AD-A038 544 NAVAL ACADEMY ANNAPOLIS MD F/G 5/11

SUMMARY OF RESEARCH ACTIVITIES. ACADEMIC DEPARTMENTS 1975-1976.(U)

FEB 77 W L HEFLIN

UNCLASSIFIED USNA-AR-2 NL

1 OF 3

AD A038544

AD A038544

(2)

SUMMARY
OF
RESEARCH ACTIVITIES
ACADEMIC DEPARTMENTS

1975-1976

DDC
RECEIVED
APR 22 1977
B

UNITED STATES NAVAL ACADEMY
OFFICE OF ACADEMIC DEAN
ANNAPOLIS, MARYLAND

AD No.
DDC FILE COPY

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

SUMMARY
OF
RESEARCH ACTIVITIES
1975 - 1976

Compiled and Edited

by

Professor Wilson L. Heflin

February 1977

ACCESSION for
NTIS White Section ☑
DDC Buff Section ☐
UNANNOUNCED ☐
JUSTIFICATION.....
BY.....
DISTRIBUTION/AVAILABILITY CODES
Dist. AVAIL. and/or SPECIAL
A

United States Naval Academy
Annapolis, Maryland

use

Approved for Public Release
Distribution Unlimited

FOREWORD

A strong undergraduate academic program cannot be maintained without a base of active faculty research and 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.

This publication is meant to be a general guide to the Naval Academy research program and is designed to acquaint the reader with faculty and midshipmen research activities. A wide range of sponsored research programs is on-going as well as a number of independent studies for which no financial support is received. What is undertaken in the way of research depends upon the interests and capabilities of the faculty, the availability of facilities and major equipment. The accomplishments of the faculty and midshipmen speak for themselves.

Research results are widely published in manuscripts, reports, and prestigious journals as well as presented at important national and international conferences. In addition to their teaching and research activities, faculty members contribute to their profession through participation in professional societies and consulting activities. This publication contains summaries of completed and on-going faculty projects, midshipmen special projects including the Trident Scholar program, and lists of presentations and publications. The work reported on was conducted during the period 1 July 1975 through 30 June 1976.

The level of research-related expenditures has increased significantly over the past several years. It is important to acknowledge the strong and continuous support provided by the Chief of Naval Research, Chief of Naval Development, and the numerous activities of the Naval Material Command. Without such, progress could not be possible.

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

Bruce M. Davidson

BRUCE M. DAVIDSON
Academic Dean

Richard D. Mathieu

RICHARD D. MATHIEU
Director of Research

TABLE OF CONTENTS

	Page
FOREWORD	iii
DIVISION OF ENGINEERING AND WEAPONS	1
Aerospace Engineering Department	3
Electrical Engineering Department	17
Mechanical Engineering Department	29
Naval Systems Engineering Department	51
Weapons and Systems Engineering Department	73
DIVISION OF ENGLISH AND HISTORY	83
English Department	85
History Department	103
DIVISION OF MATHEMATICS AND SCIENCE	121
Chemistry Department	123
Computer Science Department	141
Environmental Sciences Department	145
Mathematics Department	155
Physics Department	167
DIVISION OF NAVAL COMMAND AND MANAGEMENT	189
Management Science Department	191
Navigation Department	202
Seamanship and Tactics Department	204

TABLE OF CONTENTS

	Page
DIVISION OF U. S. AND INTERNATIONAL STUDIES	207
Area-Language Studies Department	209
Economics Department	215
Political Science Department	223
OTHER ACTIVITIES	233
Nimitz Library	234
Physical Education Department	235
INDEX OF CONTRIBUTORS	237
Faculty	237
Midshipmen	240
DISTRIBUTION LIST	241
FORM DD 1473	244

DIVISION OF

ENGINEERING AND WEAPONS

AEROSPACE ENGINEERING DEPARTMENT

Professor Andrew A. Pouring, Chairman

The wide range of interests evident in the enclosed annual research summary reflects the nature of aerospace engineering and the naval aviation community. Nearly every member of this Department's 12-man faculty is involved in gaining knowledge on some frontier either through an organized research project or as a simple extension of classroom work. For example, the individual's knowledge is extended by coordinating flight simulation in our modified GAT1 flight simulator with actual flight test experiments in our Beech Bonanza. The Beech Bonanza allowed a Trident Scholar to conduct actual flight-dynamics/wind-shear investigations. Earlier classroom special projects and midshipman research developed some of the background required to justify the present crypto-steady vaneless propeller project.

The process also works in reverse in that equipment developed for specific research needs quickly becomes laboratory apparatus in midshipman experiments. The helium bubble technique for visualizing parachute opening developed in this Department made a significant impact on the development of computer graphics, a facility now in everyday use. The graphics system now available for everyone's use has grown with the input of many midshipman research projects.

The Flow Demonstration Laboratory developed by faculty summer programs and midshipman effort is now sought by other departments to demonstrate fundamentals of fluid flow. This laboratory is a direct result of the funding support received from the Naval Air Systems Command.

An additional project with George Washington University has been funded with support from Naval Sea Systems Command and Office of Naval Research. This involves the new internal combustion engine concept of combustion with pressure exchange. A Trident Scholar is directly involved in this effort as well as a doctoral candidate at George Washington University.

To predict the outcome of research is folly. One needs only to look back on projects completed to realize this. Who would have predicted successful design, static-test firing, and flight test of Midshipman Crisalli's 1,000-pound thrust rocket? Who would have predicted discovery of a new combustion principle at the start of the new engine project 4 years ago? Research adds spice to our teaching environment and the rare excitement of discovery to those accepting the challenge.

*****

PRECEDING PAGE BLANK-NOT FILMED

LOSS OF DISTANT VISION STUDY

Researcher: Professor Bernard H. Carson (in conjunction with Commander John T. Chambers, MC, USN, Medical Department)

Sponsor: Naval Air Systems Command (Code Air 0310C)

This project, now in its third year, was motivated by a hypothesis that loss in distant vision in middle-aged naval aviators results from the overdevelopment of the eye muscles used for near vision during their college years. Using volunteer midshipmen, the USNA Medical Department has conducted a study aimed at providing data to test this hypothesis. Certain volunteers are issued mildly corrective glasses to ease the near-accommodation strain while studying, and their vision is periodically checked. Data thus generated are compared against similar data resulting from a control group. So far, no significant trends have emerged; but this may be due to the fact that vision deterioration is generally a long-term effect.

*****

INVESTIGATION OF SEEDING EFFECTS ON CONDENSATION

Researcher: Research Professor Joseph D. Gillerlain, Jr.

Sponsor: Naval Air Systems Command (Code Air 030226)

This project centers on the investigation of the effects of seeding on the condensation of water vapor in aerodynamic nozzles. The experiments are aimed at gaining further knowledge of the fundamental processes involved in heterogeneous nucleation, i.e., phase transition based on existing nuclei of different species with respect to initial particle formation and subsequent growth rates. The results have important applications in such areas as hurricane seeding techniques and anti-fog devices for airports.

An existing chemical kinetics wind tunnel will be utilized. The condensation nuclei will be provided by chemical salts generated in the atmospheric inlet of the wind tunnel. Collected samples of these particles will be examined for size distribution using a scanning electron microscope. Pressure distributions will be obtained by axial traverse of the wind tunnel test section. It is planned that a laser velocimeter will be utilized to obtain velocity profiles at different axial positions in the flow for comparisons with results calculated from the equations of fluid motion.

The chemical kinetics wind tunnel has been renovated and needed equipment has been acquired. Initial calibration tests were conducted in March and April. The first seeding experiments are planned for July 1976.

*****

MODIFIED INTERNAL COMBUSTION ENGINE PROJECT (NAHBE)

Researchers: Professor Andrew A. Pouring and Richard F. Blaser (Contractor)

Sponsor: Naval Sea Systems Command (Code NAVSEA 0331F)

The principal goal of this project is the refinement of and development of basic understanding of the new process of combustion with pressure exchange; this is the heart of the modified engine.

The plan of investigation includes a series of tests varying parameters one at a time on a CFR single cylinder, optical investigation in a transparent engine and modification of a modern 4-cylinder jeep engine, laboratory testing and installation in a vehicle for a road test.

The engine to date has given up to 35 percent improvement in fuel economy at low rpm, extended the range of internal combustion engine operation from operation at no output to full output, greatly reduced exhaust emission, and operates on many fuels.

*****

AERODYNAMICS OF THE SAVONIUS CROSS-FLOW ROTOR

Researcher: Assistant Professor Joseph F. Sladky, Jr.

Sponsor: Naval Academy Energy-Environment Study Group (Chief of Naval Development, Code MAT 03Z)

The focus of this project was to identify and optimize the geometry of a cross-flow/Savonius-type rotor. Initially, a literature survey and review was undertaken. It was found that there does not exist a systemized investigation and optimization of the rotor geometry. Evident are only rudimentary studies on the gross performance of cross-flow rotors. Completely lacking is a thorough understanding of the flow phenomenon involved. In search of information, various contacts were made with investigators in the field. Communication was established with B. Newman at Sherebrooke University and T. Sweeney at Princeton. The Princeton aerodynamic facility was visited in September, and a briefing by the laboratory director on the "Sailwing" windmill and other rotating airfoil systems was attended.

An analytical investigation was initiated first from the traditional fluid-flow approach and later by a method developed in numerical parachute flow-field analysis by Assistant Professor Paul Klimas (Aerospace Engineering Department). In the former method, an attempt was made to identify fluid forces such as lift, draft, and impulse on the blade elements as a function

of the azimuth (angle of rotation) angle of the rotor. This approach was not altogether successful. Because of the lack of aerodynamic data on the blade geometries involved and the inability to determine the blade-blade effects of two-blade systems, it was not possible to track the flow field. On the other hand, the computational method developed by Klimas and applied to the Savonius rotor was initially more successful. In this approach, the blades of the Savonius rotor are replaced by two-dimensional vortex sheets.

An experimental model was fabricated and will be tested in the Aerospace Engineering Department wind tunnel. In addition, several small models (3-inch diameter) were constructed and tested in the low-turbulence tunnel and in the water table.

*****

CRYPTO-STEADY ENERGY EXCHANGE

Researcher: Research Professor Joseph F. Sladky, Jr., Professor Andrew A. Pouring, and Professor Joseph V. Foa, George Washington University (Contractor)

Sponsor: Naval Sea Systems Command (Code NAVSEA 03512)

The objectives of the Crypto-Steady Energy Exchange (CSEE) project are to gain an in-depth insight and understanding into the fluid-fluid energy exchange by pressure forces, to identify and develop theory and experimentally verify the phenomena involved, and to develop performance maps and identify application scenarios for the CSEE principles.

Initially, an extensive review was conducted into the GSEE phenomena and associated problem areas such as fluid jet interactions, jet-jet interactions, jet stability problems, etc. Professor Foa has initiated efforts to develop a general model that will predict the performance of a number of thrust-generating systems and thus provide a comparative means for various propulsors.

The fabrication of experimental apparatus has begun. A modular type experimental program is defined. The goal is to provide a test set up that will enable a rapid conversion from air-air, fluid-fluid, air-fluid, fluid-air configurations.

The first year effort has been focused on a detailed literature survey not only in the rotating energy exchange but in areas of low interaction and jet stability as well. The design and fabrication of the test apparatus is completed. The program is on schedule and testing will commence Summer 1976.

*****

DESIGN, CONSTRUCTION, STATIC TEST, AND FLIGHT OF A LIQUID FUEL ROCKET SYSTEM

Researcher: Midshipman 1/C David E. Crisalli

Adviser: Professor Andrew A. Pouring

Sponsor: Trident Scholar Program

The objective of this Trident Scholar project was to design, construct and flight test a relatively large liquid fueled rocket. Through this project, a nonengineering major was given the opportunity to gain the maximum engineering experience in a short time by designing, constructing, static firing, and launching a liquid fuel rocket.

The following tasks were carried out:

a. Design and construction of a 900-pound thrust motor burning liquid oxygen and kerosene for 15 seconds,

b. Construction of a static test stand and test instrumentation to measure engine performance and to proof the design,

c. Static testing and calibration of the engine,

d. Construction of flight vehicle and ground support equipment,

e. Ground tests of feed and control systems and recovery systems, and

f. Flight test of vehicle.

The monumental effort of Midshipman Crisalli saw to all of the above phases with static test firing in January 1976. A thrust close to 1,000 pounds was developed on two separate static firings. The initial attempt at launch from White Sands, New Mexico, was scrubbed due to insertion of four vice two oxidizer-line-burst diagrams with a second attempt scheduled for 17 May 1976. Lift off was successful at 1138, 17 May. An altitude of approximately 8,000 feet was achieved along with a maximum velocity just past Mach one.

*****

INVESTIGATION INTO THE FEASIBILITY OF UTILIZING WIND SHEAR FOR OBTAINING CONTINUOUS NONPOWERED FLIGHT

Researcher: Midshipman 1/C Frederick F. G. Johnson

Adviser: Associate Professor Vadym V. Utgoff

Sponsor: Trident Scholar Program

The objective is to carry out an analytic and experimental investigation of the possibility of using wind shear to provide power to maintain continuous glide flight. The project entails collection of meteorological data to determine maximum vertical velocity gradients observed within and above the earth's surface boundary layer; an analytical determination of the feasibility of maintaining nonpowered flight by utilizing such vertical velocity gradients; and and experimental verification of the analysis utilizing powered and unpowered aircraft.

The feasibility of maintaining continuous nonpowered flight by utilizing a vertical wind velocity gradient is analyzed. It is concluded that wind velocity gradients which have been observed in the upper atmosphere are not sufficiently steep for this purpose; but wind shears likely to be encountered in the surface boundary layer should be adequate.

A suitable flight pattern was developed and an experimental investigation was conducted utilizing a powered airplane with the power adjusted to simulate existing and advanced sailplanes. Zero net loss of altitude was not attained, but it was concluded that further investigation is warranted with particular attention directed towards adherence to the prescribed flight pattern.

*****

THE He - NH_3 AIRSHIP: A PRELIMINARY APPRAISAL

Researcher: Professor Bernard H. Carson

One of the more overriding technical problems in adapting lighter-than-air vehicles to the heavy lift role is that of maintaining near-neutral buoyancy during cargo loading and off-loading operations. It is obvious that large amounts of cargo cannot be simply discharged from an airship at destination as is commonly done from other carriers. A number of solutions to this problem have been proposed that include the use of hybrids which combine aerodynamic and aerostatic lifting principles, the thermodynamic control of the lifting gas, and elaborate ballasting techniques which make use of the natural abundance of water at most logical cargo destinations.

In addressing this problem, an entirely novel approach is put forth using ammonia in conjunction with helium as a lifting gas. Ammonia (NH_3) has a specific density of about 60 percent that of air and is thus a lifting gas. In addition, ammonia has a great affinity for water; at standard conditions, roughly 700 volumes of ammonia will dissolve in one equivalent volume of water. The process is reversible by subsequent heating of the water-ammonia mixture. It therefore appears possible to obtain wide variations in the buoyancy range of an He - NH_3 airship, assuming that enough water and the necessary ammonia recovery plant could be carried along on a permanent basis. If such a craft could be built with its own internal buoyancy control capability, then it could operate independently, embarking and disembarking cargo at the will of the operator after the fashion of other cargo transport vehicles.

A preliminary investigation of a buoyancy management concept for lighter-than-air vehicles, using a water-ammonia system, was undertaken. Generally, the concept is found to be sound, but additional study is indicated especially in the area of weight penalties due to the system.

A report entitled "The He - NH_3 Airship: A Preliminary Appraisal" of August 1975 was written.

*****

COANDA LIFT SYSTEMS

Researcher: Assistant Professor Joseph F. Sladky, Jr.

The purpose of the study was to determine the feasibility of employing the Coanda phenomenon to generate lift forces over a large diameter sphere.

Potential applications would be along the lines of the "Aerocrane" vehicle but eliminating the large Magnus effect inherent in the design.

A quick test rig was constructed and operated. Lift forces of up to 80 grams have been measured. Experimentation is continuing on an as time allows basis. The device would, at the very least, be a useful fluids experiment in class.

*****

INVESTIGATION OF AN AMMONIA RECOVERY SYSTEM FOR LIGHTER-THAN-AIR VEHICLE APPLICATIONS

Researchers: Midshipmen 1/C Kenneth D. Beeks and John Rader

Adviser: Professor Bernard H. Carson

Based on the theoretical work of Professor Carson, an experiment was undertaken to determine the feasibility of a water-ammonia separation system for use as a buoyancy control process for lighter-than-air applications. The solubility of ammonia in water is strongly temperature dependent. The separation technique, therefore, consisted of a distilling process. A closed-cycle system was designed and on the basis of preliminary results, reasonable separation efficiencies were achieved. However, the project had to be terminated due to the hazardous nature of ammonia, which could not be safely contained in the simple apparatus as designed. Nevertheless, valuable insight into the problems of developing this system to an operational state was obtained.

*****

AEROSPACE ENGINEERING DESIGN COMPUTER PROGRAMS

Researcher: Midshipman 1/C James D. Engels

Adviser: Associate Professor Maido Saarlas

This purpose of the project was to consolidate, improve and test existing aircraft preliminary design programs for the Aerospace Engineering Design Course. Three existing programs were combined and updated to provide a version incorporating the latest engine data and to allow increased flexibility in specifying newer aerodynamic inputs. Data input formats were reviewed and modified and the new programs were checked and partly used in EA440; however, the documentation is still incomplete.

The work resulted in an informal project report.

*****

EXPERIMENTS FOR FLOW DEMONSTRATION LABORATORY

Researcher: Midshipman 3/C Jay V. Gardiner

Adviser: Associate Professor Maido Saarlas

This project consisted of designing and checking out experiments for the Aerospace Engineering Department Flow Test Laboratory. A new and improved support system for model support and balancing was designed. Six different models were designed.

*****

WIRE GUIDED MODEL

Researcher: Midshipman 2/C Martinus M. Klijn

Adviser: Associate Professor Vadym V. Utgoff

The purpose of the project was to develop a small torqueless helicopter with superior performance and safety. The concept was to use an engine-propeller combination to balance a single blade and to provide necessary torque and to use the gyroscopic moment of the engine-propeller combination to balance aerodynamic blade pitch moments. The objective is to provide automatic reduction of blade pitch for autorotative descent in the event of engine failure.

An analytic investigation was conducted which demonstrated the feasibility of the concept. A small model was built which proved the analysis.

A full scale flight vehicle will be built to further prove the concept. Midshipman Klijn proposes to continue certain aspects of this project as a Trident Scholar during Academic Year 1976-1977.

*****

INTERACTIVE GRAPHICS

Researcher: Midshipman 2/C C. R. Perry

Adviser: Professor David F. Rogers

This project has three objectives:

a. To develop proficiency in computer-aided design, interactive graphics, and the associated hardware and software;

b. To develop subroutines to aid in interfacing the cathode ray tube display with the tablet primarily in the areas of menu display and menu testing; and

c. To develop a program, using the previous two objectives, to demonstrate the use of super position of flows.

*****

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Experimental Investigation of a Fin-Cone Interference Flow Field at Mach 5," Naval Surface Weapons Center, White Oak Laboratory, Technical Report No. 75-63, April 1976. (See Presentations.)

The general purpose of this investigation was to study the separated flow field associated with a fin-body juncture. Specific objectives included: (a) determining the severity and extent of aerodynamic heating, (b) providing flow visualization results to illustrate the flow structure, and (c) obtaining a data base of heat-transfer and surface-pressure measurements upon which to develop future analytical relations to predict peak interference heating levels. Tests were conducted at Mach 5 over a unit Reynolds number range of 4.5 to 26 million per foot. A fin-cone model was used. The data consist of surface-pressure distributions, heat-transfer measurements using the phase-change paint technique, and schlieren and oil-flow photographs. Results are presented for several fin-cone geometries to include fin sweep and fin-cone gap. Where possible, comparisons are made with fin-flat-plate data.

*****

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Use of Phase-Change Paints to Study Fin-Body Interference Heating," Naval Surface Weapons Center, White Oak Laboratory, Technical Report No. 75-62, April 1976.

In recent years, the phase-change paint technique has evolved into an accepted diagnostic tool in high-speed, wind-tunnel testing. The method is considered capable of providing reliable quantitative heat-transfer results for complex configurations with interference heating patterns of unknown extent and location. This report documents use of the method at the Naval Surface Weapons center, White Oak Laboratory, to study aerodynamic interference heating on fin-body configurations. Various aspects of both the underlying theory and the experimental method are enumerated based on experience and on information from other researchers. Analytic relationships are presented which indicate how uncertainties in the various input parameters affect the uncertainty in the heat-transfer coefficient. Advantages and disadvantages of the phase-change paint method are discussed.

*****

POURING, Andrew A.,Professor,"The Kinetics of Evolution of Water Vapor Clusters in Air," USNA Report No. EW-3-74, December 1975.

The kinetic theory of cluster formation in a condensing gas proposed by Buckle attempts to calculate the course of homogenous condensation from molecular rather than thermodynamic precepts. Here it is applied to the rapid nonequilibrium expansion of atmospheric water vapor in air. A method is established for demonstrating the validity of this theory,

originally proposed for a mono-molecular gas, in the case of a complicated species such as water vapor. Cluster conditions in the temperature range 210-295°K and the vapor pressure are calculated throughout the collapse of a super-saturated metastable vapor.

An effective molecular pair interaction energy and nearest neighbor coordination number is found based on the classical zero-point enthalpy of sublimation and by iteration to satisfy initial equilibrium limiting constraints of 273°K. The internal energy redistribution frequency results from close matching of the experimental pressure distribution. A method of determining the cluster size at which macroscopic properties become relevent is described; the size is found to be a cluster of about 122 molecules at 273°K based on a hard-sphere, model-collision cross section. For the water-vapor dimer, an equilibrium constant of 4.0×10^{-21} (cm^{-3}) is found at 273°K compared to 3.1×10^{-21} (cm^{-3}) obtained from Keyes' data.

Two models for water vapor clusters result (from satisfying all constraints imposed on the theory) which are given in terms of number of nearest neighbors, pair interaction energy per molecule (2.9kcal/mol at 273°K), and possible structure on a cluster-by-cluster basis for a model approximately a Pauling-type clathrate.

*****

GILLERLAIN, Joseph D., Jr., Assistant Professor, "Experimental Investigation of a Fin-Cone Interference Flow Field at Mach 5." Paper read at Tenth Navy Symposium on Aeroballistics, Fredericksburg, Virginia, 15-17 July 1975. (Later published in Symposium Proceedings, II (March 1976) and in Naval Surface Weapons Center, White Oak Laboratory, Technical Report No. 75-63).

*****

KLIMAS, Paul C., Assistant Professor, "Fluid Mass Associated With an Axisymmetric Parachute Canopy." Paper read at AIAA Fifth Aerodynamic Deceleration Systems Conference, Albuquerque, New Mexico, 17-19 November 1975.

*****

KLIMAS, Paul C., Assistant Professor and David F. ROGERS, Professor, "Helium Bubble Survey of a Parachute Opening Flowfield Using Computer Graphics Techniques." Paper read at AIAA Fifth Aerodynamic Deceleration Systems Conference, Albuquerque, New Mexico, 17-19 November 1975.

*****

ROGERS, David F., Professor, "Quantitative Information from Helium Bubble Flow Visualization Using Computer Graphics Techniques." Paper read at 14th Aerospace Sciences Meeting, Washington, D. C., 26-28 January 1976 (published as AIAA Preprint 76-93).

*****

ELECTRICAL ENGINEERING DEPARTMENT

Commander D. B. Murton, USN, Chairman

Research in the Department of Electrical Engineering has continued to mirror the revolutionary developments in solid-state electronics technology of the past decade. While a range of interest from thin-film technology to laser communications is encompassed, there has been a focus of attention on digital electronics. This in itself covers a broad spectrum of faculty and student interest from sonar signal processing to computer interfacing, faster processing, and analysis.

This year, the Department was pleased to have two Trident Scholars, working on computer and signal processing projects, seven independent research projects by other students ranging from a highly theoretical network synthesis problem to microprocessor utilization, and faculty members involved in all of these plus other projects. In addition to direct in-house support from NAVELEXSYSCOM and other agencies, various faculty members have been called upon to aid in projects conducted by Navy laboratory centers.

Research in the Department of Electrical Engineering serves three purposes: it supports continuing development of the faculty, it provides the important element of applied engineering for midshipmen who participate in the projects, and it contributes new knowledge to the disciplines. The second of these purposes is the most important at the Naval Academy. Research must provide the basis for a strong undergraduate program. Therefore, in addition to advancing the frontiers of their research areas, faculty members are committed to maintaining dynamic and challenging projects for midshipmen who choose to specialize in electrical engineering. Participating midshipmen have the opportunity to engage, with faculty, in unstructured scientific effort in wide variety. Thus they are exposed to some of the techniques applied to the solution of practical engineering problems. Research activity provides midshipmen the opportunity to learn how the engineering community responds to the very-expanding needs of the service.

*****

PRECEDING PAGE BLANK-NOT FILMED

A BEARING SEARCH SIMULATOR

Researcher: Professor Francis J. Eberhardt (with Associate Professor Ralph P. Santoro)

Sponsor: Naval Electronics Systems Command

A hybrid system, i.e., digital position information and analog control voltage has been used to present to a loudspeaker or earphone a realistic presentation as the operator turns a handwheel simulating a passive sonar search. The input is from a two-channel tape recorder, background noise on one channel, target on the other. As the wheel is trained, the target fades in and out in a realistic simulation of a beam pattern. The target bearing can be preset to any location.

*****

VARIOUS ASPECTS OF COMPUTER INTERFACING

Researcher: Research Professor Francis Joseph Eberhardt

Sponsor: Naval Electronics Systems Command (Code NAVELEX 03)

The Research Professor has been coordinating activities in the following areas on a continuing basis:

1. Computer to computer interfacing,
2. A hybrid sonar target bearing simulator,
3. ETV series for use in professional program,
4. Midshipman Jon S. Tandy's Trident Scholar project, and
5. Computer control of laboratory signals.

*****

HIGHER ORDER FILTERS USING ACTIVE, HEIZER-TYPE RC NETWORKS

Researcher: Associate Professor Charles A. Fowler, III

Sponsor: Naval Academy Research Council

The purpose of the research is to develop the theoretical basis for higher order electric filters using an active element in conjunction with a Heizer-type distributed RC network.

One goal has been to determine the location of poles and zeros of the transfer function of the filter, and also to specify this information in terms of coefficient of polynomials that can be realized. This goal includes developing new topologies to realize band pass and high pass filters. Another goal is to produce tables of parameters from which a user can easily extract all necessary design information. Additional goals are to investigate the stability of these filters and their sensitivity to changes in parameters.

A topology to produce a band pass filter has been developed. Tables of parameters for low pass filters of the Butterworth, Bessel, or Tchebyscheff types have been produced for filters of second order through ninth. Topologies to realize high pass filters are being investigated, as are the problems of stability and sensitivity.

*****

THE EFFECTS OF TERMINAL DEPOSITION PRESSURE/TERMINAL DEPOSITION RATE RATIO (p/r RATIO) ON THE OPTICAL PROPERTIES AND REFLECTANCE OF ULTRAPURE GOLD AND ALUMINUM FILMS

Researcher: Assistant Professor Jake H. Halford

Sponsor: Naval Academy Research Council

The objective of the research is to improve the reflectivity of aluminum and gold films and to study structure of such higher reflecting films.

The optical properties of reflecting aluminum films depend on the characteristics of the surface region of the film, i.e., the region of approximately 200Å which is the optical skin depth. Observed variations in optical properties of aluminum films have been attributed to uncontrolled surface and volume oxidation of the films. This research has involved monitoring the terminal aluminum deposition rate and terminal pressure to determine the p/r ratio at the surface. This work is now being extended to measure the terminal oxygen partial pressures and terminal deposition rates to further reduce volume oxide contamination and improve film reflectance.

*****

ELECTRIC DRIVE SYSTEMS FOR DEEP OCEAN TECHNOLOGY

Researcher: Professor John A. Lee

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

Consulting services during the intersessional period consisted of technical editing of the Electric Drive Systems Handbook by DWTNSRDC staff. Work was completed 31 August 1975.

*****

DESIGN FOR FIELD TESTING ELECTROMAGNETIC SHIP'S LOG

Researcher: Associate Professor Herbert M. Neustadt

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

The objective is to develop a device for field testing a ship's log (an electromagnetic device for measuring ship's speed with respect to water), specifically:

1. Take advantage of new electronic devices (integrated circuits, digital voltmeter, analog switches, etc.) that have become available only in the past few years.

2. Design a signal processor using these new devices so as to achieve higher accuracy, lower cost, smaller size, greater reliability than previously attainable in the signal processors used with logs.

3. In the field, compare readout of the new signal processor with the readout from the ship's already installed log signal processor. Use diagnostic procedures to detect and analyze error in the installed log system. Most of the installed devices were designed 10 or more years ago. As a consequence, it is appropriate to consider the new device as an accurate convenient standard against which the performance of the installed device can be checked.

The field testing device has been breadboarded and satisfies all specifications except those associated with temperature tests. It is planned to install resistors and capacitors having low temperature coefficients in order to meet the temperature specifications.

*****

DETECTION AND ESTIMATION OF STOCHASTIC PROCESSES AFTER A PIECEWISE DESCRIBABLE TRANSFORMATION

Researcher: Assistant Professor David L. Nicholson

Sponsor: Naval Academy Research Council

Many electronic signal processing issues in radar, sonar, IR and electromagnetic intelligence systems can be considered as statistical hypothesis testing problems. In some cases, the target or hypothesis can be adequately described only by an appropriately weighted sum of component probability density functions. The sum of density functions is called a

mixture. The purpose of this research project is to develop a method of conveniently determining optimum signal processing methods for mixture density stochastic processes such as occur at the output of devices which perform a piecewise describable transformation. For optimum signal detection, both the Bayes and the Neyman-Person criteria lead to the formation of a likelihood ratio hypothesis test which is extremely awkward computationally when one or both of the probability density functions is a mixture. The likelihood ratio can be related to the traditional measures of information developed in statistical information theory. Using this theory, a procedure has been developed which is more general than the likelihood ratio procedure, is computationally much more convenient for mixtures than is the likelihood ratio and reduces to the likelihood ratio in the limit as a mixture becomes a single component density function. Approximate methods for applying the likelihood ratio test are being studied so the performance of the new information-theoretic approach can be compared to the Bayes procedures.

*****

CLOSED LOOP SPEED CONTROL OF A DC MOTOR/AC GENERATOR SET USING A MINI-COMPUTER

Researcher: Assistant Professor Richard L. Martin

Sponsor: Naval Electronics Systems Command

The development of a closed loop, real-time, motor speed control system is presented whereby a PDP-8 minicomputer is used to program and control the speed of a DC motor/AC generator set.

The frequency of the AC generator output is sensed by the mini-computer using a unique algorithm requiring only a relatively low sampling rate. Required motor speed is input by the operator via the mini-computer's switch register.

Strip chart records are provided showing the effects of changes in several of the designed parameters.

*****

FREQUENCY ANALYSIS USING A MINI-COMPUTER

Researcher: Midshipman David C. Boch

Adviser: Major David A. Wright, Canadian Air Force

Sponsor: Trident Scholar Program

The project aims were to investigate the fundamental limitations imposed by mini-computer architecture on speed of frequency analysis (FFT), the potential of special purpose peripherals for speed up of FFT; and of update mode

adaptation of FFT. A discrete Fourier transform was developed as a first step to gain experience and assess problems of fixed point scaling. An FFT program was then written, refined, analyzed for fundamental limitations and exercised. Repeated storage and access of operands together with multiplication time were key factors in limiting the FFT to around 350 microseconds per step. Study showed that a 10 percent improvement, at best, could be expected from further software refinement. Attention was shifted to the design of a hardware outrigger with such a device, so a preliminary design was formulated. Unusual features of the FFT implemented are evolutionary display and high speed unscrambling of results.

*****

THE DESIGN OF A SONAR TARGET SIMULATOR

Researcher: Midshipman Jon S. Tandy

Advisor: Research Professor Francis Joseph Eberhardt

Sponsor: Trident Scholar Program

The objective was to investigate techniques for computer control of simulated detection and tracking problems in both analog and digital passive sonar systems.

The methodology treats both analog and digital processing systems. For analog processing, the approach is to use a minicomputer to control the apparent bearing and signal strength of taped submarine signature so that an operator is presented with a realistic aural display while performing simulated search routines. For digital beam-formed systems, the attempt is being made to find a technique for introducing realistic target information for training purposes. An interface has been developed which permits minicomputer control of the relative motion of a taped target signal so that an operator sees a realistic detection and tracking problems.

The problem of introducing a simulated target into a digital beam-formed system (DIMUS) is much more complicated and the research has made significant progress only in handling one phase of the display system.

*****

THE ABSORPTION OF SOUND BY PINE TREES

Researcher: Associate Professor Stephen H. Burns

The anomalies in the absorption of sound by pine trees (see Embleton, Journal of Acoustical Society of America, 35, 1119, 1963) is being investigated. The objective is to determine whether the dominant mechanism of absorption is thermoviscous losses in the (air) boundary layer at the surface of stationary needles or losses due to the boughs set into resonance at a high-order mode at the frequency of the sound field.

The general plan of this investigation is to subject freshly cut pine boughs to an acoustic field within a small reverberation chamber. The frequency response of the chamber is measured. Comparison of this response with that of the empty chamber yields the effect of the boughs. Losses in the boughs dictate lower amplitude, greater bandwidth normal modes in comparison with those of the empty chamber. Immediately after this test, the researcher plans to observe the (clamped-free) beam modes of the same fresh boughs. Comparison of the data from these two tests should indicate the mechanism of absorption.

Previously, a reverberation chamber constructed of 2-cm thick plywood backed (on the outside) by a 4-cm thick layer of sand was used. These walls were not sufficiently rigid to make reliable measurements. A concrete reverberation chamber, such as a small septic tank, should work well.

At the present time, hardware is being developed for observation of the beam modes of boughs.

*****

A NEW ELECTRONIC MUSICAL INSTRUMENT

Researcher: Associate Professor Herbert M. Neustadt

The purpose of this special project is to develop a fundamentally new electronic musical instrument that simulates the transient behavior of the flute, recorder, piccolo, calliope or other instruments of the flute family.

Since the 1870's, when Helmholtz published his classic, "Sensations of Tone," people have thought that the human ear and brain identify a source of musical tone from the harmonic constitution of the tone. But this idea has never been entirely satisfying. Since the 1950's, it has become clear that when the ear seeks to identify the source of musical tones, the ear pays at least as much attention to the transient behavior of the tones as it does to harmonic constitution.

The transient behavior of a musical sound (how it starts, how it ends, how it behaves during and after an abrupt pitch change) carries at least as much information on the nature of the source as does the harmonic constitution of the sound when it is in steady state. Helmholtz's harmonic constitution is inherently associated with a tone in steady state; that is, a tone whose amplitude and pitch are held constant for many cycles. During the last 25 years, it has become realized that the ear pays at least as much attention to the transient part of a musical tone as it does to the sustained steady-state part. This realization is supported by the fact that the transient behavior of a tone can certainly tell the ear as much about the nature of the source (whether it is a brass, wood-wind, string, or electronic source) as the steady-state harmonics can.

The theoretical aspects have been pursued for a number of years starting in 1956-1958 while the investigator was supported by a Guggenheim Fellowship. The theoretical model has been developed and the practical problem of how to construct a satisfactory electronic device for producing a sound output with the desired transient behavior appears to be solved.

A working model of the new instrument will be constructed. It will be used to demonstrate the validity of the theories on which the new instrument is based.

*****

STATE SPACE APPROACH TO SENSITIVITY CALCULATIONS; OPTIMAL SYNTHESIS OF LADDER NETWORKS

Researcher: Midshipman 1/C Alan C. Angleman

Adviser: Assistant Professor Tian S. Lim

Various topics on network analysis and synthesis with LC elements, RC and Rl network synthesis, transfer function synthesis of ladder networks, synthesis of double-terminated RC ladder networks were studied.

This project culminated in the publication of a paper entitled "Cut-Set Analysis and Sensitivity Calculation." Midshipman Angleman presented the paper at the Institute of Electrical and Electronics Engineers Region V Annual Conference held at the University of Texas, Austin Campus, 14-16 April 1976.

*****

DESIGN OF DIGITAL COMPUTER CIRCUITS: NETWORK SYNTHESIS

Researcher: Midshipman 1/C Lester E. Carr

Adviser: Assistant Professor Tian S. Lim

This project was divided into two parts. The first part deals with digital computer circuits. Topics studied in this area included registers, counters, binary arithmetic units, decimal arithmetic units, etc. The second part of the project pertains to network synthesis. Methods of LC and RC driving-point synthesis, analysis and synthesis of transfer functions of ladder networks were among the topics covered.

*****

DESIGN AND CONSTRUCTION OF A MICROPROCESSOR BASED ON THE INTEL 8008 CENTRAL PROCESSING UNIT

Researcher: Midshipman 1/C Paul Deppe

Adviser: Associate Professor Ralph P. Santoro

Using specifications and timing diagrams supplied by the manufacturer, all of the logic required to construct a complete stored program microcomputer was designed. A pure, binary input/output was constructed with a switch register for input and LED's for outputs. The memory consisted of 8 NS1101 (256x1) RAM I. C.'s providing a 256-word memory. Construction of the project was completed, and the microcomputer was operated satisfactorily.

*****

NETWORK ANALYSIS AND SYNTHESIS

Researcher: Midshipman 1/C Michael S. Hamner

Adviser: Assistant Professor Tian S. Lim

Various methods of network synthesis including LC, RC and RL, driving-point synthesis, analysis and synthesis of transfer functions of ladder networks, etc. were studied.

*****

DESIGN AND CONSTRUCTION OF A COMPUTER TERMINAL

Researcher: Midshipman 1/C William Kneller

Adviser: Associate Professor Ralph P. Santoro

This project was the design and construction of an ASCII printer using an IBM selectric typewriter. A solenoid pack that fits on top of the keyboard was used. The data was input serially at 110 baud, then converted into parallel form by a UART. This was then buffered by a 64-character FIFO memory. The data were then used to look up codes in PROM's that contained data for controlling the solenoids and certain delay information needed for timing delays.

The project worked well but if it were to be done over again, the control would be done with a microprocessor.

*****

DESIGN AND CONSTRUCTION OF A CONTROLLER FOR A PROM PROGRAMMER

Researcher: Midshipman 1/C Philip Kumpis

Adviser: Associate Professor Ralph P. Santoro

This project had as its goal the design and construction of a hardware controller to make the INTEL MP7-03 PROM PROGRAMMER BOARD into a self-contained PROM PROGRAMMING STATION.

The final design that was constructed consisted of a single wire wrap board (31 integrated circuit chips), a control panel (hexadecimal keyboard, indicator lights, and toggle switches) and the necessary power supplies. The design provided for two modes of operation:

AUTOMATIC - The data to be stored in the PROM is first deposited into a PDP-8E computer. Software in the PDP-8E is then employed to control the programming operation through the 12-channel buffered digital I/O.

MANUAL - In this mode, the PROM ADDRESS is loaded into a computer by means of 8 toggle switches while the DATA is loaded with a hexadecimal keyboard. The programming operation is completed when the DEPOSIT switch is depressed. Under normal operation, the DATA is deposited into sequential locations. To take advantage of this, the ADDRESS counter is automatically advanced after each DEPOSIT operation. Non-sequential operation is managed by using the ADDRESS toggle switches to load the ADDRESS counter.

*****

A WIEN BRIDGE OSCILLATOR FOR ACOUSTICAL STUDIES

Researcher: Midshipman 1/C James C. Whitsett

Adviser: Associate Professor Stephen H. Burns

The project had as its goal the construction and packaging of an oscillator that would tune continuously from 40 to 4000 Hz to permit swept-frequency measurements of the acoustic absorption of pine boughs. The oscillator should have less than 1 percent total harmonic distortion with no obvious waveform glitches and an output level within ±1/2 db of it 400 Hz level.

Analysis was performed on a circuit presented in the literature. Although the basic circuit was satisfactory, that circuit proved to have an inadequate amplitude stabilization scheme. Two other amplitude stabilization schemes were investigated. While no usable hardware resulted from the project, several worthwhile conclusions surfaced concerning amplitude stabilization.

*****

ALLEY, Reuben E., Professor, "Transistors" and "Electric Motors" in Paul Tipler, Physics. New York: Worth Publishers, Inc., 1976.

Two essays were published in a new introductory physics book for engineering and physics students. These are two of 15 essays, written by people other than the author on topics that are not discussed in the text. The essays are: "Transistors," pp. 805-807 (a brief account of the theory and descriptions of applications of transistors and some other semiconductor devices) and "Electric Motors," pp. 900-904 (an account of the operating principles of DC shunt and series motors and AC synchronous and induction motors).

*****

LIM, Tian S., Assistant Professor, "Synthesis of Double-Terminated Ladder Network by Chain Matrix Decomposition," Proceedings of 1975 Midwest Symposium on Circuits and Systems, Montreal, Canada (August 1975), 332-336.

Synthesis of lossless ladder network terminated at one end has been achieved recently using chain matrix decomposition techniques. In this paper, an extension of the theory is shown to synthesize a lossless ladder network terminated at both ends. Using simple algorithms that are implemented by digital computer programs, synthesis can be effected with ease and with little expenditure of time.

*****

LIM, Tian S. Assistant Professor, "Cut-Set Analysis and Sensitivity Calculation," 1976 Institute of Electrical and Electronics Engineers Region 5 Annual Conference Digest (April 1976), 125-128.

Calculation of the first-order sensitivities of a linear time-invarient, nonreciprocal network by means of cut-set analysis is presented in this paper. Sensitivity coefficients of the network tree branch voltages with respect to the component values are calculated by simple matrix equations implemented by digital computer program.

*****

MECHANICAL ENGINEERING DEPARTMENT

Commander Owen M. Kirkley, CEC, USN, Chairman

Faculty and midshipmen research work in the Mechanical Engineering Department covers many of the areas of specialization within Mechanical Engineering. These areas include, among others: computer graphics, computer-aided design, computer simulation, turbulent-flow separation, drag measurement and reduction, vortex flow, multi-phase flow, magneto-hydrodynamics, finite-element applications, earthquake-response spectra, solar heating and air conditioning, fracture, two-phase materials, fatigue, less common metals, experimental mechanics, welding techniques, and ferrocement-boat hulls.

Research support is supplied primarily through funds from government agencies. Some support is obtained from the private sector. In addition, the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, provides the opportunity for several members of the faculty to work on research programs at their facilities during the intersessional period. As a result of this support and other independent research effort on the part of the faculty, 15 of the 20 civilian faculty members and two of the nine military faculty members have contributed to the more than 30 publications, reports, and presentations of the Department this year.

An important part of the Department's research effort during the year has been the involvement of midshipmen in independent research, design, or development projects.

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

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

*****

CURVE DESCRIPTION FOR COMPUTER GRAPHICS

Researcher: Professor James A. Adams

Sponsor: Office of Naval Research, Code 432

Various techniques have been suggested for the numerical representation of a general curve. Several of the more common include splines, Bezier curves, and B-splines. The objective of this research was to investigate an additional method based upon the integration of the Serret-Frenet equations. This method is unique in that the user can explicitly specify the curvature profile over the entire length of the curve rather than simply specifying end-boundary conditions and a finite number of intermediate constraints. This provides greater informational content about the curve,and it is easy to distinguish the difference between two curves which may graphically look very similar. One possible application is in pattern recognition.

A comparison was made of the intrinsic technique based upon the Serret-Frenet equations and the more common methods. The results are presented in two published papers which appear in Computer-Aided Design. The method is thus well documented. It remains to be seen if the method will have practical advantages in computer-aided design and numerical-part production.

*****

INVESTIGATION OF OPTIMUM CONCRETES FOR USE IN FERROCEMENT BOAT HULLS

Researcher: Associate Professor Thomas W. Butler

Sponsor: Naval Academy Research Council

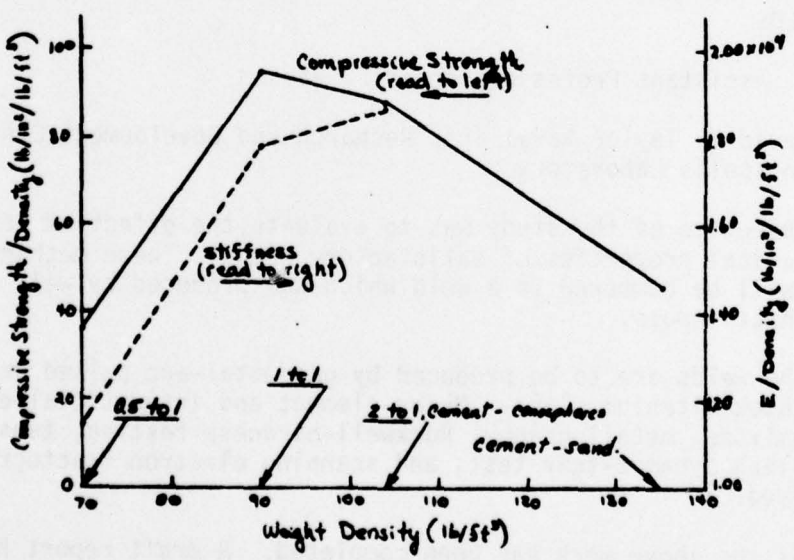
Ferrocement as used for the construction of boat hulls consists of a rather dense framework of steel rods and mesh covered by a cement-based "stucco" which keeps the water out of the boat and gives additional rigidity to the steel assemblage. The major constituent, about 80 percent by weight, of a ferrocement is the cement which is used to cover and protect the wire mesh or hardware cloth and steel reinforcing bars. Commonly, a Portland cement with sand as an aggregate is used as the covering and is "stuccoed" in place. However, the "cement" portion of the hull is not relied upon to substantially strengthen the hull because of the very low-tensile strength of concrete. For this reason, much can be done to lower the weight of ferrocement boats by decreasing the density of the "cement" portion of the hull.

This investigation employed experimental methods to attempt to optimize "cement" hull materials for ferrocement boats. The main goal of

lowering the density of the "cement" by means of increased porosity or light weight aggregate must be tempered by the need to retain other desirable properties. Also, the already low strength and stiffness should not be significantly lowered. Tests performed included tests to determine strength and stiffness of cylindrical compression specimens and steel reinforced panels as functions of design parameters.

The lightweight aggregate evaluated here consists of cenospheres, thin-walled, hollow-spherical particles which are from about 20 to 200 μ in diameter. These cenospheres are found in flyash and are a product of combustion from fossil-fuel, power-generating plants which is collected because of environmental considerations. Since they are chemically suitable as an aggregate in concrete and have a bulk specific gravity of between 0.25 and 0.4, they were tested as a possible aggregate material.

Some of the results obtained in the course of this investigation are presented in the graph which shows the variation of compressive strength and stiffness (Young's Modulus) with density of material. From this graph, it can be seen that 1 to 1 and 2 to 1 ratios of Portland Type I cement to cenospheres give considerably better strength values than does sand on a specific strength basis. Similarly, specific stiffness is increased as density increases. This indicates that for these two parameters the 1 to 1 and 2 to 1 ratios give results which are quite close to each other and considerably better than either 0.5 to 1 ratio or sand results. More tests remain to be completed.



*****

MILITARY SPECIFICATIONS ON BEARING UNIT, MAIN THRUST, SUBMARINE PROPELLER SHAFT

Researcher: Associate Professor Elliott E. Dodson

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

The purpose of this project was the development of a Military Specification to be used for future submarine machinery procurements.

The specification covers propeller-shaft, thrust-bearing units for naval submarines where such units combine a hydrodynamic-thrust bearing, a vibration reducer and a journal bearing in a common housing and utilize an external forced-feed lubricating oil system.

The units intended are comprised of pivoted-shoe, hydrodynamic-ahead and astern-thrust elements operating in an oil-flooded section of the housing and a cylindrical-journal bearing in a separate section of the housing. The ahead-thrust elements will be supported on vibration-reducer elements and the astern-pivoted shoes will be supported on leveling links. The journal bearing supports one end of the thrust shaft and may provide the radial support for the emergency-drive motor if required.

*****

EVALUATION OF MECHANICAL PROPERTIES AND MICROSTRUCTURE OF TWO-INCH ALLOY TITANIUM WELDS

Researcher: Assistant Professor Dennis F. Hasson

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

The objective of the study was to evaluate the effect of heat input on the mechanical properties of satisfactory welds. These mechanical properties will be compared to a weld which was produced by weld passes of various heat inputs.

All the welds are to be produced by gas-metal-arc pulsed welding of 2-inch thick titanium plate. Major-element and interstitial-element chemical analyses, metallography, Rockwell-hardness testing, tensile tests, 5/8-inch dynamic-tear tests and scanning electron fractography were performed.

All of the above work has been completed. A draft report has been prepared entitled "Effect of Various Heat Inputs on the Properties of Gas-Metal-Arc Pulsed Current Welding of a Titanium Alloy" by J. Kershner, David W. Taylor Naval Ship Research and Development Center and D. F. Hasson, U. S. Naval Academy.

*****

STRESS-CORROSION-CRACKING CHARACTERISTICS OF COMMERCIAL TITANIUM ALLOYS FOR NAVAL HYDROSPACE APPLICATIONS

Researcher: Assistant Professor Dennis F. Hasson

Sponsor: Naval Academy Research Council

The stress-corrosion-cracking (SCC) characteristics of commercial (standard and extra low interstitial) grades of Ti-6Al-4V materials were studied. Specimens of the material from a hot alpha plus beta rolling condition were beta annealed, recrystallized annealed, and solution treated, plus aged to obtain three process conditions for the two grades of materials. Specimens of the wedge-opening-load type were prepared from the various heat treating processed materials. These specimens were then tested in a 3.5 percent salt water solution to determine the stress intensity threshold level ($K_{1_{SCC}}$) to propogate a crack in the materials. The effects of heat treatment on ($K_{1_{SCC}}$) were then determined on the two grades of commercial Ti-6Al-4V materials which are currently utilized in naval applications. Chemical analyses, metallographic examination, and scanning electron microscope fractography were performed to assist in interpretation of results.

*****

ANALOG SIMULATION OF A WAVE-ACTIVATED, TURBINE-GENERATOR BUOY

Researcher: Associate Professor Richard A. Hirsch

Sponsor: United States Coast Guard

Equations which describe the heaving dynamics were developed as well as equations describing the output of the air-operated/turbine-generator subsystem. These equations were scaled for analog computation and the computer patching diagrams developed. An analysis of the limited full scale data available was made and this analysis indicated that the theoretical model will probably require modification before final analog computation can be done. USNA Report No. EW-9-75 was published and will be reissued as an official Coast Guard report.

*****

THE INFLUENCE OF SPECIMEN GEOMETRY AND MATERIAL PROPERTIES ON THE J_{IC} FRACTURE TOUGHNESS PARAMETER

Researcher: Assistant Professor James A. Joyce

Sponsor: National Science Foundation

The objective is to reduce the number of specimens required to obtain valid J integral fracture toughness values. This reduction of specimens would then allow effort to be concentrated on the ranges of validity of the J integral fracture toughness concept. J values can be obtained from a single specimen load displacement record if the point-of-crack extension can be determined. Tests involve loading the specimens in an Instron Tensile Test machine, monitoring load and crack opening using sensitive transducers and a data acquisition system which converts transducer output to binary signals. An on-line microprocesser stores the load-displacement record, evaluates the J parameter, and estimates the specimen-crack length by a compliance method using periodic unloadings.

Preliminary tests have shown promise but changes in both the load fixtures and electronics have been necessary to obtain an improved sensitivity and repeatability of crack length estimates.

Once the test procedure is established, specimen geometry will be varied to determine the range of applicability of the J fracture criterion. Hopefully, these limits can be related to the material's yield stress, ultimate tensile strength, and strain hardening rate.

*****

WIND POWERED HEAT PUMP DESIGN STUDY: A POTENTIAL NAVAL ALTERNATIVE ENERGY SYSTEM

Researcher: Assistant Professor Eugene L. Keating

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03Z)

An assessment of a low energy application using wind power at remote naval installations is reported. A wind energy assessment of the earth shows that climatological conditions at several Artic and Antartic sites support the detailed design study of a wind-energy system. The design analysis of a wind-powered heat pump for use at remote military installations is presented. Climatological data for Amundsen, Antarctica, and Yakutat, Alaska, support the detailed design study of such a wind-energy system. Using design information developed, a wind turbine with a blade diameter of 9.12m (30 feet) is shown to be sufficient to heat a four-room building in Yakutat, Alaska, and a five-room building in Amundsen, Antarctica.

*****

DISK PUMP DIFFUSER DEVELOPMENT PROGRAM

Researcher: Associate Professor William M. Lee

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

There has been a need for quieter running machinery throughout the Navy. One such possibility for an application as a pump is a modification of the Telsa turbine. The principle of operation of such a pump relies on the viscous forces to provide the pumping action, there being no blade or vanes on the rotor.

A previous project consisted of the investigation of the optimum design parameters for the rotor-housing assembly. The inlet-outlet regions of the disk pump were not included as part of that project.

The study undertaken in this project was an investigation of the design parameters for the diffuser of the disk pump. In addition to the geometry of the scroll portion surrounding the rotor, a transition section beyond the pump discharge was also investigated.

As part of the study, a computer program developed by Professor Warren Rice of Arizona State University was used. This computer program had been developed through the doctoral research projects of a number of graduate students under Professor Rice's supervision and guidance. The program was developed primarily on the strength of a theoretical analysis with very limited experimental support.

The objective in using the program in this investigation was to iterate a number of combinations of design parameters for the diffuser portion of the pump to obtain a combination of values that would form the basis of an experimental program. In addition to the computer program, a literature search yielded a number of articles dealing with diffuser analysis.

As a result of the investigation,a range of design parameters were established and were incorporated in the prototype design. The diffuser development results will be evaluated in the disk pump testing program.

*****

SUPPLEMENTARY TECHNICAL STUDIES FOR COANDA/REFRACTION NOISE SUPPRESSION RESEARCH AND DEVELOPMENT PROGRAM

Researcher: Professor Vincent J. Lopardo

Sponsor: Naval Air Engineering Center

The object of the test series was to determine the effect of movable side walls on the attachment characteristics of a Coanda surface.

Two sets of tests were run in this first series:

a. In the first set up, a Coanda surface with two side walls, a back wall and a base was tested. The distance of the side walls from the walls of the Coanda was varied from 11-1/4 to 1-7/8 inches.

b. In the second set up, top and front surfaces were added to further enclose the Coanda. The distance of the side walls from the Coanda was varied from 11 to 1-1/2 inches.

The condition of best attachment occurs for this turbine at 3,600 rpm and maximum load. These and other associated properties: pressure, temperature, and flow rates,were maintained for all runs. The pressure variation at five points on the Coanda surface was recorded for each.

With the limited results of this series, it appears that moving the side walls in would have little or no effect on the attachment providing the open area is within a certain range.

The test series was completed and a report is in preparation.

*****

PROPULSION DYNAMICS AND EFFICIENCY OF FAST HIGH PERFORMANCE SEA ANIMALS

Researcher: Professor John P. Uldrick

Sponsor: Naval Academy Research Council

The primary hypothesis among biologists and bio-fluid dynamists is that the evolutionary process has endowed the fast, high-performance animals that survive in the surface waters of the oceans with high-aspect ratio, lunate-shaped caudal fins for their main propulsion mechanism. The purpose of this research is to develop a theoretical base to analyze this mechanism.

The objective of this research is to develop a three-dimensional hydrodynamical theory to determine the propulsion characteristics of the

lunate-tail lifting surface. Special emphasis is placed upon ascertaining the effect of the aspect ratio, planform shape, and undulatory motion on the capability of the lifting surface to generate a vorticity field which results in a maximum fluid momentum and minimum fluid kinetic energy.

The main approach of the research is as follows:

a. Study the multitude of experimental observations and data collected by biologists and fluid dynamists concerning the mode of swimming by the high-performance sea animals;

b. Study the modern theories and techniques for analyzing the hydromechanics performance of propellers;

c. Study the modern aerodynamic theories and techniques for analyzing the unsteady forces generated by fluttering lifting surfaces;

d. From a. through b. above, develop an unsteady lifting surface theory and the necessary numerical methods for realistically predicting the lift, moment, thrust, and Froudal efficiency of a lunate-shaped lifting surface undergoing prescribed heaving and pitching while it maintains a constant average forward speed; and

e. Verify the theory by experimental observation in the Tow Tank.

By assuming small *undulatory* perturbations of a general planform lifting surface, an integral equation relating the pressure jump across the surface to the normal-wash velocity on the surface has been developed. Special numerical techniques are being worked out for the solution of this equation which properly accounts for the important singularities inherent in the pressure jump.

*****

EXPERIMENTAL ANALYSIS OF DRAG REDUCING PROPERTIES OF SPECIAL ORGANOMETALLIC POLYMER COATINGS

Researcher: Associate Professor Chih Wu

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

The friction reduction property of dilute-polymer additives in water has been the subject of considerable interest. Comprehensive reviews of the subject are given in the report. The drag-reduction phenomena is discussed. A feasibility study on ship-drag reduction through the use of the new, special-hydrophilic coating, hydron dynamic, organometallic polymer is performed. Preliminary work of model test in the towing tank is suggested.

*****

STATE-OF-THE-ART SUMMARY ON FLUX-CORED WELDING TECHNIQUES

Researcher: Assistant Professor Robert D. Wyckoff

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

An effort was undertaken to provide David W. Taylor Naval Ship Research and Development Center (NSRDC) with a current status report on developments in the flux-cored, arc-welding technique from 1965 to the present. A complete literature survey of all work, domestic and foreign, was conducted as well as personal consultations with researchers in this field at Ohio State University, Naval Research Laboratory, and private corporations. A comprehensive report was submitted to NSRDC, Code 2821, and is currently being published for use by all U. S. Navy agencies studying the HY-steel weld qualification program.

Based upon the information accumulated, a test program was established to investigate the feasibility of qualification of the flex-cored, arc-welding technique for use in welding of HY-steels.

*****

NUMERICAL ANALYSIS OF ELASTIC BODIES CONTAINING CRACKS

Researcher: Assistant Professor James A. Joyce

The objective here is to develop an ability at the Naval Academy to determine stress intensity factors for 2-D cracked bodies, i.e. an axially, internally cracked, thick-walled pipe. Using this type of analysis, the fatigue life of such a cracked body can be predicted from fatigue data now available in the literature.

A state-of-the-art program obtained from the Michigan Institute of Technology Mechanical Engineering Department (Professor F. A. McClintock) and modified to run on the USNA Honeywell 635 computer is being used for this analysis. Program difficulties have resulted for the cracked-pipe geometry with a singular matrix resulting whenever a crack-hole intersection is present in the program. Work is presently underway to alleviate the program's difficulty with this geometry. Simple test problems have been completed and present work is directed toward the above mentioned cracked pipe -- a problem of real value to the engineers at David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory.

*****

INVESTIGATION OF CRACK GROWTH RATE TESTING IN HY-130 STEEL

Researcher: Assistant Professor James A. Joyce

The major objective here is to determine the crack growth rate under corrosive conditions in HY-130 steel and to determine the effects of temperature and applied-stress intensity on the rate of crack growth. To do this, four-point bend specimens are used which are bold loaded at constant deflection. The stress at the crack tip remains relatively constant for a range of crack lengths in this type of specimen. This should allow an accurate determination of the dependence of crack growth rate on stress -- if the crack growth is monitored daily.

Computer analysis of these specimens has been completed and specimens and test apparatus are being designed.

*****

HYDROGEN NAVAL PROPULSION SYSTEMS -- A POTENTIAL NAVAL ALTERNATIVE ENERGY SOURCE

Researcher: Assistant Professor Eugene L. Keating

An assessment of utilizing nuclear energy and seawater to provide an alternative naval fuel supply is currently in progress. Preliminary calculations have been made to predict the energy levels required to generate hydrogen from seawater using nuclear power. In addition, the fuel consumption of this fuel supply by a naval gas turbine power plant was also analytically investigated. Preliminary results of this project indicate that hydrogen has favorable potentials as an alternate energy source for the Navy.

*****

WAVE ACTIVATED TURBINE GENERATOR

Researcher: Midshipman 1/C Bruce A. Giron

Adviser: Associate Professor Richard Hirsch

The analytical model of the Wave Activated Turbine Generator developed by Associate Professor Hirsch was simulated using a TR-48 analog computer. Midshipman Giron operated the computer using system-design parameters. The computer outputs, in the form of strip chart recordings, were analyzed. The results were published in a project report issued by the Department of Transportation as Report No. CG-D-57-76 (see Publications).

*****

EARTHQUAKE RESPONSE OF OFFSHORE STRUCTURES

Researcher: Midshipmen 2/C John C. Grace

Adviser: Commander Owen Kirkley, CEC, USN

Previously computed spectral values of the response of a submerged oscillator to earthquake motions were applied to a linearized system to verify the validity of the linearizing process. The study was extended to the earthquake response of five degree-of-freedom structures to determine validity of linearizing the hydrodynamic dry forces on multi-degree of freedom systems subjected to earthquake motions.

*****

RESISTANCE OF CONCRETE TO DECAY UNDER FREEZE/THAW CYCLES

Researcher: Midshipman 1/C George E. Rector

Adviser: Associate Professor Thomas W. Butler

The objective of this study was to devise a concrete sealing system which would be effective in blocking water penetration of concrete, thus making it highly resistant to freeze/thaw cycle damage. Three types of specimens were tried: concrete sealed by paraffin balls (2 percent by weight), non-sealed standard concrete, and concrete sealed by cenospheres (2 percent by weight). Of these types of specimens, the paraffin-sealed concrete gave the least water absorbtion with only a minor reduction in strength.

*****

COANDA SURFACE TEST DESIGN

Researcher: Midshipman 2/C Charles Watkins

Adviser: Professor Vincent J. Lopardo

Midshipman Watkins participated in the design and testing of a Coanda surface for optimum attachment. He drew and supervised the construction of several surfaces which were used in the final test series. An important aspect of this phase was the evaluation of the Coanda surfaces to determine the design for maximum attachment.

*****

SOLAR HEAT COLLECTION AND STORAGE

Researcher: Midshipman 1/C M. L. West

Adviser: Assistant Professor Eugene L. Keating

A finned solar-energy collector facility was designed, constructed, and tested. Several possible designs were considered as potential devices which could increase the present efficiency of solar energy collection. A final rotating finned configuration was selected from the initial design study. To ascertain the validity of the rotating fin design, a collector panel was engineered in order to test the collector's design performance. Initial data accumulated attest to the fact that the new fins will be more efficient than other systems presently in use.

*****

ADAMS, James A., Professor, "The Intrinsic Method for Curve Definition," Computer Aided Design, 7 (October 1975), 243-249.

This paper describes a technique of curve description for computer graphics based upon specified intrinsic equations of curvature and torsion as functions of a natural parameter. These intrinsic equations appear as variable coefficients in the classical Serret-Frenet equations which are coupled parametric differential equations describing the basic analytic nature of a curve. Unique curves are generated by the numerical integration of the Serret-Frenet equations.

The explicit control of the exact curvature and torsion profiles along a curve increases the analytical information content. Arbitrary smooth curves which might normally be created at a drawing board using a plastic template without analytical control can now be precisely defined in an analytical manner. This allows a precise definition of an arbitrary curve. Several examples are given to illustrate the type of results obtained for two-dimensional curves. The technique may also prove useful in pattern recognition and numerically controlled part production.

*****

ADAMS, James A.,Professor and David F. ROGERS, Professor, Mathematical Elements for Computer Graphics. New York: McGraw-Hill, 1976.

This book presents an introduction to the mathematical theory of computer graphics. Current technology is described in Chapter 1. A discussion of existing techniques for representing points, lines, curves, and surfaces within a digital computer, as well as computer software procedures for manipulating and displaying computer output in graphical form, is presented in the following chapters. Graphical elements are presented in matrix form using homogeneous coordinates. Techniques for producing axonometric and perspective views are given, along with generalized techniques for rotation, translation, and scaling.

Curve definition techniques include the use of conic sections, cubic splines, parabolic blending, Bezier curves, and B-spline curves. Computer algorithms are given in the appendix as BASIC language subprograms. These allow the reader to rapidly implement the theory described in the book. An introduction to the mathematics of three-dimensional surface description is included in the final chapter.

*****

GEREMIA, John O., Associate Professor and Chih WU, Associate Professor, "Induction Heating of a Conducting Fluid in a Tube," Proceedings of the Southeastern Seminar on Thermal Sciences," June 1976.

A theoretical analysis to determine the temperature profile and heat transfer rate of a conducting fluid subjected to induction heating (Figure 1) yields the following results:

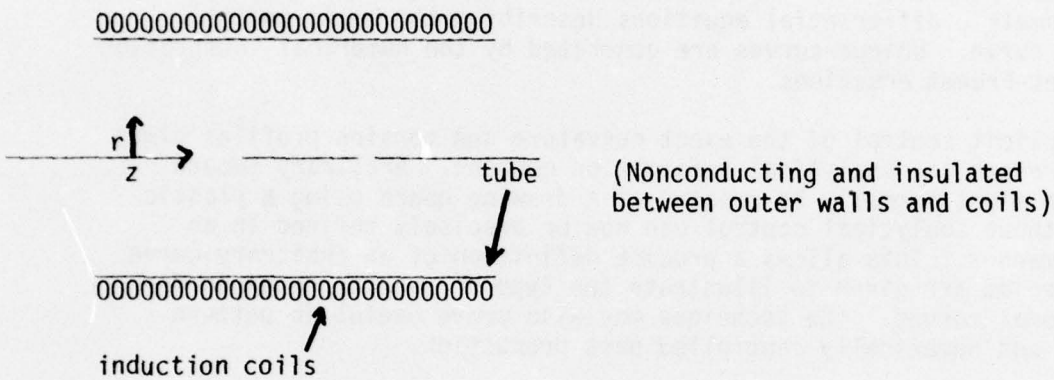


Figure 1

1. Induction heating is limited to those situations where $R/\delta < 3$, the optimum R/δ being about 2.25. Beyond this range, efficiency decreases rapidly. Here, δ is the thickness of a shell near the pipe wall where the magnetic field is concentrated.

2. When $R/\delta = 2.25$, a critical frequency for effective heating is defined in terms of electric and magnetic properties and the size of the tube.

3. A critical frequency for effective heating is given by:

$$f_c = \frac{128.5 \times 10^6}{\sigma \mu_r R^2}$$

where,

f_c = critical frequency in hertz

σ = conductivity

μ_r = relative permeability of absorbing media

R = radius of cylinder

For saltwater with conductivity of about 0.6 mhos/cm flowing in a non-conducting tube of radius say 10 cm, f_c is about 2 megahertz.

4. While the analysis was limited to laminar flow, the replacement of a laminar-velocity profile with a turbulent profile will not upset the basic method of solution presented here. This is because temperature and velocity profile are uncoupled by neglecting body forces.

5. The use of electrical energy for heating by the induction method is highly efficient, but the cost of electrical energy is still higher than other forms of energy. This process can be expected to be advantageous in saving time, space, and maintenance efforts only when the costs of oil and gas increase sharply as they are currently in the process of doing.

*****

GRANGER, Robert A., Professor, Incompressible Fluid Dynamics, U. S. Naval Academy, 1976.

A textbook was published by the U. S. Naval Academy which served as the text for the Fluid Dynamics course EM312 for the spring semester 1976. It is based on approximately 6 years of work. Previous printings were used as the fluid dynamics text in 1974 and 1975. In order to prepare the work in a form suitable for publication, the writer took sabbatical leave to refine the work.

The book has 41 chapters, approximately 1,400 pages, and deals with topics in incompressible fluid dynamics. Because of its very large scope, it is impractical to itemize the topics. The emphasis is on the theoretical approach to fluid dynamics with considerable discussion on the physics of fluid flow. The approach taken is that of mathematical physics which consists of first defining the physics of the problem, identification of the physical constraints, assumptions imposed, pertinent conservation laws and their mathematical equivalence, and appropriate problem solution technique.

There are approximately 400 examples, 500 problems, numerous demonstrations, and numerous study questions for each chapter.

*****

GRANGER, Robert A., Professor, "A Laboratory Simulation of Weak Strength Tornados," International Journal of Mechanical Engineering Education, V. 3, No. 4 (October 1975) 289-302.

A laboratory facility is presented which incorporates many of the salient features necessary for tornado formation. Some of the results obtained from the use of the facility support features found in actual tornados. The apparatus is especially suitable for showing students the role fluid dynamics plays in geophysical phenomena.

*****

HASSON, Dennis F., Assistant Professor, co-author, "A Micro-Mechanistic Interpretation of Cyclic Crack Growth Behavior in 17-4 PH Stainless Steels," Fractography Microscopic Cracking Processes, American Society for Testing and Materials (ASTM STP 600),(1976) 205-219.

A fracture mechanics and fractographic study has been made of cyclic crack growth in heat-treated samples of 17-4 PH stainless steel. Two one-half inch (1.27 cm) thick-rolled plates were studied: a vacuum-melted sample in the H1050 condition and an argon-oxygen melted sample in the H1050 and H1150 conditions. Crack-growth rates, da/dN, were obtained in ambient laboratory air as a function of stress-intensity factor range, ΔK,

using single-edge notched tension specimens. Stress ratio, R, values of 0.04, 0.40, 0.67, and 0.80 were investigated. Microscopic modes of crack extension were determined by electron fractograpy and were utilized to explain differences in macroscopic crack-growth behavior. Cleavage and microvoid coalescence can appear as modes of cyclic crack propagation in this family of steels, to the detriment of cyclic crack-growth resistance. In particular, the following notable features were observed: (1) the amount of cleavage present appears to be independent of ΔK over a wide spectrum of ΔK levels; (2) the incidence of cleavage (and accelerated cyclic crack-propagation rates) increases significantly with R; (3) heat treatment can be adjusted to minimize the incidence of cleavage; and (4) slight variation in alloy processing serves to eliminate cleavage and promote striation formation, while enhancing the fracture toughness.

*****

HASSON, Dennis F., Assistant Professor and James A. JOYCE, Assistant Professor, Lectures and Experiments in Materials Science, United States Naval Academy, (First Edition) 1976.

The lectures and experiments were written to supplement available textbooks in materials science and to provide experiments related to the classroom lectures. The lectures are on topics generally not included in materials science texts, such as, nondestructive testing, welding, naval engineering materials, metal processing and radiation damage in metals. The experiments begin with exercises introducing crystal structure. They are followed by a series of experiments which illustrate the electrical, magnetic, and mechanical properties of materials. More advanced topics include corrosion behavior, fractography,and scanning electron microscopy.

*****

HIRSCH, Richard A., Associate Professor, "Analog Simulation of a Single Degree of Freedom System with Non-Linear Damping," Transactions (Computers in Education Division of American Society of Engineering Education), 8 (July 1976), 61-72.

At some point in a typical vibrations course, students should be apprised of the fact that the real world is not always linear and, in fact, a number of dissipative forces of practical interest are inherently nonlinear. The concept of equivalent viscous damping can be introduced as one means of handling these cases. The value of the equivalent viscous damping coefficient is found by assuming that the steady-state response of the nonlinear system to a sinusoidal input is sinusoidal. Perceptive students are quick to point out that this assumption cannot be strictly true and this leads naturally to the question of, over what range of parameters is this concept useful? In order to investigate this question, a specific nonlinear system is selected and simulated using an analog computer.

The specific case described herein is that of velocity-squared damping. Comparison of the analytical results with an analog computer solution shows that the concept gives accurate results for the amplitude and phase of the steady-state response over a 20 to 1 range of the damping parameter and a 12 to 1 range of excitation frequency.

The approach described herein could be used to conduct similar investigations for other types of nonlinear damping. These investigations could be carried out as class laboratory or individual student projects.

*****

HIRSCH, Richard A., Associate Professor, "Analog Simulation of a Wave Activated Turbine Generator Buoy," USNA Report No. EW-9-75 (January 1976),Department of Transportation Report No. CG-D-57-76.

This reports presents an analog simulation model of a Wave Activated Turbine Generator Buoy which is currently under study and evaluation by the United States Coast Guard. The equations describing the heaving dynamics are developed as well as the equations describing the output of the air operated turbine/generator subsystem.

The buoy, water column, air passage, turbine and generator have been modeled and analog computer patching diagrams presented. The available full scale data have been analyzed and this analysis indicates that modifications in the model will probably be required. This conclusion cannot be made more definite since the data analyzed were for the buoy alone without a water column. It is likely, however, that even with a water column, the dissipation law will be proved to be bilinear thus simplifying the equations as presented.

*****

WU, Chih, Associate Professor, "Effect of Electrification on an Ionized Gas Suspension System," Recent Advances in Engineering Science, 6 (April 1976), 381-388.

The present study has the generalized result of Soo and Dimick on interaction of particulate matter with an ionized gas by including an external electric field and non-equilibrium states. This is followed by an analysis on the electrification effect of the properties of such a mixture.

*****

WU, Chih, Associate Professor, "Engineering Optimization Analysis of a Solar Collector," University of Maryland Research Report, August 1975.

The overall project objective was to study the effect of system options and actual process factors on the performance and optimization of a solar powered absorption air-conditioning system, including the collector and storage. Thermodynamic analysis of the basic and the modified absorption cycle incorporating a liquid-liquid heat exchanger has been completed for the commercial absorption air-conditioning pairs lithium bromide water and ammonia water. Characteristic curves of Coefficient of Performance (COP) versus generator temperature were obtained for prescribed condenser and absorber temperatures (80°F, 100°F, and 120°F) and prescribed evaporator temperatures (40°F, 45°F, and 50°F). Cycle operation was limited by a minimum and a maximum generator temperature. Within this generating range, the maximum COP was below unity, ranging from 0.3 to 0.8. The irreversibility of the absorption cycle was evaluated by comparing the absorption cycle DOP with a Carnot cycle COP. The minimum irreversibility occurred at a generator temperature slightly above the minimum required to actuate the cycle. A numerical flat-plate collector model was formulated, based on an existing heat transfer program, and verified for a simple collector configuration. A computer solution to the nonlinear differential equation governing the response of the thermal heliotrope was programmed and is currently being made operational.

*****

WU, Chih, Associate Professor, "Experimental Data Analysis of Drag Reducing Properties of Special Organometallic Polymer Coatings," David W. Taylor Naval Ship Research and Development Report, November 1975.

Drag reduction experimental methods were reviewed. Literature survey in polymer drag reduction was studied. A feasibility study on ship drag reduction through the use of the new, special organometallic polymer coatings was performed. Preliminary work of model test in the towing tank was suggested.

*****

WU, Chih, Associate Professor, "Solar Energy and Its Applications in Taiwan," Central Daily News (Chinese), Taiwan, China, 30 September 1975.

Economical viability of solar energy utilization varies with geographic location and weather conditions and may be very attractive in Taiwan where insulation is relatively high. Many different types of applications such as solar electricity generation, solar cells, solar engines, solar furnaces, solar agricultural applications, etc., are possible even at present capital costs for photovoltaic arrays. Problems associated with solar usage are also discussed.

*****

HASSON, Dennis F., Assistant Professor, "Engineering Aspects of Bone," Materials Science Seminar, The Johns Hopkins University, 8 October 1975.

*****

HASSON, Dennis F., Assistant Professor, "Bone as an Engineering Material," U. S. Naval Academy/David W. Taylor Naval Ship Research and Development Center Sigma Xi Club, Annapolis, 14 October 1975.

*****

WU, Chih, Associate Professor, "Computer Assisted Testing in Thermodynamics at the United States Naval Academy." Paper read at Annual Association for Educational Data Systems Convention, Phoenix, Arizona, 3-7 May 1976.

*****

WU, Chih, Associate Professor (with John O. GEREMIA, Associate Professor), "Heat Transfer of a Conducting Fluid in an Electrical Field." Paper read at Twelfth Annual Meeting of the Southeastern Seminar on Thermal Science, Charlottesville, Virginia, 6-8 June 1976.

*****

WU, Chih, Associate Professor, "Measurement of Heat Transfer Coefficient of an Ionized Suspension System." Paper read at National American Society of Mechanical Engineers Heat Transfer Conference, San Francisco, California, 11-13 August 1975.

*****

WU, Chih, Associate Professor, "Computer Optimization Design of a Solar Collector Plate." Paper read at Association for Computing Machinery Computer Science Conference, Anaheim, California, 10-12 February 1976.

*****

NAVAL SYSTEMS ENGINEERING DEPARTMENT

Professor Peter F. Wiggins, Chairman

Research in the Naval Systems Engineering Department plays a vital role in the professional enrichment of both midshipmen and faculty. During Academic Year 1975-76, faculty members and midshipmen participated in numerous and varied projects in the fields of marine engineering, ocean engineering, and naval architecture.

A variety of projects were undertaken, both funded and unfunded. These include faculty research in the areas of computer simulation, marine laboratory systems, wave energy studies, hydromechanics laboratory development, energy conservation, ocean energy resources, use of synthetic fuels, neutron activation studies, ship arrangement studies, ship stability studies, submarine deballasting, off-shore structure studies, environmental protection programs, and faculty-sponsored midshipman projects in the areas of undersea laboratory design and construction, advanced marine vehicles, and nuclear power plant availability.

The undersea laboratory is ready to be tested and used for further midshipman research efforts in the Chesapeake Bay. This major undertaking, encompassing faculty-midshipman interaction in design, construction, and future utilization, is reflective of the dedication to midshipman involvement found in the Naval Systems Engineering Department.

Support for research is found in many sources, from departmental operating funds to contracts and grants from such diverse organizations as the Naval Academy Research Council, the Naval Sea Systems Command, the U. S. Coast Guard, and the Naval Ship Research and Development Center.

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

*****

ENGINEERING EVALUATING OF HYDROGEN PEROXIDE, ULTRA-VIOLET SEWAGE EFFLUENT POLISHER

Researcher: Associate Professor William A. Barr

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

The objective of this study is to determine the engineering design parameters of the hydrogen peroxide, ultra-violet light method of removing the refractory (difficult to oxidize) material from waste water streams. The method has been successfully applied in the laboratory. The combined effects of dimensions, time, temperature, and materials will be evaluated for batch treatment.

To date, the experiments have been performed in a reactor consisting of a galvanized iron pipe sleeve surrounding a quartz tube. A solution test material, acetic acid (generally rated the most refractory material in waste water) and hydrogen peroxide, is contained in the space between the two cylinders. Ultra-violet light from a low-pressure mercury lamp in the quartz tube initiates the reaction previously described in Professor Edward Koubek's work. We have determined that the glass surface of the mercury lamp must be maintained at 40-45°C for maximum reaction rate.

The next experiment will be carried out with an aluminum sleeve replacing the galvanized pipe sleeve to determine the effects of the higher reflective surface of aluminum on the rate of reaction. Tests to determine the effectiveness of the method for less refractory materials will be conducted.

The experiments were completed during the last 2 weeks of May 1976.

*****

COMPUTER LIBRARY FOR THE HYDROMECHANICS LABORATORIES

Researcher: Research Professor Rameswar Bhattacharyya

Sponsor: Naval Sea Systems Command

As in all aspects of our technology, the computer has had an enormous impact on the field of naval architecture both in the design and construction of naval and merchant ships. The task of utilizing the computer effectively as a tool in naval architecture, both in education and in research, is a continuing and evolving challenge.

The overall aim of this program is to generate and implement a systematic program for acquisition of computer programs to fully utilize the

data retrievable from the new tow tank and related facilities. This will entail not only model data reduction and extrapolation to full-scale, but also will range from hydrostatic characteristics, powering from standard series and particular ship types, through overall ship design applications such as sea keeping, propellers, and possibly others. There are both educational and research applications. The potential benefits to other future research efforts cannot be overestimated; the availability of properly documented and functional computer programs as tools for the naval architect will be of immeasurable value to the student and to the researcher.

A few important computer programs are now available; namely, prediction of ship motions and generation of a hull form from the parent form. A ship hull characteristic program is underway and will be completed in the near future; a pattern search method of optimization is now being tested for the feasibility studies.

A recent publication on the computer usage in naval architecture education at the Naval Academy has been made possible through this research program.

*****

PASSIVE ANTI-ROLL FINS

Researcher: Associate Professor Rameswar Bhattacharyya

Sponsor: Naval Ship Engineering Center, Code 6136

The stabilization of motions is an important consideration in the seakeeping design of a ship. The active means of roll stabilization, such as anti-roll tanks or active fin stabilizers, have been applied successfully in reducing roll motions, but the active stabilizers are more complicated in their design and also rather expensive. In high seas, they are not always as reliable as the passive stabilization system. The passive anti-roll tanks have been used very satisfactorily in various kinds of vessels. Since they are associated with loss of stability and added weight, it is of considerable importance to investigate the effectiveness of passive anti-roll fins. The advantage of high aspect ratio anti-roll fins is that the fins will operate outside the boundary layer and the velocity of flow around the fins will be considerably higher. Hence, a greater lift can be expected from such high-aspect ratio fins. One disadvantage of high-aspect ratio fins is that they may cause some structural problems because of large overhang. On the other hand, the fins can be made retractable and the problems associated with docking, etc., can be eliminated.

The work is still in progress and will be described in a future report.

*****

REVIEW AND ASSESSMENT OF SMOKE ABATEMENT DEVELOPMENT FOR U. S. NAVY FIRE-FIGHTING FACILITIES (1965-1975)

Researcher: Professor Arthur E. Bock

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03Z)

This study traces the development of two fire-fighting school smoke-abatement systems, the Water Spray System and the After Burner System, from their inception to their state of development in mid-1975. Included are descriptions and comparisons of the two systems along with development and installation costs for the 1965-1975 fiscal years by OPN, O&M,N and MILCON categories. Conclusions regarding utilization of the two systems are stated.

Review of Navy documents, correspondence and technical reports for the period of 1965-1975, as well as personal discussions with cognizant individuals in NAVFAC Headquarters, were used to develop the history and evolution of the After Burner System and the Water Spray System of smoke abatement utilized by the Fleet Training Center Fire-Fighting Schools. This documentation begins with the formation of the San Francisco Bay Area Pollution Control District in 1958 and its effect on the Treasure Island Fire-Fighting School, and continues to the present joint-Navy/Air Force effort at Chanute Field, Illinois. This latter effort is structured to obtain specifications and to develop definitive drawings for aircraft crash/rescue team fire-fighting training simulators acceptable from both training effectiveness and pollution control standpoints.

A detailed description of the two smoke abatement systems was developed, followed by a comparison of the two systems on the bases of smoke abatement, other gaseous pollution emissions, liquid effluents, installation costs, operating costs, maintenance costs, and training effectiveness. The final step comprised a compilation of the fiscal year costs surrounding the development of these systems based on OPN, MILCON, and O&M,N expenditures. The finished report is now published as report USNA-EPRD-15 of the Energy-Environment Study Group, USNA.

*****

AN ASSESSMENT OF TWO CREW SURVIVAL SYSTEMS

Researcher: Associate Professor Roger H. Compton

Sponsor: United States Coast Guard

This is an analytical study of the conditions in which two survival systems can be expected to operate. The two systems are (1) a float-off (i.e., no davit launch) system and (2) an evacuation slide (commercial airlines) system. For the first system, a quantification of the characteristics of the flow over a sinking ship is the goal. An extensive search

of the literature for the physical description of the sinking process (i.e., time to sink, range of list, range of trim, etc.) has been completed with exceptionally meager results. This effort is being followed by the development of an analytical model of the flow. This analytical study will be verified by a simple experimental program. The second system is being studied by Professor G. W. Somers of the Anne Arundel Community College.

*****

INVESTIGATION OF OIL-IN-WATER SAMPLING DEVICES

Researcher: Assistant Professor William B. Huckenpoehler, Jr.

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

The purpose of this project was to investigate devices for extracting samples from pipe flow in shipboard bilgewater and drainage systems to determine optimum configurations of such devices. A test set up was constructed which included five separate configurations of samplers (pitot, straight tap, v-notched tee, grab sample and a commercial isokinetic sampling device) placed in vertical and horizontal runs of 1-1/2 inch diameter pipe. Sampling was done at four different flow rates and with four different concentrations of Navy Distillate Fuel Oil in water and 2190 oil in water. Flow was supplied by metered pump from a continuously agitated tank.

Samples were tested for concentration of oil by an independent chemistry laboratory. Statistical analysis was made of concentrations obtained to get correlative data. Difficulty was encountered with quick-disconnect standard sample pipe sections, as it was found that they tended to concentrate oil in the pipe sections. This was a program which was done during July and August of 1975. The project has been continued by NSRDC personnel and no publishable results are yet available. Approximately 1,200 samples were taken during the period of work on the project.

*****

HYRDOMECHANICS LABORATORY DEVELOPMENT

Researcher: Research Professor Bruce Johnson

Sponsor: Naval Sea Systems Command, Code 03512

The principal objectives are to act as technical monitor for all contracts associated with the Rickover Hall Hydromechanics Laboratory. This involves considerable time spent in design reviews of all the hardware and software being supplied to satisfy the education and research capabilities of the new towing tanks in Rickover Hall. The research capabilities being

incorporated into the towing tanks include a laser and computer-based, high-speed data acquisition system for acoustic flow noise tests, two computer controlled, servo-hydraulic dual flap wavemakers with capabilities well beyond those of any other towing tank in the United States, and the implementation of a new method of specifying and producing reproducible encountered wave spectra for ship model testing in irregular waves.

The administration of the aforementioned contracts differs from most government fixed price contracts in the amount of time spent by government representatives during the design phase of the contract. Nearly every aspect of the Hydromechanics Lab Project involves "state-of-the-art" technology, with few precedents. Consequently, contractors have been performing some research and considerable development work in satisfying a fixed-price supply contract. Since the field of ship model testing is not part of the contractors' normal business, they depend on government supplied expertise in evaluating solutions to the design problems associated with satisfying our research capabilities.

Since these capabilities depend heavily on instrumentation and computer developments in model testing, the Professor of Hydromechanics has been very active in this area of the International Towing Tank Conference (ITTC). In September of 1975, he served as Session Chairman for the Group Discussions on Installations and Instrumentation at the 14th ITCC in Ottawa, Canada. At the conference, he was selected as the United States representative to the Committee on Presentation and Information responsible for coordinating the exchange of information on instrumentation and facilities among member organizations of the ITTC.

Although most of the contractors for the Hydromechanics Laboratory are making satisfactory progress towards the summer of 1977 completion date, the job of getting seven different contractors to interface with each other through several different government contracting officers is not a simple task. This has become the primary duty of the Research Professor: to insure the compatibility of all the hardware and software associated with the towing tanks. This compatibility is essential to the total system concept needed to insure efficient utilization of the capabilities of the tanks for education and research.

*****

THE DEVELOPMENT OF ADVANCED COMPOSITE FLYWHEELS

Researcher: Assistant Professor Robert A. McCoy

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03Z)

The technical objectives of this project are the following:

1. Design analyses for advanced composite flywheels,

2. Detailed design for at least two of the most promising rotors of types not previously built,

3. Construction of models of the rotors and of a testing apparatus, and

4. Evaluation tests of these rotors including verification of

   a. Structural integrity,

   b. Shape factor, and

   c. Energy storage capacity.

Progress to date includes the completion of parts 1 and 2 of the technical objectives. Work is continuing on part 3. The construction of the testing apparatus is nearly complete. Several small cylindrical rotors of unidirectional E-glass/epoxy prepreg tape have been fabricated to evaluate various lay-up techniques. Arrangements have been made with David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, to use their special wrapping equipment for fabricating future models.

After the models have been fabricated, test evaluations will be made in order to verify the structural integrity, shape factor, and energy storage capacity of each of the models.

*****

AUTOMATED SHIP GENERAL ARRANGEMENTS

Researcher: Assistant Professor Bruce C. Nehrling

Sponsor: Naval Ship Engineering Center, Code 6131J

The purpose of this research is to define and investigate various computer-oriented methods which appear to be suitable for developing the internal configuration of a ship. Potential benefits include reduced design time and the ability to analyze an increased number of alternative designs. Work has just begun on this project.

Ship compartmentation is the process of assigning location, size, and shape to each of the compartments, or basic elements of space, required in a ship. The resulting arrangement of decks and bulkheads uniquely defines the internal configuration of the proposed ship. As the design is refined, this internal configuration will progressively evolve from a rudimentary collection of primary decks and bulkheads to a complete set of spatial inter-relationships.

Ship compartmentation involves the blending of functional objectives, technical requirements, and, to a lesser degree aesthetic considerations. The naval architect reviews these diverse and often conflicting requirements and attempts to arrive at a suitable compromise for the arrangement of compartments within the ship's hull and superstructure. This decision-making process, a blending of science and art, must be continuously performed throughout the compartmentation process for a successful design to evolve.

Present design techniques, because of their cost and time-consuming nature, allow the naval architect to develop and evaluate one or, at best, only a few configurations. Consequently, only limited progress can be made toward finding a better design. However, advances in computer techniques and technology indicate that a procedure for efficiently defining and evaluating the internal configuration of a ship during the preliminary design stage can now be developed. These efforts which have been initiated demonstrate the feasibility of such an endeavor. While feasibility has been shown, there still remains the formidable task of fully postulating and developing a successful compartmentation procedure.

This research project addresses two aspects of this task:

1. A review and evaluation of existing or proposed computer-oriented design procedures for spatial synthesis, and

2. Postulating the requirements for a computer-aided ship compartmentation procedure.

The availability of a compartmentation procedure should stimulate the naval architect's creativity and productivity by providing him with a tool for quickly and efficiently generating and evaluating a variety of alternative designs. He can then select that design which best satisfies the functional requirements of the ship, the regulatory rules, and his own perception of a "good design." This procedure would permit the designer to make a greater number of effective decisions per unit time. Consequently, a greater percentage of his available time could be spent on investigating designs which would otherwise be ignored, or in clarifying assumptions which, while possibly acceptable, have never been fully substantiated. On the other hand, this computer procedure could be used to significantly decrease the time required initially to design or subsequently modify a compartment and access plan.

*****

INVESTIGATION OF SUBMARINE EMERGENCY BALLAST BLOW SYSTEM

Researcher: Professor Bruce H. Rankin

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

This is an ongoing problem being investigated by the David W. Taylor Naval Ship Research and Development Center, Annapolis. The purpose of this project was to develop a mathematical model which agrees with an experimentally determined model of the submarine emergency ballast blow system. The researcher was asked to develop, during the intersessional period, as many components of the mathematical model as possible.

The following models were determined and computer programs were provided which compared the models to the crude experimental data that was available:

1. Simple blow of ideal gas with no heat transfer and no piping losses,

2. Simple blow of ideal gas with heat transfer but not piping losses,

3. Blow down of ideal gas with head loss due to critical flow, no heat transfer or other losses,

4. Simple blow of ideal gas considering potential head changes and pressure drops due to internals of test device (model only), and

5. Real gas model (incomplete).

Unfortunately, there was insufficient time to combine the models into a completely usable tool. The investigator was also used as a consultant on the many other phases of the project. It is expected that much of the information will be used in conjunction with experimental runs of the ballast flow facility and analysis that will follow.

*****

DYNAMICS OF OFF-SHORE STRUCTURES

Researcher: Assistant Professor Thomas H. Dawson

This research involved development and analysis of dynamic scaling laws for fixed off-shore structures. Previous work by others has been restricted to the special case where the structure experiences only flexural deformations. The present work generalized this earlier work and made it applicable to any linearly elastic structural response.

The accuracy of the scaling law was examined by comparing its predictions with results from an analytic solution for the special cases of an idealized structure consisting of a rigid deck and uniform support cylinder. Results showed agreement within 4 percent when the scale of the system was reduced a full order of magnitude.

A paper describing the work has been accepted for publication in Ocean Engineering.

*****

IMPACT TESTING OF WIRES AND CABLES

Researcher: Assistant Professor Thomas H. Dawson

A simple impact test was examined for determining the dynamic tensile response of metal wires and cables. The test consists of fixing one end of the wire (or cable) and allowing a threaded falling weight to strike the other. Assuming the dynamic stress to be a function only of the strain, energy considerations show for negligible wire inertia that the governing dynamic stress-strain law can be determined directly from impact-energy versus elongation data. Theoretical calculations were made using a finite-element numerical model which showed that wire inertia was indeed negligible for ratios of wire mass to striking mass of the order of 10^{-2} or less. The test method was applied to small-scale copper wires and the dynamic stress-strain law so determined was found to be about 30 percent higher than the corresponding static curve.

The work is described in detail in the paper to be presented at the 13th Annual Conference of the Society of Engineering Science.

*****

AVAILABILITY OF NUCLEAR POWER PLANTS

Researcher: Midshipman 1/C Bryan J. Dolan

Adviser: Assistant Professor Martin E. Nelson

This project involved a general background search into the types of outages which have had an effect on nuclear power plant availability. From this search, the investigation narrowed to outages which were directly related to governmental regulations. Specifically, 10 categories of outages have been identified which are directly the result of Nuclear Regulatory Commission regulations or directives.

The second part of the project is described under the research course project "Effect of Nuclear Regulatory Commission Regulations on Commercial Nuclear Power Plant Productivity."

*****

EFFECT OF NUCLEAR REGULATORY COMMISSION REGULATIONS ON COMMERCIAL NUCLEAR POWER PLANT PRODUCTIVITY

Researcher: Midshipman 1/C Bryan J. Dolan

Adviser: Assistant Professor Martin E. Nelson

An investigation has been made into the outages due to Nuclear Regulatory Commission regulations for commercial nuclear power plants between March 1974 and April 1975. The source of information was mainly "Unit Status Summary Reports" which are published monthly by the Nuclear Regulatory Commission. A statistical analysis was performed with the outages placed into 10 different categories. In addition, the percent reduction in capacity factor was calculated for each category. Altogether, it was found that Nuclear Regulatory Commission regulations resulted in approximately a 6-percent decrease in plant capacity factor during this period.

The report was presented at the American Nuclear Society Regional Student Meeting which was held in Charlottesville, Virginia, on April 2-3, 1976. The paper, presented by Midshipman Dolan, received an award as the outstanding paper in the division in which it was presented. This is the first time a Naval Academy paper has achieved this distinction at an American Nuclear Society Student Conference.

*****

ANALYSIS OF SCALING PROBLEMS IN AN OCEAN THERMAL ENERGY CONVERSION PLANT

Researchers: Midshipmen 1/C Garry E. Hall and Bruce Montgomery

Advisers: Assistant Professor Martin E. Nelson and Professor Arthur E. Bock

Recent feasibility studies have shown that an ocean thermal energy conversion (OTEC) plant may produce power that is economically competitive with coal and nuclear power. Consequently, a test facility or a sub scale pilot plant will shortly be built to evaluate experimentally the major components (condensors, evaporators, etc.) of an OTEC plant. However, before such a subscale model is built, a better understanding of potential scaling problems is essential.

This project involved (1) developing a list of significant variables which would affect the performance of the evaporator and condensor and (2) performing dimensional analysis to develop dimensionless groups that would be applicable between a subscale and full scale OTEC condensor and evaporator.

The study has been completed.

*****

MEDUSA, DESIGN AND FABRICATION FOR UNDERSEA LABORATORY COMPONENTS

Researchers: Midshipmen 1/C Michael Hlywiak, Daniel R. Shinego, Rodney D. Vaught, and Marc A. Watson

Adviser: Associate Professor Neil T. Monney

The midshipmen researchers worked as a team to accomplish the following projects for development of the MEDUSA Undersea Laboratory:

1. Final design and fabrication of the air supply system and the electrical system,

2. Ninety-five percent completion of the assembly of the interior and exterior undersea laboratory components, and

3. Logistics and assembly planning to use the SEARCHSTAR and a travel trailer as the surface support system for the laboratory.

*****

A NAVAL ARCHITECTURAL ANALYSIS OF YACHT RATINGS

Researcher: Midshipman 1/C Edward P. Kilbourn

Adviser: Associate Professor Roger H. Compton

This project is a naval architectural investigation into the major aspects of yacht measurement and handicapping. After gaining a working knowledge of the measurement rule and the handicapping systems presently in use, the following areas were studied:

1. The evolution of the present rule,

2. Reasons why the international rule is not universally accepted,

3. Present and proposed methods of measurement,

4. Actual measurement of a yacht's hull,

5. The rule's experience in encouraging seaworthy cruising designs,

6. The effectiveness of the rule in handicapping, based on statistical studies, and

7. The study of a current major regatta of yachts of the same rating to determine how different designs, all handicapped alike, fare in varying conditions.

*****

DESIGN OF A MINESWEEPING/FISHING VESSEL

Researcher: Midshipman 1/C Diego D. Mantilla

Adviser: Associate Professor Roger H. Compton

This project consists of the design of a fishing vessel that could be easily transformed into a minesweeping vessel, without major costs or conversions.

Specifically, this project applies to a foreign country, Ecuador, where the researcher spent a summer collecting data from fisheries and shipbuilding installations. In this country, there is a lack of fishing vessels and war-type vessels. The design of the vessel proposed will be a good start for further studies.

The design of a multipurpose fishing vessel which would be very easily transformed to a naval auxiliary is not a new idea but seems to be a viable alternative to procuring expensive, specialized, single-purpose vessel types. Procurement of lower cost multipurpose vessels in this era of high costs and tight budgets may enable governments to carry out projects which, although needed, are deferred because of lack of funds.

*****

ANALYSIS OF FLOW COAST DOWN IN A NUCLEAR REACTOR COOLANT CHANNEL

Researcher: Midshipman 1/C Joseph C. McGowan

Adviser: Assistant Professor Martin E. Nelson

Conventional heat transfer coefficient relationships for internal forced convection heat transfer have been compared to a numerical solution. The numerical solution models fully developed turbulent flow through a parallel plate channel with heat generation in both walls. The study involved modifying the computer code, MAIN 2, to handle a time-varying fluid velocity, which simulates a flow coastdown and comparing with traditional heat transfer coefficients, which are based on time invarient velocity.

The study has been completed and has been accepted for presentation at the Winter American Nuclear Society Conference to be held in Washington, D. C., November 14-19, 1976.

*****

EXPERIMENTAL STUDY IN WAVE ENERGY CONVERSION

Researcher: Midshipman 1/C Lee O. Moss

Adviser: Professor Michael E. McCormick

Midshipman Moss performed an experimental study of the Isaacs wave energy converter. His study included the design of a model and data acquisition system. His system included a wave gauge, an internal water-level gauge, and a pressure transducer for measurement of the accumulated air pressure required to drive an air trubine.

His initial tests were conducted in the U. S. Naval Academy's towing tank where the model was subjected to regular waves. Following the towing tank tests, the model was placed in the Santee Basin for irregular wave tests. The data from both tests verified the results predicted by Professor Isaacs.

*****

DEVELOPMENT OF AN ADVANCED BASIC COMPUTER PROGRAM FOR PROCESSING TOW TANK DATA

Researcher: Midshipman 1/C John F. Ravold

Adviser: Associate Professor Roger H. Compton

The purpose of this research is to modify the current tow tank program to incorporate some or all of the following changes that would enable easier and more efficient use:

1. Add a stored data capability to use previously saved data in a user file,

2. Add options for the selection of only certain data calculations (which would save computer and user time),

3. Add an option for using input data from either powered carriage or gravity tow operation,

4. Permit correction of typing errors before data processing,

5. Improve output format to conserve paper and allow easier utilization of results,

6. Separate data acquisition and expansion actions,

7. Allow an on-line force block calibration using the least squares curve fit,

8. Calculate the blockage correction and allow comparison with uncorrected results, and

9. Calculate the response amplitude operator of the model in waves and added resistance.

*****

MODEL TESTING OF A WAVE ENERGY CONVERTER

Researcher: Midshipman 1/C Richard Salazar

Adviser: Professor Michael E. McCormick

Midshipman Salazar conducted an experimental study of the amplification of shoaling waves by a convergent channel on a beach. Mr. Salazar designed the experimental equipment and the data acquisition system. He measured the deep water wave properties and the shoaling wave properties at various points along the channel in the U. S. Naval Academy's towing tank. Although Professor John Isaacs of Scripps Institution of Oceanography predicts significant wave amplification, the tests of Mr. Salazar were inconclusive.

*****

CALISAL, Sander M., Assistant Professor, "The Effect of Initial Acceleration on Ship Wave Pattern and Wave Survey Methods," USNA Report No. EW-2-76. April 1976.

The wave resistance of a ship moving at a constant speed can be calculated using information obtained from its wave pattern. Different methods which exist for wave resistance calculations are based on the existence of a linearized free-wave velocity potential and the conservation of momentum or energy in a control volume. One of the basic assumptions in the above-mentioned methods is the requirement of a constant model speed.

The effect of initial acceleration upon the wave resistance of ships was studied by Wehausen. This work shows that the wave resistance calculated for a ship model with initial acceleration will have an oscillating and decaying behavior and that the "Mean" value of the oscillation will correspond to Michell's wave resistance. An immediate conclusion from previously mentioned work might be that the measured "wave resistance" values for a ship model moving at a constant speed but with initial acceleration might show a scatter of data about a "mean" value.

This report presents a study to evaluate the effect of initial acceleration on the various existing wavy survey methods and to determine which one is least affected by this possible source of error. A procedure for determining existence of an initial acceleration wave is also proposed.

*****

CALISAL, Sander M., Assistant Professor, "A Calculation of the Free Wave Spectrum for a Ship," USNA Report No. EW-2-76, 1976.

Longitudinal wave records and corresponding wave spectra are numerically calculated for a series 60-block-60 ship moving at Froude number 0.302. Wave resistance values are then computed from the wave spectra. Three different sets of sources, as obtained by Adee, are used to represent the ship. The wave height and slope in the far field are calculated by an asymptotic series representation. Spectrum analysis on the numerical wave spectra suggests that the main reason for the high value of the numerically calculated wave resistance is the high value of the transverse wave amplitude. Plots of the longitudinal cuts are also compared with other numerical calculations and experimental results. The asymptotic calculation of the wave height proves to be an efficient way to obtain a wave record and wave resistance.

*****

COMPTON, Roger H., Associate Professor, "The Engineer and the Initial Conceptual Design of Marine Systems," Society of Naval Architects and Marine Engineers San Diego Section Paper, 19 February 1976.

The engineer's multifaceted involvement in the transformation of an abstract idea for a marine system into a physically and fiscally feasible conceptual design is described. The inherent duality of the engineer's role throughout the design evolution is emphasized. First, general principles are discussed, then a methodology for applying those principles to design is developed.

*****

DAWSON, Thomas H., Assistant Professor, "Analysis of Rocket-Assist Aspects of Infantry Anti-tank Weapons," Army Research and Development Magazine, (November-December 1975) 15.

The possible inclusion of rocket assist into conventional infantry anti-tank weapons is examined analytically. The work involves comparison of the performance of a typical rocket-assist weapon with that which would exist without rocket assist. In the interest of simplicity, only the effects of the major error sources of ranging, crosswind and round-to-round dispersion on the system accuracy are considered. Results show that, in spite of an increased crosswind sensitivity, the resulting flatter flight trajectory of the rocket-assist round increases its accuracy by almost 100 percent over that of the conventional round. The conclusion is that the use of rocket-assist projectiles in infantry anti-tank weapons is clearly worthwhile insofar as range and accuracy considerations alone are concerned. Results indicate this rationale behind recent foreign developments in such weapons.

*****

LATHAM, Robert F., Associate Professor, "A 'Hot Plant' at the United States Naval Academy," Naval Engineers Journal, 88 (April 1976) 45-52.

One of the critical personnel problems in the fleet today is the inability to attract naval officers to shipboard engineering billets. In the past, many officers have considered assignment to such billets as very unfavorable to their careers and have taken every opportunity to avoid such assignment. Over the past 26 years of teaching at the U. S. Naval Academy, I have observed many officers who approach an assignment to a shipboard engineering billet with fear and apprehension. Of course, much of this apprehension is the result of many years of neglect of the importance of operational engineering. Shipboard engineering still suffers from a "hangover" of this unintentional policy, and a feeling exists among many officers today that the hard work, the uninviting environment, and the low visibility status of the shipboard engineering officer is an unwelcomed visitation upon their careers. The Navy

has recognized this problem and in recent years has met it with a number of policies aimed at enhancing the role of the shipboard engineer, not the least of which is the relative importance of such experience to a successful career pattern.

It is the purpose of this paper to describe the beginnings of an effort at the U. S. Naval Academy (the "Hot Plant" in the Marine Propulsion Laboratory) to develop an attitude in the midshipmen that a capability in shipboard engineering is not just something which must be endured for the purposes of career enhancement but is one which is of vital importance to the Navy.

*****

MONNEY, Neil T., Associate Professor, Ed., New Directions for Naval Oceanography (SECRET). Published by the National Research Council, June 1976.

The Navy role in the national ocean program has steadily declined over the past decade. Concerned with this decline, the Assistant Secretary of the Navy (for Research and Development) requested that the Ocean Affairs Board and the Marine Board of the National Research Council consider undertaking an objective review of the Navy Oceanographic Program, to assist the Navy in determining the direction and the scope of developments in ocean science and ocean engineering. The Boards responded by establishing the following objectives for the study, in consultation with the Under Secretary of the Navy, the Assistant Secretary of the Navy (for Research and Development) and the Oceanographer of the Navy:

1. To identify the advanced ocean science and ocean engineering needed to meet Navy mission requirements in the year 1980 and beyond,

2. To identify opportunities for improved naval operations by increased utilization of ocean science and ocean engineering, and

3. To examine the relationships of the Navy's oceanographic program to the federal ocean program.

*****

McCORMICK, Michael E., Professor, "A Modified Linear Analysis of a Wave Energy Conversion Buoy," Ocean Engineering, No. 3 (1976) 133-144.

The analysis of a pneumatic-type, wave-energy conversion buoy is developed assuming independence of the buoy heaving motion and the motion of the water column within the center pipe. Results of the analysis are then compared with experimental data in a study of the relative air velocity within the turbine passage. The results compare very well. The effect of the variation of the center pipe length is found to be significant for periods

above the surge chamber resonance but is negligible in the neighborhood of the heaving resonance period. Further, the theory is applied to a prototype buoy under study by the U. S. Coast Guard, and a dimensionless design curve is developed from the results of the prototype analysis.

*****

WIGGINS, Peter F., Associate Professor, co-author, "Use of Microgram Df^{252} Sources for Capture Gamma Ray Spectral Standards for Coal Analysis," Bulletin of the American Physical Society, Series II, KE2, 1976.

A sample irradiation space (4" cube) with surrounding Lucite and paraffin for neutron moderation was built above the source storage container. A μgm Cf^{252} source ($2x10^6$ n/s) was lifted by a string for irradiations. This shielded assembly was a 3-foot cube. With a Ge(li) detector, spectra for standards with full (f), and single (s) and double (d) escapes, were obtained in several hours with major coal ash constituents. The best lines, considering interferences are: S(5.42 MeV,f); Si(3.54,f); Al(6.70,d); Fe(6.62,d). H(2.23,f) and C(3.93,d) from the moderator were clear. The results led to a larger analytical unit for coal; plastics and paraffin must be minimized to allow identification of the coal's C and H which serves as moderator. B (main line .479) is preferred for neutron shielding over Cd because of the 5.43,f and escapes. Besides assisting pilot experiments for industrial operations, a small Cf^{252} unit can be useful as an instructional tool at universitiies and provide calibration standards for experimental physics.

*****

WIGGINS, Peter F., Associate Professor, co-author, "X-Ray Fluorescense Measurements of Silver for Exposure of Environmental Monitoring Film," Transactions of the American Nuclear Society, 22 (1975) 98.

Environmental surveillance of nuclear activities has depended extensively on film dosimetry and well-established optical procedures provide a permanent record of radiation levels. Nevertheless, this film technique suffers in accuracy at somewhat under 30 milliroentgens (mr) of gamma rays, which is a region of much concern to environmentalists, and at several hundred roentegens (r), the level of lethal accidents. Thermoluminescent dosimeters can serve this extended range, but the information is lost on reading. Neutron activation of silver in dosimetry film with beta counting of Ag 108 (2.4 min. half life) and gamma counting of $Ag^{110}m$ (252 days) has been reported as an alternate to optical measurements (1,2,3). Degradation of the film by reactor radiation, which interferes with the advantages of the film as a record, was noted.

Dosimetry films were exposed at ORAU with gamma rays from a 5 millicurie Ra source (5mr to 5 r) and from a 450 curie Co60 medical facility (5r to 1000r). Five films, Kodak type 2, were used at each of 15 levels with 20 unexposed controls. The developed films were irradiated with neutrons for 1 min. in

polyethylene capsules in a pneumatic tube arrangement with 15 mgm of Cf 252 (3.5×10^{10} neutrons/sec); graphite and water served as a moderator and shield. No film degradation was noted. The 0.658 MeV line of Ag 110 (24.4 sec.), which predominates following short irradiations (4), was counted for 2 min. with twin 3 inch x 3 inch NaI(Tl) crystals in a thick iron shield. The films were also read by an optical desitometer.

This activation method can extend the range of film dosimetry to lower and higher levels of exposure than possible with optical procedures and still provide a permanent record.

*****

JOHNSON, Bruce, Professor, "Research and Educational Capabilities of the New Naval Academy Model Basin." Paper read at Association of Senior Engineers Noon Technical Meeting, Washington, D. C., 29 April 1976.

*****

McCORMICK, Michael E., Professor, co-author, "An Overview of the Ocean Energy Program." Paper read at Ocean Energy Conference, North Carolina State University, Raleigh, N. C., 27-28 January 1976.

*****

McCORMICK, Michael E., Professor, "Salinity Gradients, Tides and Waves as Energy Sources." Paper read at Ocean Energy Conference, North Carolina State University, Raleigh, N. C., 27-28 January 1976.

*****

McCOY, Robert A., Assistant Professor, "Design, Construction, and Testing of Advanced Composite Flywheels at the U. S. Naval Academy." Paper read at 1975 Flywheel Technology Symposium, University of California, Berkeley, California, 10 November 1975.

*****

NELSON, Martin E., Assistant Professor, "Comparison Between a High and Low Productivity Nuclear Power Plant." Presented at Seminar at Georgia Institute of Technology, 5 February 1976.

*****

NELSON, Martin E., Assistant Professor, "Effect of Nuclear Regulatory Commission Regulations on Power Plant Productivity." Paper read at American Nuclear Society Student Regional Meeting, Charlottesville, Virginia, 3 April 1976.

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

Lieutenant Colonel Joseph J. Blum, USAF, Chairman

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

The Weapons and Systems Engineering Department recently experienced a quantum growth of its laboratory facilities in Maury Hall. The improved environment and wide ranging facilities reflect the broad and varied interests of the faculty which include physics, medical engineering, electronics, mechanical,and electrical engineering. Although the laboratories are primarily designed to complement midshipman classroom instruction, it is anticipated that the faculty will additionally use these facilities for their own individual research, and exceptional midshipmen will have an environment capable of supporting a wide range of individual interests.

Faculty research is regularly undertaken by nearly all civilian members of the Weapons and Systems Engineering Department and on occasion by some military members as well. Funding for research activities is available from several sources, including grants or contracts from various federal agencies, as well as funding support from within the Naval Academy. Recent contracts have been made by faculty members with both the Naval Electronics System Command and the Naval Air System Command. Excellent faculty and midshipmen research relations have additionally been established with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory. Sponsored research projects currently being conducted by faculty members include the investigation of RF spectra associated with shipboard antennas and hybrid computer simulation of missile systems. Additionally, research is underway on a bioengineering study of arterial-wall motion and a program to study shipboard gas turbine reliability.

*****

PRECEDING PAGE BLANK-NOT FILMED

A FREQUENCY-ALLOCATION STUDY

Researcher: Assistant Professor C. George Brockus

Sponsor: Naval Electronics System Command

The purpose of this project is to aid in the elimination of interference from shipboard line-of-sight (LOS) transmitters in the UHF band for the receivers used in Navy SATCOM terminals. Even though guard-bands can be established, and the operation of LOS transmitters prohibited in those bands, it is desired to prevent intermodulation (IM) products generated by simultaneous transmissions outside the guard-bands from appearing in the receivers.

Work in progress at the Naval Postgraduate School will determine the susceptibility to interference versus frequency for the system in question, and actual shipboard data will establish the levels of IM products generated in typical LOS systems. These data will be used to determine the frequencies and levels of IM products which would actually cause interference.

JANAP 195 listed "Compatible Families of UHF Frequencies." Those families will be modified in such a way, in this project, as to prevent IM interference for the Gapfiller frequency plan and the FLTSATCOM frequency plan. In addition, the required separation of frequencies used in the generation of JANAP 195 will be maintained.

Work is underway to generate a FORTRAN program as the vehicle for analysis of the IM generation problem. That program, along with the recommendations for frequency allocations, will constitute the end product of the task.

*****

DEVELOPMENT OF NASAP, A NAVAL ACADEMY SYSTEMS ANALYSIS PROGRAM

Researcher: Assistant Professor C. George Brockus

Sponsor: Naval Academy Research Council

The purpose of this project is to develop a general systems analysis program to be used for instructional and analytic purposes in the design of general physical systems.

A first objective is to define certain classes of physical systems, according to the topology of the interconnection of their components, under a relaxed set of constraints made available through adoption of the new concept of short relaxed variables. A second objective is to obtain, for any particular system in each of these classes, a least-work method of deriving the model which would yield the analytic behavior of that system.

The classes had been well-defined, but the existence of a least-work method had not been established for all systems. The development of a key algorithm was mandatory to further progress. That key algorithm has been developed successfully during the tenure of this project. The first part of the solution was attained through formulating a closed-form algorithm, alternative to the Quine-McCluskey iterative technique, for finding the set of all Prime Implicants (and Implicates) of a truth function. The second part was completed through the development of the table-covering problem as a truth function whose simplification yielded the exact results needed.

*****

THE EFFECT OF MULTI-VARIABLE CONTROL FOR IMPROVING SURFACE FINISH AND STABILITY IN MACHINE TOOLS

Researcher: Assistant Professor E. Eugene Mitchell, Jr.

Sponsor: Naval Academy Research Council

Observer theory is applied to design an active controller for a machine tool such as a lathe to reduce the chatter tendency and forced vibration effects that can be detrimental to a work-piece surface finish. An observer is used to estimate difficult-to-measure relative motion between the cutting tool and workpiece. The estimated motion is used in conjunction with measured states in a second application of observer theory to design a control system that causes the cutting tool to track the work-piece motion. Stability of the controlled system as a function of mismeasurements of dynamical parameters and its ability to reduce forced vibration effects are discussed. Performance calculations are based on a second-order, machine-tool work-piece dynamical model; however, the presented methods of design and analysis can be extended to higher order systems. The results of this investigation were presented at the 1976 Joint Automatic Control Conference at Purdue University, 27-30 July 1976. Another paper has been accepted for publication in the Transactions of the American Society for Mechanical Engineers, Journal of Dynamic Systems, Measurement and Controls.

*****

SOUND SOURCES WITH DISTRIBUTED SPECTRA

Researcher: Associate Professor Olaf N. Rask

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

The objectives were the study of the origin and of the propagation paths for continuous spectra sound waves in ship hulls and machinery.

The approach consisted of recording sounds generated by a shaker driven by random warforms and using the hand-wired FFT computer at David W. Taylor Naval Ship Research and Development Center to estimate the transfer function between different points in the hull. Consistent measurements were obtained for the magnitude of the transfer function averaged over 500 Hz frequency intervals.

*****

FOX, J. Richard, Lieutenant, USN, ed. Shipboard Weapons Systems. Annapolis: U. S. Naval Academy, 1975.

The weapons delivery problem from initial detection to target destruction provides the framework for an examination of combatant systems. As a foundation, components including computers, fire control radars and data transmission methods are studied in general.

With this background, specific representative operational shipboard gun, missile and anti-submarine warfare systems are discussed in depth, and basic system components, information flow within the system and interfaces with complementary equipment, manning requirements and operational procedures, system capabilities and limitations, and functional similarities and differences between systems. New developments and planned systems are introduced in each area. As supplemental information, battery alignment, shore bombardment and spotting techniques are addressed.

Additional related areas are discussed which include ordnance stowage, handling and safety requirements, the special precautions and inspection requirements involved with nuclear weapons, the integration of search, detection, and classification systems to make up the total combat system, and system configuration forthcoming on proposed new surface platforms.

Further, a discussion on aircraft used as extensions of the ship's weapons system is presented. These aircraft are involved in anti-submarine warfare and fighter-superiority operations. The FBM submarine is also discussed. These topics point out how the rudiments of shipboard weapons systems are also applied to the weapons systems of other platforms.

*****

FOX, J. Richard, Lieutenant, USN, and Oliver H. PERRY III, Lieutenant, USN, "Computers in Naval Fire Control System, in Computers in the Navy, ed. Captain Jan Prokop, SC, USN, Naval Institute Press, Annapolis, Maryland, 1976, 159-171.

This chapter tells of the evolution of the computer in the fire control systems of the Navy, beginning with the simplest form (range keeper) and ending with the present day UYK-7 multipurpose digital computers.

*****

KNOWLES, Kenneth A., Assistant Professor, "An Intelligent Industrial Arm Using a Microscope," Institute of Electrical and Electronics Engineers Transactions on Industrial Electronics and Control Instrumentation, Vol. IECI-22 (August 1975), 309-314.

A system to control a hydraulic industrial arm using a four-bit microcomputer is described. A supervisory minicomputer can handle global routines such as scene analysis and task and trajectory planning while the microcomputer attends to the control of the arm. The microcomputer monitors arm joint positions and sensors, and maintains current joint position when no motion is desired. The supervisory minicomputer transfers a job to the microcomputer in the form of a sequence of macro-commands. The microcomptuer interprets and executes the job and returns the final status of the arm to the minicomputer.

*****

KNOWLES, Kenneth A., Assistant Professor, "Man Machine Interaction in a Low-Cost Manipulator Controller," in Proceedings of the Milwaukee Symposium on Automatic Computation and Control, 22-24 April 1976 (April 1976) 146-150.

A theoretical general purpose, low-cost manipulator control system utilizing two microprocessors is described. The main microprocessor coordinates and controls the operations of the manipulator, while the secondary microprocessor is utilized for the complex sensors, sensor displays, and indicators. The system is task independent and utilizes a hierarchical control structure to provide ease in allocation of subtasks, man-machine interaction, as well as efficient means of data storage. In manual control dominated tasks, the system supplements the human operator's control with machine-controlled subtasks (such as changing a tool on an underwater manipulator). In machine-control dominated tasks, the system executes a sequence of pre-stored tasks. The system releases control of the manipulator to the human operator whenever so commanded, or whenever unable to complete a desired task. The paper ends with a brief description of an experimental manipulator and control system developed by the researcher while at the

the University of Virginia. The system is built around a single inexpensive Intel 4004 microprocessor. The manipulator is hydraulically powered in a dual-speed, bang-bang mode. Slip, touch, and position sensors provide feedback information.

*****

MITCHELL, E. Eugene, Jr., Assistant Professor, "The Effect of Multi-Variable Control for Improving Surface Finish and Stability in Machine Tools," USNA Report No. EW-3-76, April 1976.

The quality of workpiece surface finish produced by a machine tool is a function of the relative vibratory motion between the cutting tool and workpiece and is related to the rigidity of the machine-tool structure. Machine-tool manufacturers currently rely on structural rigidity to minimize both relative vibration effects and dimensional inaccuracies resulting from static deflections. This is a major reason for heavy machine bases and columns. Even so, excitation of machine structures at their resonate frequencies by small forces can cause substantial relative motion between tool and workpiece. This is a result of the low damping that is characteristic of machine-tool structures. Because of this,low damping vibratory motion may persist for many cycles following a disturbance; under certain conditions, sustained oscillations, commonly called shatter, can occur.

The object of the work described in this paper is to determine the reduction in vibratory noise effects on workpiece surface finish to be gained by adding active control to a machine-tool; and further, to investigate the effect of controller characteristics on system performance. In an effort to gain further improvements over previous work by the author, this research investigates the possibility of using a multi-variable controller. This means that the control law is generated from several system states such as tool position, velocity, acceleration, etc. Because some of these states are not directly accessible, it is necessary to design an observer which will predict the unknown states.

*****

MITCHELL, E. Eugene, Jr., Assistant Professor and Charles F. OLSEN, Associate Professor, "Digital Computation of Frequency Response," Simulation, 25 (November 1975), 137-145.

This paper describes three algorithms for the digital computation of the frequency response o. linear systems and discusses their advantages and disadvantages. The third method presented in a novel one which applies the standard polynominal quadratic synthetic division algorithm in a unique way to the problem. The method allows the forward and feed-back path transfer functions to be inputted in any form; it computes the open-loop and closed-loop frequency response in one pass; and, most importantly, it does not require numerical factoring at any point.

*****

TWADDLE, Roy R., Lieutenant Commander, USN, et. al. Principles of Naval Weapons Systems. Annapolis: U. S. Naval Academy, 1976.

The term "weapons systems" is a generalization encompassing a broad spectrum of often dissimilar components and subsystems. This spectrum ranges from simple offensive or defensive devices, through delivery platforms, to the strategic integration and direction of complex vehicles developed to defeat an enemy or deny the enemy an objective. Within this context, basic engineering principles and concepts are presented and studied with a view toward providing a basis for subsequent training and advanced education in the art and science of naval weapons systems.

In the first section, detection and sensing systems are presented. The electromagnetic frequency spectrum is examined from the RF band through the infrared region with emphasis placed upon the fundamentals of propagation and reception. Radar principles, IR sensors, and electronic warfare concepts are discussed in the relevant areas. The similarities of these principles are then related to acoustic energy; specifically, sound propagation and reception. Radar principles, IR sensors, and electronic warfare concepts are discussed in the relevant areas. The similarities of these principles are then related to acoustic energy; specifically, sound propagation and reception in water. This leads to an examination of basic sonar principles.

In the next section, the elements of tracking subsystems are presented through an introduction to feedback control and subsequent relations to track-while-scan and phased array applications. After an examination of digital, analog, and the so-called hybrid computational subsystems, weapons delivery subsystems are presented. In studying the principles of weapons delivery, the areas of explosive mechanisms, warheads, fuzing, propulsion, and guidance techniques are addressed.

After reviewing the characteristics of basic launching subsystems, orientation of weapon systems and subsystems are discussed in terms of the fire control problem. Rather than address the fire control problem from the view of specific applications (air, surface, or subsurface), it is presented as a common facet of weapons delivery through a study of coordinate systems, miss producing effects, and the examination of a prediction-correction algorithm.

From target detection to weapon delivery, the "principles of naval weapons systems" are brought together in the final section: systems integration. Four diverse platforms are reviewed with specific emphasis placed upon components of actual weapons systems -- the F-14 Tomcat, DD-963 Destroyer, SSN-698 Submarine, and the Marine Amphibious Unit. To round out the subject of weapons systems, a review of specific tactical data systems and command and control concepts are presented, highlighting the subjective considerations of weapon system employment and control.

This text is a comprehensive work emphasizing basic principles while retaining reference to hardware applications to illustrate fundamental concepts. As such, it achieves its stated goal of being a flexible, enduring medium of information exchange concerning naval weapons systems.

*****

BROCKUS, C. George, Assistant Professor, "Laboratory Experimentation Versus Computer Simulation." Paper read at COED Technical Section of American Society for Engineering Education Mid-Atlantic Section Meeting, Villanova University, Villanova, Pennsylvania, 1 November 1975.

*****

KNOWLES, Kenneth A., Assistant Professor, "A Micro-Processor Controlled Industrial Manipulator Programmable by Teaching." Paper read at 1976 IECI Group of the Institute of Electrical and Electronics Engineers Annual Meeting, Philadelphia, Pennsylvania, 8-10 March 1976.

*****

MITCHELL, E. Eugene, Jr., Assistant Professor, "The Hybrid Computer as a Teaching Aid in a Sample-Data Digital Control Course." Paper read at 1975 Frontiers in Education Conference, Atlanta, Georgia, 20 October 1975.

*****

DIVISION OF

ENGLISH AND HISTORY

ENGLISH DEPARTMENT

Associate Professor Michael Jasperson, Chairman

Academic Year 1975-1976 was an active one in the English Department for literary research and writing. For the first time in the history of the Department, an officer instructor received a Naval Academy Research Council (NARC) grant. Her researches took her to Micronesia; the personal journal of her investigations was accepted by the Smithsonian Institution. A second NARC grant in the Department supported continued research into the American journals and letters of James, Lord Bryce.

Independent critical and biographical research by faculty members was divided about equally between American and English writers with 16 projects either underway or completed. The literature of the sea received due attention, with investigations of the writings of Joseph Conrad and Herman Melville and an exploration of the nature and significance of wardroom ballads. Among English authors, Shakespeare, John Dryden, Andrew Marvell, Edmund Spenser, and Lord Byron were subjects of critical study. A doctoral dissertation was in progress on the achievement of the modern American poet Delmore Swartz, and a critical analysis of Robert Hayden's "Middle Passage" was completed.

One book, seven articles, and an audio cassette were published, and two presentations were made at professional society meetings.

*****

PRECEDING PAGE BLANK-NOT FILMED

DETERMINATION IN MICRONESIA: THE AMERICAN INFLUENCE

Researcher: Lieutenant (j.g.) Marlene Angus, USN

Sponsor: Naval Academy Research Council

The Trust Territory of the Pacific Islands was designated by the United Nations as a strategic trust to be administered by the United States under an agreement concluded in 1947. Over the years, this area has become even more strategic as the United States pulls out of Okinawa and the Philippines. Another consideration is that Japan, a nation well-equipped to develop these island territories, is eager to enter into a free association status with the Micronesians if they so choose.

In 1966, President Kennedy sent some 400 Peace Corps Volunteers to Micronesia (among them the present researcher) as a result of severe criticism by the United Nations of neglect on the part of the administration to develop and educate the island people. In 1969, the U. S. Navy sent seven Seabee Teams into the districts. Their primary duties were to build roads, bridges, and good will.

President Johnson promised Micronesia self-determination in the form of a vote in 1972, and talks between representatives from Washington and Micronesian officials were initiated. The results of these efforts are unknown and much depends upon the Micronesians' perception and American intentions.

The islands were under naval administration until 1951 when they became the responsibility of the Department of the Interior. General Lewis Walt, U. S. Marine Corps, in 1970 explored the possibility of establishing a base in Palau. Yet, there is very little written about this current and potentially explosive situation.

The purpose of the project was to analyze Micronesia as the islands are preparing to terminate the present trusteeship status and determine a new political future. The summer of 1975 was historic for the Micronesians because of the Constitutional Convention (CONCON, held on Saipan) and the plebiscite by which the islanders were to indicate their desired political status. Because the general public knows so little about these islands, America's sole remaining trusteeship, and because of DOD interest in Micronesia's strategic value, it was hoped that this project could provide an informative, current analysis of U. S. intentions and Micronesian desires.

Personal interviews were conducted with a wide range of individuals interested in Micronesia: professors from the University of Hawaii, the High Commissioner of Micronesia, State Department representatives, military

advisors, Micronesian students, Peace Corps volunteers, American contract teachers, Micronesian "radicals," representatives to the CONCON, a Bank of Hawaii vice-president for Micronesian development, a former High Commissioner who is now a construction company vice-president in Guam, fisheries experts, former Peace Corps volunteers and staff members still involved in Micronesia, a cable TV company owner, and Micronesians in every district center.

While working on this project, the researcher learned that the Smithsonian Institution was particularly interested in collecting journals from Peace Corps Volunteers to be filed in the National Anthropological Archives and additionally to be used for a book the Smithsonian was preparing on the Peace Corps. Correspondence indicated they were eager for the researcher to write a journal of her return trip to Micronesia. (The present researcher is the only known returned Peace Corps volunteer who has become a career military officer.) The journal has been written and delivered.

A draft paper entitled "Micronesia and the Pacific Doctrine" has been prepared as part of a continuing effort to produce an objective commentary on the Micronesian/American involvement.

Lectures on Micronesia were given at the Naval War College in October 1974. Picture slides taken in Micronesia are being catalogued and will be presented to the Smithsonian Institution.

*****

THE CORRESPONDENCE AND JOURNALS OF JAMES BRYCE

Researcher: Associate Professor Allan B. Lefcowitz

Sponsor: Naval Academy Research Council

James Bryce, though one of the major commentators on the nature of culture in the United States, has largely been ignored since his death in 1922. In the Bodleian Library (Oxford) and many American libraries are large quantities of his unpublished correspondence. Of particular interest is the record of his 1870 journal to the United States, when he formed his first impressions, impressions that led directly to many articles defending American culture to the British. Recently, other papers have been uncovered in the possession of the estate of his last living heir. All of this material casts light on the formation of American and British relationships during the crucial period between the Civil War and American entrance on the world stage during the 20th Century.

The objective of the research was to prepare an edition or editions of those letters and journals relevant to Bryce's visits to America and his writing of The American Commonwealth, the most significant foreign commentary on American culture in the late 19th and early 20th Centuries.

Essentially, the research consists of the following stages: (1) preparation of a bibliography of Bryce holdings in various libraries; (2) transcription of materials; (3) annotation of names, places, events, and such information that may not be accessible to the general reader; and (4) writing of introductions.

The first published product of the research has been a 45-page article on the diary Bryce kept during his first visit: "James Bryce's First Visit to America: The New England Sections of His 1870 Journal and Related Correspondence." The article has been accepted by the New England Quarterly for publication in a future issue. In preparation is another article on the Mid-Western portions of his journal.

The project to date has been fruitful and will produce further opportunity for scholarly research. Potential areas for fruitful investigation have been found in correspondence of Sarah Whitman and Bryce; the correspondence of Bryce, Matthew Arnold, and James Freeman; and Bryce's 1884 journal kept during his visit to the United States immediately prior to beginning The American Commonwealth.

*****

CONRAD's SEAMANSHIP IN "TYPHOON"

Researcher: Associate Professor James A. Arnold

Conrad's statement in his Author's Note to "Typhoon" that "the particular typhoon of the tale was not a typhoon of my actual experience" is equivocal; it leaves open the possibility that there was no typhoon of his experience. However, he has been quoted as saying later that "I experienced another one in the Indian Ocean, and used my impression of that . . ." Indeed, the weather and sea conditions as described in the story give an accurate impression of such storms as now known and as described in late 19th Century books on weather and cyclonic storms available to Conrad. (It may be possible to find a book on seamanship of Conrad's seagoing period with a chapter on cyclonic storms such as the one Captain MacWhirr consulted.) On the other hand, some of Contrad's data on ship course, direction of swell and wind direction are inaccurate or contradictory. For example, it is impossible to determine whether the Nan-Shan's course is north or northeast, though the latter is more likely. However, in that case, the "cross swell from the direction of Formosa Channel" that the ship encounters should be coming from dead ahead rather than broad on the bow and would not cause the severe roll that the first mate wants to moderate by heading "to the eastward." In fact, Captain MacWhirr, a keen observer of detail, says to his first mate that the swell comes from northeast. Apparently Conrad cared little about accuracy of technical detail in his description so long as its general impression was correct and effective.

*****

CONRAD'S USE OF NAMES

Researcher: Associate Professor James A. Arnold

This study is an attempt to discern a pattern in Conrad's use of real and fictitious names and changes of names of persons, places, and ships in Conrad's fiction. Much data have been collected, but the study is still in an amorphous state. When data are complete, it might lend itself to computer analysis.

*****

FACTUAL ERRORS IN CONRAD SCHOLARSHIP

Researcher: Associate Professor James A. Arnold

Published scholarship on Conrad's works is astonishingly strewn with errors of fictional fact; that is, statements about characters and actions in Conrad's fiction that are demonstrably false on the basis of what Conrad wrote. The critical literature would be surveyed to collect examples of such

errors. These could be classified either by the Conrad work to which they applied or by types of errors. The first arrangement would probably be more useful as a guide to the wary.

*****

THE GEOGRAPHY OF CONRAD'S EASTERN TALES

Researcher: Associate Professor James A. Arnold

This research project is a complete survey of the setting of Conrad's eastern tales with particular emphasis on Lord Jim. It will be partly based on the published work of Conrad scholars. However, the location of Patusan in Lord Jim has not yet been correctly identified, nor has Samburan in Victory. On the basis of data in the novels themselves and a study of detailed maps in atlasses of the general areas concerned, it should be possible to locate these places.

*****

THE SIGNIFICANCE OF THE YOUNG RUSSIAN'S BOOK IN CONRAD'S "HEART OF DARKNESS"

Researcher: Associate Professor James A. Arnold

This is a sequel to an article entitled "The Young Russian's Book in Conrad's 'Heart of Darkness.'" The first article identified the book as Nicholas Tinmouth's An Inquiry Relative to Various Points of Seamanship, Considered as a Branch of Practical Science. The sequel will attempt to explain the strong appeal of the book to the young Russian and Marlow, the narrator and protagonist of the story. Such an explanation will require a careful examination of their characters with a view to determining what Conrad really wanted his readers to think of their feelings and attitudes, not only about the book but also about other characters in the story. It will also require a study of contemporary newspaper and magazine articles to define British public opinion about European operations in the Congo.

*****

CHARLES I AS MARVELL'S "UNFORTUNATE LOVER"

Researcher: Associate Professor John P. Boatman

Contrary to the current critical opinion that Andrew Marvell's "Unfortunate Lover" represents a baffling problem, at present inexplicable but possibly dealing with love in the emblem tradition, the present researcher

finds that the poem refers to the execution of Charles I in 1649, that the images and references in the poem are drawn from the popular literature of the time that saw Charles as a martyr to the cause of English liberty (in his execution speech he refers to himself as the unfortunate "lover of English liberty"), that the poem draws its images from various sources, especially the heraldry of Charles's family arms, from Eikon Basilike, (which supplied much of the phrasing), from the frontispiece of Eikon Basilike that supplied the image of Charles in a doomed ship of state about to suffer shipwreck, from the traditional literature of the martyrdom of Christ, the lover of men's souls, and from the political tradition in England that pictures any English monarch as a Christ figure with two natures: a public and private body like Christ's two natures, divine and mortal. The researcher believes that Marvell's poem should be read as (1) symbolic praise of a monarch doomed like Christ to be a martyr to his countrymen's blind zeal and mistaken aims, and (2) as an apotheosis of Charles, the spokesman of order and tradition in the State.

*****

SPENSER's "DARK NIGHT" IN "EPITHALAMIUM," LINES 326-331

Researcher: Associate Professor John P. Boatman

Contrary to the current critical opinion that lines 326-331 of Edmund Spenser's "Epithalamium" represent a bit of personal myth-making on the author's part, the present researcher finds that these lines that refer to Jove's lying with dark Night to beget "Majesty" refer instead to the birth of Christ ("Majesty") by the union of God ("Jove") and the Virgin Mary ("Night"). The researcher cites the mystic tradition that affirms that Christ was conceived in a mystic dark; that God was associated in symbolic Platonism with both bright sunlight and dark night, that spokesmen of such a tradition were available and read by Spenser at this time. The researcher cites various sources and analogues of Spenser's psssage, such as the Bible (Gospel of John); Julian of Norwich: Revelations of Divine Love; Pico della Mirandola: Conclusiones; Dionysus the Areopagite: The Mystical Theology; Bruno: The Heroic Frenzies; and others examined at first hand, including Renaissance art pieces.

*****

THE CONQUEST OF ALMANZOR: DEVELOPMENT IN DRYDEN"S HERO(ES)

Researcher: Assistant Professor Fred M. Fetrow

A majority of Restoration Drama critics have regarded Almanzor, the hero of John Dryden's The Conquest of Granada (1672), as an exaggerated yet static portrait of heroism. Many of these judgments derive from sources external to

the play; perhaps influenced by literary tradition and history, some scholars fail to examine closely the manner in which Dryden presents Almanzor in order to determine whether any moral development occurs in the characterization. A close reading of the text, with attention to the primary factors contributing to the heroic portrayal, shows that the hero indeed progresses in self-knowledge and grows in moral stature. The plot structure, secondary characterization, imagery, and the thematic concerns of the play all focus on and augment the ethical-growth pattern in the hero. Dryden correlates these elements and subordinates them to the presentation of Almanzor's development. A critical study of the play thus shows a significant moral change in Almanzor. Such evidence brings into question assumptions about the static nature of this particular hero, and suggests the need for reassessing some generally held conceptions of heroism and heroic characterization in 17th Century rhymed drama.

*****

JOHN DRYDEN'S COMEDY

Researcher: Assistant Professor Fred M. Fetrow

Modern scholars of Restoration comedy have dealt curiously with John Dryden. They have taken his comic theory as gospel but have generally slighted Dryden's comedies. Dryden alone among all his contemporary comic dramatists left a widely distributed theory of comedy, and he produced more examples of the genre than most of them. Many critics have cited Dryden's statements on comedy to explain Restoration comedy in general, or to support specific theses on particular plays or authors, but few have given similar attention to Dryden's illustrations of his theories. A correlative study of both Dryden's theory and practics shows that his comedies are not only better than most modern critics judge them, but that these plays repeatedly display characteristics which typify Restoration comedy in general. Therefore, the critical apathy toward John Dryden's comedies has yielded an incomprehensive approach to the study of the comedy of this period in British drama.

*****

ROBERT HAYDEN'S "MIDDLE PASSAGE" AS AN ANTI-EPIC

Researcher: Assistant Professor Fred M. Fetrow

Robert Hayden's "Middle Passage" is especially intriguing for its resistance to generic classification. Hayden himself remains rather ambivalent on this point. While his original plan seems explicit, he claims a sort of mystic vision as the source of his ultimate format. However, another oblique authorial reference suggests an epic intention. And when one approaches the

poem as a miniature epic, both generic mode and heightened meaning emerge. Hayden includes and yet inverts most of the epic conventions and devices. This technique of ironic inversion extends the moral implications of the ostensible subject, slave trade during the 18th Century. More importantly, it allows Hayden to use the "descent into hell" convention to ennoble an epic "anti-hero" and to speak in a mythic voice in the creation of a folk epic which glorifies the real subjects of the poem, the Black victims of "Middle Passage."

*****

STRATA AND STRUCTURE: A READING OF SHAKESPEARE'S SONNET 73

Researcher: Assistant Professor Fred M. Fetrow

While the "standard" interpretation of Shakespeare's Sonnet 73, that the speaker is pleading for increased love in the face of imminent death, accommodates the placement of Sonnet 73 in the sequence, the structure of the sonnet itself suggests another possible reading. A close analysis of this structure shows how diverse elements of the poem combine to point to another message. These elements culminate in line 12 with a cryptic statement on the narrowing disparity between youth and old age, which when thus considered, renders the couplet less ambiguous, and hence, suggests that the overall sonnet is more objective and more profound than has been indicated by previous interpretation.

*****

A MISSIONARY FROM EIMEO CHECKS UP ON OMOO

Researcher: Professor Wilson L. Heflin

Among the rare books in the St. John's College Library, Annapolis, there is a first American edition of Herman Melville's Omoo (1847), which contains marginalia in pencil on 67 of its pages. Handwriting analysis reveals that the 96 marginal entries were written by Passed Midshipman Samuel Marcy, who had been a member of the first Naval Academy faculty. But the highly critical comments in pencil are those of a resident of the island of Eimeo, just west of Tahiti, and appear to have been copied by Marcy from entries made in another copy of Omoo by an English missionary, Alexander Simpson.

The purpose of this study is to examine critically these marginal comments -- on Melville's rendering of Tahitian dialect in Omoo, his statements about missionaries, his knowledge of local geography, his deficiencies in Tahitian history and Tahitian lore, and the events of the narrative. This study should reveal the extent to which Omoo is an autobiographical narrative and extend our knowledge of Melville's technique of composition in his second book.

*****

THE ACHIEVEMENT OF DELMORE SCHWARTZ: A POET IN SEARCH OF A FORM

Researcher: Assistant Professor Merrill Leffler

In the early 1940's, Delmore Schwartz was considered a major literary figure: poet, fiction writer, translator, respected critic, editor. Conrad Aiken claimed that he and Dylan Thomas were the "two most completely satisfactory poets of the moment." And a few years later, in 1943, Allen Tate wrote an adulatory notice of Schwartz's "feeling for language . . . the only genuine innovation since Pound and Eliot came upon the scene 25 years ago." Wallace Stevens once wrote, "There is no one in whom I believe as much as I believe in Delmore Schwartz." In 1959, he was the youngest recipient of the Bollingen Prize.

In 1966, when his unidentified corpse was almost buried in Potter's Field, his work was well on its way to being ignored. What happened to Delmore Schwartz's reputation? Why did it decline so sharply? Or was the early adulation a chain reaction of overinflation?

Schwartz has an obsessive number of recurring themes and, in retrospect, his work may be seen as an attempt to find an adequate form for handling them. He wrote lyric poems, verse dramas, a long quasi-autobiographical poem, Genesis, and an unpublished one, Narcissus, as well as numerous stories. In each of these forms, his recurring poetic and fictional concerns, himself, family, memory, the burden of the past, fate, the city, the poet in America, capitalism, were interwoven. The result was a poetry both personal and public -- so much so that the contemporary estimates of Schwartz's work were tempered by the strong feeling for the man those poems and fictions created. Schwartz was admired not only by writers who knew him well but also by writers who knew him only through his work.

The purpose of this study is, in part, to disentangle the reputation from the work in order to assess Schwartz's achievement in each of the forms he used. Work so far has culminated in an intensive examination of Genesis, its structure, imagistic patterns, and literary influences.

*****

THE FLAWED POINT OF VIEW IN WILLIAM FAULKNER'S "THAT EVENING SUN"

AD-A038 544 NAVAL ACADEMY ANNAPOLIS MD F/G 5/11

SUMMARY OF RESEARCH ACTIVITIES. ACADEMIC DEPARTMENTS 1975-1976.(U)

FEB 77 W L HEFLIN

UNCLASSIFIED USNA-AR-2 NL

2 OF 3

AD A038544

since the naive narrator is the same person as the perceptive narrator -- he is just about 10 years younger -- the reader expects the narrator who began the story to complete it. That is, he expects the comments of the perceptive narrator to "frame" those of the naive narrator. When they do not, the reader feels cheated in not being given the entire outcome of the story.

*****

THE SIGNIFICANCE OF THE WARDROOM BALLAD

Researcher: Lieutenant William J. Sabo, USN

Wardroom ballads were written and sung by sailors in the 19th Century and often recounted famous sea battles, such as the engagement between the Constitution and the Guerriere during the War of 1812. The purpose of this study is to analyze a sampling of these ballads in terms of their language, form, and their poetic and dramatic qualities. The purpose of the investigation is to show how an analysis of the wardroom ballad can enhance one's understanding of the 19th Century American sailor and his war-time environment. Furthermore, since these songs represent raw responses to important events of the past, their historical value will be emphasized.

*****

SEVENTEEN GUNS FOR LORD BYRON

Researcher: Assistant Professor Charles W. Smith

The purpose of this study is to reveal new information about the visit of George Gordon Byron, the Sixth Lord Byron, to the United States' ships Constitution and Ontario on May 21, 1922, in Leghorn Roads, Italy. The standard account of the visit is that by George Bancroft, the distinguished historian and Secretary of the United States Navy, in an essay entitled "A Day With Lord Byron," in History of the Battle of Lake Erie, and Miscellaneous Papers (New York: Robert Bonner's Sons, 1891), pages 191-210. A letter from another witness, Lieutenant John Needles Hambleton, USN, which has been recently discovered in the Library of Congress, disagrees with Bancroft in some particulars, most importantly over whether or not the 17-gun salute that was fired from the Ontario in Byron's honor should have been fired at all and, if so, whether it should not have been fired from the Constitution, the flagship of the Mediterranean fleet. An examination of the naval regulations then in effect in the United States and Great Britain reveals that Byron did indeed deserve a salute, that the salute properly came from the Ontario, the last ship Byron visited in the fleet, but that the salute

should have been only 13 guns. The conclusion is that American ships of that day -- at least the ships of the Mediterranean squadron -- routinely fired 17 guns in honor of all visiting foreign dignitaries rather than try to consult the naval regulations of many different coutnries to find the exact number of guns required for each rank of dignitary.

*****

HEFLIN, Wilson L., Professor, "A Biblical Source for 'The Whale-Watch' in Moby-Dick," Melville Society Extracts, No. 23 (September 1975), 13.

Scholarly editors of Moby-Dick have long recognized a relationship between Fedallah's improbable predictions in Chapter 117, "The Whale-Watch," and the utterances of the Apparitions in Shakespeare's Macbeth, Act IV, Scene 1. The Bible, however, deserves prior, or at least equal, claim as a source of inspiration for Melville's Chapter 117. In The Book of Job, VII, 12-15, there is a passage which must have served as a short precis for "The Whale-Watch" (Melville's setting: an actual whale-watch; Ahab's troubled sleep and his prophetic dream) and provided a hint for "The Chase." "Third Day" (Ahab's death, strangled by his own whale line). Melville's Bible was the King James Version. One wonders in what compositional direction, if any, Melville might have moved had he read a different translation of the Scriptures, say the Douay Bible or the Geneva Bible, said to be "unquestionably the version Shakespeare used."

*****

HEFLIN, Wilson L., Professor, "An Indignant Contemporary Editorial on White-Jacket," Melvile Society Extracts, No. 25 (February 1976), 8-9.

Newspaper articles in the Philadelphia Pennsylvanian in opposition to flogging in the United States Navy and highly critical of "Official Arrogance" of a senior officer might have led readers to expect that Herman Melville's recently published White-Jacket: Or the World in a Man-of-War (1850) would receive favorable notice in its pages. When one of the Pennsylvanian's editors read a copy of the English edition of the book, however, his surprising response was an angry one. He questioned Melville's patriotism and accused him of a calculated "injustice to the American Navy," especially for detracting accounts of naval engagements in the War of 1812. His editorial appeared in the Thursday, May 2, 1850, issue of the Pennsylvanian (Vol. 34, No. 6074, p. 2, col. 2). It concluded:

> [White-Jacket] is uncommonly well written; and some of its pages would do credit to any author. There are many suggestions we approve, especially those enforcing the abolition of all idle and ridiculous forms in the Navy, and simplifying them according to our republican institutions . . . but we regret that the book is so defaced with calumny, as to affect all its influence for good.

*****

JASON, Philip K., Assistant Professor, "Anais Nin." Audio Cassette No. 5502. Everett/Edwards, Inc., 1976.

This introductory lecture overviews Anais Nin's career, arguing that Nin strives to reproduce the direct flow of emotional experience in her work. Nin's technique is the technique of the lyrical novelist in which clock time is obscured and replaced by the direct experience of duration. The present is a composite state: an accumulation of memories and associations. The recurring symbol of the labyrinth is observed to be central to Nin's thematic material -- a search for and confrontation with the self so hidden under elaborate roles and disguises. The lecture also traces an incremental shift in Nin's work from solely interior focus to a mixture of outer and inner concerns. The impact of Nin's work results from the reader's juxtaposing of three phenomena: the life as lived, the life as explored and recorded (her diaries), and the exploration distilled and transfigured (the fiction).

*****

JASON, Philip K., Assistant Professor,"Donne's ELEGIE XIX (To His Mistress Going to Bed)," The Explicator, 34 (October 1975), 8-11.

In "Elegy XIX", Donne's speaker attempts to talk his mistress out of her clothes. In the final couplet, the speaker announces his own exemplary nakedness and asks "What needst though have more covering than a man." Besides the sexual pun on the word "covering," Donne here manages a superb extension and conclusion to the analogy of the body as the clothing of the soul begun on line 34 so that the figure of a new individual born of the coalescence of body and soul is imaged in terms of the sexual embrace.

*****

LEFCOWITZ, Allan B., Associate Professor, The Writer's Handbook; The Writer's Workbook; Instructor's Guide to "The Writer's Handbook." Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1976.

These three works present a basic rhetoric course for college students and teachers. The approach is practical, avoiding complex terms and single-subject examples. The material covered includes both the basic principles of organization and sentence construction as well as grammar, mechanics, and the research paper. Because each writing situation presents different possibilities and problems that require different choices and solutions, the Handbook focuses on the process of writing as a practical craft involving a unique writer-reader relationship. The intention, then, is to lead the student to involve himself or herself in writing as a craft rather than as a subject area to be learned. To that end, all of the exercises are intended to generate from the student active participation in problem solving rather than in a search for the "correct" answer.

In preparing the texts, invaluable aid came from Assistant Professors Phillip Jason and Richard Wohlschlaeger.

*****

LEFFLER, Merrill, Assistant Professor, "Black Poetry in Washington," Washington Review of the Arts, 2 (Summer 1976), 32-33.

Although the purpose of this article is to review Synergy, An Anthology of Washington, D. C., Black Poetry, there is a discussion of the difficulties that white poets/critics are supposed to have in writing about black poetry. Because poems emerge from the private need in the public self, and in a language which is the property of us all, there is some part of any poetry, no matter how separate the reader may be from the writer, that must "get out." Poems must still communicate although that communication may differ from the expectations we want it to conform to.

*****

LEFFLER, Merrill, Assistant Professor, "Eight Contemporary Maryland Poets," Maryland English Journal, 14 (Spring 1976), 3-19.

The main emphasis of this article is to introduce the work of eight poets who live in Maryland and who have achieved, in the last several years, national prominence. *The tone is not critical; it characterizes the uniqueness* of each poet's work, focusing specifically on what makes it distinctive. The poets discussed are Elliott Coleman, Josephine Jacobson, Ann Darr, Linda Pastan, Myra Sklarew, Roderick Jellema, Lucille Clifton, and Daniel Mark Epstein. A short introduction discusses the problems of regionalism and the relationship of a poet's work to the geographical area in which he lives.

*****

LEFFLER, Merrill, Assistant Professor, "Washington Poetry and Publishing," Washington Review of the Arts, 2 (Spring 1976), 27-29.

This essay review discusses the problems of publishing poetry and fiction in the United States as well as the necessary rise of cooperative publishing to accommodate those writers whose work cannot satisfy the demands of the commercial publishing houses. Many writers are getting together to design, publish, and distribute their work -- the second half of the article reviews three new chapbook-length books from the new Washington Publishing House: Deirdre Baldwin's Gathering Time, Grace Cavalieri's Why I Cannot Take A Lover, and Terence Winch's Luncheonette Jealousy.

*****

SMITH, Charles W., Assistant Professor, "A Flaw in Katherine Anne Porter's 'Theft': The Teacher Taught," The CEA Critic, 38 (January 1976), 9-21.

Katherine Anne Porter's short story "Theft" contains a tense error that has caused some confusion for some of my students. The opening paragraph reads as follows:

> She had the purse in her hand when she came in. Standing in the middle of the floor, holding her bathrobe around her and trailing a damp towel in one hand, she surveyed the immediate past and remembered everything clearly. Yes, she had opened the flap and spread it out on the bench after she had dried the purse with her handkerchief.

The confusion is caused by the fact that Miss Porter uses the same tense to describe separate actions which occur at two different times in the story. The second sentence uses the past tense, the normal tense used in narrating a story. The third sentence uses the past perfect tense, the correct tense for describing an action occurring before an action in the simple past. The fault lies with the first sentence of the story: it is in the past tense, but should be in the past perfect tense. It should read: "She had had the purse in her hand when she came in." This would make it clear that the actions described in the first and third sentences occurred prior to the action described in the second sentence. This little error allows the teacher to demonstrate that when a professional writer makes a mistake, the confusion that results can be as serious in its own way as the confusion caused by mistakes in student writing.

*****

LEFCOWITZ, Allan B., Associate Professor and Philip K. JASON, Assistant Professor, "Unteaching Freshman English." Paper read at Annual Meeting of the South Atlantic Modern Language Associate, Atlanta, 7 November 1975.

*****

TOMLINSON, David O., Assistant Professor, "Moral and Legal Obligation and Compulsory Education Laws in the United States." Paper read at New York Society of Philosophy and Public Affairs, New York City, 13 December 1975.

*****

HISTORY DEPARTMENT

Professor John W. Huston, Chairman

In comparison with performance levels established in previous years, the History Department's research effort during 1975-1976 was again extremely successful. Most appropriately, the department equalled its past publication rate of a book per year. Two other volumes, both by the same author, have been accepted for publication and are currently in press. Recently, a monograph dealing with a facet of naval history during the Civil War and a major biography of Admiral Chester W. Nimitz have been published. Additionally, a basic revision of the textbook now used in Naval History is underway involving five staff members while three others are contributors to a thematic volume of essays which surveys the history of the American Navy.

Ten articles covering a variety of topics were written by members of the History Department during the year. Six articles were completed and accepted for publication which have not yet appeared. Article publication in the future will continue at a brisk pace as several staff members are nearing completion of the independent research projects summarized on the following pages. Naval history continues to be the principal publication and research focus within the Department with research also occurring in the fields of American and European History.

Two staff members received Naval Academy Research Council support for research on topics concerning naval history. Sabbatical leave enabled two members of the staff to pursue research in 18th Century British naval history and 20th Century German history. A further indication of scholarly activity and accomplishment within the Department is demonstrated by the large number of papers presented at professional meetings. Staff members delivered eight papers this past year.

In sum, the History Department is heavily involved in research which is reflected in the enrichment of the classroom experience as well as considerable numbers of scholarly publications and professional papers.

*****

PRECEDING PAGE BLANK-NOT FILMED

THE AMERICAN NAVIES IN THE AMERICAN WAR FOR INDEPENDENCE

Researcher: Assistant Professor James C. Bradford

Sponsor: Naval Academy Research Council

One important aspect of naval history, the American navies during the Revolution, has escaped modern scholarly treatment despite the abundance of available primary source materials.

The purpose of this study is to analyze the role of the American navies, state and national, during the American Revolution. In the humanistic area, this study will illustrate how the American colonies were required to conceive and construct a naval force to protect their vital trade and to defend their newly declared independence. This is especially important because the navy did not have American precedents on which to base its practice and thus this study will examine the formation of a new institution.

To date, the following topics have been addressed: (1) the formation and accomplishments of Washington's flotilla off Massachusetts and his unsuccessful attempt to form a similar force in New York; (2) the formation of the Continental Navy: emphasis was placed on the debate in Congress concerning the advisability of creating a navy, the role assigned the first fleet, and the role of the navy was expected to play in the American war effort; (3) the appointment of the first Continental naval officers; (4) the New Providence Expedition, the only fleet action undertaken by the Continental Navy; (5) the relief of Esek Hopkins as commander-in-chief of the Continental Navy; (6) Benedict Arnold's naval flotilla on Lake Champlain; (7) the 1776 defense of Charleston, South Carolina.

Thus far this project has resulted in a static exhibition, "A Pictorial History of the American Navies in the Revolution," on display in Mitscher Hall and in a chapter, "The Navies of the Revolution," in the book In Peace and War: American Naval Policies, 1776-1976 which is forthcoming from Greenwood Press in the fall of 1976.

*****

THE DIGBYS

Researcher: Associate Professor William M. Darden

Sponsor: Sabbatical Leave

In the 18th Century when Britain was becoming the dominant power of the world, she was served with distinction by the Digby family. Research for this project involved two members of this family, two full admirals who served in the Royal Navy from 1741 to 1841. They lived from the period of

the acquisition of the British Empire, to the defense of the Empire against Napoleon, then to the Pax Britannia.

The "Old Admiral" (so called by the present Digbys), Robert Digby, began his naval career as a midshipman in the War of the Austrian Succession and took part in every war in which England had an interest until 1784 when he was put on half pay as a rear admiral. During his interesting and full service life, he served with such renowned officers as Admirals Saunders, Hawke, and Keppel. He was also a member of the first modern "amphibious task force," was naval tutor to the "Sailor King" of England, King William IV; and was in command of the Royal Navy's North American Naval Station during the last years of the American Revolution.

The "Young Admiral," Henry Digby, first went to sea immediately following the American Revolution. In the last decade of the 18th Century while captain of a man-of-war serving as an independent commerce raider, he took more prizes than any other Royal Navy Officer either before or since. Hanging in the present Bank of England is a series of paintings which illustrate how Captain Digby had to have a large wagon train to carry his prizes from Portsmouth to London. Put on half pay during the Peace of Amiens, he was called back to active service in July 1805 in time to join Admiral Nelson off Cape Trafalgar in October immediately before the Battle of Trafalgar. In that battle, Digby commanded the smallest ship in Nelson's fleet; this ship was completely dismasted and her casualties were heavy as a result of being in the thick of the battle.

The "Young Admiral" was created a Baron by a grateful king following Trafalgar; Digby went to live at Minterne House in Dorset, the estate purchased by the "Old Admiral" with prize money he had earned during the Seven Years War. Interne House is still the home of the Digbys and is still run by the earnings of the "Young Admiral."

*****

THE SEA DUEL: THE LIVES OF REAR ADMIRAL SIR CHRISTOPHER CRADOCK AND VICE ADMIRAL COUNT MAXIMILIAN VON SPEE

Researcher: Assistant Professor Jack Sweetman

Sponsor: Naval Academy Research Council

On 1 November 1914, a British cruiser squadron under the command of Rear Admiral Sir Christopher Cradock, KCVO, CB, was defeated by Vice Admiral Count Maximilian von Spee's German east Asiatic Cruiser Squadron, a significantly superior force. Three months later, at the battle of the Falklands, von Spee's squadron was destroyed by a British force as much superior to

his own as it had been to Cradock's. The course of these actions, in which both admirals perished, have been described in more or less detail in various publications. The question is not what happened, but why. Neither Cradock nor Spee was forced into action. Each had been left with considerable latitude in the execution of his orders, and the course each adopted was only one of a number of equally or even more logical options. In short, their crucial decisions were not imposed by material circumstances. Their roots were subjective. The object of the research is to explain those decisions by combining a reassessment of the Coronel-Falklands campaign with a study of the men and their time.

The research has followed rigorous historical methodology. Virtually every published reference to the battles of Coronel and Falkland and the lives of Admirals Cradock and von Spee has been examined. Official records unexploited by previous researchers have been obtained from British and German archives; and correspondence has been conducted with individuals who were personally acquainted with Admirals Cradock and von Spee and/or participated in the Coronel-Falklands campaign. The Naval Academy Nimitz Library was especially useful in regard to published materials.

In the opinion of the researcher, the findings provide the first really full and complete explanation of the crucial decisions of the Coronel-Falklands campaign. A book-length study is underway.

The researcher is contributing an essay entitled "Coronel: Anatomy of a Disaster," to a Festschrift in honor of the distinguished American historian of the Royal Navy, Professor Arthur J. Marder. This volume, edited by Professor Gerald Jordan of York University, Ontario, Canada, has been accepted for publication by Croom Helm, London. The object of the researcher's contribution will be to explain the reasoning which led Admiral Cradock to seek action under circumstances he knew to be extremely adverse. Other contributors include Vice Admiral Sir Peter Gretton, Marshal of the RAF Sir John Slessor, and Professor Robin Higham.

*****

SCIENCE AND TECHNOLOGY IN THE THIRD REICH

Researcher: Associate Professor Larry V. Thompson

Sponsor: Sabbatical Leave

This project is an examination of the ambivalence exhibited by National Socialists toward modernization as a process which, in the opinion of numerous party stalwarts and ideologues, threatened the bases of German society they revered while paradoxically containing within it the technical means for solving what they believed were dangerous societal problems. For example,

the expansionist dynamic inherent in National Socialism demanded the technical means with which to achieve economic and military preponderance, but an extreme dependence upon science and technology necessary to ensure such preeminence accelerated modernization. This, in turn, revolutionized German society with its urbanization, industrialization, and rationalization attributes. The Nazis, therefore, confronted a dilemna: they needed science and technology but were fearful and hostile to some consequences which they believed accrued from these endeavors.

The researcher intends to explore this dilemma through a book-length study of the Third Reich's perception of science and technology -- the twin pillars upon which modernization rested. Delineation of the regime's ideological posture will permit an evaluation of the ambivalence hypothesis, and it will provide a more specific analysis of how an apparent contradiction between theory and practice influenced governmental policy on the education and training of a scientific and technical elite. Thus, the book will subsequently examine whether ideological inconsistency resulted in policy ambiguity affecting science and technology in German higher education. The regime's funding policies as they related to science and technology research and development support will also be analyzed. Finally, the impact which Nazi trained scientists and technicians had on the German scientific and technical community during the war will be investigated.

*****

BLACK CRAFTSMEN AND THE NEW AMERICAN NAVY: FIRST STEPS TOWARD INTEGRATION IN FEDERAL EMPLOYMENT, 1800-1812

Researcher: Associate Professor William L. Calderhead

Information from old Navy Department records, newspapers, letters, diaries, etc., from Americans of the Jefferson era has brought the picture of black participation in naval life into clear focus. Thus at the Navy yard in Washington, D. C., approximately one fourth of all workers there in the years before 1812 were black (98 blacks). Many were laborers, but there were also many with skills and a goodly number in craft apprenticeship programs. In general, they did excellent work and were considered quite competent by their peers and by the Navy Department. Although, there was a degree of black-white friction, it was minimal, and it would not be wrong to note that the integrated work force at the Washington Navy Yard was the first successful experiment in the integration of federal employment in the 19th Century.

*****

REAR ADMIRAL BRADLEY A. FISKE, USN

Researcher: Professor Paolo E. Coletta

Fiske graduated from the Naval Academy in 1874. He taught himself electrical engineering and soon produced a number of inventions useful in civil as well as naval life. Among these were the naval gun telescope sight, the electrical range finder and position finder, the stadimeter, check fire prism system, and continuous aim batter fire system (with Elmer A. Sperry). He also obtained a patent on a torpedo plane, in 1912, and some of his radio control systems for directing distant objects are still in use today. After serving in a number of ships as a watch officer, navigator, executive officer, and commanding officer, Fiske commanded a cruiser division and then a battleship division of the Atlantic Fleet. From 1913 to 1915, he was the Aide for Operations. While in this billet, he obtained the legislation creating the Office of Chief of Naval Operations. He had produced a textbook on electrical engineering in 1882. After his retirement in 1916, he wrote a number of works on the Navy and on inventions, and he still holds the record for the longest tenure, of 11 years, as President of the U. S. Naval Institute.

The book has been accepted for publicated by the Regency Press of Kansas at Lawrence.

*****

THE U. S. NAVY AND DEFENSE UNIFICATION, 1947-1953

Researcher: Professor Paolo E. Coletta

After discussing the legislative history of the National Security Act of 1947, this work seeks to tell the Navy viewpoint toward the implementation of the act until 1953. In so doing, it recounts the attitude toward unification of the President, the Secretaries of Defense, the Chiefs of Naval Operations, and the Chiefs of Staff of the Army and Air Force, and of the Bureau of the Budget and of Congressmen. Involved is the opposition to the Navy and the U. S. Marine Corps particularly by the Secretary of Defense Louis A. Johnson. The latter's scrapping of the building of a super carrier led to the subsequent "revolt of the admirals" in hearings before the House Armed Services Committee which resulted in censure for the Air Force and approval for the building of a super carrier. The Army, Air Force, and Navy views on unification during and following the Korean War are detailed. The National Security Act Amendments gave the Secretary of Defense increased authority over the services. Reorganization Plan Number 6 of 1953 still further increased this authority. By 1953, although the services did not completely agree on unification, it was evident that the increased authority for the Secretary of Defense enabled him to insist on unification. The service secretaries were thus "demoted" to middle managers -- the price the services had to pay for increased unification.

This book has been accepted for publication by the University of Delaware Press.

*****

THE PRUSSIAN AND GERMAN NAVY IN ITS FORMULATIVE ERRA, 1845-1875

Researcher: Captain Kenneth W. Estes, USMC

In attempting to describe the course of development followed by the German Navy in its very first stages, a writer naturally runs afoul of a host of German naval historians who have, in the main,tended to treat the Prussian and early Imperial Navy as a "poor relation." The fact that Germany's sea forces of this period never grew beyond the level of second-rate sea power pales in contrast to the splendid and lavishly equipped High Seas Fleet of the Tirpitz Era. That contrast reflects vividly in prevailing judgments that the early Navy was hamstrung in its natural and logical growth by animosities and budget-related jealousies of the Army competition, or overly conservative bureaucrats -- civilian and military alike -- who failed to identify Germany's "natural" need for command of "her" seas and therefore, naval power of the kind represented in the 1898 and 1900 Fleet Laws.

This study examines German's naval development in its first generation without conscious reference to later periods of her naval policy. It is therefore written with the intention of determining whether such a viewpoint may produce a differing interpretation of continuity in German naval history. Specifically, one hopes to discover whether the policies developed in the first 30 years of the Navy's existence established strong doctrinal traditions, or on the other hand, merely represent regarded expediencies which were only tolerated until political conditions changed in the form of the Wilhelm II - Tirpitz combination that led Germany to a more suitable stature as a sea power of the first magnitude. The value of such an exercise lies in the observation of a naval organization in a time of change of a many-faceted nature, not totally fathomable to the participants at the time that they guided policy making.

*****

NUCLEAR WEAPONS AND DIPLOMACY

Researcher: Assistant Professor Kenneth J. Hagan

This essay will be published in Alexander DeConde, ed., Dictionary of American Foreign Policy (New York: Charles Scribner's Sons, in press). It traces the "costly and chimerical search for clear-cut American nuclear superiority over the second strongest nation on earth" that has characterized American foreign policy since the Second World War. The author concludes, as did Bernard Brodie and several other leading strategists in 1946, that "neither we nor the Russians can expect to feel even reasonably safe unless an atomic attack by one were certain to unleash a devastating atomic counterattack by the other." The unanswerable question is why did every president between Truman and Nixon fail to perceive that only the balance of terror could offer security, and the subsidiary question is how did Richard Nixon come to understand that among nuclear nations the greatest mutual security lies in individual insecurity?

*****

GEORGE WALLACE MELVILLE, ENGINEER, EXPLORER, ADMINISTRATOR

Researcher: Professor Neville T. Kirk

The project encompasses a biography of Admiral Melville. It concludes his Civil War service on the federal blockade and in the capture of CSS Florida, his outstanding service in the Jeanette Artic expedition (1879-1881) and in the rescue of the Greely party in 1884, and his achievements as Chief of the Bureau of Steam Engineering (1886-1903). The account therefore deals with Civil War naval operations, with a significant chapter in the history of

American Artic exploration, and with the evolution of U. S. naval engineering from its pioneer stage to the era of the steam turbine (Melville designed the first successful American marine steam turbine reduction gear).

Research continues in the Busteam records and the documents relative to the Congressional investigations of the Jeanette and Lady Franklin Bay (Greely) expeditions, all in the National Archives. The voluminous files of technical periodicals and professional society publications provide hitherto unexplored sources.

*****

AN HISTORICAL SKETCH OF FERRY FARMS

Researcher: Associate Professor Arthur A. Richmond III

The purpose of this study was to provide a brief account of the historical background of the Ferry Farms subdivision for inclusion in Broadneck: Maryland's Historic Peninsula, a Bicentennial book to be published in the spring of 1976. Research was conducted primarily in deeds preserved in the Anne Arundel County land office. Project was completed in January. It traces the high points in the subdivision's history since the establishment of Heirs Purchase on the Severn shortly after the first English settlers arrived in the area in the mid-17th Century. It notes how Heirs Purchase later become known as Jobs Landing and Watkins Inheritance, how it came into possession of the Ferry Farm Realty Company in 1905, how the realty company began to develop a community to be known as Naumana on the Palisades of the Severn, and how the community became known by its present name, Ferry Farms, in the 1920's.

*****

RICA DE ORO AND RICA DE PLATA: ISLANDS OF GOLD AND SILVER

Researcher: Assistant Professor William R. Roberts

This study describes the early legends of two related groups of islands rich in gold and silver located somewhere in the Western Pacific. Tracing the origins of Rica de Oro, Rica de Plata, and Las Islas del Armenicao back to the ancient stories of Argyre and Chryse as well as early sightings of the Hawaiian Islands, the paper focuses on almost three centuries of exploration for these islands by Spanish, Portuguese, Dutch, English, Russian, and even American explorers.

*****

THE SYKES-PICOT AGREEMENT OF 1916

Researcher: Associate Professor James P. Thomas

The purpose of this project is to investigate the causitive elements in the British and French decision to agree to partition the Arab portions of the Ottoman Empire and to provide for the creation of an independent Arab state during World War I. Emphasis is placed on elements of strategic interest, of both long-term and immediate wartime significance. The agreement reached, the Sykes-Picot Agreement of 1916, is traditionally considered to have been a betrayal of Arab nationalist aspirations and has been viewed as contributing to the general disaffection of the Arabs in regard to Britain and France. The agreement also was an element in the historical background of the Palestine problem.

Investigation has already been carried out by research in British Foreign Office, War Office, Admiralty, and Cabinet Office records in the Public Record Office in London. Also, many collections of private papers of British officials have been investigated. The material in the French Ministry of Foreign Affairs Archives in Paris has been investigated. The material produced by this research is in the process of digestion, collation, and incorporation into the study. The completion date cannot be determined at this time.

*****

THE NAVAL ACADEMY IN THE PRE-CIVIL WAR ERA

Researcher: Lieutenant Charles M. Todorich, USN

The purpose of this project is to investigate the early years of the Naval Academy from 1845 to 1861. An in-depth study of this area has not been made, although many primary sources exist in the form of letters of the Superintendent, naval officers' papers, the Naval Academy duty officer's log, and official records of the Naval Academy. Depositories holding these sources include the Naval Academy library, the National Archives, the Library of Congress, and the Naval Historical Center. Areas of research include: (1) the academic development of midshipmen during this era, (2) midshipmen professional training, (3) discipline, and (4) the interaction of the Naval Academy and the town of Annapolis, and the Academy's officer and civilian staff.

*****

CONCEPTS OF PLANNING, 1929-1933

Researcher: Associate Professor Philip W. Warken

This study is a survey of the factors that contributed to a revival of the idea of economic planning in the United States in the years after the onset of the Great Depression in 1929. As the discussion of economic planning became widespread in 1931, it was noted that while many had had faith in the possibilities of democratic planning in the moments after World War I, the development of affairs in the 1920's had brought about a change in attitude. Then the general absence of planning had seemed to be the stimulus for prosperity and many lost their zeal for the old faith.

Of the many forces which came together in the early 1930's to bring about widespread discussion and acceptance of the idea of planning, three stand out: the experience of the United States in mobilizing for World War I, the development of the idea of scientific management, and the commencement of the Five-Year Plan in the Soviet Union. Each was important because it captured the imagination or provided historic precedent for planning.

Scientific management and the World War I experience provided an American context for planning, but it was the Five-Year Plan that captured the popular imagination and seemed to offer a way out of the depression. It was an example and a challenge, pointing up the contrast between the helplessness of a rudderless society drifting in a turbulent economic sea and the opportunity of a system with a purposeful hand at the conn. Fear and hope combined to emphasize that much time had been wasted in responding to the depression and that planning had to be undertaken or the continuation of the system would be placed in doubt. These ideas are then compared to the opinions of those who opposed planning proposals -- either because they felt they endangered the old order or because they felt democratic planning did not go far enough.

*****

BELOTE, William M., Professor, co-author, Titans of the Sea: The History of the American and Japanese Carrier Operations in World War II, New York: Harper and Row, 1975.

Titans of the Sea describes operations of the aircraft carrier task force from its inception in the First World War to a fully developed weapon of war in mid-1944 during World War II. The resolution of problems that arose during peacetime training and wartime strike operations are explored in detail. Official records, American and Japanese, after-action reports, and recollections of participants form the bulk of the source materials used in writing the book. The book follows the course of the carrier war in the Pacific through the Marianas campaign. An analysis of carrier operations during the Pearl Harbor attack, and through the Coral Sea, Midway, Eastern Solomons, Santa Cruz, and Philippine Sea battles is included.

*****

CALDERHEAD, William L., Associate Professor, "U. S. Frigate Constellation in the War of 1812 -- An Accidental Fleet-in-Being," Military Affairs, 40 (April 1976), 79-84.

While the United States' frigate Constellation was the pride of the old Navy as a result of her success in the Quasi War in 1798, her role in the next war in 1812 to 1815 was one of utter despair and disappointment. Instead of escaping to sea and winning memorable battles as her sister frigates were doing, she spent the war trapped in Norfolk under never-ending blockade. There were a number of opportunities for her to escape, but due to technical and administrative delays and misunderstandings, the war was over before the Constellation had been able to seize the right moment to escape to sea.

Thanks to this, the story of the ship during the war was seemingly insignificant and has been accordingly neglected. Her role, however, may not be as minimal as some have implied. Nearly a century after 1812, Alfred Mahan noted that combat ships can play a very major role even in a blockaded port, by tying down large units of enemy ships in blockade work. The Constellation certainly accomplished this, for enemy forces three times or more her weight were usually detailed by the British to guard her. Thus although she never won major battles in the war, her services and contribution to a final American victory were meaningful and should not be overlooked.

*****

COLETTA, Paolo E., Professor, "Bradley Allen Fiske," Shipmate, 39 (April 1976), 19-23.

Admiral Fiske, USNA 1874, was naturally inclined toward drafting, mathematics, physics, chemistry, and optics. During his service with the Navy, 1874-1916, he acquired about 60 patents, some of which are still useful. He rose through the grades to command cruisers, cruiser and battleship

divisions, and eventually became the Aide for Operations equivalent to today's CNO, in the grade of Rear Admiral. He served during the Battle of Manila Bay and, with Representative R. P. Hobson, initiated the legislation creating the Office of CNO. Following his retirement, he worked on a torpedo plane and the miniaturization of printing and also published a number of books and articles about the Navy and inventions.

*****

COLETTA, Paolo E., Professor, "The Defense Unification Battle 1947-50; The Navy," Prologue (Spring 1975), 6-17.

The National Security Act of 1947 described the missions of the three branches of the armed services in ambiguous terms. Moreover, the Air Force asserted that its planes and atomic bombs were the only weapons systems needed to deter war or defeat an aggressor. The Navy disagreed on the ground that the Air Force lacked a truly intercontinental bomber and that it could not control the sea or launch amphibious operations. Meanwhile the Navy said it needed a large carrier so that technological progress in ships and aircraft would not stop. A devotee of air power, Secretary of Defense Louis A. Johnson scrapped the building of CVA-58, already authorized and partly funded, whereupon Secretary of the Navy John L. Sullivan justifiably resigned. In consequence of the very limited defense funding permitted by Truman and the bickering among the services, the United States was not as ready for the Korean War as it might have been. The atomic bomb monopoly of the United States had not prevented an attack on South Korea. Nor were atomic bombs used during the war. Korea proved the need of a Navy able to provide logistic support for the other services and cover for soldiers on the ground.

*****

ESTES, Kenneth W., Captain, USMC, technical editor, Combat Fleets of the World, 1966/77. Annapolis: U. S. Naval Institute Press, 1976. Translation of J. L. Cauhat, Flottes de Combat by J. J. McDonald, 575.

The first English-language translation of the famous French Naval annual required not only the basic translation task, but also the classification of terms, nomenclature and concepts in accordance with contemporary American doctrine and standards. New material and data were added when appropriate to update but not supplant the original French contribution.

Combat Fleets remains a most authoritative and economic alternative to the wellknown Jane's naval annual and is being published in the United States and United Kingdom.

The essays and descriptive material contain a refreshing viewpoint on matters of naval strategy and technology. Technical data, especially relating to shipboard weapons systems, are quite advanced,and the drawings and photography are of the highest quality.

*****

HAGAN, Kenneth J., Assistant Professor, "The Historical Significance of American Naval Intervention," in Intervention or Abstension, ed. by Robin Higham, Lexington: University of Kentucky Press, 1975 , 21-39.

This essay raises three questions. First, to what extent is it demonstrable that there has in fact been a consistent tradition of United States naval intervention over the last hundred years? Second, if such a tradition does exist, what have been the motivating factors behind it? Finally, what does a tradition of intervention suggest about the eventual outcome of the current historiographical debate between schools of thought labeled by Jerald Combs as nationalistic, realistic, and radical? The analysis concluded that a tradition of naval intervention abroad decidedly exists, that the reasons have often been economic, and that therefore Jerald Combs's radical historians have most accurately assessed the importance of overseas economic expansion to the naval establishment.

*****

HAGAN, Kenneth J., Assistant Professor, "The Navy in the Nineteenth Century, 1789-1889," in A Guide to the Sources of Military History,ed. Robin Higham, Hamden, Connecticut: Archon Books, 1975, 152-184.

This is a 32-page bibliographical essay critically evaluating 283 works on U. S. naval history, 1789-1889. The essay is arranged topically: general histories, periods of peace, navies at war, biographies, correspondence and memoirs, naval diplomacy, naval explorations, special studies, bibliographies, periodicals, published documents depositories, and research needed.

*****

MARSHALL, Philip R., Associate Professor, "William Henry Waddington: The Making of a Diplomat," The Historian, 38 (November 1975), 79-97.

William Henry Waddington (1826-1894) became foreign minister of France with the formation of the government of Jules Armand Dufaure in December 1877. It was Waddington who first had to face the question of whether France should or should not participate in the Congress of Berlin of 1878 and, if she should, under what conditions; it was Waddington who was the leader of the French delegation at the Congress; and it was Waddington who brought back to France the official and unofficial results of the Congress, upon which he built his subsequent diplomatic career. The growth and development of this man's diplomatic acumen over his first several years in office present us with an interesting picture of the novice learning the diplomat's trade. For it was the development of Waddington's diplomatic skill that in the long run spelled the difference between a simple French acquiescence to the general European settlement which evolved from the Congress of Berlin and, as was the case, a successful defense of French balance-of-power interests in the eastern Mediterranean plus an important contribution to the growing French interest in colonial expansion in Africa.

*****

POTTER, Elmer B., Professor, "The Campaign and Battle of Valcour Island," Shipmate, 38 (October 1975), 13-16.

This article covered the background of the American victory at Saratoga, which brought France into the American Revolution and thereby assured American independence. Emphasis is placed on naval operations on Lake Champlain under the command of Benedict Arnold. Arnold was defeated at Valcour Island, but the mere presence of his fleet on the lake delayed the invasion of the British army long enough for the Americans to assemble strength to defeat it.

*****

SWEETMAN, Jack, Assistant Professor, and James W. CHEEVERS, Curator, "The Decorations of John Paul Jones," The Medal Collector, 26 (September 1975), 13-31.

In contrast to the liberality with which they are distributed today, in the 18th Century decorations were very sparingly awarded. In the course of his career John Paul Jones received a total of four. These were: a special Congressional Gold Medal voted for his capture of the British frigate Serapis in the celebrated engagement with the Bonhomme Richard; the French Order of Military Merit in the grade of Chevalier, for the same event; the Imperial Russian Order of St. Anne, awarded him while in Russian service for the defeat of a Turkish fleet at the battle of the Liman; and the badge of the Society of the Cincinnati, an association of American and allied officers who had served in the War of the Revolution. The article describes the history and appearance of these decorations and investigates the circumstances of their award to Jones. It is illustrated by materials in the Naval Academy Museum.

*****

SWEETMAN, Jack, Assistant Professor, "Notable Naval Books of 1975," United States Naval Institute Proceddings, 102 (January 1976), 87-90.

The New Year's issue of the U. S. Naval Institute Proceedings traditionally carries a review article surveying the "Notable Naval Books" of the past year. The 1975 round up, the first prepared by the present writer, describes and evaluates 16 outstanding works in the field of naval and maritime history and affairs, as follows: Clay Blair, Jr., Silent Victory: the U. S. Submarine War Against Japan; Commander Thomas B. Buell, Jr., USN, The Quiet Warrior: A Biography of Admiral Raymond A. Spruance; Commander George E. Buker, USN (Retired), Swamp Sailors: Riverine Warfare in the Everglades, 1835-1842; Francis Dousset, Les navires de guerre francais de 1850 a nos jours; Admiral of the Fleet of the Soviet Union Sergei G. Gorshkov, Red Star Rising at Sea; John Francis Gulmartin, Jr., Gunpowder and Galleys: Changing Technology and Mediterranean Warfare at Sea in the Sixteenth Century; Kenneth J. Hagan,

American Gunboat Diplomacy and the Old Navy, 1877-1889; Hans Jurgen Hansen, The Ships of the German Fleets, 1848-1945; Richard G. Hewlett and Francis Duncan, Nuclear Navy: 1946-1962; Ludovic Kennedy, Pursuit; Captain John E. Moore, RN (Retired), Editor, Jane's Fighting Ships 1974-75; Rear Admiral Samuel Eliot Morison, USNR (Retired), The European Discovery of America: The Southern Voyages: A. D. 1492-1616; Noel Mostert, Supership; Clark G. Reynolds, Command of the Sea: The History and Strategy of Maritime Empires; Admiral J. O. Richardson, USN (Retired), as told to Vice Admiral George C. Dyer, USN (Retired), On the Treadmill to Pearl Harbor; and Gerald E. Wheeler, Admiral William Veazie Pratt,U. S. Navy: A Sailor's Life.

*****

JOHNSON, David E., Associate Professor, "The Uses of Compulsory Schooling." Paper read at Meeting of Society for Philosophy and Public Affairs, New York City, 13 December 1975.

*****

LOVE, Robert W., Jr., Assistant Professor, "Anglo-American Naval Diplomacy and the Second Front, 1942." Paper delivered at annual meeting of the Association of Contemporary Historians at the Institute for Historical Research, University of London at London, 10 July 1976.

*****

LOVE, Robert W., Jr., Assistant Professor, "Bureaucracy and Technology: The Sea Powers and Naval Aviation in the Disarmament Era, 1922-1936." Paper delivered to a seminar on "Assymmetries in Technology" sponsored by the Rand Corporation, Washington, D. C., 8 May 1976.

*****

POTTER, Elmer B., Professor, "Admiral Chester W. Nimitz and the Central Pacific Offensive, 1943-1945." Paper read at Annual Meeting of the American Historical Association, Atlanta, 29 December 1975.

*****

POTTER, Elmer B., Professor, "The Role of Seapower in Our Nation's First Two Hundred Years." Paper read at Meeting of National Maritime Council and the Navy League of the United States, Baltimore, 26 March 1976.

*****

THOMPSON, Larry V., Associate Professor, "Cultural Diffusion Through Military Instruments in Latin America: The German-Argentine Case." Paper read at International Studies Association Annual Meeting, Washington, D. C., 19 February 1975.

*****

THOMPSON, Larry V., Associate Professor (with Roger D. LITTLE, Assistant Professor), "Managing Technological Change: A Dialectical View of the Role of Soft Science R&D." Paper read at Atlantic Economic Society Annual Conference, Washington, D. C., 23 September 1975.

*****

THOMPSON, Larry V., Associate Professor, "Nationalism as a Spin-Off From Technical Expertise: German Military Influence in Argentina, 1899-1940." Paper read at State University of New York Association of European Historians Meeting, New Paltz, New York, 18 October 1975.

*****

DIVISION OF

MATHEMATICS AND SCIENCE

CHEMISTRY DEPARTMENT

Professor Joseph R. Wiebush

Research in the Chemistry Department serves to maintain faculty professional competence, to enrich the course work by inclusion of insights gained by exposure of the faculty to practical problems of the naval community, and to assist this community in solution of those problems where chemical input is needed. Toward this latter goal, the chemistry faculty, with its broad range of subspecialties, and the wide range of instruments, etc., needed for midshipman education, combine to provide a flexibility found in few other places in the Navy. When an initial approach fails, an alternative is often at hand because of the completeness of our physical plant.

Our success in the former goals can be quantitatively examined by noting that 19 of our faculty, including military and civilian alike, are among the names included in this report, with 11 midshipmen listed as co-investigators. The range of topics includes efforts to understand and avoid or clean up environmental effects of naval operations (9), the preparation of and characterization of potential fuels and propellants (4), studies of therapeutic compounds (2), development of polymers and piezoelectrics, and a project relating to validation of source documents for the intelligence community. Additionally, of course, there were programs in both biology and chemistry of a more basic or nonapplied nature (4).

These studies have received funding and encouragement from the Naval Academy Research Council, Walter Reed Army Medical Center, Naval Ship Research and Development Center, Naval Ordnance Laboratory (White Oaks) and Naval Ordnance Station (Indian Head) among others.

In the descriptions that follow are research efforts whose impact on the problems of the research and development community of the Navy are meaningful though apparently small. The significance of such research on the education of midshipmen is much harder to assess, but the enthusiasm of the teacher for his subject is a recognized component of good instruction. Research fosters such enthusiasm and keeps it alive.

*****

PRECEDING PAGE BLANK-NOT FILMED

EFFECTS OF SEWAGE ON THE MARINE BIOTA: AN ANNOTATED BIBLIOGRAPHY

Researchers: Lieutenant (j.g.) Mark M. Bundy, USNR and
Professor R. Reece Corey, Jr.

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

The objective of the project is to write an annotated bibliography of the effects of sewage on the biota of marine environments. Emphasis will be placed on the introduction of the sewage, human waste, shower water, and galley garbage, into the environment from a moving source.

A literature survey has been made which covers the years 1965-1975 and is being continued. Two extensive bibliographies were found with dates of 1970 and 1971; therefore, the primary emphasis was shifted to the years since 1970. The references have been pruned of duplicates and those listed in previous bibliographies. The list currently contains approximately 250 references. These references are being cross-referenced into categories. In general, the references fall into four categories: survival of coliforms and intestinal pathogens in seawater; spread and drift of effluents from off-shore sewage outfalls; water quality of various coastal areas and their off-shore environs; and effects of sludge dumping in the sea.

*****

OXIDATION OF S^{2-} BY Cl_2

Researcher: Associate Professor Frank J. Gomba

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

Unexpected corrosion of 90-10 Cu-Ni pipes aboard surface vessels being outfitted on the James River has led the Navy to believe that S^{2-} was instrumental due to the pollution of the river by sewage. Chlorinators have been shown to be successful in treating seawater to prevent fouling of Ti alloy tubing and in preparing potable water from seawater aboard ship. Chlorine can also oxidize S^{2-}. This investigation was concerned with the rate of oxidation of S^{2-} by Cl_2 to see if chlorinators can also effectively remove S^{2-} from seawater and thus prevent corrosion of the condenser tubes. This investigation has shown that the rate of oxidation of S^{2-} by Cl_2 is apparently quite fast, providing there is efficient mixing of the seawater with Cl_2. Conventional methods of following the rate have so far proven unsuccessful because of the apparent rapid rate. Competition reactions of Cl_2 with phenol (rate known) versus $Cl_2 + S^{2-}$ have shown that the first order rate constant is at least of the order of 10^5 sec^{-1} and not greater than 10^{11} sec^{-1} (rate of proton transfer), at 25°C. Since the half-life of S^{2-} in oxidation

studies by oxygen is of the order of 17 minutes, the Cl_2 oxidation of S^{2-} should be nearly of the same order. It appears that the role of S^{2-} in corrosion of the condenser tubes may be unwarranted unless inefficient mixing of seawater with air occurs. It is recommended that fresh water be used in outfitting ships and a very rapid intake of seawater be avoided, if possible, when ships are underway. While chlorinators may be effective initially in removing S^{2-}, the generation of ClO^- may also serve as a corrosive agent. The latter has not been investigated, however.

*****

POLAROGRAPHIC DETECTION OF Cd(II) and Cu(II) IONS IN BILGE WATER

Researchers: Associate Professors Frank J. Gomba, Morris M. Oldham, and W. Donald Pennington

Sponsor: Naval Academy Energy-Environment Study Group (Chief of Naval Development, Code MAT 03421)

Earlier work noted that certain metal ions could be detected polographically in contaminated seawater. This method is extended to the detection of Cd(II), Cu(II) and perhaps Cr(VI) in bilge water. The toxicity of Cd(II) and Cr(VI) has been demonstrated in respect to mammalian cells and synergistic toxicity of Cd(II) and Zn(II) has been reported.

This work indicated that Cd(II), Cu(II), and Ni(II) can be qualitatively identified and their concentrations estimated in bilge water at concentrations above 1 ppm.

Initial attempts were made to detect Cd(II) in distilled water containing Navy Distillate and Type I detergent. Further investigation may well show that this method is suitable for the detection of these impurities in sea water and bilge water.

*****

PHOTOCHEMICALLY INDUCED OXIDATION OF REFRACTORY ORGANICS BY HYDROGEN PEROXIDE

Researcher: Professor Edward Koubek

Sponsor: Naval Academy Energy-Environment Study Group (Chief of Naval Development, Code MAT 03421)

A study is being made as to the feasibility of oxidizing certain hard-to-dispose-of organic materials with photochemically activated hydrogen peroxide. Earlier studies with acetate ion indicate that this method may have considerable potential. Consequently, the study is being extended to other organics such as organo phosphorous and arsenic compounds.

The success of photochemically produced ($H_2O_2 \xrightarrow{hr} 2\ OH^{\cdot}$) radicals in initiating the oxidation of refractory organics had led to the investigation of other methods of $OH^{\cdot}$ radical production. The use of ultrasound has been investigated for this purpose but has met with little success. However, studies are continuing using ultrasound in conjunction with hydrogen peroxide for disinfecting purposes.

Studies are also continuing in the area of photochemically induced oxidation of refractory organics with hydrogen peroxide. Currently, the studies are being extended to include organic phosphorus-type compounds as disposal of these compounds is of great concern to the military. Hopefully, these studies will lead to a more detailed knowledge of the chemistry of the process which is needed before it can be placed into full-scale operation.

*****

EXTENSION OF SYNTHESIS OF ACRIDINE CARBINOL AMINES AS POTENTIAL ANTIMALARIALS

Researcher: Professor Samuel P. Massie

Sponsor: Army Medical Research and Development Command

The objective of this project was to prepare potential antimalarials by combining the carbinol amine side chain of quinine with the acridine nucleus of atebrin.

The starting material for antebrine, 6,9-Dichloro-2-methoxyacridine, was converted to 6-chloro-9-methyl-2-methoxyacridine by use of the malonic ester synthesis. This methyl derivative was oxidized to the 9-aldehyde derivative either via the nitrone or through the use of selenium dioxide. Subsequently, the aldehyde was converted via a Reformatsky reaction to a carbinol amide which was then reduced (diborane, among other reducing agents, will be studied) to the desired carbinol amine. Related studies were also carried out.

Studies were also made preparing 4-quinoline acids (cinchonic acids) via the Pfitzinger reaction.

*****

STUDIES OF DETERGENT SYSTEMS USEFUL IN THE TREATMENT OF BILGE WATERS AND OTHER SEWAGE

Researcher: Professor Samuel P. Massie

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

The objectives of this study were: (1) to develop new detergent systems, (2) to improve methods of separating the presently used detergent systems,

(3) to carry out physico-chemical studies aimed at determining the best methods of selecting such detergent systems, and (4) to determine the best methods of measuring the quantities present in parts of the system after separation.

A preliminary review of the literature showed few references in the area. Two approaches were taken: (1) letters were sent to leading oil and detergent manufacturers so as to determine the present state of the art, and (2) experiments were run to determine the quantities of detergent present after separation.

Replies were received from a majority of the manufacturers. They gave very little useful information.

Ultra-violet spectroscopy has been used to study a non-ionic detergent (Mil-D-16791) and its relationship to three oils in cyclohexane solution and in synthetic sea water. The detergent was studied in concentrations of between 10 and 30 ppm and found to satisfactorily obey Beers law, and thus, this technique can be used to study the amounts of detergent present in small amounts. The detergent showed absorbance peaks at 284 mu and 272.5 mu. the oils also showed UV absorption, but the peaks were not sharp and the technique could not be used to identify the oils. The presence of the detergent may be detected in the presence of the oils, but the oils cannot be studied in the presence of the detergent. While absorbance is additive, the quantity of detergent present in the presence of oils cannot as yet be determined. Studies are continuing in these directions.

*****

POLAROGRAPHY OF ORDNANCE COMPOUNDS

Researcher: Assistant Professor John V. Prestia

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

TNT, RDX, HMX, and Otto Fuel (76-percent Propylene Glycol Dinitrate) as well as many other explosive materials contain nitro groups capable of being reduced and thus polarographic methods have been suggested for analysis. Normal DC polarography at a Dropping Mercury Electrode has been tried on these compounds by some investigators with little success,but Single Rapid Sweep Polarography at a single Hanging Mercury Drop has been recommended.

TNT, RDX, HMX, and Otto Fuel all show unique Peak Potential pictures when reduced at the Hanging Mercury Drop Electrode with as fast scan of the potential range. It must yet be determined, however, what complications arise when one attempts to identify one of these materials in the presence

of others. It is also necessary to analyze more dilute solutions to determine the limits of detectability possible. For practical application in the field, it is apparent that other electrode systems must be investigated since the Hanging Mercury Drop Electrode requires constant attention and care.

*****

POLAROGRAPHY OF RDX HYDROLYSIS PRODUCTS IN EFFLUENT OF ION EXCHANGE COLUMN TREATMENT OF RDX WATER

Researcher: Assistant Professor John V. Prestia

Sponsor: Naval Sea Systems Command

The hydrolysis of RDX in basic solution has been studied and the products of the decomposition have been identified. Dr. John Hoffsommer at the Naval Surface Weapons Center has noted that this same kind of decomposition of RDX takes place on an ion exchange column (Amberlite 410 -strongly basic form) and is currently involved in scaling up this process in order to treat waste streams from loading and/or demilitarization operations.

It is highly desirable to have a simple monitoring device on the effluent side of this column in order to know when the column has failed or when the column needs to be regenerated. This project involves the use of rapid scan single sweep polarography at a hanging mercury drop electrode as a possible monitoring device.

RDX is known to show reduction waves in the range -0.4 to -1.3 (versus SCE) and a Field Polarograph has been developed by Becktel and Whitnack at the Naval Weapons Center, China Lake, which might be adaptable to this application. By analyzing both the RDX water input and the effluent from the ion exchange columns, results of this research show that RDX at levels of about 0.5 ppm in the effluent streams may be detected by polarograph methods. Attempts to identify products of the decomposition by polarography have been unsuccessful to date. Reductions of other nitro-containing compounds such as nitrobenzene, nitromethane, and more importantly dimethylnitramine (since RDX is a nitramine), indicate that it is the reduction of the nitro groups of the RDX that is responsible for the observed reduction waves.

*****

DEVELOPMENT AND SYNTHESIS OF ORGANOMETALLIC POLYMERS AND PIEZOELECTRIC POLYMERS

Researcher: Associate Professor Robert R. Ressler

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

The goal of this project is twofold:

1. Prepare and test a variety of organometallic polymers containing moieties imparting antifouling properties to the polymer for use as a coating, etc., in marine environments, and

2. Synthesize and test organic polymers possessing piezoelectric properties. For the applications envisioned, the polymers will have to be thermally and piezoelectrically stable over a wide temperature range.

The first goal is well on the way toward realization; the second is still to be achieved, the work having progressed no further than the preliminary search and study of the literature and highly tentative proposals.

*****

NEW HETEROPOLY TUNGSTATES

Researcher: Professor Orville W. Rollins

Sponsor: Naval Academy Research Council

The objectives of the work effort during the period covered by this report were the preparation and characterization of new heteropoly tungstates and the preparation of papers for possible publication in the chemical literature.

The methods of study include preparation of compounds and analysis for all constituents except constitutional oxygen, potentiometric titrations of salts and their free-acid solutions, cryoscopic studies in sodium sulfate decahydrate, spectral studies of solutions in the visible and near infrared regions, both powder and single crystal x-ray structural studies, and others.

The following new undecaheteropoly tungstates were prepared and studied:

$K_{6.7}Na_{1.3}[AlO_6AlO_4W_{11}O_{30}]\cdot 15.5H_2O$(II)

$RbNaK[AlO_6GaO_4W_{11}O_{30}]\cdot xH_2O$(III)

The analysis of compound (III) has not been completed; however, both compounds (II) and (III) have been shown to possess Keggin-type anions and each contains 8 formula weights per crystallographic-unit cell, as required by the possible space groups of this cubic system.

*****

PREPARATION AND CHARACTERIZATION OF A LIQUID PROPELLANT

Researcher: Associate Professor Charles F. Rowell

Sponsor: Naval Ordnance Station, Indian Head

The Navy's Liquid Propellant Gun program has reached the state of test firing and equipment development for NOS propellants. Against this background, a program to determine the least expensive but adequate method of quality control for pilot plant production was initiated.

The specific efforts of the work at the Naval Academy involved the preparation of 0.5 kg of a standard sample of very pure and fully characterized propellant of the accepted composition.

This was accomplished with special care given to eliminate trace transition metals and isomeric components. Achievement of these goals required developing a new synthetic route for one component, the development and validation of several analytical methods,and careful characterization of both starting materials and products at all steps.

*****

LANTHANIDE SHIFT REAGENTS AND OTHER PARAMAGNETIC CHEMICAL SYSTEMS

Researcher: Lieutenant Daniel R. Sudnick, USNR

Sponsor: Naval Academy Research Council

The objective of this study was to examine the explicit temperature dependence of Lewis-base adducts of Lanthanide Shift Reagents (LSR's) through the use of Nuclear Magnetic Resonance (NMR) spectroscopy. An understanding of the temperature dependence, in comparison with the predictions from theory, would provide insight to the mechanism responsible for variations in chemical shift of the adducts' NMR signals from their normal diamagnetic resonance positions. The importance of this understanding and the utility of Lanthanide Shift Reagents has been discussed in the author's proposal.

The approach has been to examine the temperature dependence of the proton resonances of the fillowing ligands: 4-picoline, 4-picoline-N-oxide, isoquinoline quinoline-N-oxide, dimethylsulfoxide, and n-propanol. The following LSR's were employed: $Ln(dpm)_3$, $Ln(fod)_3$, $Ln(acad)_3$; Ln = Pr, Nd, Sm, Eu, Tb, Dy, Ho, Er, Tm, Yb. Continuous wave NMR employing the department's Varian A-60A was performed in the temperature range +400 to -100°C using customary solvents and methodology.

*****

HEAT OF COMBUSTION OF SYNTHETIC LIQUID FUELS

Researcher: Professor John G. Zimmerman

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

The heats of combustion of synthetic fuels were to determine (1) whether the correlations so determined were identical with those for petroleum fuels, and (2) whether other properties could be used in place of direct determination of heats of combustion when specifying heat of combustion.

Correlation studies of three types of synthetic fuels and crudes -- coal based, shale based, and tar sands based -- using heats of combustion and other properties such as gravity, aniline point, and aniline-gravity product were to be undertaken. Correlation equations of petroleum fuels were to be used to relate the behavior of synthetic fuels and petroleum fuels and new correlation equations were to be developed where the petroleum fuel correlations proved inadequate.

For those synthetics which met petroleum fuel specifications, the correlations were similar to those of their petroleum counterparts. For synthetic fuels of certain classes, particularly aviation fuels, it was found that other properties (e.g., aniline-gravity product) could substitute without detriment for actual heats of combustion.

*****

CHESAPEAKE BAY MICROBIOLOGY

Researcher: Lieutenant (j.g.) Miriam C. Bras, USNR

The Chesapeake Bay is an area that does not seem to have been studied much with regard to its microbiology. Work has been done by Walker and Colwell, 1975; Kaneko and Colwell, 1973; Nelson and Colwell, 1972; and Cook and Goldman, 1976.

The main bacteria of the Chesapeake Bay are Vibrio parahaemolyticus and other Vibrio species Thiobacillus, Pseudomonas, Alcaligenes, Enterobacter, Klebsiella, and Escherichia. Seasonal changes in bacterial populations have been noted in the survey by Cook and Goldman, 1976. A correlation of actinomycetes populations to various physical conditions in the Bay has been done by Walker and Colwell, 1975. Saylor et al, 1976, have studied some pathogenic bacteria found both in water and in sediment, and the incidence of drug resistant bacteria has been studied by Morgan et al, 1976, Sturtevant et al, 1971, Feary et al, 1972, and Colwell and Sizemore, 1974.

It seems that not much work has been done on bacteria found in sediments in the Bay area. In general, at the surface are found the sulfur oxidizing bacteria such as Thiobacilli, and the green and purple sulfur bacteria. Immediately below this layer are found the sulfate-reducing bacteria such as Desulfovibrio. Also in this layer are found the various anaerobic bacteria such as Clostridium, Caulobacteria, Corynebacteria, and Bacillus. Factors affecting the life cycles of intertidal bacteria include both diurnal and seasonal temperature changes, pH of the sediment, surface tension of the water, salinity and redox potential of the sediment. The greatest number of bacteria are found at the surface of the sediment and rapidly decrease in number with depth.

*****

SEVERN RIVER WATER QUALITY PROJECT

Researcher: Lieutenant (j.g.) Mark M. Bundy, USNR

An enumeration was made of fecal and total coliform bacteria of surface water samples from the Severn River located in Maryland. Specific sampling sites were selected and sampled weekly. Temperature and secchi disk measurements were taken at each station. The water samples were filtered through millipore filters and cultured with coliform selective media. Preliminary results indicate that the general level of coliforms is acceptable except during periods immediately after heavy rainfall.

Some of the colony growths were of a noncoliform characteristic. These are being characterized using API system for identification of enterobacteriacea.

*****

BACTIOGICAL WATER QUALITY ANALYSIS OF THE SEVERN RIVER

Researcher: Professor Roland Reece Corey, Jr.

Water quality of the Severn River was monitored for coliform bacteria at 15 stations, weekly, June-September; bi-weekly, October-November and March-May; and monthly, December-February. Counts were made for total coliforms and fecal coliforms using the membrane filter method, an approved alternate method from "Standard Methods" of the American Public Health Association. The object was to obtain an overview of water quality and base data for future studies.

*****

KINETICS OF DECARBOXYLATION OF SUBSTITUTED MALONIC ACIDS

Researcher: Associate Professor O. Lloyd Jones

Despite considerable investigation, the mechanism of decarboxylation of malonic acid and its substituted derivatives is not as yet completely understood. Its fascination lies in the fact that although the dianions appear stable towards decarboxylation in all cases, the undissociated acids and monoanions each decarboxylate spontaneously and at different rates. The reactions are most conveniently followed kinetically by measuring the rate of evolution of carbon dioxide.

The nature of the substituting atoms or groups on the malonic acid skeleton has a profound effect on the rates of decarboxylation and one may attribute the observed differences to any one, or some combination, of several causes, such as inductive and steric effects. A comparative study of chloro, dichloro, and dibromomalonic acids for example should shed light on the reaction mechanism since dichloromalonic acid is highest in inductive effect but intermediate in steric hindrance. Since a number of compounds appear promising for study and because the number of parameters to be varied, such as pH, temperature, ionic strength, and solvent, is considerable, the project is clearly a comprehensive one of long-term duration. To date, several compounds have been prepared and purified, an apparatus suitable for the collection of kinetic data has been constructed, and the measurement of reaction rates in aqueous solutions of varying pH, as well as in dioxane-water solutions has been accomplished. Attention is currently centered on dichloromalonic acid, whose preparation is somewhat difficult but whose kinetic properties are most interesting. In addition, three computer programs have been written to facilitate handling the data collected.

Since the project is a complex one, there are a number of subsidiary problems to be solved before any meaningful conclusions can be drawn, and the latter lend themselves well to midshipman study. Two midshipmen have sucessfully undertaken independent research problems directly related to this project.

*****

DOCUMENT ANALYSIS

Researcher: Lieutenant William B. Mohr, USNR

For various government agencies, document authentication is a very desirable consideration. Numerous analytical techniques are available featureing remarkably low-detectability levels, but the variability of paper substrate and ink composition cause unacceptable tolerances. An investigation of the various techniques was performed and a combination of two different methods utilizing substantially different additives was selected. Experimentation was performed to establish the various parameters such as detectability limits, error ranges, analysis times, and aging effects on reproducibility.

*****

PREPARATION OF HYDROXYLAMMONIUM NITRATE AND STUDY OF ITS THERMAL DECOMPOSITION

Researchers: Associate Professor Charles F. Rowell and
Lieutenant Donald S. Smith, USN

The overall objective is to understand the processes related to the photodegradation of nitramines. In previous work, early stages of the process have been elucidated and results published. Current work deals with hydroxylammonium nitrate (HAN), a component of many high-energy systems. Its preparation and decomposition has been difficult to define carefully because commercial scale processes have invariably led to undesirable impurities whose presence defied prevention. Very pure HAN has been prepared during the course of this project and a potential for commercial scale production exists. Based on this seed effort, a proposal was written and submitted to the Naval Ordnance Station, Indian Head.

Favorable comments were received with potential support.

*****

ENERGETICS OF CAVE CRAYFISH

Researcher: Assistant Professor David L. Weingartner

This research project focuses on the ecology of troglobitic and troglophilic crayfish inhabiting Shiloh Cave which is located in Southern Indiana. The principal goal is to establish energy and protein budgets for the two populations and to quantify the flow of energy and protein through the cave ecosystem. For the crayfish population, this required the collection of biomass and life-table information, and the measurement of respiration,

egestion, ingestion, and production rates. The nature and quanitity of food entering and leaving the cave on an annual basis was also established, and the trophic relationship between this food base and the crayfish populations was determined. Comparisons were made with epigean ecosystems.

This research, which is in partial fulfillment of doctoral requirements, is completed.

*****

COREY, Roland Reece, Jr., Professor, "Pollution Abatement Concerns at the City Level (Environmental Problems -- City of Annapolis)." Proceedings of the Technology Seminar/Workshop on the Applications of Pollution Abatement Technology to Local Governments, edited by J. W. Stinson, David W. Taylor Naval Ship Research and Development Center,Report No. 4672.

The broad environmental problems confronting Annapolis are maintenance of water quality and retention of the aspects of nature within the city. Specific environmental problems of Annapolis are storm water pollution, soil erosion, solid waste disposal, increasing number of pleasure boats, and loss of natural land features. This article is a brief analysis of these problems as they exist within the City of Annapolis at the present time and their future trends.

*****

GOMBA, Frank J., Morris M. OLDHAM, and W. Donald PENNINGTON, Associate Professors, "Polarographic Detection of Cd(II) and Cu(II) Ions in Bilge Water," USNA Report No. EPRD-19, 19 February 1976.

Earlier work noted that certain metal ions could be detected polarographically in contaminated sea water. This method is extended to the detection of Dc(II), Cu(II) and perhaps Cr(VI) in bilge water. The toxicity of Cd(II) and CR(VI) has been demonstrated in respect to mammalian cells, and the synergistic toxicity of Cu(II) and Zn(II) has been reported.

This work indicates that Cu(II), Cd(II), and Ni(II) can be qualitatively identified and their concentrations estimated in bilge water at concentrations above one part per million.

Initial attempts were made to detect Cd(II) in distilled water containing Navy distillate and Type I detergent. Further investigation may well show that this method is suitable for the detection of these impurities in sea water and bilge water.

*****

HOFFMAN, John, Commander, USN, and Charles F. ROWELL, Associate Professor, "Cyclopropane Ring Opening by Photolytically Generated Bromine Atoms," Journal of Organic Chemistry, 40 (October 1975), 3005-3010.

Bromine atoms, generated by irradiation by a mercury lamp bearing a filter to assure that only wavelengths >310 nm passed, were permitted to react with a series of 1,2-diarylcyclopropanes in carbon tetrachloride solution. The major product in all cases (>80 percent) was the 1,3-dibromo-1,3-diarylpropane. Kinetic data at approximately 10^{-3} M gave a rate expression $dBr_2/dt = -k$ (cyclopropane) (bromine)$^{1/2}$. A Hammett treatment of the data

gave p - -0.5 for both the cis series and the trans series. Synthesis of several possible minor products and their comparison with the reaction mixture by TLC is reported. Possible reactions such as induced isomerization are thus eliminated from consideration.

*****

KOUBEK, Edward, Professor, "Photochemically Induced Oxidation of Refractory Organics with Hydrogen Peroxide," I&EC Process Design and Development, 14 (July 1975), 348-350.

A method of oxidizing certain refractory organics utilizing photochemically activated hydrogen peroxide is discussed. Emphasis is placed on the removal of acetate ion found in effluents resulting from wet oxidation of organic wastes. The kinetics and mechanism of the process are discussed along with the possible advantages of the method over metal ion catalyzed hydrogen peroxide oxidation.

*****

KOUBEK, Edward, Professor, "The Solubility of $CaSO_4$: An Ion Exchange -- Complexometric Titration Experiment for the Freshman Laboratory," Journal of Chemical Education, 53 (April 1976), 254.

This article deals with the determination of the "K_{sp}" of various salt solutions by passing saturated solutions of the salts through cation exchange resins and titrating the resulting acid produced. We have incorporated a version of this experiment into our general chemistry laboratory using saturated $CaSO_4$ solutions.

The student also determines the calcium concentration by a complexometric method using EDTA with hydroxy napthol blue as the indicator.

This laboratory may be used to introduce the student to two important areas of chemistry with the added advantage that one method serves as a direct check on the other.

*****

ROLLINS, Orville W., Professor, co-author "Sodium Paradodecatungstate 20-Hydrate," Acta Crystallographica, Vol. B32, Part 5, (1976).

Preliminary crystallographic unit-cell data for sodium paradodecatungstate were obtained from Buerger precession photographs which were refined

by least-squares analysis of 2θ angle measurements for 25 reflections made with the Picker four-circle, single-crystal diffractometer. The assumed centrosymmetric space group $P\bar{1}$ was confirmed by the structure refinement. Intensities were measured with Mo $K\alpha$ radiation by means of the automated Picker instrument using a crystal of approximately rectangular shape having dimensions 0·025x0·019x0.008 cm. Within the range of measurement of $2\theta=50°$, 4399 independent reflections were recorded, of which 3822 registered intensity greater than 3σ according to counting statistics, and were used for the structure analysis. Absorption corrections (calculated on a linear grid containing 36 points within the crystal, using the program ACACA written by C. T. Prewitt) were applied based on a calculated linear absorption coefficient of $\mu=247\cdot3$ cm^{-1} (Cromer and Liberman, 1970). Dispersion corrections were used in the final stages of structure refinement, but no extinction corrections were applied.

The structure was solved by means of the symbolic addition procedure applied to the normalized structure factors (Karle and Karle, 1966). This process led to four separate phase groups among 252 reflections having $|E|>2\cdot00$. Within these groups, the phases were well determined; but many trials using various computational parameters failed to reveal any reliable relationship between different groups. Therefore, 16 Fourier syntheses of 556 E terms with $|E|>1\cdot50$ were computed on the basis of phases calculated with the reflections $5\bar{4}4$, $49\bar{9}$, and $09\bar{8}$ set positive to determine the origin and the phases of the four reflections $53\bar{3}$, $7\bar{4}\bar{2}$, $8\bar{4}\bar{2}$, and $24\bar{4}$ permuted in sequence. The 16th synthesis (Phases + + + - - - -, respectively) showed the least number of peaks; and when a model plot was made of this map, the characteristic configuration of the 12 W atoms in the paradodecatungstate isopolyion was immediately recognized. When these W positions were used for phasing, the first electron-density synthesis revealed most of the non-hydrogen atoms,and refinement proceeded from this point in a routine manner.

*****

MASSIE, Samuel P., Professor, "The Trident Scholars Program of the United States Naval Academy." Paper read at the First North American Chemical Congress, Mexico City, Mexico, December 1975.

*****

MASSIE, Samuel P., Professor, Symposium Organizer and Presider, "Grants in Chemical Education." Symposium presented at the Division of Chemical Education, Centennial Meeting, American Chemical Society, New York, N. Y., April 1976.

*****

COMPUTER SCIENCE DEPARTMENT

Commander Kenneth G. Clark, USN, Chairman

The Computer Science Department has engaged in a modest research effort since its inception in 1971. At the current time, the major emphasis is on midshipman independent research. The department has sponsored midshipmen research projects in each of the last several years. The main topic of research continues to be software design. The midshipman research project of this past year was an analysis of existing Dartmouth Time Sharing System library programs, while independent faculty research was involved with transportable compiler and data base design.

Research in the area of minicomputer and microcomputer systems will be greatly enhanced with the arrival of a new mini-computer system.

*****

PRECEDING PAGE BLANK-NOT FILMED

TRANSPORTABLE COMPILER ANALYSIS

Researcher: Assistant Professor John L. Jones

An existing compiler for the programming language SIMPLE-T is written in SIMPL-T. The compiler is meant to be transportable via several methods. One such method is to take the results of internal tables when the compiler itself is compiled and physically transport these tables to the new machine, writing only a crude interpreter for the set of quads using the symbol table and necessary data files. The existing compiler was investigated to determine the feasibility of using a transportation scheme described above to get the language SIMPL-T running on the Dartmouth Time Sharing System. It was found that the existing compiler had used external files for storage of quads and data but that the symbol table was stored internally. To enable this method of transportation to be carried out effectively, an external symbol table storage mechanism must be added to the existing compiler. Such a mechanism is currently being studied.

*****

PROGRAM SYNTHESIS BY FLOW CHART ANALYSIS

Researcher: Midshipman 1/C Douglas B. Guthe

Adviser: Assistant Professor John L. Jones

Recent work by Dijkstra, Mills, and others has shown the need for a definite methodology being applied in the design of well-structured programs. This project investigated the use of flowchart analysis to existing programs on the Dartmouth Time Sharing System public library to restructure them according to the simple principles of top down design. Several programs of logical complexity (all were in the category of games) were first flowcharted, then the flowcharts were restructured, using some heuristics and some design choices. The newly structured flowcharts were then coded back into the original language (BASIC). The two versions were then compared for length, compilation time, and execution time. The flowcharts were also coded into a new, more structured language, DXPL, and the same comparisons made. In all cases, the revised BASIC programs were found to run faster than the original ones. Their source code lengths were not found to be significantly different.

*****

SKOVE, Frederick A., Assistant Professor, "Effective Utilization of Computer Systems for Estuarine Data Storage and Analysis." Paper presented at the Third Biennial International Estuarine Research Conference, Galveston, Texas, 7-9 October 1975.

*****

ENVIRONMENTAL SCIENCES DEPARTMENT

Commander John G. McMillan, USN, Chairman

Research in the Environmental Sciences Department covers a wide range of areas in the environmental and oceanic sciences reflecting the many levels of expertise held by the civilian and military departmental faculty as well as those in the Oceanography major. All of the civilian faculty are engaged in either individual or group research projects supported both by external and internal sources. Qualified undergraduate students are encouraged to conduct research in specific areas under faculty supervision. Research efforts in those areas relevant to the estuarine sciences are strongly supported by both an 80-foot, scientifically-equipped vessel, a small runabout, and extensive laboratory facilities.

Specific areas of research activity by the Department include but are not limited to sedimentation processes and properties, submarine geology, oceanic eddy processes, estuarine pollution, estuarine ecology, and marine optics. Many of these efforts involve both faculty and students.

Support for research in the Environmental Sciences Department has been provided by the Environmental Protection Agency, the Office of Naval Research, the United States Geological Survey, Chief of Naval Development, the Naval Academy Research Council, and other sources.

*****

PRECEDING PAGE BLANK-NOT FILMED

SPACE AND TIME CHARACTERISTICS OF THE OCEANIC MESO-SCALE BAROCLINE EDDY FIELD

Researcher: Lieutenant H. Lee Dantzler, USN

Sponsor: Office of Naval Research, Code 481

This project has involved some interlocking studies of the space and time variability in the upper ocean's density and thermal structure. They center around the acquisition and subsequent analysis of additional hydrographic data for a statistical refinement of work largely already completed in this area by the principal investigator. A complementary feasibility study using expendable bathythermographs to delineate accurately the spatial and temporal characteristics of the upper ocean's meso-scale (100-1000 km, 10-100 days) thermal variability over a large area has been initiated. New data have been acquired on a line from Barbados to the Azores for study. Meso-scale variations in the ocean's thermal structure can affect the acoustic-propagation characteristics of a given geographic region; and it is only through an understanding of these features that an accurate predictive assessment of the naval acoustic environment in the ocean can be made. These studies have allowed a better understanding of the ocean's variability to be achieved along with an active scientific intercourse by the Naval Academy with the leading oceanographic institutions. This exchange of information and expertise has aided in the continuance of relevant, upper-level academic courses in the environmental sciences at the Naval Academy.

*****

ANALYSIS OF HIGH-RESOLUTION SEISMIC RECORDS FROM THE CONTINENTAL SHELF AND SLOPE OFF TEXAS AND LOUISIANA

Researcher: Assistant Professor Douglas W. Edsall

Sponsor: United States Geological Survey, Corpus Christi, Texas

This study involved the interpretation of over 7,000 miles of high-resolution seismic reflection records from the continental shelf and slope off Texas and Louisiana. As the search for petroleum and natural gas accumulations moves into deeper water, it becomes imperative to have a detailed knowledge of the bottom and subbottom features of the ocean floor in areas believed to be promising for the discovery of large producing fields. In the past, primary interest of oil companies has been centered on locating potential producing horizons at depth. However, as the depth of water in which drilling will occur increases, it is becoming necessary to concentrate also on those bottom and subbottom features which will affect the safety of the drilling platforms. Severe restraints in siting platforms have also been imposed by the necessity to file Environmental Impact Statements.

The purpose of this study was to identify and map various geologic features present in future lease areas. The maps delineate areas of the floor of the Gulf of Mexico containing a variety of geologic features such as faults, gas seeps, slumps, slat domes, and areas of mass movements. The Geological Survey uses these maps to determine which of the areas studied can be leased for future oil drilling. It also uses the maps to interpret the Environmental Impact Statemenst of those oil companies who are bidding on these blocks.

*****

THE USE OF GROINS OR SIMILAR STRUCTURES TO REDUCE MAINTENANCE DREDGING OF HARBORS

Researcher: Professor John F. Hoffman

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

Most harbors in the continental United States of interest to the U. S. Navy are located within estuaries. Because of the presence of fresh water as well as salt water in an estuary, special sedimentation problems are created. This study addresses the problem of sedimentation in estuaries and proposes a method by which maintenance dredging costs can be reduced.

While there are exceptions, most estuaries are the respository for fine-grained sediments ranging from clay to fine sand in size. In the natural course of events, these sediments eventually fill the estuary. Although a certain amount of sediment buildup within the estuary can be tolerated, the long-term solution requires removing the sediments and depositing them elsewhere.

The method proposed to supplement the usual maintenance dredging by hopper dredge operates on the principle that the removal of any sediments that may eventually end up in the shipping channel is helping the situation. It consists of three parts: entrapment of the sediment, fluidizing the sediment periodically with backwashing water and/or air, and then pumping the suspension through a pipeline out of the area.

Dikes used by the Corps of Engineers to build out and straighten river banks by trapping sediment have been selected as the entrapment mechanism. The common-pile dikes consists of two to seven rows of clusters of wooden piles. The rows are spaced approximately 5-feet apart; the clusters 15 feet to 20 feet apart.

Once collected, the accumulated sedimentary material is loosened by a back-flushing system similar to that used to back-flush water supply filter beds. The loosened suspended sediment is then pumped away in a system

similar to the slurry pumping system presently in operation in Northern Arizona, transporting a slurry of 50-percent solids and 50-percent water over a distance of 273 miles. The material transported by pipeline could be loaded on barges, stored in dike disposal areas, used as landfill, or pumped to offshore spoil disposal areas such as submarine canyons.

*****

ESTUARINE POLLUTION CONTROL: A NATIONAL ASSESSMENT

Researcher: Professor Jerome Williams

Sponsor: Environmental Protection Agency

The investigator was responsible for coordination and preparation of a report on the status of pollution in estuaries throughout the United States. This stage of the project primarily involved final editing of the 50 individual papers which comprise the report. In addition, a motion picture entitled "Estuary" was produced with the investigator being one of the primary technical consultants. The report is scheduled for release in early spring, 1977, while the motion picture was released in the spring of 1976.

The overall content of both the report and the motion picutre is compatible with ongoing Naval Academy programs, many of which include the instruction of midshipmen in principles and operations that utilize and impact the estuarine and marine ecosystems.

*****

FUTURE U. S. NAVY ENVIRONMENTAL PROTECTION RESEARCH AND DEVELOPMENT NEEDS

Researcher: Professor Jerome Williams

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

The initial, well-intentioned thrust of the Navy environmental protection effort has been somewhat dissipated as budgetary considerations have forced the Navy to concern itself primarily with operational actions based solely on legal requirements and on research and development (R&D) programs to insure that these requirements are met. In these time of tight budgets and loose inflation, it became necessary to reexamine the Navy policy on environmental R&D to guarantee an optimum expenditure of all resources.

The methodology utilized on this project started with an analysis of Navy policy as set forth by the President (through executive orders) and filtered down the chain of command through the Secretary of the Navy and the Chief of Naval Operations. It may be seen from this policy analysis that research and development efforts in environmental protection are not only desirable but, in certain areas, are prescribed. The remainder of the effort attempts to identify the R&D areas of primary concern.

*****

SEPARATION OF COPPER CONTAMINANTS FROM CHESAPEAKE BAY SEDIMENTS UTILIZING HEAVY LIQUIDS

Researcher: Midshipman 1/C Frederick Bauer

Adviser: Professor John F. Hoffman

The purpose of this research was to determine the nature of the occurrence of copper in the sediments of Chesapeake Bay. Nine cores were taken from the bottom of Chesapeake Bay at three different sites by means of a Phleger cover. Each core was cross-sectioned into wafers. Each wafer was divided into three parts. One part was analyzed for the total copper content. The resultant data for all cores was then compared to determine variations in copper concentrations and spatial distribution of these concentrations. The second part of the wafer was separated gravimetrically using solutions of thallous mallonate having specific gravities greater than 2.7. The last part of the wafer was used to determine the moisture content of the wafer and the associated mineral ash content.

The value and distribution of the copper concentrations for Station Number 1 is typical of the results found at the other two stations:

108 ppm at the Bay bottom (average of three determinations)
20 ppm 10 cm below the Bay bottom (average of three determinations)
8 ppm 25 cm below the Bay bottom (average of three determinations).

The water content of the cores ranged from 39 percent to 84 percent of the total original sample weight. The organic material contained in the cores ranged from 6 percent to 30 percent of the dry weight.

Problems encountered with the solution of thallous mallonate led to inconclusive results in the fractionating of the copper insolubles. Additional research is required in this phase.

*****

THE NATURE OF OCEANIC EDDIES

Researcher: Midshipman 1/C Frederick V. Bauer

Adviser: Lieutenant H. Lee Dantzler, Jr., USN

The frequency of occurrence and source energy characteristics of oceanic eddies were studied. From a survey of oceanographic literature eddies with diameters exceeding 400 kilometers, central temperatures some 5 degrees celsius lower than ambrient, and currents near 2 knots are preferentially found seaward of the Gulf Stream off the U. S. coast. Possible implications to naval operations are considered.

WEATHER BALLOON LAUNCHING PROCEDURES FOR USNA

Researchers: Midshipmen 1/C R. F. Brunngraber and Victor M. Neves

Adviser: Lieutenant Richard B. Brodehl, USN

The midshipmen, using technical manuals and operating instructions for the AN/SMQ3, and the other various small components such as the battery tester, baseline check box, etc., developed a clear, concise step-by-step procedure for preparing and launching radiosonde weather balloons and recording and interpreting the data received. These procedures allow the untrained novice instructor to take a class to the field laboratory and launch a weather balloon in a 2-hour laboratory period.

*****

INSTALLATION OF AIR POLLUTION MONITORING SYSTEM

Researchers: Midshipmen 1/C Melvin R. Buflod and Frank M. Murphy

Adviser: Professor John F. Hoffman

In this one-credit course, the students assembled, positioned, and checked against the appropriate operation manuals the monitoring equipment and ancillary equipment for the following gaseous pollutants: hydrogen sulfide, ozone, total hydrocarbons, methane, carbon monoxide, nitrous oxide, nitrogen dioxide, and total NONOXs.

*****

ADAPTATION OF A FRESH-WATER FISH TO SALT WATER

Researcher: Midshipman 1/C John E. Gault

Adviser: Lieutenant Commander James T. Welch, USN

The fresh-water mosquitofish (Gambusia affinis) has been used as a biological control for mosquitos in ponds and streams. This research attempted to acclimate a collection of Gambusia to a marine environment to assess the possibility of their use in controlling salt-marsh mosquitos.

After an initial bioassay to determine a starting point, several groups of test specimens were placed in aquaria of low salinities. The salinity of the tanks was slowly raised, at different rates, to oceanic values ($^{N}35°/_{oo}$).

Results showed that Gambusia was able to survive at elevated salinities; however, normal reproductive processes seemed to be impaired. Unless a breeding population of acclimated organisms can be developed, the commercial use of these fish as a salt-marsh mosquito control is not feasible.

*****

AN ANALYSIS OF THE DANGER AREAS PROPOSED IN "TROPICAL CYCLONE EVASION PLANNING"

Researcher: Midshipman 1/C Robert B. Guild

Adviser: Lieutenant Commander Richard B. Broedehl, USN

This was a study of the accuracy of the proposed tropical storm evasion techniques proposed by Captain W. L. Somervell, USN, and Lieutenant Commander J. D. Jannall, USN. The study encompassed all hurricanes in the Atlantic for the years 1968 and 1975. It comes to an excellent conclusion, showing that the warnings issued are usually too far to the right of the storm track, and that the evasion techniques do not take this into account.

*****

EXTRACTION AND IDENTIFICATION OF PIGMENTS FROM MARINE ALGAE

Researcher: Midshipman 1/C David G. Markham

Adviser: Lieutenant Commander James T. Welch, USN

Marine alge from the Chlorophyta, Rhodophyta, and Phaeophyta were processed to extract the pigment from the plastids. The procedures used were developed by Dr. L. R. Blinks of The Hopkins Marine Station of Stanford University.

Separation of the pigments was accomplished by paper chromatography and the analysis was done by spectrophotometry.

Procedures developed in this project have been incorporated into the laboratory work required for Biological Oceanography.

*****

WILLIAMS, Jerome, Professor, "Suspended Sediment Determination in Estuarine Waters from Photometer and Secchi Disc Measurements," USNA Report No. EPRD-16, 1 September 1975.

A mathematical light-scattering model previously developed by the author sums the attenuating effects of a stack of particles containing "plates." One of the unknown quantities in this model is the relative amount of light scattered in a backward direction by each particle. By considering the effects of multiple scattering, the portion of light scattered in a backward direction is calculated and turbidity parameters are then easily related to the relative irradiance loss coefficient (k) and the attenuation coefficient (c). These are directly obtainable from photometer and secchi disc measurements. Data are presented from the Chesapeake Bay which compare average particle size and total suspended load as determined by laborious visual counting and sizing techniques and by direct calculation from photometer secchi disc measurements. It is shown that the quality of the results obtained using these simple and inexpensive devices is comparable to the much more expensive and time-consuming method.

*****

EDSALL, Douglas W., Assistant Professor, "Mid-Plate Tephra, Eocene to Recent, Harvair." Paper read at Annual Meeting of Geological Society of America, Salt Lake City, 20-22 October 1975.

*****

EDSALL, Douglas W., Assistant Professor, "Temporal Variations of Pb, Sr, Ti, and Zr Concentrates in Upper Miocene to Recent DSDP Leg XIX Ashes: Magnetic Evolution at a Consuming Margin." Paper read at Meeting of American Geophysical Union, San Francisco, 8-12 December 1975.

*****

WILLIAMS, Jerome, Professor, "Extrapolation is a Loser's Game." Paper read at Meeting of Atlantic Estuarine Research Society, 7 May 1976.

*****

MATHEMATICS DEPARTMENT

Professor G. Ralph Strohl, Jr., Chairman

Research in the Mathematics Department encompasses a broad spectrum of areas. Present activity includes mathematical research in group theory, lattice theory, differential equations, ergodic theory, topology, logic, category theory, nonstandard analysis, harmonic functions, and classical analysis.

A number of research projects have received support from grants -- primarily from the Naval Academy Research Council and the Office of Naval Research. One staff member is working on a volume to be included in a new encyclopedia of mathematics. One midshipman wrote a Trident Scholar project under the direction of a member of the faculty.

*****

REGULAR ELEMENTS IN SEMISIMPLE ALGEBRAIC GROUPS

Researcher: Assistant Professor Peter P. Andre

Sponsor: Naval Academy Research Council

The goal of this project was to classify all Q-conjugacy classes of Q-regular unipotent elements in semisimple algebraic groups defined over the field of rational numbers Q. The investigation was divided into the cases of split groups and non-split groups. In the split case, the action of a split torus on Q-regular unipotent elements was examined. It was proved that the Q-conjugacy classes of Q-regular unipotent elements were in one to one correspondence to the product of copies of the multiplicative group of the rational factored by a power of this group. The degrees of the factors can be derived from the direct decomposition of the center of the big group into cyclic groups. In the non-split case, many concrete examples were examined and the Q-conjugacy classes of Q-regular unipotent elements were computed. It was conjectured that the Q-rational points of the group act transitively on the images of the Q-regular unipotent elements in a space formed by taking the product of projective spaces each produced from one of the simple root spaces.

*****

CLOSURE OPERATORS WITHOUT THE EXCHANGE PROPERTY

Researcher: Assistant Professor William R. Belding

Sponsor: Naval Academy Research Council

Problems that naturally arise from algebraic closure operators are (1) finding necessary and sufficient conditions for a closed set to have a basis, and (2) finding necessary and sufficient conditions for bases of a closed set to be equicardinal. The purpose of this project is to investigate sufficient conditions for bases to have the same cardinality for one class of closure operators.

The results obtained so far are centered on the main following result. (R,R^+) is a partially ordered ring and (M,M^+) is a strict (R,R^+)- module. So M is a left R-module and $(R^+\setminus\{0\})(M^+\setminus\{0\})\subseteq M^+\setminus\{0\}$. Let $<'$ be the order induced on M by M^+. $B\subseteq M^+$ is an R^+-basis for M^+ means $R^+B^- = M^+$ (spanning) and if r is in R, b in B with $0 <' rb <' b$ then $rb \notin R^+(B\setminus\{b\})$ · (independence). Result: if B and D are R^+-bases for M^+, then card B = card D and to within a permutation $b_i - u_i d_i$ for units u_i of $R^{\pm}$.

A preliminary version of the paper version of the paper "Bases for the Positive Cone of a Partially Ordered Module" was presented to a special session on ordered groups at the August 1975 Summer Meeting of the American Mathematical Society in Kalamazoo, Michigan. This paper has been completed and has been accepted for publication by Transactions of the American Mathematical Society.

*****

EXTENSION AND GENERALIZATION OF THE LETTENMEYER THEOREM

Researcher: Assistant Professor James M. D'Archangelo

Sponsor: Naval Academy Research Council

The objective of this work has been to apply some recently developed theory concerning differential equations with Laplace-Stieltjes transforms as coefficients to two problems. The first concerns the representation of solutions of Whittaker's equation, a differential equation arising in mathematical physics, in terms of Laplace-Stieltjes transforms of hypergeometric functions.

The second problem is to determine necessary and sufficient conditions so that a linear ordinary differential equation with coefficients which are power series of $1/z$, converging for $/z/>R$, has a solution which is a similar power series. Such a result would generalize Lettenmeyer's Theorem which partially answers this problem.

A solution has been obtained for the first problem, i.e., determining representations of solutions of Whittaker's differential equation in terms of Laplace-Stieltjes transforms of hypergeometric functions. The results are contained in the research paper entitled "On the Whittaker Differential Equation and Laplace Transforms."

Recent results of Philip Hartman concerning the existence and uniqueness of solutions of certain ordinary differential equations are applied to Whittaker's equation to obtain, in a direct simple way, representations of Whittaker functions and their products in terms of Laplace-Stieltjes transforms of hypergeometric functions. This paper has been accepted for publication in the Bulletin of the Calcutta Mathematical Society.

The second problem is much more difficult. Methods applied only gave partial information as to when solutions can be written as converging power series of $1/Z$. Work will continue on this problem and progress reported.

*****

MATHEMATICAL MODELING

Researcher: Associate Professor Arthur A. Karwath

Sponsor: Naval Research Laboratory, Code 7930

The overall project was concerned with computer-oriented research investigations in orbital mechanics and the mathematical modeling of dynamic systems. In particular, various satellite missions were investigated using current trajectory and orbital tracking programs. An attempt to extend the accuracy and flexibility of these programs was made. Also, the development of new data smoothing algorithms was undertaken.

*****

FINITE INVARIANT MEASURES FOR SEMIGROUPS OF MARKOV OPERATORS

Researcher: Assistant Professor Stephen A. McGrath

Sponsor: Naval Academy Research Council

The problem investigated deals with ergodic theory. It involves determining if there exists a finite-invariant measure for a certain semigroup of Markov operators. The problem of showing the existence of invariant measures has received much attention mainly for the following reason: if an invariant measure exists for a Markov operator P, then the individual ergodic theorem holds for P, i.e., the Cesaro sums of P and its iterates will converge pointwise for any function in the Lebesque space. The determination of the existence of limits of this type is a basic problem in ergodic theory.

It is believed that techniques used in the theses of U. Sachdeva ("Some Theorems on Category of Transformations and on Existence of Invariant Measures for Operations," Ph.D. Thesis, The Ohio State University, 1970) can be adapted to obtain the result. Several theorems appearing in Sachdeva's thesis generalize results for semigroups generated by one operator to the left amenable case. The basic ideas involve using the identification of M and m, the supremum and infimum respectively of all left-invariant means on the Banach space of all bounded real-valued functions on the semigroup of Markov operators, and a theorem of M. M. Day.

*****

MATHEMATICAL, STATISTICAL, AND DIGITAL COMPUTER ANALYSIS OF TIME SERIES DATA

Researcher: Midshipman 1/C Steven J. Raher

Adviser: Associate Professor John S. Kalme

Sponsor: Trident Scholar Program

The purpose of this project was to develop a series of computer programs for use in analyzing time-series data, such as EEG (brain wave) recordings. Programs were written to produce reliable estimates of correlations, spectra, cross-spectra, and partial coherences of multi-channel random processes. The software package was written to be easily adaptable to different sampling rates, amounts of data, and numbers of channels. Provisions for digital prefiltering of data, detrending, and smoothing (using a number of lag windows) were also included. Techniques for estimation of spectra by fitting single- and multi-channel autoregressive schemes to sampled data were also applied and found to yield results consistent with the other methods. All programs were written in FORTRAN and run on the USNA/DTSS computer system.

*****

INJECTIONS OF HALF-OPEN INTERVALS WHICH SURROUND POINTS IN THE PLANE

Researcher: Assistant Professor William L. Young

Sponsor: Naval Academy Research Council

The objective of this research is to find sufficient condition for an injection $f:[0,\infty)\to R^2$ to be spiral-like, i.e., have the property that for some pair of points p and q in R^2,

$$f([x,\infty)) \cap J \neq 0$$

for all x and for all arcs J between p and q. The motivation for this research is the investigation of the fixed-point property of planar arcwise connected continua which do not contain any simple closed curves.

In order to establish the spiral-like property, an injection is characterized by the intersection of its image with a fixed line. The idea is to describe a function which turns back within itself infinitely many times. In practice, this involves constructing a nested decreasing sequence of compact subsets each of which is enclosed by a finite piece of the image if the function. Point p is then chosen in the intersection and q outside the image.

Several sufficient conditions have been found but none general enough for use in the original fixed-point problem.

*****

THE CHAUVENET PAPERS

Researcher: Professor James C. Abbott

The Committee on publications of the Mathematical Association of America has authorized a volume of past Chauvenet Prize papers. The work consists of "assembling the papers, getting copyright permissions where possible, organizing prefatory material -- this last including details of the relationship of Professor Chauvenet to the Academy . . ."

The Chauvenet Prize was established by the Mathematical Association of America in 1925 for outstanding expository papers in mathematics. It was named after Professor William Chauvenet, the first Head of the Department of Mathematics at the Naval Academy, in recognition of his reputation as a great teacher and expositor. His legacy to the present Mathematics Department is one of devotion to exposition and teaching.

Since its inception, the Chauvenet Prize has been awarded 24 times, originally at 3-year intervals but now on an annual basis as long as suitable papers are deserving of the prize. Almost all of the past winners have gone on to become world-renowned mathematicians, thus attesting to the fact that good exposition frequently accompanies research in the hands of the best mathematicians.

The project to republish all past Prize papers was undertaken by the Mathematical Association of America in recognition of a continuing goal to encourage good exposition. It is hoped that the future papers can continue to be collected whenever they are sufficient in number to justify a new volume. The present project has in fact led to two volumes and will include biographies of authors as well as brief appendices updating early papers and pointing out subsequent developments in respective areas. References will be supplied for those who wish to follow up the original papers.

It is hoped to have the volumes ready by January 1978. If so, their announcements will be made at the Annual Meeting in Atlanta in January 1978. At that time, a Chauvenet Symposium will be held at which selected past Prize winners will be asked to give repeat performances of outstanding "exposition." This symposium will be modeled on the one held at the Naval Academy at the time of dedication of Chauvenet Hall.

*****

BOOLEAN ALGEBRA (ENCYLOPEDIA OF MATHEMATICS AND ITS APPLICATIONS)

Researcher: Professor James C. Abbott

This project consists of the writing of a 300-page volume on Boolean Algebra which will become part of the Encyclopedia of Mathematics and Its Applications. This encyclopedia is the first endeavor to present to the audience, made up of scientists and technologists, the entire body of pure

and applied mathematics. Authors were selected on the basis of their known reputation in their specialties. Although the research required is not all original, new and recent results will be included as, for example, the work of Abbott on semi-Boolean algebras and implication algebras.

*****

ABBOTT, James C., Professor, "Orthologics," Studia Logica, XXXV (1976), 2.

This paper is an extension of the work of the author in the field of implication algebras developed by him over the past decade. It relates the mathematical theory of orthoimplication algebras to mathematical logic. Orthologics arise in the study of modern foundations of quantuum mechanics. Orthoimplication algebras are generalizations of semi-Boolean algebras and implication algebras. The present paper shows how orthoimplication algebras arise as Lindenbaum-Tarski algebras of implication algebras just as Boolean algebra arises as the algebraic structures associated with classical propositional logic.

*****

D'ARCHANGELO, James, Assistant Professor, co-author, "Integration of Ordinary Linear Differential Equations by Laplace-Stieltjes Transforms," Transactions of the American Mathematical Society, 204 (April 1975), 245-266.

Let R be a constant n x n matrix and g(t) and n x n matrix of functions representable as absolutely convergent Laplace-Stieltjes transforms for $t > 0$. Sufficient conditions are given for the existence of certain solutions of the linear-first-order system $y' = (R + g(t))y$ which are representable as Laplace-Stieltjes transforms or linear combinations of such transforms with coefficients of the form $e^{bt}t^d$. The results are applied to the Bessel equation to obtain for the Hankel functions integral representations involving Legendre functions.

*****

D'ARCHANGELO, James, Assistant Professor, "An Integral Representation for the Solution Wkm of Whittaker's Differential Equation," Siam Journal of Mathematical Analysis, 6 (November 1975, 907-912.

The Whittaker differential equation arises in Mathematical Physics when solving the wave equation by means of separation of variables using parabolic coordinates. The Whittaker functions are certain solutions of this equation which provide a basic set of functions for the exact solution of the wave equation for all problems involving parabolic mirrors or parabolic antennas. Recent results concerning the existence of solutions of ordinary linear-differential equations with Laplace-Stieltjes transforms as coefficients are applied to Whittaker's differential equation. As a result, integral representations (involving in certain cases the Legendre polynomials) are obtained for the Whittaker functions and their products. Similar results are given for certain solutions of Laguerre's equation and their products.

****

HARTIG, Donald G., Assistant Professor, "On Functors from Compact Pairs to Banach Algebras," Studia Mathematica, 53 (1976), 191-198.

A compact pair (X,A) consists of a compact topological space X and a closed subspace A. The family of all compact pairs together with the continuous functions between them is called the Category of Compact Pairs, denoted CompPr. Each compact pair (X,A) determines a Banach Algebra C(X,A) consisting of the complex-valued continuous functions on X that vanish on A. Moreover each function f in CompPr, say from (X,A) to (Y,B), determines a continuous algebraic homomorphism f' from C(Y,B) to C(X,A) given by $f'(g) = g \circ f$. The correspondence $f \to f'$ described above is called a functor. This paper displays certain natural properties of this functor and demonstrates that these properties essentially characterize it.

*****

HERRMANN, Robert, Assistant Professor, "A Note on Weakly θ-Continuous Extensions," Glasnik Mathematicki, 10 (1975), 329-336.

The nonstandard theory of weakly theta-continuous, theta-continuous, and almost continuous maps is briefly discussed and employed to improve upon a result of Rudolf. In particular, we introduce the concept of weakly Z-proper map extensions. Using this concept, we show that a Z-proper map of Rudolf from a dense subspace X of Z into a a Hausdorff space is weakly Z-proper. As a partial converse, it is shown that a weakly Z-proper map from X into a quasi-H-closed space is Z-proper. It follows that if there exists a weakly theta-continuous extension F on Z of a weakly theta-continuous map f on X into a Urysohn space Y, then f is weakly Z-proper. In a highly saturated enlargement, this last result also holds if we assume that f is additionally an open map and Y is simply Hausdorff. As the main result, it is shown that every weakly theta-continuous Z-proper map on a space X dense in Z possesses a weakly theta-continuous extension F on Z. Moreover, F is theta-continuous on the remainder and unique if the codomain is Hausdorff. As a corollary to this result, we improve upon a major result of Rudolf by showing that every weakly theta-continuous Urysohn map f from a Hausdorff space X into an H-closed space Y possesses a unique weakly theta-continuous extension from the Katetov extension of X into Y.

*****

HERRMAN, Robert, Assistant Professor, "Nonstandard Topological Extensions," Bulletin of the Australian Mathematical Society, 13 (1975), 269-290.

In this paper, the nonstandard theory of filters on a nonempty meet-semi-lattice is investigated first. It is shown that most of the nonstandard theory of filters on a power set algebra hold in this weaker case. This theory is applied to the general theory of topological extensions Y for a space X. Whereas these extensions have previously been obtained and studied as types of ultrafilter extensions, we study them as subsets of an enlargement *X of X. Since the elements of the extension Y and and the base space

X are of the same set theoretic type, this nonstandard approach seems more natural than previous methods. In particular, we construct nonstandard Baire extensions for non-Baire spaces and show that they have some properties similar to a Stone-Ceck compactification. For non-quasi-H-closed spaces, we construct and study a chain of nonstandard quasi-H-closed extensions, which has a lower bound isomorphic to Liu's extension. Using normal base theory, we construct and investigate the properties of a chain of nonstandard compactifications for a non-compact completely regular space. We show that this chain has a lower bound isomorphic to the Frink compactification if the base space is Tychonoff. Finally, for a chain of normal bases ordered by inclusion which possesses a lower bound, it is shown that from the nonstandard construction viewpoint, Frink compactifications are isomorphic (homeomorphic) if, and only if, their nonstandard constructions are equal as spaces.

*****

NILES, Nathan O., Associate Professor, Plane Trigonemetry, Third Edition. New York: John Wiley and Sons, Inc., 1976.

This text proposes to give a modern flavor to trigonometry. It emphasizes the analytical aspects rather than the computational. By introducting the concept of a function in terms of domain and range, it is brought to the student's attention that trigonometric functions are evaluated at an angle or at a real number. The analytical aspects of trigonometry are discussed with respect to real numbers as well as angles. The use of electronic calculators in computations is discussed as to the accuracy of data, significant figures, and the rounding off of numbers. Many applied problems from electricity, the physical sciences,and technical subjects are included.

*****

DAVIS, Frederic I., Associate Professor, "Conical Spectra and Translation Group Automorphisms of W* Algebras." Paper read at 82nd Annual Meeting of the American Mathematical Society, San Antonia, Texas, 22-25 January 1976.

*****

FRYANT, Allan, Assistant Professor, "Growth of Entire Harmonic Functions in R^3." Paper read at Summer Meeting of American Mathematical Society, Western Michigan University, 20 August 1975.

*****

FRYANT, Allan, Assistant Professor, "Interpolation and Approximation Axi-symmetric Harmonic Functions in R^3." Paper read at Meeting of the American Mathematical Society, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, 7 November 1975.

*****

FRYANT, Allan, Assistant Professor and Morris MARDEN (California Polytechnic State University), "Green's Function With Ring Pole and Applications to Interpolation." Paper read by Dr. Marden at Meeting of the American Mathematical Society, Los Angeles, California, 15 November 1975.

*****

HARTIG, Donald, Assistant Professor, "Units in M-Spaces." Paper read at Annual Meeting of the American Mathematical Society, San Antonio, Texas, 22-25 January 1975.

*****

HERRMANN, Robert, Assistant Professor, "How to Trivialize Many Results in Topology." Paper read at Mathematical Association of America, Georgetown University, Washington, D. C., 22 November 1975.

*****

HERRMANN, Robert, Assistant Professor, "The Q-Topology, Whyburn-Type Filters and the Cluster-Set Map." Paper read at Annual Meeting of the American Mathematical Society, San Antonio, Texas, 22-25 January 1976.

*****

McGRATH, Stephen, Assistant Professor, "An Abelian Ergodic Theorem for Semi-Group Lp Space." Paper read at Summer Meeting of American Mathematical Society, Western Michigan University, 24 August 1975.

*****

MOULIS, Edward J., Assistant Professor, "On the Univalence of a Class of Analytic Functions." Paper read at the Special Conference on Complex Analysis, State University of New York, College at Brockport, Brockport, New York, 7-8 June 1976.

*****

PENN, Howard, Assistant Professor, "Inner-Outer Factorization of Functions Whose Fourier Series Vanish Off a Semigroup." Paper read at Regional Meeting of the American Mathematical Society, New York City, 12-14 April 1976.

*****

PHYSICS DEPARTMENT

Professor Ralph A. Goodwin, Chairman

The research program in the Physics Department continues to develop along several fronts. Present activity includes an energy group, a solid-state group, and independent research in the electrical properties of materials, acoustic cavitation, flow-generated-cavity resonance, noise, laser hardening, stellar photometry, nuclear scattering, and theoretical problems. In each instance, midshipman are, or have been, actively engaged in the research either as Trident Scholars or through accredited research projects.

*****

STUDY OF LIQUID MONOPROPELLANT REACTION THRESHOLDS

Researcher: Associate Professor Lawrence A. Crum

Sponsor: Naval Ordnance Station

The project deals with the effect of a high-power ultrasonic device upon liquid monopropellants. Specifically, it concerns the testing of the moderately powerful (≈25 watts) ultrasonic horn with various propellants in an attempt to (1) determine the feasibility of ultrasonic ignition, (2) determine the threshold for ignition, and (3) determine the feasibility of using the horn as an ignitor or as a sensitivity test mechanism.

Tests were made using a catenoidal horn driven at a frequency of 20 kHz and generating up to 35 watts of acoustic power. It was determined that the device was capable of causing partial ignition of the propellant but only after several seconds of insonification. Various states of partial ignition were observed, and certain cases of slow burning occurred that were probably similar to actual ignition. It was also determined that improper amounts of chelating agent could cause increased sensitivity to the ultrasonic device. Further, it was found that replacement of certain components of NOS-429 with HAN could sufficiently increase the sensitivity so that slow burning could be initiated with the device. It appears that although this method probably does not have promise as an ignitor, it does have many possible uses in propellant acceptance tests and as an aid in propellant composition research.

A report entitled "The Effect of a High-Power Ultrasonic Device on Liquid Monopropellants" was written.

*****

ACOUSTICAL CHARACTERISTICS OF COANDA-TYPE NOISE SUPPRESSOR

Researcher: Professor Samuel A. Elder

Sponsor: Naval Air Engineering Center

The objective of the project was to conduct analytical studies to investigate methods for increasing the acoustic-absorption characteristics of the Coanda enclosure. The amount of sound generated both inside and outside the protective enclosure was estimated. Internal- and external-sound transmission paths were considered.

It was found that the main noise source in the present suppressor system is quadrupole radiation from the outer shear layer of the Coanda-wall jet and its reflected image in the Coanda surface. Sound power generated here was shown to be comparable to that produced by the jet engine without suppressor. Although sound generated in the exhause plume

should be insignificant, leakage of sound out of the stack is a key factor in explaining the present deficiency of the system. The fact that the system works as well as it does despite the large amount of sound power emitted by the stack can be attributed to the relatively narrow-beam radiating characteristic of the stack opening, which thrusts the sound radiation mostly upward. The tendency of external SPL to remain constant for some distance away from the enclosure is probably due to atmospheric refraction and is likely to be modified by varying wind conditions. Because of the large sound intensities in the stack, it was suggested that the basic enclosure transmission loss could be reduced still further by employing double-wall-stack construction.

*****

MECHANISM OF FLOW-EXCITED CAVITY RESONANCE

Researcher: Professor Samuel A. Elder

Sponsor: David W. Taylor Naval Ship Research and Development Center, General Hydromechanics Research Program

The overall objective is to develop a physical model of the mechanism of flow-excited cavity resonance by means of which the effect can be controlled or eliminated in the design of ships and aircraft.

It would be very desirable to be able to predict ahead of time the frequency and amplitude of cavity oscillations induced by flow. In principle, the system represents a feedback amplifier with predictable characteristics. However, there are two areas where present understanding is incomplete: (1)the precise law governing the growth of large-amplitude shear-layer oscillations driven by transverse flow and (2) the mechanism by which these oscillations exchange momentum with the standing wave in the cavity.

By application of the computerized synchronous hot-wire technique developed in an earlier phase of the project, it is now possible to map out three-dimensional dynamic response of a separated shear layer. This is being done for various flow conditions. From these data, a conceptual model of the coupling mechanisms between the oscillating shear layer and the acoustic field in the cavity is being developed. The ultimate aim is to construct gain-frequency response functions from which stable oscillating states can be predicted by the root locus method.

*****

DIPOLAR RELAXATION IN SOLID DIELECTRICS

Researcher: Assistant Professor John J. Fontanella

Sponsor: Naval Academy Research Council

The objective of the project is to measure the real and imaginary parts of the dielectric constant at audio frequencies over the temperature range 4.2-400K and at pressures up to 3000 atm. for a variety of solids. In addition, a 15,000 atm. system is being developed along with a low-temperature pressure capability.

The primary focus of the experiment is the alkaline earth fluorides doped with rare earths. The basic problem associated with these materials is to determine the impurity configurations. Dielectric measurements provide useful information mainly when dipolar complexes are present with relaxation times on the order of milliseconds. In this case, a peak is found in the imaginary part of the dielectric constant when the relaxation time equals the reciprocal of the applied frequency. The present researcher has recently found a low-temperature relaxation in erbium-doped calcium fluoride which appears to be associated with rare-earth dimers. In europium-doped calcium fluoride, however, an analogous low-temperature peak does not exist.

This system also has applied interest as these materials are prime candidates for the transducer element in a recently developed capacitive high-pressure gauge. One of thes materials may, in fact, have a zero-temperature coefficient of capacitance if the negative-temperature coefficient of the dipoles is sufficient to cancel the intrinsic positive-temperature coefficient of the host lattice.

Measurements have also been made on the anisotropic crystals quartz, sapphire, calcite, and magnesium fluoride. An interesting feature to that work is the existence of a dielectric spectrum in calcite similar to that obtained for rare-earth doped-alkaline earth fluorides, the difference being the existence of a double main peak in calcite.

*****

FEASIBILITY STUDY OF SOLAR HEATING FOR NAVY BUILDINGS

Researchers: Associate Professors Billie J. Graham and Bruce H. Morgan

Sponsor: Naval Academy Energy-Environment Study Group (Chief of Naval Development, Code MAT 03Z)

From the feasibility study completed by the solar-energy section of the Energy-Environmental Study Group, it was shown that because of the age

and the nature of the construction of the Wherry Apartments, the use of a solar-energy system, retrofitted to the existing heating system to supply heat for the space heating requirements, cannot be economically justified. However, the energy requirements for domestic hot water are essentially constant year round; and the solar-heat collecting system for this application is much more simple in design. For these reasons, the economical use of solar energy to heat domestic hot water in these apartments appears promising.

Since the collectors are to be retrofitted to an existing system, the solar system will be designed for the 1 month in which the collector can provide 100 percent of the energy needed. For other periods, the existing system will be used to "top-off" the remaining heat required to raise the temperature to 145°F. For the four apartments in one Wherry building, it will require about 200 ft^2 of collector surface and a storage system of the order of 360 gallons. A conservative cost (relative to the solar energy) comparison for various fuels for systems which would be expected to have a lifetime of 20 years was made.

*****

LOW-FREQUENCY DIELECTRIC PROPERTIES OF WIDE-BAND-GAP SEMICONDUCTORS

Researcher: Midshipman 1/C Scott M. Jenkins

Adviser: Assistant Professor John J. Fontanella

Sponsor: Trident Scholar Program

The purpose of the project was to measure the real and imaginary parts of the dielectric constant at five audio frequencies at zero pressure over the temperature range 4.2-360K and at pressures up to 3000 atmospheres over the temperature range 77-360K for wide-band-gap semiconductors.

The approach was to put electrodes on various samples, then make measurements of capacitance and conductance, using an impedance bridge. The variable-temperature measurements are done with the samples in a variable-temperature cryostat and the pressure measurements with the samples in a variable-temperature pressure vessel.

The measurement of the complex dielectric constant at five audio frequencies over the temperature range 4.2-400K and at pressures up to 3000 atm over the temperature range 260-320K has been successfully completed for single crystal CdS and CdSe and for amorphous As_2S_3 and As_2Se_3 and ZnSe. Several interesting results have been obtained:

1. Electrodes made out of aluminum are shown to have no effect on polarization phenomena in these materials,

2. The effect of trace impurities on the dielectric properties is shown to be quite large,

3. The existence of a low-temperature maximum in the dielectric constant has been discovered for the As compounds,

4. The conductivity is shown to be approximately linear around room temperature for the amorphous compounds in agreement with some recent theories,

5. As_2S_3 is shown to be one of the best candidates for use as a capacitive pressure gauge studied to date; i.e., it has a large pressure effect and small temperature effect,

6. The polarizability is shown to be directly proportional to volume for the Cd compounds, and

7. Pressure induced conductivity analogous to light induced effects has been observed in CdS.

*****

SHIPBOARD WASTE DISPOSAL

Researcher: Associate Professor Richard L. Johnston

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

The Navy, as well as civilian and commercial vessels, must comply with federal regulations concerning water and air pollution. To comply with the law within the 3-mile limit, where severe restrictions on the dumping of sewerage apply, the Navy is investigating methods of holding and treating or disposing of shipboard wastes.

This study was primarily into the possibility of adapting the developments of the recreational industry to shipboard operation.

The main recreational vehicle systems are: a simple holding tank, a special commode using natural gas to burn the waste, a system of injecting the wastes into the exhaust system where they are burned, and a chemical-recirculating system which reduces the volume of water required for flushing and the volume of wastes to be retained in holding tanks until they have to be dumped.

A search through the available marine, environmental, recreational vehicle, and related literature was done to determine the current status of a solid-waste disposal system in use. The basic commercial shipboard system is a collecting-settling tank, separator, filter-drier, and an incinerator. A number of these systems of different manufacture have had

enough use so that its reliability and emission characteristics can be ascertained and at least one systems has been certified by the U. S. Coast Guard to meet the stringent discharge requirements for inland waters.

*****

CYCLIC LIQUID-JET BEHAVIOR IN COLLAPSING BUBBLES

Researcher: Midshipman 1/C Nicholas E. Karangelen

Adviser: Associate Professor Lawrence A. Crum

Sponsor: Trident Scholar Program

The phenomenon of cavitation has been the subject of extensive research due to its tremendous importance in the are of naval hydrodynamics. Most of the work in solving the problem of cavitation damage has been in the area of material research and only limited effort has been expended in investigating the fundamental nature of cavitation. The major problem which is currently plaguing researchers is the rapidity with which the cavitation bubble will collapse, thus limiting the quality of photography to that which can be produced by very high-speed cameras. It is the purpose of this project to refine the technique, developed at the Naval Academy, for photographing cavity collapse at a much lower frequency and to correlate this low-frequency phenomenon with existing theory.

*****

THE ELECTRON-SPIN-RESONANCE DETERMINATION OF SITE POPULATIONS IN ERBIUM-DOPED CALCIUM FLUORIDE

Researcher: Midshipman 1/C Danny H. Mills

Adviser: Professor Charles W. Rector

Sponsor: Trident Scholar Program

The populations of Er^{3+} ions were measured in each of the several different types of sites in which they are found in CaF_2. The relative populations in the different sites were determined as a function of the total concentration of erbium ions in the crystal.

Electron-spin-resonance techniques were used to obtain absorption resonances characteristic of CaF_2: E_r^{3+} in the different sites. The doped crystals had to be maintained at liquid-helium temperature (4.2K) and spin-resonance spectra taken as a function of angle of the DC magnetic field with respect to the (110) axis of the crystal in order to determine the symmetry and thus identify the site. These data were then recorded for selected lines, digitized, and processed in a PDP-8 minicomputer. Data were then sent into a file in the Honeywell 635 and received additional processing using the convenient APL language in order to arrive at population figures.

The data link between the PDP-8 minicomputer and the 635 Honeywell 635 is successful. Digital-filtering techniques in the PDP-8 software remove a large portion of system and background noise in the data. APL-language programs were used to correct phase distortion and "Potato" drift in the first derivative data, to perform indefinite integration in order to recover the absorption curves, and to find the area of the individual fitted-absorption curves. A new model for the correction of phase distortion in the first derivative curves has been proposed.

*****

PRECISION MEASUREMENT OF THE FORWARD SCATTERING AMPLITUDES OF OXYGEN AND GERMANIUM THERMAL NEUTRONS

Researcher: Associate Professor Carl S. Schneider

Sponsor: National Science Foundation

The proposal delineated three objectives:

1. Precise determination of the thermal-neutron scattering amplitude of oxygen from measurements of the refractive bending due to a quartz prism,

2. Precise determination of the thermal-neutron scattering amplitude of germanium from measurements of the refractive bending due to a germanium prism, and

3. Observation of the small-angle scattering of thermal neutrons from amorphous $TbFe_2$ to investigate the extended short-range magnetic order in the sample.

The double perfect crystal neutron spectrometer developed at the National Bureau of Standards reactor was used to precisely measure the angles of refraction of right prisms of Ge, SiO_2, and Cu as a function of orientation in the beam. Data were fitted to an equation exact to first order in $\delta = 1-n \simeq 10^{-5}$, where n is the refractive index of the sample for thermal neutrons.

The small-angle scattering which decreases as the fourth power of the scattering angle for large angles and drops two orders of magnitude to the first maximum , requires signal to noise of 10^3:1 and a resolution tail which decreases faster than θ^4. This is accomplished for neutron beams using Bonse-Hart or Gaussian-mosiac monochromator and analyzer.

The first two objectives have been completed with the additional determination of the thermal neutron scattering amplitude of copper.

Procurement of noncurved Ge single crystals and their fabrication into a Bonse-Hart channel-reflecting system has proved difficult. Present efforts are directed toward a thermal-gradient induced mosaic and curve-reducing technique so that a narrow intense beam can be extracted.

*****

DEFECTS IN SEMICONDUCTORS, LASER HARDENING

Researcher: Associate Professor Robert N. Shelby

Sponsor: Naval Research Laboratory

The project includes studies of the threat of high-power lasers to satellites and the properties of defects in semiconductor materials. Specific topics considered have been:

1. Studies of laser hardened satellite thermal control coatings, and

2. The development of experimental techniques for the measurement of the characteristics of defects produced by fabrication or radiation in selected semiconductors. A knowledge of the presence and characteristics of these defects will yield basic information about the semiconductor material, information useful for quality control in device fabrication, and data for use in prediction of device performance.

*****

THEORETICAL DESCRIPTION OF TWO-DIMENSIONAL ADSORBED HELIUM FILMS

Researcher: Lieutenant Robert L. Siddon, USNR

Sponsor: Naval Academy Research Council

The objective of this research is to continue development of a theoretical description of two-dimensional helium films.

Two methods of investigation have been used to describe two-dimensional adsorbed helium films. The first is a quantum lattice gas model of adsorbed films which is applicable to the film when the density and temperature are such that an order-disorder transition occurs. The second is a low-density expansion of the thermodynamic functions of the adsorbed film. The second method is applicable in a wide range of densities and temperatures in which the film can be called a quantum degenerate gas. The current research consists of further investigation into the many-body aspects of the film and the effect of the substrate on the thermodynamic functions of the helium monolayer. The research is being conducted in conjection with the University of Washington Low-Temperature Laboratory.

The principal investigator and Associate Professor M. Schick of the Physics Department at the University of Washington include the effect of the substrate on the thermodynamic functions of the two-dimensional film by first calculating the two-particle correlation coefficient g(R,T) for the Lennard-Jones potential and then relating the g(R,T) to the second virial coefficient of the system. The thermodynamic functions are then found from the virial coefficient.

To determine the validity of this approach, the investigator has calculated g(R,T) for the more tractable case of a system of hard discs and found the corresponding second virial coefficient and the resulting thermodynamic functions. The results of the calculation agree with that obtained by different methods.

*****

INFRARED ABSORPTION OF HIGHLY TRANSPARENT SOLIDS

Researcher: Associate Professor Donald J. Treacy

Sponsor: Naval Research Laboratory

The object of this investigation is to obtain sufficient understanding of the mechanism of infrared absorption by highly transparent glasses and crystals that the properties of new systems may be predicted.

The multiphonon absorption in As_2S_3 in crystalline and amorphous form was studied to establish a model for absorption on the high frequency side of the fundamental lattice absorption in molecular crystals and glasses. This model is important, for a large number of these materials are being considered as potential laser windows and residual absorption must be minimized if they are to withstand the high-power levels produced by a laser. The program of investigation was to obtain absorption spectra in the frequency region from 400 to 1000 cm^{-1} and to determine what, if any, changes occurred in going from the natural mineral form of As_2S_3, orpiment, to the amorphous form. The spectra have been recorded and a model proposed for the room temperature behavior of both forms. The low-temperature spectra are almost complete and the temperature behavior of the multiphonon absorption is being modeled.

The absorption bands in the crystalline form are broadened in going to the glass. While none of the integrated absorption is lost in the amorphous form, the peak absorption over many spectral ranges is reduced from its crystalline form.

The temperature dependence of the multiphonon absorption is almost completed.

*****

A GLOSSARY OF THE CTHULHU MYTHOLOGY

Researcher: Professor Gerald P. Calame

The Cthulhu mythology is a wholly invented mythology, conceived by H. P. Lovecraft and added to by later writers. The mythos has grown since the appearance of Lovecraft's "The Call of Cthulhu" in 1928 so as to include 132 stories (as of December 1975). These stories have become highly connected through the common lore of the invented mythology, one story referring to characters and beings in completely different stories written by different authors. The result is that a reader encountering one of the stories for the first time is likely to be left confused.

The researcher is preparing a glossary of terms and names that appear in the mythology. To date, he has read and summarized 82 of the stories, as well as four of the pre-Cthuloid stories written by H. P. Lovecraft before the appearance of the "The Call of Cthulhu." He hopes, during the summer of 1976, to read 19 more that should be available through the Library of Congress, and then to prepare a glossary covering these 100 stories.

The ultimate aim of the research is the publication of a book that will serve as a sort of "Dictionary" of the mythology.

*****

HELM MODEL FITS TO CARBON-12

Researcher: Assistant Professor John P. Ertel

Helm model fits for the C-12 levels 15.11 MeV (transverse magnetic), 16.1 MeV (transverse magnetic) have been made for inelastic-electron scattering above the photon point. These were found to be in excellent agreement with particle-hole model calculations in the same region.

Neutrino cross-sections at these energies were also calculated from the theory but have only been verified at the 15.11 and 16.1 MeV levels due to lack of data from the experimental world. Work is currently going on for the higher order transfers of energy.

*****

CYLINDRICAL WAVES AND THEIR RAYS

Researcher: Assistant Professor William E. Fasnacht

This is a theoretical study of the emission and scattering of cylindrical waves of the form

$$H_n^{(1,2)}(kr)e^{\pm in\phi}$$

where kr is assumed large and n may be less than, approximately equal to, or greater than kr. From examination of the appropriate asymptotic expansions, a picture of the cylindrical waves has been developed as a forced vortex core of radius n/k that merges smoothly into outgoing spiral waves. The emission results are consistent with this picture and the scattering results demand it.

The simplest source of these cylindrical waves is an azimuthal traveling wave on the surface of a cylinder of radius a, where the amplitude of the emitted wave shows a sharp maximum when n = Ka.

When these cylindrical waves are scattered by a cylinder of radius a, all results are consistent with the picture that, outside the vortex core, the cylindrical wave propagates along rays tangent to a circle of radius n/K. Within the vortex core, no ray picture is possible, but scattering results are compatible with the vortex picture.

It is the nature of the scattering problem that an exact solution to the problem is readily obtained,but in the form of an infinite series so slowly convergent that it serves only as a starting point for further analysis. Because of an intricate interaction of observation point, method of analysis, and appropriate asymptotic forms, some 20 different results are required to give a useful solution to the scattering problem in all regions.

*****

COMPUTER-ASSISTED STUDY OF THE RELATION OF TEMPERAMENT REFERENCE TO MELODIC STRUCTURE

Researcher: Scott Stornetta (Junior at Severna Park High School)

Scott Stornetta, an 11th-grade student at Severna Park High School, is a participant in the Anne Arundel School System for Gifted Students. He is interested in the field of physics with an emphasis on computer applications. He has undertaken a project in psychoacoustics.

A systems program for PDP8/I minicomputer is being developed for generation of various musical-scale temperaments including Just, Pthyagorean, and Equal. This will be used in computer synthesis of music in order to investigate the relation of temperament preference to melodic structure for musically trained ears. Earlier studies at Albany State College suggest that there is an objective relation between melody and interval temperament.

*****

DIPOLAR RELAXATION IN SOLID DIELECTRICS

Researchers: Midshipmen 1/C David Bair, David Jones, and Donald Link

Adviser: Assistant Professor John J. Fontanella

The real and imaginary parts of the dielectric constant were measured at five audio frequencies at zero pressure over the temperature range 4.2-360K and at pressures up to 3000 atmospheres for rare-earth doped alkaline earth fluorides. The approach is to put electrodes on various samples, then make measurements of capacitance and conductance, using an impedance bridge. The variable temperature measurements are done with the samples in a variable temperature cryostat and the pressure measurements with the samples in a variable temperature pressure vessel.

By Midshipman Bair -- The complex dielectric constant has been measured at five audio frequencies over the temperature range 4.2-400K for samples of "pure" and europium doped CaF_2. In addition, these measurements have been made up to 3000 atm every 5 degrees from 260-320K. This has allowed the first determination of the activation volume for a dipolar relaxation process in the alkaline earth fluorides. These measurements need to be extended to low temperatures. Preparations are being made for such work.

By Midshipman Jones -- Samples of erbium-doped barium and strontium fluoride have been prepared for measurement and the dielectric constant measured from 4.2-400K. Two rather strong relaxations have been observed in these materials. Pressure measurements are currently underway.

By Midshipman Link -- Samples of europium and praseodymium-doped CaF_2 have been ground and polished and are currently ready for measurement. Theoretical calculations of the potential energy of ions in the static lattice have been made. These calculations have revealed two possible modes of relaxation for an interstitial impurity ion. Further calculations are in progress. Finally, dielectric relaxation studies on a superionic conductor have recently been completed. Several interesting results have been obtained.

*****

ROCKET TELEMETRY

Researcher: Midshipman 1/C T. D. Frederick

Adviser: Associate Professor Donald J. Treacy

A system for monitoring and transmitting data during an unmanned rocket flight was designed, assembled, constructed, and flown. The goals

were to monitor ionizing radiation, temperature, and roll rate of the rocket. Appropriate sensors to monitor temperature and roll rate were chosen and integrated into oscillator circuits which could be multiplexed into an S-band transmitting system. The ionizing radiation countersystem was multiplexed into the transmitting system. The detector for the ionizing radiation and counting electronics were obtained from the Naval Research Laboratory and integrated with a VCO designed by the investigator. The system was tested in flight and performed its assigned tasks and continued to transmit even after the rocket fell apart.

*****

COMPUTERIZED HOT-WIRE INVESTIGATION OF SEPARATED-SHEAR LAYERS WITH APPLICATION TO SHIP SILENCING

Researcher: Midshipman 1/C David M. Schubert

Adviser: Professor Samuel A. Elder

This is a fundamental investigation of the stability of jets and free-shear layers, making use of the new computer-assisted synchronous hot-wire technique developed by Professor Elder. The experiment consists of a point-by-point, space-time mapping of the oscillatory velocity profile in a jet or free-shear layer driven by a transverse-sound field. Using synchronous-computer averaging, the periodic component of the interface motion will be reduced from the data. In this way, the growth of instability waves will be studied as a function of exciting frequency and amplitude. Since phase as well as amplitude information is preserved by this method, it should be possible to detect phenomena not usually accessible by hot wire. This includes eddy trajectories, interface-surface undulations, and complex phase-velocity determinations of instability waves. Results will be compared with linearized- and nonlinear-stability theory and with other data obtained in classic papers on the subject involving conventional hot-wire technique. The work is directly related to current, Navy-supported investigations of flow-exited cavity resonance. It has important implications to ship silencing and sonar-self noise.

*****

PHYSICAL BASIS OF ORGAN PIPE VOICING

Researcher: Midshipman 1/C Theoren P. Smith III

Advisor: Professor Samuel A. Elder

The investigation is the first attempt to make a direct experimental check on the theory of organ-pipe mechanism, developed by Professor Elder. Measurements are being made on an entire rank of stopped diapason pipes in order to test the ability of the theory to account for general scaling

laws of pipe voicing. Along the way, some results of fundamental interest have been obtained which will be useful to workers in other fields besides musical acoustics. For example, a better understanding has been obtained concerning the nature of nonlinear-orifice impedance. Also, new light has been shed on the interplay between acoustic and fluid dynamic-source terms in cavity resonator experiments.

*****

PLASMA DISCHARGE

Researcher: Midshipman 1/C Frederick Yarger

Adviser: Associate Professor Donald J. Treacy

A plasma discharge system was assembled to investigate the microwave dispersion and optical (visible) emission spectra of gases. The discharge was to be contained in a vacuum system construction. X-band microwave gear was assembled to investigate the dispersion in the gigahertz spectral region. A two-meter Jarrell-Ash monochrometer was employed for visible spectral analysis.

*****

ACOSTA, Virgilio, Associate Professor and Billie J. GRAHAM, Associate Professor, co-authors, Curso de Fisica Moderna. Harla S. A. De C. V., Mexico D. F., 1975.

This is a translation and adaptation of the author's book Essentials in Modern Physics. The translation was done in Mexico. The book is intended to be used in Latin America and Spain. Two more chapters have been added in Quantum Mechanics and two more in Solid-State Physics. Translation was done by Joaquin Sada Anaya who is the Chairman of the Physics Department of the National Polytechnic Institute of Mexico City. The Institute takes care of the education of the great majority of the engineers in Mexico. The book covers the usual areas of relativity, wave-partial duality, nuclear model of the atom, Bohr's theory, wave mechanics, nuclear physics, radio acitivity,nuclear fission and fusion, solid-state physics, and ends with three chapters in astrophysics.

*****

CRUM, Lawrence A., Associate Professor, "Bjerknes Forces on Bubbles in a Stationary Sound Field," Journal of the Acoustical Society of America, 57 (June 1975), 1363-1370.

This paper concerns the translational forces exerted on pulsating air bubbles in a stationary-sound field. These forces, normally called Bjerknes forces, are derived by simple arguments and classified as to their origin. Measurements have been made of the relative velocity of approach of two bubbles undergoing a mutual Bjerknes force. The measurements were made in a rigid-glass container oscillated in a vertical direction at 60 Hz by a shaker table. The ambient pressure above the liquid was reduced in order to obtain large pulsations, and attracting bubbles were photographed with a movie camera. Observed and calculated values for the velocity of approach are in agreement provided a drag law assuming interfacial slippage is used.

*****

CRUM, Lawrence A., Associate Professor, co-author, "Liquid Monopropellant Ignition by Acoustic Cavitation," Journal of the Acoustical Society of America, 58 (1975), 575. Paper read at Acoustical Society Meeting, San Francisco, California, 3-7 March 1975.

It is known that acoustic cavitation can provide an effective means of concentrating mechanical energy; the pressure inside a collapsing cavity may reach thousands of bars and the temperature thousands of degrees. Liquid propellants have been considered for use in large military guns for several years, but lack of internal ballistics control has prevented their implementation. An acoustic technique utilizing cavitation is being examined for possible use in one specific problem area, propellant ignition.

It has been determined that an acoustic horn, developing an intensity of approximately 20 W at its tip, can initiate in the propellant free oxygen release, metal oxidation, and, in certain instances, ignition. It is suggested that this technique has possible use as an ignitor in a liquid-propellant gun or as a sensitivity-test mechanism for various propellant lots. (Work has been supported by the Naval Ordnance Station, Indian Head, Maryland.)

*****

ELDER, Samuel A., Professor, "Interim Report: Study of Flow-Excited Cavity Resonance," Report, David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, June 1976.

A fundamental investigation of cavity-resonance oscillation has been performed for the case of a flush-mounted, rectangular-opening deep cavity in the wall-boundary layer of a subsonic-air stream. Sound field inside the cavity was monitored by measn of a condenser microphone. Disturbance of the flow in the region of the mouth was detected by a movable hot-wire probe. A new computer-assisted synchronous hot-wire technique was developed to permit measurement of the instantaneous-velocity profiles of the undulating interface. From these data, the trajectories of vorticity pertubations, en route from leading to trailing edge, were measured; and the surface displacement waves of the interface were mapped.

Several feedback paths appear to be important: "edgetone" coupling from the trailing edge (as predicted by Powell), "acoustic" coupling from the standing wave in the cavity, and vortex-field coupling from the cast off eddy. Using superposed elementary wave functions, an attempt is made to model the oscillating wave displacement profile of the flow interface at the cavity mouth plane. Generation of sound pressure in the cavity seems to be largely due to entrance of external fluid through the mouth plane. The contribution to acoustic volume flow due to edgetone sources has been investigated. It appears that despite reactive elements in the system, very little gain in volume flow can be expected from this cause because of poor fluid-dynamic coupling.

*****

FASNACHT, William E., Assistant Professor, "Heat Transfer Modification Through Boundary Layer Control," Report No. USNA-EPRD-14, 1 August 1975.

A study was made of the possibility of conserving energy through modification of boundary-layer thickness. While it is possible through elaborate apparatus to change convective heat transfer by a factor of two to five, the somewhat larger contribution of radiative heat transfer is not altered by these procedures. What could be done to heat transfer through a window by boundary-layer control was compared to what could be accomplished with a storm window and the storm window was found to be significantly more effective.

*****

FONTANELLA, John J., Assistant Professor and Thomas C. BRASCO, Midshipman 1/C, co-authors, "Accurate Determination of the Audio Frequency Dielectric Properties of Quartz and Vitreous Silica," 1975 Annual Report of the Conference on Electrical Insulation and Dielectric Phenomena, Pub. 2600 National Academy of Sciences, Washington, D. C. (1975). (See Presentations, Physics Department.)

The 1000 Hz, 300K dielectric constant and loss of α-quartz from two sources and 29 kinds of commercially available vitreous silica have been measured to an accuracy of 0.01 percent and a precision of about 1 part in 300,000 by the 2-fluid technique. In addition, the relative changes with temperature (2.5-400K), pressure (0-3kbar at 308K), and several audio frequencies have been determined for selected samples. Three terminal techniques were used throughout. For vitreous silica, the observed room temperature dielectric constant ranges from 3.8061 to 3.8304. These results and the low-temperature measurements are correlated with hydroxyl ion content and other imperfections. The room temperature dielectric constants of the crystalline quartz samples from the two sources agree quite well; however, several impurity associated relaxations are observed at low temperatures.

*****

FONTANELLA, John J., Assistant Professor, co-author, "The Dielectric Spectrum of Erbium-Doped CaF_2," Journal of Physics C: Solid-State Physics, 9 (1975), 1055-1064.

The complex dielectric constant has been measured at five audio frequencies (10^2-10^4 Hz) over the temperature range 4.2-400K for eight concentrations (0.001 percent - 3.0 percent) of erbium in calcium fluoride. Relaxation processes with activation energies of about 0.15, 0.4, 0.5, and 0.7 ev have been observed which correspond to previously reported dipolar complexes in rare-earth doped alkaline-earth fluorides. In addition, a previously unreported relaxation with an activation energy of approximately 0.028 ev has been found at low temperatures and high rare-earth concentrations. It is concluded that this relaxation is cluster associated.

*****

GUTSCHE, Graham D., Professor, "Astrophysics: An Integrative Course," American Journal of Physics, 43 (August 1975), 695-696.

A one-semester course in introductory stellar astrophysics at the advanced undergraduate level is described. The course aims to integrate all previously learned physics by applying it to the study of stars. After a brief introductory section on basic astronomical measurements, the main topics covered are stellar atmospheres, stellar structure, and stellar evolution. Problem assignments are designed to encourage the use of the computer and of current astronomical literature. The experience of the past 6 years indicates that this approach has been an effective means of applying many diverse areas of physics to a common system.

*****

MORGAN, Bruce H., Associate Professor, "Cost Benefit of Utilizing Thermal Storage for Peak Cooling Power Leveling," Report No. USNA-ERPD-3, 19 September 1975.

Calculations indicate that provision for diurnal ice storage, reducing peak air conditioning power demand, would save money by decreasing the amount and therefore the cost of the electrical generating equipment which must be installed. The thermal storage facility of a solar heating system might be used for this purpose, perhaps with chilled water rather than ice.

*****

MORGAN, Bruce H, Associate Professor, Billie J. Graham, Associate Professor, Kenneth F. READ, Assistant Professor (Mechanical Engineering), and Dr. James Sharber, (Florida Institute of Technology), "Solar Heating Feasibility Study," Report No. USNA-ERPD-12, 30 June 1975.

After a preliminary study of the possibility of utilizing solar energy in a variety of ways such as fuel production and electric power generation, it was decided that the use of solar energy for the heating of buildings was closer to practical realization than any other. A good overview of the recent work in this area was obtained at a Workshop on Solar Heating and Cooling of Buildings sponsored by NSF/RANN.

A study was made of a local Navy two-story apartment building which included the available weather and insulation data, the types of solar-heat collectors available, the heat requirements of the apartments, and the economic aspects of the utilization of solar energy. It was found that a solar-collector system with an area of 1000 ft^2, about one-third the plan area of the building, could supply 173 million BTU of the heat required at an annual cost of $9/MBTU. This must be compared to the cost of oil at $4.14/MBTU.

It was concluded that because of the age of the building and the nature of construction, the investment required to utilize solar energy for space heating could not be amortized over the expected life of the building. However, since the demand for domestic hot water is essentially constant throughout the year, there is good evidence to indicate that the use of solar energy to supply the heat for domestic hot water could compete with conventional fuels.

*****

SCHNEIDER, Carl S., Associate Professor, "Coherent Nuclear Scattering Amplitudes of Germanium, Copper, and Oxygen for Thermal Neutrons," Acta Crystallographica, A32 (May 1976), 375-379.

The forward nuclear scattering amplitudes of germanium, copper, and oxygen for thermal neutrons have been determined from measurements of the

refractive bending (10-100 seconds arc) of a nearly monochromatic thermal neutron beam by right-angled prism samples. Using the double perfect crystal diffractometer at NBS, accuracies of .004 seconds arc were achieved in the computer-fitted refractive shifts of the reflection peak, allowing precisions from 2 to 10 parts in 10,000. Corrections were for prism attenuation, finite-beam collimation and immersion of the prisms in air. The results b_{Ge} = 8.1929(17) fm, b_{Cu} = 7.689(6) fm and b_O = 5.830(2) fm are in agreement with previous less accurate results except for oxygen which lies four standard deviations above an earlier determination.

*****

SCHNEIDER, Carl S., Associate Professor, "Small Angle Scattering," NBS Technical Note 896 (January 1976), 59-60.

The forward nuclear scattering amplitudes of germanium, copper, and oxygen for thermal neutrons are reported.

The small angle neutron-scattering instrument is described as extracting a 4.0 Å neutron beam using pyrolytic graphite crystals and a Be filter. This beam passes through the double perfect Si crystal diffractometer which resolves 2 seconds arc. The nearly infinite slit height (2 degrees) allows unfolding of the intensity data to observe defects or particles up to one micron in diameter. Computer studies of this unfolding by Mellin transform show the "ringing" which arises because of inadequate data range and step.

Application of the instrument to refraction studies with a Christiansen filter is considered.

*****

TREACY, Donald J., Associate Professor, co-author, "Second-Order Raman Scattering Crystalline As_2S_3," Bulletin of the American Physical Society, 21 (March 1976), 226. (See Presentations, Physics Department.)

Polarized first- and second-order Raman scattering measurements have been performed in natural single crystals of As_2S_3, thus determining all six components of Raman tensor appropriate to the C_{2v}^7 layer symmetry. Second-order modes at 584 and 652 cm^{-1} are observed to be relatively dispersionless. A comparison of the second-order Raman data with two-phonon infrared absorption measurements shows a strong similarity of the peak positions and line widths. In addition, the bb component of the second-order Raman scattering intensity is observed significantly smaller than the intensity of the other five components.

*****

ELDER, Samuel A., Professor, Earl R. PINKSTON, Professor, and John R. SMITHSON, Professor, "Lecture Demonstration in Sound." Lecture demonstration at 91st Meeting of Acoustical Society of America, Washington, D. C., 7 April 1976.

*****

FONTANELLA, John J., Assistant Professor and Thomas C. BRASCO, Midshipman 1/C, "Accurate Determination of the Audio Frequency Dielectric Properties of Quartz and Vitreous Silica." Paper read at Conference on Electrical Insulation and Dielectric Phenomena, National Bureau of Standards, 4 November 1976.

*****

FONTANELLA, John J., Assistant Professor, co-author, "Activation Volumes for Dipolar Complexes in Erbium and Europium Doped Calcium Fluoride." Paper read at March Meeting of American Physical Society, Atlanta, 29 March-1 April 1976.

*****

FONTANELLA, John J., Assistant Professor, "The Effect of Pressure on Rare-Earth Doped-Alkaline Earth Fluorides." Paper read at Tenth Annual Washington Area High-Pressure Conference, University of Maryland, 20 November 1975.

*****

TREACY, Donald J., Associate Professor, co-author, "Second-Order Raman Scattering in Crystalline As_2S_3." Paper read at March Meeting of American Physical Society, Atlanta, 29 March-1 April 1976.

*****

DIVISION OF

NAVAL COMMAND AND MANAGEMENT

MANAGEMENT SCIENCE DEPARTMENT

Commander Manuel B. Sousa, Jr., USN, Chairman

The research performed by members of the Management Science Department reflects the wide range of expertise present in the faculty. The Operations Analysis Study Group placed greatest emphasis on research and was assisted by an annual grant from Chief of Naval Operations (OP-953). The funds are provided to assist the Operations Analysis Study Group in conducting a "cooperative program of operations research studies in Tactical Development and Evaluation in all warfare areas with faculty members working on joint tasks with the Office of the Chief of Naval Operations (OP-953) and fleet Tactical Development and Evaluation activities . . ."

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

Pioneering work in Brain Wave analysis was continued by one member of the faculty, evoking nation-wide interest in the research performed.

The large number of midshipmen projects reflect the Department's belief that student research under the supervision of an interested and dedicated faculty is a broadening and valuable educational experience. The opportunity to utilize the knowledge and skill gained during the prior 3 intensive years of work gives first class midshipmen an appreciation and understanding of the usefulness and importance of their education.

*****

PRECEDING PAGE BLANK-NOT FILMED

RESEARCH PROFESSOR IN OPERATIONS ANALYSIS

Researcher: Research Professor Thomas D. Burnett

Sponsor: Chief of Naval Operations, OP-095

The purpose of the Research Professorship in the Management Science Department is to develop projects that will give midshipmen majors valuable training in how to attack diverse problems in operations analysis, with emphasis on military applications. Students may conduct research projects for one of two semesters and obtain elective course credit for this work. Projects of this nature must be sufficiently complex so that approximately 100-150 hours per semester of student effort is applied.

Among the areas investigated within the above context are "A Monte Carlo Simulation of Search and Barrier Patrols," "Acoustic Variability in the Ocean," and "Considerations of Measures of Effectiveness of Sonobuoy Patterns." It is the responsibility of the Research Professor to oversee the production of the operations research midshipmen on those projects.

Through visits to Naval Tactical Development and Evaluation commands such as OPTEVFOR, COMSURFLANT and COMSURDEVGRU and by attending Military Operations Research conferences, the Research Professor is kept informed of contemporary problems in the fleet and Navy air (especially those concerned with anti-submarine warfare) and has devised timely and relevant projects for midshipmen majors in the Operations Analysis Study Group.

*****

EXTENSION OF BRAIN WAVE ANALYSIS

Researcher: Associate Professor Karel Montor

Sponsor: Naval Personnel Research and Development Center, Code 9312

This project provided the Academy's Brain Wave Analysis Laboratory with equipment support that would enable the developing of an 8-minute neurological test that can be used to check spectral symmetry between hemispheres as well as establish hemispheric latencies to visual-evoked potentials.

It also facilitated review of all data and enabled rapid ingesting of the various available information. It was determined that if both samples of normal spectral and correlogram plots could be placed on a single page with associated subject data evaluation thereof would be more precise. Special cameras, scopes, and associated analysis equipments were purchased to obtain these results. Facility updating has been completed and all objectives met.

*****

APPLICATION OF VISUAL-EVOKED RESPONSES TO NORMAL AND ABNORMAL EEG ANALYSIS

Researcher: Associate Professor Karel Montor

Sponsor: Office of Naval Research, Code 441

The objectives of this project are to acquire and analyze visual-evoked brain electrical responses of a large sample of patients diagnosed as having various neurological disorders and to attempt to establish relationships between the characteristics of the brain response, diagnostic category, and behavior. In addition, the project has the objective of continuing the EEG data collection and analysis of USNA midshipmen and attempts to relate characteristics of the brain wave response to academic and/or physical education performance.

Neurological recording visits have been made to several of the Veterans Administration (VA) hospitals around the country and patients were selected that were of interest to both the hospital and this project. In addition, a recorder has been placed in one VA hospital as well as in a university psychiatric clinic for gathering of additional data for analysis.

Preliminary evidence seems to indicate that advance identification of neurological disorders is possible and further that the obtaining of base-line data on all military persons would be advisable in that it would permit better medical treatment.

*****

THE MIDSHIPMAN TIME PROFILE

Researchers: Lieutenant Commander James L. Bagby, Jr., USN, Associate Professor W. Charles Mylander, and Captain Edward A. Smyth, USMC

The objective of this study was to perform and present a complete analysis of the midshipman's time demands at the USNA, and to do so in such a manner to assist the future provisioning of maintenance of sufficient time for academic studying by the midshipmen.

Several categories of midshipmen were identified and used in order to reduce the extreme variance of time profiles that exist relative to any one so-called "typical" midshipman. Several categories of activity were defined in order to estimate systematically the time available for studying and to identify clearly what activities are taking time away from that available for studying.

The report provided a complete weekly profile of the midshipman's distribution of hours among several categories of activity including discretionary time available for academic study. A matrix of time demands for nine categories of midshipmen and 14 categories of activity was presented.

It was concluded that most midshipmen can generate 2 hours study time per academic credit hour (and some actually do), provided:

1. They do not average more than 7 hours sleep per day,

2. They do not overextend themselves by incurring an excessive number of weekday extracurricular obligations,

3. They possess the fortitude to study regularly, even when tired and even when tempted by competing engagements in leisure, and

4. Their attempts to study are not frequently interrupted by disturbance.

*****

A SEQUENTIAL MEDIAN TEST OF HYPOTHESES

Researcher: Research Professor Thomas D. Burnett

The objective was to devise a sequential statistical hypothesis testing technique to choose between two specified distributions using the median of a sample. This technique can be used in weapons test and evaluation to see if design specifications are met. The sequential aspect is desirable to save time and money, and the use of the median is well-adapted to the distribution

of weapon accuracy measurements which often contain bad shots and outliers.

The approach involves both the theoretical and computer simulation of the properties of the statistical test and the development of a computer algorithm to generate the statistical test for specified hypothesized distributions.

The test generation algorithm has been developed and tested. The performance characteristics of the test are being compared with other statistical procedures designed to perform the same or similar tests. Work is continuing on the theoretical aspects of the test.

*****

AD-A038 544 NAVAL ACADEMY ANNAPOLIS MD F/G 5/11

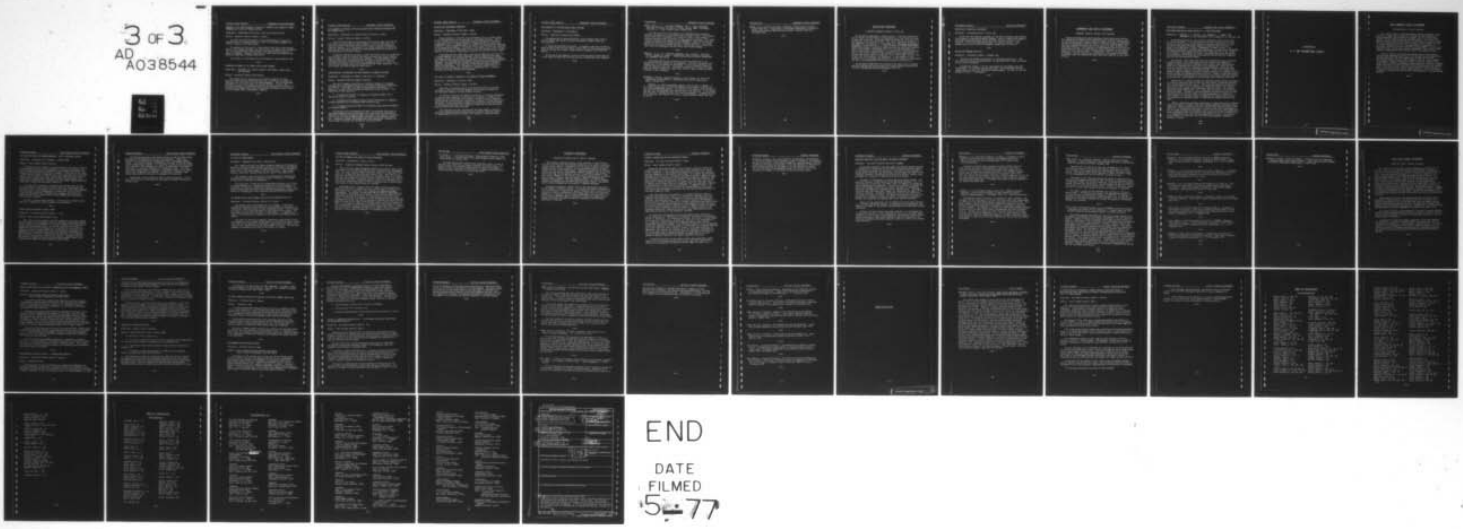
SUMMARY OF RESEARCH ACTIVITIES. ACADEMIC DEPARTMENTS 1975-1976.(U)

FEB 77 W L HEFLIN

UNCLASSIFIED USNA-AR-2 NL

3 OF 3

AD A038544



END

DATE FILMED

5-77

ANALYSIS OF THE EFFECTIVENESS OF A MULTIPLE TORPEDO ATTACK AGAINST A TARGET SOMEWHERE ON A CIRCLE OF KNOWN LOCATION

Researchers: Midshipmen 1/C Patrick S. Bole and Timothy Naville

Adviser: Research Professor Thomas D. Burnett

The study involves the analysis of the effectiveness of a multiple torpedo attack on a submarine which is known to be located somewhere on a circle of radius K with known center.

The analysis of this tactic's effectiveness took into account the geometry of the torpedo placement, the timing of this placement, the characteristics of single torpedoes, and the mutual interference characteristics of pairs of torpedoes. Computer simulation was used along with geometric and analytical modeling to evaluate the tactic.

This study is a continuation of one performed in second semester 1975.

*****

PREPARING FOR WOMEN AT THE UNITED STATES NAVAL ACADEMY

Researchers: Midshipmen 1/C Charles Campbell, Mark Moore, Joseph Sturm, and John Webb

Adviser: Associate Professor Karel Montor

The purpose of this project was to establish schedules for tasks required to get ready for the women and assist in monitoring progress and proposing areas for attention by the USNA management. The four midshipmen performed in an excellent manner for Captain William J. Holland, USN, including studying in person women admission and performance at the New York State Maritime Academy and pointing out potential difficulties which could only be foreseen from a midshipman's viewpoint.

*****

THE ALIGNMENT OF PORTABLE BATTLEFIELD RADAR UNITS FROM DATA ACQUIRED FROM AN AIRCRAFT FLYBY

Researchers: Midshipmen 1/C Richard Feckler and Dolph N. Watts

Adviser: Research Professor Thomas D. Burnett

Along with the advent of new portable battle front radars has come the difficulty of precise location and alignment. Errors of these types can materially affect operations, particularly those of pinpoint bombing and close air support. It is the object of this study to provide a statistical technique to align and/or locate two interconnected radars on the basis of data gathered on an aircraft flyby.

A computer simulation was used to create the flyby as well as to generate the locations in the sky at which the radars perceive the aircraft based on inputs of both errors in location and alignment. From the geometry of the radar-airplane-radar configuration and the relative locations of the two estimated locations of the aircraft at a sequence of points in time, the location and alignment errors are estimated through linear regression. Software changes can then be made for these errors.

*****

CONSIDERATIONS IN MEASURING THE EFFECTIVENESS OF SONOBUOY PATTERNS

Researchers: Midshipmen 1/C James D. Hann and R. F. Nathanson

Adviser: Research Professor Thomas D. Burnett

The use of computer simulation and analytical analysis to evaluate sonobuoy pattern performance results in a variety of measures of effectiveness (MOE's). These MOE's are used to make absolute evaluation of a pattern or to make relative comparisons among two or more patterns. The objectives of this study are:

1. To establish criteria of selection of appropriate MOE's for a particular tactical situation,

2. To determine the extent to which relative performance of compared sonobuoy patterns can be affected by MOE selection, and

3. To suggest appropriate MOE's for evaluating operational performance of sonobuoy patterns.

The approach was to determine which MOE's are presently being used in evaluating sonobuoy pattern performance and to ascertain how the value of these MOE's relate to assumptions about the nature of the tactical situation such as time on station, communication performance, buoy-spacing accuracy, etc. Comparisons between the assumed and actual operational situation can then be made to evaluate the validity of the various MOE's.

*****

AN ARTILLERY ADJUSTMENT ALGORITHM

Researcher: Midshipman 1/C William L. Meeks

Adviser: Research Professor Thomas D. Burnett

Present methods of artillery fire adjustment utilize a minimal amount of the information that can be provided by the forward observer. This is a result of the difficulty in obtaining accurate estimates of the amount of adjustment which is needed because of irregularity of the terrain and problems of visual perspective and of the desire to standardize the reporting of the necessary adjustment. The object of this study is to write a statistical algorithm which can objectively utilize the best estimates from a forward observer of the amount of adjustments necessary to bring the fire on target.

Experimentation has shown that in the task of adjusting artillery fire, a forward observer will select a benchmark distance against which impact to target distances can be measured. Any errors in establishing the benchmark distance are translated into proportional errors in artillery adjustment distances. An algorithm was designed to use the successive estimates of necessary adjustment to calculate the proportionality factor with which errors are being made. This information, along with characteristics of ballistic error and observer variability in adjusting fire, is used to estimate the actual necessary gun adjustment.

*****

THE EFFECT OF ACOUSTIC VARIABILITY ON SONOBUOY PATTERN PERFORMANCE

Researcher: Midshipman 1/C John R. Pagan

Adviser: Research Professor Thomas D. Burnett

Objectives of research were to investigate the effect of acoustic variation in the ocean on the performance of individual sonobuoys and the integrated impact on various sonobuoy patterns.

The nature of spatial and temporal variability of acoustic propagation in the ocean was researched in the existing literature. A model of this variability was constructed and a computer simulation used to generate a representation of the acoustic signal which is typical of those observed in the ocean. Single and multiple sonobuoy configurations were then exposed to the signals associated with a submarine transiting the area and performance characteristics were evaluated.

The literature has been searched and time-space models if acoustic variability which have been constructed yield acoustic profiles similar to those observed in the real ocean. This project is being continued.

*****

DEVELOPMENT OF A STARTING BLOCK FORCE PLATFORM

Researcher: Midshipman 1/C Jon Watkins

Adviser: Associate Professor Karel Montor

The purpose was to design and build a force platform that could be used to measure the vectors of force just before a runner leaves the starting block.

A system was developed and tested. It tended to show that the device would be more useful for high school runners than for those experienced ones found on college track teams, through starting freshmen could definitely benefit.

By the end of the semester, initial testing had been accomplished and a final report written that could be used as a further basis for research.

*****

BAGBY, James L., Jr., Lieutenant Commander, USN, W. Charles MYLANDER, Associate Professor, and Edward A. SMYTH, Captain, USMC, "Midshipman Time Profile." USNA In-House Study, October 1975.

The time profile of nine categories of midshipmen were analyzed to determine the amount of discretionary time available to them. Discretionary time is that time a midshipman can allocate to study, use to engage in voluntary extracurricular activities or pass away as he chooses. This study involved interviews with members of the Commandant's staff and various midshipmen and analysis of the Bancroft Hall academic schedules. Only plebe and third class intercollegiate athletes in season were found to have less than 2 hours discretionary time per credit hour during the week.

*****

BOWLER, R. T. E., III, Lieutenant Commander, USN, co-author, "The Naval Officer: Manager or Leader?" United States Naval Institute Proceedings, 101 (December 1975), 64-67.

The authors discuss the military and civilian perceptions of the relationship between leadership and management. Military literature views managership as a sub-element of leadership. Civilian theorists generally hold the converse to be true. The authors conclude this conflict of views poses an identify problem for young naval officers, many of whom have been schooled in both viewpoints.

*****

MYLANDER, W. Charles, Associate Professor, "User's Manual for the Linear-Programming System LPREVISE," USNA Operations Analysis Study Group Report, January 1976.

LPREVISE is a linear-programming computer code written in FORTRAN. It is a sophisticated code and contains features of the current, state-of-the-art, linear-programming systems. The purpose of this manual is to familiarize the user with the procedures that must be used to run the code. It is assumed that the user is already familiar with linear programming. To demonstrate the use of the code, this manual will follow a sample problem through from start to finish.

*****

MONTOR, Karel, Associate Professor, "Diagnostic Implications of Visual-Evoked Potentials." Paper read at Third Annual Neurological Consultants' Teaching Day, Veterans Administration Hospital, Brooklyn, New York, 15 October 1975.

*****

NAVIGATION DEPARTMENT

Lieutenant Commander Richard A. Smith, RN

The Navigation Department's research effort in 1976 was directed primarily towards the development and implementation of hand-held calculator formulas and techniques. Both midshipmen and Navigation instructors have contributed in this research effort. The results have been impressive. The Department's production of a programmed text, Navigation by Hand-Held Calculator," established the U. S. Naval Academy as a leader among educational institutions in navigation applications of the hand-held calculator. Other faculty members subsequently went on to develop programming for specific applications and equipment. In recognition of our growing expertise in this field, a member of the Navigation faculty addressed the national Navigation Education Symposium, held in New London in April 1976, on the topic of Calculators for Navigation. As an extension of this interest, on-site assistance was provided to a type commander investigating the use of chip programmable held-held calculators by fleet units.

The Navigation Department also produced seven audio-visual cassettes and also provided editing assistance for several navigation publications including The American Practical Navigator (Bowditch).

*****

NAVIGATION BY HAND-HELD CALCULATOR

Researcher: Lieutenant Wilson E. Fitch, USN

Within the last semester, programs for the SR-52 calculator were written. These comprise a complete navigation package. That is, almost every commonly performed navigation problem can be performed including celestial sight reduction. It has been documented except for specific examples. This package would be very useful to navigators aboard ships or aircraft.

*****

NAVIGATION PROGRAMS FOR SR-52

Researcher: Lieutenant Timothy L. Vaughan, USN

"Navigation by Handheld Calculator" is a 50-page program text. This text basically defines and demonstrates the applications of a small calculator to the field of navigation.

The Bowditch chapter is for the same purpose as the program text mentioned above. It is almost ready at this time. The coordinators for this project were the author and the Defense Mapping Agency. All work is the sole property of the U. S. Government.

*****

SEAMANSHIP AND TACTICS DEPARTMENT

Commander Joseph M. Quigley, USN, Chairman

Because the maneuvering board techniques (which every naval officer must understand to rapidly assess relative motion situations between ships at sea) have historically been a difficult concept to grasp, the Seamanship and Tactics Department's research effort in 1976 was directed toward more efficient teaching techniques that can be applied to those students with predicted difficulty. The necessity for understanding and the difficulties associated with type of instruction has led the Department to the twofold purpose for this ongoing study. The Department's goal is the development of methods to tailor instructional techniques to the student and to more efficiently teach the manuevering board techniques required of every naval officer.

*****

MIDSHIPMAN MANEUVERING BOARD CAPABILITY: A PREDICTION MODEL

Researchers: Commander J. M. Quigley, USN, Commander J. L. Bagby, USN, (Management Science Department), and Lieutenant P. W. Korinus, USN

A maneuvering board is a set of polar coordinates used to solve relative motion problems. Every sea-going naval officer must possess an acute ability to rapidly assess relative motion situations between ships at sea. The maneuvering board techniques needed to accomplish this are first taught to the USNA plebe in NS101, Fundamentals of Naval Science. The developing midshipman is afforded ample opportunity to exercise and strengthen his maneuvering board capability during Third Class and First Class Cruises at sea; NS252, Shiphandling and Tactics; and NS300, Operations and Tactics. Upon graduation, the prospective Surface Warfare Officer must be intimately familiar with the maneuvering board.

Unfortunately, the maneuvering board has traditionally been a difficult concept to grasp. While some people with good spatial and mathematical thought assimilate the basic technique easily, others labor long hours and never fully understand the simplicity of the methodology. Realizing the necessity and difficulties surrounding maneuvering board instruction leads us to the twofold purpose of this ongoing study. First, this research will attempt to define a method to predict a plebe's potential to translate relative motion problems into maneuvering board solutions. Second, a concurrent analysis of instructor effectiveness will hopefully lead to more efficient teaching techniques that can be applied to those students with predicted difficulty.

Specifically, a prediction model was developed through regression analysis of available statistics from the Class of 1979; namely, a whole-man multiple score and psychological-test scores. This model was adjusted and applied to the Class of 1980. Several statistically significant NS101 class sections were formed and, together with appropriate control sections, are currently undergoing normal instruction. It is hoped that the results will verify the prediction model. The most significant element of maneuvering board instruction,and the most difficult factor to quantify,appears to be instructor effectiveness. A concurrent study is attempting to identify those instructors achieving the greatest success in imparting the manuevering board concepts.

Ideally, these more successful instructors of maneuvering board technique could be assigned to students with below average predicted maneuvering board capability. Ability grouping could also free the more advanced students from many hours of discouraging labor which is keyed to the least common demoninator of student mastery of the subject, while at the same time not demoralizing those midshipmen having difficulty with the mastery of spatial relationships. It is hypothesized that since section composition criteria is not known to either student or instructor, the "self-fulfilling prophecy" syndrome is unlikely to result.

*****

DIVISION OF

U. S. AND INTERNATIONAL STUDIES

PRECEDING PAGE BLANK-NOT FILMED

AREA-LANGUAGE STUDIES DEPARTMENT

Professor Guy J. Riccio, Chairman

The research effort in the Area-Language Studies Department, which had shown a steady decline, matching the equally steady reduction of faculty personnel, gave evidence of a modest, but not insignificant, reversal of this trend during the 1975-1976 period. This small resurgence of research activity was led by the publication of one book, which will add significantly to the field of Chinese lexical studies, as well as further research activities, both sponsored and independent, in particular specialty fields by individual faculty members. Finally, one interesting and, in some ways, unusual independent study project, undertaken by a midshipman of the Class of 1976, is also worthy of note.

Areas of research which have been either areas of long-standing interest among Department faculty or have been particularly and actively pursued during the 1975-1976 academic year include the following: 16th Century German literature and literary criticism, lexical studies in Portuguese, syntactical-lexical studies in Spanish, naval-military terminology in Chinese, contemporary Spanish-American literature, computer-aided instruction in French, current military doctrine and naval developments in the Soviet Union, church history and church-state relations in the Soviet Union, and the issue of human growth in a finite environment, a subject of research activity by one of the Department's foreign exchange officers.

*****

PRECEDING PAGE BLANK-NOT FILMED

THE NEO-LATIN POETRY OF GERMAN HUMANISTS: CELTIS, REUCHLIN, HUTTEN

Researcher: Lieutenant (j.g.) Michael C. Halbig, USNR

Sponsor: Naval Academy Research Council

The purpose of the project is to develop some of the forms of the new German Humanism that was winning momentum in the early 16th Century and was overcoming the medieval scholasticism that dominated the Church, the monastic orders, and the universities of Germany. This consists of a study of the literary careers of three men who lived around the turn of the 15th Century, who all studied in Italy, and who upon returning north stood at the nucleus of German intellectual and literary life during the first quarter of the 16th Century: Conrad Celtis (1459-1508), Johannes Reuchlin (1455-1522), and Ulrich von Hutten (1488-1523).

The study will be primarily based upon the literary texts of these men with a focus on what facets of 'high literature' they brought back north with them, as reflected on their own work; what effect these elements had on certain of their contemporaries in the north as well as on the successive two generations of German-Latin literati; and finally, the extent to which their contact with the south shaped their perception of their own age in Germany.

The basic study has been completed. A draft essay is being written and will be submitted to various journals for publication.

*****

CHINESE-ENGLISH GLOSSARY OF NAVAL TERMS

Researcher: Assistant Professor Daniel T. Y. Lee

Sponsor: Naval Intelligence Support Center

The initial project, begun in 1972 and supported by the Naval Academy Research Council with subsequent funding by the Naval Intelligence Support Center, called for the compilation of a simple Chinese-English glossary of approximately 1,000 naval terms. In view of the entry of the People's Republic of China into the community of nations and the expectation that studies on China in various fields will be increasing, the project was expanded to include current naval terms that have been standardized in Mainland China. The task of consulting source material was a difficult one, owing to the paucity of data on this subject. Subsequent contacts and travels to Taiwan and to Hong Kong yielded invaluable sources, such that the total number of terms collected exceeded 8,500.

The published glossary lists Chinese entries in the left hand column according to the pronunciation of the first character. These first characters are alphabetically arranged according to the pinyin phonetic system. The order of homonyms is governed by the order of the four tones on the Chinese popular speech. In a succession of entries having the same first character, the arrangement of entries is determined by the phonetic renderings of successive characters in alphabetical order. The right hand column renders English equivalents, and Chinese characters in simplified script are added to all entries. In addition, a character index showing page number of each entry is appended to the glossary.

Terminology in this glossary is naval as well as nautical. It contains not only basic naval terms but also those considered indigenous to Chinese usage.

*****

THE ISSUE OF HUMAN GROWTH

Researcher: Commander Bruno Lepori, Italian Navy

This research analyzes the Systems Dynamics technique of forecasting applied to large and complex systems, through the analysis of the Reports to the Club of Rome on the issue of Human Growth in a finite environment, their critics, and recent works on the main sub-issues: food, energy, minerals, pollution, sociopolitical, moral, ethnic, Third World, etc.

This project is thus the result of the examination of 40 books and approximately 100 articles, from 1970 to 1976; it consists of 70 pages of text plus 40 footnotes and appendices.

The conclusions, on the basis of overwhelming evidence, are in favor of Systems Dynamics as a forecasting method, and of the correctness of the analysis of mankind's predicament provided by the Club of Rome. The solution proposed by the reports are presented and analyzed, stressing the urgency to do <u>something</u> to stop unchecked and undifferentiated growth.

*****

THE MOSCOW SACRED CHURCH COUNCIL AND THE SOVIET REVOLUTION OF 1917

Researcher: Assistant Professor Vladimir S. Tolstoy

The general plan of the manuscript is as follows: a historical introduction depicting events leading to the convening of the Council is followed by a detailed account of each subsequent session. Brief accounts are given in full of those sessions for which there are no minutes. The last chapter is entitled "The Council in Retrospect." It analyzes the Council's significance and influence in the life of the Orthodox Church in general.

The book will end with an appendix containing a translation of such key documents as the attitude of the Council to the Treaty of Brest-Litovsk, "The Theory on the desirable relationship between Church and State," and a report on the "Significance of the Patriarchate in Russia." Thus the book attempts to reconstruct a picture of the Council as a whole.

*****

THE ROLE OF WOMEN IN THE NOVELS OF ERICO VERISSIMO

Researcher: Midshipman 1/C Hugh A. Willis

Adviser: Lieutenant Commander Antonio Pacheco, Brazilian Navy

One of the best known contemporary Brazilian novelists, both at home and abroad, is Erico Verissimo who was born in 1903 and died in November 1975. His total literary output, which was primarily in the field of the novel but included the essay and short story as well, dates back to the decade of the thirties and continued until his death. Many of his novels have been translated into English, and Verissimo himself was very familiar with the United States' scene, having been a scholar in residence at one university in the United States as well as having served in various diplomatic posts in this country during his lifetime.

Midshipman Willis' research into his subject included reading and examining criticism of several key novels by Verissimo, including two in which women play a significant role, Clarissa and Caminhos Cruzados (Crossroads). He analyzes the character and qualities of these women and draws specific conclusions on the psyche of the Brazilian woman and her interaction with her environment, as influenced by cultural and social forces. In addition to an analysis of the representative works themselves, Midshipman Willis was also able to personally interview the author himself, whom he visited in his home in Porto Alegre, Brazil, during the summer of 1975. This interview, conducted in Portuguese and taped, made it possible for the researcher to delve into Verissimo's views on the writer's creative art as well as his treatment of women in his novels, thus constituting a valuable, primary source of material for incorporation into his study.

*****

LEE, Daniel T. Y., Assistant Professor, "Chinese-English Glossary of PRC Naval Terms." Printed by Naval Intelligence Support Center, Report No. NIS-ASTZ-001-76, January 1976.

The published glossary contains over 8,500 basic naval, as well as nautical terms, which are considered indigenous to Chinese usage. The Chinese entries are arranged alphabetically according to the pinyin phonetic system. Each term is also written in Chinese characters using simplified script along with the English equivalent.

*****

ECONOMICS DEPARTMENT

Associate Professor Clair E. Morris, Chairman

The Economics Department faculty, which consists of seven officers and seven civilians, was particularly productive in the realm of scholarly research during 1975-76. Publications of the faculty covered topics that ranged from the "green revolution" in less-developed countries to small business failure in the United States. Numerous presentations of research conclusions were made at professional meetings throughout the country, and starts were made on new endeavors that will yield rich dividends in the near future. Members of the faculty used diverse methodologies to explore areas of public finance, money and banking, industrial organization, computer-aided education, and macro-model building. One faculty member's research was sponsored by the Naval Academy Research Council, and another had his efforts enhanced by the purchase of computer equipment.

Research has become an integral part of the professional activities of the Academy's Economics faculty. It provides that edge of relevance in the classroom that is required for dynamic teaching, and it instills in the instructor a form of professional self-respect that builds the confidence needed to do a masterful job of relating knowledge of the discipline. It also builds an important mental orientation in both the student and the teacher that makes classroom instruction a meaningful and satisfying experience in learning.

*****

FINANCIAL INNOVATIONS AND THE REGULATORY PROCESS

Researcher: Assistant Professor Arthur G. Fraas

Sponsor: Naval Academy Research Council

Commercial banks have assumed a role of primary importance within our economic system by virtue of the peculiarly public character of an aspect of their operations -- the issuance of demand deposit liabilities, the most important component of the nation's money stock. To mitigate the disruptive consequences arising from a collapse in the banking system, a number of steps have been taken in the course of the development of American commercial banking to reduce the incidence of bank failure. These steps have involved the separation of commercial banking as an economic activity from other lines of commerce and the imposition of an elaborate legal and regulatory structure on the operations of the resulting institutions -- commercial banks. The intention of this structure is to force the internalization of the social costs associated with banking operations into the decision-making process of individual commercial banks.

Since the effect of this structure is to impose additional costs on commercial bank operations, there is an incentive for commercial banks to introduce innovations which circumvent this statutory and regulatory structure (and, the associate cost). There is also an incentive for entrepreneurs outside of commercial banking to introduce innovations which permit them to carry on commercial banking operations while remaining outside the extensive statutory and regulatory structure to which commercial banks are subject. Of course, these innovations cannot be viewed in a benign fashion by the regulatory authorities, because the effect of these innovations may be to break down the efficacy of the regulatory structure.

We argue that the emergence of the Eurocurrency market represents a classic instance of an innovation of the payments system which has developed outside of regulation -- an innovation which owes its success in large measure to its evasion of regulation. We point out that one of the consequences of this competitive tension between the regulated banking system and the unregulated Eurocurrency markets is an inevitable expansion of the unregulated sector that undermines the effectiveness of regulation and ultimately threatens the overall stability of the payments system. It has been sufficient to demonstrate that through the introduction of the innovative arrangement (in this case, entry into the Eurocurrency markets) additional private profits can be realized because commercial bankers can avoid some of the costs imposed on domestic banking by the present regulatory structure.

A detailed discussion of the extent to which the Eurocurrency system remains free of existing regulatory constraints (and their costs) while securing all the benefits of creating a private means of payment (i.e., a

Eurodollar, Euromark, etc.) which exploits the mechanisms and guarantees of the world's major national payments systems is presented. By examining the major differences in regulation between the regulated domestic banking systems and the Curocurrency system, it has been possible to identify two major reforms necessary to the stability of the Eurocurrency system: (1) the elimination of the endogenous nature of reserves, and (2) the provision of a lender of last resort to the Eurocurrency market.

*****

HOUSEHOLD PORTFOLIO SELECTION MODEL FOR MARGIN CONSTRAINT

Researcher: Assistant Professor Rae Jean B. Goodman

Conventional portfolio selection models have omitted several concepts -- interaction of liabilities of the liability structure and the impact of the purchase on margin of securities. A portfolio selection model of the household sector has been constructed to investigate the impact of the liability structure, the purchase of securities on margin, interest rates and demand for liquidity on the portfolio decision process.

The model is formulated as a constrained maximization problem. The objective function, a modification of the Markowitz maximand -- $E-\lambda V$, is restricted by (1) Cash Flow, (2) Credit Limit, (3) Margin, (4) Adding Up, and (5) Nonnegativity constraints. The Cash Flow constraint includes the interaction between liabilities and assets, the impact of expenditure decisions, the demand for liquidity and the interest rates. The Credit Limit and Cash Flow constraints interact to incorporate the impact of the liability structure. The Margin constraints allow for the possibility of purchase of assets on margin. The Adding Up constraints allow for the possibility of purchase of assets on margin. The Adding Up constraint prevents the household from spending more funds than are available.

Several of the constraints are in probabilistic form; hence the model is a nonlinear programming problem. By changing various parameters, the impact on the model of the factors discussed above are investigated through simulations.

Briefly, the results which have been found are: (1) increasing outstanding debt results in a more conservative (less risk) and lower return portfolio, (2) an increase in the demand for cash balances likewise forces a more conservative, lower return portfolio, and (3) a decrease in the certainty of meeting the margin constraint results in a more risky, higher return portfolio.

*****

FREDLAND, J. Eric, Assistant Professor, co-author, "A Toxonomy of Public Bads Arising from the Use of Collectively Consumed Facilities," Seton Hall University Faculty Working Paper 7511, February 1976. (See Presentations.)

A variety of "public bads" (negative external effects) arise to erode certain collectively consumed public facilities, once these facilities are provided. The facilities particularly subject to this erosion are recreation and cultural facilities. The literature groups eroding effects under the general heading of congestion, but in fact there are several distinct types of erosion, of which congestion is only one. This paper identifies and distinguishes types of public bads and examines the relationship among them. It includes discussion of policy alternatives for handling different bads.

*****

FREDLAND, J. Eric, Assistant Professor and Clair E. MORRIS, Associate Professor, "A Cross-Section Analysis of Small Business Failure," Atlantic Economic Journal , 3 (November 1975), 111. (See Presentations.)

Considerable federal assistance is provided to "small" business. The rationale for this assistance is in part that small firms face disadvantages in competing in the marketplace against larger more diversified firms. This paper presents results of an empirical examination of business failures, defined as those firms involved in bankruptcy or otherwise closing with loss to creditors. The purpose is to study the relationship between selected characteristics of firms, particularly size measures, and their propensity to fail. The data are a sample of 2,000 firms that failed in 1971 drawn from the files of Dun and Bradstreet, inc., and a similar sample of 2,000 going concerns, drawn for comparison purposes. The most interesting result that emerges is that size of firm and likelihood of failure are not strongly correlated.

*****

GIBB, Arthur, Jr., Assistant Professor, "National Mobilization Under Democracy." Report presented to the Executive Secretary, United Nations Fund for Population Activities, December 1975.

Together with its statistical and other attachments, this report describes the status of Philippine agricultural development just prior to the advent of the "Green Revolution" and documents the joint United States - Philippine efforts during 1965-1967 to mount a national program for the dissemination of the new "miracle" varieties of rice.

The report's first section describes the trends in food grains production and consumption from 1947 to 1967, analyzing the underlying trends in hectarage, yields, and frontier expansion. The principal rice growing regimes are described and analyzed. The development and characteristics of the "miracle" rice varieties are explained. A model of innovative leadership for a national mobilization of grass roots programs is suggested.

The report's second section documents the evolution of the joint United States - Philippine pilot province rural development program into the national rice self-sufficiency program of 1967-1971. It provides detailed insights not available in public documents into the step-by-step emergence of a national commitment to promote the program to disseminate the new rice varieties.

*****

LITTLE, Roger, Assistant Professor and Larry THOMPSON, Associate Professor, "Evaluation and Funding of Soft Technology." In-house report for Naval Personnel Research and Development Center, San Diego, California.

This report examined how behavioral and social science research and development corresponded to the Research, Development, Test and Evaluation process. Chapter 1 reviewed the present definitions and descriptions of Research, Development, Test and Evaluation and emphasized some discrepancies where the soft sciences were concerned. Chapter 2 defined research and development within a behavioral and social science context. The chapter additionally distinguished research and development from non-research and development with special reference to the Naval Personnel Research and Development Center. The dialectical interdependence of research and development and non-research and development was demonstrated and suggestions were advanced as to how this dynamic interface might affect project categorization. Chapter 3 identified and defined 11 characteristics of research and development. These characteristics were incorporated into a scaling index for assisting in proposal categorization. Several Naval Personnel Research and Development Center products were scored and categorized using this technique. Chapter 4 contains specific and general recommendations derived from our interviews and research.

*****

FREDLAND, J. Eric, Assistant Professor and Clair E. MORRIS, Associate Professor, "A Cross-Section Analysis of Small Business Failure." Paper read at Atlantic Economic Conference, Washington, D. C., 11-13 September 1975.

*****

FREDLAND, J. Eric, Assistant Professor and Frank D. TINARI, Dr., "A Taxonomy of Public Bads Arising from the Use of Collectively Consumed Facilities." Paper read at Annual Convention of the Eastern Economic Association, Bloomsburg, Pennsylvania, 15 April 1976.

*****

FREDLAND, J. Eric, Assistant Professor and Anthony M. J. YEZER, Dr., "The Distributional Implications of Alternative Water Quality Improvement Strategies." Paper read at Annual Convention of the Western Economic Association, San Francisco, California, 17 June 1976.

*****

GOODMAN, Rae Jean, Assistant Professor, "A Parametric Study of a Household Portfolio Selection." Paper read at Western Finance Association, San Diego, June 1975.

*****

LITTLE, Roger D., Assistant Professor, "Computer Games as a Supplement to Self-Paced Instruction." Paper read at Community College Social Science Association-Eastern Community College Social Science Association (Joint Meeting), Washington, D. C., 1 November 1975.

*****

LITTLE, Roger D., Assistant Professor and Larry C. THOMPSON, "Managing Technological Change -- A Dialectical View of the Role of Soft Sciences." Paper read at Atlantic Economic Conference, Washington, D. C., 11-13 September 1975.

*****

WHITAKER, A. Royall, Associate Professor, "Differential Equations and Differential Analyzers in Econometric Research." Paper read at Atlantic Economic Conference, Washington, D. C., 11-13 September 1975.

*****

WHITAKER, A. Royall, Associate Professor, "Inflation-Free Full Employment at Adequate Wages through Wage Subsidies." Paper read at Eastern Economic Association, Bloomsburg, Pennsylvania, 15 April 1976.

*****

POLITICAL SCIENCE DEPARTMENT

Professor John R. Probert, Chairman

The faculty of the Political Science Department, consisting of 12 civilians, four officers and one Foreign Service Officer, undertook a total of 17-distinct research or research-related projects during 1975-76. Six of these were sponsored research with sponsorship coming from the Bureau of Naval Material, the Advanced Research Projects Agency, the Naval Academy Research Council, and the Naval Academy itself, via sabbatical leaves. Such diverse subjects as the environmental impact of naval installations on the Atlantic seaboard, the environmentalism practiced by foreign navies, transaction flows among nations, factors in Indonesian foreign policy, midshipmen values and attitudes, and the art of making judicial decisions were involved. Unsponsored research, varying as widely in subject matter as the sponsored, covered such topics as ASEAN and the People's Republic of China (PRC); the Navy and the energy crisis; the Indian Ocean area and the USSR, USA,and PRC; and teaching international relations.

Methodological variation also characterized the Political Science Department's research effort, including descriptive, historical, and normative approaches as well as the behavioral with its emphasis on the empirical with extensive quantification. The Department's unparalleled computerized data resources have been most conducive to the latter approach and represent a continuing inducement to research along those lines.

The research effort of the Department in the form of output included numerous papers presented and participation in panels at learned societies, lectures to outside groups, articles in professional journals, as well as formal reports to sponsors.

Enhancing as it does the academic reputation of the Naval Academy, the Department's substantial research effort also retains and adds to the momentum and quality of the Department's teaching effort. The faculty, kept abreast of developments in its various fields of expertise by its research, carries its expanded knowledge into the classroom, enlivening and updating discussion and sparking midshipmen interest and learning thereby.

*****

NAVAL INSTALLATIONS ON THE ATLANTIC SEABOARD AND THEIR ENVIRONMENTAL IMPACT

Researcher: Associate Professor Charles L. Cochran

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

This study evolved from a concern that there was no central storage of information concerning the broad range of data related to environmental problems encountered by the Navy. The result is inefficiency due to a lack of coordination and lack of knowledge as to how other installations have handled certain situations.

Originally, the study proposed gathering information from naval bases along the Atlantic Seaboard to be stored in a data base. The data base would be used for storing and retrieving data which would be Navy oriented. The study in fact came to the conclusion that the process of pulling the information together into one file would be such a costly project as not to be feasible. Even if various earlier studies that had been done were to be put together in a uniform retrieval system, there would still be many gaps between the studies,requiring additional effort to fill these lacunae.

The result of the study was to lead to the conclusion that a model should be developed that would be sent to each Navy activity to allow it to measure itself. That method would be intended to provide a concise environmental report as well as to identify pollution problems of activities so that the deficiencies may be acted upon.

A matrix model on environmental protection is proposed to provide a standard for the measurement of environmental concerns of all naval activities that can be kept current through a periodic reporting system. To be useful, the model must itself be kept up to date by the inclusion of new legislation that would impact on the model.

*****

MIDSHIPMAN VALUES AND ATTITUDES: A LONGITUDINAL ANALYSIS

Researcher: Associate Professor John A. Fitzgerald

Sponsor: Sabbatical Leave

The notion that the service academies are capable of graduating, and indeed do graduate, a product that is unique and distinctly different in its attitudinal orientation from that produced by civilian colleges and universities is open to question, at least in the case of the U. S. Naval Academy. Our data

indicate that the midshipman remains attuned to the values and attitudes of the larger society and undergoes changes in these areas that are generally consonant with the larger societal changes.

Our original hypothesis, that the Naval Academy recruits those with an initially conservative orientation to social, economic, and political values and graduates a group characterized by a more intense, stable, and consistent conservatism, was not borne out. In some areas, his conservatism has increased, but in others it has decreased. All in all, he is much like the product of any other institution of higher learning.

Perhaps the most significant implication of our findings is that there appears to be little danger, at least in the junior ranks of the Navy, of there developing an officer corps estranged from the larger civilian society and possessed of an extremist conservative ideology, quite the contrary. They appear rather apolitical in their orientation to the political system; and if Barber is correct in his finding that there is no serious "generation gap" in the Navy officer corps as a whole, then we may conclude that this middle-of-the-road and conservative apoliticalness is probably a characteristic of the Navy officer corps in general.

*****

INDICATORS OF TRANSACTION FLOWS

Researcher: Professor John A. Hutchins

Sponsor: Advanced Research Projects Agency (ARPA)

The objectives of this project are:

1. To collect a minimum of 2 years' data for international communications and international diplomatic representation on a worldwide basis;

2. To develop or adapt special purpose storage retrieval and analysis programs; and

3. To deliver all data and programs to an ARPA specified computer center in an ARPA specified form and format.

Data have been collected by contacting the countries directly, through the Department of State and other government agencies, and by other means. Programmers have been hired, special programs have been written, and programs have been tested. Data for international communications and diplomatic representation have been collected, processed, stored, and tested for 3 years.

The major part of the project has been completed. Two papers, analyzing the programs, are being prepared. Some work still remains in running correlation programs with other types of data.

*****

THE ART OF MAKING JUDICIAL DECISIONS AND THE SERVICE ACADEMY CHAPEL CASE

Researcher: Professor Elmer J. Mahoney

Sponsor: Sabbatical Leave

In separate monographs researched partially prior to sabbatical leave in the Spring Semester, AY 1975-76, and during that leave, that part of the American judicial process comprising the actual making of decisions by the U. S. Supreme Court and the substance of the decision by the courts on compulsory chapel at the Service Academies were studied and analyzed.

In the Judicial decision article, the conclusion arrived at, after reviewing numerous salient cases and most of the literature on the Court, is that the Court, while occasionally erring, has "for the most part . . . been most adroit in reading the signs which society has signalled . . ."

The Service Academy chapel case article arrives at the conclusion after tracing the case from inception to final appeal to the U. S. Supreme Court, that, given the precedent on separation of church and state, compulsory chapel at all government institutions, including the Academies, was almost certain to be prohibited.

*****

ENVIRONMENTALISM AND FOREIGN NAVIES

Researcher: Professor Rocco M. Paone

Sponsor: Naval Academy Energy-Environment Study Group
(Chief of Naval Development, Code MAT 03421)

The purpose of this project was to study the role of foreign navies in the creation of national environmental policies of their governments. Investigation involved much correspondence and telephone conservations with foreign embassy officials, foreign environmental specials, and U. S. Defense Attaches abroad, and a number of personal interviews. The plan aimed at selection of navies of Western Hemisphere, Europe, and the Pacific Region. It also included some five variables, both dependent and independent, which aimed at reflecting foreign naval environmental policies.

National environmental legislative results are still questionable mainly because of lack of implementation measures, insufficient punitive measures for violations, cost of enforcing environmental laws, greater desire to support industrialization, and inability to perceive pollution abatement as a long-term value. Most navies do not have separate research and develop (R&D) offices and budgets. Naval R&D requirements are generally served via a national environment or science research agency. Foreign navies generally are consulted in pollution abatement matters relating to them and implement government policy by:

1. Obeying national legislation on pollution abatement;

2. Policing waters for violations; and

3. Improving sewage disposal systems aboard ship and avoiding oil spills.

*****

FACTORS IN INDONESIAN FOREIGN POLICY: THE NATIONAL RESILIENCE CONCEPT AND THE ARCHIPELAGO PRINCIPLE

Researcher: Associate Professor Robert L. Rau

Sponsor: Naval Academy Research Council

Indonesia has more than one-half the population of Southeast Asia and extensive coastlines to protect from political and economic security threats. Economic instability in this decade and a recent history of internal political chaos and periodic external expansionism have demanded the formulation of specific foreign policy principles.

National Resilience and the Archipelago Principle are of importance conceptually because they represent symbols of the Indonesian quest for leadership and influence in Southeast Asia.

The concept of National Resilience is a uniquely Indonesian construction which stems from Javanese myth, the family kinship system, and political reality. The Archipelago Principle evolved from National Resilience in that the Indonesian government believes that political, economic, and military strength is predicated upon the protection of its national interests by virtue of explicit controls of the nation's assets.

Although the implementation of the Archipelago Principle has not yet occurred, the legal and diplomatic ground work has been accomplished. The continuing incidence of tanker groundings and subsequent oil spills, in the

Straits of Malacca will encourage quicker application of some restrictions on the use of certain of the Straits in the archipelago. Increasing future naval activity in the Indian Ocean by the super power in addition to an expanding Japanese naval presence in maritime Southeast Asia will also, in all probability, influence the Indonesian government to compromise in the attainment of its political and security objectives in the next decade.

*****

PAONE, Rocco M., Professor, "The Big Three in the Indian Ocean," Seapower, 18 (August 1975), 28-35.

This article examines the naval objectives, roles, and activities of the USSR, the People's Republic of China, and the United States in the Indian Ocean. It stresses very carefully the variables related to Soviet naval activies, including a number of impediments that could constrain the extension of USSR naval power in the Indian Ocean.

The article centers much attention on China's political and military interests in the ocean's heartland -- and how China views this region -- as one "in which she may engage in her favorite forms of activity at reasonable cost and with some hope of useful returns" and concomitantly "spoil the efforts of Russia and the United States." Very significant growth of her economic, political, and military activities are analyzed. This expansion has reached the level of competition with the USSR and the United States.

The third section of the article stresses the United States policy of acquiring and maintaining a stabilized balance of power in the ocean area and the idea that to attempt more at this time, i.e., strive for local superiority, would be counterproductive.

*****

PAONE, Rocco M., Professor, "The Navy's Response to the Energy Crisis," Naval Institute Proceedings, 101 (July 1975), 33-40.

This article stresses the attempts and accomplishments of the U. S. Navy in the field of energy economy with particular emphasis on the Navy's utilization of liquefaction of coal (USS Johnston and its trip to the Indian Ocean), and synthetic fuels, geothermal power sources, fluidized bed burner equipment, central solar hot water heating system, energy technology, shipboard energy conversion, radioisotope thermoelectric generators and seaborne nuclear electric power plants. The creation of the Office of Navy Energy and Resources Research and Development and the Navy's energy economy program are explained.

*****

RAU, Robert L., Associate Professor, "Normalization with the People's Republic of China: With Emphasis on ASEAN States," Pacific Community, 7 (1976), 230-247.

This article discusses the general question of the diplomatic recognition of the People's Republic of China by the ASEAN nations. Specifically, it outlines the individual bargaining positions of each ASEAN state relative to

the question of whether to recognize the People's Republic of China. Maylasia, the Philippines, and Thailand have recognized Peking; as of May 1976, Indonesia and Singapore have not. Explanations as to why Indonesia and Singapore had not recognized China are provided in the paper.

*****

ATKINS, G. Pope, Associate Professor, "Approaches to the Study and Teaching of Inter-American Relations." Paper read at Workshop of Committee on Latin American Studies of the Washington, D. C., 10 October 1975.

*****

FITZGERALD, John A., Associate Professor, "Midshipman Attitudinal Change: A Longitudinal Analysis." Paper read at Bi-annual Conference of the Inter-University Seminar of the Armed Forces, Chicago, 16-18 October 1975.

*****

PAONE, Rocco M., Professor, "Aspects of the Foreign Policy and Seapower of the People's Republic of China." Paper read at National Security Seminar on Education in National Security Affairs, Georgia State University, Atlanta, 13 March 1976.

*****

PAONE, Rocco M., Professor, "Environmentalism and the DOD Budget." Paper read at Annual Meeting of the Institute for World Affairs, July 1975.

*****

PAONE, Rocco M., Professor, "Foreign Navies and Environmentalism." Paper read at Panel of International Studies Association, Toronto, 25-29 February 1976.

*****

RAU, Robert L., Associate Professor, "Considerations in Indonesian Foreign Policy: The National Resilience Concept in the Archipelago Principle." Paper read at the Midwest Conference on Asian Affairs, Ohio University, Athens, Ohio, 24 October 1975.

*****

RAU, Robert L., Associate Professor, "The Politics of Security Cooperation Within ASEAN." Paper read at Southeast Study Club Symposium on "Southeast Asia in the 1970's," Northern Illinois University, DeKalb, Illinois, 27 February 1976.

*****

OTHER ACTIVITIES

PRECEDING PAGE BLANK-NOT FILMED

SKALLERUP, Harry R., Associate Professor, Books Afloat and Ashore; A History of Books, Libraries, and Reading Among Seamen During the Age of Sail. Hamden, Connecticut: Archon Books, 1974.

This seminal work attempts to trace the origins and development of several types of early shipboard and shoreside libraries for seamen, as well as to document the strong tradition of books and reading at sea. The period covered extends from the invention of printing to the beginning of the American Civil War. Emphasis is placed upon the history of books, libraries, and reading in the Navy and Merchant Marine of the United States, although the first chapter presents a broad, brief survey of a few examples, international in scope, of the early use of books, and of the precedents for libraries at sea. The second chapter provides some background to the common beginnings of seaman's welfare in Great Britain and the United States, especially as it relates to the provision of reading matter to mariners by religious groups and individuals. Each succeeding chapter progresses chronologically, but also concentrates on one or more specific aspects of the American history, such as the role and influence of books in the education of midshipmen and seamen in the early navy and the founding of the Naval Academy; the organization of private maritime libraries, such as that of the U. S. Naval Lyceum; the provision of scientific books for naval exploring expeditions and shoreside agencies, such as the Naval Observatory; the effect of welfare organizations, such as the American Seamen's Friend Society; which promoted educational and recreational reading among seamen; and the activities of seamen themselves in securing books to take with them on distant voyages. The last chapter is devoted to a consideration of the conditions aboard 19th Century sailing ships which fostered or hindered reading at sea. Appendices include the listing and description of all books furnished to officers and sailors by the U. S. Navy (1828-1843), and the first portable library of the American Seamen's Friend Society. Also contained are bibliographic notes and illustrations.

*****

AN INVESTIGATION OF PERSONALITY CHANGES DURING A FOUR-YEAR PERIOD IN MIDSHIPMEN WHO HAVE PARTICIPATED IN VARSITY INTERCOLLEGIATE ATHLETICS AT THE U. S. NAVAL ACADEMY

Researcher: Assistant Professor Albert A. Cantello

Sponsor: Naval Academy Research Council

The view that participation in varsity intercollegiate athletics contributes to the development of desirable personality characteristics is widespread. Young men who participate regularly in competitive intercollegiate programs are said to exhibit behaviors in common social situations which differ from those young men who do not participate in such activities. However, there has been surprisingly little research on the potential psychosocial benefits of intercollegiate athletics.

The purpose of this study was to investigate whether participation in varsity athletics at the U. S. Naval Academy significantly alters personality scores on the Sixteen-Personality Factor Profiles Test (16-PF) when comparing these psychological indices after 4 years.

This study was designed to gather data concerning the following hypothesis: there is no significant change in the personality scores of midshipmen as measured by the 16-PF test after 4 years of participation in varsity athletics at the U. S. Naval Academy.

The independent variable in this study was participation in varsity athletics at the U. S. Naval Academy. The dependent variable was the varsity athletes' development of personality characteristics as measured by 16-PF scores.

The null hypothesis of no difference was sustained for the characteristics of reserved versus emotionaly stable, sober versus happy-go-lucky, tough-minded versus tender-minded, trusted versus suspicious, forthright versus shrewd, relaxed versus tense and tender-minded emotionally versus alert and poised. The scores of the midshipmen athletes indicated a significant increase in intelligence and also indicated that they became less humble and more assertive.

On the basis of the findings of this study of the relationship between varsity athletics and personality indices, decision-making capabilities may be increased to aid in the selection, understanding, and counseling of midshipmen.

The following conclusions are based on these findings:

1. All midshipmen varsity athletes' personality scores, as measured by the 16-PF, are still "malleable" upon their arrival at Annapolis as plebes.

2. Intercollegiate varsity athletics, in its more sophisticated sense, involves all the intricacies of the learning process. The midshipman athlete is not merely a body performing but a body-mind entity.

*****

INDEX OF CONTRIBUTORS

Faculty Member/Page

Abbott, James C., 160, 162
Acosta, Virgilio, 183
Adams, James A., 30, 43
Alley, Reuben E., 28
Andre, Peter P., 156
Angus, Marlene, 86
Arnold, James A., 89, 90
Atkins, G. Pope, 231

Bagby, James L., 194, 200, 205
Barr, William A., 52
Belding, William R., 156
Belote, William, 114
Bhattacharyya, Rameswar, 52, 53
Blum, Joseph J., 73
Boatman, John P., 90, 91
Bock, Arthur E., 54, 62
Bowler, R. T. E., III, 200
Bradford, James C., 104
Bras, Miriam C., 132
Brockus, C. George, 74, 82
Brodehl, Richard B., 151, 152
Bundy, Mark M., 124, 132
Burnett, Thomas D., 192, 194, 196 197, 198
Burns, Stephen H., 23, 27
Butler, Thomas W., 30, 41

Calame, Gerald P., 178
Calderhead, William L, 108, 114
Calisal, Sander M., 66
Cantello, Albert A., 235
Carson, Bernard H., 4, 9, 11
Chambers, John T., 4
Cheevers, James W., 117
Clark, Kenneth G., 141
Cochran, Charles L., 224
Coletta, Paolo E., 108, 109, 114, 115
Compton, Roger H., 54, 63, 65, 67
Corey, R. Reece, Jr., 124, 133, 136
Crum, Lawrence A., 168, 173, 183

Dantzler, H. Lee, 146, 150
D'Archangelo, James M., 157, 162
Darden, William M., 104
Davis, Frederic I., 165
Dawson, Thomas H., 60, 67
Dodson, Elliott E., 32

Eberhardt, Francis J., 18, 22
Edsall, Douglas W., 146, 154
Elder, Samuel A., 168, 169, 181, 184, 188
Ertel, John P., 178
Estes, Kenneth W., 109, 115

Fasnacht, William E., 178, 184
Fetrow, Fred M., 91, 92, 93
Fitch, Wilson E., 203
Fitzgerald, John A., 224, 231
Fontanella, John J., 170, 171, 180, 185, 188
Fowler, Charles A., III, 18
Fox, J. Richard, 77, 78
Fraas, Arthur G., 216
Fredland, J. Eric, 219, 221
Fryant, Allen, 165

Geremia, John O., 44
Gibb, Arthur, Jr., 220
Gillerlain, Joseph D., Jr., 4, 13, 15
Gomba, Frank J., 124, 125, 136
Goodman, Rae Jean, 218, 221
Goodwin, Ralph A., 167
Graham, Billie J., 170, 183, 186
Granger, Robert A., 46
Gutsche, Graham D., 185

Hagan, Kenneth J., 110, 116
Halbig, Michael C., 210
Halford, Jake H., 19
Hartig, Donald G., 163, 165
Hasson, Dennis F., 32, 33, 46, 47, 50
Heflin, Wilson L., 93, 97

Herrmann, Robert, 163, 165
Hirsch, Richard A., 33, 41, 47, 48
Hoffman, John F., 147, 150, 151
Hoffman, John M., 136
Huckenpoehler, William B., Jr., 55
Huston, John W., 103
Hutchins, John A., 225

Jason, Philip K., 98
Jasperson, Michael, 85
Johnson, Bruce, 55, 71
Johnson, David E., 119
Johnston, Richard L., 172
Jones, John L., 142
Jones, O. Lloyd, 133
Joyce, James A., 34, 39, 47

Kalme, John S., 158
Karwath, Arthur A., 157
Keating, Eugene L., 34, 40, 42
Kirk, Neville T., 110
Kirkley, Owen M., 29, 41
Klimas, Paul C., 15
Knowles, Kenneth A., 78, 82
Korinus, P. W., 205
Koubek, Edward, 125, 137

Latham, Robert F., 67
Lee, Daniel T. Y., 210, 214
Lee, John A., 19
Lee, William L., 35
Lefcowitz, Allan B., 87, 98, 101
Leffler, Merrill, 94, 99
Lepori, Bruno, 212
Lim, Tian S., 25, 26, 28
Little, Roger, 220, 221
Lopardo, Vincent J., 36, 42
Love, Robert W., Jr., 119

Mahoney, Elmer J., 226
Marshall, Philip R., 116
Martin, Richard L., 21
Massie, Samuel P., 126, 139
McCormick, Michael E., 64, 65, 68, 71
McCoy, Robert A., 57, 71
McGrath, Stephen A., 158, 165
McMillan, John G., 145
Mitchell, E. Eugene, Jr., 75, 79, 82
Mohr, William B., 134
Monney, Neil T., 62, 68
Montor, Karel, 192, 193, 196, 199, 201
Morgan, Bruce H., 170, 186
Morris, Clair E., 215, 219
Moulis, Edward J., 166
Murton, D. B., 17
Mylander, W. Charles, 194, 200

Nehrling, Bruce C., 57
Nelson, Martin E., 61, 62, 64, 71
Neustadt, Herbert M., 20, 23
Nicholson, David L., 20
Niles, Nathan O.164

Oldham, Morris M., 125, 136

Pacheco, Antonio, 213
Paone, Rocco M., 226, 229, 231
Penn, Howard, 166
Pennington, W. Donald, 125, 136
Potter, Elmer B., 117, 119
Pouring, Andrew A., 3, 5, 6, 7, 13
Prestia, John V., 127, 128
Probert, John R., 223

Quigley, Joseph M., 204, 205

Rankin, Bruce H., 59
Rask, Olaf N., 75
Rau, Robert L., 227, 229, 231
Read, Kenneth F., 186
Rector, Charles W., 173
Ressler, Robert R., 128
Riccio, Guy, 209
Richmond, Arthur A., III, 111
Roberts, William R., 111
Rogers, David F., 12, 15, 43
Rollins, Orville W., 129, 137
Rowell, Charles F., 130, 134, 136

Saarlas, Maido, 11
Sabo, William J., 95
Santoro, Ralph P., 18, 25, 26
Schneider, Carl S., 174, 186, 187
Shelby, Robert N., 175
Siddon, Robert L., 176
Skallerup, Harry R., 234
Skove, Frederick A., 143
Sladky, Joseph F., Jr., 5, 6, 9
Smith, Charles W., 94, 95, 100
Smith, Donald S., 134
Smith, Richard A., 202
Smyth, Edward A., 194, 199

Sousa, Manuel B., Jr., 191
Strohl, G. Ralph, Jr., 155
Sudnick, Daniel R., 130
Sweetman, Jack, 105, 117

Thomas, James P., 112
Thompson, Larry V., 106, 119, 120, 220
Todorich, Charles M., 112
Tolstoy, Vladimir, 212
Tomlinson, David O., 101
Treacy, Donald J., 176, 180, 182, 187, 188
Twaddle, Roy R., 80

Uldrick, John P., 36
Utgoff, Vadym V., 8, 12

Vaughan, Timothy L., 203

Warken, Philip W., 113
Weingartner, David L., 134
Welch, James T., 151, 152
Whitaker, A. Royall, 221, 222
Wiebush, Joseph R., 123
Wiggins, Peter F., 51, 69
Williams, Jerome, 148, 153, 154
Wright, David A., 21
Wu, Chih, 37, 44, 48, 49, 50
Wyckoff, Robert D., 38

Young, William L., 159

Zimmerman, John G., 131

INDEX OF CONTRIBUTORS

Midshipman/Page

Angleman, Alan C., 25

Bair, David, 180
Bauer, Frederick, 150
Beeks, Kenneth D., 11
Boch, David C., 21
Bole, Patrick S., 196
Brunngraber, R. F., 151
Buflod, Melvin R., 151

Campbell, Charles, 196
Carr, Lester E., 25
Crisalli, David E., 7

Deppe, Paul, 25
Dolan, Bryan J., 61

Engels, James D., 11

Feckler, Richard, 197
Frederick, T. D., 180

Gardiner, Jay V., 11
Gault, John E., 151
Giron, Bruce A., 41
Grace, John C., 41
Guild, Robert B., 152
Guthe, Douglas B., 142

Hall, Garry E., 62
Hamner, Michael S., 26
Hann, James D., 197
Hlywiak, Michael, 62

Jenkins, Scott M., 171
Johnson, Frederick F. G., 8
Jones, David, 180

Karangelen, Nicholas E., 173
Kilbourn, Edward P., 63
Klijn, Martinus M., 12
Kneller, William, 26
Kumpis, Philip, 26

Link, Donald, 180

Mantilla, Diego D., 63
Markham, David G., 152
McGowan, Joseph C., 64
Meeks, William L., 198
Mills, Danny H., 173
Montgomery, Bruce, 62
Moore, Mark, 196
Moss, Lee O., 64
Murphy, Frank M., 151

Naville, Timothy, 196
Nathanson, R. F., 197
Neves, Victor M., 151

Pagan, John R., 198
Perry, C. R., 12

Rader, John, 11
Raher, Stephen J., 158
Ravold, John F., 65
Rector, George E., 41

Salazar, Richard, 65
Schubert, David M., 181
Shinego, Daniel P., 62
Smith, Theoren P., III, 181
Sturm, Joseph, 196

Tandy, Jon S., 22

Vaught, Rodney D., 62

Watkins, Charles, 42
Watkins, Joh, 199
Watson, Marc A., 62
Watts, Dolph N., 197
Webb, John, 196
West, M. L., 42
Whitsett, James C., 27
Willis, Hugh A., 213

Yarger, Frederick, 182

DISTRIBUTION LIST

Assistant Secretary of the Navy
(Research and Development)
Department of the Navy
Washington, D. C. 20350
Attn: Dr. P. Waterman

Chief of Naval Operations
Department of the Navy
Washington, D. C. 20350
Attn: OP-098, OP-099, OP-0991B

Chief of Naval Research
Department of the Navy
Arlington, Virginia 22217
Attn: Code 100, 102, 102T,
102-OS, 200, 400, 430,
438, 450, 465, 500

Deputy Chief of Naval [redacted] Material
(Development)
Department of the Navy
Washington, D. C. 20360
Attn: Code 03, 03L, 03T, 034

Commander
Naval Air Systems Command
Department of the Navy
Washington, D. C. 20361
Attn: Code 03, 03E, 03P, 0310

Commander
Naval Sea Systems Command
Department of the Navy
Washington, D. C. 20362
Attn: Code 03, 032, 0351

Commander
Naval Electronic Systems Command
Department of the Navy
Washington, D. C. 20360
Attn: Code 03, 0304

National Science Foundation
Washington, D. C. 20550
Attn: Code MPE, SE, BBS, AAEO

Commander
Naval Facilities Engineering Command
Department of the Navy
Alexandria, Virginia 22332
Attn: Code 03, 032B

Commander
Naval Oceanographic Office
Department of the Navy
Washington, D. C. 20373

Oceanographer of the Navy
Department of the Navy
Hoffman II
200 Stovall Street
Alexandria, Virginia 22332

Director
Naval Research Laboratory
Department of the Navy
Washington, D. C. 20375
Attn: Code 1000, 4000, 5000,
6000, 7000, 8000

Commanding Officer
Naval Intelligence Support Center
4301 Suitland Road
Washington, D. C. 20390

Commander
Naval Intelligence Command
2361 Eisenhower Avenue
Alexandria, Virginia 22331

Commander
Naval Air Development Center
Warminster, Pennsylvania 18974

Commanding Officer
Naval Air Propulsion Center
Trenton, New Jersey 08628

Chief of Research and Development
U. S. Marine Corps
Arlington Annex
Washington, D. C. 20380

Director
Department of Defense Computer
Institute
Washington Navy Yard
Washington, D. C. 20374

Commander
Naval Surface Weapons Center
White Oak
Silver Spring, Maryland 20910

Commanding Officer
Naval Coastal Systems Laboratory
Panama City, Florida 32401

Commander
David W. Taylor Naval Ship Research
and Development Center
Bethesda, Maryland 20084
Attn: Code 00, 01, 012

U. S. Coast Guard Headquarters
Office of Research and Development
400 Seventh Street, N. W.
Washington, D. C. 20590

Officer-in-Charge
David W. Taylor Naval Ship Research
and Development Center
Annapolis, Maryland 21402
Attn: Code 04, 27, 28, 285

Commander
Naval Electronics Laboratory Center
San Diego, California 92152

Commander
Naval Air Test Center
Patuxent River, Maryland 20670

Commander
Naval Surface Weapons Center
Dahlgren Laboratory
Dahlgren, Virginia 22448

Commander
Naval Weapons Center
China Lake, California 93555

Environmental Protection Agency
Washington, D. C. 20460
Attn: Asst. Administrator for R&D

Commanding Officer
Naval Ocean Research and
Development Activity
National Space Technology Laboratories
Bay St. Louis, Mississippi 09520

Director
Naval Historical Center
Washington Navy Yard
Washington, D. C. 20374

Commandant
U. S. Coast Guard
Department of Transportation
Washington, D. C. 20590
Attn: Director, RD&D

Commanding Officer
Naval Ordnance Station
Indian Head, Maryland 20640

Commanding Officer
Naval Air Engineering Center
Lakehurst, New Jersey 08733

Chief of Naval Air Technical Training
Naval Air Station, Memphis (75)
Millington, Tennessee 38054

Chief of Naval Education and Training
Naval Air Station
Pensacola, Florida 32508

Commander
Naval Undersea Center
San Diego, California 92132

Commanding Officer
Naval Underwater Systems Center
Newport, Rhode Island 02840

National Bureau of Standards
U. S. Department of Commerce
Washington, D. C. 20234
Attn: Associate Director of
Academic Liaison

U. S. Energy Research and Development
Administration
Washington, D. C. 20545
Attn: Office of University Programs

Director
Langley Research Center
National Aeronautics and Space
Administration
Hampton, Virginia 23665
Attn: Office of University Affairs

Commanding Officer
Naval Medical Research and Development
Command
National Naval Medical Center
Bethesda, Maryland 20014

Commanding Officer
Naval Personnel Research and
Development Center
San Diego, California 92152

Director
Office of Naval Research
Branch Office
495 Summer Street
Boston, Massachusetts 02210

Director
Office of Naval Research
Branch Office
536 South Clark Street
Chicago, Illinois 60605

Commander
Naval Ship Engineering Center
Center Building
Prince George's Center
Hyattsville, Maryland 20782

Superintendent
Naval Postgraduate School
Monterey, Calfornia 93940
Attn: Code 023 (Dean of Research),
0212 (Library), 02 (Provost)

Superintendent
U. S. Coast Guard Academy
New London, Connecticut 06320

Superintendent
Merchant Marine Academy
Kings Point, New York 11024

Superintendent
U. S. Air Force Academy
Colorado Springs, Colorado 80840
Attn: Director of Research

Superintendent
U. S. Military Academy
West Point, New York 10996
Attn: Assistant Dean for
Academic Research

President
Naval War College
Newport, Rhode Island 02840

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22217

National Endowment for the
Humanities
806 15th Street, N. W.
Washington, D. C. 20506
Attn: Division of Research Grants
Division of Education Programs

Director
Defense Advanced Research Projects
Agency
1400 Wilson Boulevard
Arlington, Virginia 22209

Commanding Officer
Army Research Office
Durham, North Carolina 27706

Headquarters
U. S. Army Material Command
Alexandria, Virginia 22337

Wright-Patterson Air Force Base
Dayton, Ohio 45433
Attn: Air Force Aero Propulsion
Laboratories
Aeronautical Systems Division
Air Force Materials Laboratories

Commanding General
Marine Corps Development and Education
Command
Quantico, Virginia 22134

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: USNA AR#2

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER: (Rept.)

4. TITLE (and Subtitle): (6) Summary of Research Activities. Academic Departments 1975-1976.

5. TYPE OF REPORT & PERIOD COVERED: (9) Annual 1 July 1975-30 June 1976.

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s): Compiled and Edited by (10) Professor Wilson L. Heflin

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS: Office of Academic Dean, U. S. Naval Academy, Annapolis, Maryland 21402

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS: N/A

11. CONTROLLING OFFICE NAME AND ADDRESS: (14) USNA-AR-2

12. REPORT DATE: (11) February 1977

13. NUMBER OF PAGES: (12) 237p.

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report): Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE: N/A

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This annual report summarizes the research work of the Naval Academy faculty and midshipmen for the period 1 July 1975 - 30 June 1976. Sponsored and independent research projects are listed by title, followed by the names of the investigators and an abstract. A list of publications and their abstracts are included as well as presentations at professional meetings, conferences, and seminars.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

S/N 0102-LF-014-6601

Unclassified 245600 4/B

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)