profit organization that provides technical assistance to third world countries and AMSAT, the world-wide amateur satellite organization, are combining resources to launch a digital store-and-forward message system satellite, PACSAT, in 1986. The satellite will provide whole world coverage at least twice a day to simple, portable ground station terminals. A modified version of X.25 will be used for both up and down links.

Preliminary efforts involved design and construction of a briefcase terminal and a local terrestrial network for evaluation. A digital repeater was temporarily installed at Goddard Space Center and used to link into the Washington, D.C. local area packet network on 145.010 MHz. Due to the terrestrial range

limitations of VHF, an HF-to-VHF bridge system was developed to extend the local area network to several thousand miles on 10.147 MHz. For this first such bridge in the country, software and firmware development was an evolutionary process. By the end of the summer, the network consisted of over twenty-five users of VHF and ten on HF from as far away as Arizona and British Columbia, linked by three repeaters and the bridge system.

Talks and demonstrations of the terrestrial packet radio system were given to the Man, Computer and Cybernetics Society of the IEEE, to several community service amateur radio organizations, and to the Goddard Summer Faculty Fellow to give visibility to the PASCAT program and to focus interest on further development.

Computer-Aided Design, Advanced Concept Machines

RESEARCHER: PROFESSOR FRANCIS J. EBERHARDT

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The researcher continued work on development of computer programs to implement design equations of large

propulsion motors. Present work is on normally conducting, acyclic motors for sub or SWATH use, in the 5-15 Megawatt range.

Computer Derivation of Equivalent - Circuit RLC Values for an Ultrasonic Transducer from Frequency-Response Measurements

RESEARCHER: ASSISTANT PROFESSOR DAVID S. HARDING

SPONSOR: NAVAL RESEARCH LABORATORY

The purpose of this project, directed by Professor Antal A. Sarkady, is to develop a microcomputer-based method for the measurement of the equivalent-circuit RLC parameters of ultrasonic transducers. The RLC parameter values can be used to characterize the electro-mechanical properties of transducers. Knowledge of acoustic properties obtained through electrical measurements can then be used to improve quality control of ultrasonic

transducers used in NDE (nondestructive evaluation). This method has proved successful for tuned transducers, those containing a coil in parallel with the crystal, to tune out capacitive reactance at the mechanical resonance of the crystal. The project continues with efforts to improve the method for untuned transducers: the development and use of a negative impedance converter to tune out the holder capacitance over a wide range of frequencies.

Circuit Design for Nuclear Radiation Test of CMOS Multiplier Chip

RESEARCHER: ASSOCIATE PROFESSOR TIAN S. LIM

SPONSOR: NAVAL RESEARCH LABORATORY

The purpose of this project is to design a microprocessor-based electronic circuit to be used to test the effects of nuclear radiation on a CMOS 8×8 multiplier chip. Knowledge of such effects is important for military and space applications of integrated circuits. The multiplier chip undergoing testing is attached to a DUT (Device Under Test) board which is enclosed in a metal container. The container is then lowered

to the cobalt 60 radiation source located at the bottom of a 15-foot deep pool. Doses of radiation from cobalt 60 are applied in steps at increasing quantities until the multiplier chip, which is tested between doses, begins to malfunction. The multiplier chip is electrically connected to the 8085 microprocessor via a driver board. An 8085 assembly language program is used for functional test of the multiplier.

Radiation Testing of ULSI Components

RESEARCHER: PROFESSOR RICHARD L. MARTIN

SPONSOR: NAVAL RESEARCH LABORATORY

Basic procedures for radiation testing of ULSI components have been developed to ensure consistent results based on consistent biasing of the individual internal components. A procedure for determination of longest expected RAM

read access times based on a limited number of measurements was also developed and verified. A presentation of IMTC/85 was one result. This research supports a project for the Defense Nuclear Agency.

Nondestructive Pipe Condition Monitoring

RESEARCHER: PROFESSOR ANTAL A. SARKADY

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The goal of this research is to develop sensors and an automated measurement system which can be used nondestructively to detect and characterize flaws in naval condenser and boiler pipes. During the past year, commercial multi-frequency eddy current instruments were

evaluated and tested for the condenser pipes.

During the past year, also, signal processing algorithms were developed for the boiler pipes to compute the pipe thickness in steel boiler pipes. In addition, a 32-element switchable ultrasonic array was designed and tested.

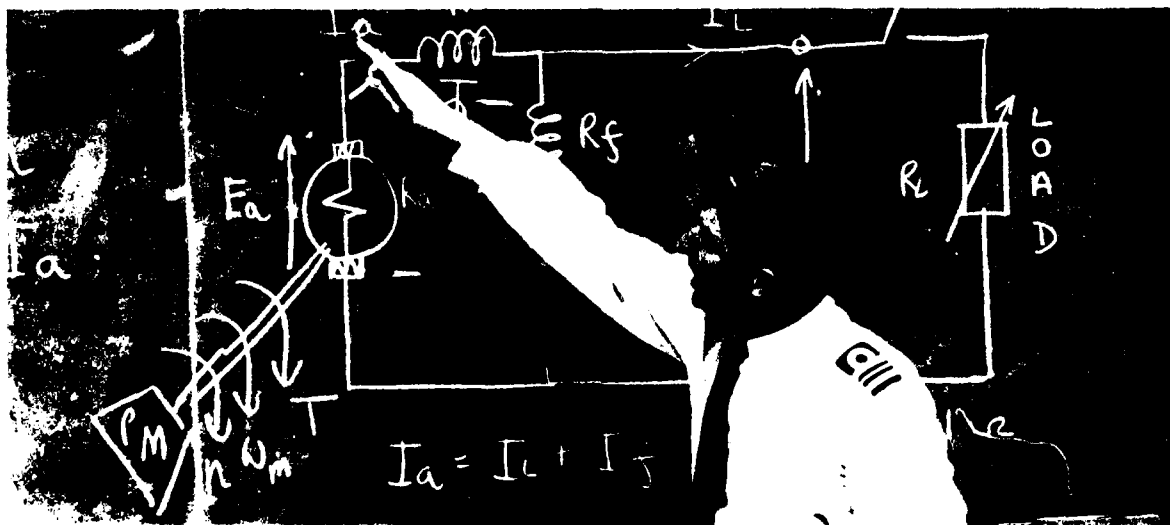
Characterization of Ultrasonic Transducers

RESEARCHER: PROFESSOR ANTAL A. SARKADY, ASSISTANT PROFESSOR DAVID S. HARDING
AND ASSOCIATE PROFESSOR (RETIRED) HERBERT NEUSTADT

SPONSOR: NAVAL RESEARCH LABORATORY

The aim of this research work is to develop automated measurement systems and models to characterize ultrasonic transducers. A precise characterization is required to improve

the uniformity of Nondestructive Evaluation measurements in naval ship yards. During the past year, Mason and Hayward equivalent circuits/models were developed.



Publications

AVERILL, Warren P., Captain, USMC, **"Antennas Make the Difference,"** *Marine Corps Gazette*, 68 (October 1984), 26-27.

If the Marine Corps were to go to war tomorrow against a foe equipped with Soviet-built communication jammers, it could be denied the use of radio communications during critical periods of operations. For this reason, the Marine Corps has placed great emphasis on electronic counter-countermeasures (ECCM) training. But presently, the Marine Corps' only planned alternative is to use other means of communications, such as wire telephones and message runners. There is another choice, however, and that is to change antennas. When the threat of jammers is present, the half-wave dipole is better than the whip or RC-292 antenna. The dipole is better because horizontally polarized antennas receive signals radiated from vertically polarized antennas very poorly. In most cases, the power transmitted from a jammer using a vertical antenna must be boosted by a factor of 20 (13 db) to have the same effect on a receiver after the change from a whip antenna to a horizontal dipole.

BRUNINGA, Robert E., Commander, USN, **"EASTNET: A Year Later,"** *Proceedings of the Fourth ARRL Amateur Radio Computer Networking Conference*, 30 March 1985, pp. 15-24.

There are numerous applications for a low cost digital store-and-forward message system which cannot be met by existing commercial and common carrier data networks. Recognizing the need to communicate with remote third world villages in support of their worldwide aid programs, VITA (Volunteers in Technical Action) has funded research by the Amateur Satellite Corporation to launch PASCAT, a low cost packet radio satellite. Under FY84 Naval Academy Research Council funding, an experimental packet radio repeater was built and used to test packet protocols and message delivery between Washington, D.C., Annapolis, and southern New Jersey. This paper summarizes the status of the

Network; a year later it has grown north to Boston and Canada, and as far south as Florida. Refinement of the AX.25 protocol and level-three networking is an ongoing research effort.

RYNONE, William, Assistant Professor, **"Uninterruptible Power Supplies,"** *BYTE Magazine*, 10 (January 1985), 183-190, 192.

This article contains a listing of manufacturers' data for both standby and continuous duty uninterruptible power supplies, in addition to the relative advantages of both types. The data are for those units employed primarily in supporting personal computers. Questions that potential buyers should ask are summarized. Also included is a separate discussion of modifications that may be performed on a standard high intensity light to enable emergency standby operation.

SARKADY, Antal A., Professor, David S. HARDING, Assistant Professor, and Herbert NEUSTADT, Associate Professor (retired), **"Computer Derivation of Equivalent-Circuit RLC Values for an Ultrasonic Transducer from Measured Values of the Transducer's Driving-Point Impedance,"** *Nondestructive Testing International*, 17 (December 1984), 343-348.

An ultrasonic transducer is modelled as a circuit having three parallel branches. The RLC parameters for the equivalent circuit are computed from measured values of the complex driving-point impedance of the transducer in the frequency range 0 to 6 MHz. The computed RLC values representing the acoustically active part of the crystal are highly reproducible under constant loading. Significantly, these values change substantially when the loading is changed from air to water or to metal. The impedance measurements and the RLC computations for a transducer are performed on-line in less than one minute by a portable 16-bit microcomputer using a 512-point FFT algorithm.

SARKADY, Antal A., Professor and Herbert NEUSTADT, Associate Professor (retired), **"Digital Signal Processing Techniques in Ultrasonic Thickness Measurements,"** *Proceedings of the 6th Annual EPRI NDE Meeting, 28-29 November 1984, Chapter 27, pp. 1-13.*

A microcomputer-based ultrasonic thickness measurement system was developed to measure wall thicknesses in tubing such as is

used in boilers, condensers, heat exchangers, and nuclear steam generators. The wall thickness at a given location is estimated by a signal-processing algorithm which enhances the echo signal and uses a Fourier decision technique to estimate the thickness. This algorithm is FFT intensive and designed to be easily implemented in hardware. In steel tubing, the thickness measurement range using a 5 MHz transducer is from 0.02 in. to 0.2 in. with 0.003 in. resolution.



Presentations

ALLEY, Reuben E., Professor, **"Optics in the History of Western Painting,"** Pacific Northwest Association for College Physics Meeting, Portland, Oregon, 29 March 1985.

AVERILL, Warren P., Captain, USMC, **"Near Vertical Incidence Skywave Communications,"** Fleet Marine Force Pacific Communications Electronic Officers' Conference, Honolulu, Hawaii, 11 April 1985.

BROUGHTON, M. Blythe, Visiting Research Professor, **"Application of the Simplex Optimization Method to the Estimation of Network Parameters,"** USNA Electrical Engineering Department Faculty Seminar, February 1985.

BROUGHTON, M. Blythe, Visiting Research Professor, **"Application of the Simplex Optimization Method to the Estimation of Transducer Equivalent Circuit Parameters,"** Fifteenth Symposium on Nondestructive Evaluation, San Antonio, Texas, April 1985.

BROUGHTON, M. Blythe, Visiting Research Professor, **"Rapid Evaluation of Transition Matrixes and Inversion of Rational Laplace Transforms,"** Sixteenth Annual Pittsburgh Modeling and Simulation Conference, Pittsburgh, Pennsylvania, April 1985.

BROUGHTON, M. Blythe, Visiting Research Professor, and Herbert M. NEUSTADT,

Associate Professor (retired), **"Computer Derivation of Hayward Parameters for an Ultrasonic Transducer from Driving Point Impedance Measurements,"** Fifteenth Symposium on Nondestructive Evaluation, San Antonio, Texas, April 1985.

BROUGHTON, M. Blythe, Visiting Research Professor, **"Computer Analysis of Piece-Wise Linear Systems,"** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, Staff Research Seminar, May 1985.

BRUNINGA, Robert E. Commander, USN, **"Linking Personal Computers by Packet Radio,"** COMPCON 84, Arlington, Virginia, 19 September 1984.

MARTIN, Richard L., Professor, **"Use of Personal Computers During Gamma Radiation Testing of CMOS RAMs,"** IMTC/85, Tampa, Florida, 21-22 March 1985.

SARKADY, Antal A., Professor, **"Digital Signal Processing Techniques in Ultrasonic Thickness Measurements,"** Sixth Annual EPRI NDE Meeting, Palo Alto, California, 28-29 November 1984.

SARKADY, Antal A., Professor, **"A Computer-Controlled Array of Ultrasonic Transducers for Fast Inspection of Steel Pipes,"** Fifteenth Symposium on Nondestructive Evaluation, San Antonio, Texas, 23-25 April 1985.

Mechanical Engineering

ASSOCIATE PROFESSOR JACK H. SMITH
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, combustion, fluid mechanics, heat transfer, solid mechanics, acoustics, dynamic effects, lubrication, corrosion, fracture mechanics, composite materials, welding and design, and computer-aided graphics.

Research is supported mainly through funds from 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. Eight faculty members have been active in the reported research of the Department this year that follows.

An important part of the Department's research effort each year is the involvement of midshipmen in independent research, design, and development projects. There were twelve midshipmen research projects completed this academic year.

Supporting the research effort in mechanical engineering are the extensive laboratory facilities located in Rickover Hall. 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 need for the faculty to stay abreast of developments in many diversified areas of mechanical engineering, thereby enabling them to be more effective classroom teachers.

Sponsored Research

DDG-51 Machinery Space Cooling

RESEARCHER: ASSOCIATE PROFESSOR ELLIOTT E. DODSON

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

As a means of reducing ventilation requirements of machinery spaces, the use of seawater cooling coils for supplemental cooling provides a promising alternative for gas-turbine-powered naval combatant ships, such as the DDGX Class.

An assessment of the possible savings, both in weight as well as fuel costs, which might accrue from seawater cooling within machinery spaces (as opposed to conventional ventilation) of a DDGX Class ship was the principal objective of this project, with

DDG-51 selected for analysis.

It was concluded that the use of seawater cooling coils coupled with minimum ventilation in the machinery spaces of DDG-51 would represent significant savings in both fuel costs and installed weight when compared with conventional ventilation (ventilation only). These savings, representing only those associated with the cooling system and cooling equipment, would be applicable for the case of the Collective Protection System, CPS, coverage as well as for the case of no CPS coverage.

Investigation of Smoke Nuisance on Surface Effect Ships

RESEARCHER: ASSOCIATE PROFESSOR JOSEPH D. GILLERLAIN, JR.

SPONSOR: UNITED STATES COAST GUARD

The smoke nuisance problem on surface effect ships may involve smoke coming down on the deck, smoke entering the ventilation systems, and smoke being drawn into the lift fans. It is recommended that windtunnel tests be performed on a representative surface effect ship configuration in order to investigate the smoke nuisance problem and to suggest how it might be alleviated.

The investigations will be carried out in several phases, specifically:

1. Perform windtunnel tests using smoke flow visualization for existing configurations, with some minor variations of geometry. Air drag resistance data will also be obtained during the smoke flow tests.
2. Check existing computational codes for stack design and stack plumes. Compare

these theoretical calculations with experimental results from wake structure flow field measurements.

3. Test existing geometries with simulated stack gases and simulated intake fans. Suggest and test new geometries. Obtain flow field measurements, air drag resistances, and smoke flow visualization data.

The first year's efforts were directed toward completing Phase I. Presently, a representative model of appropriate scale is being built at the Naval Academy from drawings provided by the United States Coast Guard. The geometry will be slightly variable by interchanging basic shapes to permit a parametric study. Photographs from smoke flow visualization tests and air resistance drag data will be obtained.

Corrosion Fatigue of Advanced Materials

RESEARCHER: PROFESSOR DENNIS F. HASSON

SPONSOR: NAVAL SURFACE WEAPONS CENTER, WHITE OAK LABORATORY

The research involves consultation and test performance to provide corrosion fatigue of advanced materials. Reversed bending fatigue

testing in a saline atmosphere will be performed. Fractography of the specimens will also be performed.

Crack Formation and Propagation in Ceramic Composites at High Loading Rates

RESEARCHER: PROFESSOR DENNIS F. HASSON

SPONSOR: OFFICE OF NAVAL RESEARCH

The research was to determine the mechanisms of crack formation and propagation in ceramic composited with various composite architectures. Instrumented Charpy V-notch specimens were tested to obtain the fracture mechanics behavior and parameters. Macro

and micro fractography was performed by scanning electron microscopy. Mechanisms were proposed for crack initiation and growth. The information will be utilized to improve fracture resistance in ceramic composites.

Damage Development in Fiber-Reinforced Composite Materials

RESEARCHER: ASSISTANT PROFESSOR RUSSELL D. JAMISON

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project dealt with characterizing damage growth in composites subjected to tensile loading. The major objective was to establish by direct experimental observation the modes and chronology of damage development in [0, 90], and [0, 0], laminates of graphite/epoxy and E-glass/epoxy material as a function of load level. This physical description of damage development would then be available for: (1) proper interpretation of previous fatigue results; (2) gaining a better understanding

of the tensile failure mechanism itself; and (3) in the case of unidirectional laminates for assessment of several current micromechanical strength models. The methods used were x-ray, edge replication, and specimen deply.

Principal results were the establishment for the first time of the load vs fiber fracture density for these laminates and of the strong interactions between ply cracks and fiber breaks in the cross-ply laminates.

Dynamic Elastic Plastic Test Method Development

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. JOYCE
SPONSOR: NUCLEAR REGULATORY COMMISSION

The objectives of the project are to: (1) utilize the Key Curve method to develop J-R curves at 100 in/sec loading rate obtained in a drop-tower test using A106 piping and A533B plate materials, (2) explore application of A.C. potential drop to obtain a direct measurement of crack length during drop-tower tests, and (3) complete carry-over project to develop conditions for tearing instability arrest in a compliant test system with variable inertia.

Data collected from load transducers integral to the specimen and high frequency fiber optic displacement transducers have demonstrated large inertia oscillation components. Application of numerical modeling and experimental spectral analysis techniques has independently demonstrated that these oscillations are elastic in nature. Removal of these oscillations from

load and displacement signals has been accomplished by numerical smoothing (filtering) methods, and the resulting curves have been adequate for J-R curve determination using key curve methods. Results have been obtained to date on HY130, HY80, and A302 structural steels. The researcher has concluded that a direct method to measure crack length like a potential drop would be more valuable than the indirect key-curve method now employed.

Results obtained to date have allowed comparison of material J-R curves on the material upper shelf at static, servohydraulic, and drop-tower test rates for which crack velocities of up to 25 m/sec have been obtained. All tests have remained fully ductile with ductile rupture fracture mechanisms. All results have shown increasing J_{lc} and T values with increasing test velocity.

An Investigation of Boxing Gloves and Boxing Headgears to Determine Fillers Resulting in Reduced Impact

RESEARCHER: ASSOCIATE PROFESSOR JACK H. SMITH
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

An investigation was conducted of different fillers for boxing gloves and boxing headgears in an attempt to find a filler which reduces the impact of a punch. Twenty different combinations of glove fillers and five different headgears were tested. Within the limitations of the test setup and the range of fillers used, an optimum filler and optimum headgear were determined. The criterion used to determine impact effect was severity index.

The optimum combination of material for a boxing glove filler, outer layer first, consisted of, one-half inch of close-cell foam latex, three-quarter inch of closed-cell foam PVC (Husitonic brand), three-eighths inch of

closed-cell foam PVC (Rubitex 313 V brand), and one-half inch of polyurethane open-cell foam. The headgear with the least impact effect, outer layer first, consisted of, one-half inch of Encelite closed-cell foam (Uniroyal), three-eighths inch of closed-cell foam PVC (Rubitex 313 V brand), and one-half inch of polyurethane open-cell foam.

As a result of this research, the American Boxing Federation, which supervises all amateur boxing in the United States, has required that the gloves and headgear filler formulae that produced the minimum severity index, as determined by this research, be used in all amateur bouts.

Closed Cycle Vaporization Cooling

RESEARCHER: PROFESSOR RUSSELL A. SMITH

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The project concerned the application of non-linear optimization techniques to study improvements in alternative concepts for cooling

auxiliary loads in submarines. Potential methods were identified and their exercise was initiated on one alternative. Work is continuing in 1985-1986.

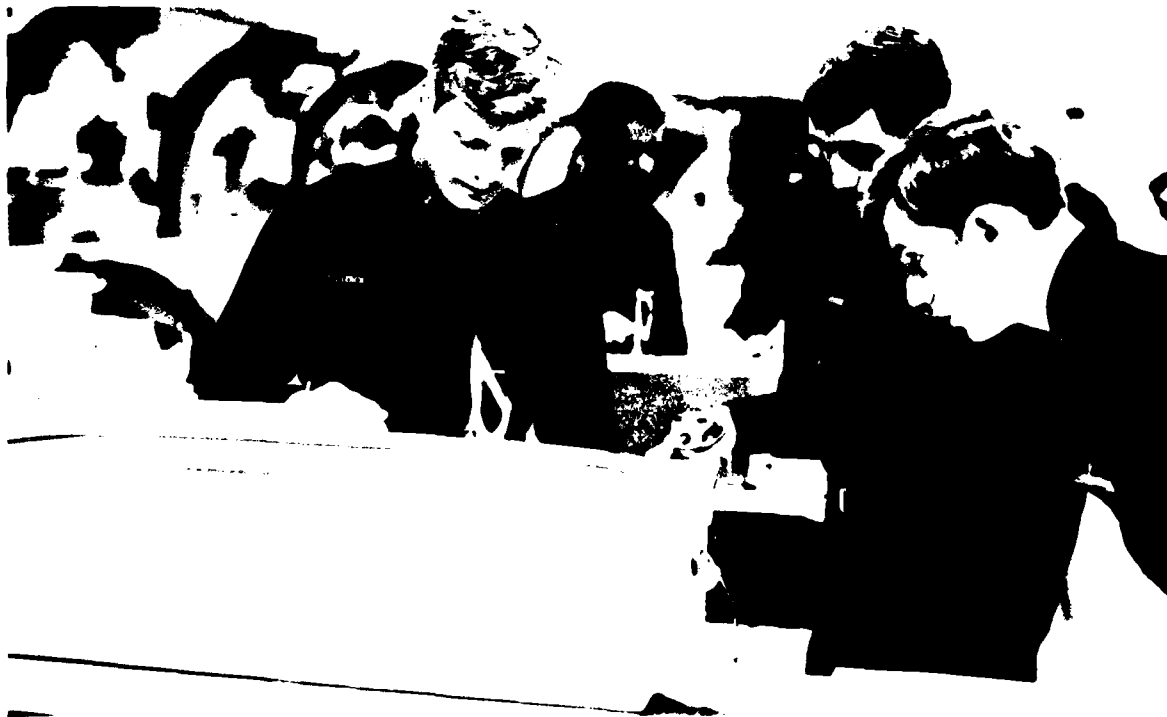
Quiet Submarine Piping System Design

RESEARCHER: PROFESSOR J. PAUL ULDRICK

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The purpose and objectives of the project are to (1) develop fundamental principles to characterize and predict the vibrational excitation mechanisms and system response characteristics of fluid conveying piping systems on modern submarines, (2) design and construct an experimental mechanical system to test the validity of coherence analysis in source identification, and (3) develop software and synthesize the necessary hardware for text and graphic processing, communications, and data transfer and analysis for microcomputers.

The plan of investigation was to design and implement experimental configurations for laboratory and sea trial measurements and to develop digital time series analysis techniques to characterize and model known and unknown excitation mechanisms in submarine piping systems; to design and implement the necessary software to transfer information to and from remote laboratory instrumentation and analysis systems to microcomputer stations over commercial telephone lines; and to develop the analysis software to model dynamic flow noise phenomena.



Independent Research

Dynamic Fracture Toughness of Naval Materials

RESEARCHER: PROFESSOR DENNIS F. HASSON

Studies of the dynamic fracture toughness of naval steels, metal matrix and ceramic materials are in progress. Apparatus to test and record the information are under study.

For the steels, an instrumented Charpy V-notch apparatus is in use. The program will provide information on the fracture mechanics and crack type and behavior in these materials.

Development of Post- and Pre-Processors for Finite Element Analysis

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. JOYCE

The objective of this research is to develop computer graphics based software for data input and output from 2D finite element programs.

The existing finite element analysis programs in FORTRAN are computationally very efficient but awkward to use, because they require tedious preparation of structural grid data sets. Programs to generate a grid from boundary-only data exist, and these need to be combined with graphics tablet hardware to make a user-friendly data entry scheme.

Graphical display of calculated results is also presently not available, and this should be straightforward, using the modern graphics

available in CADIG Department. Display of element stresses, strains, and model displacements would greatly enhance the appreciation of the structural analysis solution. Also useful would be routines to develop contours of equivalent stress levels.

This project offers an opportunity to become familiar with the state-of-the-art computer digitizing and graphical display systems, as well as the opportunity to utilize a VAX 11/780 computer using the UNIX operating system. Limited technical assistance is available from CADIG employees to explain the operation of the equipment available and to aid in program development.

Low Cycle Fatigue Crack Growth

RESEARCHER: ASSOCIATE PROFESSOR JAMES A. JOYCE

The objective of this project is to develop experimental data to evaluate the usefulness of the J-integral to characterize fatigue crack growth rates in elastic plastic cyclic loadings. This project has been funded in previous years by David W. Taylor Naval Ship and Research Center (DTNSRDC) but is unfunded in 1985. The effect has been modified to look at earthquake-type spectra and to utilize

HSLA pipeline type steels. A cooperative effort was initiated with the University of Maryland and this topic, utilizing the previous work done at the Naval Academy and DTNSRDC and the larger capacity MTS test equipment available at the University of Maryland. Specimens were prepared and testing began during the spring of 1985.

Research Course Projects

Development of Interface Between CADIG PS300 System and Dram

RESEARCHER: MIDSHIPMAN 1/C DAVID R. BIXBY

ADVISER: PROFESSOR J. ALAN ADAMS

The purpose of the project was to implement a new software package for studying the Dynamic Response of Articulated Machinery (DRAM), to create a user-friendly environment by developing a preprocessor and documented examples, and to create more realistic computer graphic displays on the PS/300 that give the user interactive control over rotation, scaling, speed, and placement of graphical output.

Programming was done in PS/300 code and the "C" programming language. The problem-solving experience will prove useful in basic courses such as dynamics, as well as in advanced courses such as vibrations and computer graphics. This work will continue during the summer and into the fall. New, fully documented software is expected to be ready for use in teaching and research by the Fall, 1985.

Engine Performance Analysis

RESEARCHER: MIDSHIPMAN 1/C ROBERT B. DISHMAN

ADVISER: ASSOCIATE PROFESSOR EUGENE L. KEATING

The project involved the performance testing of a reciprocating piston engine and a rotary engine. The engines were operated using non-air gases. Comparisons were made with a base air model. The feasibility of operating these engines in a closed system with a

non-air gas was of primary concern. The development of a closed internal combustion engine would be ideal for naval applications, such as providing auxiliary power in submarines. The project also included experimental modeling on a computer.

Internal Combustion Engine Study Utilizing Superflow 900 Dyno

RESEARCHER: MIDSHIPMAN 1/C JON A. FRANKE

ADVISER: ASSOCIATE PROFESSOR EUGENE L. KEATING

An internal combustion engine was operated in conjunction with a Superflow 900 Dyno-microprocessor to investigate the interface as an experimental alternative to other methods. Specific investigations included the engine response to acceleration, deceleration, various air-fuel ratio., and various compression

ratios. The performance parameters that were measured included brake and indicated thermal efficiency, mean effective pressure, and specific fuel consumption. Additionally, an engine performance map was produced. Comparisons were made to existing data using other more conventional methods of experimentation.

Analysis of a Solar-Heated House

RESEARCHER: MIDSHIPMAN 1/C JONATHAN A. FULTON
ADVISER: ASSOCIATE PROFESSOR SHIRLEY T. FLEISCHMANN

Part one of this project involved the assessment of the heating load on an already-constructed home located in Massachusetts. In part two, the possibility of a heat pump utilizing a large water tank as a thermal storage unit was explored. Experiments were conducted using the heat pump in the applied fluids lab to

ascertain the effects of various parameters on heat pump performance. Various options were explored for the use of the heat pump as an auxiliary heat source to the passive solar design. These options included forced warm air heat and hot water with baseboard radiation.

Pressure Measurements on a Hydrofoil

RESEARCHER: MIDSHIPMAN 1/C WILLIAM B. HIGGINS
ADVISER: PROFESSOR ROBERT A. GRANGER

Pressure measurements were performed at selected positions on the upper surface of a NACA 66-006 hydrofoil submerged in a flow of water at velocities ranging from 4 to 15 feet per second for the purpose of determining the topographical characteristics of the local pressure coefficient. This was done in conjunction with a previous experiment using the same hydrofoil which studied the cavitation characteristics of the foil. The measurements are made by placing the foil in a recirculating water channel, connecting the pressure taps to Validyne variable reluctance pressure transducers, and reading the output voltages with a data acquisition system contained in the software of a Hewlett-Packard 9000-236 microcomputer.

The reduced, graphical form of the data obtained is given and is expected to be accurate within 10%. Some of the significant features of the results are as follows:

1. At a Reynolds number based on local chord of between 3×10 and 5×10 , a transition phenomenon occurs at the 50% chord location whereby the pressure peaks and then drops off rapidly. There

does not appear to be any significant dependency on angle of attack.

2. The coefficient of pressure increases with Reynolds number at a given location, with the peak moving closer to the leading edge with angle of attack.

A possible explanation for the result that the maximum pressure occurs spanwise near the tip comes from the first result. If a transition is occurring at a Reynolds number of 3×10 , then as measured at 50% chord, the transition is likely to occur at the wider portion of the fin first for a given velocity. This would link all of the observations. A quick examination of common flat plate results reveals that indeed transition from laminar to turbulent flow occurs at a local Reynolds number of about 6×10 . This result is for the case of no pressure gradient. For the fin, the local Reynolds number corresponding to the observed transition is between 1.5×10 and 2.5×10 . Of course, this includes a pressure gradient. This consistency in order of magnitude helps substantiate the original explanation. The drop in pressure corresponds to the transition from laminar to turbulent boundary layer flow.

Reciprocating Aircraft Engine Performance Using Alcohol

RESEARCHER: MIDSHIPMAN 1/C JEROME T. MARR
ADVISER: ASSOCIATE PROFESSOR EUGENE L. KEATING

The researcher investigated the predicted and measured performance of various reciprocating aircraft engines using alcohol fuels. The cost of aviation grade spark ignition fuels now makes alcohol substitution potentially

attractive. In this project, analysis and engine testing with alcohol under various conditions was studied, with an emphasis on the compatibility of alternate aviation gasolines such as alcohol.

Analysis of Reconstituted Charpy V-Notch Specimens of High Yield Strength Steels

RESEARCHER: MIDSHIPMAN 1/C TODD D. OLSON
ADVISER: PROFESSOR DENNIS F. HASSON

An analysis of reconstituted Charpy V-notch (RCVN) specimens of HY80 steels was performed. It was found that electron beam welded (EB weld) RCVN specimens and press fit-seal welded (PF weld) RCVN specimens generally followed the load-time response of the corresponding original specimens. Simultaneous plotting of the load-time curves and energy-time curves for an original and its reconstituted specimens showed that the EB weld-specimens provided the closest repetitive

response to the original test while the PF weld-specimens deviated at greater levels. In the transition region and on the upper shelf of the ductile-to-brittle transition (DBT) curve, the behavior of the EB weld-specimens and the original specimens was nearly indistinguishable. PF weld-specimens tended to overestimate the toughness of the HY80. SEM stereo pair fractography showed repetitious surface features between original and reconstituted specimens.

Dynamic Fracture Toughness of High Yield Steels on the Upper Shelf

RESEARCHER: MIDSHIPMAN 1/C TODD D. OLSON
ADVISER: PROFESSOR DENNIS F. HASSON

An analysis of the dynamic fracture toughness of high yield steels on the upper shelf was performed. It was found that the addition of side-grooves in the precracked Charpy V-notch (SG PCVN) specimens appreciably lessened the time to reach maximum load. Also SG PCVN specimens yielded valid dynamic fracture toughness results as prescribed by proposed ASTM procedures. Contrary to expectations, increasing the strain rate in HY80 did not increase the dynamic fracture toughness on the upper shelf. In other words, slow rate dynamic fracture toughness tests yielded unconservative upper shelf J_{II}

values for HY80 steel. Slow rate dynamic fracture toughness tests produced conservative upper shelf J_{II} values for HY100 steel. Dynamic yield strength increased with an increase in strain rate and a decrease in temperature for both the HY80 and HY100 steels. On the average, 15.7 percent of the fracture energy was due to crack initiation in the HY80, and 16.6 percent of the fracture energy was due to crack initiation in the HY100. SEM stereo pair fractography showed microvoid coalescence in the crack extension area of both HY80 and HY100 representative specimens.

Computer Animation of CAM Mechanism

RESEARCHER: MIDSHIPMAN 1/C PETER D. STAMPS
ADVISER: LIEUTENANT DOUGLAS J. McVICAR, CEC, USN

The animation of the motion of a CAM is a process which lends itself to computer graphic application. This project, in the form of a computer program, processes a data file containing CAM-profile information

and draws the CAM and its associated displacement, velocity, and acceleration curves as a function of crank angle. The program runs on NATS using a TEK 4014 terminal.

Wavetek 5830A Analyzer – Tektronix 4052 Interface

RESEARCHER: MIDSHIPMAN 1/C PETER D. STAMPS
ADVISER: PROFESSOR J. PAUL ULDRICK

The project developed the necessary software to perform the following functions: (a) allow remote control of the wavetek analyzer from the Tektronix terminal; (b) graph the various analyzer display functions on the Tektronix terminal for presentation and hardcopy; (c) store sample

time series and frequency dynamic measurement data on the Tektronix 4907 file manager for future analysis; and (d) perform computer-controlled automatic accelerometer calibration employing the wavetek analyzer, Tektronix terminal, and B&K accelerometer calibration shaker.

Toughness and Fracture of Glass

RESEARCHER: MIDSHIPMAN 1/C JAMES P. WINKLER
ADVISER: PROFESSOR DENNIS F. HASSON

The toughness and fracture behavior of untreated soda-lime silica glass plate were examined. The behavior of the glass under drop penetrator impact type of testing, similar to that reported by Howard in 1944, was performed. The results, which agreed with Howard's, showed that the specimen edge method of constraint affects the impact energy absorption and fracture pattern results. In the present study, an instrumented Charpy impact

tester was utilized to provide more detailed load and energy versus time information than previously reported. The results were repeatable, but required more analysis and variation in notch size and shape. Scanning electron microscope fractography was also performed. It showed that the size of the mirror is determined by the size of the initial flaw. Also a large mirror is associated with low strength and toughness.

Publications

FLEISCHMANN, Shirley T., Assistant Professor, co-author, "**Mean Streamwise Spacing of Organized Structures in Transitional and Developed Bounded Turbulent Flows,**" *AIAA Journal*, 22, (1984), 766.

The mean periods, $\bar{T}$, of passage of organized structures detected by a wide variety of criteria in all regions of turbulent boundary layers, pipes, and channel flows over a range of two Reynolds number decades are compared to that of the transition "spike." When scaled with the local mean velocities, U , and the shear layer thicknesses, δ , to form a nondimensional streamwise spacing, they fall within a fairly narrow range of $1.5 \leq TU/\delta \leq 3.5$. The streamwise spacing shows little variation across most of the shear layer for any particular data set.

GRANGER, Robert A., Professor, "**Dynamic Tests and Model Simulation of a Nose-Towed Underwater Vehicle,**" *Computational Methods of Experimental Measurements*, Proceedings of the Second International Conference, Eds. C. A. Brebbia and G. A. Keranidas. Southampton, England: A Computational Mechanics Center Publication, 1984, pp. 1-55 - 1-66.

Simulation of underwater environmental situations for towed sensing vehicles is of increased interest to the marine engineer and to the U.S. Navy. Towed submersibles with sensing devices are used to detect underwater fixed and moving objects as well as to provide information on the properties of the sea.

The U.S. Naval Academy conducted a hydrodynamic experimental analysis of a unique towed-sensing vehicle. This vehicle conformed to a specific set of requirements for stable operation through a range of towed velocities and cable lengths. A towing apparatus had to be designed to tow the model at a fixed depth, along with a means to vary the length of towing cable. Accurate simulation of prototype motions required designing experimental apparatus to impose vertical and horizontal oscillatory motions of various amplitudes and frequencies to the towed vehicle. This would help simulate actual sea-state conditions found to exist for the prototype towed vehicle. The object was to

study the principal variables necessary for hydrodynamic stability for an underwater vehicle being towed by a ship or aircraft.

All components were first analyzed theoretically. An optimum geometry was sought for both structural integrity and for a specific hydrodynamic performance that duplicated as closely as possible conditions that existed for a towed vehicle at sea. Much of the theoretical analysis was performed on a Honeywell 635 Computer main frame. Supplementing this was a CADIG (Computer-Aided Design and Interactive Graphics). As the name implies, this resource specializes in graphic capabilities utilizing "stand alone" equipment, including digitizing tablets, three-dimensional displays on a CRT screen, and a numerically controlled milling machine. The final theoretical configuration was programmed via the CADIG facility, the output checked on the 3-D screen, and then fed into the milling machine. Thus each component was machined under tight control resulting in an experimental apparatus that duplicated the theoretical model.

GRANGER, Robert A., Professor, *Fluid Mechanics*. New York: Holt, Rinehart and Winston, 1985.

The text covers ideal and real fluids in internal and external flows using fixed and moving frames of reference. Cartesian, cylindrical, and intrinsic coordinate systems are used, as well as vector and tensor notation. Some new material not covered in other fluid mechanics textbooks includes real vortex flows, detailed flow visualizations, new forms of differential linear momentum, certain energy loss expressions, free-surface effects, Prandtl's boundary layer equations, models in turbulent flow, boundary layer transition, and certain topics in drag.

The perspective taken in this text is that fluid mechanics is an applied mathematics course. Without this perspective, fluid mechanics can become masked in mystery for the student, with results that seem more like magic than mathematics. Fluid mechanics, however, should not be reduced to a basic form that becomes a disservice in the teaching of outstanding engineers. This text will challenge the best and be a salvation to the weakest of students.

HASSON, Dennis F., Professor, co-author, **"Fracture Toughness of HY130 Steel Weld Metals,"** *Welding Journal*, 63 (1984), 197-s - 202-s.

The fracture toughness of HY130 steel weld metals and base metal was investigated using 1T compact tensile tests. The purpose of the study was to determine the effect of various welding procedures on the fracture toughness of as-deposited HY130 steel weld metals compared to rolled base metal.

Mechanical property, Charpy V-notch energy, hardness and J_k computer interactive fracture toughness tests, along with metallography and scanning electron microscopy, were performed on gas metal arc (GMA) welds and gas tungsten arc (GTA) welds and also on rolled base metal.

The HY130 weld metals deposited by GMA welds had lower crack initiation energy, J_k , values and tearing resistance, T , than the HY130 steel base metal. This was attributed primarily to the oxygen content of the weld metals. The microstructure of the weld metals deposited by GMA welds also had an effect on toughness. The HY130 weld metals deposited by GTA welds had superior fracture toughness compared to HY130 base metal. Low heat input GTA welding conditions produced the highest fracture resistance. This was attributed to the repeated reheating, refining and tempering of the weld metal microstructure during the fabrication of these welds.

HASSON, Dennis F., Professor, co-author, **"The Effect of Notch Acuity on the Fracture Toughness of Silicon Carbide/Aluminum Metal Matrix Composites,"** Naval Research Laboratory, Memorandum Report 5417, February 1985.

Discontinuous silicon carbide/aluminum alloy (SiC/Al) metal matrix composites (MMC's) have exhibited improved physical and mechanical properties as compared to the properties of the wrought matrix alloy. These improved properties include high specific modulus, high creep strength, high fatigue resistance, low thermal expansion, and good thermal stability. The SiC/Al composites can be worked using standard metallurgical processing, and hence they are inexpensive to produce compared to other MMC systems. The tensile ductility and fracture properties of the composite

reported to date, however, are less than those of the wrought alloy. The tensile ductility has been improved by control of process parameters, but relatively little improvement in fracture toughness or notch sensitivity has been achieved.

JAMISON, Russell D., Assistant Professor, co-author, **"Characterization and Analysis of Damage Mechanics in Fatigue of Graphite/Epoxy Laminates,"** Effect of Defects in Composite Materials, ASTM 836, (1984), 21-55.

The mechanisms by which subcritical and critical damage develops in several lamination geometries of T300/5208 and T300/914C graphite/epoxy material during tension-tension fatigue were closely examined. A damage analogue in the form of stiffness reduction was used to provide a framework by which the sequence of damage development could be correlated with mechanical response.

Results of the observed damage development sequence for cross-ply and quasi-isotropic laminates are presented, along with a preliminary association between this damage and the characteristic stiffness reduction curves for these geometries. The geometries used were characterized by distinct, predominant, early subcritical damage conditions. This secondary and subsequent damage development was examined in relation to known, predictable beginning state. Of particular emphasis in each case was the role of this developing damage state in the fracture of fibers in the 0-deg plies.

A number of significant damage conditions, not heretofore reported, were observed: the production of interior delaminations at the 0/90-deg interfaces of [0,90]_n laminates by the gradual growth of longitudinal cracks in the 0-deg plies; the existence of a dense distributed microcrack condition at all distinct interfaces of [0,90 45]_n laminates; the segregation of 0-deg fiber breaks in all laminates into zones coincidental with cracks in the adjacent plies; and, the appearance of shear fracture in 0-deg fibers associated with the passage of longitudinal splits.

Mechanisms for each of these damage conditions are proposed in terms of the micromechanics of the predominant damage condition with which they are associated and the global stress state.

JOYCE, James A., Associate Professor, co-author, "**J Integral Fracture Toughness and Tearing Instability Behavior of ASTM A106 Steel Pipes**," *Pressure Vessel and Piping Series*, Vol. 95, *Circumferential Cracks in Pressure Vessels and Piping*, Vol. II, 1984, pp. 295-307.

An experimental investigation was performed to evaluate the applicability of using J-Integral Tearing Instability Analysis to describe the fracture behavior of 8-inch diameter nuclear grade ASTM A106 steel pipe. Forty-eight inch long pipe sections with circumferential fatigue precracks were loaded in four point bending using a variable compliance test arrangement. Variations of crack length, moment arm length, and machine stiffness were used to control the ductile fracture behavior of the pipes, resulting in either stable or unstable crack extension. Two different J-Integral analyses were used to describe the fracture behavior. In one analysis, the material behavior was modelled by assuming elastic-perfectly plastic behavior, while the second analysis utilized measurements of mechanical response of the loaded structure including hardening performance of the steel. A series of nine fracture tests were performed on the 8-inch diameter pipes with computerized data acquisition of load, deflection and crack length. The crack lengths were measured using elastic compliance, and direct current potential drop techniques simultaneously. These experimental and analytical techniques were used to generate J-resistance curves and T-applied values for all of the tests. The evaluation of the J-Integral tearing instability analysis was performed using J versus T plots of each test. The results of this investigation indicated that J-Integral tearing instability analysis can accurately describe the ductile tearing behavior of 8-inch ASTM A106 steel pipe provided the actual load, displacement, crack length and hardening behavior is available. Additionally, the results indicated that such an analysis with assumed elastic fully plastic behavior appears to produce conservative results.

KEATING, Eugene L., Associate Professor, co-author, "**Measured and Modeled Enhancement of Transition Metal Emissions in the d.c. Plasma Jet**," *Spectrochimica ACTA*, 40B (1985), 593-616.

Enhancement of sensitive transition metal lines by a sodium matrix is measured in a 3-electrode d.c. plasma jet. Spiking with 0.43 M NaCl causes enhancement by factors of 1.85-2.92 in ionic lines and of 1.22-1.99 in atomic lines for eight of the structurally related analyte elements, but suppresses Zn I and ZN II emissions by about 25%. Emission response to NaCl of lines within the same spectrum, or between different spectra of like ionization stage, can be stimulated to 15% and 20-25%, respectively, by approximations linear in energy differences. For ionic lines, these differences are the absolute value of the line excitation potential minus the energy of the ion state most readily pumped by Penning ionization by argon. For atomic lines, it is the difference between emitting state excitation potential and the first ionization potential. Analyses of the experimental data strongly suggest that (1) Na acts mainly to perturb radiative transfer rather than collisional redistribution processes; (2) population pumping of excited analyte states is largely driven by Penning ionization; (3) accelerated radiative cooling due to Na is manifested in a lowering of local kinetic temperature; (4) to a first-order of approximation, ambipolar diffusion, analyte-Na collisions of the second kind, and analyte ground state spin, do not influence emission line enhancement by easily ionized elements (EIE). Approximations are developed for predicting transition metal enhancements by arbitrary Na doping concentrations, and means are sketched for extending the method to other analyte group EIE combinations. Practical implications of the work are noted.

LOPARDO, Vincent J., Professor, **"Comparison of Gas Turbine Engines Using the Exergy Method"** Proceedings of the Association for the Advancement, Modelling and Simulation in Enterprises, 3 (1985).

In this paper, the author analyzes four gas turbine models using the exergy method. Following a brief description of the method, a GTF990 series gas turbine without a regenerator is compared with a similar engine containing a regenerator. The exergy flows, as well as the dissipated exergy, for all of the components are evaluated and compared. The exhaust stream exergy is reduced by approximately 40% and the fuel required is decreased by approximately 17% with the use of a regenerator. However, it is also apparent that the exergy remaining in the exhaust stream is still at too high a value to be discarded.

Two different gas turbine engines, the GTF990 series and the GTF40 series are then compared. Both of the engines are equipped with regenerators of equal effectiveness. The results for these two are quite similar, indicating that at least in this specific case it is quite possible that the important parameter is the regenerator and not the style of the engine. The results of both comparisons are presented in graphical displays of the exergy flow and exergy dissipation in each of the gas turbine components. A comparison is also made with First Law results.

ULDRICK, Paul J., Professor, co-author, **"Use of Recompressed Impulse Response to Identify Sources and Paths of Structure-Borne Noise in Wide Flange I-Beams and Pipes Conveying Fluid,"** *Journal of Sound and Vibrations*, 95 (1984), 439-467.

A procedure is described for identifying sources and paths of structure-borne noise in structures built up from wide flange I-beams, as well as piping systems conveying compressible and incompressible fluid.

The use of impulse response or modified impulse response to estimate time-delays frequently is of little value because the wave propagation is dispersive. With reflections present, it is impossible to distinguish and identify the wide peaks. If one can establish the dispersion law — namely, the relation between frequency and wave number — one can "recompress" the impulse response in a certain sense, with respect to length of paths. The peaks are fairly narrow, and one can identify noise paths. A discussion is given for various dispersion relations, together with theoretical justification and practical implementation. Some experimental results are given.

WU, Chih, Professor, **"Cycle Analysis of a Dry Geothermal Zeotropic Power Plant,"** *The International Journal of Energy Systems*, 4 (1984), 31-33.

A novel Dry Geothermal Zeotropic Power Plant is proposed and analyzed in this paper. Dry Geothermal Fields in which no water is present are an important potential source of Geothermal energy. A heat transfer fluid, water, is injected into the Dry Geothermal Field to tap the thermal energy with a secondary closed vapor power plant. The pressurized injected water in the evaporator and cooling water in the condenser are the non-constant temperature heat source and heat sink for the secondary vapor cycle. A zeotrope, a mixture of two or more fluids which have different boiling points, is proposed to be used as the working fluid for the vapor cycle. Due to the special feature of the zeotrope, the working fluid may have a temperature variation well matched and parallel to that of the surrounding fluid with which the heat transfer takes place during the evaporation and condensation processes. Improvement on the efficiency of the zeotropic vapor cycle is potentially possible. The zeotropic vapor cycle is investigated theoretically, and a greater power production by the geothermal plant is predicted.

WU, Chih, Professor, **"Non-Azeotropic Mixture Energy Conversion,"** *Journal of Energy Conversion and Management*, 25 (June 1985), 199-206.

The thermodynamic performance of an energy conversion device may be improved potentially by using a non-azeotropic mixture in a vapor cycle. A non-azeotropic mixture has a temperature distribution parallel to that of the surrounding fluid with which heat transfer takes place during the evaporation and condensation processes. The non-azeotropic mixture vapor cycle is investigated theoretically in this paper, and energy savings of such an energy conversion cycle is predicted.

WU, Chih, Professor, **"Alternative Energy Conversion Demonstration Laboratory at U.S. Naval Academy,"** *Alternative Energy Sources*, 6 (1985), 573-582.

This paper describes an alternative energy conversion demonstration laboratory which supplements classroom theory in a senior

engineering elective course in energy conversion in the Department of Mechanical Engineering at the U.S. Naval Academy. Oil, nuclear energy, and other conventional sources of power have been the dominant sources for industrial society and the U.S. Navy, and will continue to be so for the foreseeable future. There are other possibilities, however, including wind power, solar power, ocean thermal power and tidal power. A need for alternative sources of energy for the Navy was recognized at the time of the Arab oil embargo in 1973, and an academic program in alternative energy has been developed to help satisfy that need. Specific demonstrations in energy awareness, wind energy, ocean thermal energy, wave energy, solar energy, and chemical energy storage are described in the paper. Some of these devices are unfamiliar to the students. The demonstrations greatly enhance the alternative energy source material. The demonstrations also add immeasurably to the students' interest, as well as illustrate the use of basic principles that the students have learned in other courses.



Presentations

FLEISCHMANN, Shirley T., Assistant Professor, **"How to Handle the Demands of Career & Family - One Point-of-View,"** International Conference of Women in Engineering and Science, Washington, D.C., June 1984.

GRANGER, Robert A., Professor, **"Computational and Experimental Investigations of the Stability of Towed Vehicles,"** Second International Conference on Computational Methods and Experimental Measurements; New York/Southampton, June 1984.

HASSON, Dennis F., Professor, **"Fracture Toughness of Discontinuous SiC/Al Metal Matrix Composites,"** The Metallurgical Society/American Institute of Mining, Metallurgical and Petroleum Engineers, Fall Meeting, Detroit, Michigan, 20 September 1984.

HASSON, Dennis F., Professor, **"Corrosion and Corrosion-Fatigue Behavior of IN625 Weld Surfaced 3.25 Nickel Steel,"** American Society for Metals, International Conference of Nickel-Bare Alloys, Cincinnati, Ohio, 24 October 1984.

HASSON, Dennis F., Professor, **"A Review of Titanium Welding Processes,"** The Metallurgical Society/American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, New York City, 26 February 1985.

JAMISON, Russell D., Assistant Professor, **"The Role of Microdamage in the Tensile Failure of Graphite/Epoxy Laminates,"** International Symposium on Composites: Materials and Engineering, Newark, Delaware, 25 September 1984.

JAMISON, Russell D., Assistant Professor, **"On the Interrelationship between Fiber Fracture and Ply Cracking in Graphite/Epoxy**

Laminates," ASTM Symposium on Composite Materials: Fatigue and Fracture, Dallas, Texas, 25 October 1984.

JAMISON, Russell D., Assistant Professor, **"Composites Research and Development in Europe,"** Applied Physics Laboratory Seminar, Columbia, Maryland, 15 October 1984.

JOYCE, James A., Associate Professor, **"Dynamic J-R Curve Testing of a High Strength Steel Using the Key Curve and Multi-Specimen Techniques,"** Seventeenth National Symposium on Fracture Mechanics, Albany, New York, 7-9 August 1984.

JOYCE, James A., Associate Professor, **"Progress and Problems on Upgrading the ASTM E813 Standard for J_{IC} Testing,"** ASTM E24 Committee Week meeting, Charleston, South Carolina, 17-20 March 1985.

SMITH, Russell A., Professor, **"Use of Computers in Accident Reconstruction,"** Annual Meeting of Transportation Research Board, Washington, D.C., 15 January 1985.

WU, Chih, Professor, **"Recent Development in Engineering Experimental Design and its Potential Application to Electric Appliances and Devices,"** Gulin Electronics and Electric Appliance Research Center, Gulin, China, 1 June 1984.

WU, Chih, Professor, **"Effects of Voids on Contact Heat Conduction Transfer,"** 1984 International Applied Simulation and Modeling Conference, San Francisco, California, 4-6 June 1984.

WU, Chih, Professor, **"Development in Computer-Aided Design and its Potential Application to Transportation Systems,"** Jiaotong University, Beijing, China, 10-12 June 1984.

WU, Chih, Professor, **"Computer Graphics and its Application to Transportation Systems,"** Jiaotong University, Beijing, China, 13 June 1984.

WU, Chih, Professor, **"Computer and Education,"** Harbin Technological University, Harbin, Liaoning, China, 15-16 June 1984.

WU, Chih, Professor, **"Computer Optimization in Railway Vehicle Design,"** Dalian Railway Engineering College, Dalian, Liaoning, China, 19-20 June 1984.

WU, Chih, Professor, **"Experimental Optimization in Railway Vehicle Design,"** Dalian Railway Engineering College, Dalian, Liaoning, China, 21-22 June 1984.

WU, Chih, Professor, **"Computer-Aided Instruction and its Potential Application in China,"** Dalian Railway Engineering College, Dalian, Liaoning, China, 23 June 1984.

WU, Chih, Professor, **"Energy and Railway Engineering,"** Dalian Railway Engineering College, Dalian, Liaoning, China, 24 June 1984.

WU, Chih, Professor, **"A Simulation Model for a Water-To-Water Shipboard Heat Pump,"** 1984 International AMSE Summer Conference, Athens, Greece, 27-29 June 1984.

WU, Chih, Professor, **"Computer-Aided Education in Energy Conversion at the U.S. Navy Academy,"** 1984 Chinese-American Academic and Professional Convention, Los Angeles, California, 29 June - 2 July 1984.

WU, Chih, Professor, **"A Numerical Method for the Forced Responses of Damped Composite Systems,"** International Conference on Numerical Methods for Transient and Coupled Problems, Venice, Italy, 9-13 July 1984.

WU, Chih, Professor, **"Computer-Aided Design on Temperature Matching Heat Exchangers,"** International Symposium on Design and Synthesis, Tokyo, Japan, 11-13 July 1984.

WU, Chih, Professor, **"Potential BioMedical Engineering Applications of Direct Energy Conversion Devices,"** Third Southern BioMedical Engineering Conference, Birmingham, Alabama, 15-16 October 1984.

WU, Chih, Professor, **"Analysis of Refrigerant Mixtures for Shipboard Applications,"** 21st Annual Meeting of the Society of Engineering Science, Blacksburg, Virginia, 15-17 October 1984.

WU, Chih, Professor, **"Choice of Working Fluids for Mixed-Refrigerants Low Temperature Energy Conversion Applications,"** 21st Annual Meeting of the Society of Engineering Science, Blacksburg, Virginia, 15-17 October 1984.

WU, Chih, Professor, **"Improving the Energy Effectiveness of Tall Building Cooling and Heating Systems by the Application of Zeotropic Refrigerant Mixtures,"** Third International Conference on Tall Buildings, Hong Kong, 10-15 December 1984.

WU, Chih, Professor, **"Optimization on the Structure of a Forest Railway Vehicle,"** Sixteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, Pennsylvania, 25-26 April 1985.

WU, Chih, Professor, **"Probabilistic Modeling of Boundary Lubrication,"** Symposia on Statistics, Ontario, Canada, 27-31 May 1985.

WU, Chih, Professor, **"New Steam Locomotives: A Potential Solution to Railroad Power Modernization in China,"** International Energy, Power and Environmental Systems Conference, Santa Barbara, California, 29-31 May 1985.



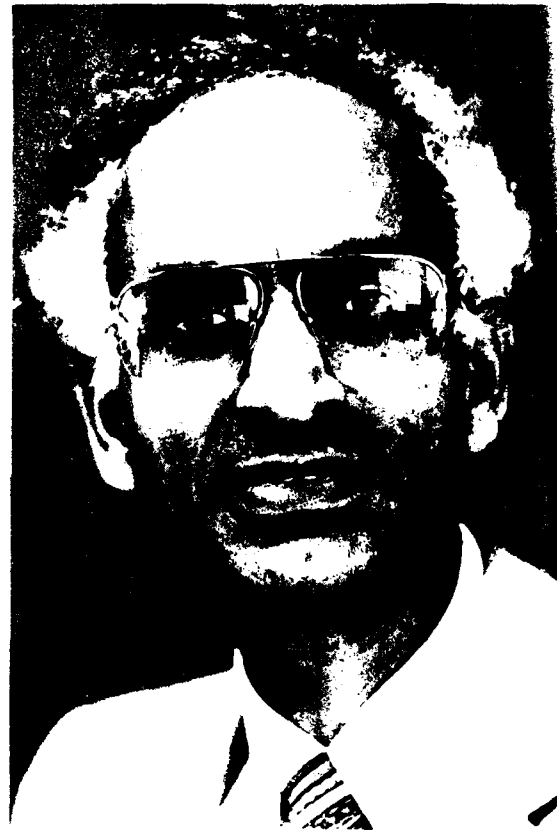
Naval Systems Engineering

PROFESSOR RAMESWAR BHATTACHARYYA
CHAIRMAN

The Naval Systems Engineering Department conducted scholarly research and professional development works most vigorously in marine engineering and naval architecture, as well as in ocean engineering during the academic year 1984-1985. Faculty members and midshipmen took part in numerous sponsored and non-sponsored research activities, including the Trident Scholar program. A number of faculty members participated in non-funded research and directed senior level midshipmen in their research activities, utilizing the excellent laboratory and computer facilities available to this Department.

The Department continued to participate actively in professional society meetings and conferences, both nationally and internationally. Research results have been published in journals and technical publications, or presented at national and international seminars. The outcome of the Department's deep involvement in research by the civilian and military faculty members is reflected in the academic environment in the classroom for professional and major courses.

The research themes of the Department and faculty were varied. They include heat transfer analysis, neutron analysis and measurement technique, thermochemical hydrogen production using solar energy, biomass gasification technology, resistance and seakeeping investigations for ships, advanced marine vehicles, deep and shallow water resistance studies, reliability analysis of ship structures in a seaway, stochastic analysis of ships' behavior emphasizing the time-domain analysis, computer-aided design and manufacturing of propellers, wave forces on vertical cylinders, generation of complex periodic irregular wave, linear programs for dredging management wave energy conversion, motion of hinged barges in long-crested seas, analytical



methods to maximize the driver performance and engineering aspects of life support equipment.

Research funding was made available from many sources including departmental operating funds and contracts and grants from various organizations such as the Naval Academy Research Council, the Naval Sea Systems Command, the U.S. Coast Guard, the Office of Naval Research, the Naval Facilities and Engineering Command, and the Naval Civil Engineering Laboratory.

Sponsored Research

Heat Transfer Analysis of a Heat Barrier Piston Engine

RESEARCHER: LIEUTENANT COMMANDER DAVID A. BLANK, USN

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The primary objective of this analysis is to determine numerically the temperature distribution and heat transfer rate throughout the piston cap and cylinder walls of a "Heat Barrier Piston Engine" operating the engine with hypergolic combustion. Included in the analysis is the numerical determination of the Flow Field within the engine.

The method of investigation involves the modeling of the species concentration equations, the energy equation including combustion, the momentum equations, the turbulence energy and

the turbulence dissipation equations which apply to the combustion of a fuel air mixture inside a diesel engine with a heat barrier in the piston. These equations are solved simultaneously at approximately 400 locations within the engine for various time steps. The temperature data are displayed on the CADIG IKONAS display for various piston positions, and a color movie of heat flow through the engine with time is generated. The model is complete, the computer code with graphics support is finished, and data are being collected.

Resistance and Seakeeping Data Base for U.S. Coast Guard Cutters

RESEARCHER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

SPONSOR: UNITED STATES COAST GUARD

This project is an experimental study of resistance and seakeeping characteristics of existing Coast Guard hull forms. Resistance characteristics are determined as a function of displacement and trim. Seakeeping

characteristics are determined in regular head and following seas. The resulting data base is used in operations research studies of resource allocation. Testing of six different hull forms will continue through FY-86.

Medium Endurance Cutter Seakeeping Evaluation

RESEARCHER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

SPONSOR: UNITED STATES COAST GUARD

This is an experimental investigation of deck wetness for the USCG Famous Cutters Class. The investigation has verified the reported wetness problem to be one of spray vs. deck

submersion. Current experiments are concerned with location of a spray deflector to minimize wetness. The investigation will be completed in FY85.

Capsize Research Program

RESEARCHER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

SPONSOR: UNITED STATES COAST GUARD

This is a basic research program to investigate the mechanism of capsizing. The breaking wave generation capability developed in the Hydromechanics Laboratory is utilized to evaluate statistically the capsize resistance of a systematic series of two-dimensional hull forms.

The long-range goals of this program are: (1) an analytic description of breaking waves, (2) an understanding of the relationship of basic hull design parameters to capsize resistance, and (3) an analytical means of evaluating capsize resistance of propelling ship designs.

High Speed Instability of Planing Craft

RESEARCHER: ASSOCIATE PROFESSOR HOWARD A. CHATTERTON

SPONSOR: NAVAL SEA SYSTEMS COMMAND AND UNITED STATES COAST GUARD

Two high-speed small craft of similar design have been built for the Navy and Coast Guard. Both exhibit a directional instability at high speed which restricts the operational usefulness of the craft. A program

of experimental investigations has been devised with two objectives: (1) to verify the suspected source of instability for one craft, and (2) to provide a parametric data base for future design.

The Resistance of a Systematic Series of Semiplaning Transom Stern Hulls

RESEARCHER: PROFESSOR ROGER H. COMPTON

SPONSOR: NAVAL SEA SYSTEMS COMMAND

The results of a systematic series of small (5') models of hulls typical of coastal patrol, training, or recreational power boats are studied. Hull form parameters studied include length-to-beam ratio, displacement-length ratio, longitudinal position of the center of gravity and section shape (hard chine or round bilge). The effects of these parameters on the calm water resistance and running attitude (sinkage and trim) over a range of speeds corresponding to waterline length Froude numbers from 0.10 to 0.60

were investigated in the 120' towing tank at the Naval Academy Hydromechanics Laboratory.

The experimental results as well as cross-faired and non-dimensionalized presentations of the still water resistance trends found are analyzed. Comparisons with other resistance prediction methods for hulls of the subject type are made. An example of the application of the resistance prediction to the new 108' yard patrol craft (YP) being acquired by the Naval Academy is included.

Wave Forces on Vertical Cylinders

RESEARCHER: PROFESSOR THOMAS H. DAWSON

SPONSOR: OFFICE OF NAVAL RESEARCH

End force measurements were made on a fixed vertical cylinder in regular waves using the Naval Academy's 380-ft towing tank. The purpose of

the measurements was to investigate theoretical wave force distribution by comparing predictions with measurements. The work is continuing.

Investigation of Relative Motion Morison Equation

RESEARCHER: PROFESSOR THOMAS H. DAWSON
SPONSOR: NAVAL CIVIL ENGINEERING LABORATORY

Earlier work on the applicability of the Morison equation for predicting wave forces on fixed cylinders is to be extended to the case where the cylinder is in relative motion.

Work will involve experimental measurements (using 380' towing tank) predictions. This work is of interest to the Navy in connection with design of deep-water platforms.

Deep and Shallow Water Resistance Studies

RESEARCHER: ASSOCIATE PROFESSOR BRUCE C. NEHRLING
SPONSOR: UNITED STATES COAST GUARD

As part of an ongoing Coast Guard-sponsored shallow water resistance program, the powering requirements of a proposed river pushboat and a newly constructed barge were determined experimentally. A towing tank model of the pushboat was built from hull forms lines developed as part of this project. The model was towed by itself and also while rigidly

connected to an existing model of a new barge having a sharply raked bow and notched stern. Still water EHP tests of both deep and shallow water were conducted in the Naval Academy's 120' towing tank. These tests provided a clear prediction of the pushboat's performance both by itself and while being operated as part of an integrated tug-barge unit.

14 MeV Neutron Dose Comparison Studies

RESEARCHER: PROFESSORS MARTIN E. NELSON AND PETER F. WIGGINS
SPONSOR: NAVAL SURFACE WEAPONS CENTER

The objective of this research effort was to compare the dose obtained from 14 MeV neutrons by several methods. The USNA neutron generator was used as the 14 MeV neutron source. The basis of all comparisons involved the AN-PDR 70, a neutron remmeter, which is currently being used by the Navy to measure neutron dose. The neutron dose as determined by the AN-DPR 70 was compared to dose requirements using a

NE-213 detector, neutron-activated copper foils, and thermoluminescence detector (TLD). The TLD response was measured in three different positions: posted, off body, and in a body area monitor. The results to date indicate a lower dose response of the ANTO compared to the dose determined by measurements with the copper foils and the NE-213 detector. The dose measurements from the TLD are currently being evaluated.

Submersible Thermo-Chemical Engines

RESEARCHER: ASSISTANT PROFESSOR KENNETH L. TUTTLE
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The objective of this project is to review and edit extant information on submersible thermo-chemical engines and reactants. Steps in the procedure include: (1) a review of technical reports and references on the subject;

(2) tabulation of the physical and chemical combustion properties and operating characteristics; and (3) a comprehensive report of the results in a format suitable for inclusion as an appendix to a technical report.

Reliability Analysis of Ship Structures in a Seaway

RESEARCHER: ASSISTANT PROFESSOR GREGORY J. WHITE

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The ever-increasing use of high-strength materials and advanced technologies in surface ship structure design requires a very careful and systematic analysis to insure that levels of safety are maintained. Due to the uncertainties involved with future loading conditions, material properties, quality of workmanship in construction, and the limitations in numerical methods of analysis, the absolute safety of a structure cannot be established.

Structural reliability has its roots in the fields of civil and aerospace engineering and has made great strides forward in the last decade. Many methods have been proposed

to evaluate the risk of structural failure. These methods include: first order second moment (FOSM), advanced second moment (ASM), and Monte Carlo simulation using both conditional expectation and antithetic variates techniques for variance reduction. All of these methods consider the type of problem, the various parameters involved, and the uncertainties associated with these parameters. In estimating the risk, the uncertainties are modeled as random variables with mean values, variance, and probability density and distribution functions. Each method uses this information in a different manner, involving some assumptions and limitations.

Stochastic Analysis of Ships' Behavior on the Ocean Emphasizing the Time Domain Analysis

RESEARCHER: VISITING RESEARCH PROFESSOR YASUFUMI YAMANOUCHI

SPONSOR: NAVAL SEA SYSTEMS COMMAND

The behavior of marine vehicles and structures in the ocean environment is most adequately treated as a stochastic process. The behavior of marine vehicles and structures

is being reviewed and studied. The possibility of expanding this technique into non-linear problems will also be considered, together with proposals for future studies.

Optimization of Bow-Bulb Forms for Resistance and Seakeeping Characteristics: A Comparison of Existing Computer Software Predictions with Experimental Results

RESEARCHER: MIDSHIPMAN 1/C JEFFERY W. HOYLE

SPONSOR: TRIDENT SCHOLAR PROGRAM

ADVISERS: PROFESSOR BRUCE JOHNSON AND ASSOCIATE PROFESSOR BRUCE C. NEHRING

The favorable effect of a bulbous bow in reducing the wavemaking resistance of a surface ship is well known. Most of the research into bulb effects, however, has dealt with the resistance and powering aspects of commercial ships. Before bulbous bows can be adopted into general use for naval frigates and destroyers, extensive research into their seakeeping qualities as well as high speed powering characteristics is necessary.

The purpose of this project was to investigate the optimization of a bow bulb for resistance and seakeeping characteristics of a naval frigate. Several alternative bulbs were designed for the FFG7 using a bulbous bow

design methodology developed by the Naval Sea Systems Command. The Navy Standard Ship Motion Computer Program was used to see if seakeeping performance differences could be detected between the connecting designs. The bulbs' resistance characteristics were studied using the XYZ Free Surface Program. The most favorable analytical results from both a powering and seakeeping point of view were then model-tested using an existing FFG7 model to verify the analysis. Emphasis was placed on comparison of current computer software results with the experimental response of the appended model.



Research Course Projects

Neutron Attenuation Coefficient Measurements Using a NE-213 Detector

RESEARCHER: MIDSHIPMAN 1/C HAROLD E. BARR

ADVISER: PROFESSOR MARTIN E. NELSON

The purpose of this research was to determine the neutron attenuation coefficients for 14 MeV neutrons using a NE-213 scintillator. Using the 14 MeV neutron generator as a source, gamma and neutron data were collected and analyzed using a three-dimensional matrix.

From this data, neutron energy spectra were obtained, and by comparing the spectra with and without shielding materials, the attenuation coefficients of such materials as iron, lead, aluminum, and polyethylene were determined.

Breaking Waves on a Fixed Pile

RESEARCHER: MIDSHIPMAN 1/C TIMM P. BECHTER

ADVISER: PROFESSOR THOMAS H. DAWSON

The objective of this project was to determine the force of a breaking wave on a pile, compared to the force of a non-breaking wave. This project was performed in the 380' towing tank in the Hydromechanics Laboratory. The project used an eight-foot solid aluminum (2-inch diameter) pile cantilevered from the towing tank carriage

by two force blocks. The X and Z forces were measured for breaking and non-breaking waves of varying height and frequency. Wave profiles were measured by either a single probe at the pile or an 8-probe array, in order to define the wave's shape at impact. Data analysis was performed with the Hydro Lab Computer.

Oscillating Water Column/Wave Motion

RESEARCHER: MIDSHIPMAN 1/C JOSEPH C. CANVIN

ADVISER: PROFESSOR MICHAEL E. MCCORMICK

An experiment designed to observe and measure the internal waves of an oscillating water column was conducted in the 120-foot wave and towing tank. The effects of water column length were determined by studying several values of the ratio of this length

to wavelength. The effect of baffles on internal sloshing motions were also studied. The results of the study were then compared with those theoretically predicted by the theory of Professor Michael E. McCormick.

Analysis of 14 MeV Neutron Energy Spectrum by a NE-213 Liquid Detector

RESEARCHER: MIDSHIPMAN 1/C CHARLES R. MERRITT
ADVISER: PROFESSOR MARTIN E. NELSON

This project used the Naval Academy's 14 MeV Neutron Generator System to determine the neutron attenuation coefficient and dose for various materials. The NE-213 scintillating detector discriminated between neutron and gamma ray rise times, yielding a distinct neutron energy spectrum. The spectrum became input for the unfolding codes' output which permitted dose calculations to be made from neutron fluence as a

function of energy level. This dose level was compared to the dose measured from an A/N PDR-70 Radiac. The materials used included iron, lead, aluminum, polyester, and polyethylene-based slabs to determine shielding coefficients. The long-range goal of this research is to develop a portable spectrometer system capable of producing neutron energy output as well as dose measurements.

Applications of a Personal Computer in Naval Architecture

RESEARCHER: MIDSHIPMAN 1/C JOHN C. NIXON
ADVISER: PROFESSOR ROGER H. COMPTON

The objective of this project was to put together a software package for use by the Naval Architecture student on an IBM-PC or compatible computer. The advantages of a personal computer are that it is more user friendly, it is quicker, and as the number of personal computers in Bancroft Hall increases, it allows student utilization of these programs in his or her own room. A set of three programs written by Professor Compton was taken off the NATS system for conversion and integration into a new software package. The main obstacle of the project was the adaptation of the programs, written in BASIC 6, to GW BASIC for use on the personal computer. For the most part, most of the commands did not need to be changed, though there were those that would not translate, such as function routines (e.g., DEF FNA),

and file commands. The process of converting the programs led to a greater understanding of PC Basic language versus that of the NATS system. The programs were adapted to permit screen only or screen/printer output. The three programs were put together into a package on one disk. A menu and a disk operating system (DOS) were added to the disk to yield a total software package. One simply has to place the disk into the computer and boot it. The user then has the option of selecting a Ship Motions Program, a Ship Hydrostatics Program, an Effective Horsepower Analysis Program, or exiting the package. The program was done on a Zenith 161-52 portable computer, which is compatible with the IBM-PC. Other compatibles such as the COMPAQ may also utilize this software disk.

Wave Energy Conversion Information Gathering

RESEARCHER: MIDSHIPMAN 1/C JAMES M. POLO

ADVISER: PROFESSOR MICHAEL E. MCCORMICK

In preparation for a planned test of the McCormick wave energy turbine, information was gathered from various reports, papers, and books. This information included

performance data on oscillating water columns, turbines, and ancillary equipment. With this information, the test of the McCormick turbine was designed.

The Evaluation of a Hydrogen Engine's Performance in an Artificial Atmosphere

RESEARCHER: MIDSHIPMAN 1/C JEFFREY A. REEVES

ADVISER: ASSISTANT PROFESSOR KENNETH L. TUTTLE

The Navy is currently conducting research into the feasibility of hydrogen-fueled engines for propulsion of the deep submergence vehicle. Obviously, this propulsion system will not operate in normal atmospheric conditions. The intent of this project was to make predictions as to what atmosphere would yield the highest engine efficiency. There were three variables

in the testing procedure: (1) composition of the atmosphere, (2) compression ratio of the engine, and (3) RPM of the engine. The scope of this research included designing and building the systems necessary to convert an existing test engine from air to synthetic air and from conventional hydrocarbons fuels to hydrogen fuel.



Publications

CHATTERTON, Howard A., Associate Professor, **"Evaluation and User's Guide for the Holtrop-Mennen Approximate Power Prediction Method,"** Division of Engineering and Weapons Report EW-27-84, August 1984.

The Holtrop-Mennen Approximate Power Prediction Method was developed by two researchers at the Netherlands Ship Model Basin. It is based upon a statistical analysis of model tests performed at the facility. The method was coded for the Naval Academy Time Sharing Computer System, and results compared with model and full-scale trial data for a range of surface ship hull forms. The validity of the prediction is sensitive to hull shape. The prediction is more accurate for merchant ships than for naval hull forms. The wetted surface predictor within the program proved to be exceptionally accurate for all hull forms.

CHATTERTON, Howard A., Associate Professor, **"Summary of Motions Tests Using 1.7 Meter Models of Single and Twin Strut SWATH Vessels,"** Division of Engineering and Weapons Report EW-29-84, November 1984.

Two 1.7 meter SWATH models were constructed by engineers of the Naval Sea Systems Command to compare the maneuvering characteristics of single and twin-strut designs. An attempt to use these same models for an experimental study of seakeeping characteristics proved unsuccessful. The models were too small to avoid significant effects from instrumentation. Three instrumentation schemes devised to minimize interferences are described and evaluated.

DAWSON, Thomas H., Professor, **"In-Line Forces on Fixed Vertical Cylinders in Deep Water Waves,"** *ASCE Journal of Energy Resources*, 107 (March 1985), 18-24.

Laboratory measurements of the total in-line forces on a fixed vertical 2-in. diameter cylinder in deep-water regular and random waves are given and compared with heights ranging from 2 to 22 in. and frequencies

ranging from 0.4 to 0.9 Hz that the Morison equation, with Stokes wave theory and constant drag and inertia coefficients of 1.2 and 1.8, respectively, provides good agreement with the measured maximum wave forces. The force variation over the entire wave cycle is also well represented. The linearized Morison equation, with linear wave theory and the same coefficients, likewise provides close agreement with the measured wave forces for irregular random waves having approximate Bretschneider spectra and significant wave heights from 5 to 14 inches. The success of the constant-coefficient approximation is attributed to a decreased dependence of the coefficients on dimensionless flow parameters as a result of the curricular particle motions and large kinematic gradients of the deep water waves.

JOHNSON, Bruce, Professor, John DALZELL, Visiting Research Professor, and Louise WALLENDORF, Ocean Engineer (Hydromechanics Laboratory), **"On the Generation of Complex Periodic Irregular Waves,"** *Proceedings of the Seventeenth International Towing Tank Conference*, Gothenburg, Sweden, September 1984.

Several problems in the generation of periodic irregular waves remain unsolved. Although transfer functions obtained by generating independent regular waves is a reasonably smooth curve, the transfer function obtained while converging on a specified irregular wave spectrum frequently appears to be highly non-linear, with large deviations from the regular wave transfer function. Recent unpublished studies by the authors have shown the wavemaker transfer function to vary with the location of the wave probe in the tank and with the randomization "seed" used in randomizing the phases of the various harmonics. This observation tends to support the concept that higher harmonics are carried by the longer wave components at higher than normal phase velocities. Thus a given harmonic generated by the wavemaker can have its frequency "shifted" as it travels down the tank, and this may explain the shift in the spectral content of the waves as they progress down the bank.

LINDLER, Keith W., Assistant Professor, co-author, **"Second Law Analysis of Solar Absorption Cooling Cycles and Systems,"** *ASME Journal of Solar Energy Engineering*, 106 (August 1984), 291-298.

Solar-powered absorption cooling cycles and systems are analyzed via the Second Law of Thermodynamics. Irreversibility is used as a figure of merit for components and cycles. The irreversibility of individual components is determined for several solar-powered absorption cycles and systems. The understanding of the causes of these irreversibilities pinpoints the areas of possible cycle and system improvements.

MAYER, Robert H., Jr., Assistant Professor, **"Linear Programs for Dredging Management Decisions,"** *Dredging and Dredge Material Disposal: Proceedings of the Conference, Dredging '84*, ASCE, New York City, 1984, pp. 1063-1071.

Recurrent economic concerns facing decision makers in the dredging industry are considered. Problems related to contract bidding, project planning, and resource utilization are formulated as linear programs. Cost-effective solutions by automated computation are easily and inexpensively obtained.

MAYER, Robert H., Jr., Assistant Professor, co-author, **"Uses of LP: An Aggregate Blending Example,"** *Applications of Small Computers in Construction*, ed. W. C. Moore, ASCE, New York City, 1984, pp. 8-13.

The use of well-known linear programs, heretofore largely confined to limited mainframe usage for the management of engineered construction, is explored using a well-known aggregate blending example.

McCORMICK, Michael E., Professor, **"Research Needs in Wave Energy Conversion,"** Report, Wave Power Executive Committee, ASCE, February 1985.

A summary of recent and future research efforts in wave energy conversion is presented. These efforts are four of the nine generic devices known. The primary areas are waves focusing added-mass and radiation damping effects, air turbines, and oscillating water column capture chamber geometry.

McCORMICK, Michael E., Professor, **"A Theoretical and Experimental Study of the Motions of Hinged-Barges in Long Crested Seas,"** Division of Engineering and Weapons Report EW-1-85, February 1985.

The normal mode method of solution of structural dynamics problems requires proportionality between the damping matrix and either the inertial matrix or the restoring matrix. With this proportionality, the necessary orthogonality condition is satisfied. In hydromechanical situations, the proportionality of the matrices does not exist, since components of both the damping matrix (radiation damping) and the inertial matrix (added-mass) are frequency dependent. Hence, the motion analyses in these situations require either limiting approximations for closed-form solutions or extensive numerical solutions.

In this study, a method of analysis of the coupled motions of hinged-barges in long-crested seas is presented. The analysis is a normal mode type which does not require proportionality of the damping matrix with either the inertial matrix or the restoring matrix. In the analysis of a system of N barges the $N + 1$ second-order equations of motion are transformed into $2(N + 1)$ first-order equations.

This method of analysis is applied to a two-barge McCabe Wave Pump system operating in both deep water regular waves and random waves. Results of the analysis are then compared to experimental results obtained in a wave tank. This shows that the McCabe Wave Pump system can effectively be used as a pump-storage system. Because of the good agreement with the experimental results, confidence in the theory is established.

NEHRLING, Bruce C., Associate Professor, co-author, **"Powering Experiments in Deep and Shallow Water for a USCG Tug-Barge Combination,"** Division of Engineering and Weapons Report EW-4-85, March 1985.

A series of resistance experiments were conducted at the United States Naval Academy's Hydromechanics Laboratory on a model of a proposed United States Coast Guard pushboat. Additional experiments were conducted with this pushboat rigidly connected to a model of an existing barge having a sharply raked bow and a notched stern. Calm water resistance experiments were conducted in deep and shallow water over a fixed bottom. Plotted results clearly show the influence that both ship speed and water depth have on a vessel's powering requirements. These results also serve to compare the pushboat's relatively poor solo performance with that of the integrated tug-barge unit.

NEHRLING, Bruce C., Associate Professor, **"Powering Experiments in Deep and Shallow Water for a Modified USCG 160' WLIC,"** Division of Engineering and Weapons Report EW-25-84, October 1984.

A series of shallow water resistance experiments were conducted at the Naval Academy's Hydromechanics Laboratory. The lines of an existing United States Coast Guard 160' WLIC (Aids to Navigation Vessel) were modified by replacing the tunnel stern with a paddle-wheel stern. The bow of the vessel was not changed. Calm water resistance experiments were conducted in both deep and shallow water over a fixed bottom. Plotted results clearly show the notable influence that both ship speed and depth have on a vessel's powering requirements.

NELSON, Martin E., Professor, and Clyde C. RICHARD, Associate Professor, **"Predicting the Future Equivalent Availability of a Utility Powerplant following Conversion to Coal Firing,"** *Proceedings of Twelfth Inter-Ram Conference*, April 1985, pp. 418-422.

Recently several electric utilities have made decisions to convert some of their oil-burning units to coal-firing. In one recent case, a Public Utility Commission decided to establish a target equivalent availability factor from which the utility would be rewarded or penalized, depending on the future performance of the unit. This paper describes the techniques used to establish the target availability for the unit's performance after its conversion.

NELSON, Martin E. and Peter F. WIGGINS, Professors, **"Neutron Measurement and Analysis Technique Using a NE-213 Type Detector,"** *Transactions of American Nuclear Society*, (November 1984), 386-387.

Neutron measurements using a NE-213 detector have been widely performed in the nuclear industry. The Naval Academy, with the support of Naval Surface Weapons Center, has developed a new approach to obtain neutron measurements from a NE-213 detector. The techniques developed were necessary to meet the project objectives, which include: (1) measuring linear attenuation coefficient for new types of materials; and (2) verifying adequacy of the AN-PDR 70 neutron rem meter response to high energy neutrons.

The results obtained demonstrated positively that three-dimensional computer graphics enhance data analysis obtained from a NE-213 type detector and improve the resultant measurement of neutron energy spectrums, neutron linear attenuation coefficients, and neutron dose.

NUCKOLS, Marshall L., Assistant Professor, co-author, **"The Use of Analytical Methods to Maximize the Performance of Divers' Breathing Apparatus,"** *Proceedings of Ocean 84*, 10-13 September 1984. Marine Technology Society, Washington, D.C., pp. 527-531.

The use of computer simulation in the design, development, and testing of complex military hardware systems has become increasingly widespread throughout the research and development community. A breathing system simulator for diver life-support equipment has been developed which makes possible the modular "construction" of any conceivable breathing gas system from a bank of computer memory-resident components. This paper discusses the application of this analytical tool to optimize the conceptual design of the advanced diver underwater breathing apparatus. Design and environmental parameters are evaluated to determine their effects on the overall system performance. A "best" design is proposed based on this analysis method for a lung-powered breathing apparatus.

TUTTLE, Kenneth L., Assistant Professor, **"Review of Biomass Gasification Technology,"** *Progress in Biomass Conversion*, Vol. 5, Orlando, Florida: Academic Press, 1984, pp. 263-279.

The information available on gasification is large and unwieldy. This approach is to review the best sources of in-depth information available to the author. The references listed

give detailed descriptions of the three currently commercial biomass gasification processes. They are supplemented with brief descriptions and comparisons of the processes. This review identifies those commercially operating biomass gasifiers known to be meeting design specifications successfully. Also it identifies manufacturers whose commercial gasifiers are in startup.

Biomass gasification has broken through several barriers in the past few years. The successes are the results of commendable team efforts. The problems associated with these systems were by no means limited to engineering. As with the emergence of any new technology, the number of obstacles to be overcome was discouragingly large. Furthermore, none of the gasification development teams had large budgets; yet, the technical and economic feasibility of biomass gasification is now being demonstrated in several locations by commercially operating gasifiers.

WHITE, Gregory J., Assistant Professor, co-author, **"Reliability Methods for Ship Structures,"** *Naval Engineering Journal*, 97 (May 1985), 86-96.

This paper evaluates the available reliability methods as to their suitability for estimating the risk of structural failure in ships. The merits and shortcomings of each method are discussed, and each is then used to solve a simple example problem. The most effective method is chosen for more advanced work in this field.

Presentations

CHATTERTON, Howard A., Associate Professor, **"Hydrodynamic Resistance Tests on a Scuba Diver,"** Oceans '84, Washington, D.C., 10 September 1984.

CHATTERTON, Howard A., Associate Professor, **"Small Vessel Capsizing,"** Fishing Vessel Safety Centers Association Conference, Washington, D.C., 26-27 November 1984.

DAWSON, Thomas H., Professor, **"Simple Experiments Illustrating Bell's Deformation-Mode Description of Metal Plasticity,"** Symposium on Current Theories of Plasticity, Norman, Oklahoma, 30 July 1984.

JOHNSON, Bruce, Professor, John DALZELL, Visiting Research Professor, and Louise WALLENDORF, Ocean Engineer, (Hydromechanics Laboratory), **"On the Generation of Complex Periodic Irregular Waves,"** Seventeenth International Towing Tank Conference, Gothenburg, Sweden, 12 September 1984.

LANGAN, Thomas J., Associate Professor, and Rameswar BHATTACHARYA, Professor, **"Collaboration Between the Mathematic and Engineer in Computer-Aided Design and Manufacturing,"** Seattle, Washington, 19 July 1984.

LINDLER, Keith W., Assistant Professor, **"Thermochemical Hydrogen Production Using Solar Energy,"** ASME Solar Energy Division Meeting, Knoxville, Tennessee, 25-28 March 1985.

MAYER, Robert H., Assistant Professor, **"Structural Systems Analysis of Cofferdams,"** 1984 Annual Convention of the American Society of Civil Engineers, San Francisco, California, 5 October 1984.

MAYER, Robert H., Assistant Professor, **"Linear Programs for Dredging Management Decisions,"** Dredging '84: An ASCE Specialty Conference on Dredging, Clearwater, Florida, 14 November 1984.

McCORMICK, Michael E., Professor, **"Motions of Hinged-Raft in Confused Seas,"** Netherlands Ship Model Basin, Wageningen, the Netherlands, December 1984.

NELSON, Martin E. and Peter F. WIGGINS, Professors, **"Neutron Measurement and Analysis Techniques Using NE-213 Type Detector,"** American Nuclear Society Conference, Washington, D.C., November 1984.

NELSON, Martin E., Professor, and Clyde C. RICHARD, Associate Professor, **"Predicting the Future Equivalent Availability of a Utility Powerplant following Conversion to Coal Firing,"** Twelfth Inter-Ram Conference, Baltimore, Maryland, April 1985.

NUCKOLS, Marshall L., Assistant Professor, **"The Use of Analytical Methods to Maximize the Performance of Divers' Breathing Apparatus,"** Oceans '84, Washington, D.C., 10-13 September 1984.

NUCKOLS, Marshall L., Assistant Professor, **"Engineering Aspects of Life Support Equipment,"** University of Rhode Island, North Kingston, Rhode Island, 5 March 1985.

WHITE, Gregory J., Assistant Professor, **"Reliability Methods for Ship Structures,"** ASNE Day, Washington, D.C., 3 May 1985.

YAMANOUCHI, Yasufumi, Visiting Research Professor, **"Applications of AR-Model Fitting,"** Seakeeping Panel, Hydrodynamic Command, Society of Naval Architects and Marine Engineers, New York City, 9 November 1984.

Weapons and Systems Engineering

PROFESSOR CHARLES F. OLSEN
CHAIRMAN

Research within the Weapons and Systems Engineering Department provided the faculty an environment for continued professional growth and the opportunity to remain current in today's rapidly advancing systems technology. Additionally, every graduating Systems Engineering major participated in independent research, design, and development projects which reinforced the essential interface between academics and practical application. The establishment and expansion of a new Robotics course and laboratory, the acquisition of new microcomputers, and the bringing on-line of the new VAX 11/785 Hybrid Computer Laboratory have provided the tools essential for keeping the Weapons and Systems Engineering Department at the forefront of current systems engineering technology.

Every faculty member, both civilian and military, participated in independent research directed at solving current U.S. Navy problems or in support of the midshipmen research programs. Faculty research areas included radiation effect on integrated circuits, control of deep submersible vehicles, magnetoelastic strain analysis, casualty control, and gas turbine engine dynamics.

Again this year, emphasis has been placed on the faculty-midshipmen relationship during the student independent research course. Each midshipman was assigned both an administrative and a technical adviser. These advisers not only provide support of a technical nature but also emphasize planning, schedule development, and oral and written presentations. Thus, the student is introduced to all aspects of the research process. Typical examples of the fifty-five midshipmen research topics included optical scanning systems, robotic systems, energy control systems, tracking



systems, voice recognition systems, and analog and digital control systems.

Funding for research activities has been available from multiple sources including grants and contracts from various federal agencies and naval laboratories as well as funding support from within the Naval Academy. This year's sponsors included the David W. Taylor Naval Ship Research and Development Center and the Naval Research Laboratory.

Sponsored Research

Radiation Effects Testing of Integrated Circuits

RESEARCHER: ASSOCIATE PROFESSOR ROBERT DEMOYER, JR.
SPONSOR: NAVAL RESEARCH LABORATORY

The objective of the research is to determine experimentally transient and permanent effects on integrated circuits due to short bursts of radiation. The particular circuits under study are static random access memories (SRAM) fabricated by a newly developed stacked complementary metal oxide semiconductor (CMOS) technology.

A SRAM tester was designed and constructed for this purpose, based on a single board BASIC microcomputer and auxiliary hardware. This equipment, functionally

equivalent in many respects to commercial testers, can associate logical address with physical cell location, load and test patterns, and perform read-and-write functions in synchronization with radiation bursts produced by a linear accelerator.

Linear accelerator tests are currently being conducted on both $4K \times 1$ bit and $8K \times 8$ bit SRAMs. This is an ongoing effort which will expand to different integrated circuits and will require the continued development of test equipment and procedures.

Real Time Control System for Deep Submersible Vehicles

RESEARCHER: ASSOCIATE PROFESSOR RICHARD V. HOUSKA
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

This work extends research started in FY84 to develop a simple real time control system for multiple hydraulic loads. It includes modeling the system and controller using state variable techniques, as well as developing the interface hardware and control software using an eight-bit microcomputer system.

The overall design objective is to develop a control system which is both efficient and quiet, using digital computer technology. An important requirement is that programming shall be done in a high level computer language such as BASIC, FORTRAN, or PASCAL.

Magnetoelastic Strain Gage

RESEARCHER: PROFESSOR E. EUGENE MITCHELL
SPONSOR: NATIONAL BUREAU OF STANDARDS

Metglas is a metal, in the form of a thin ribbon, that has some of the physical properties of glass. It is amorphous and exhibits magnetostriction and the Villari effect. When the ribbon is annealed, it has an extremely high mechanical-to-magnetic coupling.

The objective of this research is to use

this high coupling property to make a very sensitive strain gage. Strain gages are currently being made that have a gage-factor on the order of 2500. As a point of comparison, a standard resistance gage has a gage-factor of 2. Three patent applications have been filed on the sensor to date.

Study of Reconfiguration for Casualty Control

RESEARCHER: ASSOCIATE PROFESSOR OLAF N. RASK

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

A study was made to determine if it were feasible to have a numerical characterization of the residual fighting ability of a ship under various damage conditions. An example would be the substitution of a search radar or simple receiver for a tracking radar.

An algorithm of uniting the outputs of various atypical sources of information was proposed. This union or sum can be compared with the information from the usual source which in this example is the tracking radar. A report is pending.

Dynamic Modeling of Auxiliary Sizes Regenerative Gas Turbine Engines

RESEARCHER: ASSOCIATE PROFESSOR JERRY W. WATTS

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

One method the Navy is investigating the saving of energy is to put a heat exchanger in the exhaust stack of ship gas turbine auxiliary engines and make the cycle regenerative. The saving is more attractive for free power turbines, but free power auxiliary engines pose control problems. The control problems are being investigated via computer models.

It has been necessary to create or modify the following computer models: (1) Heat exchanger dynamic model; (2) Fuel control adaptation; (3) Free power turbine simple cycle transients; and (4) Free power turbine regenerative cycle transients. Items 1, 2, and 3 are done and item 4 will be completed during the summer of 1985.



Independent Research

Application of Row Reduction Techniques

RESEARCHER: ASSOCIATE PROFESSOR C. GEORGE BROCKUS

Row reduction techniques were applied to the development of several new algorithms of interest in control system analysis and design. The first application was made in the determination of the characteristic polynomial of a matrix. The remaining four applications dealt with the determination of eigenvectors for a matrix in separate

cases. The first case dealt with distinct real eigenvalues. The second considered repeated but uncoupled eigenvalues. The third handled repeated and coupled eigenvalues. The fourth presented an algorithm using purely real algebra to deal with the eigenvectors for conjugate pair complex eigenvalues.

Microcomputer Vision Algorithms

RESEARCHER: ASSOCIATE PROFESSOR KENNETH A. KNOWLES

Numerous digital vision system enhancement and pattern recognition programs were developed in Microsoft MBASIC for use on CP/M based microcomputer systems. The algorithms used were for processing an 80×24 picture element (pixel) digital image

of up to 25 brightness levels per pixel. The processing consisted of noise reduction algorithms; edge enhancement techniques; object location; object size; object orientation; image rotation and translation; and Fourier transformation.



Design Course Projects

Each Systems Engineering major enrolls in ES402, Systems Engineering Design, the capstone course of the major, during his senior year. The student is required to propose, design, construct, test, and evaluate a system, a system in which he has a particular interest. The results of academic year 1984-1985 follow.

Professors Charles F. Olsen and E. Eugene Mitchell and Associate Professors C. George Brockus, Robert DeMoyer, Richard V. Houska, Kenneth A. Knowles, Olaf N. Rask and Jerry W. Watts provided technical and systems design assistance and expertise for the listed design course projects.

Automatic Dock Landing Controller

Midshipman 1/C Jose A. Alas

Adviser: Lieutenant Commander Leslie R. Carter, USN

Hybrid Simulation of a Ballistic Missile

Midshipman 1/C Lewis Alexander

Adviser: Lieutenant Colonel John C. Wiles, USAF

Microprocessor Course Control of a Seagoing Platform

Midshipman 1/C David C. Asjes

Adviser: Commander John A. Van Devender, USN

Digital Voice Recognition

Midshipman 1/C Andrew J. Bellus

Adviser: Commander Robert N. Christianson, USN

Robotic Vision: Handwritten Numeral Recognition

Midshipman 1/C Earl C. Bowers

Adviser: Lieutenant Commander Carl E. Wick, USN

Wireless Stereo Speakers

Midshipman 1/C Eric B. Boyer

Adviser: Lieutenant Commander Allen W. Moored, USN

Torsional Vibration Absorber

Midshipman 1/C Bradley Buswell

Adviser: Captain Michael K. McClanahan, USMC

An Isolated-Word Speech Recognition System

Midshipman 1/C Eric M. Campbell

Adviser: Lieutenant Commander Hugh C. Dawson, USN

Digital Compression Calculator

Midshipman 1/C Scott M. Carlson
Adviser: Lieutenant Commander David J. Hogen, USN

A Self-Navigating Robot

Midshipman 1/C Louis J. Cedrone
Adviser: Lieutenant Commander Carl E. Wick, USN

Ultrasonic Doppler Speed Measurement of a Crew Shell

Midshipman 1/C Kevin D. Clinch
Adviser: Lieutenant Commander Leslie R. Carter, USN

Digital Fly-by-Wire System for Aileron Control in an Aircraft

Midshipman 1/C James C. Clody
Adviser: Lieutenant Commander George T. Vrabel, USN

Microwave Radar for Velocity Sensing

Midshipman 1/C Joseph A. Coen
Adviser: Lieutenant Commander Peter F. Coste, USN

Ultrasonic Blind Spot Scanner

Midshipman 1/C Mark R. Coonrod
Adviser: Lieutenant Commander Michael B. Candalor, USN

Analog Dual-Axis Sun Tracker

Midshipman 1/C Timothy W. Croy
Adviser: Lieutenant Colonel John C. Wiles, USAF

Automatically Controlled Ultrasonic Non-Destructive Testing System for the Early Detection of Fatigue Damage and the Prediction of Remaining Life

Midshipman 1/C Max E. Degorbitz
Adviser: Commander Gene P. Bender, USN

Photoelectric Light Tracker and Passive Range Detector

Midshipman 1/C John V. Denardo
Adviser: Commander Robert N. Christianson, USN

Digital Control of a Water Tank's Level and Temperature

Midshipman 1/C Karl T. Diederich
Adviser: Lieutenant Commander Peter F. Coste, USN

AC Power Line Frequency

Midshipman 1/C Gregory A. Garcia
Adviser: Lieutenant Commander David J. Hogen, USN

A Microprocessor-Controlled LED Scrolling Display System

Midshipman 1/C Caroline Gaulke
Adviser: Commander Robert N. Christianson, USN

Laser Guided Glider

Midshipman 1/C James M. Grimson
Adviser: Lieutenant Commander Gary L. Smith, USN

Utilizing Infrared Detection in a Security Tracking System

Midshipman 1/C Michael F. Hajosy
Adviser: Lieutenant Commander Allen W. Moored, USN

Electric Light Tracker

Midshipman 1/C Mike A. Haumer
Adviser: Lieutenant Commander Peter F. Coste, USN

Speed Control of AC Motors

Midshipman 1/C Laurence Hickey
Adviser: Lieutenant Commander Allen W. Moored, USN

A Microcomputer-to-Robot Infrared Link

Midshipman 1/C Thomas P. Hobbib
Adviser: Lieutenant Commander Gary L. Smith, USN

Microprocessor-Controlled Robotic Fire Fighter

Midshipman 1/C Timothy S. Holt
Adviser: Lieutenant Commander George T. Vrabel, USN

Voice-Controlled Robot

Midshipman 1/C Robert F. Johnson
Adviser: Captain Michael K. McClanahan, USMC

Digital Infrared Voice Communication System

Midshipman 1/C J. K. Kehlenbach
Adviser: Lieutenant Commander Hugh C. Dawson, USN

Seeing Robot

Midshipman 1/C Thomas A. Kerber
Adviser: Commander Gene P. Bender, USN

Depth Control System

Midshipman 1/C Stephen Kintzel
Adviser: Lieutenant Commander David J. Hogen, USN

High-Gain Direction-Finding Antenna System for an FM Receiver

Midshipman 1/C Eric M. Krebs
Adviser: Lieutenant Commander Leslie R. Carter, USN

Digital Voice Recognition

Midshipman 1/C Raymond Legenza
Adviser: Captain Gary Magnuson, USMC

Digitally Controlled Force-Reflecting Teleoperator

Midshipman 1/C Matthew Licholai
Adviser: Lieutenant Commander George T. Vrabel, USN

Electro-Hydraulic Servomotor Identifier

Midshipman 1/C Curtis E. Lyter
Adviser: Lieutenant Commander Leslie R. Carter, USN

A Pseudonoise-Coded Secure Voice System

Midshipman 1/C David A. Magnoni
Adviser: Lieutenant Commander Hugh C. Dawson, USN

An Electronic Compass with Digital Output

Midshipman 1/C Bradley Carl Mai
Adviser: Lieutenant Commander Hugh C. Dawson, USN

A Microcomputer-Based System for Elementary Cryptanalysis

Midshipman 1/C Peter D. Martino
Adviser: Lieutenant Commander George T. Vrabel, USN

Signal Strength Controlled FM Antenna System

Midshipman 1/C James P. McNeilly
Adviser: Lieutenant Colonel John C. Wiles, USAF

Expert System for Control Systems Compensation Analysis

Midshipman 1/C Kurt W. Menke
Adviser: Lieutenant Commander David J. Hogen, USN

Pulse Code Modulation

Midshipman 1/C Stanley C. Newton
Adviser: Captain Gary Magnuson, USMC

Voice Activated Controller

Midshipman 1/C James N. Olmsted
Adviser: Captain Gary Magnuson, USMC

Laser Guided Visual Tracker

Midshipman 1/C Michael L. Petouhoff
Adviser: Lieutenant Commander Carl E. Wick, USN

Automatic Light Tracking System

Midshipman 1/C Peter M. Phelps
Adviser: Lieutenant Commander Peter F. Coste, USN

Automatic Deraileur Control for a Ten-Speed Bicycle

Midshipman 1/C Michael Phillips
Adviser: Lieutenant Commander Gary L. Smith, USN

Micromouse '85

Midshipman 1/C Patrick Piercey
Adviser: Lieutenant Commander Michael B. Candalor, USN

A Digitizer for Visual Input to a MacIntosh Microcomputer

Midshipman 1/C Samuel M. Platt
Adviser: Lieutenant Commander Carl E. Wick, USN

A Digital Micrometer

Midshipman 1/C Jeffrey M. Reese
Adviser: Captain Michael K. McClanahan, USMC

Telephone Operated Remote Control

Midshipman 1/C Patricio Salgado
Adviser: Commander Gene P. Bender, USN

Computer-Controlled Model Railroad

Midshipman 1/C Michael H. Siewertsen
Adviser: Lieutenant Commander Michael B. Candalor, USN

A Thermal-Guided Fire Extinguishing Platform

Midshipman 1/C Peter J. Soltesz
Adviser: Lieutenant Commander Gary L. Smith, USN

Multiple Sense Controller for Home Heating and Cooling

Midshipman 1/C Michael G. Stepaniak
Adviser: Lieutenant Commander Allen W. Moored, USN

Analysis and Compensation of a Passive Solar Tracker

Midshipman 1/C Forest D. Thola
Adviser: Lieutenant Colonel John C. Wiles, USAF

Automatic Steering Device for a Straight-Four

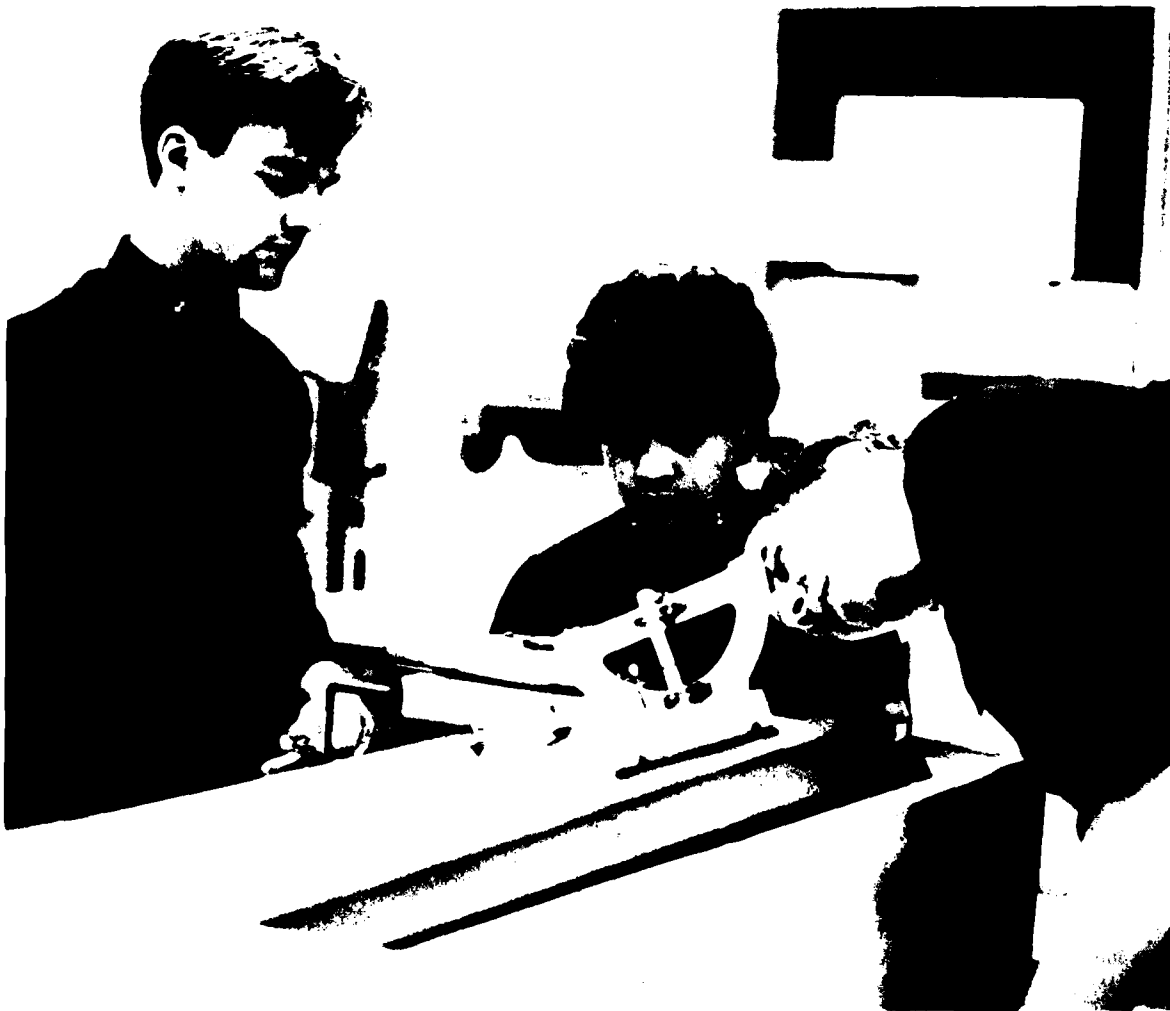
Midshipman 1/C Michael C. Torbit
Adviser: Lieutenant Commander Michael B. Candolor, USN

Remote Sensing Laser Microphone

Midshipman 1/C John A. Van Cleave
Adviser: Captain Michael K. McClanahan, USMC

Microprocessor Interface to Control Touch Pad Input to a Computer

Midshipman 1/C Gordon Williams
Adviser: Commander Robert N. Christianson, USN



Publications

BROCKUS, C. George, Associate Professor, **"Short Term State Variables in Modeling Engineering Systems,"** *Modeling and Simulation*, 15 (December 1984), 951-955.

The concept of short-term state variables is introduced to permit the size of the state space of a system to be viewed as an invariant property of the system. Several practical benefits are realized for the analysis of differential systems as a result of the adoption of that concept. Several new definitions for proper and improper systems become available under that viewpoint, and new analysis techniques have been developed for that variety of system types. A subset of the representations, newly available for a given system, can be obtained with a minimum amount of work.

DeMOYER, Robert, Associate Professor, and E. Eugene MITCHELL, Professor, **"A Versatile Digital Controller Algorithm Incorporating a State Observer and State Feedback,"** *Institute of Electrical and Electronic Engineers Transactions on Industrial Controls*, February 1985, 78-84.

A digital controller algorithm is developed which forces a single input-single output plant, defined by its transfer function, to respond according to a specified model transfer function. The algorithm is implemented by two difference equations and incorporates a state variable observer and state variable feedback control. The procedure used is sometimes referred to as a model reference feedback control system.

The purpose of the paper is to develop a general digital controller design procedure. Following this, some general guidelines are presented for the class of digital controllers.

Several plants are controlled, and general results are shown that relate controller accuracy to sampling time, microcomputer data word length, coefficient word length, and accumulator word lengths. The algorithm is implemented on a microcomputer using an 8080 CPU and was found to have a control loop time on the order of two milliseconds.

MITCHELL, E. Eugene, Professor, **"Gage Factors and Noise Tests,"** Division of Engineering and Weapons Report EW-23-84, November 1984.

Previous work has shown that a magnetoelastic ribbon has the potential to be used as a strain gage. Strain induced-change in inductance of a coil wrapped around the ribbon, with the proper signal conditioning, produces a direct reading of strain.

The purpose of this report is to describe the progress made on several of the assigned tasks and to describe the extensions and advances made on previous work. Two major contributions have been made. First, a method called remote sensing has been discovered. This procedure eliminates the need to wind a coil about the ribbon and opens the way to a much more versatile sensor. Second, a partially verified by an alternate procedure and indicates gage factors approaching the previously reported theoretical values.

Attempts were made to separate torsion signals from bending signals. This experiment was unsuccessful because torsion and bending signals were discovered to be the same.

The preliminary measurements of noise to signal ratios were acceptable. Further study has shown that the difficulties were not due to the magnetostrictive ribbon, but were in the electronics and/or instrumentation.

MITCHELL, E. Eugene, Professor,
**"Magnetoelastic Force Feedback Sensors for
Robots and Machine Tools - An Update,"**
Society of Mechanical Engineers Robotics 9
Conference, (Abstract), Detroit, Michigan,
June 1985.

This paper describes the current status of a new transducer that is under development. The transducer measures torque and force and is many times more sensitive than standard strain gages.

The original function of the transducer was to provide force feedback for a robotic wrist. Initially, the transducer was designed as an integral part of the wrist. However, in its current configuration, the area of application is much larger.

The transducer may offer two important advantages to robotic sensor implementation. It appears that the transducer signal processing

electronics will be simpler than required for standard resistance strain gages, and due to greater sensitivity, signals on the order of plus and minus one volt are directly available for use.

MITCHELL, E. Eugene, Professor, **"A New
Magnetoelastic Force Transducer,"** Institute
of Electrical and Electronic Engineers
Conference on Robotics and Machine Tools,
(Abstract), St. Louis, Missouri, June 1985.

This paper describes a magnetoelastic based force transducer, one that may be used in the manner of a standard strain gage. The sensor appears to offer several advantages over resistance and semiconductor strain gages. In particular, it has a sensitivity more than an order of magnitude greater than semiconductor strain gages.



Presentations

BROCKUS, C. George, Associate Professor, **"Applications of Row Reduction Techniques,"** Fifteenth Pittsburgh Modeling and Simulation Conference, Pittsburgh, Pennsylvania, April 1985.

HOUSKA, Richard V., Associate Professor, **"A General Approach to Matrix Canonical Forms,"** Fifteenth Pittsburgh Modeling and Simulation Conference, University of Pittsburgh, Pennsylvania, April 1985. (Abstract of this presentation will be published in October 1985.)

KNOWLES, Kenneth A., Associate Professor, **"Implementation of Several Matrix Robot Digital Vision Algorithms on Typical Microcomputer Systems,"** Fifteenth Annual Pittsburgh Modeling and Simulation Conference, Pittsburgh, Pennsylvania, April 1985. (Abstract of this presentation will be published in October 1985.)

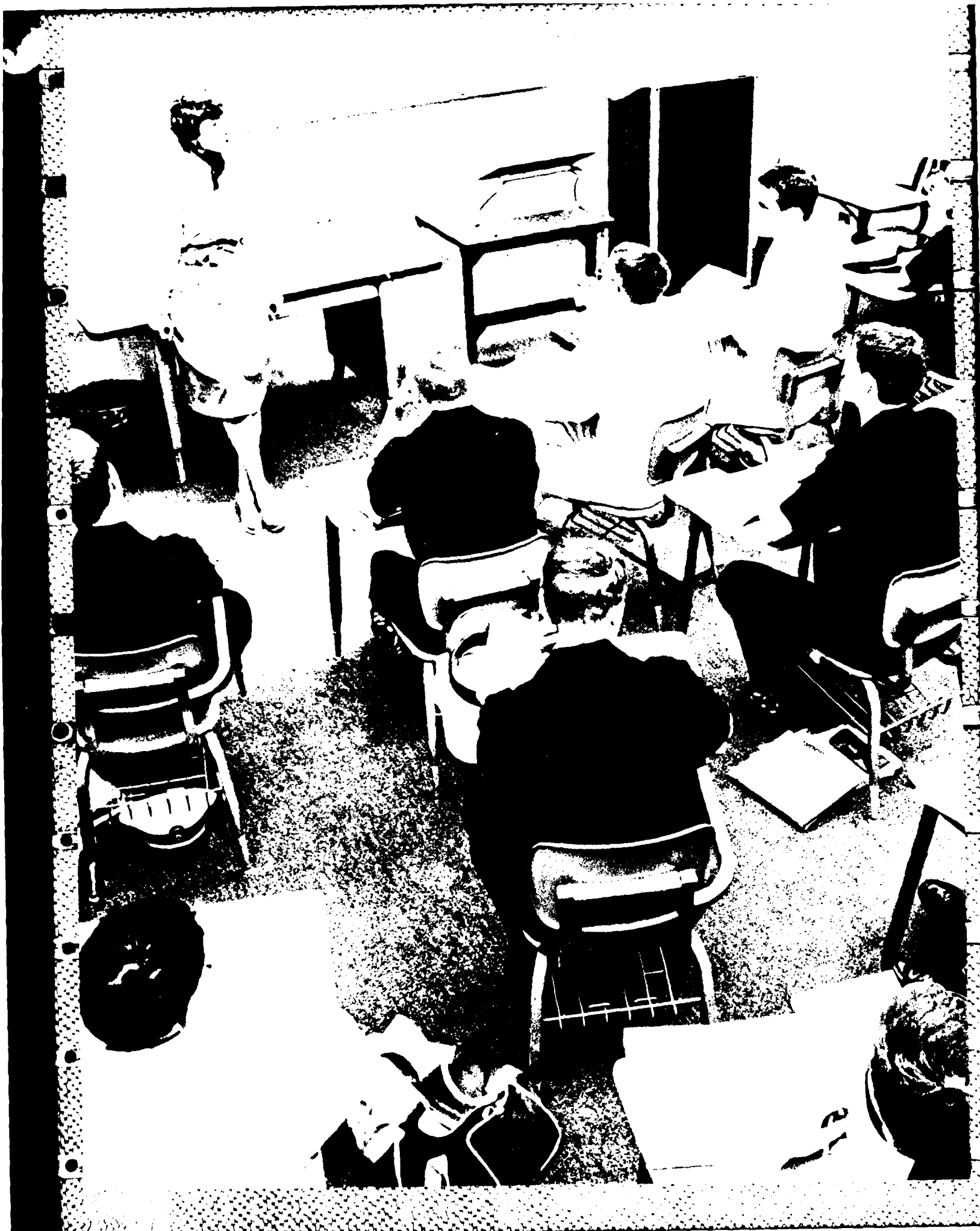
KNOWLES, Kenneth A., Associate Professor, **"Robot Antics,"** Sixth Annual Anne Arundel County Mathematics Conference, Anne Arundel Community College, Arnold, Maryland, 2 April 1985.

MITCHELL, E. Eugene, Professor, **"A New Magnetoelastic Force Transducer,"** Institute of Electrical and Electronic Engineers Conference on Robotics and Automated Machinery, St. Louis, Missouri, June 1985.

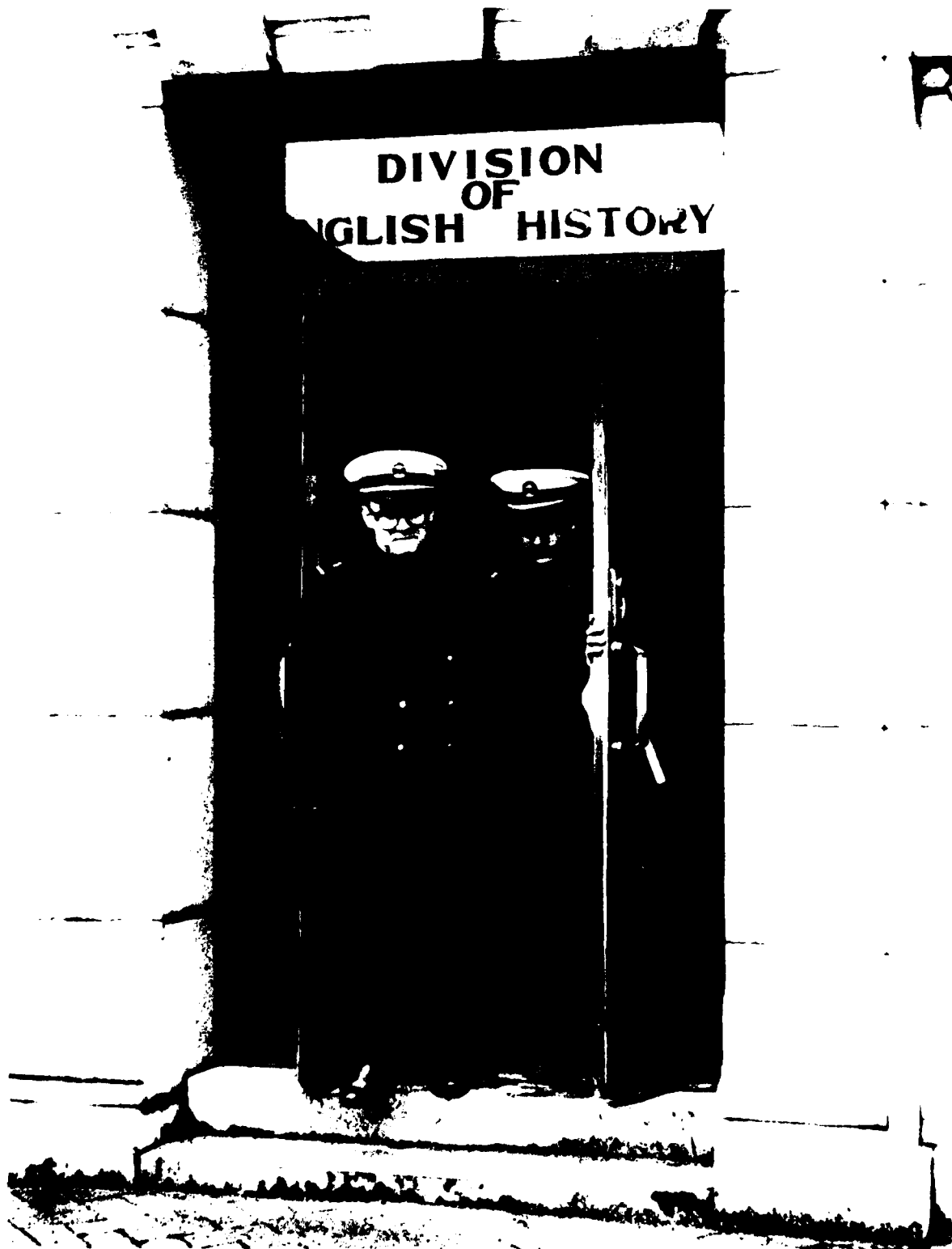
MITCHELL, E. Eugene, Professor, **"Magnetoelastic Force Feedback Sensors for Robots,"** Society of Mechanical Engineers Robotics 9 Conference, Detroit, Michigan, June 1985.

WATTS, Jerry W., Associate Professor, **"Control of an Inverted Pendulum,"** Ninety-Second American Society for Engineering Education Annual Conference, Salt Lake City, Utah, June 1984.

WATTS, Jerry W., Associate Professor, **"Simulation and Control of an Inverted Pendulum,"** Fifteenth Pittsburgh Modeling and Simulation Conference, Pittsburgh, Pennsylvania, April 1985. (Abstract of this presentation will be published in October 1985.)



Division of English and History





English

PROFESSOR DAVID O. TOMLINSON
CHAIRMAN

The Department of English again in Academic Year 1984-1985 was active and prolific in both research and scholarly publication. Five sponsored research projects were underway during the year, ranging in topic from the Middle English Breton lay to fairy tale elements in the fiction of Charles Dickens. Several other faculty members conducted independent research in areas similarly diverse. While a majority of the projects concentrated on British literature (as represented by authors such as Milton, Carew, Tennyson, Kipling, Arnold, and Bryce), others dealt with topics as timely as contemporary black literature and as near as the city of Annapolis itself. These individual efforts in research, along with the faculty advising of midshipmen in their own research course projects, attest to the continuing strength of the English Department's staff and programs.

The English faculty published numerous books and articles this academic year, notably including a writing/rhetoric textbook for use in foundation courses much like those taught to Plebes at the Naval Academy. Just as faculty publishing signifies a vitality in both research and teaching, so the extensive listing of faculty presentations suggests the importance of sustained communication among professional colleagues throughout academe and within the lay community. All of these activities, whether directly related to research, or as outgrowths of it, work



to enhance the academic program available to midshipmen in the English Department at the Naval Academy.

Sponsored Research

Imagined Places: Poems

RESEARCHER: ASSISTANT PROFESSOR NANCY PROTHRO ARBUTHNOT

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The project is a volume of poems dealing with travel in the U.S. and abroad. The meditative, lyrical poems pose questions about the significance of travel, of discoveries in travelling about other peoples and cultures and about the self. Although intending to be philosophical in nature and general in scope,

the poems begin from personal experience. Divided into three sections — Foreign Places, the American West, and Home — the book traces a journey, both personal and social, through isolating experiences and toward understanding the importance of place and the meanings of society and home.

Fairy-Tale Elements in *Bleak House*

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

SPONSOR: NATIONAL ENDOWMENT FOR THE HUMANITIES (NEH)

In *Bleak House*, Charles Dickens' attempts to show "the romantic side of familiar things" depend upon fairy lore and fairy-tale structure. The Smallweed household, for example, "has discarded all amusements, discountenanced all storybooks, fairy tales, fictions and fables." It is a stronghold against childhood and

imagination, even in its accoutrements, many of them made of iron, a substance traditionally used to repel fairies. On a larger scale, recalling the typical plots and characters of fairy tales helps us to understand the development of the relationships between and among the major characters.

Lewis Carroll and Wordsworthianism

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

SPONSOR: NATIONAL ENDOWMENT FOR THE HUMANITIES (NEH)

This article examines the influence of William Wordsworth on Lewis Carroll's *Alice's Adventures in Wonderland* and *Through the Looking Glass*.

It reveals several heretofore unnoticed analogues and allusions, and examines the rich ambivalence of Carroll's attitude towards Wordsworth.

Tennyson's *Idylls of the King* in the Context of English Romanticism

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The study places Tennyson's *Idylls of the King* in the context of English Romantic poetry, especially the work of John Keats, whose style, values and rhetorical strategies influenced Tennyson deeply as he shaped the materials of Arthurian legend into a poem addressing

the exigencies of life in a postlapsarian world. By placing Tennyson's work in its appropriate literary context and by studying it from a rhetorical, as opposed to a biographical, perspective, its post-Romantic nature can be seen in clear relief.

The Psychological Dimension of Middle English Lays

RESEARCHER: ASSISTANT PROFESSOR TIMOTHY D. O'BRIEN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The Middle English Breton lay represents a later version of the literary genre practiced first and most successfully by Marie de France, an Anglo-Norman poet of the twelfth century. The Breton lay is a short, highly symbolic, tightly organized, and dream-like romance. As the object of scholarly attention, it has generally stimulated two kinds of responses: study of its sources and examination of the

way it communicates, allegorically, Christian truths. In this project, however, the focus is the psychological structure and meaning of the Breton lay insofar as they can be clarified by the principles of Jungian depth psychology. Receiving the most attention in this study are three works of the Middle English period: *Sir Orfeo*, *Sir Launfal*, and Chaucer's *The Franklin's Tale*.

The Poetry of Robert Graves

RESEARCHER: ASSISTANT PROFESSOR HARDY C. WILCOXON, JR.
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The Poetry of Robert Graves constitutes a book-length study which defines the central, characterizing features of book-length study which places Graves in literary-historical terms, and which assays the value of Graves's poetic achievement. The project contributes significantly to Graves scholarship in offering a new theory to explain why Graves has chosen to write in a style that is frankly archaic in some ways and at odds with developments in twentieth-century poetry and in establishing for the first time with any accuracy the poets with whom Graves

has the most significant affinities.

The gist of Wilcoxon's thesis is that Graves's style is essentially an "allegorical" or "emblematic" style, which aligns him most clearly with poets of the late seventeenth century, and that he has chosen to write thus because the concise, simple meanings that an allegorical or emblematic style encourages have helped him articulate and express his sharply divided feelings. Graves is, as it were, in the business of creating conflicts of meaning and feeling; and stark, black-and-white distinctions are especially well suited for creating conflicts.

Independent Research

Robert Hayden: A Biographical and Bibliographical Summary

RESEARCHER: PROFESSOR FRED M. FETROW

The project is primarily a compilation of the primary and secondary bibliographic materials related to the life and work of Robert Hayden. Designed as an entry in a biographical/bibliographical reference text on "contemporary American poets," this material will be organized into an initial section of descriptive essay in account of the extant criticism addressing Hayden's

poetry. The duality of content adheres to a standardized format usually presented in source-reference books of its kind. The primary feature and strength of the overall project should be in the descriptive detail used to summarize and evaluate the work of scholars done in response to Hayden's limited oeuvre, but expanding influence and attention.

The Design of Tennyson's Poetry

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

This book-length study considers Tennyson's career in terms of the four characteristic designs of his major long poems, examining how each is the product of a gradual transformation of Romantic voices, interests and forms. The relationships between and among these four designs are addressed in the course of the study, as are their characteristic rhetorical strategies and central themes. The study aims to clarify these matters as well as Tennyson's

place in the history of English poetry. It demonstrates the fundamentally ethical goal of Tennyson's poetry, and its means of accomplishment — briefly, through salvaging the forms of Romantic poetry and changing their rhetorical directions. Tennyson works to help the reader accommodate himself to life within a fallen world, an imperative which proves as strenuous as the Romantic quest for a new Jerusalem.

Kipling and Nineteenth Century Poetry

RESEARCHER: ASSISTANT PROFESSOR EILEEN TESS JOHNSTON

Rudyard Kipling's poetry reveals a rich awareness of the nineteenth century tradition of British and American poetry. To read Kipling is partly to hear the voices of Whitman, Browning, Tennyson, Swinburne,

Rosetti, Morris, and Yeats. Kipling's stances toward his masters in the art range from the reverential to the ironic; his poetry sums up the tradition and in some ways calls it into question.

An Edition of The American Commonwealth

RESEARCHER: PROFESSOR ALLAN B. LEFCOWITZ

James, Lord Bryce's seminal work *The American Commonwealth* first appeared in 1888. While it attracted wide attention at the time, it has in recent years not received the study it should from scholars and the general public. A new edition to celebrate the centennial of its

publication would place the work once more in the public eye where its value in reevaluating America's cultural and historical past will be invaluable. Negotiations with Bryce's original publisher, the Macmillan Company, are in progress.

Articles Commemorating the Centennial of Matthew Arnold's Death

RESEARCHERS: PROFESSOR ALLAN B. LEFCOWITZ AND
LIEUTENANT COLONEL LAWRENCE MAZZENO, USA

Fifty noted Arnold scholars have been invited to submit proposals for contributions to the volume.

Each article will focus on an issue raised by Arnold which is still pertinent in our own day.

A Complete Annapolis Bibliography

RESEARCHER: ASSOCIATE PROFESSOR MICHAEL P. PARKER

The literature concerned with the city of Annapolis is vast and scattered: it includes histories, guidebooks, periodical articles, directories, biographies, ephemera, etc. The goal of the project is to provide an annotated bibliography of all published items dealing

with Annapolis; a general survey of available manuscript and newspaper materials; and a guide to locating Annapolis items at major area libraries. The completed bibliography will prove of value both to the serious student of local history and to the Annapolis resident.

Thomas Carew and the Court of Charles I

RESEARCHER: ASSOCIATE PROFESSOR MICHAEL P. PARKER

The projected study will constitute a comprehensive investigation of the life and poems of Thomas Carew. The most accomplished poet working at the court of Charles I, Carew played a role in shaping the public image the Stuart monarchy attempted to project; his poetry enunciates the standards of cool elegance and restrained playfulness that the king demanded of his court. Carew, nevertheless, maintains a distance from the

courtly culture he helped to create. His works dedicated to private patrons suggest values different from those he embraces in the poems on affairs of state, and the tension between these realms of experience provides the field for Carew's poetic utterances. The study will place Carew within his literary, social and political contexts. In doing so, it will illuminate the complex sensibility that underlies his best work.

Milton and Violence

RESEARCHER: ASSOCIATE PROFESSOR JOHN WOOTEN

This research was born in dissatisfaction with various scholarly and critical efforts to account for or characterize John Milton's political and personal development before, during, and after the English Civil War. Milton moved from a passionately active political idealism to a seemingly pacifistic state of world-weary resignation during his adult life. In the 1640's and 1650's he ardently defended the beheading of Charles I and forcefully celebrated the martial victories of Oliver Cromwell. By 1667, however, Milton had modified his views. In *Paradise Regained*, for example, we have a severely restrained and passionless dismissal of all the Satanic temptations to martial glory, political power, and even humanistic learning. Milton's post-Restoration change of heart and mind is dramatic.

What happened to Milton? Fine critics

like Arthur E. Barker and, more recently, Christopher Hill have analyzed the political conflicts at the center of seventeenth-century English history and have applied their analyses to Milton's shifting but developing perspective on those conflicts. James A. Freeman and Michael Lieb have recently looked more carefully at Milton's views on warfare specifically, but neither explains well the tension in Milton's treatment of the subject. What Barker, Hill, Freeman, and Lieb do not consider with enough attention is the important related issue of the levels of attitudes toward violence in Renaissance English culture.

A fuller examination of this subject sheds new and necessary light on Milton's growing disenchantment with physical force as an acceptable weapon for social order.



Research Course Projects

"Who Shall Say I Am Not the Happy Genius of My Household?"

RESEARCHER: MIDSHIPMAN 1/C ROBERT W. POOR
ADVISER: ASSISTANT PROFESSOR HARDY C. WILCOXON, JR.

The title, taken from William Carlos Williams's poem "Dance Russe," fairly indicates the subject of the researcher's examination: through careful attention to particular poems, especially a long poem entitled "The Sparrow," he very ably described the tolerant, humane, playful and celebratory spirit of Williams's poetry. The object of the investigation was

to connect general observations, such as those about Williams's "spirit," with observations about the way the writer was choosing and arranging words on a page. The researcher also compared Williams's style and manner with William Butler Yeats' grandiloquent and large-gestured habits of expression.

Sounds Over Dry Grass: An Essay on the 'Musical' Structure of Eliot's Poetry

RESEARCHER: MIDSHIPMAN 1/C MICHAEL M. CASEY
ADVISER: ASSISTANT PROFESSOR HARDY C. WILCOXON, JR.

By focusing mainly on T. S. Eliot's poem "The Hollow Men," Casey has described many aspects of style (such as sound patterns and line lengths) that Eliot uses to create meanings in ways not strictly "logical," but "associational" or "musical." In other

words, the researcher has focused attention on an especially famous and characteristic poem and described the significant ways in which Eliot departed from traditional, discursive styles and created a substantially non-discursive style.

The Life and Work of Gil Scott-Heron

RESEARCHER: MIDSHIPMAN 1/C CARLTON PIERCE
ADVISER: PROFESSOR FRED M. FETROW

Originally conceived and planned as a correlation of biographical fact and literary technique, this study of Gil Scott-Heron devolved into a critical-analytical study of his work primarily, with some biographical information serving as a backdrop.

The student researcher was able to highlight the main features of the author's life and work. The ultimate conclusion reached includes a renewed appreciation

for Heron's innovative use of stylistics, as well as a belated and grudging recognition of the extent of his polemic didacticism. The study resulted in information and insights truly original; the substantial thesis could very well serve to introduce Gil Scott-Heron, an important voice in Afro-American literature, to the syllabus for HE240, "American Black Literature," as taught at the Naval Academy.

Publications

ARBUTHNOT, Nancy Prothro, Assistant Professor, "'On the Edge of Space:' Wallace Stevens's Last Poems," *The New England Quarterly*, 57 (September 1984), 347-358.

Looking at old age and anticipating death, the last poems of Wallace Stevens often begin in a melancholy key but soon modulate to an almost joyful sense of new life. The key images in these poems are those of the child and the explorer and familiar figures from life and myth — Penelope and Ulysses, independent-minded New Englanders, wise old men. The poems balance a knowledge of death with a life vitally redeemed by a new sense of self as Stevens celebrates Being.

HEFLIN, Wilson L., Professor, "Literature of the Sea," in *Bibliographical Guide to the Study of the Literature of the U.S.A.* Ed. Clarence Ghodes and Sanford E. Marovitz. Durham, North Carolina: Duke University Press, 1984, pp. 154-155.

This section provides a reading list for teachers instructing a course in American literature of the sea and for students interested in the subject. General reference books are cited as well as those dealing specifically with the sea such as writings of James Fenimore Cooper, Herman Melville, and Richard Henry Dana, Jr.

JASON, Philip K., Professor, "The University as Patron of Literature: The Balch Program at Virginia," *JGE: The Journal of General Education*, 35 (Fall 1983), 174-188.

By examining the Balch Program, which ran from the late 1950's into the early 1960's, we see a representative, though encapsulated, version of the writer-in-residence phenomenon from the point of view of both the artists and the institution. The long-term residencies of William Faulkner and Katherine Ann Porter were arrangements in which the University served as host and patron, exchanging a desirable workplace for minor duties. The shorter residencies of Stephen Spender and

John Dos Passos reveal shrinking funds for such enterprises. At a later stage, visiting writers would make visits of one week or less, while others would gain employment as regular staff — no longer special cases to be treated in special arrangements. The shift in the relationship of the writer and the university includes the development of creative writing courses and programs as part of the curriculum.

JOHNSTON, Eileen Tess, Assistant Professor, "'This were a medley': Tennyson's *The Princess*," *English Literary History*, 51 (Fall 1984), 549-574.

The Princess is the least appreciated of Tennyson's major works and also the one most deserving of revaluation. The poem's genre, style, imagery, characterization, plot and narration can all best be understood in relation to medley. Medley is the formal realization of the poem's central vision of human potentiality, both the individual's and the society's, and lends itself to the celebration of those qualities Tennyson wished to affirm: variety, inclusiveness, energy, receptivity, and harmonious order. Ultimately, *The Princess* projects towards society an attitude that is itself a medley — a mixture of hopefulness and skepticism.

LEFCOWITZ, Allan B., Professor, co-author, "Old Age and the Modern Literary Imagination," *Aging in Literature*. Eds. Laurel and Laurence M. Porter. Troy, Michigan: International Book Publishers, 1984, pp. 129-148.

This article argues that old people in literature are generally passive actors and victims. The paradigms of old people in literature are as follows: (1) Age as a model for youth; (2) age as a touchstone for proper behavior; (3) age as a symptom of the society's failure; and (4) age as a mirror of life. What appears distinctively modern in the treatment of age is the diversity reflecting our modern cultural pluralism.

NOLAN, Charles J., Jr., Associate Professor, **Contributions to the Annual Bibliography of English Language and Literature**. Volume 56. Eds. Michael Smith and Mary Jean DeMarr. Leeds, Great Britain: Modern Humanities Research Association, 1984.

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, Great Britain, where the *Annual Bibliography* is published. The result each year is one of the two major bibliographies in English studies.

NOLAN, Charles J., Jr., Associate Professor, **"The Joys of Teaching,"** *JGE: The Journal of General Education*, 36:1 (1984 [1985]), 46-49.

After a year's foray into the land of the deans, the author reconfirmed that his principal source of professional joy comes from teaching. The chance to be in daily contact with the great works of the English language, the chance to touch the lives of others, the opportunity to continue to learn, the chance to write about that new learning, even the frequently exasperating chance to work on committees — all bring joy and a sense of continuing growth.

NOLAN, Charles J., Jr., Associate Professor, **"Shooting the Sergeant: Frederic Henry's Puzzling Action,"** *College Literature*, 11 (1984), 269-275.

The scene in *A Farewell to Arms* in which Frederic Henry shoots a deserting sergeant has often puzzled readers. Because it is clear

that Hemingway intends his protagonist to be an heroic figure, Frederic's violent act seems a mistake in characterization. Fitzgerald, in fact, urged Hemingway to delete the scene, though whether in conversation or in the more famous author's long critique of *Farewell* is uncertain. Rightly read, however, the scene reveals a man still fulfilling the obligations he accepted when he took his commission in the Italian army. During the disastrous retreat from Caporetto, Frederic continues to work his way toward Udine with his ambulances. When the two sergeants refuse to help and walk off down the road, Frederic first warns and then orders them to return; only after they refuse and start to run off does he shoot at them. The act, about which Frederic feels ambivalent, is part of what Henry sees as his duty. Later, when the Carabinieri try to execute him, he will make his separate peace, but for the moment he will do what he believes he must, however distasteful his actions are to him.

O'BRIEN, Timothy D., Assistant Professor, **"Word Play in the Allegory of King Horn,"** *Allegoria* 7:2 (1984), 110-122.

Though the Middle English romance *King Horn* is generally regarded as the product of a peurile imagination, it contains an intriguingly coherent allegorical texture. Superficially the poem's episodes disregard the demands of probability and its characters lack motivation. However, the main concern of the composer is not with realism in the poem's events and characters but with the way they can function as commentary on the allegorical word play which controls the structure and meaning of the poem. The names of the characters — Horn, Rhymenhild, Fikenild, for instance — and such words as "fare," "fere," and "fair" develop rather elaborate puns which not only express a culture's desire for an omnipotent and just king but also reassert the authoritative coherence within that culture's language. The poem's subject, then, is its language.

PARKER, Michael P., Associate Professor, *The Saybrook Arras*. New Haven: Saybrook College in Yale University, 1984.

The Saybrook Arras, presented to Saybrook College in Yale University in 1934 to commemorate its founding, incorporates a wealth of historical and iconographic detail. This study provides a brief history of Old Saybrook, Connecticut, and of the early years of Saybrook College; it gives capsule biographies of the first Fellows of the College; and it includes a detailed commentary of the hundred-odd ornaments that embellish the Arras. This work represents a valuable contribution to the history of Yale College and to the study of applied arts in America.

PARKER, Michael P., Associate Professor, "Carew, Kit Villiers, and the Character of Caroline Courtliness," *Renaissance Papers* 1983, pp. 89-102.

Thomas Carew's "To the Countesse of Anglessie" revises Jacobean history in terms of Caroline preoccupations. The poem ostensibly eulogizes Kit Villiers, the Earl of Anglesey; the embarrassing details of the historical Anglesey's life are glossed over, however, and Carew presents instead an Anglesey who is the pattern of Caroline courtliness. Banishment from the court is reinterpreted as a voluntary embrace of the country life; drunkenness and lack of self-control become a capacity for measured enjoyment. The elegy itself derives from Jonsonian models, but the virtues Carew chooses to stress reflect a new Caroline concern with manners rather than with morals. The poet adduces the example of this idealized Anglesey in persuading the countess to moderate her grief and conform her behavior to the courtly standard of elegant restraint. Carew consigns the historical Anglesey to a merited oblivion, but the idealized portrait he sketches survives as an example of the courtly values of the early 1630's.

TINSLEY, Molly B., Associate Professor, "Amateurs, A Short Story," *Redbook*, September 1984, 73-76, 81.

The story is a romantic comedy about a young woman, Lucia, recently divorced, working for

the first time and supporting her twelve-year-old daughter.

Disconcerted by the singles scene, she gets more free advice from her mentor, Paige, than she can make sense of. All Paige's tips prove irrelevant, however, when Lucia meets Frank. (She has car trouble; he offers his phone). They both admit how afraid they are of social life among the once married. On the basis of this candor, they become friends.

TOMLINSON, David O., Professor, *Introductions and biographies of authors in Short Stories of the Sea*. Selected and arranged by George C. Solley and Eric Steinbaugh. Annapolis: The Naval Institute Press, 1984.

Each of five sections of the short story anthology — Sea and Short, Sea Lore and Legend, Adventures at Sea, Storm and Shipwreck, and Great Stories of the Sea — is prefaced by a short essay which establishes the theme and places the stories in the section in relationship to that theme. In addition, biographical sketches of the thirty-one authors represented in the volume are included. The sketches not only trace the authors' careers as writers but also tie the stories used in the anthology to that career and, where possible, to their interest in or experience with the sea. The stories are primarily nineteenth and twentieth-century productions of English and American writers though some continental representation is included as well.

WHITE, David A., Assistant Professor, "Miguel de Cervantes," *Critical Survey of Long Fiction: Foreign Authors*. La Canada, California: Salem Press, 1985, pp. 324-333.

The essay, written for a series of reference volumes on fiction, covers the life and major work of Spanish writer, Miguel de Cervantes. After a biographical survey, the essay focuses mainly on Cervantes' masterpiece *Don Quixote*, exploring the ways Cervantes created the modern novel, his use of realistic dialogue, his presentation of a vivid, self-contained world. The essay concludes with a discussion of the principal characters in the work, the many ways they have been viewed over the centuries and what they have come to represent in the imagination of the world.

WICKER, Nancy R., Assistant Professor, co-author, *The Writer's Roles: Readings with Rhetoric*. Glenview, Illinois: Scott, Foresman and Company, 1985.

The book, through explanation and illustration, emphasizes the process of writing, of taking account of one's self, one's world, audience, and purpose. In determining what to say, to whom, and how, a writer chooses a role or a rhetorical stance. Depending upon the relationship among author, subject, and audience, a writer's rhetorical stance relies primarily on observing, explaining, evaluating,

or persuading, and in some cases on a combination of those skills. A good book, for instance, can move a writer to record observations in a journal, to write a report explaining the book's contents, to draft a review evaluating the book for a magazine or newspaper, or to persuade people to read the volume.

The Writer's Roles contains four sections on those various roles a writer might adopt — observer, expositor, evaluator, and persuader. A fifth section focuses on written forms of spoken discourse, and a sixth includes the writer in multiple roles.



Presentations

ARBUTHNOT, Nancy Prothro, Assistant Professor, **"East vs. West in Dorothy Scarborough's *The Wind*,"** Southwest Regional Teachers of English Conference, Albuquerque, New Mexico, 4 October 1984.

BERGMANN, Harriet F., Associate Professor, **"Beginnings of Feminism in the 60's,"** Seminar in the 60's, George Mason University, Alexandria, Virginia, 22 March 1985.

HILL, John, Associate Professor, **"The Canterbury Tales: The Idea!"** Illinois Medieval Association, Normal, Illinois, 23 February 1985.

HILL, John, Associate Professor, **"Chaucer's Perplexed Reader,"** The Graduate Center, City University of New York (CUNY), 13 October 1984.

HILL, John, Associate Professor, **"Literature, Art, and Science: Oxford, 1857,"** English Club, Wagner College, New York, 22 March 1985.

JASON, Philip K., Professor, Moderator, **"Session on Sustenance,"** East Central American Society for Eighteenth Century Studies Meeting, Annapolis, Maryland, 28 October 1985.

JASON, Philip K., Professor, **"Teaching the Book of Poems,"** USNA English Department Athenaeum, April 1984.

LEFCOWITZ, Allan B., Professor, with Lieutenant Colonel Lawrence Mazzeno, USA **"Democracy and Culture: Matthew Arnold, James, Lord Bryce, and the Idea of America,"** Matthew Arnold in His Times and Ours: A Symposium, Texas A&M University, College Station, Texas, 1 March 1985.

LEFCOWITZ, Allan B., Professor, **"The Problems of Publishing Poetry in the 1980's,"** University of Baltimore, 26 September 1984.

MADISON, Robert D., Assistant Professor, **"The American Naval Ballad in the 1840's,"** Mystic Seaport Museum Symposium on Music of the Sea, Mystic, Connecticut, June 1984.

MADISON, Robert D., Assistant Professor, **"Cooper's Columbus,"** James Fenimore Cooper Conference, State University of New York (SUNY), Oneonta, New York, July 1984.

MADISON, Robert D., Assistant Professor, **"Cooperstown's Contribution to Cooper Scholarship,"** James Fenimore Cooper Conference, State University of New York (SUNY), Oneonta, New York, July 1984.

MADISON, Robert D., Assistant Professor, **"The Development of Nuclear Submarine Literature: Rickover to Red October,"** SEAmester Program, St. Michaels, Maryland, 17 May 1985.

MADISON, Robert D., Assistant Professor, co-author, **"An Inquiry into the Practicability of Certain Eighteenth Century Improvements in Navigation,"** Southeastern American Society for Eighteenth Century Studies Meeting, Athens, Georgia, 8 March 1985.

MADISON, Robert D., Assistant Professor, co-author, **"Teaching Literature of the Sea Afloat and Ashore,"** American Sail Training Association Meeting, New London, Connecticut, October 1984.

NOLAN, Charles J., Jr., Associate Professor,
"The Joys of Teaching," Conference of the
 College English Association, Cincinnati, Ohio,
 26 April 1985.

PARKER, Michael P., Associate Professor,
 Moderator, **"The Progress of the Arts in the
 Eighteenth-Century Chesapeake,"** ASECS
 East Central Region Conference, Annapolis,
 Maryland, 26 October 1984.

O'BRIEN, Timothy B., Assistant Professor,
"Two Middle English Androgynes,"
 Midwestern Modern Language Association,
 Bloomington, Indiana, 2 November 1984.

WICKER, Nancy R., Assistant Professor, **"The
 English Major in a Time of Technology,"** The
 1984 Conference on Freshman and Sophomore
 Literature, Laramie, Wyoming, 25-29 June 1984.

PARKER, Michael P., Associate Professor,
"The Saybrook Arras," Meeting of the
 Saybrook College Fellowship, New Haven,
 Connecticut, 28 November 1984.

WILCOXON, Hardy C., Assistant Professor,
**"Ambivalence and Inspiration in the Poetry
 of Robert Graves,"** Louisville, Kentucky,
 21 February 1985.





History

ASSOCIATE PROFESSOR FREDERICK S. HARROD
CHAIRMAN

Members of the History Department had an active and productive year in research and publication. The faculty published two books, edited one book, edited a series of reprinted classics in naval literature, and published eighteen articles, papers, encyclopedia entries, and book reviews.

During 1984-1985, the Department participated actively in professional conferences both in this country and Europe. At twenty-two such meetings, faculty members presented papers.

The results of the research conducted by members of the History Department are reflected not only in the impressive range of publications and presentations but also in the classroom. This work provides an ongoing enrichment of instruction offered to midshipmen.



Sponsored Research

Lordship and Military Obligation in Anglo-Saxon England

RESEARCHER: ASSISTANT PROFESSOR RICHARD P. ABELS
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The subject of this project is a study of military obligation in England from the seventh to the eleventh century. The researcher analyzes the manner in which military institutions and the practice of war were affected by changes in Anglo-Saxon land tenure, by the challenge of the Viking invasions, and by the growth of royal lordship. The aim of this study is to answer a specific question that has wide-ranging implications for medieval military and social history: what was the precise relationship between the obligations arising from the lordship bond and military service in pre-Conquest England? The answer to this question will help to

clarify one of the knottiest problems in English history, namely, the impact of the Norman Conquest upon the military organization of England.

This project has resulted in a full-length monograph, which represents a synthesis of the written sources and the archaeological record. This research has also resulted in two articles, one published this year and the other due out in July, and in an invitation to write the introductions to the Hertfordshire and Bedfordshire Domesday Book surveys for the 1986 Domesday Facsimile Project that Alecto Editions is undertaking at the request of the British Public Record Office.

Taverns and Laboring Class Communities

RESEARCHER: ASSISTANT PROFESSOR THOMAS BRENNAN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This study covers popular culture in eighteenth-century Paris, with a focus on the role of taverns as a community forum and center for sociability. Judicial documents provide the evidence for both a textual and quantified analysis of the "nameless poor" and their use of taverns, drink, and leisure. The evidence of elite, state, and church

commentaries on taverns also provides a striking contrast to the attitudes expressed by the common people. This contrast between elite and popular perceptions reveals an important clash of cultures during the transition to the modern world. This project has resulted in a book manuscript which was submitted for publication in the summer of 1985.

Purging the English Navy: An Examination of the Committee for Regulation, 1649-1653

RESEARCHER: ASSISTANT PROFESSOR WILLIAM B. COGAR

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

From the outset of the English Civil War in 1642 to the summer of 1648, the Navy supported the Parliament against King Charles I. Only when the Army and the radicals in the House of Commons demanded the dissolution of the monarchy and the establishment of a republican Commonwealth did a part of the Navy defect to the royalists. This Naval Revolt had considerable repercussions on the Navy after the King was executed and the Commonwealth established. It was quickly learned within the new regime that a considerable number of men in the Navy had either sided with the defectors or had supported the Naval Revolt in principle. For this reason, the Parliament created a "Committee for Regulation," consisting of zealous and radical London merchants,

to purge the Navy of those malignant and disaffected elements.

This project is twofold. First, the researcher assessed the Committee's membership to determine why the new regime turned to London merchants for this task. Secondly, the project showed that while purging the Navy and its administration on grounds of political probity, the Committee also effectively administered the Navy when there was so much political and administrative dislocation and confusion. The minute book for the Committee, from which most of the research is derived, was only recently discovered and housed in the Tower of London.

At present, all the research for this project is completed, and the final draft of this proposed article is now being completed.

The Souls: High Society and Politics in Late Victorian Britain

RESEARCHER: ASSISTANT PROFESSOR NANCY W. ELLENBERGER

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

"The Souls" is a study in the social history of the British upper classes at the end of Victoria's reign. It examines a group of some three dozen aristocrats who figured prominently in the social and political life of the nation before the First World War. The work is based on a number of collections of family papers that are still in private hands and that have

not been seen by other historians. Using these personal effects, the researcher analyzes the ideas, attitudes, and behavior of the group within the context of social, political, and economic changes affecting their class as a whole.

The research was completed in the summer of 1984 in England.

Soldiers in Search of a Mission: Politics and Military Professionalism in Peru, 1930-1968

RESEARCHER: ASSOCIATE PROFESSOR DANIEL M. MASTERSON
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project is designed to produce a book on the theme of the Peruvian military's quest to define a comprehensive mission for itself beyond the confines of its traditional roles of frontier defense and internal security. This study examines the influence of national politics, inter- and intra-service

rivalries, foreign training missions, and an increasingly sophisticated military educational system upon the development of military professionalism and a "nation-building" consciousness within the Peruvian military during the four decades under study.

The Mind's Eye: Photography in Twentieth-Century America

ASSISTANT PROFESSOR DAVID P. PEFLER
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project is an examination of the growth of American photography in the twentieth century, focusing particularly upon the prolific period from 1930 to 1960. The researcher examines the ideas and values of leading American photographers, and the ways in which they brought those beliefs and values to fruition in their work. An aim of the project is to fill a gap in the existing scholarship, for while there exists a substantial body of art criticism on the medium, there is no scholarly treatment of

the ideas associated with photography. The researcher's principal question is one that has wide-ranging implications for the history of twentieth-century thought: in what ways did these creative individuals seek to resolve the tension that arose from working in a medium with an almost worshipful attitude toward objectivity, while daily seeing the evidence in their own work that even the simplest fact cannot be presented without altering its pure objectivity in some way?

Popular Education in Nineteenth-Century France: A Social History of the Women's Normal Schools

RESEARCHER: ASSISTANT PROFESSOR ANNE T. QUARTARARO
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This project is an examination of the social values and academic mission of teacher-training schools in France during the nineteenth century. The study of these normal school institutions offers a concrete way to analyze the formation of a national society in France. This project on the normal schools taps new archival sources in order to understand the mission of education for the masses. In particular, study has been done on how the national government began to incorporate

women's schooling into a model for a progressive, modern state.

The researcher visited several departmental archives in France (in the Yonne, and Loiret, and the Yvelines) in order to determine the social background of some of the young women who attended these training schools. The researcher completed additional research in France during the summer of 1985. A redrafting of the book-length manuscript should be finished by the end of 1985.

Independent Research

Social Physics: The Uses of Thermodynamics in the Philosophy of History

RESEARCHER: ASSOCIATE PROFESSOR ROBERT ARTIGIANI

Physicists and biologists have shown the profound importance of the Second Law of Thermodynamics in explaining the processes by which ordered structures can emerge through random interactions. It seems also clear that the development of ordered structures reveals a hierarchical relationship among natural processes. Some theorists — e.g., A. Iberall or I. Prigogine — have argued

that the pattern found in physical, chemical, and biological sciences can be translated into the humanities. If that is so, then a major step forward in the philosophy of history is possible. To take that step, however, careful analysis of the physical and biological arguments is necessary, as well as the development of a substantial systems theory.

Dictionary of Admirals and Generals of the U.S. Navy, Marine Corps, and Coast Guard, 1861-1918

RESEARCHER: ASSISTANT PROFESSOR WILLIAM B. COGAR

This monograph will be the first volume of a projected multi-volume work giving relatively short but very reliable and balanced biographies of those individuals who held flag-rank in the U.S. Navy and Coast Guard and those men who were general in the Marine Corps. The first volume will cover the period

from that of the Civil War through World War I, during which the Navy and the Marine Corps first used the ranks of admiral and general, respectively. Each entry will include personal information, a chronological career summary, career highlights, a short and select bibliography and a photograph where possible.

Conflict and Reliance on Texts: Recourse to Documents in Republican Rome

RESEARCHER: ASSOCIATE PROFESSOR PHYLLIS CULHAM

This project continues the work begun in the article "Tablets and Temples" (see Publications section) which has now appeared and serves as a prolegomenon to "Rome and Italy" listed below. It continues an

analysis of the difficulties presented by questions of Roman literacy and prepares the way for an argument that approaches based on material culture instead of texts are superior.

Rome and Italy: A Millennium of Material Life, 500 B.C. – 500 A.D.

RESEARCHER: ASSOCIATE PROFESSOR PHYLLIS CULHAM

The project represents a Braudelian synthesis of the *mentalité* and the material culture of the civilizations of the Italic peninsula in the millennium indicated. The goal is to recover

the reality and immediacy of the ancient past and to understand the dialectic processes through which it was transformed without relying on elite perceptions filtered by texts.

A Changing Army: Interpretations of American Military History from Colonial Times to the Present

RESEARCHERS: ASSOCIATE PROFESSOR KENNETH HAGAN AND
ASSISTANT PROFESSOR WILLIAM R. ROBERTS

This is a collection of eighteen essays by scholars and military men tracing the development of the American Army and

edited by the researchers. Each essay provides a comprehensive as well as interpretive view of the Army over the years.

John L. Sullivan and his America

RESEARCHER: ASSISTANT PROFESSOR MICHAEL T. ISENBURG

This work is intended to be a fifteen-chapter biography of the first American cultural hero in sport, the heavyweight champion John Lawrence Sullivan (1858-1918). The objective is to analyze Sullivan's life in the context of the times in which he came to maturity and gained his greatest popularity. American

popular culture in the 1880s, the dawn of the modern world in this regard, is studied as well. Sources include primary and secondary works of the period as well as more modern materials. Currently, the Prologue and the first three chapters have been written in draft, the research having taken the last three years.

The Cruise Missile and the Tactical Principle of Mass

RESEARCHER: ASSISTANT PROFESSOR MICHAEL T. ISENBURG

This article argues that the traditional tactical principle of mass should be modified to take into account the advent of the cruise missile. Formations and

ship platforms are considered tactically in the light of the new weapons. Operating parameters are advanced for the cruise missile.

Century's End: Americans Between a Past and Towards a Future: 1895-1905

RESEARCHER: LIEUTENANT COMMANDER ANDREW KOCZON, USNR

The researcher is attempting to demonstrate a general American consciousness at the turn of the century as well as to make some specific observations on the ways in which people approached the actual turning of the century. Thereby he hopes to revise the prevailing belief that the new century began around 1913 to a date much closer to 1900, if not 1900 itself. He hopes to demonstrate a major change from

a production to a consumption ethic, and, by the use of source materials such as architecture, popular songs, advertisements, disease incidence, and the appearance of new ideas about everyday life, to create a perception of the quality of life at the turn of the century. This research is intended to result in a doctoral dissertation in history at Rutgers University.

War in the Falkland Islands, 1982

RESEARCHER: ASSOCIATE PROFESSOR ROBERT W. LOVE, JR.

Begun two days after the conflict, this study of the 1982 Falklands/Malvinas War examines the validity of the opposing claims; treats historic U.S. interests in the dispute; and argues that the immediate cause of the conflict centered on South Georgia and was triggered in December 1981 rather than by the failure of the 28 February 1982 United Nations talks.

The second half of the book traces the reconquest and defense of the Malvinas by the Argentines, U.S. efforts to mediate the

crisis, and British offensive operations to recover the Falklands. Also, the text details the assistance of the islanders to United Kingdom forces. The author concludes that the key to the British victory was the United Kingdom-Chile alliance, plus the failure of the Argentines to expose their major naval and air assets before the climactic invasion. Also, the book demonstrates that British command errors rather than Argentine ability resulted in most of the losses of combatant vessels.

Believing Is Seeing: Documentary Photographers and the Depression Southwest

RESEARCHER: ASSISTANT PROFESSOR DAVID P. PEELER

Documentary photography was a form of American expression that blossomed in the 1930s, and documentary photographers found the Southwest a particularly compelling subject and place for their work. This project explores the motives and methods of those photographers, and examines their fascination with the Southwest. The methodology has involved a careful reading of the photographers' papers, letters, and articles, as

well as an analysis of their pictures. The conclusion is that the Southwest proved so compelling because it fitted the photographers' image of what a Depression *should* look like, and that the same subjectivity was a key element in their individual photographs. The larger lesson is that photography is, despite its seeming objectivity, like other forms of expression — a thing governed to a large extent by the creator's vision.

Hope Among Us Yet: Social Criticism and Social Solace in Depression America

RESEARCHER: ASSISTANT PROFESSOR DAVID P. PEELER

How can we account for the large number of works of social art that surfaced in the United States during the Depression? The obvious answer is that the economic crisis helped produce them, but this answer does not go far enough, for in a very basic sense all works of art are products of their times. In this book-length project, the researcher has used the personal papers, published writings, and images of four groups of artists (social novelists,

documentary photographers, traveling essayists, and social realist painters) to account for social art of the Depression years. His conclusion is that these creative individuals at first feared the Depression and lashed out at the economic system that seemed to have produced it. But after a time, they came to believe that some indefinite "human spirit" would buoy humans through any crisis, and took solace in that belief. The project is undergoing last revisions.

Jefferson's Nursery of Republican Patriots: The University of Virginia

RESEARCHER: ASSISTANT PROFESSOR DAVID P. PEELER

Thomas Jefferson was the founder of the University of Virginia. In part he acted as an Enlightenment man who believed that reason, and especially the trained mind, could plumb the workings of the universe and human societies. But Jefferson had other motives for erecting the University; he

hoped that it would take the nation's future leaders and steep them in the principles of his Republican Party. The method for this project has involved a careful reading of the public and private papers surrounding the early years of the University. The project is complete.

The General Staff and the Emergence of the Modern Military Establishment

RESEARCHER: ASSISTANT PROFESSOR WILLIAM R. ROBERTS

This study underscores the different goals that military leaders sought to achieve through the creation of an army General Staff in 1903. Previous historians have argued that the American General Staff was patterned after European institutions and designed to make the army a more effective fighting force. Its purpose, they maintain, was to make the army a more professional organization. The researcher, however, concludes that the staff reforms introduced at the beginning of the

twentieth century by Secretary of War Elihu Root did less to improve the professional skills of military men than they did to centralize and strengthen the system of administrative controls used by secretaries such as Root and their military advisers to govern the organization they headed. The General Staff Act of 1903, in short, contributed as much to the bureaucratization as it did to the professionalization of the military establishment.

Reform and Revitalization

RESEARCHER: ASSISTANT PROFESSOR WILLIAM R. ROBERTS

This essay covers the problems and reform of the U.S. Army in the period 1890 to 1903. This is one of the essays in *A Changing Army: Interpretation of American*

Military History from Colonial Times to the Present edited by Associate Professor Kenneth Hagan and Assistant Professor William R. Roberts.

The Encyclopedia of American Naval History

RESEARCHER: ASSISTANT PROFESSOR JACK SWEETMAN

This work is intended 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 1500 to 2000 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, aircraft, ships, etc.) and longer, analytical entries on topical areas (amphibious operations, for example). The result should prove a useful aid to anyone working in the field of naval history, whether student, teacher, researcher, or buff. The expected completion date is not before 1988.

The Wars of Expansion

RESEARCHER: ASSISTANT PROFESSOR JACK SWEETMAN

This project traces the awards of the Medal of Honor in America's foreign war from 1871 to 1932, with the exception of World War One. An interpretative introduction places these struggles in the broad context of American foreign policy. It is followed by eight subsections dealing individually with the Korean Expedition (1871), the Spanish-American War (1898), the Philippine Insurrection (1899-1902),

the Boxer Rebellion (1900-1901), the Landing at Veracruz (1914), the First and Second Nicaraguan Campaign (1927-32). Each of these subsections reviews the history of the particular conflict and the Medals of Honor awarded for it, focusing on one or two representative acts of valor. Work on the project has been completed. The result will appear as a chapter in *Above and Beyond: the History of the Medal of Honor*.

Battlefield Atlas of the American Revolution

RESEARCHER: ASSISTANT PROFESSOR CRAIG L. SYMONDS

This volume is a companion to the researcher's *Battlefield Atlas of the Civil War* (Annapolis, 1983) and will survey the critical campaigns and battles of the Revolutionary War in forty full-page color maps, each of which will be

accompanied by a page of text. In addition the book will contain introductory essays on the Early Campaigns, the Turning Point, the War in the South, and the Yorktown Campaign. Publication is forthcoming.

The Improvised Army

RESEARCHER: ASSOCIATE PROFESSOR CRAIG L. SYMONDS

During the American Civil War, the U.S. Army increased from a small frontier garrison force to a modern army numbering in the millions. In the process, the U.S. Army had to adjust not only to its new size, but to the new nature of modern warfare. This essay argues that most of the wartime adjustments

were temporary in nature and responses to a crisis rather than permanent reforms. It is one of the essays in *A Changing Army: Interpretations of American Military History from Colonial Times to the Present*, edited by Associate Professor Kenneth Hagan and Assistant Professor William R. Roberts.

Major General William H. Wotherspoon

RESEARCHER: PROFESSOR PHILIP W. WARKEN

The project is an essay on the life and contributions of General Wotherspoon concentrating on his tenure as Chief of

Staff of the Army. It will be included in a book on the Army Chiefs of Staff.



Research Course Projects

An Examination of the Elites in Weimar and Fascist Germany

RESEARCHER: MIDSHIPMAN 1/C JONATHAN D. EDWARDS

ADVISER: PROFESSOR LARRY V. THOMPSON

This research project was pursued as a means of developing the researcher's knowledge of the nature of German society and the transformation it underwent as the nation moved from a collapsing democracy to a totalitarian rule.

A basis for the pursuit of this study was constructed through the use of Gordon Craig's *Germany: 1933-1945*, which provided an excellent general overview of the Fascist phenomenon in Germany. This work, in conjunction with various other texts, was important in formulating a solid feeling for how the Nazis changed the German State, in particular the governmental institutions of the Weimar Republic.

This facet was further examined in detail

through a paper which advanced the thesis that the highly-centralized Nazi State, a veritable experiment in social engineering, served to elevate the German State to a position of ultimate authority through a type of what can best be described as "secularized religion."

The next phase was a look at the reasons why the Third Reich emerged from the Republic. It was found that the Weimar institutions had preserved the traditional values concerning the power structure in Germany (i.e. authoritarian rule) and in this way had sealed its own doom.

The researcher completed the study with a book by Richard Hamilton entitled *Who Voted for Hitler?* which served as a good summary of this area of German history.

John A. Lejeune and the Development of the Marine Corps' Amphibious Doctrine 1908-1928

RESEARCHER: MIDSHIPMAN 1/C GREG OLSON

ADVISER: PROFESSOR JOHN W. HUSTON

This project was designed to investigate the relationship of General John A. Lejeune's tour as Commander, 2nd Division, American Expeditionary Force (AEF), to the development of the U.S. Marine Corps' amphibious doctrine during his tenure as Commandant in the 1920's. General Lejeune served as Commander, 2nd Division, AEF, as a Marine Corps officer in command of a division composed of both Army and Marine Corps units. He reported to senior Army officers, and was placed under French command from time to time.

The researcher contends that Lejeune's experiences in France contributed to his determination to establish the Marine Corps as an autonomous service under the Department of the Navy. Research for this topic was accomplished using the microfilm copies of the Lejeune papers available in Nimitz Library. In addition, the records of the 2nd Division, AEF and material available at the Marine Corps Historical Society and through History Files, U.S. Marine Corps, provided primary source material.

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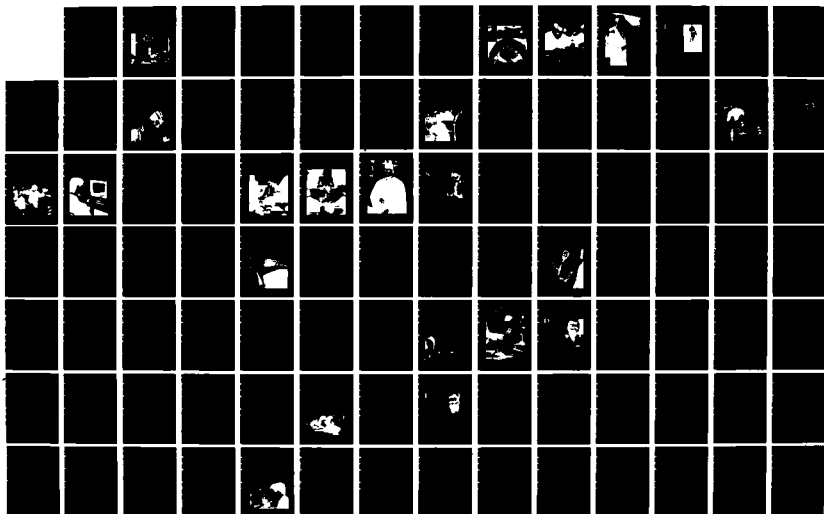
SUMMARY OF RESEARCH ACADEMIC DEPARTMENTS 1984-1985(U)
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The Impact of Enigma on the Allied Conduct of World War Two

RESEARCHER: MIDSHIPMAN 1/C CRAIG B. TAYLOR

ADVISER: PROFESSOR LARRY V. THOMPSON

This project studied the effect that Enigma and Ultra had on how the Allies, especially Britain, fought World War II. The researcher explored the background and development of Enigma. He studied the pre-World War II efforts of the Polish intelligence to break Enigma. The subsequent cooperation with the British intelligence helped immensely, because the Poles already had developed a computer to aid in cracking the millions of permutations possible to the Germans as they sent their code. The researcher argues that Ultra, the British effort to crack Enigma, was a major

contributor to Allied success against the German war effort. Its first major role was in the Battle of Britain, in 1940, when the British were able to decipher Luftwaffe transmissions. Later, transmissions from the Germany Navy and Army were also deciphered.

The ability of the British, and also the Americans to decipher German military communications traffic greatly contributed to the successful prosecution of Allied military operations. Thus Ultra was a major factor in the winning of World War II.



Publications

BOGACZ, Theodore W., Associate Professor, **"Values Made Tangible: Cultural Artifacts and Humanistic Education,"** in *Proceedings of the Tenth International Conference on Improving University Teaching*, College Park, Maryland: University of Maryland, 1985, 240-248.

In this essay, the researcher argues that the arts can and should be a continual focus of attention in a course on Western cultural values. This is so not only because their concrete, often tactile qualities leave a lasting impression on the student, but also because great works of art and architecture are often products of an entire society and thus illustrative of its values. In recalling Augustus's Altar of Peace or Louis XIV's Versailles, the student will remember not only a work of art but also a whole set of associations which will provide a key to understanding the larger culture.

The core of this essay is a discussion of the Parthenon and Chartres Cathedral as places of worship which reveal the larger values of fifth-century B.C. Athens and thirteenth-century A.D. France. The essay concludes with a discussion of how the very alienation of the artist from society since the late eighteenth century can be used to illustrate changing values in the modern world.

BRENNAN, Thomas, Assistant Professor, **"Beyond the Barriers: Popular Culture and Parisian Guinguettes,"** *Eighteenth-Century Studies*, 18 (Winter 1984-85), 153-169.

This article considers the impact of a new form of popular entertainment in eighteenth-century Paris. The *guinguette*, a tavern in the outskirts of the city, became increasingly important to the laboring classes as a source of cheaper wine and uninhibited sociability. Yet a careful analysis of contemporary literature and police records shows that *guinguettes* did not become the scene of popular drunkenness and debauchery that historians commonly depict. They did, however, represent a step in the direction of the commercialization of leisure as they gradually replaced the traditional neighborhood tavern.

BRENNAN, Thomas, Assistant Professor, **"A Bibliography of the Social History of Alcohol,"** *Alcohol in History*, 11 (Spring 1985), 14-15.

The article is a brief bibliographic survey of studies of the production, consumption, and culture of alcohol in France. After considering a number of fundamental monographs on the art and geography of wine production, it notes the comparative absence of similar work on alcohol consumption and its cultural significance. This gap is being filled by several American researchers including this author.

CULHAM, Phyllis, Associate Professor, **"Tablets and Temples: Documents in Republican Rome,"** *Provenance*, 2 (Fall 1984) 15-31.

The belief that the Romans placed historical records in the Atrium for retrieval and consultation is a figment of the nineteenth-century German historical imagination. Those records either did not exist or were not retrievable. This conclusion has sweeping consequences for all of modern historiography on antiquity, since it impugns the credibility of all the ancient, Roman historical narratives.

GOOD, Jane E., Associate Professor, **"Society of Friends of Russian Freedom,"** *Modern Encyclopedia of Russian and Soviet History*, Vol. 36, 1984, pp. 108-110.

This article, based on primary source material in Russian and English, describes an organization founded during 1890 in England, with branches in several American cities. The purpose of the society was to promote the cause of Russian freedom through the support of Russian revolutionaries. The society was active until 1917, was disbanded temporarily, and was reconstituted after 1918 to fight Bolshevism. The society was very instrumental in bringing attention of people outside Russia to the plight of Russian revolutionaries.

HUSTON, John W., Professor, "**General Henry H. Arnold**," in Otis Graham, Jr. and Meighan Robinson Wander, eds., *Franklin D. Roosevelt, His Life and Times: An Encyclopedic View*, Boston: G.K. Hall Co., 1985, pp. 7-8.

This analysis treats the life of General Arnold with particular emphasis on his relations with President Franklin D. Roosevelt after Arnold became Chief of the Army Air Corps in 1933. The relationship was at first a difficult one with Roosevelt insisting that more aircraft should be diverted to Britain and France that Arnold felt should be taken from the build-up of American forces. Upon Roosevelt's realization that through the use of air power, American fighting against the Axis could be first accomplished, Arnold and FDR became amiable colleagues if not close friends. At FDR's insistence, Arnold was taken to every major diplomatic-strategic conference beginning with the Argentina meeting in September 1941 and continuing through Cairo, Casablanca, Tehran, and Potsdam. Thus FDR as a president known for his predilection for the Navy, came to rely extremely heavily upon Arnold as the spokesman for air power.

HUSTON, John W., Professor, "**General Claire Chennault**," in Otis L. Graham, Jr. and Meighan Robinson Wander, eds., *Franklin D. Roosevelt, His Life and Times: An Encyclopedic View*, Boston: G.K. Hall Co., 1985, pp. 56-57.

This treatment covers a stormy relationship between Chennault and President Roosevelt. Chennault, before the United States entered the war, had resigned from the United States Army in a dispute over the efficacy of the bomber versus the fighter plane. He became the chief air advisor to Chiang Kai-shek and, when the U.S. entered the war, Chennault was continued in China, now as an American General. His devotion to Chiang, his optimistic beliefs in the potential of air power based in China, and his use of Chiang to gain materiel and personnel support for the China theater made Chennault a controversial figure in the United States Army. Chennault's unwillingness to accept the China theater as a minor one made him a *persona non grata* in Washington circles, and his relations with FDR reflected this atmosphere.

ISENBERG, Michael T., Assistant Professor, *Puzzles of the Past: An Introduction to Thinking About History*. College Station: Texas A & M University Press, 1985.

This is an introductory approach to teaching history students the critical skills necessary to both understand and enjoy historical writing.

LOVE, Robert W., Jr., Associate Professor, "**Alfred Thayer Mahan**," in Otis L. Graham, Jr. and Meighan Robinson Wander, eds., *Franklin D. Roosevelt, His Life and Times: An Encyclopedic View*, Boston: G.K. Hall Co., 1985, p. 255.

This essay describes Mahan's career, summarizes his works, and argues that they profoundly influenced FDR's naval policy from 1933 to 1945.

LOVE, Robert W., Jr., Associate Professor, "**Ernest J. King**," in Otis L. Graham, Jr. and Meighan Robinson Wander, eds., *Franklin D. Roosevelt, His Life and Times: An Encyclopedic View*, Boston: G.K. Hall Co., 1985, pp. 224-225.

This essay describes King's career and argues that he did not intend to disrupt the "Europe first strategy" of the U.S. in World War II.

MARSHALL, Philip R., Professor, "**H. A. Giles and E. H. Parker: Clio's English Servants in Late Nineteenth-Century China**," *The Historian*, 44 (August 1984), 520-538.

This is a discussion of the lives, the works, and the deeper contributions of these two British historians of Chinese life and society. The motivations of Giles and Parker in taking up Chinese studies, via the British Consular Service, are examined. Of special interest is the extreme popularity of their writings in nineteenth-century England and other English-speaking countries. The viewpoints of these authors, so much less Sinophobic than their early nineteenth-century predecessors, help to mold the modern, more tolerant and balanced view of Chinese culture and history.

PEELER, David P., Assistant Professor, "Unlonesome Highways: The Quest for Fact and Fellowship in Depression America," *Journal of American Studies*, 18 (November, 1984), 185-206.

During the Depression, a significant number of American novelists, poets and essay writers abandoned their earlier efforts. They adopted a new form of expression, the travel report, and based their reports upon their excursions into the countryside. In doing so, people like Sherwood Anderson and James Agee hoped to assuage some of their own loneliness, and also hoped that simple facts could explain both the crisis and how Americans reacted to the crisis. These were largely urban intellectuals loose in the heartland, and they were unable to build friendships with the rural Americans they encountered. Furthermore, they found little explanation for their collections of facts, for no ideology or testable hypotheses had guided their collecting.

SWEETMAN, Jack, Assistant Professor, *American History: An Illustrated Chronology of the U.S. Navy and Marine Corps, 1775-Present*, Annapolis: Naval Institute Press, 1984.

This work provides an annotated chronology of significant events in the history of the U.S. Navy and Marine Corps from the War of the Revolution through April 1984. Coverage is given to social, administrative, and technological as well as operational history, and major "external" events, such as the Roosevelt Corollary, which have influenced the activities of the sea services as instruments of national policy, are included. The text is complemented by illustrations selected by the author and specially-commissioned maps. Ease of reference is facilitated by four separate indexes (calendar, U.S. naval vessels, other vessels and general).

SWEETMAN, Jack, Assistant Professor, Series Editor, "Classics of Naval Literature," Naval Institute Press.

This series, inaugurated by the Naval Institute Press in May 1984, is designed to provide attractive new editions of classic works of naval history, biography and fiction. In addition to the unabridged original text, each work

includes a substantial introduction and, when appropriate, explanatory notes by an expert in the field. Some editions also include new illustrations and maps. The following works appeared during this reporting period:

Rear Admiral William S. Sims and Burton J. Hendrick. *The Victory at Sea*. Introduction and notes by David F. Trask, 1984.

Leonard F. Guttridge and Jay D. Smith. *The Commodores*. Introduction by James C. Bradford, 1984.

Charles Nordhoff. *Man-of-War Life*. Introduction and notes by John B. Hattendorf, 1985.

William H. Parker. *Recollections of a Naval Officer*. Introduction and notes by Craig L. Symonds, 1985.

SYMONDS, Craig L., Associate Professor, ed. *Recollections of a Naval Officer* by William H. Parker, Annapolis: U.S. Naval Institute, 1985.

William H. Parker served as an officer in both the U.S. Navy and the Confederate Navy. In the course of his long career, he served in both the war with Mexico (1846-48) and the Civil War. His *Recollections* are written in a sprightly narrative style and provided excellent reading as well as insight. The editing of his memoirs involved checking the accuracy of his facts and dates and adding explanatory or correcting footnotes as appropriate. A twenty-page editor's Introduction places Parker in historical context. The book is part of the "Classics of Naval Literature" series.

SYMONDS, Craig L., Associate Professor, "William Bainbridge: Bad Luck or Fatal Flaw" in James Bradford, ed., *Captains Under Sail*, Annapolis: U.S. Naval Institute Press, 1985.

Commodore William S. Bainbridge was the hard luck officer of the American sailing navy. He was the only U.S. Naval officer to surrender his vessel in the Quasi War with France, and he ran a frigate aground on a hostile shore during the Barbary Wars and lost both the ship and the crew to the enemy. This essay argues that Bainbridge's "misfortunes" were the product of personal shortcomings rather than bad luck.

Presentations

ABELS, Richard, Assistant Professor, **"Bookland Tenure and the Late Saxon Fyrd,"** Seventh Annual Battle Conference for Anglo-Norman Studies, Battle, Great Britain, 22 July 1984.

ABELS, Richard, Assistant Professor, **"The Military Organization of Alfredian England,"** Third Annual Conference of the Haskins Society, University of Houston, Houston, Texas, 10 November 1984.

ARTIGIANI, Robert, Associate Professor, **"The 'Model Reader' and the Thermodynamic Model,"** Conference on *The Name of the Rose*, Austin, Texas, 21 September 1984.

ARTIGIANI, Robert, Associate Professor, **"Thermodynamics and History,"** Duquesne History Forum, Pittsburgh, Pennsylvania, 7 November 1984.

ARTIGIANI, Robert, Associate Professor, **"Organizing the Nation,"** Modelling Complex Systems, Austin, Texas, 9 March 1985.

ARTIGIANI, Robert, Associate Professor, **"Cultural Evolution and Technology,"** World Future Studies Federation, Dubrovnik, Yugoslavia, 1 April 1985.

ARTIGIANI, Robert, Associate Professor, **"Revolution and Societal Discontinuity,"** Core Group on Alternative Pathways of Social Development, Budapest, Hungary, 11 June 1985.

BOGACZ, Theodore W., Associate Professor, **"High Diction and the Portrayal of the Western Front in the English Press, 1914-1918,"** Western Conference of British Studies, Las Cruces, New Mexico, 27 October 1984.

BOGACZ, Theodore W., Associate Professor, **"Values Made Tangible: Cultural Artifacts and Humanistic Education,"** Tenth International Conference on Improving University Teaching, College Park, Maryland, 5 July 1984.

BOGACZ, Theodore W., Associate Professor, **"The Fortunes of 'Modernity' in England, 1910-1945,"** Principia College, Elsah, Illinois, 3 January 1985.

BRENNAN, Thomas, Assistant Professor, **"Drinking Companions and Social Networks in Old Regime Paris,"** Conference of Social Science History Association, Toronto, Canada, 27 October 1984.

BRENNAN, Thomas, Assistant Professor, **"Drinking and Drunkenness in Eighteenth-Century Paris,"** Conference of American Historical Association, Chicago, Illinois, 28 December 1984.

CALDERHEAD, William L., Professor, **"The Failure of D'Estaing's Mission in 1778: Deliberate or Coincidental?"** Great Plains History Conference, Bismarck, North Dakota, 28 September 1984.

CALDERHEAD, William L., Professor, **"Highlights of the Service of the Maryland Line in the American Revolution,"** Baltimore Round Table, Baltimore, Maryland, 15 November 1984.

CALDERHEAD, William L., Professor, **"Civil War Prisons, A Story of Unmitigated Shame? Fort Delaware, A Case Study,"** Missouri Valley History Conference, Omaha, Nebraska, 8 March 1985.

CULHAM, Phyllis, Associate Professor, **"Ten Years After Pomeroy: A Decade of Studies of Women in Antiquity,"** The Johns Hopkins University, Baltimore, Maryland, 5 April 1985.

CULHAM, Phyllis, Associate Professor, **"The Male Mentalité: Julio-Claudian Women and Texts,"** Classical Association of the Atlantic States, Washington, D.C., 15 October 1984.

CULHAM, Phyllis, Associate Professor, **"Polybius: Foucault's Historian,"** Maryland Classics Colloquium University of Maryland, College Park, Maryland, 10 April 1985.

CULHAM, Phyllis, Associate Professor, **"Literacy and Stored Information,"** Association of Ancient Historians, University of Pittsburgh, Pittsburgh, Pennsylvania, 3 May 1985.

GOOD, Jane E., Associate Professor, **"Ekaterina Breshkovskaia: A Russian Populist in America,"** Sixteenth National Convention of American Association for the Advancement of Slavic Studies, New York, New York, 2 November 1984.

HUSTON, John W., Professor, **"General H. H. Arnold and World War II Leadership in the Army Air Forces,"** Air University, Maxwell Air Force Base, Alabama, 29 August 1984.

HUSTON, John W., Professor, **"General Carl 'Tooey' Spaats and Combat Leadership in World War II,"** Air University, Maxwell Air Force Base, Alabama, 30 August 1984.

HUSTON, John W., Professor, **"General H. H. Arnold and the Struggle for Unification in the U.S. Armed Services,"** Armed Forces Colloquium, French Ministry of Defense, Paris, France, 4 September 1984.

HUSTON, John W., Professor, **"The United States Air Force and History,"** Minot Air Force Base, North Dakota, 18 September 1984.

HUSTON, John W., Professor, **"Jonas Green, Colonial Printer,"** Anne Arundel County Chapter, Daughters of the American Revolution, Annapolis, Maryland, 13 February 1985.

HUSTON, John W., Professor, **"Where Have They All Gone? Students in Colonial and Revolutionary America,"** Lecture Series, Friends of St. John's College and Anne Arundel County Committee of the Maryland Trust, Annapolis, Maryland, 27 February 1985.

JOHNSON, David E., Professor, **"Terrorism: a Conceptual Analysis,"** Joint Services Committee on Professional Ethics, Fort McNair, Virginia, 11 January 1985.

JOHNSON, David E., Professor, **"On Engineering and Values,"** Pi Tau Sigma, Mechanical Engineering Honor Society, U.S. Naval Academy, Annapolis, Maryland, 24 April 1985.

KOCZON, Andrew, Lieutenant Commander, USNR, **"Central America: The Perils and Possibilities in U.S. Involvement,"** Special Forces, U.S. Naval Reserve Unit, Elizabeth, New Jersey, 15 June 1985.

LOVE, Robert William, Jr., Associate Professor, **"American General Staff Reform in Perspective,"** U.S. Military History Commission, Organization of American Historians, Minneapolis/St. Paul, Minnesota, 18 April 1985.

MASTERSON, Daniel M., Associate Professor, **"Current Prospects in Latin America,"** Talbot County International Studies Series, Easton, Maryland, 11 October 1984.

QUARTARARO, Anne T., Assistant Professor, **"Women, Schooling and Social Education in the Nineteenth Century,"** Society for French Historical Studies, University of Southern California, Los Angeles, California, 23 March 1985.

PEELER, David P., Assistant Professor, **"Believing Is Seeing: Documentary Photographers and the Depression Southwest,"** Conference on Texas Myth in Film, Houston, Texas, 20 January 1985.

THOMPSON, Larry V., Professor, **"Comment on Friedrich Katz, *The Secret War in Mexico: Europe, The United States and the Mexican Revolution*,"** Annual Meeting of the Rocky Mountain Council on Latin American Studies, Seeley Lake, Montana, 28 September 1984.



Division of Mathematics and Science





Chemistry

PROFESSOR CHARLES F. ROWELL
CHAIRMAN

The Department's reputation within the Navy nationally and internationally in the field of chemistry continues to increase. This is evidenced by the collaboration between our younger faculty members with the Naval Research Laboratory and the David W. Taylor Naval Ship Research and Development Center on Navy problems and by the association of our faculty with workers at Ohio State University, the University of Massachusetts, the University of Delaware, and the University of Padova in Padova, Italy. There has been a shift toward more fundamental research as new faculty members have joined the Department, but almost all of this work has found sympathetic support from Naval sources due to its potential application.

There has been a reduction in the number of student research courses due to the imposition of Academy curricular requirements and a general tightening of chemistry course requirements. The research reported is of very high quality and represents a truly significant contribution to the education of these young officers.

First rank publications and presentations have increased as the professional growth of the faculty continues apace.



Sponsored Research

Synthesis and Chemistry of Dinuclear Organometallic Compounds

RESEARCHER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF
SPONSOR: RESEARCH CORPORATION

Dinuclear organometallic compounds are of interest because of their ability to serve as models for catalytic sites on surfaces and for their potential ability to function as unique homogeneous catalysts. This research has as its goal the synthesis of a wide range of dinuclear compounds in which the metal atoms are held in close proximity.

In the last year, significant progress has been made in the synthesis of diarylchromium-carbonyl complexes, mixed-metal complexes based on the bis(cyclopentadienyl)methane

ligand. In particular, it has been found that phenylcyclopentadiene and bis(cyclopentadiene)methane react cleanly with thallium ethoxide to produce the corresponding air-stable thallium reagents which can be used as starting materials with many metal carbonyls.

Portions of this research program are being conducted in collaboration with Professor William Geiger of the University of Vermont and with Professor Marvin Rausch of the University of Massachusetts.

Haptotropic Rearrangement of Fluorene Chromiumdicarbonylphosphine Compounds

CO-RESEARCHER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF
SPONSOR: NATIONAL RESEARCH COUNCIL (C.N.R.) OF ITALY

Fused ring organic compounds such as anthracene, phenanthrene, and the fluorenyl anion have two distinct aromatic centers which can serve as points of attachment for a transition metal moiety. In several cases, it has been shown that the metal can move from one center to another with a relatively small activation barrier. When transition metal groups such as chromiumtricarbonyl are bonded to fluorene, the metal occupies one of the normal six-membered ring positions. If one of the methylene hydrogens is removed and a fluorenyl anion is generated, the metal can move to the newly formed five-membered ring. Professor Alberto Ceccon and his coworkers at the University of Padova, Italy,

have carefully examined this process for fluorene and many related compounds.

In collaboration with Professor Ceccon and Assistant Professor Joyce Shade, this researcher directed efforts toward understanding the effect of altering the metal atom's ligands in ways which alter the electron density at the metal atom. A series of fluorenechromiumdicarbonylphosphine derivatives have been prepared, and the effect of the phosphine ligand on the metal's ability to undergo haptotropic rearrangement is being studied. The synthesis of these compounds has been completed by the Academy team, and rearrangement studies are being conducted by the Italian workers.

Electrochemical Studies at Platinum Electrodes Modified with Oxidized Phenol Films

RESEARCHER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

SPONSOR: NAVAL RESEARCH LABORATORY

Further studies of the electrochemistry of organic compounds at modified platinum electrodes have been made. It has been observed previously that electrochemical oxidation of phenol in acetonitrile produces a very thin polymer film on the electrode surface, and that this film markedly affects the electrochemical behavior of various species in solution. In continuing efforts, platinum electrodes have been coated with a variety of phenol derivatives possessing positively or negatively charged substituents. Films containing negatively charged sites were prepared by oxidation of tetraethylammonium salicylate, whereas oxidation of (2-hydroxybenzyl) triphenylphosphonium tetrafluoroborate (prepared by reaction of silver tetrafluoroborate with the corresponding bromide salt) produced a film with positively charged sites. The behavior of these films was evaluated in fresh acetonitrile solutions containing p-benzoquinone.

As observed from the phenol films studied previously, the current for the second benzoquinone redox process was greatly diminished compared to that seen at clean platinum, indicating that the presence of charged sites bound to the electrode surface cannot account for the observed effect. It now seems likely that the rate of electron transfer in the second benzoquinone reduction step is diminished at the coated electrode, the effect being very general with respect to coating type.

Studies were also carried out with much thicker films formed by oxidation of phenol in basic methanol. Reduction of benzoquinone at electrodes coated in this manner produced voltammetric surface waves for oxidation of the benzoquinone anion radical and dianion on the positive-going cyclic voltammetric sweep, indicating that these species form a solid phase on the electrode surface.

Properties of Helical Polyacetylene

RESEARCHER: ASSOCIATE PROFESSOR MARK ELERT

SPONSOR: NAVAL RESEARCH LABORATORY

The recently discovered helical isomer of polyacetylene (an electrically conducting polymer) is poorly characterized experimentally. The researcher has undertaken calculations to determine the equilibrium geometry, electronic properties, and crystal packing of helical polyacetylene (HPA) chains.

The conformation of isolated HPA chains was investigated by performing semiempirical MNDO electronic structure calculations with full geometry optimization for finite chain segments. Oligomers containing up to 24 carbon atoms were considered. The optimum geometry was found to be very close to a perfectly periodic structure with six (CH) groups per helix turn and a unit cell length of 4.84 Å.

The electronic structure of infinite HPA chains at the predicted equilibrium geometry

was calculated using a tight-binding model. The band gap was found to be in excess of 4 eV, making this isomer unsuitable for applications requiring high conductivity.

The crystal structure of HPA was determined by performing an inter-molecular energy minimization as a function of inter-chain distance and helix setting angle for rigid HPA chains on a hexagonal lattice, using standard van der Waals potential energy interaction parameters. The predicted unit cell parameters are very close to the experimental values determined by x-ray diffraction. The packing energy per (CH) unit is comparable to that found for the planar isomer, demonstrating that helix formation might be favored during acetylene polymerization under appropriate reaction conditions.

Phosphazine Hydraulic Fluids

RESEARCHER: ASSOCIATE PROFESSOR FRANK J. GOMBA
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

A critical literature survey was conducted to evaluate development and progress in use of

substitute hydraulic fluids in the U.S. Navy with emphasis on phosphazines.

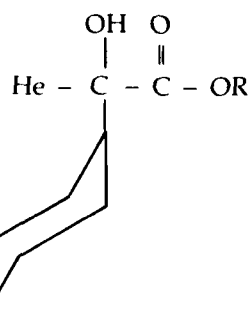
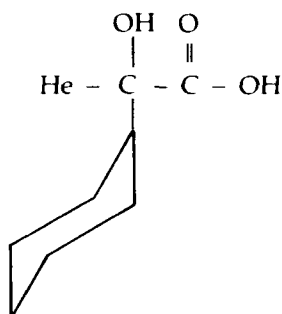
Derivatives of Cyclohexyl Glycolic Acids as Chemical Defense Agents

RESEARCHER: PROFESSOR SAMUEL P. MASSIE
SPONSOR: WALTER REED ARMY INSTITUTE OF RESEARCH

The primary objective of these studies has been preparation of cyclohexyl glycolic acids, and their subsequent conversion to basic esters for study as chemical defense

agents, especially against anti-nerve gas chemicals.

The general formulas for these types of compounds are:



R = 3-quinicidyl
3-tropanyl
 β -diethylaminoethyl
He = heterocycle

The synthesis of these compounds involves addition of a Grignard reagent to the heterocyclic-substituted glycolic

acid. These glycolic acids have proven very difficult to prepare in useful yields.

Evaluation of Liquid Crystals, Dot Fluids, and Compliant Coatings for Hydrodynamic Flow Visualization on Surfaces

RESEARCHER: ASSISTANT PROFESSOR TAYLOR B. JONES
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

An examination of three new hydrodynamic flow visualization techniques has shown that shear-sensitive liquid crystals enable high resolution observations to be made of both steady and unsteady boundary layer separation and transitions characteristics on surfaces.

Some effects of varying the viscosity and chemical composition of fluids used to make "oil" dot patterns were determined. Optical methods of detecting shear induced displacements of compliant coatings were unsuccessful in a water tunnel environment.

Approaches to Pyridyl Glycolic Esters: Pathways to Anticholinergic Drugs

RESEARCHER: ASSISTANT PROFESSOR TAYLOR B. JONES
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Seven routes to pyridyl glycolic esters have been explored. Although the glycolic esters are well known, the presence of pyridine functional group renders

more-or-less standard routes of preparation unsuccessful. More esoteric routes involving lanthanide ions serving as anchors are under study.

Organometallic Coatings Program: Analytical and Quality Control

RESEARCHER: ASSOCIATE PROFESSOR JOHN W. SCHULTZ
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

Organometallic tin polymers were analyzed using Raman, infrared, and nuclear magnetic spectroscopy, to determine new methods for characterizing polymers used in the

manufacture of anti-fouling paints. Ideally these methods will correlate to the performance and longevity of the paints and can be used for quality control purposes.

Synthesis and Characterization of Organometallic Complexes Using Phase Transfer Catalysis and Photochemical Techniques

RESEARCHER: ASSISTANT PROFESSOR JOYCE E. SHADE
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The reactions of cyclopentadienyl carbonyl complexes of iron and ruthenium with allyl and crotyl organic reagents have been investigated. Factors which affect the identity and sigma versus pi bonding selectivity of the products obtained include: (1) the identity of the ligands on the starting materials, (2) the rate and manner of addition of reactants, (3) the identity of the solvents used in the reaction and (4) the nature of the substituent to be removed

from the organic reagent. Synthesis of the pi-bonded crotyl derivatives of the ruthenium system appeared to have been possible using this phase-transfer catalytic approach, based on spectral evidence. Isolation and purification of the isomeric products have not yet been accomplished. Additional work on the separation and complete characterization of the crotyl reaction products is continuing.

Models for Collisions of Two Diatomic Molecules

RESEARCHER: ASSISTANT PROFESSOR BOYD A. WAITE
SPONSOR: NAVAL RESEARCH LABORATORY

Studies of potential surfaces and the crucial points that lead to chemical reactions are progressing toward clarification of significant

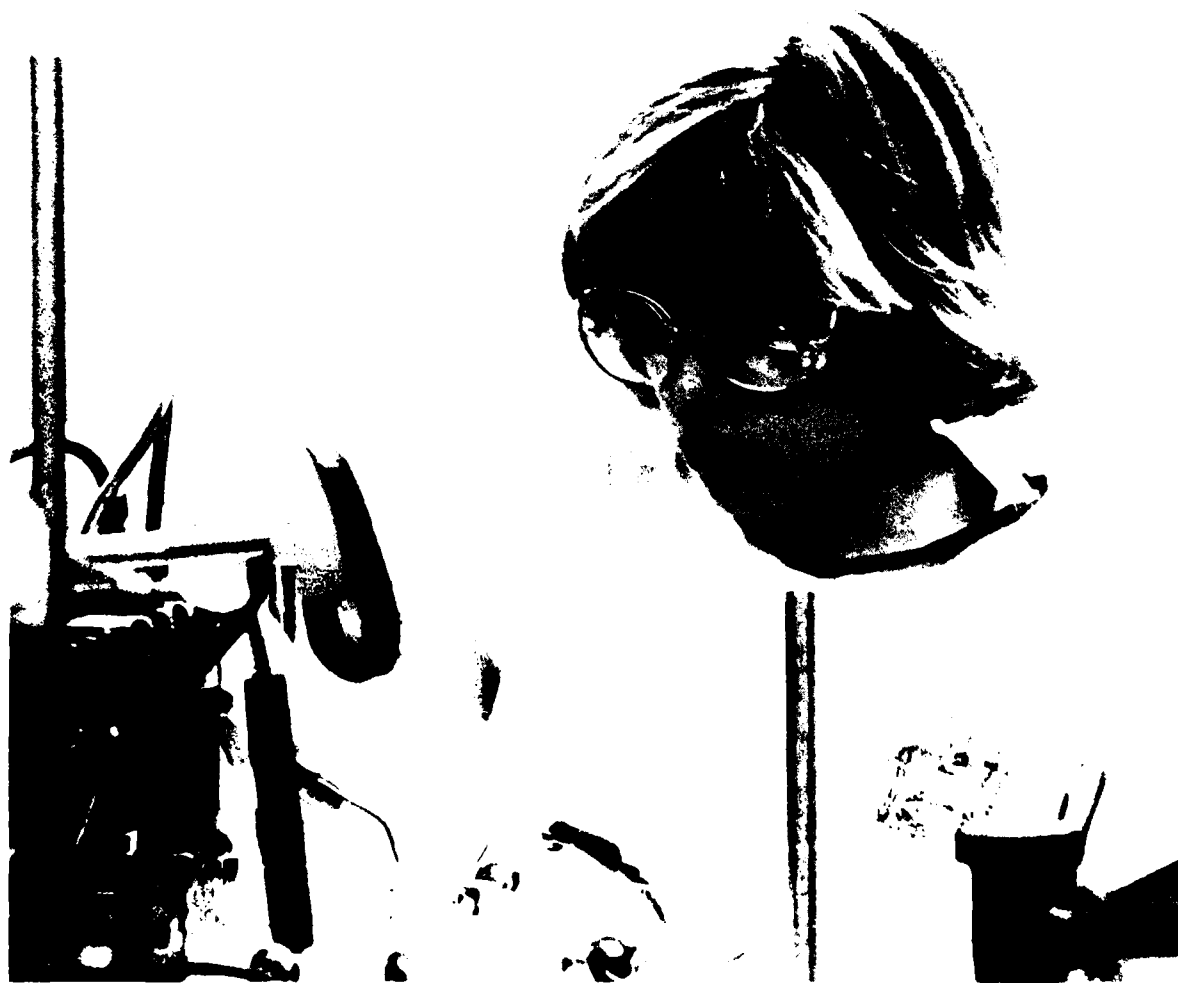
energy parameters. Comparison of Quantum, Classical, and Semiclassical Approaches for a fairly restricted example has been completed.

A Generalized Kinetic Model of the T-Cell Independent Primary Immune Response

RESEARCHER: MIDSHIPMAN 1/C RANDALL N. HYER
SPONSOR: TRIDENT SCHOLAR PROGRAM

This project involved study of kinetics of the primary immune response in vertebrates. A generalized kinetic model was developed which simulated the dynamical behavior of the cell and antibody concentrations during the response. The model was based upon the pioneering work of G. Bell, whose original model included the use of switching functions to represent certain of the rate constants in his scheme. These switching functions essentially guaranteed the quality of results obtained. The purpose of the model developed in this study was to propose a mechanism for the primary immune response (mediated

by antibody) which involved *only* kinetic steps without use of switching functions. A triggering mechanism was developed which not only turns on the immune response, but also turns it off when it is completed. This switching-off mechanism resembles autocatalysis processes in chemical systems. Calculations were performed using subroutines from the International Math and Statistics Library for solving coupled differential equations of the stiff type. Results indicate that the generalized model correctly predicts the behavior observed in the primary and secondary immune responses.



Independent Research

The Reaction of Spin-Orbit State-Selected $\text{Ca}(^3\text{P}^\circ)$ with Alkyl Halides

RESEARCHER: LIEUTENANT MARK L. CAMPBELL, USNR

An optical pumping state selection technique has been employed to study the chemical reactivity of individual $\text{Ca}(^3\text{P}^\circ)$ spin-orbit states. The researcher has studied the spin-orbit dependence of the CaX ($\text{X}=\text{Br}, \text{I}$) A and B chemiluminescence channels for the reaction of $\text{Ca}(4s4p^3\text{P}^\circ)$ with CH_3Br , CH_2Br_2 , $\text{CH}_2\text{CHCH}_2\text{Br}$, $\text{C}_6\text{H}_5\text{CH}_2\text{Br}$, CH_3I and CH_2I_2 . The spin-orbit dependence for these molecules is substantial, with a reactivity ordering similar to that observed previously with Cl_2 and Br_2 , namely $J=2 > J=1 > J=0$.

One complication in these experiments is the presence of the additional metastable state

$\text{Ca}(4s3d^1\text{D})$ which also reacts to form excited CaX . An optical pumping experiment in which ^1D atoms were removed by excitation of the $4s4p\ ^1\text{P}^\circ - 4s3d\ ^1\text{D}$ line at 671.11 nm has shown that the ^1D contribution to the reaction is substantial, representing over 90% of the reaction in the case of CH_3Br , but somewhat less for the other reactants. Based on these experiments, the researcher has been able to determine the chemiluminescence cross-sections for both ^1D and $^3\text{P}^\circ$, and, based on a two-level model system, he has determined the nonreactive intramultiplet mixing cross sections for the selected alkyl halides.

Electrochemistry of Acyl Halides

RESEARCHER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

In an effort to understand further the mechanisms which give different products for benzoyl chloride and benzoyl fluoride reduction, electrochemical investigations of benzoyl chloride in the presence of various additives have been carried out in acetonitrile/tetraethylammonium perchlorate. Upon addition of pyridine to benzoyl chloride solutions, a pyridinium complex is formed which, upon reduction, yields products similar to those obtained in

benzoyl fluoride reductions (benzyl benzoate). These results suggest that reductive formation of a rather stable anion radical is involved in both cases. By comparison, reduction of benzoyl chloride (no additives) results in the formation of stilbenediol dibenzoate, a product derived from initial coupling of benzoyl radicals. These investigations have been very fruitful and are not being extended to other acid chloride systems.

Cation Radical – Nucleophile Interactions in Molten Salts

RESEARCHER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

Research in molten salts has centered on the reactions of 9,10-diphenylanthracene (DPA) cation radical in the molten salt system aluminum chloride: 1-methyl-3-butylimidazolium chloride. Addition of bromide and iodide to solutions of DPA cation radical in the neutral melt results in reduction of the cation radical to neutral DPA, whereas addition of chloride

produces the compound, 9,10-dichloro-9,10-diphenyl-9,10-dihydroanthracene. Reaction with diphenylacetylene leads to formation of a product in a pseudo first-order reaction (excess of diphenylacetylene). The nature of this product, thought to be an adduct of DPA cation radical with diphenylacetylene, will be the subject of future work.

Lithium/Acid Halide Cell Systems

RESEARCHER: ASSISTANT PROFESSOR GRAHAM T. CHEEK

Reaction of thionyl chloride with carbon/polyacrylic acid mixtures has resulted in carbon formulations containing active materials (acid chloride functions)

for use in cathodes for lithium batteries. Future work will involve incorporation of catalysts in the cathodes in order to facilitate reduction of alkyl halides used as active materials.

Studies of Ant Venoms: Isolation and Structure

RESEARCHER: ASSISTANT PROFESSOR TAPPEY H. JONES

Natural products from ant venoms collected world-wide were isolated, identified, and

synthesized when isolated compound was unknown.

Synthesis and Characterization of $(\eta^5-C_5H_5)Fe(R\text{-prophos})X$ Complexes

RESEARCHER: ASSISTANT PROFESSOR JOYCE E. SHADE

Recently, methods for the generation of several chiral bidentate phosphine ligands have been reported which provide the compound in excellent yield and with high optical purity. The majority of the research reported to date using these ligands has been in the development of catalysts for asymmetric syntheses, particularly in the areas of hydrogenations, hydrosilylations, and alkylations. Little has been done, however, to study to formation of new cyclopentadienyl-metal complexes containing these ligands as substituents. The goal of this project has been the preparation of cyclopentadienyl iron complexes containing the bidentate phosphine ligand $(R-(+)\text{-1,2 bis(diphenylphosphino)propane or [(R)-prophos]}$. The cationic complex

$[(\eta^5-C_5H_5)Fe(R\text{-prophos})NCCH_3]Br$ has been prepared and characterized, along with a series of neutral derivatives of the form $(\eta^5-C_5H_5)Fe(R\text{-prophos})X$. Upon review of the data obtained, additional avenues of investigation were determined to be necessary to complete the investigation. In an effort to bring this study to a conclusion, an additional series of complexes was synthesized containing the ruthenium metal. Spectral data was obtained on this series of complexes and is being compared to that of the iron system. In addition, analyses and mass spectral information on these compounds are being obtained to further characterize these compounds.

Research Course Projects

A Potential Energy Surface for C1CN Trajectories

RESEARCHER: MIDSHIPMAN 1/C JOHN A. ELLEGOOD

ADVISER: ASSISTANT PROFESSOR BOYD A. WAITE

A potential energy surface for the excited electronic state of the triatomic molecule C1CN was determined. Potential energy values for various nuclear configurations were obtained from semi-empirical quantum chemistry calculations performed at the Naval Research Laboratory by other researchers. A functional form was chosen which closely resembles the functional form already used in model studies

of the photodissociation of C1CN and other halogen cyanides. It was found that the functional form chosen could be fitted with extremely low deviation from the energy points. The final form obtained for the excited state potential energy surface will be used in classical trajectory studies in order to determine the rotational energy distribution of the CN fragment upon photodissociation.

Synthesis of Cyclopentadienylironcarbonyl Compounds from Cyclopentadienylthallium

RESEARCHER: MIDSHIPMAN 1/C THOMAS M. FRITZ

ADVISER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF

Cyclopentadienylironcarbonyl compounds have been the subject of numerous papers in the literature because of their importance in the catalysis of a variety of organic synthetic processes. Unlike the closely-related ferrocene, the cyclopentadienyl rings of the carbonyl compounds are not subject to easy substitution reactions; thus, few reports have appeared describing the synthesis of ring-substituted derivatives. Recent work in this laboratory and others has led to the synthesis of numerous substituted cyclopentadienylthallium reagents which can be used as starting materials for

the preparation of metal carbonyl compounds. Although there had been no previous application of thallium reagents to the synthesis of iron compounds, there appeared to be no fundamental reason why these reactions should not be successful.

The researcher examined the reaction of cyclopentadienylthallium and tetracarbonyl-irondibromide and found that it was possible to produce cyclopentadienyliron dicarbonylbromide in good yield. This work had been expanded to the synthesis of a new series of iron dinuclear complexes.

Studies on the Synthesis of Benzilic Esters as Possible Precursors in the Preparation of Chemical Defense Agents

RESEARCHER: MIDSHIPMAN 1/C ROBERT C. HADLEY

ADVISER: PROFESSOR SAMUEL P. MASSIE

A study has been made of the use of alkali metal adducts of diaryl ketones as an alternate route to the synthesis of cyclohexyl glycolic esters. This route was considered because previous studies in these laboratories had shown the route of cyclohexyl α -oxoacetic acids to be unsuccessful. Although the work

of Eastham, and others, was carefully followed, no useful product was obtained.

A second approach to the ultimate goal involved studies on the synthesis of 2-pyridyl aldoxime methiodide, commonly known as pralidoxime iodide. The results appear promising.

Synthesis and Characterization of Cyclopentadienyl Ruthenium-olefin Complexes

RESEARCHER: MIDSHIPMAN 1/C JULIE J. KREPSZ

ADVISER: ASSISTANT PROFESSOR JOYCE E. SHADE

The chemistry of cationic (pentahaptocyclopentadienyl) (olefin) iron dicarbonyl complexes and their subsequent reaction with a variety of nucleophiles at the olefinic position to product stable, neutral sigma-alkyliron complexes has been extensively studied. Little work has been done, however, with the ruthenium analogues of this systems. The investigation into similar reactions of isocyanide derivatives of the iron and ruthenium metals had also not been pursued.

The purpose of this research was the synthesis and characterization of several ruthenium carbonyl and isocyanide complexes. The study focused on the synthesis of compounds containing ruthenium as the central

metal atom. Ligands on the metal included a cyclopentadienyl ring, carbonyl groups (Co), cyano groups (CN), and methyl isocyanide groups (CNCH₃). The metal systems are of particular interest for their potential reaction with such olefins as ethylene or propylene.

The synthetic route required the conventional synthesis of several starting materials. An involved series of reactions were necessary to obtain the desired bisisocyanide salt complexes. These reactions were conducted several times in an attempt to optimize product yield and purity. Improvements to the overall synthetic route which were developed will now be incorporated into the next phase of this synthetic study.

Taft Substituent Constants of Cobalt Compounds

RESEARCHER: MIDSHIPMAN 1/C SUSANNE SAALAU

ADVISER: ASSISTANT PROFESSOR THOMAS E. BITTERWOLF

Previous work in this laboratory has demonstrated that the electronic properties of organometallic compounds can be effectively measured by the Taft method. This method requires the synthesis of *m*- and *p*-fluorophenyl derivatives of the compound of interest followed by measurement of the ^{19}F chemical shift relative to that of fluorobenzene. Shifts of the ^{19}F chemical shift relative to fluorobenzene provide a measure of the extent of electron donation or withdrawal of a substituent on the benzene ring.

This study was directed toward the synthesis

of *m*- and *p*-phenylcyclopentadienylcobalt-dicarbonyl. These compounds are moderately air sensitive and required the use of Schlenk equipment for their synthesis. These compounds are the first phenyl-substituted cyclopentadienylcobaltdicarbonyl derivatives and, in addition to their importance in the current research, will serve as models for bimetallic compounds to be examined in the other research programs. The syntheses of the fluorophenyl compounds were highly successful and point the way for future work on rhodium and iridium.



Publications

BITTERWOLF, Thomas E., Assistant Professor, **"Polymer Bound Bimetallic Complexes as Surface Reactants on Semiconductor Electrodes,"** *Metal-Containing Polymetric Systems*, eds. J. E. Sheats, C. E. Carraher, Jr., and C. U. Pittman, Jr., Plenum Publishing Company, New York, pp. 137-148, 1985.

Several bimetallic complexes in which two metal atoms are held in close proximity have been shown to react with acids to liberate dihydrogen. In some cases the oxidized metal compound can be reduced back to starting material making a cyclic process possible. Recent research has shown the polymer-bound bimetallic compounds can be coated onto the surface of p-type semiconductors to fabricate a cell capable of utilizing sunlight to aid in the generation of dihydrogen from acid solutions. This chapter reviews the recent developments in the synthesis of novel bimetallic compounds which have the potential of serving as electroactive catalysts in such a cell. In particular, progress on the derivativization of biarylbis (chromiumdicarbonyl)-u-diphosphine to produce polymer precursors is discussed.

CHEEK, Graham T., Assistant Professor, and Pamela A. HORINE, First Lieutenant, USMC, **"Electrochemical Reduction of Benzoyl Chloride and Benzoyl Fluoride,"** *Journal of the Electrochemical Society*, 131 (August 1984), 1796-1801.

Voltammetric studies of the cathodic reduction of benzoyl chloride and benzoyl fluoride at vitreous carbon and platinum in acetonitrile/tetraethylammonium perchlorate have shown that reduction occurs at potentials (E_p) of -1.82 and -2.29 V, respectively, vs $Ag/AgNO_3(0.1\text{ M})$. Reduction of benzoyl chloride involves one electron per molecule, forming a 2:1 mixture of trans- and cis-stilbenediol dibenzoate. Electrochemical reductions of both product isomers produce good yields of diphenylacetylene. Evidence for the formation of the benzoyl radical, as opposed to the benzoyl anion, was obtained from experiments in which benzoyl chloride was reduced in the presence of another, less easily reducible acyl chloride (p-anisoyl chloride). The involvement

of benzil as an intermediate in benzoyl chloride reduction is supported by voltammetric data for benzil reduction. An n value of 1.1-1.2 was observed for benzoyl fluoride reduction, which led to the formation of benzyl benzoate, diphenylacetylene, and stilbenol benzoate (total yield: approximately 35%) as identifiable products, the remainder of the product being material of higher molecular weight. The greater stability of the anion radical produced from reduction of benzoyl fluoride (compared to that of benzoyl chloride) is evidenced by observation of a reversible system at cyclic voltammetric sweep rates above 50 V/sec, and is thought to reflect the fact that fluoride is generally not as good a leaving group as is chloride.

CHEEK, Graham T., Assistant Professor, and Pamela A. HORINE, First Lieutenant, USMC, **"Electrochemical Behavior of Organic Compounds at the $(SN)_x$ Paste Electrode,"** *Journal of the Electrochemical Society*, 132 (January 1985), 115-119.

The electrochemical characteristics of several types of organic compounds have been investigated at the $(SN)_x$ paste electrode in acetonitrile/tetraethylammonium perchlorate solution. The current density for reduction of benzoquinone in the presence of protons, formed either by hydroquinone oxidation or by addition of HC_{10} , to benzoquinone was found to be considerably less than that for this process at platinum or vitreous carbon. Electrochemical oxidation of representative aromatic amines and hydrocarbons involved behavior similar to that observed at platinum, showing that the oxidized species produced, whether stable or not, undergo no specific interaction with the electrode surface. Although the heterocyclic compounds pyridine, quinoline, and acridine are not themselves oxidizable in the $(SN)_x$ paste potential range, addition of these compounds caused the appearance of an oxidation process at a potential approximately 100 mV negative of the $(SN)_x$ anodic background oxidation. The dependence of the current observed for the process upon heterocycle concentration indicates that the process corresponds to a

shift of the (SN)₁ oxidation caused by a nucleophilic interaction of the heterocycles with the (SN)₁ as it undergoes oxidation. These results indicate that the oxidation of (SN)₁ itself leads to the formation of rather reactive products, while the (SN)₁ surface behaves essentially as a noninteracting, metallic electrode in the potential region between +0.95 and -0.40 V vs SCE, over which (SN)₁ is electrochemically stable in acetonitrile.

JONES, Tappey H., Assistant Professor, co-author, "**(5Z,9Z)-3-Alkyl-5-methylindoizidines from *Solenopsis* (*Diplodoptrum*) Species,**" *Journal of Chemical Ecology*, 10 (1984), 1233-1249.

A homologous series of indoizidines was separated from the venom of *Solenopsis* (*Diplodoptrum*) species. The identification by instrumental methods was verified by counter synthesis and comparison. The stereo-chemistry of the unconjugated diene alkyl function was assigned by both routes.

JONES, Taylor B., Assistant Professor, co-author, "**Evaluation of Liquid Crystals, Dot Fluids and Compliant Coatings for Hydrodynamic Flow Visualization Surfaces,**" Report, David W. Taylor Naval Ship Research and Development Center/SPD-1107-02.

An examination of three new hydrodynamic flow visualization techniques has shown that shear-sensitive liquid crystals enable high resolution observations to be made of both steady and unsteady boundary layer separation and transition characteristics on surfaces. Some effects of varying the viscosity and chemical composition of fluids used to make "oil"-dot patterns are reported. Optical methods of detecting shear-induced displacements of compliant coatings were unsuccessful in a water tunnel environment.

MASSIE, Samuel P., Professor, co-author, "**Derivatives of 2-acetylquinoline as Potential Antimalarial Agents,**" *European Journal of Medicinal Chemistry*, 19 (1984), 49-53.

A series of 2-acetylquinoline thiosemicarbazones with potential antimalarial properties was prepared by the reaction of methyl hydrazine-carbodithiote with 2-acetylquinoline to afford methyl 3-[1-(2-quinolyl)ethylidene] hydrazine-carbodithioate(II). Displacement of the S-methyl group of the latter compound by amines gave the desired 2-acetylquinoline thiosemicarbazones(III). Related thiosemicarbazides were obtained by reduction of the azomethine group of II with sodium borohydride to give methyl 3-[1-(2-quinolyl)ethyl] hydrazinecarbodithioate(IV). The S-methyl group of IV was displaced by amines resulting in the formation of 1-[1-(2-quinolyl)ethyl] thiosemicarbazides(V). Evaluation of the antimalarial activity of compounds types III and V, performed in mice infected with *Plasmodium berghei*, showed that most of the test compounds effected cures in the dose range of 320-640 mg. kg.

SHADE, Joyce E., Assistant Professor, "**Photochemical Reactions of Bis(Bistri-methylsilylamido)tin(II) with Hexacarbonyl-molybdenum and Tungsten,**" *Inorganica Chimica Acta*, 99 (1985), 991-1002.

Irradiation of $M(CO)_6$ ($M = Mo, W$) and $Sn[N(SiMe_3)_2]_2$ in hexane with UV light results in carbonyl substitution to form both $M(CO)_5$ $SN[N(SiMe_3)_2]_2$ and $M(CO)_4(Sn[N(SiMe_3)_2]_2)_2$ complexes. The $M(CO)_4L_2$ species present the first examples in which both *cis* and *trans* isomers have been observed upon substitution of bulky divalent main group IV ligands. The highly air-sensitive $W(CO)_5L$ and $W(CO)_4L_2$ complexes have been isolated from each other through a series of crystallizations out of pentane at reduced pressures. The yellow and golden crystals have been characterized by infrared spectroscopy and elemental analyses.

WAITE, Boyd A., Assistant Professor, "A Classical Plus Tunneling Model for Unimolecular Reaction Dynamics: The HNC-HCN Isomerization," *Journal of Physical Chemistry*, 88 (October 1984), 5076-5083.

A classical-plus tunneling model is developed for describing mode-specific behavior in unimolecular reaction dynamics. Initial conditions are chosen to correspond to various bond-specific preparations, the system then evolving according to the full classical Hamiltonian. At barrier turning points, the trajectories are stopped, and local tunneling probabilities are computed and averaged over to yield a survival probability as a function of time. The HNC-HCN unimolecular isomerization reaction is studied with a potential energy surface of Pearson *et al.* Results indicate a fair amount of mode specificity at low energies, but much less mode specificity at energies above the classical threshold for the reaction. A phenomenological analysis of mode specificity in unimolecular reactions is also presented, yielding results in qualitative agreement with the trajectory calculations.

WAITE, Boyd A., Assistant Professor, co-author, "Classical Model Studies of Dissociation Following Linear to Bent Triatomic Photoexcitation," *Chemical Physics Letters*, 111 (November 1984), 544-548.

Classical trajectory methods are used to calculate rotational energy distributions for the CN fragment upon photoexcitation and dissociation of C₁CN and ICN molecules. It is demonstrated that photodissociation involving a transition from a linear ground state to a bent-excited state can account for the gross structure in the rotational distributions of the CN fragment for these molecules. If one excited

state dominates in the ICN spectrum, its potential energy surface must be characterized by a bending angle near but not equal to the linear configuration. Such a surface would allow for trajectories to "hit" the far bending wall and rebound back towards the linear configuration, thus accounting for the large component of small rotational angular momentum of the CN fragment observed experimentally for the ICN system. The surface for C₁CN must be more diffuse in the bending degree of freedom in order to account for its observed CN fragment rotational distribution.

WAITE, Boyd A., Assistant Professor, "A Gas Kinetic Explanation of Simple Thermodynamic Processes," *Journal of Chemical Education*, 62 (March 1985), 224-227.

Simple thermodynamic processes such as isothermal and adiabatic compressions or expansions are explained in terms of notions from gas theory. The Laws of Thermodynamics are based on experimental observations and, in principle, need no justification in terms of the existence of atoms or molecules. However, for the student, the connection is a conceptual necessity, and this work attempts to provide a simple interpretation of thermodynamic results in terms of collisions and wall encounters. The fundamental concepts of heat and work are defined in terms of random and organized internal energy transfer processes. These definitions are then extended to explain the changes in temperature and pressure accompanying certain thermodynamic processes. Students should be able to understand more fully the impact of molecules and kinetic theory on simple processes as a result of this work.

Presentations

BITTERWOLF, Thomas E., Assistant Professor,
**"Dihydrogen Liberation from Bimetallic
 Organometallic Compounds,"** University
 of Padova, Padova, Italy, June 1984.

BITTERWOLF, Thomas E., Assistant Professor,
"Synthesis of Bimetallic Compounds," Loyola
 College, Baltimore, Maryland, September 1984.

BITTERWOLF, Thomas E., Assistant Professor,
**"Recent Advances in the Synthesis of
 Dinuclear Compounds,"** University of
 Vermont, Burlington, Vermont, March 1985.

BITTERWOLF, Thomas E., Assistant Professor,
**"Use of Cyclopentadienylthallium Reagents
 in the Synthesis of Dinuclear Complexes,"**
 University of Massachusetts, Amherst,
 Massachusetts, March 1985.

BITTERWOLF, Thomas E., Assistant Professor,
 and Thomas M. FRITZ, Midshipman 1/C,
**"Cyclopentadienylthallium Dimers as
 Precursors for Bimetallic Compounds,"**
 American Chemical Society National Meeting,
 Miami, Florida, May 1985.

BITTERWOLF, Thomas E., Assistant Professor,
"Synthesis of Bimetallic Compounds,"
 Centenary College of Louisiana, Shreveport,
 Louisiana, May 1985.

CHEEK, Graham T., Assistant Professor,
**"Cation Radical - Nucleophile Interactions of a
 Room-Temperature Molten Salt,"** Thirty-sixth
 Regional Meeting of the American Chemical
 Society, Raleigh, North Carolina, October
 1984 and Gordon Research Conference on
 Electrochemistry, Santa Barbara, California,
 January 1985.

CHEEK, Graham T., Assistant Professor,
**"Reactions of 9,10-Diphenylanthracene Cation
 Radical in a Room-Temperature Molten Salt,"**
 1985 Electrochemical Society Spring Meeting,
 Toronto, Ontario, Canada, May 1985.

ELERT, Mark L., Associate Professor,
**"Conformation and Electronic Properties
 of Helical cis-Polyacetylene,"** Solid State
 Theory Group, Naval Research Laboratory,
 Washington, D.C., June 1984, and International
 Chemical Congress of Pacific Basin Societies,
 Honolulu, Hawaii, December 1984.

ELERT, Mark L., Associate Professor,
**"Electronic Structure Calculations for
 Heterocyclic Ring Chain Polymers,"** American
 Physical Society National Meeting, Baltimore,
 Maryland, March 1985.

ELERT, Mark L., Associate Professor, **"Band
 Structure and Crystal Parking Calculations for
 Helical cis-Polyacetylene,"** American Physical
 Society National Meeting, Baltimore, Maryland,
 March 1985.

HYER, Randall N., Midshipman 1/C, and Boyd
 A. WAITE, Assistant Professor, **"A Generalized
 Kinetic Model for the Primary Immune
 Response,"** Forty-ninth Annual Intercollegiate
 Student Chemists Convention, Collegeville,
 Pennsylvania, 13 April 1985. (Midn. Hyer was
 awarded First Prize for the Physical Chemistry
 Division for his presentation.)

JONES, Taylor B., Assistant Professor,
**"Approaches to Pyridyl Glycolic Esters:
 Pathways to Anticholinergic Drugs,"**
 Departmental Research Seminar, United
 States Naval Academy, Annapolis, Maryland,
 April 1985.

JONES, Tappey H., Assistant Professor, co-author, **"A Naval Diolefinic Pyrrolizidine from *Cheloner antarecticus*,"** Abstract #377, Southeast Regional Meeting of the American Chemical Society, Raleigh, North Carolina, October 1984.

SHADE, Joyce E., Assistant Professor, **"Synthesis of Transition Metal Complexes Using Phase Transfer Catalysis and/or Photochemistry,"** University of Padova, Padova, Italy, June 1984 and U.S. Naval Academy, Department of Chemistry, Annapolis, Maryland, October 1984.

SHADE, Joyce E., Assistant Professor, co-author, **"Synthesis and Infrared**

Characterization of Mono and Bis Stannylene Molybdenum and Tungsten Carbonyl Complexes," American Chemical Society Meeting, Miami, Florida, May 1985.

WAITE, Boyd A., Assistant Professor, co-author, **"Rotational Energy Distribution Following Photoexcitation of Triatomic Molecules,"** National Meeting of the American Chemical Society, Philadelphia, Pennsylvania, August 1984.

WAITE, Boyd A., Assistant Professor, and Randall N. HYER, Midshipman 1/C, **"A Generalized Kinetic Model for the Primary Immune Response,"** Thirty-seventh Symposium on Fundamental Cancer Research: Immunology and Cancer, Houston, Texas, March 1985.



Computer Science

COMMANDER LOUIS J. GIANNOTTI, USN
CHAIRMAN

In recognizing the importance of research to the ultimate goal of the Department, which is the best possible education of midshipmen, a Department Research Committee was formed to facilitate and coordinate research within the Department. In order to provide an information base for agencies interested in sponsoring research, the committee prepared, published, and will maintain a Computer Science Department "Personnel Information Directory for Research." This directory contains educational, professional, and research backgrounds on each member of the Department, as well as current research interests.

The committee also established a field trip program for faculty members to receive first-hand knowledge of current computerized applications in the civilian and military sectors. The program included trips to DCTECH (an automated manufacturing facility), the Aberdeen Proving Grounds, and the Naval Research Laboratory. For the benefit of all Academy faculty, the committee established a Computer Science Colloquium program. Topics this past year included Networks, Supercomputing, Ada, and Computer-Aided Design, Manufacturing, and Management.

Current research efforts range from research in pure computer hardware and software, through Artificial Intelligence to research in related fields such as Operations Analysis and Management. In an effort to foster cross pollination of research ideas, a Professorial Chair has been established



in cooperation with IBM. The Chair will be filled, for its first term, by Philip Ryan, a computer hardware specialist from IBM.

Sponsored Research

A Knowledge-Based System for Multi-Sensor Integration on P-3C Aircraft

RESEARCHER: ASSOCIATE PROFESSOR PATRICK R. HARRISON

SPONSOR: CENTER FOR APPLIED RESEARCH IN ARTIFICIAL INTELLIGENCE,
NAVAL RESEARCH LABORATORY

The purpose of the Multi-Sensor Information Integration (MSII) project is to demonstrate the use of Knowledge-Based System techniques to improve the integration of various kinds of levels of sensor data with complex time-dependent systems state data. The project focuses on the Tactical Coordinator aboard the P-3C aircraft. It is the job of the Tactical Coordinator to integrate and evaluate incoming sensor information and systems, state information and use this information

to reason about the behavior of targets. The Tactical Officer must reason within the constraints introduced by higher authority, mission objectives and the complex problem environment. MSII finds its greatest potential in assisting with time-critical aspects of target prosecution and with highly ambiguous, low confidence, and highly dense data situations. For example, one function is in solving a single/multiple target ambiguity.



Independent Research

Ada as a Pedagogical Tool

RESEARCHER: LIEUTENANT COMMANDER GEORGE F. ROWLAND, USN

The project is a course development study of academic utilization of Ada Programming Language. The researcher is developing use of VAX 11/780 and concurrent processing systems to demonstrate how weapons technology and computer tools with Ada

can be integrated. The desired result is to interleave Ada at the introductory computer training level and as a research tool to include real-time technology inclusion in weapons engineering and the professional development department.



Research Course Projects

Factors Influencing Graduate Record Exam Scores of United States Naval Academy Midshipmen

RESEARCHER: MIDSHIPMAN 1/C BRYAN P. CAISSE

ADVISER: MAJOR WILLIAM J. HAFLEY, USMC

It has been shown that United States Naval Academy midshipmen taking the Graduate Record Exam consistently score in the upper percentiles in the quantitative portion, but no better than average in the verbal portion. The research proposed and investigated several possible causes for this showing, to include: (1) the technically-intensive education received

by midshipmen; (2) the male/female imbalance (males traditionally score high in quantitative tests), and (3) a similar showing by an incoming class on Scholastic Aptitude Test scores. The researcher also attempted to compare the scores with those obtained by other institutions in an effort to see whether the quality of instruction at the Academy could be a determining factor.

New Enhancements to the PDP-11 Simulator of Naval Academy Time Sharing System

RESEARCHER: MIDSHIPMAN 1/C CRAIG A. COX

ADVISER: ASSOCIATE PROFESSOR FRANK L. K. CHI

The PDP-11 simulator on the Naval Academy Time Sharing System was enhanced to provide macro facilities. Four macros, .PRINT, .GTLIN, .TTYIN, .TTYOUT, were incorporated into the

simulator to allow user inputs and outputs. Three new assembler directives were added. The existing directives .WORD and .BYTE were modified to allow multiple operands.

A Study of Grade Creep at the United States Naval Academy

RESEARCHER: MIDSHIPMAN 1/C MARK D. LITTLE

ADVISER: MAJOR WILLIAM J. HAFLEY, USMC

A study of Grade Creep at the United States Naval Academy was conducted for the years 1976-1981. The researcher planned to continue the study through 1985. Unfortunately, the documentation for the program used to

conduct the original study was unusable. The scope of the research project was then narrowed to a preparation of a user's manual for the collection of software and data files necessary to conduct a Grade Creep study.

An Analysis of the Naval Academy's Effectiveness in Producing Proficient Graduates

RESEARCHER: MIDSHIPMAN 1/C STUART B. MUNSCH

ADVISER: CAPTAIN ARTHUR J. ATHENS, USMC

The purpose of this project was to provide input to the Commandant, Superintendent, and Academic Dean concerning the future direction of the Naval Academy, with emphasis on what aspects of the Academy program need to be strengthened to graduate a more proficient Naval Officer. The objective was to allow a select group of Naval Academy graduates to respond to a questionnaire, providing them a forum to reflect on

their Academy experiences, and provide suggestions for the future direction of the Academy. The questionnaire was sent to former Rhodes Scholars, Brigade Commanders, Regimental Commanders, and Alumni Association Award Winners. The questionnaire asked the respondent to talk about skill and attitude development at the Academy, deficiencies in the program, and suggested readjustments.

Automation of the Academic Dean's Research Finances

RESEARCHER: MIDSHIPMAN 1/C JEFF ROBINSON

ADVISER: LIEUTENANT COMMANDER HARRY W. JOHNSON, USN

This independent research project consisted of creating a database management system designed to manage the financial records of the Academic Dean's research and development finances. The system chosen for the project was a personal computer using the D-Base III software package. The computer acquired for the project

was equipped with a 10M hard-disk drive, which provides an excellent storage location for the databases. The entire program was designed to be user-friendly, and is entirely menu driven. Each desired function in the project was broken into one or more subroutines, making the program very structured.

Publications

CHI, Frank L. K. Associate Professor, "**On the Dimensional Cosmological Principles,**" *The Astrophysical Journal*, 289 (February 1985), 443-445.

The dimensional cosmological principles proposed by Wesson require that the density, pressure, and mass of cosmological models be functions of the dimensionless variables, which are themselves combinations of the gravitational constant, the speed of light,

and the spacetime coordinates. The space coordinate is not the co-moving coordinate. In this paper, the dimensional cosmological principle and the dimensional perfect cosmological principle are reformulated by using the co-moving coordinate. The dimensional perfect cosmological principle is further modified to allow the possibility that mass creation may occur. Self-similar spacetimes are found to be models obeying the new dimensional cosmological principle.



Presentations

HARRISON, Patrick R., Associate Professor, co-presenter, **"Knowledge-Based Multi-Sensor Integration: The Knowledge Base,"** Association for Computing Machinery Meeting, Washington, D.C., June 1985.

WHITE, Jonathan C., Captain, USMC, **"Local Area Networks,"** Computer Science Department Presentation Series, United States Naval Academy, Annapolis, February 1985.





Mathematics

PROFESSOR FREDERIC I. DAVIS
CHAIRMAN

Scholarly activity in the Mathematics Department continues to grow in total output and in diversity. This past year the faculty published one textbook and over 32 scholarly articles in professional journals. In addition, more than 55 talks and lectures were delivered at universities and professional society meetings throughout the United States and in other countries. Represented in this report are examples of mathematics for the sake of mathematics and mathematics used to understand real world phenomena. Algebra, number theory, logic, classical and modern analysis, topology, graph theory, modeling, probability, statistics, mathematical physics, numerical analysis, linear programming, mathematical pedagogy, and philosophy are among areas in which research has taken place.

While some of this work was done independently, much of it was supported by grants from institutions such as the National Science Foundation, the Canadian Natural Sciences and Engineering Research Council, the National Aeronautics and Space Administration, the Office of Naval Research, the Naval Sea Systems Command, the David W. Taylor Naval Ship Research and Development Center, and the American Society for Engineering Education.

The research described below enhances the reputation of the Department and the Naval Academy, and it enriches the teaching of those



who are involved in such inquiry. To be an effective teacher, one must continually be involved in the process of learning.

Sponsored Research

Proteus Mode Selection

RESEARCHER: ASSOCIATE PROFESSOR PETER P. ANDRE

SPONSOR: NAVAL SEA SYSTEMS COMMAND

(ANTI-SUBMARINE WARFARE PROJECT OFFICE)

The Proteus processor is a specialized spectrum analyzer used to help detect underwater targets by analyzing the spectrum of sound energy picked up by a sonobuoy.

The goal of this project was to construct a software package to aid an operator of a Proteus processor to select the optimal mode for the processor, given information about the target and the environment. The software package allows as inputs the figures of merit (FOM) of the target at any frequency of

interest, along with the variances of the FOMs. It also uses a term to measure the average propagation loss at each user-specified frequency. The program then constructs an FOM for each window which the processor can use. The best windows are then pieced together to form modes. The program then constructs an FOM for each mode and orders the modes by the mode FOM. The package gives the user a list of the ten best modes.

Even Hamiltonian Paths

RESEARCHER: ASSISTANT PROFESSOR CRAIG K. BAILEY

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A graph is a finite collection of points and lines. A path is a sequence of points with each point connected to the one before it in the sequence by a line. A path is a Hamiltonian path if it passes through all the points of the graph.

A graph with a Hamiltonian path can have the numbers $1, 2, 3, \dots, N$ assigned to its points such that the point labeled I is adjacent to the point labeled $I-1$ for $I = 2, 3, \dots, N$. A graph with an even Hamiltonian path can have the

numbers $1, 2, 3, \dots, N$ assigned to its points such that (a) the point labeled I is adjacent to the point labeled $I-1$ for $I = 2, 3, \dots, N$ and (b) the point labeled I is adjacent to an even number of the points labeled $1, 2, 3, \dots, I-1$ for $I = 3, 4, \dots, N$. A clique in a graph is a maximal subset of the points of the graph in which each pair of points is connected by a line.

It was determined that graphs with uniform clique size which overlapped in special ways could not have even Hamiltonian paths.

Survival Analysis of Test Panels of Antifouling Paints

RESEARCHER: ASSOCIATE PROFESSOR JAMES L. BUCHANAN

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,

ANNAPOLIS LABORATORY

This project seeks to subject to statistical analysis data gathered from site testing of antifouling paints for the purpose of

comparing paints.

The investigator wrote software for the graphical representation of the data.

Vibrations of a Viscoelastic Bar with End Mass

RESEARCHER: ASSOCIATE PROFESSOR JAMES L. BUCHANAN

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The steady state vibration of a thin bar of viscoelastic material is characterized by two parameters, the dynamic Young's modulus and the loss tangent, both of which vary with the frequency of vibration. As a practical matter, the measurements on which the calculation of these quantities is based are made by attaching accelerometers to each end of the bar. The equations of motion must take into account the presence of these masses. The problem reduces to the numerical solution of two transcendental equations in two

unknowns. These equations manifest numerical instability away from the resonance frequencies.

The investigator is pursuing several avenues of inquiry: (1) finding means of initializing the Newton-Raphson method which will work over a wide frequency range, (2) isolating frequency ranges where effective measurement of the two parameters is impossible because of numerical instability, and (3) determining which values of certain auxiliary parameters lead to physically reasonable solutions of the equations.

Dynamic Models in Mathematics

RESEARCHER: ASSOCIATE PROFESSOR MICHAEL W. CHAMBERLAIN

SPONSOR: NAVAL ACADEMY INSTRUCTIONAL DEVELOPMENT ADVISORY COMMITTEE

The objective of this project was to begin creating up-to-date classroom tools for mathematics instructors so that midshipmen can grasp difficult material involving motion and geometry more quickly, more correctly, and with better retention. Specifically, currently available equipment was used to create color, animated,

three-dimensional computer-generated graphics segments. These were recorded on videotape with narration for use in the researcher's Calculus III section. The topics covered were: motion in space, 3-D surfaces, quadric surfaces, partial derivatives, increments and differentials, directional derivatives, and multiple integrals.

Computer-Aided Engineering for Space Shuttle Design

RESEARCHER: ASSISTANT PROFESSOR CAROL G. CRAWFORD

SPONSOR: NATIONAL AERONAUTICS AND SPACE ADMINISTRATION AND AMERICAN SOCIETY
FOR ENGINEERING EDUCATION FACULTY FELLOWSHIP PROGRAM

The Mechanical Systems Branch of the Systems Engineering Division at the Johnson Space Center is responsible for the design and development of mechanical systems aboard the Space Shuttle. This engineering process is greatly enhanced by the use of computer-aided design (CAD) and computer-aided engineering

(CAE). This project dealt with the development of CAD/CAE tools to aid in the design of new mechanical systems and in the analysis of existing flight-tested systems. Special attention was given to solid modeling, finite element modeling, finite element analysis, and kinematic and dynamic analysis.

Aspect Graphs and Robot Vision System Design

RESEARCHER: ASSISTANT PROFESSOR CAROL G. CRAWFORD

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
CARDEROCK LABORATORY

Aspect graph construction is part of an effort to develop an efficient method to transfer geometric data from a solid modeler to a robot vision system. The technique (based on research developed by J. J. Koenderink and A. J. van Doorn of the Rijksuniversitat at Utrecht, Netherlands) interprets how the human vision system derives and encodes information about three-dimensional objects. This research has

led to two publications presenting algorithms for the automatic generation of aspect graphs. Current investigations include the design of more efficient algorithms and the potential use of aspect graphs in three-dimensional imaging of fractiles in robot vision. A cooperative effort with the Machine Vision Group at the National Bureau of Standards has provided a test-bed for recent results.

Computer Modeling of the Far-Field Acoustic Output of a Submersible Hull

RESEARCHER: PROFESSOR JAMES M. D'ARCHANGELO

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The aim of this project was to test an existing structural-acoustic-hydrodynamic Model for a submersible hull subject to internal and external exciting loads. The ultimate aim is to produce an engineering-mathematical computer model which will predict the far-field acoustic output level of a hull and be flexible enough and inexpensive enough to use as a design engineering tool for the present and succeeding

generations of submarines.

The model utilizes an "analytic" or "normal mode solution" technique rather than finite elements, because a physical understanding and explanation can be gained of the major contributing modes and because of the prohibitive expense involved with accurate high element density models using finite elements.

Determining the Existence of Subsamples in a Sample from a Mixture

RESEARCHER: ASSISTANT PROFESSOR GARY O. FOWLER

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

In the early stages of testing anti-fouling coatings for ship hulls, test panels are prepared and exposed to marine conditions. The amounts of fouling are then reported on a regular basis. Occasionally, a collection of panels that should be fouling at the same rate, appears to have some panels fouling at a more rapid rate than the others. That is, a collection of panels that should act as if it were a sample from a single population instead acts as if it were two samples, each from different populations. Two problems have been investigated. First, is the single sample really two samples, and second, how should the sample units be divided into the two samples?

Two existing methods for answering these problems were tested. The Akaike Information Criterion (AIC) has good theoretical properties,

but did not perform well when applied to actual data. In particular, when data were generated from a mixture of two binomial distributions with different parameters, AIC was unable to distinguish the two samples even when the differences were visible to the casual observer. Further investigations showed that AIC is very sensitive to rather small changes in the statistic used in the procedure. In contrast to AIC, a numerical method of estimating maximum likelihoods by Dempster, Laird and Rubin (1977), called the EM algorithm, proved to be very good at distinguishing the two samples. However, this method is slow and can converge to a local rather than a global maximum. Some care must be taken in the computer implementation of the EM algorithm.

Negative Energy States in Quantum Gravity?

RESEARCHER: ASSISTANT PROFESSOR MARK J. GOTAY

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The mechanism of "quantum tunneling through classical constraints" proposed by Ashtekar and Horowitz is analyzed from the standpoint of geometric quantization theory. It is shown that quantizations which lead to this phenomenon are spurious, and

a quantization ansatz is proposed which eliminates such pathologies. It follows that this mechanism does not provide a physically viable means of transcending the classical positive energy theorems in quantum gravity.

Constraints, Reduction and Quantization

RESEARCHER: ASSISTANT PROFESSOR MARK J. GOTAY

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Theorems are proven which establish the equivalence of the geometric quantization of the extended and reduced phase spaces

of a constrained classical system with symmetry. Several examples are presented.

Non-Coincidence Index and the Fixed Point Property

RESEARCHER: ASSISTANT PROFESSOR MICHAEL E. HOFFMAN

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

A topological space is said to have the fixed point property (FPP) if every continuous function from the space to itself fixes some point of the space. If attention is restricted to "nice" spaces like manifolds, the FPP is fairly rare. The investigator has defined, for any space, a number (a positive integer or ∞), the non-coincidence index, which is 1 if the space has the FPP and increases for spaces that deviate further from having the FPP. This investigation

concerns the relationship between manifolds of finite non-coincidence index greater than 1 and those with the FPP. For example, the investigator has shown that, under certain conditions, a manifold of finite non-coincidence index admits a free group action such that the orbit space has the FPP. A related question, also under investigation, is: If a manifold M has a free action by a finite group G , under what conditions does the orbit space M/G have the FPP?

A Two Processor Sensitivity Analysis

RESEARCHER: ASSOCIATE PROFESSOR ARTHUR A. KARWATH

SPONSOR: NAVAL SEA SYSTEMS COMMAND

(ANTI-SUBMARINE WARFARE SYSTEMS PROJECTS OFFICE)

This project is a comparative analysis of two different acoustic signal processors. A probabilistic model is used to study the sensitivities of the processors as a function of

variations in the acoustic energy received by the detectors. The data used were obtained in several different oceanic regions and in different seasons. The work is classified secret.

Research into the Joint Applications of the Theory of Semigroups with the Theory of Fuzzy Sets to Problems in Pattern Recognition

RESEARCHER: ASSOCIATE PROFESSOR BAO-TING LERNER
SPONSOR: NATIONAL SCIENCE FOUNDATION

The objective of this project is to investigate and develop the joint applications of the theory of semigroups with the theory of fuzzy sets to provide solutions to problems in pattern recognition and computer vision. Using the techniques and results of fuzzy set theory, the problem of inferring the nature or shape of an object from incomplete or imprecise sensory data will be studied.

Recently, there have been considerable efforts to build computer vision systems which have the capability to describe objects and their interspatial relations. The main thrust of these systems is to derive

three-dimensional information about the objects from their two-dimensional visual images. However, the problem of analyzing these images is compounded by complex and imprecise data arising from factors such as illumination, viewing angles, and topological properties of objects. Fuzzy set theory affords an effective methodology to deal with such imprecise and complex processes.

Three pattern recognition problems and their solutions in terms of the concepts of fuzzy sets and semigroups are outlined as specific research tasks.

Dynamical Models of Tumor Chemotherapy

RESEARCHER: ASSISTANT PROFESSOR THOMAS J. MAHAR
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The purpose of this research is to study the qualitative behavior of dynamical models of tumor growth and regression under a given chemotherapy protocol. Of particular interest are the effects of age-structure and cycle-specific drugs. The specific objectives are to formulate various models of tumor growth and compare their dynamical behavior. If the models lead to different predictions of the future course of the tumor, experimental data can be used to determine the best model. If the models offer essentially similar predictions, two alternatives are available. First, the simplest model can be used if it leads to clinically acceptable predictions. Second, if none of the models is trustworthy in its predictions, much more complicated models can be studied. In view of the coarseness of most clinical measurements, this second alternative has little appeal. The models would have to include many assumed biological mechanisms which would be difficult to measure.

The methods used to study these questions include phase plane analysis, differential

inequalities, the method of characteristics, and asymptotic methods.

The results to date include the following: All generic, lumped-parameter models lead to the same qualitative predictions, except for the possible eradication of the tumor. A very simple condition determines whether or not the model predicts that a tumor might be eradicated with appropriate treatment. Many models, including the one that seems to fit clinical data best, predict that the tumor can never be eradicated by any chemotherapy protocol.

Models which age-structure in the tumor population are much more complicated than the lumped-parameter models and require assumptions about the underlying biological mechanisms which are difficult to verify. Using only qualitative assumptions about these mechanisms, it can be shown that a number of these age-structure models can be reduced to equivalent, lumped-parameter models even when cycle-specific drugs are employed. Several other classes of models are being studied.

Applications of Stochastic Estimation and Control Theory

RESEARCHER: ASSISTANT PROFESSOR PAUL B. MASSELL
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

An algorithm for finding a near-optimal solution for a discrete time-control problem (motivated by a chemotherapy scheduling problem) was analyzed in various ways. This involved determining when an optimal solution can be found, how good the solution is in general, and comparing the above algorithm with some well-known bin-packing algorithms.

An investigation of the statistical properties of

certain simple discrete dynamical systems was begun. In particular, the iterates of the quadratic map $y = rx(1 - x)$ were investigated for values of r in the chaotic region, $3.57 < r < 4$. Computer graphs were generated for many values of r and Liapunov exponents were calculated for a few values of r . Computer graphs were also generated for the complex quadratic map; this leads to curves called Julia sets.

Extending Quasi-Free Derivations

RESEARCHER: ASSISTANT PROFESSOR GEOFFREY L. PRICE
SPONSOR: NATIONAL SCIENCE FOUNDATION

A linear operator δ defined on a uniformly dense $*$ -subalgebra $D(\delta)$ of a C^* -algebra B is called a $*$ -derivation if it satisfies the identity $\delta(xy) = (\delta x)y + x(\delta y)$, for x and y in $D(\delta)$. Determining conditions on a derivation which guarantee that it is a generator of a C^* -dynamics is a topic undergoing intensive study by numerous authors. One direction which this theory has taken is to pursue the similarities between generators of a C^* -dynamics and generators of one-parameter groups of unitary operators on a Hilbert space (self-adjoint operators). In particular, one

would like to develop an index theory for derivations analogous to deficiency indices for symmetric operators on a Hilbert space. Since quasi-free derivations are defined using symmetric operators, they are a natural place to start exploring this analogy. Recent joint work with P.E.T. Jorgensen shows that a quasi-free derivation δ_A satisfying certain restrictions will have only quasi-free generator extensions. An immediate goal is to relax the conditions on A to consider extensions of derivations δ_A , where A has arbitrary deficiency indices.

Extendability of Derivations

RESEARCHER: ASSISTANT PROFESSOR GEOFFREY L. PRICE
SPONSOR: NATIONAL SCIENCE FOUNDATION

Let T be the circle group acting as gauge-automorphisms of product type on a uniformly hyperfinite C^* -algebra A , and let A^T denote the corresponding subalgebra of fixed points of A under the action (the gauge-invariant CAR algebra). Examples have been produced of derivations on A^T which are generators on A^T (see the previous

abstract), but which fail to extend to closed densely-defined derivations on A . This result is a byproduct of a comparison of the centers of A and of its fixed-point subalgebra A^T . It would be interesting to try to pin down necessary and sufficient conditions for a commutative $*$ -derivation on A^T to admit densely-defined extensions to A .

Shifts on C^* -Algebras

RESEARCHER: ASSISTANT PROFESSOR GEOFFREY L. PRICE
SPONSOR: NATIONAL SCIENCE FOUNDATION

Let A be a von Neumann algebra. Two endomorphisms α, β of A are said to be outer conjugate if there exists a unitary operator U in A and an automorphism γ of A such that $\alpha(U \cdot U^*) = \gamma \circ \beta \circ \gamma^{-1}$. A remarkable result of Alain Connes states that if α is an aperiodic automorphism on the hyperfinite II_1 factor (a factor is a von Neumann algebra with trivial center), then α is unique only up to outer conjugacy.

In joint work with R. T. Powers, the problem of determining the outer conjugacy classes of

binary shifts on the hyperfinite II_1 factor R is considered. α is a binary shift if (1) the intersection of all the shifts $\alpha^n(R)$ is trivial; (2) there exists a self-adjoint unitary U such that R is generated by U and its shifts under α ; and (3) U either anti-commutes or commutes with its shifts $\alpha^n(U)$.

Preliminary work indicates that the outer conjugacy classes of binary shifts are indexed by the number n such that the n^{th} shift $\alpha^n(R)$ has a non-trivial commutant in R , $n = 2, 3, \dots, \infty$.

Evaluation of Robotic Control Systems

RESEARCHER: ASSISTANT PROFESSOR JAMES M. STORMES
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
CARDEROCK LABORATORY

Robotic technology has many potential applications to Navy logistics functions. Routine aircraft maintenance involves time-consuming procedures. Munitions handling and damage control are inherently dangerous. The value of automating such procedures is no less than that of automating manufacturing.

The adaptation of robotic technology to such functions requires the evaluation and solution of several potential problems. Manufacturing robots function in a stable environment, are immobile, and manipulate payloads that are of relatively small mass as compared to the manipulator itself. The question arises whether

control systems designed for such conditions will perform adequately when subject to ship motions or attempting to manipulate massive payloads. The mobility requirements of a damage control robot pose even greater difficulties.

To address such questions, the researcher has proposed a program of investigation centered upon the IRI M50 robot. The program consists of three parts: construction of a computer-based model of the IRI M50; evaluation of the performance of the existing control system; and investigation of several alternative methods of control.

Products of Sums of Squares

RESEARCHER: ASSISTANT PROFESSOR JOANN S. TURISCO
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The main objective of this project is the classification of triples (p, q, r) for which one can find formulas of the type: $(x_1^2 + \dots + x_p^2)(y_1^2 + \dots + y_q^2) = z_1^2 + \dots + z_r^2$ where the x_i 's and y_j 's are indeterminants, and each z_k is a bilinear form in the x_i and y_j . By the well-known theorem of Hurwitz, the formula exists for $p < q = r$ only when $p = 1, 2, 4$, or 8 . The Radon-Hurwitz Theorem provides a solution when $p = r$ or $q = r$. This study deals with the case where $p \neq r$ and $q \neq r$.

There are two aspects to this project. First there is the problem of obtaining triples (p, q, r) for which the above formula holds. These triples are called "admissible." The second, and more difficult, problem is that of determining, for fixed p, q , the smallest r for which such a formula exists. The methods used for

determining the existence of admissible triples involve explicit constructions. An infinite sequence of examples is obtained by using certain "special" Clifford algebra representations. Several other examples are constructed using certain orthonormal and "diagonal" properties of the bilinear forms z_k with the aid of a computer program developed by Associate Professor James Buchanan, Mathematics Department, USNA. It is shown that these examples do give the minimal r for various values of p and q .

Some insight into the problem of determining the minimal value of r is obtained by considering isometry classes over the field of rational numbers of a certain quadratic form associated to the "Hopf" map which corresponds to the bilinear forms z_k , $1 \leq k \leq r$.

Ultrasonic Wear Particle Sensor

RESEARCHER: ASSOCIATE PROFESSOR JOHN C. TURNER
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The purpose of this multiyear project is to develop an ultrasonic detector for metal wear particles in an oil line. Test bed data have been analyzed to determine noise levels, model the outputs as a function of inputs, and to develop a means of relating the particle size distribution to the ultrasonic returns. This has involved

statistical analysis, as well as mathematical modeling of the physical process.

The overall noise level of the data has been determined, and a framework for relating system outputs to inputs has been developed. In the coming year, the results of the test bed analysis will be applied to real bearing-failure data.

Biotoxin Release Rate

RESEARCHER: ASSOCIATE PROFESSOR JOHN C. TURNER
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The purpose of this project is to determine the rate of release of biotoxins from shipboard paints. The objective is to analyze the current methodology for measuring these rates to determine their statistical validity.

One step was to construct a statistically designed experiment to evaluate the current method. This experiment is currently being run and the data are yet to be analyzed.

Nonlinear Multi-Curve Least-Squares Fitting of Dielectric Data

RESEARCHER: ASSOCIATE PROFESSOR PETER J. WELCHER
SPONSOR: OFFICE OF NAVAL RESEARCH

The investigator has written about 7000 lines of Fortran code which provide for the fitting of dielectric relaxation data obtained by Professor John Fontanella of the Physics Department, USNA. The data consist of measurements taken at 17 frequencies, various temperatures, and various pressures. There are a number of contending expressions said to describe the data, as well as different ways of fitting the parameters in those expressions. The program currently covers all but one of the expressions in the literature.

A novel approach to fitting the data is used. The curves obtained by holding temperature constant and varying frequency often are similar in shape and may be superimposed.

Until now, this has apparently been done by hand. The fitting process was automated to allow for both the shape of the curve and the shift of the data to the "master curve" calculated by the computer. The data shifts then provide a well-defined way of getting at other information of physical interest, namely the activation energy for the relaxation.

Future work will involve extending the capabilities of this powerful multi-curve data-fitting program to cover other theoretical expressions describing data currently being taken with new lab equipment. Longer-term objectives include polishing the user interface and providing interactive graphics to follow the calculations as they are done.

Continuity and Differentiability with Respect to Parameters of Average Values in Dynamical Systems

RESEARCHER: ASSISTANT PROFESSOR WILLIAM D. WITHERS
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

Consider a space X together with a function f from X into itself and another real- or complex-valued function u on X . This serves as a model of a physical system where X is the space of possible states of the system, f

describes the evolution of the system during one unit of time, and u represents some physical quantity associated with the system. Of primary interest is the long-term average value of u :

$$A(u) = \lim_{n \rightarrow \infty} \frac{1}{n} \sum_{k=0}^n u(f^k(x)).$$

In the case where f , and perhaps u also, depends on an additional parameter a , $A(u)$ is also a function $A(u,a)$ of a . The conditions under which $A(u,a)$ is a continuous or differentiable function of a , together with methods for calculating the derivative of $A(u,a)$ with respect to a , are investigated.

The overall framework has been obtained for a proof that, under fairly general conditions, the function $A(u,a)$ is a differentiable function of a . The arguments used in the proof also yield an efficient algorithm for calculating the derivative of $A(u,a)$ with respect to a in a large subclass of systems.

The Weil Transform and the Uncertainty Principle

RESEARCHER: ASSISTANT PROFESSOR WILLIAM E. YANCEY

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

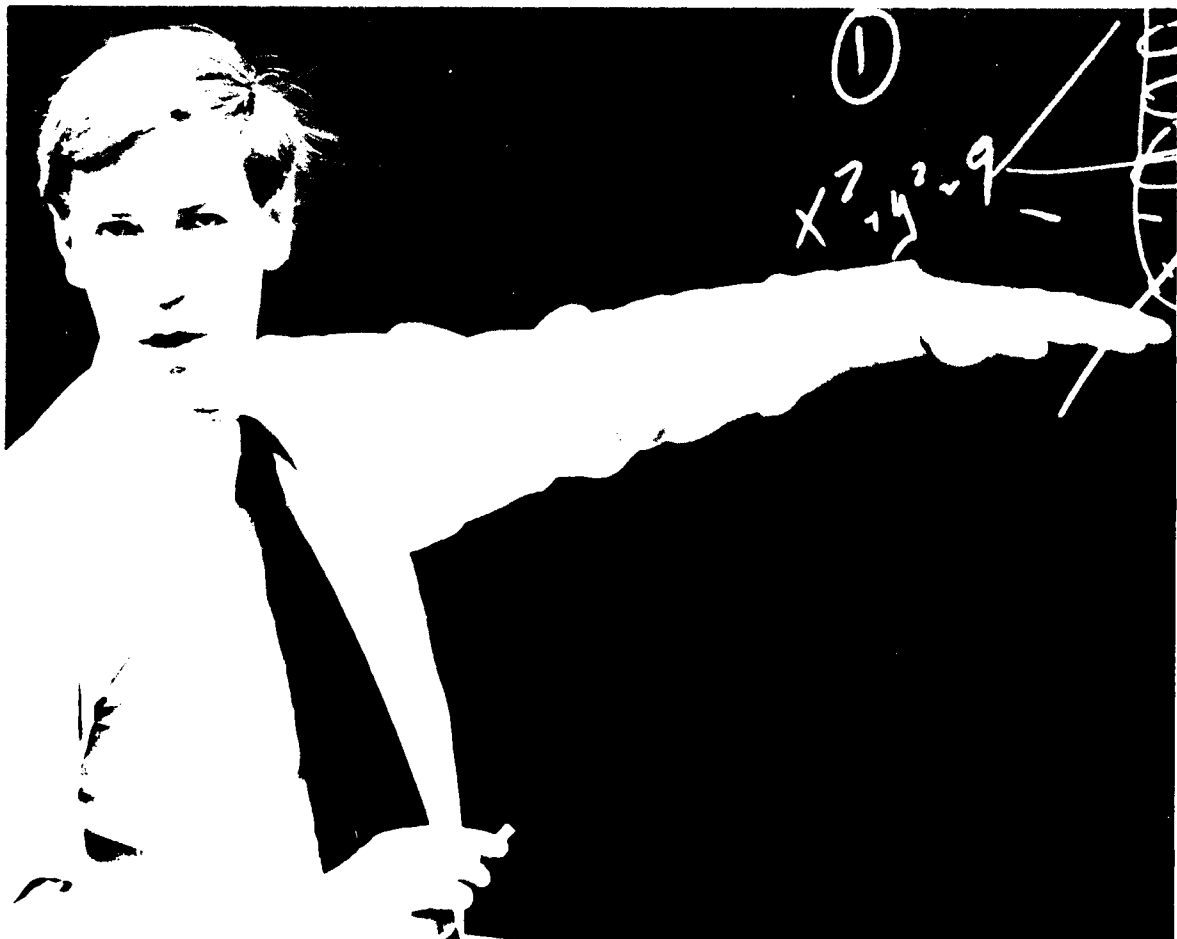
The Fourier Transform is used in signal processing to transform a signal $f(t)$ in the time domain to its Fourier Transform $F(\omega)$ in the frequency domain. The Uncertainty Principle states that the time-band duration of the signal and the frequency-band duration of the transform are in inverse proportion. Thus, short duration signals have wide frequency bands, over which it is time-consuming to search for peak frequencies.

By restricting the Weil Group representation to the rotation group, one obtains a one-parameter family of integral transforms, which are called collectively the Weil Transform. For intermediate values of the parameter, the transform interpolates between the identity and the Fourier Transform. Moreover, since the Weil Transform derives from a group

representation, the Weil Transform obeys a composition law. Thus, one can obtain an "nth root" of the Fourier Transform.

By using this fractional Fourier Transform, one can obtain modified versions of various Uncertainty Principle results. Modified inequalities are proved and functions are obtained for which the lower bounds are achieved for the standard Heisenberg Uncertainty Principle, the time- and band-limited restricted cases, and the Slepian-Pollack-Landau energy concentration cases.

These results suggest that the Weil Transform may be of practical use in the analysis of short time-duration signals. The next reasonable step is to try to implement the computation of the Weil Transform, possibly using a digital analogue if some efficient algorithm can be developed.



Independent Research

Approximating Function Theoretic Kernels

RESEARCHER: ASSOCIATE PROFESSOR JAMES L. BUCHANAN

In the function theoretic study of partial differential equations, there are a number of important integral representations of solutions to elliptic equations. The calculation of the associated kernels, even approximately,

has heretofore been confined to a few simple cases. The investigator is looking at more complicated cases where computer algebra may be brought to bear in the computations.

Nilpotent Products of Abelian Groups

RESEARCHER: ASSOCIATE PROFESSOR ANTHONY M. GAGLIONE

Let G be a free product of a finite member of groups $G(i)$; i.e. $G = G(1) * G(2) * G(s)$ where each $G(i)$ is a finitely generated Abelian group. Let G_n denote the n th term of the lower central series of G . (This is the series of subgroups of G defined inductively by $G_1 = G$ and $G_{n+1} =$ group generated by all commutators $(a, b_n) = a^{-1}b_nab_n$ where $a \in G$ and $b_n \in G_n$.) The main object of this

project is to investigate the structure of the quotient groups $\overline{G}_n = G/G_{n+1}$ for $n = 1, 2, 3, \dots$. These $\overline{G}_n$ are nilpotent products by definition. The goal of this investigation is to "completely determine" all the $\overline{G}_n$ for all positive integers n . The phrase "completely determine" here means to find presentations for these groups in terms of generators and relators.

Singular Angular Momentum Maps

RESEARCHER: ASSISTANT PROFESSOR MARK J. GOTAY

This project is intended to analyze the algebraic and differential geometry of singular momentum maps for the group $SO(n)$. The structures of such systems have been completely uncovered

and they have been Poisson-reduced in all dimensions. The results have been compared to the (singular and slightly incorrect) predictions of the Marsden-Weinstein reduction procedure.

Locally Free Sheaves on Quasi-Projective Schemes

RESEARCHER: ASSISTANT PROFESSOR CHARLES C. HANNA

If X is a scheme, the structure sheaf $\mathcal{O}_X$ is the archetypal locally free sheaf on X . If X is projective or quasi-projective over a scheme Y , then the twisting sheaf of Serre gives rise to a family $\{\mathcal{O}(n)\}$ of locally free sheaves of rank one on X . Kleiman proved in 1969 that if Y is $\text{Spec } k$ for some algebraically closed field k , then every locally free sheaf on X whose rank exceeds the dimension of X has some $\mathcal{O}(n)$ as a subsheaf. The investigator extended this result in 1981 to the case of k , an arbitrary noetherian ring. The key theorem was an

extension of a theorem of Eisenbud and Evans on basic elements to the context of graded modules. Heitmann has recently published a version of the Eisenbud-Evans theorem which requires no noetherian hypotheses on the underlying ring. The goal of this research, now in its preliminary stages, is to extend this result and some other work of the investigator on graded rings to determine under what hypotheses an arbitrary locally free sheaf on a quasi-projective scheme has some $\mathcal{O}(n)$ as a subsheaf.

Natural Set Theory

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

In this investigation, the researcher is interested in modeling the basic axioms of ZFC-set theory in terms of a natural meta-language. This natural language utilizes the concepts of "floors," the natural partial order of "above" or "below,"

and the intuitive concept of "induction."

Assuming classical meta-logic, comprehensive proofs are being developed that show that each axiom of ZFC holds true within this natural model.

Subparticles and Realism in Quantum Theories

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

By utilizing the Extended Grundlegend Model — a nonstandard model for fragments of natural and formal languages — certain elementary descriptions within particle physics are rationally translated into behavioral descriptions for a possible new class of sub-objects termed subparticles. The necessity for subparticles follows from the most basic logical operator that produces a describable change in a natural system. Subparticles are basically generated by a

hypercontinuous subtle (supermind) logical operator $*S$ applied to a hyperconsistent singleton set $\{w\}$. The object w is a purely nonstandard hyperfinitely long word and the subparticles are generated in a hypercontinuous manner.

Subparticles apparently yield a mediating structure for all quantum transitions, provide an actual substratum for relativistic and cosmological theories, and may be the bases for a pregeometry in the sense of Wheeler.

Language and Science

RESEARCHER: ASSOCIATE PROFESSOR ROBERT A. HERRMANN

This research discusses and mathematically models such concepts as rational description, indirect verification, scientific theories, scientific speculation, Mill-induction and other forms, falsifiability, and hypothesis modification, among others. In particular, it is established that the concept of statistical randomness is language dependent and that the concept of philosophical or absolute random cannot be utilized within a scientific theory.

The concept of non-random finite choice is modeled by the finite choice operator and extended to hyperfinite choice within the D-world structure. Applying hyperfinite choice and an internal logical operator, it is established that from the D-world point-of-view, no natural system behavior that is consistently described by a natural language is absolutely random; rather, it is deterministic in character.

Logic in the Classroom

RESEARCHER: ASSISTANT PROFESSOR GAIL A. KAPLAN

The purpose of the research in progress is to test the proposition that reasoning ability and the learning process can be improved through the instruction of principles of logic. The particular method used in the instruction of these principles involves the playing of various logical games based on materials developed by Layman Allen, inventor of WFF N'PROOF, and Raymond Smullyan, author of *What is the Name of this Book?*. The approach has been tested with gifted and talented junior high school students over a period of several years, and

this year was tested for the first time at the elementary school level. The results have been encouraging in the sense that students in the final stages of instruction have demonstrated a marked improvement in reasoning, as measured by ability to solve logical problems. Efforts will now be made to apply the techniques to matched samples at the high school and college levels. The efficacy of the approach will then be evaluated by assessing differences in academic performance between samples exposed to the instruction and those unexposed.

Mid-Point Discretization of Hamiltonian Systems

RESEARCHER: ASSISTANT PROFESSOR THOMAS J. MAHAR

The purpose of this research is to study the qualitative behavior of the difference equations which correspond to the mid-point discretization of Hamiltonian systems of differential equations. The specific objective is to compare the dynamical behavior of the differential and difference equations in a neighborhood of their fixed points. This analysis has been extended to some global questions for systems in the plane.

The method used to study these questions includes the Implicit Function Theorem (for existence of solutions to the difference equations), the Birkhoff-Lewis fixed point theorem and the Kolmogorov-Arnold-Moser invariant tori theorem for elliptic fixed points, and the Hartman-Grobman theorem for hyperbolic fixed points.

The results are the following: First, the differential and difference equations have the same set of fixed points, and these fixed points have the same stability type. Second, the systems are topologically conjugate near hyperbolic fixed points. Thus, the systems have precisely the same qualitative behavior

here. Finally, the systems usually are not topologically conjugate near elliptic fixed points. The Birkhoff-Lewis fixed point theorem and the Kolmogorov-Arnold-Moser invariant tori theorem show that the mid-point discretization captures most of the recurrent behavior of a Hamiltonian system near an elliptic fixed point. Unfortunately, the difference equations also exhibit non-recurrent behavior which need not occur in the differential equations. It appears that this misbehavior cannot be avoided when discretizing differential equations.

A number of additional results have been obtained in various special cases. It can be shown that inappropriate, non-recurrent misbehavior must occur in the mid-point discretization, near elliptic fixed points, of most Hamiltonian systems in the plane. In another direction, it can be shown that mid-point discretization of delay-differential equations and nonlinear, undamped wave equations continues to capture a great deal of the recurrent behavior of such systems.

Linear Programming

RESEARCHER: ASSOCIATE PROFESSOR MARK D. MEYERSON

Linear programming involves finding a solution to a set of linear inequalities which maximizes a linear constraint function. The simplex algorithm is widely used for this, although recently some promising alternatives have been suggested.

This project is the development of a new algorithm for solving linear programming

problems. The algorithm, based on the polyhedral shape of the "feasible" region, allows one to travel through the middle of the region, avoids the use of slack variables, and searches for the solution in a recursive manner. In early tests on medium-sized problems, it has been twice as fast as the simplex method.

Numerical Computation of Electrical Potential Due to Crack Growth

RESEARCHER: ASSOCIATE PROFESSOR MARK D. MEYERSON

The study of the fracture mechanics of metal specimens requires the accurate measurement of the growth of a small crack. One technique for making this difficult measurement is to analyze the

change in electrical potential across the specimen.

This project does such an analysis using numerical methods and the Schwarz-Christoffel formula from complex analysis.

Using Computer Graphics as an Aid to the Teaching of Mathematics

RESEARCHER: ASSOCIATE PROFESSOR HOWARD L. PENN

The purpose of this project is to produce computer graphics which can be used as an aid to the teaching of mathematics. Topics for which computer graphics have been or are being developed include the heat equation, the vibrating string, the vibrating spring, the derivative as the limit of the slope of secant lines, polar coordinates, and vector fields.

This year, the focus of the project has shifted away from the production of video tapes to the production of interactive graphics programs which can be run on an IBM-PC or PC-compatible in the classroom. The programs are being written in True BASIC to maximize compatibility with the NATS system.

A Transfer Device for Matrix Theorems

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM P. WARDLAW

A method is given for obtaining a number of theorems for matrices over arbitrary commutative rings by "transferring" the

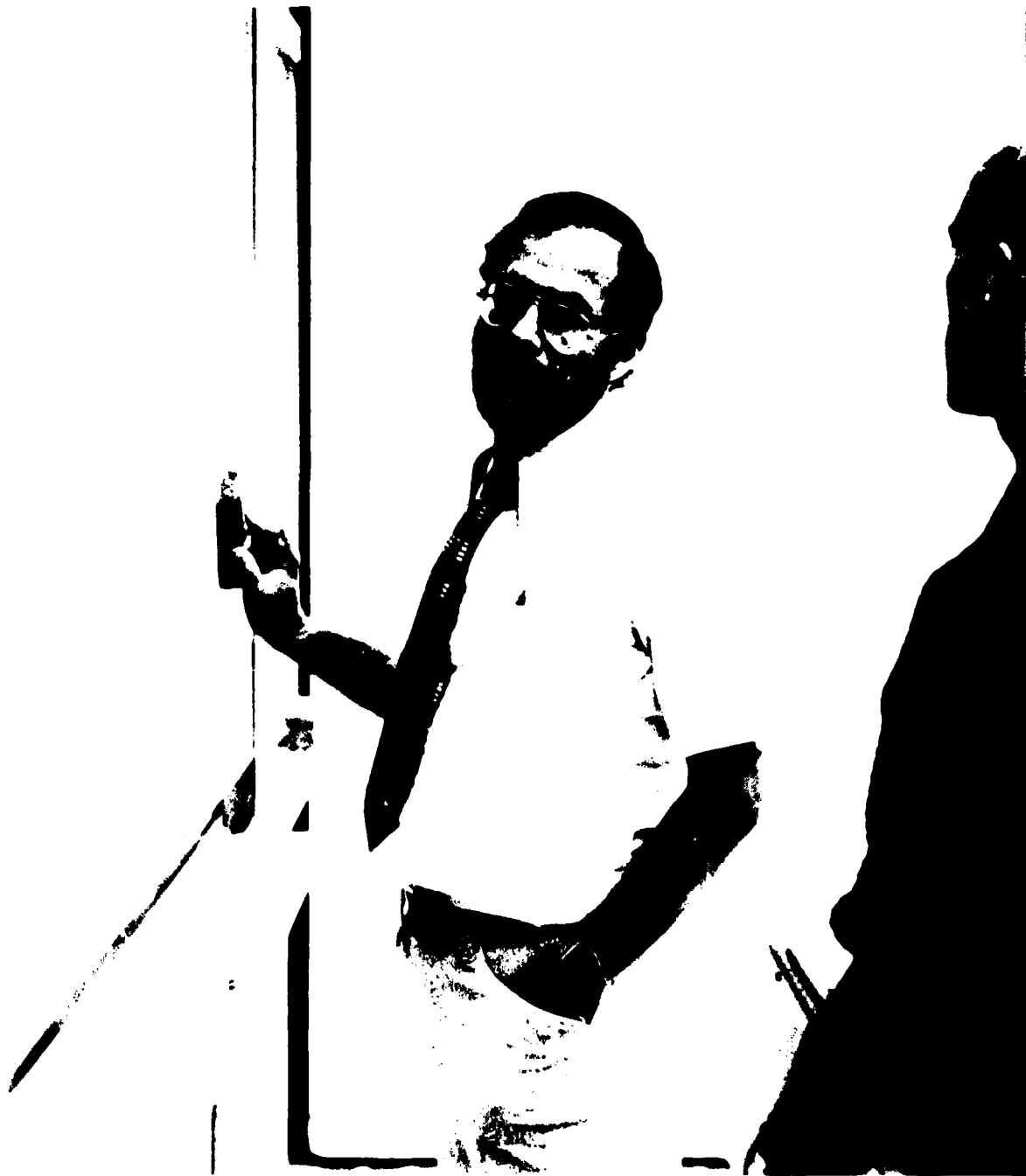
corresponding theorems for matrices over the real numbers.

Finitely Associative Groupoids and Algebras

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM P. WARDLAW

The cardinality and structure of finitely associative groupoids and algebras is being investigated. Previous investigations using the computer allowed the proof of a number of basic theorems concerning these structures. However, computer time restraints prevent

the use of the same techniques to obtain more information about the structures. The theorems obtained are now being studied to suggest more efficient computer techniques to obtain enough information about these structures to extend the theory.



Research Course Projects

Decision Aids Application: A Battle Group Scenario

RESEARCHER: MIDSHIPMAN 1/C TAMMY L. KING
ADVISER: LIEUTENANT COMMANDER MARK D. FROST, USN

The Navy is currently developing the Fleet Mission Program Library — a collection of computer programs which models common tactical situations which can be used as decision aids. The purpose of the project was to develop a decision aid by modeling a common tactical problem, developing an algorithm which defines a measure of effectiveness to evaluate alternative courses

of action, and producing a computer program for executing the algorithm. The tactical situation modelled is that of a battle group transiting a region under enemy satellite surveillance and defended by enemy surface combatants employing cruise missiles. The objective of the scenario is to route the battle group through the region to avoid detection and attack.

Factors Affecting Graduate Record Examination Scores at USNA

RESEARCHER: MIDSHIPMAN 1/C BRYAN P. CAISSE
ADVISERS: MAJOR WILLIAM J. HAFEEY, USMC, PROFESSOR THOMAS J. SANDERS,
AND ASSOCIATE PROFESSOR JOHN C. TURNER

The purpose of this project for SA412/SA442 was to determine if the quality of education at USNA affects performance on the Graduate Record Examination (GRE). The method was to apply statistical analysis — primarily multiple linear regression — to GRE scores, SAT scores,

QPR, major, sex, and class standing.

Verbal GRE was found to be related to verbal SAT, class rank, and major. The available data were insufficient, however, to draw any inference concerning the effect of a Naval Academy education on GRE scores.

Officer Retention Projections

RESEARCHER: MIDSHIPMAN 1/C WILLIAM LYONS
ADVISER: ASSOCIATE PROFESSOR JOHN C. TURNER

The purpose of this project for SA412/SA442 was to develop a model for predicting officer retention in the Navy. Originally, it was hoped to include exogenous variables such as unemployment and inflation. However, time constraints precluded doing so.

The method used was to apply multiple linear

regression to the number of officers two years past Minimum Service Requirement (MSR) as a function of the number of officers in that cohort at MSR+1, MSR, MSR-1, etc. This was done for different designators — pilot, NFO, etc. and compared to the current method. The regression model yielded significantly better projections.

The Impact of the Denying of Soviet-Bloc Conventional Data on Global Numerical Weather Prediction

RESEARCHER: MIDSHIPMAN I/C DAKOTA L. WOOD
ADVISER: ASSISTANT PROFESSOR DEAN G. DUFFY

Weather is an important factor in any military scenario. Given an international scene where high East-West tension has resulted in the denial of conventional meteorological data over Soviet-bloc countries, to what extent is our ability to analyze and forecast weather for the Navy's global mission compromised? The investigator simulated what might have happened had Soviet-bloc data been withheld

from the international community during the period from 10 November 1979 to 17 November 1979. Four five-day forecasts are made during this period and the impact of the data denials is examined through objective verification of sea-level and 500-mb height forecasts. Except for very short forecasts, the impact of Soviet-bloc data is of secondary importance to the errors inherent in the numerical method.

Project Outboard (Applications for the Naval Gunfire Support Mission)

RESEARCHER: MIDSHIPMAN I/C RIKI G. YOUNG
ADVISER: ASSISTANT PROFESSOR GARY O. FOWLER

Project Outboard is essentially a system which allows naval vessels to determine accurately the direction from which electronic signals are being emitted. At present, it is used mainly for locating enemy vessels at sea in order to perform more accurate bearing-only-launches of anti-ship missiles. However, there exists another possible use for this system in assisting the Naval Gunfire Support (NGFS) mission. Since it is conceivable that a desired target may not be visible from the sea, and that the only method available for eliminating it may be conventional naval gunfire, the Project Outboard system could be useful for locating the target for future action. Thus, the purpose of this study was to determine the number of rounds to fire at the target in order to obtain an acceptable probability of its destruction, $P(\text{kill})$.

The solution approach involved a two-step

plan of attack. First, extensive research provided a base for developing a realistic NGFS scenario; and second, a computer simulation was performed in order to test the effectiveness of such a mission. The results of this simulation showed that a high number of rounds were required to achieve the peak $P(\text{kill})$ of about 80%.

In conclusion, it appears that unless a much more accurate system is developed, using Project Outboard alone would become a very expensive exercise in area bombardment. Also, if the target's destruction were critical to the overall success of a greater mission, this method of targeting should not be used, due to the limit it imposes on $P(\text{kill})$. But this study did serve an important function by giving naval officers an alternative method of conducting NGFS, if they can be satisfied with the expected results.

Publications

ANDRE, Peter P., Associate Professor, "**Proteus Mode Selection**," Report to Anti-Submarine War Systems Project Office, May 1985.

An operator of a Proteus processor must select the best setting for the processor to detect an underwater target. The Promodel Package helps the operator to select the best setting, given information about the potential target and the environment. This software package is a user-friendly program written in FORTRAN with full documentation. The documentation contains a user manual, an operator manual and a programmer manual. The package allows the operator to input the means, variances, and correlations of the figures of merit of the potential target, along with the information about the propagation loss. The operator receives a list of the best modes with which to search for the target.

BAILEY, Craig K. and Mark E. KIDWELL, Assistant Professors, "**A King's Tour of the Chessboard**," *Mathematics Magazine*, 58 (November 1985), 285-286.

Can the king make a complete tour of the chessboard visiting each square exactly once, with the added restriction that when he visits a particular square there is an even number of neighboring squares that he has already visited? The answer is "No." A near-invariant which can change only on the last move of the attempted tour is used to show the king cannot complete a tour of any rectangular board. Counting arguments are used to assign a value to a board which is unattainable by the near-invariant.

CRAWFORD, Carol G., Assistant Professor, "**Aspect Graphs and Robot Vision**," *Proceedings of the IEEE Computer Vision and Pattern Recognition Conference*, (June 1985), pp. 382-385.

This paper presents a method for transferring geometric data from a solid modeler to a robot vision system. The technique is based

on research developed by J. J. Koenderink to interpret how the human vision system derives and encodes information about 3-D objects. Information about an object is stored in the form of a graph, called an aspect graph, together with functions associated to each vertex. Thus, the aspect graph provides a mathematical model of the solid. Current investigations and results in aspect graph construction and applications are presented.

D'ARCHANGELO, James M., Professor, co-author, "**Complex Eigenfrequencies of Axisymmetric Objects: Physical Interpretation in Terms of Resonances**," *IEEE Proceedings*, 72 (1984), 1652-1653.

Complex eigenfrequencies of spheroids and finite-length cyclinders for electromagnetic and acoustic vibrations are calculated and compiled. This includes eigenvibrations of nonlongitudinal type, studied earlier by the investigators for the first time. A physical explanation is provided for these in terms of the resonances caused by the phase matching of helical surface waves on the object.

D'ARCHANGELO, James M., Professor, and Philip SAVAGE, Ensign, USN, "**Complex Eigenfrequencies of Rigid and Soft Spheroids**," *Journal of Acoustical Society of America*, 77 (1985), 6-10.

The complex eigenfrequencies of impenetrable or penetrable target objects form a pattern which is characteristic for a given target, as far as shape and/or composition is concerned; they manifest themselves as poles (resonances) in the amplitude of waves scattered from the object. The investigators obtain the eigenfrequency patterns of acoustically rigid and soft spheroids in the complex frequency plane, and study their displacements when the eccentricity of the spheroids is varied. The eigenfrequencies were obtained numerically by subjecting spheroidal wave functions to the Neumann or Dirichlet boundary conditions, respectively.

DUFFY, Dean G., Assistant Professor, **"The Temperature Distribution Within a Sphere Placed in a Directed Uniform Heat Flux and Allowed to Radiatively Cool,"** *Journal of Heat Transfer*, 107 (1985), 28-32.

The temperature field within a sphere is found when the sphere is heated by a directed heat flux and cooled by blackbody radiation. For small heat fluxes, the analytic solution is obtained by transform methods. For large heat fluxes, the solution is computed numerically.

GOTAY, Mark J., Assistant Professor, co-author, **"Time and Singularity,"** *The Big Bang and Georges Lemaitre*, A. Berger, Ed., D. Reidel, 1984, pp. 123-131.

The investigators show that the occurrence of quantum gravitation collapse and, more generally, the validity of Wheeler's "rule of unanimity" are inextricably linked to the classical choice of time. The crucial distinction is between "fast" and "slow" times, that is, between times which give rise to complete or incomplete classical evolution respectively. It is conjectured that unitary slow-time quantum dynamics is always non-singular, while unitary fast-time quantum dynamics inevitably leads to collapse. These findings are illustrated by an analysis of the dust-filled Friedmann-Lemaitre-Robertson-Walker universes.

GOTAY, Mark J., Assistant Professor, co-author, **"Apartheid in the Dirac Theory of Constraints,"** *Journal of Physics A*, 17 (1984), 3063-3066.

The investigators study the extent to which first- and second-class constraints decouple in the Dirac constraint algorithm and degenerate dynamical systems. It is found that the two classes are inextricably intertwined. Some consequences of this failure of 'apartheid' are discussed.

GOTAY, Mark J., Assistant Professor, co-author, **"Poisson Reduction and Quantization for the $n+1$ Photon,"** *Journal of Mathematical Physics*, 25 (1984), 2154-2159.

For a dynamical system in which the constraints are given by the vanishing of a singular momentum map J , reduction in

the usual group-theoretic sense may not be possible. Nonetheless, one may still "reduce" $J^{-1}(0)$, at least on the level of Poisson algebras. An example of such a singular constrained system is the " $n+1$ photon," that is, a massless, spinless particle in $(n+1)$ -dimensional Minkowski space-time. The investigator applies the generalized reduction procedure to the $n+1$ photon, explicitly constructing the Poisson algebra of gauge invariant observables. This technique also enables a complete analysis of the effects of the singularities in $J^{-1}(0)$ on the system. After quantization, results are obtained which are in agreement with a quantization of the extended phase space and the subsequent imposition of the constraint.

GOTAY, Mark J., Assistant Professor, co-author, **"Reduced Canonical Formalism for a Particle with Zero Angular Momentum,"** *Group Theoretical Methods in Physics*, Zachary, W. W., Ed., Singapore: World Scientific, 1984, pp. 83-91.

The reduced canonical formalism for a particle with zero angular momentum is constructed using algebraic techniques. The results are compared with those obtained by an application of the (singular) Marsden-Weinstein reduction technique.

HERRMANN, Robert A., Associate Professor, **"Preconvergence Compactness and P-Closed Spaces,"** *International Journal of Mathematics and Mathematical Sciences*, 7 (1984), 303-309.

In this article, the major result characterizes preconvergence compactness in terms of the preconvergence closedness of second projections. Applying this result to a topological space (X,T) yields similar characterizations for H-closed, nearly compact, completely Hausdorff-closed, extremely disconnected Hausdorff-closed, Urysohn-closed, S-closed, and R-closed spaces, among others. Moreover, it is established that the s-convergence of Thompson (i.e. rc-convergence) is equivalent to topological convergence where the topology has as a subbase the set of all regular-closed elements of T .

HERRMANN, Robert A., Associate Professor, **"Senate Subcommittee Report on the Meta-logical Difficulties Associated with U.S. Supreme Court Opinion Roe V. Wade. 22 Jan. 1973, 410 U.S. #70-18,"** Niagara Falls, New York: Inquirer Press, 1985.

In this investigation, the language and logical procedures used by the Court are analyzed mathematically. Utilizing this language and the foundational logic employed within the court references, a finite describing and naming set model is constructed for the Court process of "broadening a Constitutional Term." Employing finite set theory, it is established that the Court has done one of the following with no other possibility: (1) the Court has contradicted the concept of the Separation of Powers; or (2) the Court has produced within this opinion an absolute contradiction. This analysis concludes with a discussion of the ramifications and difficulties associated with conclusions (1) and (2).

HERRMANN, Robert A., Associate Professor, ***Oneness, the Trinity and Logic***, Hazelwood, Missouri: Wordafame Press, 1984.

Translating from the original Greek and Latin the actual quotations of the Church Fathers and utilizing the most ancient Greek and Hebrew manuscripts of both the Old and New Testaments, the researcher made a logical analysis of these two competing philosophies. Describing set models, as well as philosophically interpreted portions of the nonstandard physical-world model for the development of natural systems, are utilized in order to give a firm logical basis for this analysis. The meta-logic used in order to reconcile these concepts is the same logic displayed within the ancient documents. The established conclusions are fully discussed.

HOFFMAN, Michael E., Assistant Professor, co-author, **"On Cohomology Automorphisms of Complex Flag Manifolds,"** *Proceedings of the American Mathematical Society*, 91 (September 1984), 643-648.

The investigators conjecture a classification of the automorphisms of the rational cohomology ring of $U(n)/H$ for H a closed connected

subgroup of maximal rank in $U(n)$, and summarize earlier proofs of this conjecture in special cases. A partial proof is given for the general conjecture by characterizing the two-dimensional classes of maximal height in the cohomology ring of $U(n)/H$. Using this characterization, it is proven that any automorphism of the cohomology ring must have the conjectured form in two dimensions. This allows a proof of a form of the conjecture "mod decomposables."

HOFFMAN, Michael E., Assistant Professor, **"Non-coincidence Index of Manifolds,"** *Pacific Journal of Mathematics*, 115 (December 1984), 373-383.

For a connected topological manifold M , the noncoincidence index of M is defined to be that positive integer (or ∞) which reflects the abundance of fixed-point-free self-maps of M . This index is a topological invariant, and is 1 if and only if M has the fixed point property. The investigator establishes some sufficient conditions for the noncoincidence index of M to be ∞ , and then develops techniques for computing the noncoincidence index when it is finite. These results are used to compute the noncoincidence index of the homogeneous spaces $U(n)/H$, where H is conjugate to a subgroup of form $U(1)^k \times U(n-k)$. The computation requires a classification of the endomorphisms of the cohomology of those spaces, which is established in the last section of the paper.

KALME, John S., Associate Professor, and John P. ULDRICK, Professor (Mechanical Engineering), **"Use of Recompressed Impulse Response to Identify Sources and Paths of Structure-Borne Noise in Wide Flange I-Beams and Pipes Conveying Fluid,"** *Journal of Sound and Vibration*, 95 (1984), 439-467.

A procedure is described for identifying sources and paths of structure-borne noise in structures built up from wide flange I-beams, as well as piping systems conveying compressible and incompressible fluid. The use of impulse response or modified impulse response to estimate time-delays frequently is of little value, because the wave propagation is dispersive. With reflections present, it is impossible to

distinguish and identify the wide peaks. If one can establish the dispersion law, namely, the relation between frequency and wave number, one can "recompress" the impulse response in a certain sense, with respect to length of paths. The peaks are fairly narrow and one can identify noise paths. A discussion is given for various dispersion relations, together with theoretical justification and practical implementation. Some experimental results are given.

LERNER, Bao-Ting, Associate Professor, "On Fuzzy Semigroups and Applications to Problems in Computerized Pattern Recognition," David W. Taylor Naval Ship Research and Development Center Report, October 1984.

The report describes applications of fuzzy set theory and in particular, fuzzy semigroups, to problems in pattern recognition and computer vision. Under investigation are the following problems: (1) the derivation and development of new imaging operators for the analysis of visual images utilizing semigroup theory; (2) the investigation of types of invariance involved in the semigroup of imaging operators; and (3) the applications of the investigator's

previous research results on homomorphisms of fuzzy sets to the segmentation phase of pictorial pattern recognition.

MALEK-MADANI, Reza, Assistant Professor, co-author, "Formation of Singularities of a Conservation Law with Memory," *SIAM Journal of Mathematical Analysis*, 16 (1985), 530-540.

The formation of singularities in smooth solutions of the model Cauchy problem

$$u_t + \phi(u)_x + a' * \psi(u)_x = 0, \quad x \in \mathbb{R}, \quad t \in [0, \infty]$$

$$u(x, 0) = u_0(x)$$

is studied. In (*) $\phi, \psi: \mathbb{R} \rightarrow \mathbb{R}$ are given smooth constitutive functions, $a: \mathbb{R}^+ \rightarrow \mathbb{R}$ is a given memory kernel, subscripts denote partial derivatives, $' = d/dt$ and $*$ denotes the convolution on $[0, t]$. Under physically reasonable assumptions concerning the functions ϕ, ψ , and a , it is shown that a smooth solution u develops a singularity in finite time whenever the smooth data u_0 become "sufficiently large" in a precise sense.

MANICKE, Robert L., Assistant Professor, **"Journal of Geometrical Foundations of Metric Multidimensional Scaling,"** *Journal of Mathematical Social Sciences*, 9 (July 1985), 441-462.

This paper deals with the topological and measure-theoretic foundations of metric multidimensional scaling. The first four sections develop minimal separation properties for a set of points or space to model a stimulus. The last three sections give probabilistic structure to random stimulus points and their random connecting paths. The last section propounds the concept of stochastic spatial admissibility by connecting results of the two main sections.

MEYERSON, Mark D., Associate Professor, **"Return of the Grazing Goat in n Dimensions,"** *The College Mathematics Journal*, 15 (November 1984), 430-432.

Two Theorems are proved to answer the following:

A goat is tethered to the edge of a disc-shaped field of radius r . The goat's rope is of length kr . If the field is n dimensional, what fraction of it can the goat reach, and what happens as n approaches infinity?

McCOY, Peter A., Associate Professor, **"Characterization of Solutions to the Generalized Cauchy-Riemann System,"** *Journal of Mathematical Analysis and Applications*, 101 (July 1984), 465-474.

For a generalized biaxially symmetric potential U on a semi-disk D , a harmonic conjugate V is defined by the generalized Cauchy-Riemann system. There is an associated boundary value theory for the Dirichlet problem. The converse of the Dirichlet problem is considered by determining the boundary functions to which U and V converge. The unique limits are hyperfunctions on the boundary of D . In fact, the space of hyperfunctions is isomorphic to the spaces of generalized biaxially symmetric potentials and their harmonic conjugates. A representation theorem is given for U and

V in terms of convolutions of certain Poisson kernels with continuous functions that satisfy a growth condition on the boundary of D .

PENN, Howard L., Associate Professor, **"Computer Drawn Polar Coordinate Graphs,"** *Collegiate Microcomputer*, 2 (August 1984), 273-279.

One subject area in the standard Calculus sequence with which students frequently have difficulty is polar coordinates. By having students write their own programs to graph polar coordinate equations, the traditional methods of presenting this material can be enhanced. The student can look at a larger number of the standard types of curves such as $R = \cos(N \cdot T)$ and $R = A + B \cdot \sin(T)$. The process of writing and running such a program reinforces some of the concepts of this subject, such as the parametric nature of such curves and the transformation from polar to rectangular equations. To produce reasonable curves, the student must also consider the largest value of R needed and the number of multiples of π to produce a complete graph. This paper includes graphs of 19 unusual polar equations, many of which were first produced by students. The paper also has a listing of programs for the Terak, Apple, and Atari Computers.

PRICE, Geoffrey L., Assistant Professor, **"Extremal Traces on Some Group-Invariant C^* -algebras, II,"** *Publications, Research Institute for Mathematical Sciences, Kyoto University*, 21 (1985), 201-206.

In quantum mechanics, one considers an operator algebra acted on by a group of symmetries of the physical system. The fixed point subalgebra is the set of physical observables of the system.

In this paper, the algebra considered corresponds to the Ising model, and the group of symmetries is compact and of product type. In this setting, the extremal traces on the fixed point algebra can be classified. They are determined to be restrictions of certain symmetric states of product type. Any two such states which restrict to the same tracial state are found to be conjugate by an element of the Weyl group of the symmetry group.

PRICE, Geoffrey L., Assistant Professor, **"On Some Non-Extendable Derivations of the Gauge-Invariant CAR Algebra,"** *Transactions of the American Mathematical Society*, 285 (September 1984), 185-201.

A densely-defined derivation on an operator algebra is said to be a generator if it is the time derivative of a C^* -dynamical system. Recent research on derivations explores conditions which guarantee that a derivation is a generator, or more generally, has a generator extension. The subject of this paper is to introduce a class of derivations which are generators on the fixed point subalgebra of the gauge action on the lattice algebra, but which have no generator extensions to the lattice algebra itself.

SANDERS, Thomas J., Associate Professor, **"On Approximate n -Connectedness,"** *Fundamenta Mathematicae*, 118 (1983), 68-74.

The concept of approximate n -connectedness has been given by K. Borsuk in his book *Theory of Shape* as a property of topological spaces to correspond in the theory of shape to the concept of n -connectedness in homotopy theory. In this paper, this concept is characterized using the homotopy bi-groups. Also, a Vietoris-Smale type theorem in compactly generated shape theory is proven, conditions are given under which the shape groups are isomorphic to the usual homotopy groups, and a result on lifting CG-shape maps and some of its applications to the theory of decomposition spaces are given.

STORMES, James J., Assistant Professor, **"Evaluation of Robotic Control Systems,"** Report, David W. Taylor Naval Ship Research and Development Center, Carderock, Maryland, October 1984.

In this report, a program of investigation is presented to evaluate the performance of various robotic control systems under conditions which may be found in potential Navy logistics applications. This program is centered upon the IRI M50 robot, and consists of three parts: construction of a computer-based model of the IRI M50; evaluation of the performance of the existing control system; and investigation of several alternative methods of control.

TURISCO, JoAnn S., Assistant Professor, **"A Family of Quadratic Forms Associated to Quadratic Mappings of Spheres,"** *Linear Algebra and its Applications*, 65 (March 1985), 249-260.

The general form of a real quadratic mapping of spheres can be determined by studying the diagonalization of each form in an associated family of quadratic forms. In particular, the eigenvalues provide a means for detecting maps which are of the Hopf type. When the eigenvalues are nonzero for every form in the family, the forms associated to $f: S^n \rightarrow S^m$ give rise to a quadratic form on the tangent bundle of the unit sphere S^n . If f is of the Hopf type, nondegeneracy of each form occurs only when $n = 1, 3, 7, 15$.

WARDLAW, William P., Associate Professor, **"Solution to Problem 1179,"** *Mathematics Magazine*, 57 (November 1984), 303.

Minimum Polynomial and Rank

Let A be a square matrix of rank r . Show that the minimum polynomial of A has degree at most $r + 1$.

Solution: Let the $n \times n$ matrix A have rank r . Then $A = BC$ for some matrices B and C , where B is $n \times r$ and C is $r \times n$. Thus the $r \times r$ matrix CB has minimum polynomial $m(x)$ of degree $d \leq r$, and

$$AM(A) = BCM(BC) = Bm(CB)C = 0.$$

Since A is a zero of the polynomial $xm(x)$ of degree $d + 1$, the minimum polynomial of A has degree $\leq d + 1 \leq r + 1$.

WOLFE, Carvel S., Associate Professor, *Linear Programming with Basic and FORTRAN, and Instructors Manual and Answer Book*, Reston, Virginia: Reston Publishing Company, 1985.

This text book is an up-to-date treatment of Integer Programming containing proofs, derivations of algorithms, and original problems. The branch and bound algorithm has a unique method for branching based on penalties, probability, and experience. The transportation algorithm is shown equivalent to the Simplex Method. Background linear algebra is covered. Methods for handling cycling, duality, and the Revised Simplex Method are given. All necessary programs to carry out the algorithms are discussed in the text and are given in an accompanying IBM disk.

Presentations

ABBOTT, James C., Professor, **"Book, How to Write One; How to Read One. The Logical Foundations of Computer Science,"** Mathematics Colloquium, U.S. Naval Academy, Annapolis, Maryland, November 1984.

ANDRE, Peter P., Associate Professor, **"Mode Selection for ASW Search,"** Projects in Operations Analysis, U.S. Naval Academy, Annapolis, Maryland, 21 February 1985.

BAILEY, Craig K., Assistant Professor, **"Banana Splits and Billiard Balls: Examples of Counting Problems,"** Washington and Lee College Mathematics Colloquium, Lexington, Virginia, 28 September 1984.

CRAWFORD, Carol G., Assistant Professor, **"Computer-Aided Engineering for Space Shuttle Design,"** The Johnson Space Center, Houston, Texas, 11 August 1984.

CRAWFORD, Carol G., Assistant Professor, **"Math Avoidance and Career Limitations,"** Anne Arundel Community College, Arnold, Maryland, October 1984.

CRAWFORD, Carol G., Assistant Professor, **"Aspect Graphs and Robot Vision,"** IEEE Conference on Computer Vision and Pattern Recognition, San Francisco, California, 12 June 1985.

CRAWFORD, Carol G., Assistant Professor, **"Mathematics Research and Robotics,"** McGraw-Hill Mathematics Research Division Meeting, New York City, 26 June 1985.

DUFFY, Dean G., Assistant Professor, **"Geostrophic Adjustment in a Baroclinic Atmosphere,"** Conference on Oceanic and Atmospheric Waves, New Orleans, Louisiana, 6 March 1985.

FOWLER, Gary O., Assistant Professor, **"Producing a Ranking Consonant with the Rankings of a Panel,"** Annual Meeting of the American Statistical Association, Philadelphia, Pennsylvania, 16 August 1984.

FOWLER, Gary O., Assistant Professor, **"A Model of the Life of Antifouling Coatings Used by the U.S. Navy,"** Biometric Society Meetings, Raleigh, North Carolina, 26 March 1985.

FROST, Mark D., Lieutenant Commander, USN, **"Computer Network Aboard an Aircraft Carrier,"** CompCon84: IEEE Conference on the Small Computer (R)Evolution, Arlington, Virginia, 20 September 1984.

GAGLIONE, Anthony M., Assistant Professor, **"Are Some Groups More Discriminating Than Others?"** International Conference on Infinite Group Theory, Iraklion, Crete, Greece, 8 August 1984.

GAGLIONE, Anthony M., Assistant Professor, co-author, **"A Contribution to the Commutator Calculus,"** International Conference on Infinite Group Theory, Iraklion, Crete, Greece, 9 August 1984.

GOTAY, Mark J., Assistant Professor, **"Singular Angular Momentum Maps,"** Summer Canadian Mathematical Society Meeting, Edmonton, Alberta, June 1984.

GOTAY, Mark J., Assistant Professor, **"Singular Angular Momentum Maps,"** Seminar, Naval Research Laboratory, Washington, D.C., November 1984.

GOTAY, Mark J., Assistant Professor, **"Singular Angular Momentum Maps,"** Mathematics Colloquium, U.S. Naval Academy, Annapolis, Maryland, November 1984.

GOTAY, Mark J., Assistant Professor,
"Constraints, Reduction and Quantization,"
 Seminar, Department of Physics and
 Astronomy, University of Maryland, College
 Park, Maryland, March 1985.

GOTAY, Mark J., Assistant Professor,
"Negative Energy States in Quantum Gravity?"
 Canadian Conference on General Relativity and
 Relativistic Astrophysics, Halifax, Nova Scotia,
 April 1985.

HERRMANN, Robert A., Associate Professor,
"Subparticles," Regional Meeting of the
 Mathematical Association of America,
 Annapolis, Maryland, 10 November 1984.

HERRMANN, Robert A., Associate Professor,
**"Subparticles and their Relation to Creative
 Science,"** Essex Community College, Baltimore,
 Maryland, 1 June 1985.

HOFFMAN, Michael E., Assistant Professor,
"Sine, Cosine, and Binomial Coefficients,"
 MD-VA-DC Sectional Meeting of the
 Mathematical Association of America,
 Annapolis, Maryland, 10 November 1984.

HOFFMAN, Michael E., Assistant Professor,
"Free Actions and the Fixed Point Property,"
 Winter Meeting of the Canadian Mathematical
 Society, London, Ontario, Canada, 12
 December 1984.

HOFFMAN, Michael E., Assistant Professor,
**"Cohomology Endomorphisms of Complex
 Grassmann Manifolds,"** University of
 Maryland Topology/Geometry Seminar,
 College Park, Maryland, 4 February 1985.

KAPLAN, Harold M., Professor, **"Small
 Samples of Non-Negatives,"** Probability-
 Statistics Day, George Mason University,
 Fairfax, Virginia, 1 December 1984.

KAPLAN, Harold M., Professor, **"Three
 Computer Programs with Dependable
 Alpha,"** Probability-Statistics Day, Temple
 University, Philadelphia, Pennsylvania,
 20 April 1985.

KIDWELL, Mark E., Assistant Professor,
**"Kneading Cycles of Unimodal Functions:
 A Routed Trees Approach,"** University of
 Maryland Topology Seminar, College Park,
 Maryland, 1 August 1984.

KIDWELL, Mark E., Assistant Professor,
**"In What Order Do Kneading Cycles
 Appear?"** University of Maryland Topology
 Seminar, College Park, Maryland, 6 December
 1984.

KIDWELL, Mark E., Assistant Professor,
"Cutting Paper with a Mathematician,"
 St. Paul's United Church of Christ, Seabrook,
 Maryland, 6 April 1985.

KIDWELL, Mark E., Assistant Professor,
**"What, Another Talk About Maps of the
 Interval?"** Mathematics Colloquium, U.S.
 Naval Academy, Annapolis, Maryland,
 10 April 1985.

LERNER, Bao-Ting, Associate Professor,
"On Fuzzy (Right-Topological) Semigroups,"
 First International Conference on Fuzzy
 Information Processing, Kauai, Hawaiian
 Islands, 23 July 1984.

MAHAR, Thomas J., Assistant Professor,
"Discrete-Time Models of Physical Systems,"
 Watson Research Center, Yorktown Heights
 New York, 18 October 1984.

MAHAR, Thomas J., Assistant Professor,
**"Mid-Point Discretization of Hamiltonian
 Systems,"** Rensselaer Polytechnic Institute,
 Troy, New York, 4 March 1985.

MALEK-MADANI, Reza, Assistant Professor, **"Traveling Waves in Nonlinearly Viscoelastic Media and Shock Structures in Elastic Media,"** Special Session on Nonstrictly Hyperbolic Conservation Laws, 91st Annual Meeting of the American Mathematical Society, Anaheim, California, 10 January 1985.

MANICKE, Robert L., Assistant Professor, **"Geometrical Foundations of Statistical Decision Theory,"** Eastern Regional Probability-Statistics Day, Temple University, Philadelphia, Pennsylvania, 20 April 1985.

MASSELL, Paul B., Assistant Professor, **"Ergodic Theory and Dynamical Systems,"** Mathematics Colloquium, U.S. Naval Academy, Annapolis, Maryland, 9 January 1985.

MASSELL, Paul B., Assistant Professor, **"A Near-Optimal Algorithm for a Discrete-Time Control Problem,"** Conference on Complexity of Approximately Solved Problems, Columbia University, New York City, 17 April 1985.

McCOY, Peter A., Professor, **"Approximating Pseudoanalytic Functions on the Unit Disk,"** Mathematical Association of America, Annapolis, Maryland, October 1984.

McCOY, Peter A., Professor, **"Boundary Value Problems Associated with Jacobi Polynomials in Two Real Variables,"** Colloquium, Howard University, Washington, D.C., November 1984.

McCOY, Peter A., Professor, **"Singularities of Hyperbolic Partial Differential Equations in Two Complex Variables,"** Mathematics Colloquium, U.S. Naval Academy, Annapolis, Maryland, April 1985.

MOULIS, Edward J., Assistant Professor, **"Academic Scheduling at the U.S. Naval Academy,"** Pilot Workshop on Academic Scheduling, West Lafayette, Indiana, 14 September 1984.

Mylander, W. Charles, Professor, co-author, **"Computational Experience with a Pipeline Bidding Model for Newly Found Gas Reserves,"** Operations Research Society of America, Boston, Massachusetts, 29 April 1985.

PENN, Howard L., Associate Professor, **"The Vibrating String,"** Joint American Mathematical Society and Mathematical Association of America Summer National Meeting, Eugene, Oregon, 17 August 1984.

PENN, Howard L., Associate Professor, **"Using Computer Graphics as an Aid to Teaching Mathematics,"** Salisbury State Mathematics Department Colloquium, Salisbury, Maryland, 8 October 1984.

PENN, Howard L., and Peter J. WELCHER, Associate Professors, **"True BASIC,"** University of Maryland IBM-PC Seminar, College Park, Maryland, 6 March 1985.

PENN, Howard L., Associate Professor, **"True BASIC, a New Programming Language for the IBM-PC,"** MD-DC-VA Section of the Mathematical Association of America Spring Meeting, Hollins, Virginia, 27 April 1985.

PRICE, Geoffrey L., Assistant Professor, **"Derivations Annihilating a Maximal Abelian Subalgebra,"** Seminar, SUNY, Center at Buffalo, Buffalo, New York, October 1984.

PRICE, Geoffrey L., Assistant Professor, **"Derivations Annihilating a Maximal Abelian Subalgebra,"** Mathematics Colloquium, U.S. Naval Academy, Annapolis, Maryland, February 1985.

PRICE, Geoffrey L., Assistant Professor, **"Derivations Annihilating a Maximal Abelian Subalgebra,"** Seminar, University of Pennsylvania, Philadelphia, Pennsylvania, February 1985.

PRICE, Geoffrey L., Assistant Professor, **"On Quasi-Free Derivations,"** Great Plains Operator Theory Conference, Texas A & M University, College Station, Texas, May 1985.

WARDLAW, William P., Associate Professor, **"An Extension of Euler's Theorem,"** Mathematical Association of America Annual Meeting, Annapolis, Maryland, 10 November 1984.

WARDLAW, William P., Associate Professor, **"Pell-Like Equations,"** Mathematical Association of America, Hollins, Virginia, 27 April 1985.

WELCHER, Peter J., Associate Professor, co-author, **"Universal Curves and Normalizing Dielectric Relaxation Data,"** International Conference on Defects in Insulating Crystals, University of Utah, Salt Lake City, Utah, 21 August 1984.

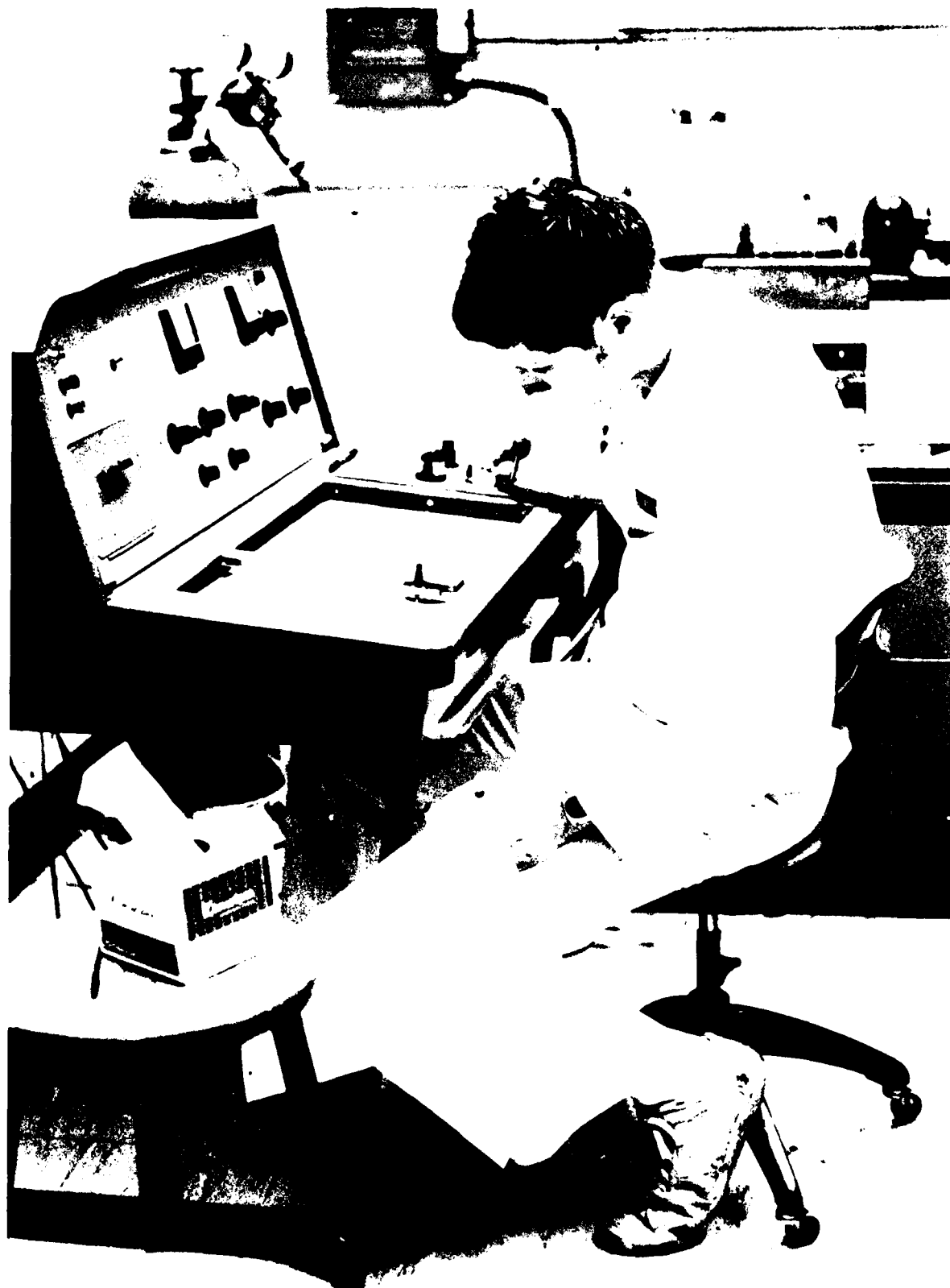
WOLFE, Carvel S., Associate Professor, **"Scheduling Problems Solved by Integer Programming,"** Mathematics Colloquium, U.S. Naval Academy, Annapolis, Maryland, 11 February 1985.

ZAK, Karen E., Assistant Professor, **"Order Properties of Boolean-like Rings,"** Conference on Universal Algebra and Lattice Theory, The Citadel, Charleston, South Carolina, 13 July 1984.

ZAK, Karen E., Assistant Professor, **"On the Semi-Boolean Algebra Properties of Boolean-like Rings,"** American Mathematical Society, Anaheim, California, 11 January 1985.

ZAK, Karen E., Assistant Professor, **"Applications of Matrix Theory,"** Broadneck High School, Cape St. Claire, Maryland, 21 May 1985.





Oceanography

COMMANDER KENNETH H. HUNT, USN
CHAIRMAN

During the 1984-1985 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 Oceanography Department's research vessel.

Funding for these research activities has been available from a number of sources, including grants from our contracts with the Office of Naval Research, Defense Mapping Agency, Naval Air Systems Command, Naval Sea Systems Command, Naval Explosive Ordnance Disposal Technology Center, and the Naval Academy Research Council.

Specific areas of research activity within the Department included but were not limited to longshore currents, sedimentation processes and properties, light attenuation, turbidity, estuarine ecology, marine biofouling, dredging, environmental effects on electro-optic systems, chemical composition of snowfalls, orographic fogs, and remote sensing.



Sponsored Research

Feeding Ground Dynamics in the Denmark Strait

RESEARCHER: ASSOCIATE PROFESSOR JOHN W. FOERSTER
SPONSOR: OFFICE OF NAVAL RESEARCH — CODE 422-CB

Within longitude 28W to 32W and latitude 62N to 66N, an intense feeding ground system frequented by several species of large whales has been located. The area on the eastern side of the Denmark Strait is influenced by the Irminger Current. Data on Phytoplankton and Zooplankton are presented. In addition, studies on the meteorology of the area, mass transport of the water, ocean stability dynamics, and nutrient concentrations have been compiled.

Satellite data will be used to augment the analyses. All data researched and to be presented will be used to demonstrate the dynamics of a feeding ground able to support the polar summer feeding of apex predator populations of fin, sei, minke, and sperm whales. Investigations to date have revealed an intermittent upwelling system believed to be caused by the arctic storms moving through the Denmark Strait every 5-7 days.

Propagation of EM Energy in Hazes, Fogs, and Clouds

RESEARCHER: VISITING PROFESSOR EDWARD E. HINDMAN
SPONSOR: NAVAL AIR SYSTEMS COMMAND

Propagation of electromagnetic (EM) energy (UV, visible, and IR wavelengths) is affected by hazes, fogs, and clouds. The effects are primarily due to particle sizes, numbers, and compositions. The submicron and supermicron (>30 ml) droplet numbers are inadequately described. The submicron droplets primarily affect scattering and the supermicron droplets affect absorption. The objectives of this research are to describe and understand the sub- and supermicron droplet populations and their effects on EM

energy propagation. The research is conducted in laboratory simulated clouds at Colorado State University, Fort Collins, and in natural clouds which form at Storm Peak Laboratory, Steamboat Springs, Colorado, and Mount Washington Observatory, Gorham, New Hampshire. The laboratory and natural clouds contain large numbers of submicron droplets, the effects of which are under investigation. This new knowledge has application for naval remote-sensing systems development.

Digital Image Processing Laboratory

RESEARCHER: VISITING PROFESSOR PAUL M. MAUGHAN
SPONSOR: OFFICE OF NAVAL RESEARCH

The researcher developed a program to establish a digital image processing laboratory facility at the Naval Academy. The program included establishing research and instructional requirements and uses; researching

comparable facilities for hardware software commodity; hardware/software acquisition procedures; identifying funding scenarios; and initiating procurement of first-phase facility.

Underwater Visibility of the Patuxent River

RESEARCHER: PROFESSOR JEROME WILLIAMS

SPONSOR: NAVAL EXPLOSIVE ORDNANCE DISPOSAL TECHNOLOGY CENTER

Two interesting phenomena have been uncovered as a result of preliminary data analysis efforts:

(1) There appears to be a marked diurnal variation in water clarity in the surface layers associated with the presence or absence of phytoplankton. Changes in beam attenuation coefficients of a factor of 2 occur between morning and evening hours with the evening readings showing higher surface water clarity. This phenomenon apparently has not been

previously reported in the literature, and will be reported on at the Eighth Biennial Estuarine Research Federation Conference in July 1985.

(2) Near the bottom, the major contributing factor in the loss of water clarity is suspended sediments, and here water clarity is closely connected with the tidal cycle. Dirtier water seems to be associated with water movement as sediments recently deposited on the bottom during slack periods are resuspended during high current periods of ebb and flood.

Optical Properties of Coastal Waters

RESEARCHERS: PROFESSOR JEROME WILLIAMS AND ASSOCIATE PROFESSOR JOHN W. FOERSTER

SPONSORS: DEFENSE MAPPING AGENCY AND NAVAL EXPLOSIVE
ORDNANCE DISPOSAL TECHNOLOGY CENTER

Data were examined in an attempt to determine the relative importance of optical scattering rather than absorption in Chesapeake Bay waters. Data indicate that scattering predominates in this turbid environment, with the scattering-to-absorption ratio falling between 10 and 20. This may be as much as an order of magnitude greater than is the case with tropical oceanic waters.

Bottom samples were collected and optical

reflectance measurements were made during June of 1984 from most of the Chesapeake Bay and Patuxent River stations. During this reporting period, these reflectance data were analyzed to determine how the optical properties of bottom material varied with location in the Chesapeake Bay system. The surprising result is that all the samples were about the same, indicating a reflectance of between 20-30%, and exhibiting neutral grey color.

Independent Research

Chemical Composition of Snowfalls and Snowpacks: Contribution of Rime Ice and Hoar Frost

CO-RESEARCHER: VISITING PROFESSOR EDWARD E. HINDMAN

Aerosol particle scavenging by snow is poorly understood. Consequently, a study was conducted at Storm Peak Lab (3220m MSL) in the Colorado Rocky Mountains to investigate the fractionation of atmospheric aerosol particles among ice crystals (snow), cloud water, and cloud interstitial aerosol particles. The experiments were conducted when the laboratory was enveloped by a supercooled mixed-phase cloud with cloud base typically 300m below the laboratory. Snow, cloud water, and aerosol particles were collected and analyzed for trace elements and soluble ions. The cloud water and snow were also

analyzed for pH and conductivity.

Results show most of the soluble species from the aerosol particles (ions, acidity, etc.) are present in the supercooled liquid water. Snow which grows at the expense of cloud droplets (depositional growth) has low concentrations of contaminants. Snow which grows by colliding with and removing supercooled liquid water droplets (accretional growth or riming) can contain 10-100 times higher concentrations of contaminants. These results indicate that, when the snow crystal riming mechanism dominates snow crystal growth, it controls the chemical composition of the snow.

Weather Modification Related Physical Studies of Rocky Mountain Orographic Clouds

CO-RESEARCHER: VISITING PROFESSOR EDWARD E. HINDMAN

Precipitation processes that lead to the production of snowfall in the Colorado Rockies are not fully understood. This lack of knowledge has inhibited the full application of cloud seeding technologies for the augmentation of snowfall. Consequently, the purpose of this research is to describe more completely and, hence, understand the processes.

The research approach is a combination of laboratory, field, and theoretical studies. Laboratory cloud chamber studies investigate basic ice nucleation processes. Field measurements involve both remote and in-situ sensors for a complete description

of cloud physical and dynamical processes. Theoretical studies emphasize numerical simulations of cloud physical and dynamical processes, studies which are interactive with the laboratory and field investigations.

Significant new knowledge has resulted about the spatial and temporal distribution of cloud liquid water and its interaction with developing ice crystals. Further, basic water-balance estimates reveal a small fraction of the moisture flowing over the mountains precipitates, suggesting that seeding on upwind barriers should not significantly affect precipitation on downwind barriers.

Research Course Projects

A Baseline Marine Environmental Study of the Lower Severn River

RESEARCHER: MIDSHIPMAN 1/C ELIZABETH A. GILSTAD

ADVISER: LIEUTENANT STEVEN D. KINNEY, USN

A method for data gathering is developed and implemented for the lower Severn River.

Parameters included temperature, pH, salinity, conductivity, nitrites and nitrates.

The data gathered by this project will act

as a baseline for future analysis of the lower Severn, helping to model physical and chemical processes. Anomalies in data as compared to the baseline may then be associated with man's influence on the estuarine environment.

The Focusing of an Ultrasonic Sound Beam through a Pipe Wall

RESEARCHER: MIDSHIPMAN 1/C CHARLOTTE D. MONK

ADVISER: ASSISTANT PROFESSOR MURRAY S. KORMAN

Ultrasonic detection of wear particles that contaminate hydraulic machine oil can be used to predict the gradual failure of critical bearings in engineering hydraulic systems. The detection of these particles involves the focusing of an ultrasonic beam into the center of a Cu-Ni pipe. Scattered sound pulses from these minute particles are used to classify the contaminants and predict the rate of bearing failure.

Theoretical designs are discussed that allow the sound generated from "clamp-on" transducers located exterior to the pipe wall:

(1) to penetrate through the pipe wall with minimum reflection, and (2) to focus the beam along its center axis. A model transmission coating made up of nine wave-bearing layers is designed to allow transmission in a limited frequency bandwidth centered at 5 MHz. Focusing is achieved using a multi-element transducer array arranged over a cylindrical surface. An alternate method of focusing involves using two elliptical cavities each sharing a common focal point.

Investigation of the Spectral Response of Scattered Acoustic Pulses in the Presence of Turbulence

RESEARCHER: MIDSHIPMAN 1/C SCOTT L. NASSON
ADVISER: ASSISTANT PROFESSOR MURRAY S. KORMAN

Echosounding in the atmosphere has been used to measure the mean flow and velocity fluctuations of turbulent layers. Spectral broadening of backscattered sound pulses may be used to measure some of the velocity parameters of the turbulent interaction region. Theoretical studies can predict this spectral broadening in the case of plane wave sources and infinite array receivers. In reality, however, the receiving array in an echosounding experiment has a limited directivity due to the size and number of its receiving elements. In this investigation, a ten-element linear array was designed and constructed to receive 40kHz acoustic pulses. The individual elements are

summed together using an audio mixer that was also designed for this project. Turbulence was created by a five-inch diameter circular air jet with a nozzle exit velocity of 50 m/s, and a piezoelectric tweeter was used to transmit sound pulses into this turbulent jet. The electronic signals from the receiving array were digitized and processed by a Wavetek 660 Fast Fourier Transform analyzer. The incident and scattered frequency spectra are compared, with the results indicating a broadening of the spectra around the peak frequency of 38.2kHz at an angle of 45 degrees, while very little broadening occurs at zero degrees.

Analysis of the Effects of Preservation and Storage on the Chemical and Hydrodynamic Properties of Microfouling Biofilms

RESEARCHER: MIDSHIPMAN 1/C EMIL T. PETRUNCIO
ADVISER: PROFESSOR JEROME WILLIAMS

Past research has indicated that microbial slime films and other forms of surface microfouling significantly reduce the efficiency of objects that are exposed to seawater, such as ship hulls and heat exchangers. The adsorption of an organic layer followed by modification and colonization by pioneer bacteria increases the drag of objects in contact with the waters. Although toxic anti-fouling coatings temporarily prevent the buildup of macrofouling organisms, this treatment is ineffective in preventing the formation of microbial slime films.

In order to study the surface-specificity of the formation of biofilms, plates of various surface energies are exposed to sea water and removed at different stages of microfouling. The biofilm is then analyzed by infrared spectroscopy and scanning electron microscopy to determine its chemical composition, amount, and morphology. In a study of the effects of microfouling on a ship's hull, a test plate with materials of various surface energies could be temporarily attached to a hull and, after several legs of voyage, removed and studied either in-situ or

at a laboratory after preservation and storage. In-situ measurements are difficult due to the delicate instrumentation and careful observation required. Ideally, a ship could travel anywhere and upon reaching its destination, preserve and send the test plate back to a laboratory.

This experiment was designed to investigate the effects of glutaraldehyde preservation on the hydrodynamic properties of a biofilm sample. Glass microscope slides, both plain and silicon coated, were exposed to water from the Severn River and then analyzed through tests designed to measure degrees of fouling present. Fluid frictional resistance was measured from slides which were fresh, as well as from slides which were treated with glutaraldehyde. Additionally, infrared spectroscopy and scanning electron microscopy were performed on select slides.

Results indicated that glutaraldehyde is not suitable for use as a preservative of microfouling biofilms. Glutaraldehyde changed the hydrodynamic properties of the fouling surface in unpredictable ways and did not permit analysis of surface-specificity of biofilms.

An Attempt at Numerical Hydrographic Modeling

RESEARCHER: MIDSHIPMAN 1/C MICHAEL P. SKELLY

ADVISER: PROFESSOR JEROME WILLIAMS

A numerical hydrographic model uses mathematical equations to represent the topography and processes of an estuarine system. To effectively utilize these models, a computer is used to carry out the calculations. The models break the estuary down into segments or boxes, hence they are given the name "computer box models."

This computer box model was designed to model the salinity variance in the Patuxent River. Once the salinity was accurately modeled, the computer box model could then be designed to replicate such things as

sedimentation rates or pollution dispersion.

This box model project was designed to organize the data into a usable form and input the information into a program which calculates the representative upper and lower salinities and depth of division caused by the halocline of each box. This output is then entered into a second program which generates the advection coefficients (Q) and exchange coefficients (E). Finally, the velocities in the horizontal and vertical directions are calculated from the Q's generated in the previous program.

Design and Economic Analysis of Seapowered Hydraulics

RESEARCHER: MIDSHIPMAN 1/C LARRY W. SWITZER

ADVISER: PROFESSOR JEROME WILLIAMS

This report contains the findings from the second semester of research performed on an ocean wave energy conversion system. The first report, "Seapowered Hydraulics" (Fall 1984), contains background information on ocean wave energy conversion and a general description of a wave-follower system conceived by Lieutenant Commander Ace Sarich, USN, Naval Systems Engineering Department. This description includes all the basic components and addresses some perceived problems such as fouling,

corrosion, and energy transport. The Spring-1985 portion of the research was envisioned in the conclusions of the first report as a study to determine whether or not the hydraulic system could be built and operated efficiently. This involves a study of capital costs, maintenance costs, energy output, energy value, and system life. This phase requires exact engineering design in place of a general description in order to determine accurately the costs of such a system.

Publications

FOERSTER, John W., Associate Professor, **"From Here to Where: Future Think, Conceptualizing Regional Survival,"** S' in N. Ansel (Ed.) *Maryland's Future*, (June 1985), pp. 55-63.

Regional governing bodies could be more efficient than county governments. The multiple layers of government bureaucracy could be lessened, services improved, and duplicate programs streamlined. Case studies relating to the environment and to education are used to show the potential effectiveness of regional government.

HINDMAN, Edward E., Visiting Professor, **"Anatomy of a Wave Flight,"** *Soaring*, (Journal of the Soaring Society of America) 48 (November 1984), 44-49.

On 30 November 1982, the author flew his HP-14T sailplane from 16,000 feet MSL to 28,000 feet in mountain wave conditions downwind of the Rocky Mountains near Fort Collins, Colorado. Postflight analyses revealed the mountain wave resulted from strong, stable, southwesterly air flow across the north-south oriented front range of the Rockies. The flow was due to a "sharp" shortwave trough approaching from the west. A rotor cloud formed during the brief 1.75 hour flight due to the onset of moisture in the SW flow. The measured 300 to 500 feet min^{-1} lift was consistent with that predicted using the Lester wave-forecasting system.

HINDMAN, Edward E., Visiting Professor, **"Ninth Conference on Weather Modification,"** *Bulletin of American Meteorology Society*, 66 (March 1985).

This paper includes the significant points resulting from the Ninth Conference on Weather Modification, Park City, Utah,

21-23 May 1984. The points resulted from thorough discussions (in the "wrap-up" session) of summaries of each session. The results from the conference were further discussed, where appropriate, in the follow-on Workshop on Precipitation Enhancement, Park City, 23-25 May 1984. Accordingly, this report and the companion workshop summary provide an up-to-date status of weather modification research.

Two significant features characterized the conference. First, significant new and exciting work was reported in a time when funding has remained at best level, or perhaps has declined somewhat. Second, there was a large number of young investigators present, demonstrating a desire to begin their careers in this field. These aspects of the conference bode well for the future of the science and technology of weather modification.

HINDMAN, Edward E., Visiting Professor, **"Have Winch, Will Travel!"** *Soaring* (Journal of the Soaring Society of America), 49 (April 1985), 32-35.

Launching sailplanes using a surface-based winch has been a common practice in Europe. It has been a rare occurrence in the United States due to, in part, the lower towplane costs in the United States. However, towplane operating costs in this country are increasing. Consequently, the Northern Colorado Soaring Society, based in Fort Collins, has developed a winch-launching capability. The winch has reduced per-launch costs by up to 75% and has enabled the club to operate wherever a sailplane can be trailered. Flights off the winch have been as significant as those from aero-tows. For example, it is reported that the high-altitude mountain wave was contacted after skillful piloting, in the convective boundary layer, of a winch-launched sailplane.

HINDMAN, Edward E., Visiting Professor, **"'Cloudbusters' at MWO,"** *Mount Washington Observatory News Bulletin*, 26 (Spring 1985), 9.

Using his "cloud gun", the researcher recently "shot" a number of cloud samples at the Observatory. The samples vividly show the sizes and numbers of subcooled cloud droplets — the droplets which cause the famous rime ice formations on Mount Washington. Visiting Professor Hindman, along with his assistants, Midshipmen 2/C David V. Watts and Robert S. Ewing, collected samples of the ice and snow crystals for pH and trace element analysis. These samples will be analyzed by Dr. Randy Borys of Colorado State University's Storm Peak Laboratory, Steamboat Springs, Colorado. Borys and Hindman are conducting a study of the effect of snow crystal icing on the chemical composition of snow, the "Acid Snow" phenomenon.

The brief, but intense, investigations by Visiting Professor Hindman and his midshipmen assistants will provide new information on the physical, chemical, and optical properties of cloud droplets and snow crystals. Such knowledge has application not only for the acid precipitation problem, but for the propagation of light energy in clouds relevant to naval systems.

HINDMAN, Edward E., Visiting Professor, **"Properties of Aerosol Particles Detected by Satellite in Coastal Regions,"** *Preprints Eleventh International Conference on Atmospheric Aerosols, Condensation and Ice Nuclei*, September 1984, Budapest, Hungary. Vol. II, pp. 148-154.

The particles detected in the marine boundary layer were primarily spherical, 1-6µm in diameter, and of oceanic origin. Optical depths 0.04 to 0.10 were resolved. The particles detected above the boundary layer were primarily submicron, partially hygroscopic, and a mixture of rural,

oceanic, and possibly urban particles. These particles could mask radiation scattered by boundary layer particles.

HINDMAN, Edward E., Visiting Professor, **"Cloud Riming Regions for Snow Crystals that Impact Mountaintops in the Colorado Rockies,"** *Preprints Ninth International Cloud Physics Conference*, 21-28 August 1984, Tallinn, USSR, pp. 67-70.

Characteristics of the droplet and crystal spectra and water contents required for snow crystal riming are known. Further, surface, remote, and airborne measurements of these properties have been and are being reported for wintertime Rocky Mountain clouds. The characteristics and measurements were combined to identify at least two crystal riming regions. The first region is upwind of topographic features, a short distance west of the primary barrier, and the second region is immediately upwind of the primary barrier. The contribution of each region varies with the storm and storm stage. The first region is accessible to airborne measurements; the second is not.

HINDMAN, Edward E., Visiting Professor, **"Droplet Nucleation, Growth and Evaporation in a Slow-Expansion Cloud Chamber,"** *Preprints Ninth International Cloud Physics Conference*, 21-28 August 1984, Tallinn, USSR, p. 217-220.

A controlled, slow-expansion cloud chamber was used to investigate droplet activation, growth, and evaporation. The resulting measurements reproduced the droplet activation and growth behavior first predicted by Howell. The measurements revealed possible evaporation of certain cloud droplets in supersaturated conditions.

HINDMAN, Edward E., Visiting Professor, co-author, **"Marine Aerosol Optical Depth from Satellite Detected Radiance."** *Preprints Conference on Satellite Meteor/Remote Sensing and Applications*, American Meteorological Society, Boston, Massachusetts, pp. 11-14.

Recent improvements in the sensitivity of satellite-borne sensors have made it possible to detect variations in aerosol optical depths from space. These variations may be caused, in part, by relative humidity variations through growth of particles by water vapor condensation. The variations also may be caused by particle population variations at constant humidity. To examine these hypotheses, a set of near-simultaneous satellite images and aircraft measurements were collected from 20 September to 7 October 1982 off-shore of southern California. The satellite images were from the NIMBUS-7 CZCS and the NOAA-7 AVHRR. The airborne measurements consisted of aerosol particle characteristics and state variables. Extinction due to scattering was calculated from the measured particle size distributions. The satellite-detected radiance values have been compared to vertical and horizontal distributions of extinction. The results show a positive relationship between scattering by marine aerosol particles and satellite-detected radiance. Also, scattering by marine particles is related positively to variations of relative humidity. Therefore, satellite sensors appear to be able to yield information on relative humidity variations as well as boundary layer optical properties.

HINDMAN, Edward E., Visiting Professor, **"Characteristics of Subcooled Liquid Clouds at Mountaintop Site in the Colorado Rockies,"** Oceanography Department Seminar, U.S. Naval Academy, Annapolis, October 1984.

Knowledge of the subcooled liquid water characteristics of winter mountain clouds is important for a variety of applications; aircraft icing, cloud seeding operations, water budget studies, to name a few. Daily observations and measurements of subcooled liquid water

have been made by Colorado ski patrol personnel at high elevation sites for the past four winters. These data have shown that certain regions have consistently more liquid water than others due to barrier effects, the liquid water episodes persist 3 to 12 hours, and more liquid water flows over the barriers than precipitates upwind, indicating an unexploited cloud seeding potential.

HOFFMAN, John E., Professor, *Introduction to Nearshore Oceanography*. Annapolis: Defense Printing Plant, 1985.

Nearshore Oceanography is defined as the study of the physical and engineering sciences as they apply to the interaction of the air, sea, and land in the coastal zone.

Ordinarily there is more than one method of obtaining an immediate objective. Therefore, the long-term effects of each method should be studied. The immediate and long-term effects of each method should be evaluated not only within a problem area, but also in adjacent shore areas.

Detailed summaries of applicable methods, techniques, and useful data pertinent to the coastal zone have been included in this text.

WILLIAMS, Jerome, Professor, **"The New Salinity Scale and What It Means to Estuarine Oceanography,"** *Estuaries*, 7 (September 1984), 269.

During the Seventh Biennial International Conference of the Estuarine Research Federation at Virginia Beach, 22-26 October 1983, a workshop was held to discuss "The new salinity scale and what it means to estuarine oceanography." The workshop convener was Professor Jerome Williams, and the participants included: Dr. Jean Lebel, University of Quebec; Dr. Charlotte Mangum, College of William and Mary; Mr. Carlos Mayoral, U.S. Naval Oceanographic Office; Dr. Frank Millero, University of Miami; and Dr. Donald W. Pritchard, SUNY, Stony Brook.

The conclusions reached by the workshop participants are described and discussed.

WILLIAMS, Jerome, Professor, and Frederick A. SKOVE, Assistant Professor (Computer Science), "The Relative Effect of High Speed Recreational Boating on Water Clarity," USNA Report OCTR-84-02, August 1984.

A small sub-estuary of the Chesapeake Bay was examined for the effects of water skiing on turbidity. Measurements were made of chlorophyll, wind, and precipitation, in addition to boat traffic and three measures of turbidity. By correlating the equivalent suspended load (a more reliable measure of turbidity including readings of Secchi Disc, transmittance, and suspended solids) with chlorophyll, wind, rain, and boat traffic, it is shown that boat traffic has about the same effect as wind or rain but is much less important in accounting for turbidity increases than chlorophyll concentration. It is therefore concluded that high speed recreational boating may have an important effect on water clarity in certain areas where the turbidity is already high from other causes and rooted plants are major components of the local ecosystem.

WILLIAMS, Jerome, Professor, Frederick A. SKOVE, Assistant Professor (Computer Science), and John W. FOERSTER, Associate Professor,

"The Effect of Suspensoids on Optical Parameters in a Typical Estuary," USNA Report OCTR-84-01, August 1984.

As a first step in the optical modeling of coastal areas, the effects of various suspensoids on optical parameters were studied in the Patuxent River, a sub-estuary of Chesapeake Bay. Particle populations were measured using a Coulter Counter, while both inherent and apparent optical properties were being monitored. Results are presented indicating strong relationships between beam attenuation and total suspensoids, including both suspended sediments (particle diameters between 1 and $5 \times 10^{-6}m$) and phytoplankton (particle diameters between 15 and $5 \times 35^{-6}m$). Relationships of natural phenomena such as tidal currents and daylight period with sediment and plankton populations are also demonstrated.

From these studies, it appears possible to develop models capable of predicting, within reasonable limits, optical properties of coastal waters when local conditions such as weather, input stream characteristics, and local topographic conditions are known.



Presentations

FOERSTER, John W., Associate Professor, **"Plankton and Whaling Ground Dynamics in the Denmark Strait,"** International Plankton Symposium, Tokai University, Shimizu, Japan, July-August 1984.

HINDMAN, Edward E., Visiting Professor (co-author), **"A Survey of the Technology and Politics of Weather Modification,"** Specialty Conference, ASCE Irrigation and Drainage Division, Flagstaff, Arizona, July 1984. (Appears in *Water, Today and Tomorrow*, J. A. Replogle and K. G. Renard, Eds., ASCE, New York, New York, 298-305.)

HINDMAN, Edward E., Visiting Professor, **"Naval Academy Research Chair, 1984-1985,"** Naval Air Systems Command Meteorological Processes Program Review, Washington, D.C., 24 September 1984.

HINDMAN, Edward E., Visiting Professor (co-author), **"Characteristics of Subcooled Liquid Clouds at Mountaintop Sites in the Colorado Rockies,"** Third Mountain Meteorological Conference, American Meteorological Society, Portland, Oregon, October 1984.

HINDMAN, Edward E., Visiting Professor, **"Acid Snow?"** USNA Sigma Xi Chapter, Annapolis, 20 February 1985.

HINDMAN, Edward E., Visiting Professor, David V. WATTS and Robert S. EWING, Midshipmen 2/C, **"Cloudbusters at Mt. Washington,"** Oceanography Department Seminar, USNA, Annapolis, April 1985.

NELSON, Cee Cee, Lieutenant Commander, USN (co-author), **"Satellite Cloud and Precipitation Analysis Using Interactive Computer System,"** Conference on Satellite/Remote Sensing and Applications, Clearwater Beach, Florida, 26 June 1984.

WILLIAMS, Jerome, Professor, Frederick SKOVE, Assistant Professor (Computer Science), and John FOERSTER, Associate Professor, **"The Effect of Suspensoids on Optical Parameters in a Typical Estuary,"** Ocean Optics VII, Monterey, California, 25 June 1984.

WILLIAMS, Jerome, Professor, **"Where Have All the Plankton Gone?,"** Atlantic Estuarine Research Society Fall Meeting, Salisbury, Maryland, 12 October 1984.

WILLIAMS, Jerome, Professor, and John FOERSTER, Associate Professor, **"Preliminary Reflectance Measurements on Chesapeake Bay Bottom Samples,"** Defense Mapping Agency Technical Base Review, NSTL, Mississippi, 7 November 1984.

WILLIAMS, Jerome, Professor, and Frederick SKOVE, Assistant Professor (Computer Science), **"Measurements of Single Scattering Albedo in a Typical Estuary,"** Defense Mapping Agency Technical Base Review, NSTL, Mississippi, 7 November 1984.

WILLIAMS, Jerome, Professor, **"Water Clarity in Coastal Waters,"** Assateague Shelf and Shore Workshop, Duck, North Carolina, 12 April 1985.

Physics

PROFESSOR FRANK L. MILLER
CHAIRMAN

Today's Navy is increasingly reliant upon technology. Improvements in the areas of nuclear power, sonar, electro-optics, electronics, and computers are rapidly incorporated into equipment used by the fleet. This Department strives to maximize coverage in all the physics courses of the basic concepts upon which this technology is based. Our graduates should be provided with a firm understanding of those fundamental physical concepts in order to function effectively in this age of technological warfare.

In order to accomplish this goal, we strive to maintain a state-of-the-art expertise in several areas through active involvement in current research. Whenever feasible, midshipmen are involved in these on-going research efforts with the faculty through the Trident Scholar Program or Research Project courses. Current faculty research includes the areas of non-linear acoustics, ship acoustic signatures, electromagnetic properties of materials, laser optics, radiation effects, solar and galactic astronomy, solid state physics, polymer physics, and nuclear physics.

Support of this year's research included the Office of Naval Research, the David W. Taylor Naval Ship Research and Development Center, the Naval Research Laboratory, the National Aeronautics and Space Administration, and the Naval Sea Systems Command.

The increased availability of and use of microcomputers in research has stimulated drastic change in all of the physics course laborato-



ries, which have been revised and improved this past year through the use of microcomputers as laboratory instruments. The resulting increase in student interest and efficiency has been gratifying.

Sponsored Research

A Servo-Controlled Cold Infrared Spectrometer

RESEARCHER: ASSISTANT PROFESSOR C. ELISE ALBERT

SPONSOR: NAVAL RESEARCH LABORATORY

The goal of this project is the completion of the last stage of a cooled, moderate resolution Cassegrain Fabry-Perot spectrometer, initially designed for observations in the near infrared wavelength range. A unique feature of this instrument is its fully servo-controlled operation, which allows for self-alignment, variable resolution, stop-and-integrate detection, continuous scanning, and automation under microprocessor control.

During this year, the instrument has been developed in three observing runs with the Kitt Peak National Observatory 50" telescope

in July and August 1984 and January 1985.

Microprocessor control, including self-calibration, is operating successfully. Extensive data reduction programs have been developed, which provide both real-time rough reduction and later in-depth analysis. Both the instrumental and reduction systems have been tested successfully on standard infrared sources such as planetary nebulae and ionized hydrogen regions. Observing runs scheduled for 1985-1986 will study molecules in the Jovian atmosphere and infrared emission from the galactic center.

Acoustic Resonance Scattering by an Elastic Cylinder

RESEARCHER: PROFESSOR DONALD W. BRILL

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER, ANNAPOLIS LABORATORY

The following is the index for an informal report in description of the summer 1984 work which was submitted to the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory: (1) shear wave scattering from an elastic sphere in an elastic medium; (2) construction of the

scattering matrix; (3) resonance scattering theory (RST) formulation; (4) special cases (liquid sphere in an elastic medium, elastic sphere in a liquid medium, and liquid sphere in a liquid medium); and, (5) polymeric acoustic system feasibility presentation.

Reciprocity Calibration in Unconventional Geometries

RESEARCHER: LIEUTENANT COMMANDER CHARLES L. BURMASTER, USN
SPONSOR: NAVAL RESEARCH LABORATORY

A non-standard method for the electroacoustic reciprocity calibration of a condenser microphone is theoretically developed and experimentally employed to calibrate a W.E. 640AA laboratory standard microphone. The calibration so obtained was found to be in agreement with a comparison of the same microphone made at the National Bureau of Standards to within an experimental uncertainty (sigma) of approximately .05 dB over the frequency range from 245 to 1470 hz.

Beginning with theory previously published by Isadore Rudnick, reciprocity equations for the open circuit voltage receiving sensitivity are optimized for experimental measurements in a plane wave resonant cavity to include the effects of finite microphone compliance and the non-adiabatic boundary conditions. Two right cylindrical plane wave resonant cavities of different dimensions were constructed to

provide a self-consistency check on the method.

A preliminary comparison of the theory for a free field reciprocity calibration, a pressure coupler reciprocity calibration, and a plane resonant reciprocity calibration is made to illustrate the common physics pertinent to the reciprocity principle that underlies the three methods.

Experimental calibrations based upon free field reciprocity were made alternately with plane wave resonant reciprocity calibrations to provide an ongoing experimental comparison when combined with published diffraction effects for a standard mounting of WE640AA laboratory standard microphone. The National Bureau of Standards comparison calibration was based upon an absolute pressure coupler reciprocity calibration and was obtained shortly after the resonant reciprocity calibration measurements were complete.

Computer Modeling of Laser Systems

RESEARCHER: PROFESSOR GERALD P. CALAME
SPONSOR: NAVAL RESEARCH LABORATORY

An optimal beam propagation program, based on the FFT algorithm, has been written. The program is modular, and therefore

exceptionally flexible. It is being used to model non-linear laser systems of interest to the Naval Research Laboratory.

Surface Modification of Ion-Implanted Iron

RESEARCHER: ASSOCIATE PROFESSOR FRANCIS D. CORRELL

SPONSOR: NAVAL RESEARCH LABORATORY

This work was part of a large NRL effort to understand better several physical processes that occur during the ion implantation of metals. In this project, the sputtering and carburization of Ta-implanted Fe were studied. Previous work had shown that the wear resistance of several commercially important steels could be improved by implanting with high doses of Ta and other ions. Carburization of the surfaces had been suggested as an important factor in this improvement. Sputtering is also known to be important in high-dose implantations, since it can limit the attainable concentrations of the implanted species and can, under certain circumstances, lead to the development of new surface textures on the implanted objects.

In one series of experiments, thin films of pure Fe were implanted with 150-keV Ta ions to fluences of 18×10^{16} ions/cm². Rutherford backscattering (RBS) was used to measure the retained dose of Ta, the sputtering rates of Ta and Fe, and the evolution with implantation dose of the Ta depth distribution. Nuclear Reaction Analysis (NRA) and Auger Electron Spectroscopy (AES) were also used to measure the C and O content of the films. The data were compared with the predictions of two computer models to evaluate the effects of carburization and atom migration on the concentration-vs-depth profile of the implanted

Ta and on the approach to steady-state conditions.

A second series of experiments was begun in August, and has continued through FY85. The primary goal of these experiments is to study further the carburization and C- and Ta-migration in Ta-implanted Fe by controlling the temperature of the implanted samples and the concentration of atmospheric C in the implantation chamber. A secondary goal is to investigate the changes in surface texture that appear to occur during implantation, and to correlate these changes with sample temperature and vacuum conditions.

Polished bulk samples of pure Fe were implanted, under various conditions of temperatures and pressure, with 185-keV Ta ions to fluences of 1×10^{15} to 2×10^{17} ions/cm². Continuous in-situ AES was performed during the implantations to monitor changes in the surface composition of the samples and thereby determine the attainment of steady-state conditions.

Rutherford backscattering measurements were made on all of the implanted samples, using several different scattering geometries to gain additional information on surface texture. These data are still being analyzed. Additional implantations are planned under other combinations of temperature, chamber pressure, and beam geometry.

Self-Sustained Oscillations Due to Orifices Phase I: Non-Linear Impedance of an Underwater Orifice

RESEARCHER: PROFESSOR SAMUEL ELDER

SPONSOR: NAVAL SEA SYSTEMS COMMAND

The prevention of vibration and acoustic radiation generated by flow over hull cavities and through orifices is a recurrent problem in ship performance. Under previous contract support, it has been determined that "wall-flex" resonance, an incompressible breathing-mode oscillation of the cavity analogous to Helmholtz resonance in air, is of major importance in accounting for orifice-associated tones. In order to apply fluidic feedback theory to such a system, it is necessary to obtain fundamental data on the non-linear response of underwater cavity orifices, an area which has never been investigated. An experimental and theoretical study is being performed, using "calibrated" orifice-cavity systems already developed for underwater tone investigations, from which it should be possible to predict and eliminate such effects at the design state. In Phase I, J9 and J13 projectors are being used to ensonify especially constructed cavities for investigation

of resonant response. Using internal and external hydrophones as detectors, sound particle velocity in the cavity mouth is maintained constant as frequency response is scanned through resonant value. From the 3 dB points of the driver-reaction response, Q of the cavity is determined. By repeating at a series of amplitudes, it is possible to obtain characteristic curves of $1/Q$ vs. amplitude. By varying parameters, such as mouth/cavity area ratio, etc., search will be made for a universal curve of non-linear orifice response. Towed model tests will then be performed to assess the accuracy of amplitude/frequency predictions for underwater wall-flex cavity tones, using feedback equations in conjunction with the non-linear damping curve. Although the work is being performed at the Naval Academy, it is fully integrated and coordinated with ongoing investigations at David W. Taylor Naval Ship Research and Development Center in Carderock, Maryland.

Stress Effects on Magnetostrictive Hum

RESEARCHER: ASSISTANT PROFESSOR JOHN P. ETEL

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

Preliminary studies of the anisotropies produced by stress or magnetic annealing of grain-oriented silicon steel (GOSS) have shown reductions in magnetization changes and corresponding magnetostrictive hum in transformers. Study

of this phenomena continues, as the researcher begins to investigate a finite element analysis approach to the magneto-dynamics of the processes involved, including the thermodynamic domain energies.

Degaussing Range Studies

RESEARCHER: ASSOCIATE PROFESSOR WILLIAM E. FASNACHT

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The basic effort is to determine the capabilities and limitations of a prolate spheroidal harmonic mathematical model of the magnetic scalar potential produced by a ferromagnetic source. The two fundamental issues are determination of the coefficients in such

an expansion to fit magnetometer data, and finding what can be known of the physical state of the source from these coefficients. A related but peripheral issue is the use of magnetometer data to establish the track of a vessel.

Activation Volumes and Electrical Relaxation in Ion Conducting Polymers

RESEARCHERS: PROFESSOR JOHN J. FONTANELLA AND

ASSISTANT PROFESSOR MARY C. WINTERSGILL

SPONSOR: OFFICE OF NAVAL RESEARCH

The primary objective of the project was to measure the effect of pressure on the conductivity of ion conducting polymers. The purpose of these measurements is to determine an activation volume for the conduction process which yields information about the conduction mechanism. Such measurements have been made on poly (ethylene oxide) (PEO) complexed with alkali metal thiocyanates and perchlorates.

Additional information about materials has been gained by doing electrical relaxation spectroscopy at zero pressure. Measurement

of the complex dielectric constant as a function of temperature and frequency provides a method of characterizing the materials. A large number of samples, including PEO complexed with a variety of alkali metal thiocyanates, perchlorates, and halides and a range of pure poly (vinyl acetate) PVA, PVA complexed with alkali metal salts and copolymer mixes of PVA and PEO, have been characterized in this way. These techniques allow the identification of the relaxation peaks associated with the glass transition and other processes.

Ultrasonic Detection of Wear Particles

RESEARCHER: ASSOCIATE PROFESSOR DAVID A. NORDLING

SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

Ultrasonic pulse echo technique is being used to detect particulates in an oil test loop. It has been shown that particles can be detected in a circulating fluid loop using this technique. A 5 MHz ultrasonic tone burst is used in a pulse echo fashion. The system was seeded with glass beads ranging in size from 1 to 100 microns and AC fine test dust. Using pulse return count, one can gain information about the size or amount of particulate in the test loop.

It has also been demonstrated that oil in water can be measured. Currently, tests are being conducted on a bearing failure test facility.

The researcher plans to investigate other frequency tone bursts and transducer configurations. At present, the ultrasonic transducer must be mounted through the wall of the pipes of the circulating loop. Investigations are being made into transducer applications which do not require mounting transducers through the pipe wall.

Analysis of MJOLLNIR Pulsed Chemical Laser Test Interaction Data

RESEARCHER: PROFESSOR CHARLES W. RECTOR
SPONSOR: NAVAL RESEARCH LABORATORY

Target impulse data were taken by a Los Alamos Laboratory group using 6061 aluminum targets and the Kirtland Air Force Base MJOLLNIR facility (a high power HF/DF chemical laser). These data were reduced, analyzed,

and interpreted.

Additional data of a different nature were also taken by the resident staff of the MJOLLNIR facility under a contract with the Naval Research Laboratory. These data are currently being examined.

Acoustic Radiation Theory

RESEARCHER: VISITING PROFESSOR HARRY A. SCHENCK
SPONSOR: NAVAL OCEAN SYSTEMS CENTER

This project involves application of the Helmholtz integral formulation to solve acoustic radiation and scattering problems for bodies of arbitrary shape. Using this method shows the basis for and limitations

of the usual sonar equation approach. This is analytical work with computer modeling, with the objective of submitting a paper for publication in the Journal of the Acoustical Society of America.

Magnetoelastic Fracture Theory

RESEARCHER: PROFESSOR CARL S. SCHNEIDER
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The large stresses involved in steel fracture generate magnetization charges. Voltage signals in the potential drop technique of studying rapid fractures are heavily contaminated with magnetoelastic contributions. These have been

eliminated using the ACPD (alternating current potential drop) method, while residual magnetic signals remain even at high DC currents in the DCPD method. Experiments are ongoing to clarify the effect and theoretically remove it.

Stress Effects on Magnetostrictive Hum

RESEARCHER: PROFESSOR CARL S. SCHNEIDER
SPONSOR: DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER,
ANNAPOLIS LABORATORY

The anisotropy induced by either stress or magnetic annealing of grain-oriented silicon steel (GOSS) reduces magnetization charges. The

corresponding magnetostrictive domain energies can be used to predict the magnetic anisotropy, and experiments are ongoing to verify this theory.

Soft Upset Events Induced by Alpha Particles in Josephson Junctions

RESEARCHER: PROFESSOR ROBERT N. SHELBY

SPONSOR: NAVAL RESEARCH LABORATORY

The project on alpha particle induced soft upset events in Josephson Junctions was completed with a study of upset events in small edge junctions furnished by IBM. The general conclusions of the work are: (1) all Sperry and IBM junctions tested experience upsets under alpha irradiation;

(2) all junctions tested have upset rate of the order of the alpha flux through the junction area for biases near one; and, (3) the IBM junction exhibits large changes in critical current under alpha irradiation, which is suggestive of trapped flux being scattered into the junction region by the alphas.

Nonlinear Optics

RESEARCHER: ASSOCIATE PROFESSOR LAWRENCE L. TANKERSLEY

SPONSOR: NAVAL RESEARCH LABORATORY

A five-year study of the generation of vacuum ultraviolet light by the nonlinear conversion of rare gas-halide laser radiation was completed. The past year's efforts focused on XeF lasers and phase matching. A general parameter study was made to find the optimal conditions for efficient conversion to the third harmonic. The overall results show that nonlinear conversion is a desirable source of VUV

radiation for applications requiring high spectral brightness, but not high power.

In addition to the direct conversion studies, rare gas-halide laser systems were operated as radiation sources for a solid state experiment conducted by another Naval Research Laboratory group and for a Raman study conducted by scientists visiting from Florida State University.

NQR in $\text{As}_z \text{Se}_x \text{S}_{3-k}$ Crystals

RESEARCHER: PROFESSOR DONALD J. TREACY

SPONSOR: OFFICE OF NAVAL RESEARCH

Nuclear quadrupole resonance (NQR) is a sensitive technique for determining the local configuration of atoms in a solid. This technique was applied to mixed crystals of arsenic (selenide/sulphide) to learn more

about their structural properties as a basis for modeling glasses of similar composition. The glasses are technologically important as optical memories and infrared-transmitting windows. The work is almost complete.

Investigation of Dust Associated with Shell Stars

RESEARCHER: MIDSHIPMAN 1/C MARK S. BOEHLE

ADVISER: ASSISTANT PROFESSOR C. ELISE ALBERT

SPONSOR: TRIDENT SCHOLAR PROGRAM

The purpose of this project was to investigate the association of dust with shell stars, an unusual class of stars whose properties are not well understood. They are identified by emission lines in their spectra, which have been produced in a "shell" of hot gas surrounding the star. Additional observed properties such as infrared excess and variability, have indicated the presence of dust, and detailed shell models including circumstellar dust have become common in the literature. However, the direct association of dust with individual shell stars has not been demonstrated conclusively.

The two shell stars chosen for this project were AB Aurigae and FS Canis Majoris. The project was divided into two main parts. The first phase was designed explicitly to show the presence of dust around the program shell stars, and the second phase investigated the variability of the shell stars.

The technique used for the completion of both Phase One and Two was photoelectric photometry. Two sets of filters, broad band and narrow band, were used in two photometers to study the shell stars. The color index obtained

from the broad band filters can detect the effects of dust on the star's light and, when compared to neighboring stars, can show whether the dust is directly associated with the star. Variability was searched for, utilizing both sets of filters. The broad band filters detect any kind of variability, and the narrow band filters differentiate between the dust as a source of variability and the actual varying of the star's physical properties.

Surprisingly, AB Aurigae was not found to have a significant amount of circumstellar dust, and its observed infrared excess and variability have been attributed to the large nebulous cloud in which it is located. Contrary to popular assumptions, such shell stars are not necessarily associated with dust. FS CMa, however, has a strong indication of circumstellar dust, and its observed variability has been shown to be a result of its circumstellar dust shell rather than any variation of its actual physical properties. A model where dust, perhaps left over from the star's formation, is orbiting in small inhomogeneous clouds close to the star, appears to best explain the observations toward this star.

Independent Research

Positronium Formation in Low-Energy Positron- H^- Collisions

RESEARCHER: PROFESSOR RUTHERFORD H. ADKINS

Positronium (Ps) formation in collisions between e^+ and H^- ions is an especially interesting process since it is exothermic, and the lowest three levels of Ps can be formed even at zero incident energy. In addition, the Coulomb attraction between the initial particles gives a formation rate that increases like $1/v$ as the incident energy decreases. Because of this attraction, many partial waves must be retained in the calculation even at zero energy.

The researcher has begun a program to compute the cross-sections for formation into all the open Ps channels at very low energy, using a series of increasingly accurate approximations. These are based on the two-state trial function

$$\psi = F(x) \phi(r_1, r_2) + G(R_1) \phi(q_1) \psi(r_2) + \\ + G(R_2) \phi(q_2) \psi(r_1)$$

where ϕ is the H^- wave function, ϕ and ψ represent Ps and H respectively, and F and G are the wave functions of the incident e^+ and the outgoing Ps center of mass.

In the simplest approximation, the incident e^+ moves in a pure Coulomb potential, giving rise at zero energy to Bessel functions for the partial-wave components of F:

$$F_L(x) = \sqrt{\left(\frac{\pi}{kx}\right)} J_{2L+1}(\sqrt{8x}),$$

and the outgoing Ps atom is in a plane wave state; exchange is neglected in the final state. This Coulomb-Born approximation has been shown to give partial cross-sections in serious violation of the unitarity limits. In the next approximation, the e^+ moves in the more realistic potential of the H^- ion, which is repulsive at short distances but attractive at large. The preliminary result for s-waves is much more reasonable.

Cometary Ion Tail Narrow Band Imagery Dynamical Planetary Magnetospheric Field Modeling

RESEARCHER: ASSOCIATE PROFESSOR IRENE M. ENGLE

The researcher generalized some special case results obtained for a project sponsored by the American Society of Engineering Education. The generalized results will be submitted for

journal publication.

The researcher continued work on representation of results of the self-consistent modeling of the Jovan planetary magnetosphere.

Optical Measurement of Liquid Magnetic Susceptibility

RESEARCHER: ASSISTANT PROFESSOR JOHN P. ERTTEL

Continued investigation into the distortion of a liquid surface in a magnetic field has been theoretically studied and found to be simply related to the specific susceptibility of the sample, the gradient of the field energy density, and the local gravitational field. The surface profiles of several liquids will soon be measured

using a LASER reflection technique and compared with that predicted from the magnetic field and field gradient at the liquid surface. The experimental apparatus has been designed, and fabrication is underway to allow experimental verification of this new powerful technique for measuring magnetic susceptibility.

An Investigation into the RMS-Track Radius for Electron-Hole Pairs Created by Ionizing Particles or Radiation in MOS/CMOS Memory Cells

RESEARCHER: ASSISTANT PROFESSOR JOHN P. ERTTEL

Studies were continued into the numerical modeling of the RMS-track radius created by ionizing particles incident upon MOS memory structures. While there exist a few singular results, the method is in good agreement with results of other investigators. The code

used for this calculation will continue to be defined as the basis/starting point for a model of single event upset characteristics due to the diffusion of charge carriers towards the depletion layer where binary information is stored.

EFPADP (Ertel's Fool-Proof Automatic Digitizing Package)

RESEARCHER: ASSISTANT PROFESSOR JOHN P. ERTTEL

Current state-of-the art digitizing tablets fall into two basic categories depending on whether they measure a position ultrasonically or through inductive coupling. The resolution of these devices, after interpolation, typically varies from about 0.05 to about 0.005 of an inch depending on the model and price range. While any of these devices can be a tremendous aid in obtaining numerical

information from a 2-D (dimensional) source, it is felt that they all suffer, to a greater or lesser degree, from two distinct problems which are not likely to be cured by any redesign. These are: (1) difficulty in alignment of the natural axes of the tablet to the 2-D article to be digitized; and, (2) possible, if not probable, lack of orthogonality between the coordinate axes of the source article.

Illumination Software

RESEARCHER: CAPTAIN JAMES D. LESIKAR, II, USAR

The objective of this project is to develop an illumination almanac valid anywhere in the world for any date of tactical interest, to satisfy the needs of the U.S. Army's intelligence and aviation communities. In addition to the standard solar/lunar rise/set times and twilight data, Go/No-Go times for safe "nap of the earth" flying will also

be calculated. Compact, efficient ephemeris and illumination algorithms have been developed which are accurate to better than two arc-minutes in position, and are conservative in the estimation of brightness. Implementation on a particular machine is awaiting the Army's choice of a Garrison computer system.

Surface Ship Towed Array Sonars

RESEARCHER: LIEUTENANT COMMANDER MICHAEL H. TRENT, USN

An intensive literature search was conducted of DoD and other sources on the subject of "linear towed array sonar systems" with the purpose of providing technical information, fleet feedback, and personal expertise to personnel in the Sensors Branch of Underwater Systems Department at the Naval Surface Weapons Center, White Oak Laboratory. Key

topics included results of operational evaluation of the An/SQR-10 TACTAS, target motion analysis, multipath effects, and improved signal processing techniques. In conjunction with this project, the researcher participated as a technical observer in THIRD FLEET "Battle Group ASW Readiness and Effectiveness Measurement Exercise" (BGAREM 84-85).



Research Course Projects

A Study of Quasars

RESEARCHER: MIDSHIPMAN 1/C ANTHONY ORLANDO

ADVISER: ASSISTANT PROFESSOR C. ELISE ALBERT

The purpose of this project was to investigate observational data on quasars, including their distances from earth and possible origins. The project resulted in a term paper discussing the properties of quasars, with particular concentration on those properties observed in the optical spectrum. Conflicting interpretations of data pertaining to controversial issues were presented and analyzed. The researcher

came to the conclusion that the large quasar redshifts are most likely caused by the Doppler effect, due to the cosmological expansion of the Universe, and that the most plausible theories for quasar energy sources involve accretion disks around a super massive object. Quasars with the largest redshifts are probably the oldest objects observed in the Universe.

Detection of Trace Elements in Petroleum

RESEARCHERS: MIDSHIPMEN 1/C JEFFREY J. BRIGHTWELL AND GREGORY J. MCGIFFNEY

ADVISER: ASSISTANT PROFESSOR FRANCIS D. CORRELL

The goal of this project was to assess the feasibility of detecting trace elements in petroleum using instrumental neutron activation analysis (INAA). Such "oil fingerprinting" can have a number of practical applications, including identifying the source of marine oil spills.

The general procedure in INAA is to expose a sample to either slow or fast neutrons, inducing nuclear reactions that leave some of the trace-element nuclei in excited states. As these unstable nuclei decay, they emit gamma rays of characteristic energies. These gamma rays enter a photon detector, which produces an output pulse whose amplitude is proportional to the energy deposited by each detected gamma ray. The amplified pulses are then processed using a multichannel pulse-height analyzer, which displays the discrete gamma ray energies as peaks in a pulse-height spectrum. The observed pattern of gamma ray peaks constitutes a unique "fingerprint" of each different petroleum sample.

The samples studied in this project were three crude oils and two refined products obtained from the Environmental Protection Agency. The source of neutrons was either the USNA subcritical reactor (moderated fission spectrum, mostly "slow" neutrons) or the USNA deuterium-tritium (DT) neutron generator (fast, 14-MeV neutrons). Gamma rays from the activated samples were studied using a

hyperpure Germanium detector, a 1000-channel multichannel analyzer, and a commercial software package running on an Apple IIe microcomputer.

The results of the slow neutron activation were inconclusive, primarily due to the low neutron flux from the subcritical reactor and the small concentrations of trace elements in the samples. The only trace element to be positively identified was ^{56}Mn , a particularly favorable case.

The results of the fast neutron activation were better, because of the higher neutron output of the DT generator and the short halflives of the unstable nuclei produced by fast-neutron activation. Analysis of the gamma spectra showed that all of the petroleum samples contained ^{55}Mn , ^{138}Ba , and either ^{27}Al or $^{29,30}\text{Si}$ (or both Al and Si, since the same product nuclei can be produced via different reactions on these targets). More interesting elements, for the purposes of oil fingerprinting, were not unambiguously detected, suggesting that their concentrations and the sample sizes were too small, considering the limited neutron flux and other experimental constraints.

This work successfully detected a few of the most abundant trace elements in petroleum, but it also demonstrated that routine, highly-sensitive activation analysis of petroleum is probably not practical using the neutron sources presently available at the Naval Academy.

Assembly and Calibration of the 400-keV Van de Graaff Accelerator

RESEARCHERS: MIDSHIPMEN I/C JEFFREY BRIGHTWELL AND GREGORY J. MCGIFFNEY
ADVISER: ASSISTANT PROFESSOR FRANCIS D. CORRELL

The goals of this project were to complete the assembly of a reconditioned 400-keV Van de Graaff accelerator, obtain an accelerated proton beam, measure the radiation produced by the operating accelerator, and calibrate the beam energy.

The assembly of the accelerator included refurbishing, installing, and testing the high-voltage terminal, vacuum system, momentum-analyzing magnet, and a short, evacuated beam line. Once this phase of the project was accomplished and a 15- μ A proton beam was successfully extracted, a radiation survey was performed to determine x-ray levels around the operating accelerator. On the basis of this survey, a lead shield varying in thickness between 0.25 and 0.5 inches was designed and installed. The dose rate everywhere outside the shield was less than 0.11 mR/hr, a value consistent with radiation safety regulations.

The final phase of the project involved calibrating the kinetic energy of the proton beam using the resonant $^{16}\text{F}(p, \alpha)^{16}\text{O}^*$ reaction. A thick lithium fluoride target was bombarded with protons from the accelerator, and the yield of 6.1-MeV gamma rays from the reaction was measured as a function of proton energy using a 3" $\times$ 3" sodium iodide (NaI) detector and a 1000-channel multi-channel analyzer. The resonance energy of the reaction is 340 keV, and is indicated by a sharp increase in the gamma ray yield as the incident protons reach that energy. The measurements made during this portion of the project yielded a first-order energy calibration of the accelerator, and revealed that its maximum useful operating voltage is approximately 370 keV. The project concluded by successfully accelerating and roughly calibrating a proton beam.

Investigation of the Spectral Response of Scattered Acoustic Pulses in the Presence of Turbulence

RESEARCHER: MIDSHIPMAN I/C SCOTT L. NASSON
ADVISER: ASSISTANT PROFESSOR MURRAY S. KORMAN

Echolocation in the atmosphere has been used to measure the mean flow and velocity fluctuations of turbulent layers. Spectral broadening of backscattered sound pulses may be used to measure some of the velocity parameters of the turbulent interaction region. Theoretical studies can predict this spectral broadening in the case of plane wave sources and infinite array receivers. However, in reality, the receiving array in an echolocation experiment has limited directivity due to the size and number of its receiving elements. In this investigation, a ten-element linear array was designed and constructed to receive 40 kHz acoustic pulses. The individual elements

were summed together using an audio mixer that was also designed for this project. Turbulence was created by a five-inch diameter circular air jet with a nozzle exit velocity of 50 m/s, and a piezoelectric tweeter was used to transmit sound pulses into this turbulent jet. The electronic signals from the receiving array were digitized and processed by a Wavetek 660 Fast Fourier Transform analyzer. The incident and scattered frequency spectra are compared, with the results indicating a broadening of the spectra around the peak frequency of 38.2 kHz at an angle of 45 degrees, while very little broadening occurs at 0 degrees.

The Focusing of an Ultrasonic Sound Beam through a Pipe Wall

RESEARCHER: MIDSHIPMAN 1/C CHARLOTTE D. MONK
ADVISER: ASSISTANT PROFESSOR MURRAY S. KORMAN

Ultrasonic detection of wear particles that contaminate hydraulic machine oil can be used to predict the gradual failure of critical bearings in engineering hydraulic systems. The detection of these particles involves the focusing of an ultrasonic beam into the center of a Cu-Ni pipe. Scattered sound pulses from these minute particles are used to classify the contaminants and predict the rate of bearing failure.

Theoretical designs are discussed that allow the sound generated from "clamp-on" transducers

located exterior to the pipe wall: (1) to penetrate through the pipe wall with minimum reflection, and (2) to focus the beam along its center axis. A model transmission coating made up of nine wave-bearing layers is designed to allow transmission in a limited frequency bandwidth centered at 5 MHz. Focusing is achieved using a multi-element transducer array arranged over a cylindrical surface. An alternate method of focusing involves using two elliptical cavities each sharing a common focal point.

Experimental Hydrodynamic Studies on Various Keel Design Models

RESEARCHER: MIDSHIPMAN 1/C MARGARET MENZIES
ADVISER: ASSISTANT PROFESSOR MURRAY S. KORMAN

A Standfast 40" model is adapted for tow-tank testing in the USNA Hydromechanics 120 ft. and 380 ft. tow-tank facilities. This project deals with designing and testing four keels fastened to the hull. Keel #1 is a standard fin keel constructed of steel that has been designed to meet 12-meter standards from the point of view of model testing. Keel #2 is an inverted keel, keel #3 is a bulbed keel, and keel #4 is a wing-finned keel. They are all constructed from steel. Keel #1, the standard, was designed to have a root-cord length long enough to reduce scaling effects based on Reynolds' Number.

A value of 28 inches was chosen. The lateral area and the volume for each keel was kept the same for all the other keel cross sections. The scale ratio of the model keels is 1 to 7.3, based on average values of 12-meter keels which established the span on the model to be 8.9 inches. The bulb design was based upon some submarine data, while the wing design was chosen from aerodynamic studies. Measurements of drag vs velocity (up to 10 ft. per second) were performed on the Standfast model with keel #1. Theoretical predictions are in agreement with experiment with 20% error bars.

Radio Frequency Modulation of a Single Mode Argon Laser

RESEARCHER: MIDSHIPMAN 1/C TRACY S. JOHNSON

ADVISER: ASSOCIATE PROFESSOR LAWRENCE L. TANKERSLEY

The goal of the project was to phase modulate the light from a single mode argon laser at microwave frequencies. The result would be a frequency modulated light beam. Similar modulation experiments have yielded modulation at frequencies up to three gigahertz. This effort attempted an extension to eight gigahertz modulation. The project proceeded in five stages of which only four were completed. The steps were: (1) background calculations; (2) crystal preparation; (3) microwave development; (4) low power experiments; and, (5) high power experiments.

Initial calculations for phase modulation with Automated Data Processing, and an electro-optic crystal, indicated that microwave powers of a few kilowatts would yield ten percent power levels in the first order

sidebands. Additional calculations projected an optimal crystal length of about one centimeter. Several weeks were devoted to cutting, polishing, fabricating, and characterizing at the 100 milliwatt power level. The microwave system functioned as expected, and it appears to be suitable for intermittent kilowatt power level operation. Finally, the experiment was conducted at the available subwatt RF power levels. The light was analyzed with a signal averaged confocal interferometer. No modulation was observed. This result was in agreement with the theory.

The next step was to upgrade the microwave source to the several hundred watt level. There are no high power sources available at the Naval Academy, but an initial modulation test can be made quickly when a source is available.

Transport Number Measurements in Conducting Polymers

RESEARCHER: MIDSHIPMAN 1/C JONATHAN J. DORN

ADVISER: ASSISTANT MARY C. WINTERSGILL

The purpose of the research was to construct apparatus to determine whether the charge carriers in conducting polymers are electrons or ions. A sample holder was constructed which is capable of being loaded in a dry box where subsequent measurements could be performed in vacuum. Next, the electrical equipment was assembled and interfaced with an Apple IIe microcomputer via and IEEE 488 card.

A computer clock was installed and programmed to take measurements automatically at fixed time intervals. The initial data runs were for poly(ethylene oxide) complexed with lithium triflate and blocking electrodes. That material has been widely studied by other workers and the expected behavior was observed. The system will next be applied to polymers with unknown characteristics.

Publications

ALBERT, C. Elise, Assistant Professor, co-author, **"On Absorption by Hot Instellar Gas II. Fe XIV λ 5303,"** *The Astrophysical Journal*, 28 (15 June 1984), 639-643.

The spectra of 26 stars have been observed in the region of the coronal [Fe XIV] λ 5303 line at detection limits near an equivalent width of limit in the best cases. No absorption which can be attributed to Fe XIV ions in hot interstellar medium. Toward the high-latitude 0 star HD 93521, a variable absorption line was easily detected on one night but was absent at similar detection limits on five other nights, including the following one. The transitory absorption could have arisen in hot instellar gas with properties $T \leq 1.2 \times 10^6$ K and Fe XIV/FeX > 3 or, because it varied on a putative rotational timescale of HD 93521, in hot gas which is magnetically confined in an inhomogeneous stellar envelope, for example.

ALBERT, C. Elise, Assistant Professor, co-author, **"Cryogenic Servo-Controlled Infrared Fabry-Perot Spectrometer,"** *Optical Engineering*, 24 (March/April 1985), 275-284.

High resolution infrared spectroscopy obtains fundamental information about the kinematics, composition, and energetics of astronomical infrared sources, because it can sort out typical Doppler velocity components and separate adjacent lines from various species. In important cases, the instrument which has the maximum possible sensitivity for detection is a cryogenic Fabry-Perot spectrometer, because it rejects noise from the bright and often flickering background without injecting any radiation. Such an instrument's only limitation is the performance of the best detectors. Coupled to a two-dimensional array, a cryogenic Fabry-Perot can produce spectroscopic infrared images of high quality. A prototype cryogenic infrared Fabry-Perot spectrometer has been developed and operated successfully on-site. The system uses a unique

optical servo-control for reliable sensing of the interferometric surfaces, and electromagnetic voice coil displacement drivers for the large motions needed for flexible operation. The present etalons and detector are optimized for the 4 to 5 μ m band. The article presents a description of the instrument, recent astrophysical results obtained at a telescope, and a summary of development plans. Such a system can be operated from space out to submillimeter wavelengths.

ALBERT, C. Elise, Assistant Professor, co-author, **"A Far-Infrared Fabry-Perot for Space,"** Ninth International Conference on Infrared and Millimeter Waves, *Conference Digest* (22-26 October 1984), 120-121. [Takarazuka, Japan]

High-resolution spectroscopy (resolving powers $R \geq 10^4$, $\Delta V \leq 30$ km s⁻¹) yields fundamental data about the nature and evolution of infrared sources, because it clarifies details of kinematics, composition and energetics. In choosing a high resolution instrument, the maximum sensitivity to individual spectral features is a consideration of paramount importance. A cryogenic Fabry-Perot interferometer provides the background rejection needed to reach detector-noise-limited sensitivity in cases where the maximum sensitivity to a single line is required. Furthermore, because the optical path of a Fabry-Perot is folded many times, an instrument of modest size, coupled with an order sorting device like a grating or another Fabry-Perot, can achieve high resolution in a small space, even at long wavelengths. Finally, a Fabry-Perot with an array of detectors can provide relatively straightforward imaging capability. The article presents design concepts for a cryogenic, servo-controlled, electromagnetic coil displacement Fabry-Perot which could be used in space. Also included are results from a prototype instrument now operating at short wavelengths at the 1.3 meter telescope of Kitt Peak National Observatory.

BRILL, Donald W., Professor, co-author, **"Acoustic Resonance Scattering by a Penetrable Cylinder,"** *Journal of the Acoustical Society of America*, 73 (May 1983), 1448-1455.

Although sound scattering by submerged elastic cylinders has been the subject of many papers, it was only recently that this and similar problems have been examined in the light of the resonance scattering theory (RST). Crucial experiments have been performed recently at Le Havre, France, in which the modal resonances contained within the cylinder's backscattering cross-section were isolated by means of a background subtraction, experimentally accomplished by a clever time-gating technique. The present paper generates a variety of tailor-made calculations and graphical displays required to examine thoroughly those experiments in the light of the RST. For the same cylinder, liquids, and frequency ranges of interest, the authors produced many spectral graphs displaying all the modal resonances that combine with the modal backgrounds to produce the observed and or predicted cross-sections. Resultant calculations (a) display the whispering gallery and Rayleigh-type poles in the complex frequency plane and show their connection with the target resonances they generate, which manifest themselves as circumferential waves around the target, (b) explain quantitatively why some of the modal resonances were missed in the experiment, (c) establishment comparisons between predicted and observed monostatic and bistatic form functions (or cross-sections) in a direct scattering mode of operation, and (d) show ways to improve both the monostatic and bistatic measurements performed at Le Havre, paving the way toward the solution of inverse scattering situations. Within the limits of simple shapes and compositions, and within the controlled environment of the laboratory, these favorable comparisons have satisfactorily validated many of the predictions of the RST in the field of acoustics.

BRILL, Donald W., Professor, co-author, **"Acoustic Spectrogram and Complex-frequency Poles of a Resonantly Elastic Tube,"** *Journal of the Acoustical Society of America*, 75 (June 1984), 1680-1693.

This article is a study of the resonance scattering undergone by an air-filled hollow cylinder excited by an incident plane acoustics wave. The authors construct the boundary value problem, obtain its classical solution based on the Resonance Scattering Theory (RST), and generate a variety of useful computed results, some of which are later compared to experimental observations recently performed in France. After presenting highly accurate expressions for the phase and group velocities and for the phase and group attenuations of the first few surface waves circumnavigating (the extreme cases) of rigid and soft cylinders, these dispersion plots are displayed in all instances. The authors also analyze the modal backgrounds and modal resonances of the shell, display them in a wide spectral band, determine the SEM-type pole-position diagram in the complex $k_1 a$ plane, and obtain and display the background-suppressed cross-section of the tube. This result serves to generate the acoustic spectrogram of the shell, as well as to show the excellent agreement of this theoretical prediction with the experimental observations carried on in France. The authors analyzed cross-sectional poles and cross-sectional dips and reduced many of the present shell results to particular cases for impenetrable cylinders and solid elastic cylinders. For these latter ones, dispersion plots were obtained for the phase and group velocities of the internal surface waves revolving around them. They also determined expressions for the nearfield shell cross-sections at different ranges, and compared them to the usual farfield results. The sound pressure levels transmitted onto the shell's interior were determined to exhibit the controlling role of the tube resonances have on the isobaric contours. Display of extensive computerized calculations illustrates all these points. Comparisons with experimental observations are shown to be quite favorable, particularly for the background-suppressed shell cross-section, and for its acoustic spectrogram.

CORRELL, Francis D., Assistant Professor, co-author, **"Sputtering and Migration during Ta Implantation of Fe,"** *Nuclear Instruments and Methods in Physics Research*, B7/8 (1985), 798-802.

This work evaluates the importance of sputtering and diffusion to the measured concentration profiles of Ta implanted into Fe. The samples consisted of thin Fe films deposited on sapphire or glass substrates and implanted with 150-keV Ta ions to fluences of $(1-18) \times 10^{16}$ ions/cm². Rutherford backscattering analysis provided measurements of the retained dose, the sputtering rate of Fe and Ta, and the evolution of the Ta depth distribution, all as functions of ion dose. These measurements indicated that preferential removal by sputtering, combined with atomic migration, led to a 50% increase in the saturation retained dose of Ta, when compared to the value predicted by simple theory without these two effects.

CORRELL, Francis D., Assistant Professor, co-author, **"Sputtering, Diffusion, and Carburization in Ta-Implanted Fe,"** *Bulletin of the American Physical Society*, 29 (1984), 110.

Interest in ion implantation of Fe has been stimulated by the discovery that high-fluence implantation of Ta (and other) ions into some steel can improve their wear and oxidation behavior. In some cases, the production of a carburized surface layer seems associated with this improvement. A preliminary study of thin, Ta-implanted Fe films revealed a saturation retained dose of Ta that is 50% larger than the value predicted by a simple model, but the role of C and O found in the films was not fully resolved in that study. In the present work, polished bulk

Fe samples were implanted with 150-keV Ta⁺ ions to fluences from 1 to 30×10^{16} cm⁻². In-situ Auger electron spectroscopy was used to monitor the approach to steady state. Most samples were implanted at room temperature and under UHV conditions, but some were implanted at about 80K or 520K, and some in a CO atmosphere at about 1×10^{-6} Torr. The Ta retained dose and depth profile were measured using Rutherford backscattering. For some samples, the O, C, and Ta profiles were measured using in-situ AES. The results will be compared with model predictions that incorporate diffusion, carburization, and preferential removal.

ELDER, Samuel A., Professor, **"Theory of Flow-Excited Cavity Resonance in an Incompressible Fluid,"** *Journal of the Acoustical Society of America*, 76 (1984), S31.

In heavy incompressible fluids, such as water, Helmholtz resonance is not expected to occur. However, tests with a towed free-flooding cavity have shown that an incompressible breathing-mode resonance does occur at certain speeds which produces tones analogous to those caused by Helmholtz resonance in air. The effect seems to be dependent on the presence of wall-vibration modes, capable of producing a modulation in the cavity cross-section. Following a procedure developed for air-cavity resonances, a feedback theory is derived in terms of lumped mechanical circuit parameters. It is shown that Strouhal number for resonance is fixed by quantization of stability waves in the separated shear layer. System amplitude is believed to be limited by nonlinear orifice impedance analogous to that which is known to take place in air cavities.

FONTANELLA, John J., Professor, Mary C. WINTERSGILL, Assistant Professor, and Douglas R. FIGUEROA, Visiting Professor, **"Dielectric Relaxation, Ionic Conductivity and Activation Volumes in Cubic Lead Fluoride Doped with Alkali-Metal Cations,"** *Journal of Physics C: Solid State Physics*, 17 (1984), 4399-4411.

Audio-frequency complex impedance measurements have been performed on pure and alkali-metal doped lead fluoride at zero pressure over the temperature range 5.5 to 380K and at pressures up to 0.25 GPa over the temperature range 260 to 333K. The dielectric spectra show distinct alkali-metal associated relaxations in each case. The activation enthalpy for the principal relaxations in sodium (0.221 eV), potassium (0.252 eV) and rubidium-doped PbF_2 (0.218 eV) are close to that for the motion of free vacancies. Thus the peaks are attributable to the motion of bound fluorine vacancies around the substitutional impurity ions. The principal relaxation observed for the lithium-doped samples, lithium ions being the smallest of the alkali metals, has a higher activation energy (0.331 eV). This may be due to the reorientation of Li^+ substitutional- Li^+ interstitial pairs. The ionic conductivity at temperatures above those of the dielectric peaks is interpreted in terms of the thermal dissociation of the impurity-vacancy complexes. The activation energies and activation volumes were found to be very sensitive to ion size, both reaching a maximum for the potassium dopant. Finally, the ratio of activation volumes to activation energies was found the same for all dopants, in excellent agreement with theoretical predictions.

FONTANELLA, John J., Professor, and Mary C. WINTERSGILL, Assistant Professor, **"Electrical and Differential Scanning Calorimetry Studies of Poly(ethylene oxide) Complexed with Alkaline Earth Thiocyanates,"** *Journal of Polymer Science: Polymer Physics*, 23, (1985), 113-120.

Audio frequency dielectric relaxation measurements and differential scanning calorimetry studies have been performed on poly(ethylene oxide) (PEO) complexed with calcium and barium thiocyanate. The measurements were performed over the temperature range 5.5-300K. The activation enthalpy for the peak corresponding to the

γ relaxation of pure PEO depends upon the size of the dopant cation. The activation enthalpy for the second peak is independent of the nature of the dopant cation and is very similar to that observed for the α_c relaxation observed in pure PEO. Next, the room temperature electrical conductivity for the complexed materials is much smaller than that for pure PEO and hence very much less than for PEO complexed with alkali metal salts. However, above T_g , the conductivity rises rapidly and is larger for the barium thiocyanate complexed PEO than for the calcium complexed material. Finally, the DSC studies show that one effect of the ions is to shift the glass transition temperature to higher temperatures.

KORMAN, Murray S., Assistant Professor, **"Scattering of Nonlinear Crossed Beams in the Presence of Turbulence in Water,"** NRL-USNA Program for Cooperative Research FY84 Report, October 1984.

Scattering experiments are performed involving the mutual interaction of perpendicular crossed sound beams interacting in the presence of the turbulence created by a submerged water jet. The sound beams (generated by one-inch diameter piston transducers) are pulses of 200 μsec duration with individual carrier frequencies of $f_1 = 2.1\text{MHz}$, $f_2 = 1.9\text{MHz}$, respectively. A one-inch diameter receiving transducer (with resonant frequency near 4.0MHz) is located outside the interaction region. In the presence of turbulence, a nonlinearly generated 4.0MHz "sum" frequency component pulse of scattered acoustic energy is detected outside the interaction region. However, in the presence of turbulence, virtually no scattering is detected at the sum frequency component. This latter result is in agreement with Westervelt's theory on the scattering of sound by sound.

Measurements of the scattered pulse radiation at the sum frequency component are recorded (using a Norland 3001 digital oscilloscope) at 10° intervals for a complete 360° rotation of the crossed beam scattering apparatus. These results are compared with "conventional" single-beam scattering measurements involving just the incident 1.9 MHz pulsed sound beam.

Using the scattering results of conventional linear beam scattering and nonlinear crossed beam scattering, one can characterize the hydrodynamic properties of the turbulent

interaction region. One important question is to determine the relative degree of improvement in measuring turbulent flow using a crossed beam geometry. Here the interaction region is presumably less than that from the single beam scattering geometry.

LESIKAR, James D., Captain, USAR, co-author, **"Transverse-Spin Dependence of the P-P Total Cross-Section $\Delta\sigma_T$ from 0.8 to 2.5 GeV/c,"** *Physical Review*, D31, (1 March 1985), 966-975.

The difference $\Delta\sigma_T = \sigma(11) - \sigma(\bar{1}\bar{1})$ between the proton total cross-sections for protons in pure transverse-spin states was measured at incident momenta 0.8 to 2.5 GeV/c in experiments performed at the Los Alamos Clinton P. Anderson Meson Physics Facility and the Argonne Zero Gradient Synchrotron. In agreement with other data, peaks were observed at center-of-mass energies of 2.14 and 2.43 GeV/c², where ¹D₂ and ¹G₄ dibaryon resonances have been proposed.

NORDLING, David A., Associate Professor, co-author, **"Measuring Particulate in Oil by Ultrasonic Beams of Pulse Echo,"** David W. Taylor Naval Ship Research and Development Center, Report 83-45, July 1984.

An oil test loop with circulating oil (2190) was constructed at DTNSRDC to test and demonstrate the use of ultrasonic pulse echo technique for the detection of particulate. A 5 MHz tone burst was used. The system was seeded with glass beads in sizes 10 to 15 microns, 15 to 25 microns, 25 to 35 microns, 35 to 45 microns, 45 to 75 microns, and 75 to 105 microns, to demonstrate and calibrate the technique in terms of size. AC fine test dust was also used to seed the system. It was shown that the technique was capable of detecting particulate and able to discriminate in terms of size.

NORDLING, David A., Associate Professor, co-author, **"Detecting Wear Particles in Oil by Ultrasonic Pulse Echo,"** *Proceedings of the 40th Mechanical Failure Prevention Group*, April 1985.

Using an ultrasonic tone burst in a pulse echo, wear particles can be detected in a size range from 5 microns to over 100 microns.

A comparison is made between this technique and existing methods for detecting particles in lubricating systems. The technique for extracting size range information from the pulse count return is given. It is also shown that this technique has application in other areas, such as detecting water in oil and oil in water. Plans are underway for applying this technique to a bearing failure test set-up at David Taylor Naval Ship Research and Development Center, Annapolis Laboratory.

ROYCE, Gerald A., Visiting Professor, John J. FONTANELLA, Professor, and Mary C. WINTERSGILL, Assistant Professor, **"Radiation Effects in Samarium-Doped Calcium Fluoride,"** *Journal of Luminescence*, 29 (1984), 205-213.

A study was conducted of the effect of gamma radiation on samarium-doped calcium fluoride crystals. Optical absorption measurements indicate that many of the samarium (3⁺) ions are converted to samarium (2⁺) during irradiation. Heavy doses of 1 Mrad also modify the trapping structures and enhance certain defects within the crystals. A comparison is provided between unirradiated and heavily irradiated calcium fluoride crystals with three samarium concentrations: 0.01, 0.1, and 1.0 percent.

SCHNEIDER, Carl S., Professor, co-author, **"Magnetoelastic Processes in Steel,"** *Journal of Applied Physics*, 57 (1985), 4198.

A magnetoelastic model described previously has been computer programmed to allow averaging over polycrystalline grain orientations and integration of observed susceptibility to predict magnetization changes continuously. In magnetoelastic (field and stress, H- σ) processes, Brown's effective field due to stress on 90° domain walls, with Kondorsky's model of hysteresis has been extended with the differential susceptibility to describe accurately magnetization changes in σH , $\sigma\sigma H$, $H\sigma$, and $HH\sigma$ processes for coercive fields and stresses: magnetization in the σH process initially exceeds and then drops below that due to H alone. Susceptibility in the $\sigma\sigma H$ process was predicted and then observed to be first higher and then lower than for H alone. Magnetoelastic sensitivity, $H(\sigma\sigma)^n$, was observed to increase with magnetization as predicted by this model and by Bozorth. No Villari reversal was observed.

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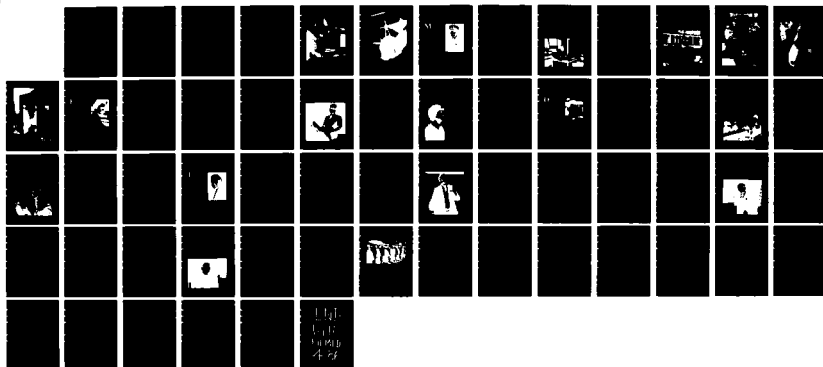
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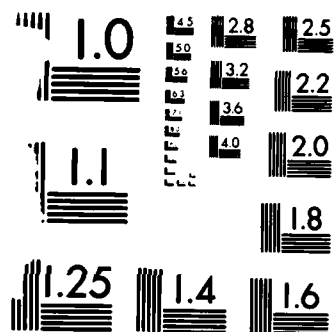
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TREACY, Donald J., Professor, 1) *Optical Constants of Crystalline As_2Se_3* , 2) *Optical Constants of Amorphous As_2Se_3* , 3) *Optical Constants of Crystalline As_2S_3* , 4) *Optical Constants of Amorphous As_2S_3* . Academic Press, 1985. Ed. E. D. Palick.

This is a portion of a compendium of the optical constants of the materials listed in the *Handbook of Optical Constants of Solids*.

TREACY, Donald J., co-author, "**Local Order and Defects in MBE-grown a-GaAs**" J. *Non-Crystalline Solids*, 66, (July 1984), 133-139.

Electron spin resonance (ERS) and ^{71}Ga and ^{75}As nuclear magnetic resonance (NMR) measurements have been performed on a 20μ thick film of a-GaAs deposited on a SiO_2 substrate by molecular beam epitaxy. The ESR spectrum exhibits the four²-line $S = 1/2$, $I = 3/2$ hyperfine pattern characteristic of the singly ionized arsenic antisite defect $(\text{As}_{\text{Ga}})^+$ commonly observed in crystalline GaAs. The concentration of As_{Ga} centers is estimated to be $10^{17} - 10^{18}\text{cm}^{-3}$ which is 2-3 orders of magnitude higher than those typically found in as-grown (unirradiated) crystalline samples. ^{71}Ga and ^{75}As NMR line widths suggest substantial quadrupole broadening due to slight deviations from crystalline bonding parameters, but with overall preservation of short-range tetrahedral order.

WINTERSGILL, Mary C., Assistant Professor, John J. FONTANELLA, Professor, and Douglas R. FIGUEROA, Visiting Professor, "**Association and Bound Motion in Alkali-Metal Doped Cadmium Fluoride**," *Physical Review*, B29 (1985), 5909-5919.

The effects of temperature and hydrostatic pressure on the ionic conductivity and the dielectric relaxation have been measured

for lithium-, sodium-, and potassium-doped cadmium fluoride. Activation energies and activation volumes for the association region and for motion of the bound defects have been determined. These were found to depend strongly on the size of the dopant. For the nominally sodium-doped material, a single relaxation attributable to sodium is observed and is associated with NN fluorine vacancy — sodium substitutional pairs. For the potassium-doped material, two distinct relaxations are observed, which suggest the presence of both NN and NNN fluorine vacancy-potassium substitutional dipoles. A single relaxation peak is observed in the lithium-doped material. It is attributed either to NN fluorine vacancy-substitutional lithium pairs or to lithium interstitial-lithium substitutional complexes. The activation energy for jumps of bound vacancies is largest for the sodium dopant, for which the lattice distortion is the least. The activation energies and the activation volumes for bound vacancy motion were found to be in approximately the same ratio as the values reported for free vacancy motion as expected from dynamical diffusion theories.

WINTERSGILL, Mary C., Assistant Professor, and John J. FONTANELLA, Professor, "**Electrically Conducting Poly(vinyl acetate)**," *Journal of the Electrochemical Society*, 131 (1984), 2208-2209.

Electrically conducting polymers have recently been the subject of intense interest. Polyacetylene has been widely studied as an electronic conductor. Ionic conductors include poly(ethylene oxide), poly(propylene oxide), poly(acrylonitrile), poly(vinylidene fluoride), poly(tetramethylene oxide), and poly(ethylene succinate). In the present note, the observation of electrically conducting poly(vinyl acetate) (PVAc) is reported. Ionic conduction is inferred from the data.

Presentations

ADKINS, Rutherford H., Professor, co-author, **"Positronium Formation in Low-Energy Positron - H Collisions,"** Seventh International Conference on Positron Annihilation, New Delhi, India, 6-11 January 1985.

ALBERT, C. Elise, Assistant Professor, **"Interstellar Gas in the Galactic Halo,"** U.S. Naval Academy Chapter of Sigma-Xi, Annapolis, Maryland, 19 September 1984.

BRILL, Donald W., Professor, co-author, **"Resonance Scattering of Elastic Waves by an Elastic Sphere in an Elastic Medium,"** 108th Meeting of the Acoustical Society of America, Minneapolis, Minnesota, 9 October 1984.

BRILL, Donald W., Professor, co-author, **"Numerical Calculations for Resonance Scattering by an Elastic Sphere in an Elastic Medium,"** 109th Meeting of the Acoustical Society of America, Austin, Texas, 9 April 1985.

CALAME, Gerald P., Professor, co-author, **"Reduction of Beam Aberrations with Stimulated Raman Scattering,"** Conference on Lasers and Electro-Optics, Baltimore, Maryland, 21-24 May 1985.

CORRELL, Francis D., Assistant Professor, co-author, **"Sputtering and Migration during Ta Implantation of Fe,"** Fourth International Conference on Ion-Beam Modification of Materials, Ithaca, New York, 16-20 July 1984.

CORRELL, Francis D., Assistant Professor, co-author, **"Sputtering, Diffusion, and Carburization in Ta-Implanted Fe,"** Eighth Conference on the Application of Accelerators in Research and Industry, Denton, Texas, 12-14 November 1984.

ELDER, Samuel A., Professor, **"The Physics of Church Growth,"** Special Lecture for Men's Retreat, Chesapeake Presbyterian Church, Montross, Virginia, 11 May 1985.

ERTEL, John P., Assistant Professor, **"Automated Registration (Alignment and Calibration) of Digitizing Tablets,"** Second International Congress on Computers in Science (SCICOMP II), Washington, D.C., 30 October 1984.

FONTANELLA, John J., Professor, Peter J. WELCHER, Associate Professor, Mathematics, and Mary C. WINTERSGILL, Assistant Professor, **"Universal Curves and Normalizing Dielectric Relaxation Data,"** International Conference on Defects in Insulating Crystals, Salt Lake City, Utah, 20-24 August 1984.

FONTANELLA, John J., Professor, Mary C. WINTERSGILL, Assistant Professor, and Peter J. WELCHER, Associate Professor, Mathematics, **"Electrical Relaxation in Poly(ethylene oxide),"** Symposium on Dielectric Phenomena in Honor of the 70th Birthday of Professor Robert H. Cole, Providence, Rhode Island, 14-15 January 1985.

FONTANELLA, John J., Professor, Gerald A. ROYCE, Visiting Professor, Mary C. WINTERSGILL, Assistant Professor, and Peter J. WELCHER, Associate Professor, Mathematics, **"IR, X-Ray, DSC, Electrical Relaxation and Conductivity Studies in PEO Complexed with Lithium Triflate,"** American Physical Society, Baltimore, Maryland, 25-29 March 1985.

FONTANELLA, John J., Professor, Mary C. WINTERSGILL, Assistant Professor, and Peter J. WELCHER, Associate Professor, Mathematics, **"High Pressure and Molecular Weight Variation of Electrical Relaxation in Poly(ethylene oxide),"** American Physical Society, Baltimore, Maryland, 25-29 March 1985.

FONTANELLA, John J., Professor, **"High Pressure Work at the U.S. Naval Academy,"** Fourteenth Meeting of the Washington Area High Pressure Colloquium, Naval Surface Weapons Center, White Oak, Maryland, 26 April 1985.

KORMAN, Murray S., Assistant Professor, **"Enhancement of the Nonlinear Scattering of Crossed Sound Beams in the Presence of Turbulence Due to a Concentration of Bubbles in the Interaction Region,"** 108th Meeting of the Acoustical Society of America, Minneapolis, Minnesota, 8-12 October 1984.

KORMAN, Murray S., Assistant Professor, **"Multiple Scattering of Sound by Turbulence in Water,"** 109th Meeting of the Acoustical Society of America, Austin, Texas, 8-12 April 1985.

KORMAN, Murray S., Assistant Professor, **"Report to the Committee on Education in Acoustics on the Growth and Decline of Student Membership in the Acoustical Society of America,"** 109th Meeting of the Acoustical Society of America, Austin, Texas, 8-12 April 1985.

NORDLING, David A., Associate Professor, and Robert N. SHELBY, Professor, **"A Student Experiment on Mapping Electric Fields Using the Microcomputers,"** The American Association of Physics Teachers, Flagstaff, Arizona, June 1985.

NORDLING, David A., Associate Professor, **Invited participant on Lecture Demonstrations,** The American Association of Physics Teachers, Flagstaff, Arizona, June 1985.

NORDLING, David A., Associate Professor, **Invited participant in Session on "Microcomputers in Physics Laboratories,"** The American Association of Physics Teachers, Flagstaff, Arizona, June 1985.

SCHNEIDER, Carl S., Professor, **"Magnetoelastic Processes in Steel,"** Thirtieth Steel Annual Conference on Magnetism and Magnetic Materials, San Diego, California, 27-30 November 1984.

SHELBY, Robert N., Professor, David A. NORDLING, Associate Professor, and John P. ERTEL, Assistant Professor, **"Presentation on Microcomputer Use in the Physics Labs at USNA,"** Chesapeake Section of American Association of Physics Teachers Meeting, USNA, Annapolis, Maryland, May 1985.

TANKERSLEY, Lawrence L., Associate Professor, co-author, **"High-Energy Vacuum — Ultraviolet Frequency Conversion,"** Thirteenth International Quantum Electronics Conference, Anaheim, California, 18 June 1984.

TRENT, Michael H., Lieutenant Commander, USN, **"Environmental Impact on Acoustic Sensors during BGAREM 84-4,"** Battle Group ASW Readiness and Effectiveness Measurement 84-4 Post Exercise Critique, THIRD FLEET Headquarters, Pearl Harbor, Hawaii, 29 June 1984.

WINTERSGILL, Mary C., Assistant Professor, John J. FONTANELLA, Professor, and Michael K. SMITH, Lieutenant, USN, **"Electrical and Thermal Properties of Poly(vinyl acetate) Complexed with Alkali Metal Salts,"** American Physical Society, Baltimore, Maryland, 25-29 March 1985.

WINTERSGILL, Mary C., Assistant Professor, and John J. FONTANELLA, Professor, **"TSDC Studies in PEO and PEO Complexed with KSCN,"** American Physical Society, Baltimore, Maryland, 25-29 March 1985.

Division of Professional Development





Leadership and Law

COMMANDER THOMAS H. BERNIS, USN
CHAIRMAN

Members of the Leadership and Law Department conduct various kinds of applied research in support of institutional objectives. To this end, research is directed toward the professional development of midshipmen to become effective and efficient leaders of tomorrow's fleet and Marine Corps.

While not reported in detail, the Department's ongoing efforts to determine the best way for counseling midshipmen and providing them with improved study materials continued.



Independent Research

A Comparison of Aerobic and Non-Aerobic Exercise in the Treatment of Depression

CO-RESEARCHER: ASSISTANT PROFESSOR ERIC D. BOWMAN

Forty-one women, recruited from the Rochester, New York, community, who met the Research Diagnostic Criteria (RDC) for Major or Minor unipolar depression (Spitzer, Endicott, & Ribins, 1978), were randomly assigned to one of three treatment conditions: aerobic running, non-aerobic weight training, or wait-list control. Subjects in the aerobic running condition contracted to exercise on an indoor track four times a week for thirty (30) minute periods. Similarly, subjects in the weight training condition exercised four times a week for thirty (30) minute periods on a Universal Gym. Subjects within both treatment groups exercised under the supervision of research assistants who were trained to monitor both exercise conditions. Each subject's level of depression

was assessed using a number of measures including the Beck Depression Inventory (Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961) and the Hamilton Rating Scale for Depression (Hamilton, 1960). Change in cardiovascular fitness was assessed by pre- and post-treatment submaximal treadmill testing (Astrand and Rodahl, 1977). This is a preliminary report of pre-, post-, and one-month follow-up data for the depression measures.

Depression, as measured by the BDI and HRSD, significantly reduced in the two treatment groups with no change in the control group ($p .00001$), and there was no significant difference between the two exercise conditions. Changes for treated subjects were maintained at the one-month follow-up.

Assessment of Outcomes of Sail Training

RESEARCHERS: VISITING PROFESSOR RICHARD M. EVANS
AND LIEUTENANT COMMANDER DEXTER S. BRYCE, USN

The semantic differential technique is used to assess the meaning of concepts concerned with seamanship, leadership, and love for the sea, which may be modified by the activity of Sail Training. In its first use, midshipmen

who experienced the storm, and to a control group which has had summer cruising in powered craft. Subsequent use will be in a controlled experiment with 1985 offshore sail training.

Developing a Myopia-Avoidance Protocol and Research Program

RESEARCHER: PROFESSOR KAREL MONTOR

Efforts continued to establish and develop a procedure and technique with the world-famous Wilmer Eye Institute of the Johns Hopkins Medical School for the prevention of myopia in college students. This is a continuing program which has been in development for

the past several years and will be coordinated with the USNA Medical Officer and other members of the medical and optometric communities. During the reporting year, approval to proceed has received Navy authorization.

Development of a New NL303 Leadership Text

RESEARCHER: PROFESSOR KAREL MONTOR

During the reporting period, interviews were conducted with former Chiefs of Naval Operations: Admirals Carney, Burke, McDonald, Zumwalt, and Holloway, and an interview of Admiral Hayward was conducted by Lieutenant Tom Hutchinson at the Admiral's office in Hawaii. In addition,

letters were sent to ninety top officials of the naval service for their individual inputs, with a number of answers received from former Commandants of Marine Corps: Generals Shepherd and Greene, and an interview program started with General Barrow.

NL486 Leadership IV: Practicum

RESEARCHER: PROFESSOR KAREL MONTOR

Eighteen midshipmen working with a wide range of military and civilian personnel at the Naval Academy researched and developed approaches to improvements in Academy operations, as well as preparing materials for use by officers here and at other installations around the country. Programs included the Lite Lunch Program, Leadership Forum '86,

Improving Operations by Company and Battalion Commanders, Development of Anecdotal Information about Senior Officers of the Naval Service for the New NL303 Text Book, Preparing to Join the Surface Line Community after Graduation, Preparing to Join the Air Community after Graduation, and a wide variety of other projects and research subjects.



Publications

BORRO, Ronald, Lieutenant Commander, USN, Harvey HOPSON, Major, USMC, Kevin McMAHON, Lieutenant Commander, USN, David MYERS, Lieutenant Commander, USN, Clayton SANDERS, Lieutenant, USN, and Jonathan P. EDWARDS, Lieutenant, USN, *Law for the Junior Officer*, Annapolis: Defense Printing Plant, 1985.

Law for the Junior Officer presents a survey of military law, concentrating on the functioning of the military's disciplinary and judicial systems. Included are chapters on crimes and defenses, nonjudicial procedures, courts-martial, search and seizure, interrogations and the right to counsel, and pretrial restraint. Also included is an administrative law chapter which addresses standards of conduct in the naval service, administrative investigations, injury reporting, claims, access to official records, relations with civilian authorities, and administrative separations. The text is designed to acquaint the midshipman with those aspects of military law with which the individual will be dealing daily in the course of his or her junior officer duties.

CRIGLER, Patricia W., Commander, MSC, USN, "Incest" in *The Military Family*, Frances W. KASHLAW, and Richard I. RIDENOUR, New York: Guilford Press, 1984, pp. 98-124.

A fairly exhaustive exploration of the topic of incest, its definitions, practice, "causes," types of perpetrators and their psychological roots, exploration of family dynamics, outcomes of incest victims, social systems

responses, and treatment and responses to the problem by armed forces mental and family health organizations.

MONTOR, Karel, Professor, and Anthony CIOTTI, Lieutenant Colonel, USMC, *Fundamentals of Naval Leadership*, (4th ed.), Annapolis: Naval Institute Press, 1984.

Midshipmen are presented with materials designed to inculcate them with an understanding and ability to use concepts related to the study of human behavior, motivation and learning, reaction to conflict, and frustration of groups. Also included are materials related to moral leadership, the role of the naval officer, the personal qualities for effective leadership, the dynamic qualities of leadership, counseling and interviewing, discipline and morale, training, organization and administration, and the Code of Conduct for members of the Armed Forces of the United States, plus leadership cases for discussion.

MONTOR, Karel, Professor, and Anthony CIOTTI, Lieutenant Colonel, USMC, *Readings in Naval Leadership*. Annapolis: Defense Printing Plant, 1984.

This is a compilation of articles dealing with the "real" world of naval leadership, including coverage of such subjects as responsibility, authority, integrity, the lives of great military individuals, heroism in battle, working with members of the naval service, leadership cases for discussion, and numerous other areas which complement *Fundamentals of Naval Leadership*.

Presentations

CRIGLER, Patricia W., Commander, MSC, USN, "Alcoholism" and "Adult Children of Alcoholics," National Obstetrics and Gynecology Conference, Las Vegas, Nevada, October 1984, Alcohol Rehabilitation Service, Naval Hospital, Long Beach, California, January 1985, and Women's Forum, Washington, D.C., March 1985.

CRIGLER, Patricia W., Commander, MSC, USN, "Precursors to Leadership," Keynote speech to Women in Government, Washington, D.C., May 1985.

MONTOR, Karel, Professor, "The Video Future in the Classroom," Frontiers in Education Conference, Philadelphia, Pennsylvania, 5 October 1984.

MONTOR, Karel, Professor, "Interpersonal Leadership Challenges," Marine Corps Command and Staff College, Quantico, Virginia, 27 November 1984.

MONTOR, Karel, Professor, "Leadership Instruction at the Naval Academy," Parents and Sponsors Club of Maryland, Annapolis, Maryland, 30 September 1984.





Division of U.S. and International Studies



SCIENCE



Economics

PROFESSOR J. ERIC FREDLAND
CHAIRMAN

Economics faculty members have engaged in many notable scholarly activities in the past year. Two members were on sabbatical. Professor Little's sabbatical research focused on the accession and retention of military manpower. Professor Johnson, supported in part by the Fulbright Commission, spent his sabbatical year in Sweden. Results of his research in both health and environmental economics were presented in Rotterdam, Athens, and Berlin, as well as in Sweden. Associate Professor Goodman spent the second semester doing research for the Department of Housing and Urban Development on financial problems of elderly homeowners. Associate Professor Gibb pursued his interest in rural development in less-developed countries. Assistant Professor Zak co-authored, with Associate Professor Goodman, a paper on the Federal Reserve System's payments clearing activity, as well as working in the areas of public choice and industrial organization. In keeping with the growing Departmental emphasis on national defense economics, Professors Bowman, Fredland, and Little were involved in both sponsored and independent research projects on defense manpower. In sum, all nine civilians and two officer faculty members were involved in research, publication, and/or presentations.

Two other developments occurred which will increase future research activity within the Department. In early May, a Memorandum of Understanding between the Naval Academy and the Office of the Deputy Chief of Naval Operations (Manpower, Personnel and Training) was signed, establishing a visiting research chair in



the Economics Department. The occupant each year will teach one course and devote two-thirds time to research supportive of DCNO (MPT) requirements. Later in May, a similar Memorandum of Understanding was signed by the Superintendent and the Commander of the Naval Supply Systems Command.

Sponsored Research

Truncation Bias in Civilian Wage Profiles of Veterans

RESEARCHERS: ASSOCIATE PROFESSOR WILLIAM R. BOWMAN
AND PROFESSOR ROGER D. LITTLE

SPONSOR: DEPUTY CHIEF OF NAVAL OPERATIONS (MPT)

This study compared Internal Revenue Service (IRS) and Social Security Administration (SSA) longitudinal earnings records of Navy enlisted veterans to determine the degree of truncation bias and an estimate of the

impact of this bias on civilian wage models for these veterans. Results will be used by OP-126 to assist in developing improved wage models used to forecast retention rates in the Navy.

Delinquency Behavior of Servicemen and Potential Recruits

RESEARCHERS: PROFESSORS J. ERIC FREDLAND, ROGER D. LITTLE,
AND JOHN A. FITZGERALD (POLITICAL SCIENCE)

SPONSOR: DEPARTMENT OF DEFENSE (DIRECTOR OF ACCESSION POLICY)

The objective of the work is to compare delinquent behavior of those who have been in the military less than one year, those in more than one year, and those not in the military but interested in joining, with men in the same age who are not interested in joining. The data set used is the National Longitudinal Survey New Youth Cohort, which allows control over various socioeconomic characteristics which may be associated with delinquent behavior. Specific objectives are to identify important delinquency variables and to

determine what kind of delinquent behavior is "average" for the youth population in general and to compare that with the delinquent behavior by those in the military and those interested in joining. Comparisons of fifteen forms of delinquent behavior and three forms of contact with the criminal justice system indicate that blacks are less delinquency prone than whites and that those interested in serving and those in the military less than one year are more delinquent than those civilians not interested in serving.

Vocational Training Requirements: A Comparison of Qualifications and Standards for Civilian and Military Occupations

RESEARCHER: PROFESSOR ROGER D. LITTLE

SPONSOR: DEFENSE TRAINING AND EDUCATION CENTER

The objective of this research is to investigate, for young adult male workers, the duration and intensity of formal vocational training and on-the-job training of military and civilian workers employed in specific civilian occupations which have military counterparts. Additionally, these workers will be compared by various measures of quality and aptitude such as as educational

level, I.Q., and scores on the Armed Services Vocational Aptitude Battery including the Armed Forces Qualification Test. Data are from the National Longitudinal Survey, 1979 and subsequent waves. Comparisons by occupation will be made using a recently developed Department of Defense/Department of Labor cross-classification system identified as Project CROSSWALK.

Independent Research

Consumption Linkages in Rural Growth: Theoretical, Empirical, and Policy Aspects

CO-RESEARCHER: ASSOCIATE PROFESSOR ARTHUR GIBB, JR.

The objective of this project is to evaluate, however tentatively, the magnitudes and parameters of consumption linkages within the rural economy and to draw a set of preliminary conclusions as to the available policy options to influence these linkages. The paper is an amalgam of the complementary research efforts of two authors. Thus, it presents

empirical evidence on both consumption and employment patterns in rural regions, suggests a model of the indirect income effects of agricultural growth, and then considers the policy implications of this evidence by placing it in the regional and national contexts which labor force analysis permits.

Home Equity Conversion Mortgages

CO-RESEARCHER: ASSOCIATE PROFESSOR RAE JEAN B. GOODMAN

Extensions of the present value model developed in the Congressional Report will be included. The extensions are alternative distribution of terminations and alternative discount rate scenarios.

The objective is to estimate the insurance premiums which would be required to get investors/lenders to offer reverse mortgages under alternative scenarios.

Value of Information on Health Risks: The Case of EDB

RESEARCHER: ASSOCIATE PROFESSOR F. REED JOHNSON

The objective of this project was to estimate the impact on market behavior of changing information on pesticide contamination of grain products by ethylene dibromide. The results were to be evaluated in light of the U.S. Environmental Protection Agency's policies with respect to disseminating information on health risks. Data on newspaper coverage of the

contamination incident was combined with monthly sales data for affected products in nineteen regions of the country. A demand function was estimated for grain products and combined with an expected utility model with changing information. The resulting parameters were used to estimate welfare losses associated with imperfect information on health risks.

Nonconsumptive Values of Old-Growth Forests of the Swedish "Fjällnara Skogar"

CO-RESEARCHER: ASSOCIATE PROFESSOR F. REED JOHNSON

The Swedish Forest Service has proposed to harvest old-growth forests near the timberline in the mountains of western Sweden. This region is ecologically sensitive and important for recreation and wildlife conservation purposes. This study is undertaking a contingent valuation survey of visitors to determine willingness to pay to preserve the

forests. The survey constructed a hypothetical market for preservation and elicited bids. The sample of winter visitors has been collected and a preliminary analysis of the data is complete. This data will be supplemented by a sample of summer visitors, analyzed, and submitted to the Swedish Environmental Protection Board.

Military Technology and Defense Manpower Policy

RESEARCHER: PROFESSOR ROGER D. LITTLE

In support of work being done by Brookings Senior Fellow Martin Binkin, relationships between technological change and the constraints placed on it by the occupation structure and individual characteristics of the labor force are being investigated.

Part of the work entails analysis of future civilian and military occupational requirements, and another aspect entails estimating the availability of capable and/or trained manpower to the high-growth occupations in these sectors.

J. Laurence Laughlin and the Quantity Theory of Money

RESEARCHER: PROFESSOR CLAIR E. MORRIS

This study was designed to establish more accurately the position of J. Laurence Laughlin, a turn-of-the-century economist, in the context of the history of economic thought. One aspect of the project was to assess Laughlin's influence on the debate over the quantity theory of money, which lay at the heart of many socio/political movements of the late nineteenth century.

A review and analysis of Laughlin's

writings on monetary subjects during the period 1875-1905 was undertaken. His theoretical assumptions, techniques and data used, and conclusions, were all studied in order to get insights into the nature and character of economics as a discipline during the period. The researcher continues to explore other aspects of Laughlin's career and contributions.

Wages, Fringes, Union, Union Membership, and Industry Concentration

CO-RESEARCHER: ASSISTANT PROFESSOR THOMAS A. ZAK

This paper presents preliminary results of an investigation into the wage-concentration issue. Evidence was found that some individuals receive economic rents for working in concentrated markets. The additional compensation probably takes the form of greater fringe benefits. Although the results are statistically significant, the relatively small effect of concentration on compensation calls into question its practical significance. Thus, it is not likely to have a major impact on deadweight

loss-estimates, or seriously affect the distributional consequences of monopoly power. This conclusion must be qualified, however. Since the sample is drawn from young workers at or near entry level, the researcher expects industry characteristics to have a weaker effect on this group than for other workers. Because of their greater mobility, labor markets for these individuals are likely to be more competitive, thereby reducing any compensation premium associated with market concentration.



Publications

GIBB, Arthur, Jr., Associate Professor, **"Tertiary Urbanization: The Agricultural Market Centre as a Consumption-Related Phenomenon,"** *Regional Development Dialogue*, (U.N. Center for Regional Development, Nagoya, Japan), 5 (Spring 1984), 110-143.

The agricultural market centre in developing nations typically is statistically invisible. Largely as a result of this fact it has tended to be misperceived and misdefined. Because of the obviously crucial role the market centre plays in agricultural growth, it has generally been perceived as mainly an agricultural production-related phenomenon, while consumption-related activities were judged as subordinate. In fact, consumption-related activities are considerably more important than production-related ones in determining the size and scope of activities in these towns and central villages.

In this article, an attempt was made to demonstrate that labor force data is uniquely able to "get around" the invisibility problem and provide a basis for rigorous analysis of urbanization in agricultural regions. In the process, market towns will be revealed as predominantly consumption-related phenomena, at least when defined in terms of employment, a fact with fairly radical policy implications.

GOODMAN, Rae Jean B., Associate Professor, *Home Equity Conversion Mechanism*, Report to Congress, Government Printing Office, Washington, D.C., May 1985.

Elderly homeowners face a wide spectrum of long- and short-term problems; some relate to costs of home ownership, and some relate to standard of living. The paper examines: (1) the financial situation of the elderly with the emphasis on elderly homeowners who own homes with no mortgage debt; (2) the alternative methods which elderly homeowners have of meeting problems; (3) the factors which affect the supply of and demand for

reverse mortgage; (4) the issue of insurance for reverse mortgages; and (5) the potential of sale-leaseback arrangements.

The report shows that while the overall economic position of the elderly is nearly comparable to that of the non-elderly, elderly homeowners often face a liquidity problem. The two solutions discussed at length here are reverse mortgages and sale-leaseback arrangements. Both of these solutions permit the homeowners to generate cash flow from their home equity and remain in their own home. A reverse mortgage pricing model based on the net present value of the stream of payments and of the home at sale is developed. The report concludes that: (1) specific disclosure requirements should be established to aid the elderly homeowner in evaluating different reverse mortgages; (2) sale-leaseback arrangements are viable financial arrangements for the elderly for either the short-term or the long-term, as long as there is protection in the lease contract against inflation for the elderly homeowner; and (3) the Federal Government should not administer an insurance demonstration program for reverse mortgages.

JOHNSON, F. Reed, Associate Professor, **"Om Natursyn och teknologi,"** *Varld och Vetande*, 11 (November 1984), 347-350. (English title: "On Ecological Attitudes and Technology") Published in Sweden.

Values expressed by advocates of environmentalism raise difficult but well-known philosophical problems: the relationship between means and ends and the theory of value. Environmentalists argue that human and "natural" welfare are compatible, if only people accept a harmonious relationship with nature, consistent with "real needs." Economics rejects the concept of need independent of the expressed choices of individuals. The negative consequences of technological change are more likely to be ameliorated by carefully designed social regulatory policies than by naive attempts to change basic human preferences.

LITTLE, Roger D., Professor, and Robert L. WOLF, Major, USMC, "**The AVF After a Decade**," U.S. Naval Institute *Proceedings*, 110 (August 1984), 136-138.

This article briefly summarizes and integrates the papers and discussion of a conference held at the Naval Academy, 2-4 November 1983. Contained are comments addressing the four major sessions of the conference: the Gates Commission Report Projects and the Realities to Date; the Impact of Technology, Weapons Systems, and Force Size on Future Demand; the Economy, Budget, and Supply in the 1980's; and Alternate Manpower Procurement Policies for the 1980's. Also included are brief excerpts from major

conference speeches by Secretary Casper W. Weinberger, Assistant Secretary Lawrence J. Korb, Professor Charles C. Moskos, Jr. and Dr. Martin Anderson.

PERKINS, Charles A., Commander, SC, USN, "**The Challenge is to Motivate**," *Shipmate*, 48 (April 1985), 19-20.

This is a retrospective look at the military instructor at the Naval Academy from both the midshipman and instructor viewpoint. The article emphasizes the opportunity, advantages, and challenges faced by the officer in developing midshipmen into the type of officer he/she would like to serve with.



Presentations

FREDLAND, J. Eric, and Roger D. LITTLE, Professors, **"Psychic Income and Self-Employment,"** Conference of the Association for Private Enterprise Education, Chicago, Illinois, 23 April 1985.

GIBB, Arthur Jr., Associate Professor, **"Linkages Between Economic Geography and Business and Economics Curricula: What Opportunities Do They Suggest?"** Middle States Meetings of the American Association of Geographers, West Chester, Pennsylvania, September 1984; American Association of Geographers Annual Meetings, Detroit, Michigan, April 1985.

JOHNSON, F. Reed, Associate Professor, **"American Research in Environmental Economics,"** Department of Water in Environment and Society, Linköping University, Linköping, Sweden, 7 September 1984.

JOHNSON, F. Reed, Associate Professor, **"Value of Information on Health Risks: The Case of EDB,"** Stockholm School of Economics, Stockholm, Sweden, 11 January 1985; University of Stockholm, Stockholm, Sweden, 24 January 1985; Department of Forest Economics, University of Umea, Sweden, 12 March 1985; Department of Economics, Erasmus University, Rotterdam, Holland, 1 April 1985; Karolinska Institute, Stockholm, Sweden, 24 April 1985.

JOHNSON, F. Reed, Associate Professor, **"Research Priorities in Environmental Economics,"** University of Stockholm, Stockholm, Sweden, 1 February 1985; Hellenic Economic Association, Athens Greece, 26 March 1985; Institute for Environment and Society, Science Center Berlin, Berlin, West Germany, 22 May 1985.

JOHNSON, F. Reed, Associate Professor, **"Nonconsumptive Values and Forest Management,"** School of Forestry, University of Umea, Sweden, 12 March 1985; School of Agriculture, Uppsala University, Uppsala, Sweden, 10 May 1985.

MORRIS, Clair E., Professor, **"J. Laurence Laughlin and the Quantity Theory: Nineteenth-Century Skeptic,"** Annual Conference of the Eastern Economic Association Meetings, Pittsburgh, Pennsylvania, March 1985.

WHITAKER, A. Royall, Associate Professor, **"National Debt or National Fraud?"** Republican Seniors of Glen Burnie, Maryland, 4 April 1985.

ZAK, Thomas A., Assistant Professor, **"Issues in the Provision of Public Goods,"** Eastern Economic Association Meetings, Pittsburgh, Pennsylvania, March 1985.

Language Studies

ASSOCIATE PROFESSOR MICHAEL C. HALBIG
CHAIRMAN

During the 1984-1985 academic year, Language Studies faculty members were active in research across a broad range of fields and topics—from charting the Chinese military leadership to contemporary literary criticism, Spanish Golden Age literature, and developments in modern Dutch. Highlights include Assistant Professor Fletcher's completion of the *First Netherlandic Conference Proceedings*; major progress by Associate Professor Rivera-La-Scala, Assistant Professor Fletcher, and Associate Professor Halbig on additional book-length manuscripts; and Assistant Professor Corredor's extraordinary productivity as evidenced in seven conference presentations at organized professional meetings. Three faculty members traveled overseas in support of their research efforts, and two were funded to present the results of their scholarship at international gatherings in the Netherlands and in Belgium. The Department also received \$1.2 million in DOD research and development funds to explore the application of international satellite television to interactive video computer technology. This highly promising area, briefly described in Associate Professor Dahlgren's report of her research, will likely benefit many more disciplines than foreign language study in the coming years.



Sponsored Research

The Modernisms of Gyorgy Lukacs: A Study of his Literary Criticism

RESEARCHER: ASSISTANT PROFESSOR EVA L. CORREDOR

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The work of the Hungarian philosopher and critic Gyorgy Lukacs (1885-1971) has attracted attention in those humanistic disciplines most concerned with the development of Western thought. Over the last two decades, many publications have appeared on his work and development in general, yet none to date has dealt with Lukacs' work globally and from a specifically literary point of view. The purpose of this present study is to fill this gap.

For the past few years, the researcher has been studying Lukacs' work in its gradual development under the influences of the philosophies of Aristotle, Kant, Hegel, Nietzsche, and Marx. According to her interpretation, in all his theories, Lukacs seems to battle with the concept and experience of "modernism," a phenomenon he attributes to negative developments in recent history. Her study therefore focuses on the complex dichotomies surrounding the "modernist self" that are at the heart of Lukacs' literary theories.

Research for this project was carried out in several steps: (1) bibliographic search with the help of the DIALOG Information Retrieval Services of Nimitz Library; (2) systematic research of the topic conducted at the Bibliotheque Nationale and the Bibliotheque des Sciences de l'Homme in Paris; and (3) at the library of the University of Heidelberg in Germany, where Lukacs had studied and which in recent years has attracted several Lukacs scholars as visiting professors. The most rewarding part of the project was carried out in Budapest, where the researcher read a paper at an international conference (FILLM), visited Lukacs' archives and discussed her own work with scholars from all over the world. This allowed her to verify her general perspective and interpretation.

The study has prompted several papers, reviews, and invitations to conferences in Europe and the United States.

Bringing Satellite Telecasts into the Classroom

RESEARCHER: ASSISTANT PROFESSOR SHARON G. DAHLGREN

SPONSOR: NAVAL ACADEMY INSTRUCTIONAL DEVELOPMENT ADVISORY COMMITTEE

The satellite-receiving capabilities of the United States Naval Academy allow students of foreign language and international studies to have direct access to a wide variety of programming intended for native speakers. The educational possibilities of this information explosion, however, have yet to be realized. In this project, the investigator intends to use satellite telecasts to develop an interactive program, combining computer technology and video, either in video tape or videodisc format, as a vehicle for making programming available to all levels of language instruction. The principal products will include a series of edited tapes, ranging in level from beginning to advanced, organized according to topic, type of program, and country of origin. Accompanying these tapes will be a computer-assisted lesson, designed for individual work, so that students may progress through the material in a nonlinear fashion at their own speed. The project has begun with the collection and editing of international telecasts recorded directly from the satellite dish. A Spanish and

a French tape are currently being compiled. In developing learning strategies, the investigator has completed a workshop in the authoring language for the Sony SMC-70, using the Courseware Design System (CDS), and the Basic Prototype Environment (BPE), in development at the Defense Language Institute. BPE permits the establishing of flowcharts for interactive video lessons and printouts to assist the instructor in examining the overall structure of the lesson plan, with branching techniques, before keying in lesson content. BPE also has provisions for foreign language font-loading. The investigator is currently using "CSedit" to create a character set for the Spanish language. This project will be an important means for the USNA faculty — not just the instructors of Language Studies — to be fluent in the powerful new technology of interactive video, to assess the range of its applications, and to develop effective, interesting programs which will serve to motivate students to be aware of world cultures.

A Corpus-Based Investigation of Semantic Factors in Dutch Gender Use

RESEARCHER: ASSISTANT PROFESSOR WILLIAM H. FLETCHER

SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The purpose of this project is to investigate the extensive restructuring of the gender system of Dutch along semantic lines. Its ultimate objective is to help linguists understand the processes of origin and development of gender systems and to give guidelines for the use of forms reflecting gender for both non-native and non-standard users of Dutch.

The principal method of investigation is a quantitative analysis of semantic-based gender deviations from the lexical norm in a number

of *corpora* of spoken Dutch. Work has already been undertaken to examine one such corpus (from the Werkgroep Frequentietelling) and will be expanded to include additional *corpora* and observations in the Netherlands during the summer of 1985. It is hoped that the research will ultimately contribute to a long-term project comparing developments in the Dutch gender system with those in its seventeenth-century offshoots, New York state Dutch and Afrikaans.

Automated Biographic Analysis of the Chinese Military Leadership

RESEARCHER: ASSOCIATE PROFESSOR DANIEL T. Y. LEE

SPONSOR: DEFENSE INTELLIGENCE AGENCY AND

NAVAL ACADEMY RESEARCH COUNCIL

This is a continuing long-term project to study biographic characteristics and career patterns of the significant military leaders in the People's Republic of China. This project had been supported by funding from the Defense Intelligence Agency until FY84, and is partially supported during 1985 by the Naval Academy Research Council.

Biographical entries are prepared according to strict syntactical rules, with imbedded computer flags affixed to proper names and locations, allowing researchers to link

biographical names with names of locations in the biographical text.

Research includes automated linkages, identifying newcomers in the PLA hierarchy, and the development of a public appearance file that will be tied to the biographical file.

Research conducted in Taiwan, Hong Kong, and China during this period has resulted in 120 new biographical entries in the file. The previous 601 entries have been updated and augmented during this period. The total number of biographies in the data base now stands at 863.



NO SMOKING
BY THE AGENCY
FOR CHINA STUDIES



Independent Research

Didactic Guidelines for the Use of Dutch Postpositions

RESEARCHER: ASSISTANT PROFESSOR WILLIAM H. FLETCHER

The purpose of the project is to investigate the use of Dutch postpositions in adverbial expressions of direction (in contrast with similar expressions with prepositions) with the ultimate goal of providing pedagogically useful rules for non-native learners of Dutch. Of interest to theoretical linguists will be the implications of the findings for theories of verbal and compositional aspect.

Several hypotheses advanced by the researcher on the basis of observation of spontaneous use of postpositions in the spoken language are being tested against additional

attestations of their use in grammatically encoded *corpora* of spoken and written Dutch. The large number of examples provided by these *corpora* will assure completeness of the presentation. It will help determine whether the situation is a result of the collusion of several factors (verbal and prepositional aspect and idiomatics), or is, instead, subject to a single principle.

A paper discussing the issues and advancing simple rules and exercises for classroom use was presented at the conference of the Internationale Vereniging voor Neerlandistiek in Nijmegen, the Netherlands, in August 1985.

Jacob Masen's *Rusticus Imperans Androphilus*, and *Mauritius Plays*: Facsimile Edition with Translation and Introduction

RESEARCHER: ASSOCIATE PROFESSOR MICHAEL C. HALBIG

This edition constitutes a two-volume set on Jacob Masen's theater. It includes an enlargement to quarto format of the 1662 Latin original on the verso page and an English translation on the recto. Critical footnotes are provided on each page to correct typographical errors in the original

and to identify obscure references in the text. The introduction includes a discussion of the orthography, the translation criteria, a description of the Latin original and a brief overview of Masen's career, as drawn from the editor's research in the Jesuit archives in Rome.

Juan de Mena's Coplas de los Siete Pecados Mortales: Second and Third Continuations

RESEARCHER: ASSOCIATE PROFESSOR GLADYS M. RIVERA-LA-SCALA

During the past year, the researcher has completed the first critical edition of two major continuations of Juan de Mena's poems on the seven deadly sins. An intertextual analysis of the main work and all three of its continuations was made. This material is now ready for publication as Volume II of the long study of Juan de Mena and his followers.

The first chapter offers a comparative study of the four discrete works, analyzing themes, imagery, meter, and rhyme. In the second chapter, the researcher gives a detailed

description of the manuscripts, and of the sixteenth-century printings used in establishing the base text, and then discusses the interrelationships among the many versions of the works. A corrected version of the continuations in modern script follows. Editorial, literary, and linguistic notes constitute the next section, which ends with glossaries of medieval Spanish terms and proper names. Also included is an extensive bibliography of primary and secondary source materials on fifteenth-century Spanish and European didactic poetry.



Publications

BATTKE, Winfried A., Commander, Federal German Navy, **"Die Offizierausbildung in der U.S. Navy-Viele Wege zum gleichen Ziel?"** *Truppenpraxis*, 3 (May-June 1985), 245-255.

The publication deals with the goal of the U.S. Navy to recruit roughly 7,000 officer candidates per year and the different training and education programs (USNA, NROTC, OCS, et al.). It compares the different U.S. approaches with the German naval officer candidate training programs which have been altered decisively within the last decade. In depicting the different U.S. training programs, the article gives an evaluation from various American points of view. In its final part, the publication describes the various education and training programs of U.S. naval officers, concentrates on comparing career expectations of service college graduates and those who have completed postgraduate studies programs, and, by emphasizing the advantage of different approaches to achieve a relatively high career goal, draws a comparison with the limited career expectations of German naval officers.

DAHLGREN, Sharol G., Assistant Professor, **"Interactive Video Programs and Teaching Foreign Language: Using USNA's Computer-Supported Instruction System (CSIS) and Video Tapes in French,"** *Proceedings of Computers and The Humanities Conference*, 1984, pp. 55-63.

The objective of this article is to make a case for computerized instruction dealing with one aspect of language learning: listening comprehension. The author reviews existing programs in the field, such as the "Montevidisco," videodisc format for students of Spanish. The real breakthrough in computer-assisted instruction centers on the development of interactive video. The discussion of a hands-on experience follows, with evaluations of the CSIS authoring language available at the U.S. Naval Academy and the utilization of videotaped commercials from French television. Details of the prototype lesson plans include the code sheet, organization of material according to computer frames, and samples in French appropriate to test student comprehension of material recorded at native speed.

FLETCHER, William H., Assistant Professor, ed. *Papers from the First Interdisciplinary Conference on Netherlandic Studies*. Lanham, Maryland: University Press of America, 1985.

This volume is a report on, and a compilation of, twenty-seven papers from the First Interdisciplinary Conference on Netherlandic Studies, held in College Park, Maryland, and Washington, D.C., 11-13 June 1982. It includes papers from the fields of Netherlandic language and literature, history of the Low Countries, political, musicology and immigration studies, as well as poetry and a short story.

RICCIO, Guy J., Professor Emeritus, co-author, **"The Anglo-Portuguese News: Index, 1937-1977"** (microfilm publication, Library of Congress, 1985).

Pursuant to a grant awarded jointly by the Gulbenkian Foundation in Lisbon and the Tinker Foundation in New York, a complete index of *The Anglo-Portuguese News*, a primarily English-language newspaper published bi-weekly in Portugal since 1937, was compiled through 1977. Preparation of the index was prompted by the Library of Congress's acquisition in 1979 of a complete file of the APN, microfilm copies of which were subsequently made available to, and acquired by, other libraries, including Nimitz Library.

The index, entirely computer-generated, was constructed by adapting and existing program (BIBLSORT) in the Academy's program library. It consists of approximately 12,000 citations, each classified within one of more of over 200 categories and arranged alphabetically, within each category, by a key "sort" word or phrase. An introduction, which briefly narrates the history of the APN, names many of the principal contributors, provides instructions on the use of the index, and lists the categories, precedes the body of the index itself.

The paper's multi-faceted coverage of the world scene, with emphasis on Britain and Portugal, makes it a promising source of valuable information to scholars and researchers in the broad humanities/social sciences spectrum. The index is entirely in English, as is about 90% of the paper, a suitable notation being used, however, when an item cited is in Portuguese or, in a few instances, in another language.

Presentations

CORREDOR, Eva L., Assistant Professor, **"Constitution et fragmentation du soi des Essais de Montaigne au Roland Barthes par roland barthes,"** Sixteenth International Congress, International Federation for Modern Languages and Literature, Budapest, Hungary, 22-27 August 1984.

CORREDOR, Eva L., Assistant Professor, Organizer and Presiding Officer, Session on **"Critical Theory,"** Convention of the Philological Association of the Pacific Coast, Vancouver, Canada, 9-11 November 1984.

CORREDOR, Eva L., Assistant Professor, **"From Lukacs to Posthistoricism,"** Congress of the Language Association, Washington, D.C., 27-30 December 1984.

CORREDOR, Eva L., Assistant Professor, **"The Elusive Self in Roland Barthes' Autobiography,"** Twentieth-Century Literature Conference, University of Louisville, Kentucky, 22 February 1985.

CORREDOR, Eva L., Assistant Professor, **"History in the Text,"** Guest Lecture, United States Military Academy, 5 March 1985.

CORREDOR, Eva L., Assistant Professor, **"Cosmopolitanism vs. a City for Oneself,"** Annual Conference of International Association of Philosophy and Literature, City University Graduate School, New York, 2-4 May 1985.

CORREDOR, Eva L., Assistant Professor, **"Le Role de l'intellectuel apres Lukacs,"** Conference on Figures de l'intellectuel-ecrivain, organized by Universite Libre de Bruxelles, Brussels, Belgium, 13-15 June 1985.

DAHLGREN, Sharon G., Assistant Professor, and HALBIG, Michael C., Associate Professor, **"Satellite Telecasts and Video,"** CALICO Conference, Baltimore, Maryland, 29 January 1985.

DAHLGREN, Sharon G., Assistant Professor, **"The Feminine Adjuvant in Calderonian Drama: A Semiotic Approach to the Comedia,"** Golden Age Spanish Drama Symposium, University of Texas, El Paso, Texas, 7 March 1985.

DAHLGREN, Sharon G., Assistant Professor, Moderator, Plenary Session on Juan Ruiz de Alarcon, Golden Age Drama Symposium, University of Texas, El Paso, Texas, 7 March 1985.

DAHLGREN, Sharon G., Assistant Professor, Chairman, Session on Calderonian Drama, Golden Age Drama Symposium, University of Texas, El Paso, Texas, 6 March 1985.

FLETCHER, William H., Assistant Professor, Panel discussion **"Future Directions for Netherlandic Studies at American Colleges and Universities: Dutch Language Study and Beyond,"** Symposium on Reflections on the Netherlands, Madison, Wisconsin, 27 April 1985.

Political Science

PROFESSOR ROBERT L. RAU
CHAIRMAN

The Political Science Department increased its significant volume of quality faculty research, publication, and travel for research purposes in 1984-1985. The scope of research shows that political scientists at USNA are contributing in a significant way to policy development in the U.S. government, as well as to the expansion of knowledge in many sub-fields of this discipline. Research support from the Naval Academy Research Council continues to play a significant role in the Department's research efforts. Many of the private and other governmental research grants evolved as a result of work originally sponsored by NARC. One book was published. Seven chapters were contributed to books. Five journal articles were or will be published. Twelve report/monograph-length projects were completed on policy related topics.

Research of this kind reflects the expertise in a variety of fields located in the Department. Most of these reports were funded by Congressional or Executive branch agencies with specific questions to be researched. The faculty maintained its active speaking schedule away from the Academy and delivered twenty-seven presentations. Midshipman research activity continues to expand. Eight midshipmen were sponsored by the Department at conferences at West Point, Texas A&M University, and Air Force. Special research projects for those midshipmen attending the conferences were completed prior to their



attending the conference. In 1985, the Department established a program in which selected midshipmen will present papers at academic conferences.

Sponsored Research

Argentina's Foreign Policies

RESEARCHER: PROFESSOR G. POPE ATKINS
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This research project is the writing of a book-length manuscript analyzing the foreign policies of Argentina. It is coauthored by a leading West German Latin Americanist.

Within an approach stressing foreign policy decision-making as a function of the environments in which policies operate, analysis of the Argentine case is organized around six networks of relations and the linkages among them. These networks involve relations (1) within the Argentine national system, (2) with European nations and

organizations, (3) in the South American southern cone, South Atlantic, and Antarctic regions, (4) with the United States and in the Inter-American System, (5) with the Third World outside the Americas, and (6) with the communist bloc. Each of these environments has presented distinct situational considerations for Argentine policymakers. The result has been the evolution of a complex set of policy characteristics that provides the keys to understanding Argentina's international behavior.

History of U.S. Micronesian Status Negotiations

RESEARCHER: COMMANDER ANDREW H. BAGGS, USNR
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

The Trust Territory of the Pacific Islands (TTPI) will be terminated within the coming months. The U.S. Senate has completed its committee stage and the House is in committee. The United Nations' blessing is then expected soon afterwards. The former Japanese Mandate islands of the Marshalls, the Carolines, and the Palaus will become freely associated states with the United States, that relationship outlined by the Compact of Free Association. The Republic of the Marshall Islands, the Republic of Palau, and the Federated States of Micronesia chose to become sovereign, rather than to accept a more integrated relationship as did the Commonwealth of the Northern Marianas.

The negotiations that ultimately resulted in the Compact of Free Association underwent a number of evolutions during the past fifteen years. The major initial considerations moved from the decision on future sovereignty to the creation of four republics in lieu of one Micronesian state. The Federated States (Yap, Truk, Ponape, and later, Kosrae) wanted very finite specifications in the Compact concerning

future aid, health, and education. Palau realized its strategic location and initially agreed to lease a 30,000 acre site for U.S. military use for fifty years. The Marshalls accepted a thirty-year agreement for the Kwajalein Missile Range and struggled with nuclear claims from residents of Bikini and Eniwetok. The U.S., in turn, obtained access to the former Trust Territory for fifteen years, denied unwanted third parties, and pledged 2.7 billion dollars in return.

After the decision by President Kennedy to terminate the strategic Trust as soon as practical, U.S. negotiators initially were charged with few requirements other than arriving at an agreement suitable to (and for) the Micronesians, the U.S. (especially Congress and DOD), and the U.N. Trust Council. Negotiations finally began during the Nixon administration, proceeded by fits and starts, and recently resulted in plebiscites and legislative actions by the Micronesian states. This research examines the objectives, desires, the positions obtained, and the negotiation process undertaken by the U.S.

Evolution of Law and Policy in Surveillance Issues, 1950-1985

RESEARCHER: PROFESSOR CHARLES L. COCHRAN
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

After World War Two, a succession of threats perceived by the national intelligence community and law enforcement officials led to the increased reliance on a variety of surveillance techniques by certain government agencies. Various committees supported the need to use various forms of surveillance to gather information clandestinely. In the 1960s and early 1970s, there was an expansion of domestic surveillance through a variety of techniques, including, most notably, electronic surveillance.

Inevitably, in the abuses that followed, several court challenges laid bare violations of Constitutional rights of American citizens (particularly the First and Fourth Amendments to the Constitution).

The revelation of abuses led to Congressional investigations, with resulting restrictions on

surveillance and the use to which surveillance information can be put. The Committees and subsequent Court decision made a distinction between information gathered on citizens and information that can be gathered by appropriate agencies upon foreign intelligence interests.

An examination of the trends and events that gave impetus to increased uses of surveillance was performed, along with an analysis of new developments in surveillance techniques and an examination of how they raised hopes of avoiding legal prohibitions. The study next examined the impact of litigation and court decisions in publicizing abuses and changing the law. The study finally examined the options available for policymakers to prevent foreign governments from acquiring sensitive information through electronic and other surveillance while protecting civil liberties.

The Role of Perception in the U.S.-Japanese Security Relationship

RESEARCHER: CAPTAIN KEVIN P. O'KEEFE, USMC
SPONSOR: NAVAL ACADEMY RESEARCH COUNCIL

This research will focus on the critical role perception plays in the evolving U.S.-Japanese security relationship, and the resulting gap it has produced between policymakers in Washington and Tokyo. With the steady reduction of U.S. military presence, coupled with the dramatic increase in Soviet military power in East Asia, the question of an increased security role for Japan in the region has been a topic of keen discussion between the two nations with very little tangible success. The major stumbling block has been a sharp perceptual divergence over the seriousness of the threat being faced, and what role Japan should and is capable of playing in meeting that threat. This research will attempt to isolate those perceptions held both in Tokyo and Washington, and to indicate a more coherent U.S. policy approach towards Japan.

The basic approach to this research will be twofold. Initial investigation will concentrate on detailed analysis of the evolution of U.S. security policy in East Asia over the past five years. This will be accomplished primarily through access to documents at the Departments of Defense and State, and interviews with current key individuals in the policy-formulation process. Additionally, discussions will be held with Japanese Embassy officials. The objective of this portion of the research will be to establish Japan's role in East Asia as seen by the United States.

The second phase of research will involve on-scene interviews with both U.S. military and civilian officials at HQ, U.S. Forces, Japan, and the American Embassy; and with Japanese military officers and civilians at the Japan Defense Agency and the Ministry of Foreign Affairs.

An Experimental Study of Cognitive Processes and Information on Political Problem Solving

RESEARCHER: ASSOCIATE PROFESSOR HELEN E. PURKITT

SPONSOR: NATIONAL SCIENCE FOUNDATION

This is an experimental study of how people use prior beliefs, problem information, and mental heuristics in making judgments and decisions about political problems. This study relies heavily on recent insights on human information processing and problem-solving behavior generally in developing a complex

experimental design to investigate political problem solving. The study is placed in the context of small groups because of the extensive presence of group decision making in politics and as a method to elicit data on the cognitive operations of decision makers.

National Policies on Arms Control

RESEARCHER: PROFESSOR RODNEY G. TOMLINSON

SPONSOR: JOINT CHIEFS OF STAFF (SCSSC)

The U.S. and Soviet Arms Control Negotiations are conducted with 70 other nations present at observers. These nations act as veritable rooting sections, cheering and booing the Americans or Soviets as the moment dictates. This project studied national policies of the observer nations with regard to Arms Control.

Each nation's policies were examined as to Chemical, Conventional, and Nuclear Arms. Areas of agreement and disagreement were identified. Where some nations might show inconsistency between behavior and the "advice" and criticism heaped on the USA, these are identified and brought to the nation's attention.

World Politics in the General Assembly 1984-85

RESEARCHER: PROFESSOR RODNEY G. TOMLINSON

SPONSOR: DEFENSE COMMUNICATIONS AGENCY

This project focuses on identifying trends and patterns in United Nations voting. The project entails collecting all roll-call votes in the General Assembly session, preparing an analytical summary and storing this information, along with the votes and text summary, in the computer, and then performing a series of statistical summaries. A set of models designed

to detect alliances and coalitions is employed. It has been found that coalitions are issue-specific, with no general bloc voting of the cohesiveness shown during the Vietnam War period. Alliance ebb and flow has appeared between years and, as noted above, usually is issue-specific. Current efforts center on development of a full history of the U.N. since its inception.

Biographical Analysis of the Chinese Leadership

RESEARCHER: PROFESSOR RODNEY G. TOMLINSON (WITH ASSOCIATE PROFESSOR
DANIEL T. Y. LEE, LANGUAGE STUDIES DEPARTMENT)
SPONSOR: DEFENSE INTELLIGENCE AGENCY

This is an ongoing study of eighteen characteristics of the leaders of the People's Republic of China. English-text summaries are prepared according to strict syntactical rules with imbedded flags to permit computers to perform textual and statistical analyses from

both a micro to a macro perspective. Research includes automated linkages of "who knows whom" to identify rising (and falling) stars in the Chinese leadership. Research includes development of appearance files to keep tabs on the daily activities on the Chinese Leaders.



Independent Research

Changing United States-Latin American Relations

RESEARCHER: PROFESSOR G. POPE ATKINS

This study analyzes United States-Latin American relations, the context within which Iberian activities in Latin America take place. The treatment is not a critique of or prescription for U.S. policies, but an examination of the distribution of international power and influence in Latin America. The first part of the study explores the general bases for U.S. policy, with reference to historical antecedents and to some considerations for nonhemispheric activities

and Latin American responses. The second part is organized around the concept of a still important but diminishing U.S. hemispheric role over the past two decades. The third and final part evaluates present trends. Distinctions are made among different "policy arenas" within Latin America: the Inter-American System, Mexico, the Caribbean Basin, Brazil, and the Southern Cone of South America. The project has been completed.

The Implications of Information Technology for U.S. Government and Politics

RESEARCHER: ASSOCIATE PROFESSOR STEPHEN E. FRANTZICH

This 40-page study for the U.S. Congress Office of Technology Assessment speculated on the social, organizational, and political implications of introducing modern information technology (specifically) computers and satellite communications) into the U.S. government. It served as a discussion point for the Advisory

Committee on the Impact of Information Technology on Government. The researcher concluded that modern information technology is far from a benign influence; its introduction will have an impact on organizational structure, internal and external power distribution, the citizenry, and the substance of policy decisions.

Congressional Applications of Information Technology

RESEARCHER: ASSOCIATE PROFESSOR STEPHEN E. FRANTZICH

This is an 80-page description of the use of modern information technology by the U.S. Congress, with special emphasis on current organizational, social and political implications and an analysis of future trends. After outlining Congress' needs and role in the information nexus, the paper outlines the ways in which Congress has tapped computers and satellite television to satisfy some of its information needs. In-depth case studies of electronic mail, C-SPAN (the cable TV coverage of Congress), and computer-based information sharing across the branches of government augment the briefer

descriptions of other applications. An attempt is made to assess the implications of technology for a political institution such as Congress and to speculate on the future trends. The report is based on government documents, an application of the professional literature to the Congressional setting, and over 50 interviews with Members of Congress and their staffs. The paper will serve as the basis for Office of Technology Assessment panel discussions, be integrated into a published report, and eventually lead to Congressional hearings by the committees which originally requested the studies.

Defense and Detente: U.S. and West German Perspectives on Security Policy

RESEARCHER: ASSISTANT PROFESSOR GALE A. MATTOX

This study has been a two-year project by a German-U.S. research team of five with individual responsibilities for assigned chapter (Chapter 7 "Security Regimes"). Work over the past year has included several

conferences to discuss conclusions and recommendations and, in the case of Chapter 7, supplemental research to include an analysis of President Reagan's Strategic Defense Initiative.

Intermediate-Range Nuclear Force Negotiations and Public Debate

RESEARCHER: ASSISTANT PROFESSOR GALE A. MATTOX

The research on the intermediate-range nuclear forces (INF) negotiations and public debate focused on the European reaction to the November 1983 deployment of INF and its effect on the NATO alliance, as well as U.S. relations with its allies. The method of investigation included use of archives in

Western Europe and interviews. The purpose of the research was to supplement a book manuscript dealing with U.S.-Geneva negotiations and to contribute to the researcher's own background for instruction of the course "U.S. National Security Policy." Both objectives were met.

Short-Range and Battlefield Nuclear Weapons: Implications for NATO

RESEARCHER: ASSISTANT PROFESSOR GALE A. MATTOX

The need to modernize NATO arsenals while also reducing the number of nuclear weapons has prompted considerable official and public discussion in the United States and Western Europe. It was the subject of the Montebello decision of NATO Ministers in 1983 and a

SACEUR study in 1984-85. This is an ongoing project under a NATO research grant for the period September 1984-December 1985. The research has been conducted through use of archives and extensive interviewing, and a NATO trip is planned for Fall 1985.

Research Course Projects

The Soviet Military and the Government

RESEARCHER: MIDSHIPMAN 1/C RICHARD ABRESCH
ADVISER: ASSOCIATE PROFESSOR ARTHUR R. RACHWALD

Within the past decade, the Soviet Union has attained the status of superpower. It has not achieved this distinguished status in the same manner as did the United States. The United States was the number one economic power in the world, and could influence the world economic stability by its own fiscal and economic policies. The U.S. also stood as the leader of the democratic free world able to sway world politics and first nuclear arsenal, and one of the most advanced military organizations in the world. These attributes undeniably made the U.S. the strongest nation in the world to such an extreme that she was considered a superpower.

On the other hand, the Soviet Union's economy is closed, inefficient, and relatively small. Its political leverage is a factor only in the communist nations of the world, therefore, making it play a much smaller role in

world affairs than the U.S. The only redeeming factor for the Soviets is their military might. The Soviet Union has the largest conventional force in the world, and has reached parity with, or has perhaps even surpassed the American nuclear force. In other words, the Soviets have at least matched the U.S. in military power, and for this reason alone their country has attained superpower status.

Specifically, within this study, the military was examined in terms of its organization, and its place within society. With this as background knowledge, the state and the military were linked by defining the relationship between the elements of the Soviet State. This framework resulted in the discussion of the influences of the military on the entire Soviet society, including the question: could the Soviet military take control of the Soviet Union? The answer is that such a probability exists.

Language Learning and Political Analysis Using a Satellite

RESEARCHER: MIDSHIPMAN 1/C THOMAS L. ADAMS
FACULTY ADVISERS: PROFESSOR RODNEY G. TOMLINSON AND
ASSOCIATE PROFESSOR SHARON DAHLGREN (LANGUAGE STUDIES DEPARTMENT)

This study examined political attitudes in Latin America by studying in Spanish the native broadcasts intercepted by the new USNA satellite dish. The research permitted primary source analyses while providing an opportunity for extensive language practice. The final oral presentation of the findings was in Spanish and of 45-minute duration. Television broadcasts are closely controlled by Latin American governments. In Mexico, for example, domestic problems receive little attention, while outside events such as the

USA support of the Contras in Nicaragua come under scathing attack by the Mexican media. Trends and patterns in regional politics begin emerging with the length of time the monitoring encompasses. For example, watching over a one-month period yields little, but a six-month period permits detection of shifts in attitudes and policies. Overall, it was found that considerable benefits accrued to the student, first, development of a "sense" of the politics of the region, and second, considerable practice in the language at native speed.

The Brezhnev Doctrine: Its Roots and Implications for Today

RESEARCHER: MIDSHIPMAN 1/C ANDREW A. BUTTERFIELD
ADVISER: ASSOCIATE PROFESSOR ARTHUR R. RACHWALD

On the morning of 21 August 1968, Soviet troops and tanks rolled unopposed into Czechoslovakia. While this intervention in a sovereign state's domestic affairs by the Soviets had quite a few precedents, it still ran contrary to most communist rhetoric. Therefore, a justification for the action had to be created. About a month after the invasion, "a Soviet theorist using the pseudonym Sergei Kovalev" put it this way: "... every communist party is responsible not only to its own people but to all the socialist countries and to the entire communist movement."

In November 1968, Leonid Brezhnev himself expressed this idea even more emphatically, underlining the "qualified sovereignty" soon came to be known as the "Brezhnev Doctrine." Not really a new communist concept, the Brezhnev Doctrine was more of an articulation of a policy in fact of long standing in the USSR anyway — incorporating the realistic, not rhetorical, ideas of the Comintern and Lenin himself, and even historical Russian actions and ideas.

The Soviet invasion met with disapproval and criticism from all sides. In addition to Western criticism, it came from "practically all the elements in world public opinion which on past occasions had been sympathetic to the Soviet Union." It included every non-Arab Third World country, such organizations as the World Federation of Trade Unions (which it could be assumed represented quite a few of those worldwide workers struggling for socialism that Sergei Kovalev mentioned), as well as the communist parties of the Western democracies. Despite being a member of the Warsaw Pact, Rumania's independent-minded Ceausescu refused to participate in the invasion and even courageously denounced it, as did Cuba's Castro (albeit somewhat obliquely) and ex-Soviet bloc member Yugoslavia's Tito (unconditionally). This criticism from normally "loyal" sources was understandable — for the question in most non-Soviet communists' minds was naturally along the lines of: "Are we next?" For this doctrine could obviously be applied again elsewhere.

Media Analysis: The 1984 Election

RESEARCHER: MIDSHIPMAN 1/C GREER G. OLSEN
ADVISER: ASSOCIATE PROFESSOR STEPHEN E. FRANTZICH

This independent project focused on the media coverage afforded Geraldine Ferraro during the 1984 presidential campaign. Its intent was to determine whether Ferraro's status as the first woman nominated by a major party for a national ticket earned her significantly more press than she would otherwise have received. Television, news magazine, and newspaper coverage was analyzed using "The CBS Evening News," *Time*, and *The Washington Post* as sources. Ferraro's coverage was compared to that of her running mate Walter Mondale and her "rival" George Bush during

the nine weeks of the "official campaign" (Labor Day-Election Day).

While Ferraro received almost twice as much press coverage as Bush in all three media, she did not even approach Mondale's total. However, her candidacy focuses greater attention on the vice-presidential candidates, causing both Bush and Ferraro to receive more press than their predecessors. Finally, it was concluded that much of the attention heaped on Ferraro derived from journalists looking for a story: she was an interesting novelty in a dull, predictable campaign.

The Cambodian Conflict in Southeast Asia: Strategic Considerations

RESEARCHER: MIDSHIPMAN 1/C ERIC W. OLSON

ADVISER: PROFESSOR ROBERT L. RAU

In January 1979, the armed forces of the Socialist Republic of Vietnam successfully overthrew the Pol Pot regime in Democratic Kampuchea and established the present government of the People's Republic of Kampuchea. Since that time Cambodia has been occupied by Vietnamese troops opposed by a loose tripartite coalition composed of Pol Pot's Khmer Rouge and two non-communist resistance groups. Because the Indochina region adjoins an area of the world rich in natural resources, the conflict in Cambodia has captured the interests of several regional

and global actors. Although attempts at resolving the conflict have been made in greater earnest recently, a solution amenable to all parties involved has yet to be reached. The reasons the conflict is so difficult to resolve are founded in the history of Cambodia, and they are the topic of Part I. Part II addressed the security perceptions of the regional states with regard to the continued fighting in Cambodia. A possible means for ending the conflict is proposed, and the impact of such a solution on future security issues in the region is explored.



Soviet Political Heritage

RESEARCHER: MIDSHIPMAN 1/C JOHN W. CLIFTON
 ADVISER: ASSOCIATE PROFESSOR ARTHUR R. RACHWALD

History supports the fact that there tends to be reaffirming of a previously developed national character. This process of development often involves many changes at the surface. The ruler, ruling class, or even the ideology may change; however, the true nature of the people remains. This concept of an inherited national political culture is readily applicable to the Soviet Union.

The Russians have experienced great continuity for the last 500 years. The Soviet Union has, and continues to expand rapidly; however, the people around the heart of this massive nation have pretty much stayed in place because of governmental restraints. There has been no mass immigration into or out of the region. Therefore, because of these reasons, the Russians have an unusual political continuity unlike that of any other nation. They are a product of their own experiences, virtually untouched by outside influence. Therefore, broad generalizations about Russian political heritage can be made. These conclusions are necessary to an effective long-term foreign policy, as the Russians serve at the heart of the present political system of the Soviet Union.

Typically those outside of the Soviet Union have preconceived notions about the people and government of this strange nation. It is permissible and totally correct to say that the Soviets can be stereotypically cast. This stereotyping often portrays the Soviets as being a rather backward, harsh, but fearful big family. These points are well founded. Russian political heritage was examined from the following four points:

1. The Soviets, because of a history steeped in war and invasion, most notably the Mongol Yoke, are intensely xenophobic and shall continue the massive conventional, nuclear, and biological arms buildup regardless of the rest of the world.
2. Tied closely to the zealous xenophobia is the extreme backwardness of this vast country. By disallowing the visitation and free flow of foreign ideas that would have "corrupted" the Russian Orthodox/Czarist tradition, a filtering process took place which destroyed the Russian opportunity to partake in events such as the Reformation, the Industrial Revolution and the Enlightenment.
3. The harsh, indiscriminate brutality and absolutism associated with the czarist rule is as much alive today as it was hundreds of years ago. Lenin's revolution was for the benefit of one alone: Lenin himself and his eventual successors.
4. The last point that must be made is the concept of Mother Russia being thought of as a big family. Society and those within it tend to conform, adjust, and adapt to policies set forth by the government. This conformism is extremely important as it limits the dynamism of the society.

An Inquiry into the Trilateral Commission

RESEARCHER: MIDSHIPMAN 1/C JEFFREY SIGLER
 ADVISER: FOREIGN SERVICE OFFICER MAHLON HENDERSON

The purpose of the project was to conduct an unbiased inquiry into the workings and influence of the Trilateral Commission, comparing its role in influencing governmental decision-making in the Carter and Reagan presidencies. The objective was to determine, if possible, the

extent of influence the Commission brings to bear on decisions of significant effect on political and economic matters in the United States, the European democracies, and in Japan. The research proceeded by extensive readings and by interviews of Commission members.

The Break Between the People's Republic of China and the Socialist Republic of Vietnam: Causes and Effects of the Disintegration of Friendly Relations

RESEARCHER: MIDSHIPMAN 1/C THOMAS Y. SYLVESTER

ADVISER: PROFESSOR ROBERT L. RAU

The objective of this project was to investigate closely the relationship between the People's Republic of China and that of Vietnam. It is of importance to anyone who is interested in Far East Asian politics to understand why two bordering communist nations have had such a falling out since the Vietnam War. Traditionally, China has had a more or less paternal attitude towards its Vietnamese neighbor. It was supportive of the North Vietnamese Communists during the Vietnam War. However, after South Vietnam was

successfully taken over, the relatively friendly relationship soon deteriorated. There have been numerous border clashes and hostilities, culminating in the brief Chinese invasion of Vietnam in 1979. To explain fully the volatile relationship, extensive research was conducted to document clearly the seemingly paradoxical situation. The culminating research paper also considers the broader implications of a hostile relationship, namely what significance this has for the United States and the Soviet Union.

Selling the President's Strategic Defense Initiative

RESEARCHER: MIDSHIPMAN 1/C JOSEPH VALENTINE

ADVISER: ASSOCIATE PROFESSOR STEPHEN E. FRANTZICH

With the various rounds of negotiations on Arms Control in Geneva this past winter and spring, the President's SDI program calling for research on ballistic missile defense underwent and is currently undergoing a series of political pressures that seek to derail the program before it can gain momentum and make possible a deployable ballistic missile defense system. The purpose of this project was to define the various political pressures and then examine what methods and techniques the Reagan Administration used to sell its program.

The major political pressure groups can be classified into four groups: 1) The NATO countries; 2) The Soviet Union; 3) Congress, and 4) the American public. With interviews at the State Department, the Defense Department's Office of Legislative Affairs, and

in the Office of the House Armed Services Committee, it was easier to see what methods the administration used to hurdle the political obstacles. Because the topic was so current, the newspaper and other periodicals were extremely useful in obtaining the statements of representatives of the foreign countries concerned and the Administration's public position.

Thus far, the Administration has been effective in selling the SDI program by downplaying the Soviet threats of increased offensive missile production and a new arms race in space, while simultaneously focusing our NATO allies' attention on the economic advantages of joining the research program rather than addressing the long-term problems with deployment.

Publications

BECKMAN, Robert L., Assistant Professor, *Nuclear Non-Proliferation: Congress and the Control of Peaceful Nuclear Activities*, Boulder, Colorado: Westview Press, June 1985.

This book examines the Nuclear Non-Proliferation Act of 1976 and other stringent non-proliferation laws that seek to tighten U.S. nuclear export criteria and strengthen the international non-proliferation regime. It juxtaposes efforts of nuclear managers with those of reformers who remain intent on strengthening safeguards to prevent horizontal proliferation. The author looks at the development of the Atoms for Peace program, the mindset that grew up along with it, and the shifts in congressional thought about the promise and problems of the peaceful nuclear fuel cycle.

BECKMAN, Robert L., Assistant Professor, **"The Treaty on the Non-Proliferation of Nuclear Weapons: The 1985 Review Conference and Matters of Congressional Concern,"** Congressional Research Service Report No. 85-80S. Library of Congress, Washington, D.C., 22 April 1985.

This report provides background information on the forthcoming third review conference of the Treaty on the Non-Proliferation of Nuclear Weapons. It describes the origins and contents of the treaty, and discusses the review conferences of 1975 and 1980, with brief surveys of notable trends and events related to each conference. Preparations for the third conference are then described along with controversial issues expected to rise. The report concludes with an identification of matters that may be of interest to Congress.

FRANTZICH, Stephen E., Associate Professor, **"Enhancing the Academic Validity of Political Science Internships"** in Joseph Honan, and Alan Balutis (eds.) *Public Service Internships*, New York: Shenckman Publishers, 1984, pp. 230-267.

An increasing number of political science majors are being given the opportunity to augment traditional educational experiences through internships. In many cases, the learning provided is expected to occur naturally. This can be a false assumption. This book chapter outlines ways in which internship-based learning can be enhanced through specific exercises and experiences.

FRANTZICH, Stephen E., Associate Professor, **"Congressional Applications of Information Technology,"** U.S. Congress, Office of Technology Assessment Report 84-10/16, February 1985.

Congress has moved from the back waters of using information technology to state-of-the-art applications in many realms. This paper discusses the adoption process, outlines potential implications, and takes a close look at three specific applications: electronic mail, televised broadcasting of congressional proceedings, and the sharing of computerized information between the legislative and executive branches. The broadcasting of Congress on television has already had an internal effect on congressional procedures and an external impact on public awareness. The usage and implications of electronic mail and information transfer are both much more limited. Most use of information technology has been focused on those applications supporting constituent relations. While the potential for broader impact on the policy process is clearly there, the potential has yet to be reached.

FRANTZICH, Stephen E., Associate Professor, **"The Implications of Information Technology for U.S. Government and Politics,"** U.S. Congress, Office of Technology Assessment Report, July 1984.

This broad-based study analyzes the potential implications of modern information technology for the American political system. The technological revolution, particularly in communications, promises to affect the nature of political decision-making, the relative power of political actors, and the final substance of public policy. While the application of technology is often seen as affecting only the efficiency of information acquisition and retrieval, its implications are much farther reaching. In politics, information is a power resource, and those who have it, or more importantly, know how to get it, increase their power potential dramatically. For the decision-makers, changing the pattern of information gathering and communications affects their potential for doing the job, their job satisfaction, and the nature of the decisions they make. For the citizen, communications technology provides new opportunities for becoming informed, but also makes them more vulnerable to effective communications. While the age of "Teledemocracy" is not here yet, the technology is on the near horizon.

GALLAGHER, Thomas P., Lieutenant Commander, USN, **"Our Amphibious Navy,"** U.S. Naval Institute Proceedings, 981 (November 1984), 160-162.

The Navy-Marine team is flexible in forward areas and helps fulfill the task of naval presence in critical circumstances, as the team is increasingly likely to be used as implementers of our foreign policy. Training should be made more realistic and be geared towards that role.

MATTOX, Gale A., Assistant Professor, co-author, **"West German Arms Sales to the Third World Countries,"** Atlantic Quarterly, 2 (Summer 1984), 171-182.

President Reagan has been widely quoted as hoping to achieve more support from the Europeans for Western defense objectives in the Persian Gulf. However, despite the more

visible role played by the Federal Republic of Germany in the international arena in recent years, it has become clear that any military involvement outside NATO would be constrained by constitutional and historical limitations which reflect Germany's determination in the post-World War II era to avoid becoming party to any future conflict. As a result, Chancellor Helmut Kohl will be as much subject to constraint in arms transfer policy as his predecessors, and any German military contribution to the Middle East is highly unlikely. German arms export policy will continue to represent a policy of muddling-through.

MATTOX, Gale A., Assistant Professor, *Perspectives on International Security: An Exchange of Views.* Pittsburgh: University Center for International Studies, University of Pittsburgh, 1984.

In 1979, the NATO Ministerial Council adopted a decision to deploy Pershing II and Ground-launched Cruise Missiles in Western Europe in 1983, unless negotiations with the USSR led to an agreement limiting both these intermediate-range nuclear weapons and their Soviet SS-20 counterparts. This occasional paper is an analysis of discussions of this decision and the public opposition to the decision by a group of 30 American and West European academicians, analysts, and others. The meeting was held in Pittsburgh 14-18 November 1983. This report presents the ensuing debates of that conference and analyzes the implications for U.S.-West European relations. A review of US-USSR proposals from the INF negotiations, as well as background information on the negotiations, is included.

RACHWALD, Arthur R., Associate Professor, **"Poland's Socialism,"** Current History, 83 (November 1984), 357-360.

Despite the fact that in Poland the military had to take over the reins of state, Soviet orthodoxy did not return. The Soviet leaders accepted the "e pluribus unum" principle of an empire whose centrifugal tendencies cannot be battled. The trend toward evolutionary accommodation to national patterns ("Polandization" of communism) continues, particularly evident in the relatively liberal nature of the system and the growth of the private sector of the economy.

RACHWALD, Arthur R., Associate Professor, "Poland '84," *Yearbook on International Affairs*, Hoover Institute, Stanford, University, 1985, pp. 343-360.

This second invitation to contribute the chapter on Poland focused on both domestic and foreign policy developments in 1984. The prevailing characteristic of the Polish politics in 1984 was the search for a national model that would harmonize the universal principles of Leninism with the Polish preference for pluralism. This pressure to shift political priorities from "proletarian internationalism" to a "Polish model of socialism" has consistently been frustrated by the dogmatic "hardlines" who advocate a "policy of combat" or "class struggle" instead of the "class alliance" approach adopted by General Jaruzelski.

RAU, Robert L., Professor, "The Role of the Armed Forces and Police in Malaysia," E. C. Olsen, ed., *The Armed Forces in Contemporary*

Asian Society, Westview Press, Denver, Colorado, 1985, pp. 59-88.

This monograph investigates the Armed Forces and Royal Malaysian Police in the security of Malaysia. The evolution of the Malaysian army, especially the Royal Malay Regiment, is covered in detail and the interrelationship of the Royal Malaysian Police and the other ground units of the army is explored in depth. A major portion of the study is devoted to the discussion of Malaysia's security situation in Southeast Asia. Central threats are identified and cooperation solutions which have existed since 1970 with the United Kingdom, Australia, and New Zealand are outlined. Other issues covered in the monograph include ethnic relations within the Malaysian Armed Forces; changes in tactics and development; and the recent movement to form an integrated security scheme within Association for Southeast Asian Nations.



Presentations

ATKINS, G. Pope, Professor, **"Closing Symposium Comments,"** British Foreign Office Conference on Latin America and the World Outside, Wilton Park, England, 30 November 1984.

ATKINS, G. Pope, Professor, **"Changing United States-Latin American Relations,"** Conference on Iberia and Latin America, American Enterprise Institute, Washington D.C., 28 September 1984.

ATKINS, G. Pope, Professor, **"The United States and Central America: International Conditions and Conceptual Limitations,"** International Studies Association, Washington, D.C., 8 March 1985.

ATKINS, G. Pope, Professor, **"Central American Instability and Great Power Politics,"** Atlantic Conference on Latin American Studies, Baltimore, Maryland, 15 March 1985.

ATKINS, G. Pope, Professor, **"The Cuban Revolution,"** Brandeis Women's Club of Annapolis, Maryland, 14 February 1985.

ATKINS, G. Pope, Professor, **"Brazil Today,"** Annapolis Lions Club, Annapolis, Maryland, 14 February 1985.

ATKINS, G. Pope, Professor, **"The United States and Latin America,"** Seminar on the States and the Third World, Annapolis, Maryland, 4 April 1985.

BAGGS, Andrew, Commander, USNR, **"Micronesia: From WW II to Free Association with the States,"** American Association of University Women, Annapolis, Maryland, 28 November 1985.

BECKMAN, Robert L., Assistant Professor, **"The Reagan Foreign Policy: Managua to Geneva,"** Interfaith Center to Reverse the Arms Race, Pasadena, California, 27 May 1985.

BECKMAN, Robert L., Assistant Professor, **"Vietnam and Nicaragua: Parallels for Policy,"** Naval Academy Parents' Club of Long Island, Long Island, New York, 5 May 1985.

BECKMAN, Robert L., Assistant Professor, **"Vietnam: A 10-Year Perspective: U.S. Involvement Reconsidered,"** American University, Washington, D.C., 25 April 1985.

BECKMAN, Robert L., Assistant Professor, **"The Nuclear Non-Proliferation Treaty Reconsidered,"** International Studies Association, Washington, D.C., 7 March 1985.

COCHRAN, Charles L., Professor, **"International Legal Issues and the Electromagnetic Spectrum,"** Seminar for the National Telecommunications and Information Agency, Washington, D.C., June 1984.

FRANTZICH, Stephen E., Associate Professor, **"Information Technology and the U.S. Congress,"** for Thai Parliamentarians sponsored by the Asia Foundation and the Congressional Management Foundation, Washington, D.C., 17 April 1985.

MATTOX, Gale A., Assistant Professor, **"Security Regimes,"** Volkswagen Project Conference on Defense and Detente: A German and American Perspective, Research Institute of the Protestant Church, Heidelberg, Germany, 16 November 1984.

MATTOX, Gale A., Assistant Professor, **"The Implications of U.S. National Interests for Its Alliance Policy,"** Conference of Young Press Leaders, Bonn, Germany, 26 January 1985 (in German).

MATTOX, Gale A., Assistant Professor, **"Does Peace Have a Chance?"** Community College of Hamm and U.S. Embassy, Hamm, Germany, 24 January 1985 (in German).

MATTOX, Gale A., Assistant Professor, **"U.S. Security Policy,"** CDU Women's Seminar, Bonn, Germany, 6 February 1985 (in German).

MATTOX, Gale A., Assistant Professor, **"The German Media and Its 'Amerikabild' of U.S. Foreign and Defense Policy,"** Inaugural Symposium of the Institute for the Study of German-American Relations, University of Virginia, Charlottesville, Virginia, 1 March 1985.

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MATTOX, Gale A., Assistant Professor, **"U.S. Alliance Politics,"** German American Institute, Heidelberg, Germany, 14 March 1985 (in German).

MATTOX, Gale A., Assistant Professor, **"The Foreign and Security Perspectives of the United States,"** Sponsored by the U.S. Embassy, Iserlohn, Germany, 16 March 1985 (in German).

MATTOX, Gale A., Assistant Professor, **"The Present State of German-American Relations,"** sponsored by the U.S. Embassy, Hamburg, Germany, 30 March 1985 (in German).

PURKITT, Helen E., Associate Professor, **"The Significance of the Current Protest Movement against South Africa,"** Current Issues Forum, International Studies Association, Washington, D.C., 8 March 1985.

PURKITT, Helen E., Associate Professor, **"Understanding Cognitive Processes in Foreign Policy Decision Making: An Information Processing Perspective,"** Annual Meeting of the International Studies Association, Washington, D.C., 9 March 1985.

PURKITT, Helen E., Associate Professor, **"Analyzing Global Systems: A Problem Solving Perspective and Some Suggested Applications,"** Joint Meeting of the Society for General Systems Research and the National Academy of Sciences, Los Angeles, California, 30 May 1985.

RAU, Robert L., Professor, **"Singapore in ASEAN,"** Southern Center for International Studies, Atlanta, Georgia, 16 April 1985.



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