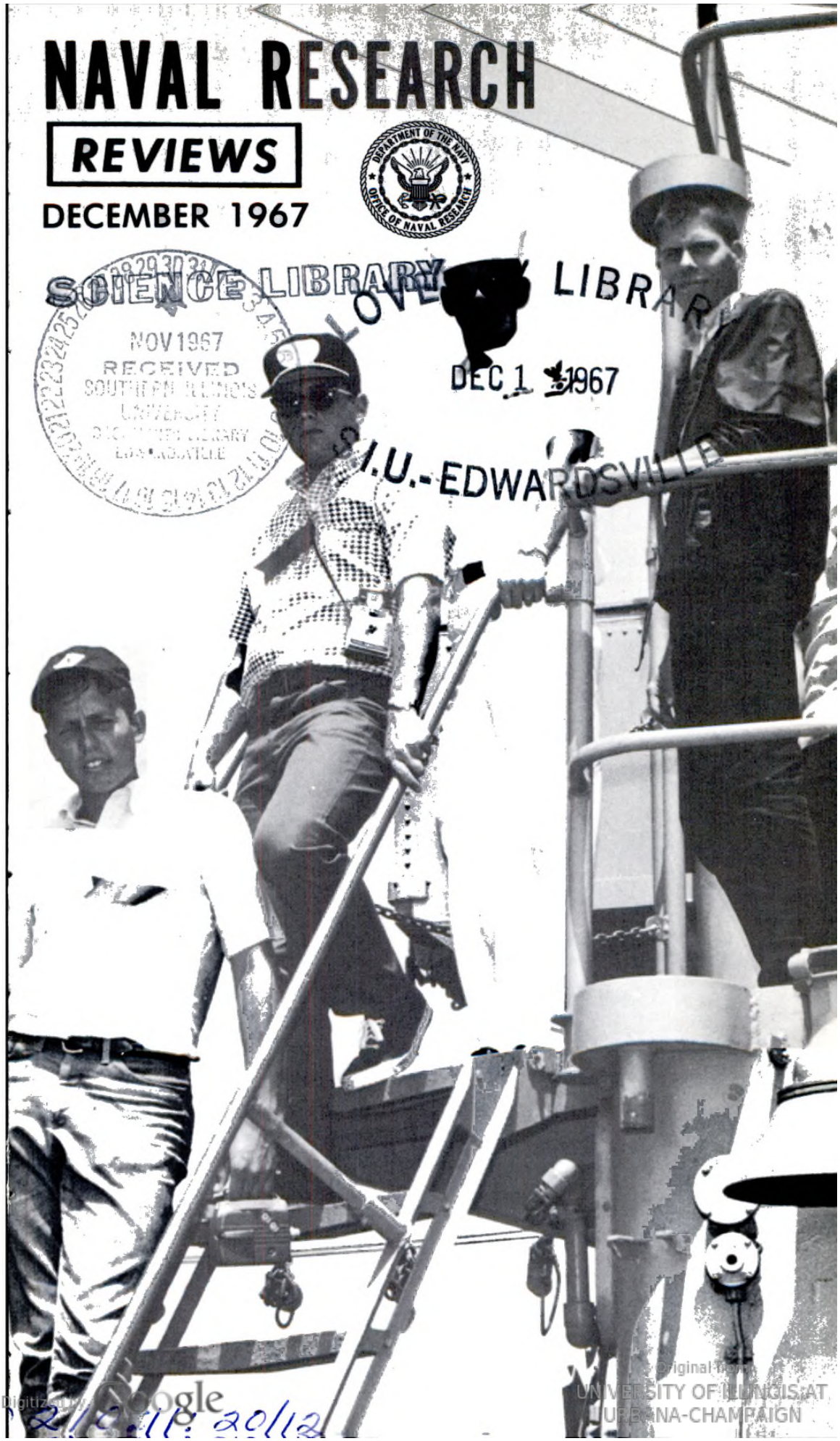
NAVAL RESEARCH

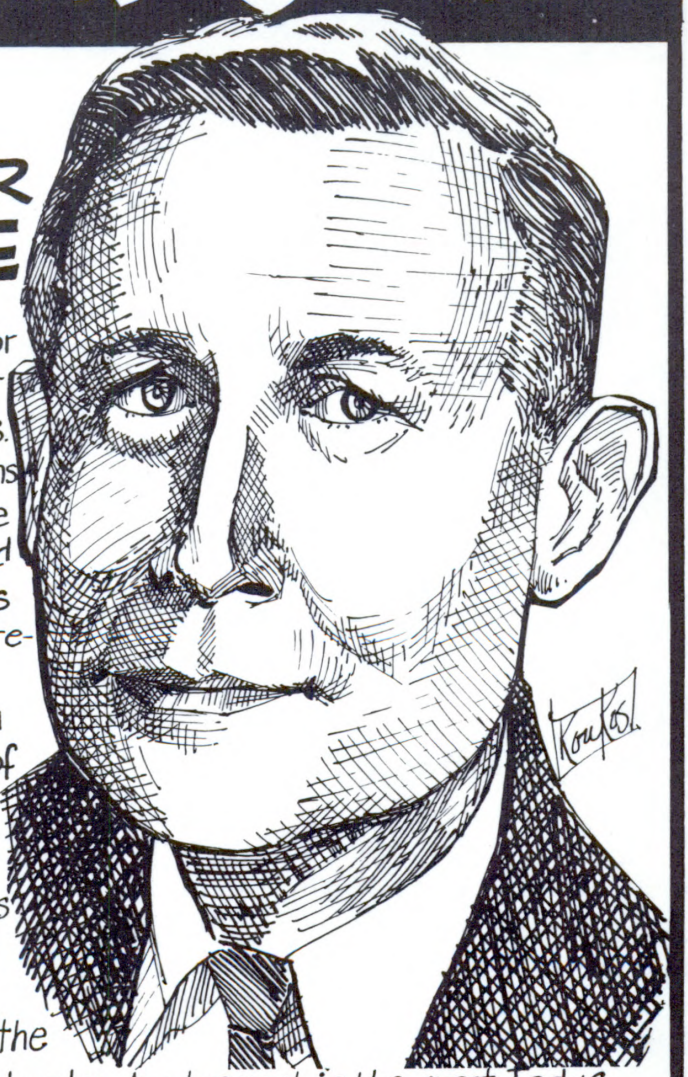
REVIEWS

DECEMBER 1967



Portraits in Science

DR. ROGER REVELLE



Dr. Revelle is director of the Harvard Center for Population Studies. Through his investigations of the physical nature of oceans he has gained international fame. His early oceanographic research involved the analysis of deep sea cores, measurement of bottom currents and studies of the physical and chemical processes in sea water. During 1961-63 he headed a panel which studied the problems of land and water development in the great Indus River Basin of Pakistan. For this work Dr. Revelle was decorated in 1964 with the order of "Sitara-i-Imtiaz" by the President of Pakistan. Dr Revelle is a member of many committees, among them the Research Advisory Committee of A.I.D., the Scientific Advisory Panel of the House Committee on Science and Astronautics and the Naval Research Advisory Committee.

Project ARGUS—A Program of Isolation and Confinement Research

William W. Haythorn
Behavioral Sciences Department
Naval Medical Research Institute

The Navy has long been aware that prolonged isolation and confinement of men in relatively small vehicles or habitats can have undesirable effects—not only on their social-emotional well-being, but also on their performance effectiveness. Thus, to study the problem, the Navy established Project ARGUS (Advanced Research on Groups Under Stress) at the Naval Medical Research Institute in 1962. Initial funding was provided by the Office of Special Projects.

The immediate objectives of Project ARGUS were to build a body of scientific knowledge regarding the effects of isolation and confinement, the nature of individual differences in tolerating such stresses, and the effects of various techniques used to minimize any impairment of psychological functioning resulting from them. The long-range goal of the program was to provide a base of knowledge which would aid in developing improved vehicle design criteria, selection and training procedures, and crew management techniques. Also, this knowledge would contribute to the development of advanced sea-based deterrent systems, deep submergence systems, man-in-the-sea habitats such as Sealab, manned spacecraft, *etc.*

Initially, heavy emphasis was placed on identifying and assessing the effects of stress encountered in closed ecological systems in which normal atmospheric conditions would be maintained. Four sources of stress seemed paramount: stimulus reduction, social isolation, confinement, and interpersonal friction. Anecdotal and research data from a variety of sources, *e.g.*, submarines, Antarctic weather stations, Arctic radar stations, and laboratory studies, indicated that these four sources were capable of impairing man's adaptation and performance in many ways. These same sources of stress also appear relevant in hyperbaric systems such as Sealab. However, in such systems they are combined with increased pressure, exotic gas atmospheres, and the physical dangers of working in a marine environment outside of the capsule.

The ultimate objective of the research program was (and is) to improve the cost effectiveness ratio of future Navy underwater systems. Thus, an effort was made to construct a conceptual framework which would relate the effectiveness criteria to the group behavioral processes which determined these criteria. These processes, in turn, would be related to the variables involved, *i.e.*, the kinds of people comprising the crew; the

nature of the environment provided the crew; and management interventions such as training, leadership, and incentive programs. In this manner, a chain of causal relationships was envisioned which would link crew compositional, environmental, and management intervention variables with the intra-crew processes which produce criterial outcomes. The research program was then developed within this framework.

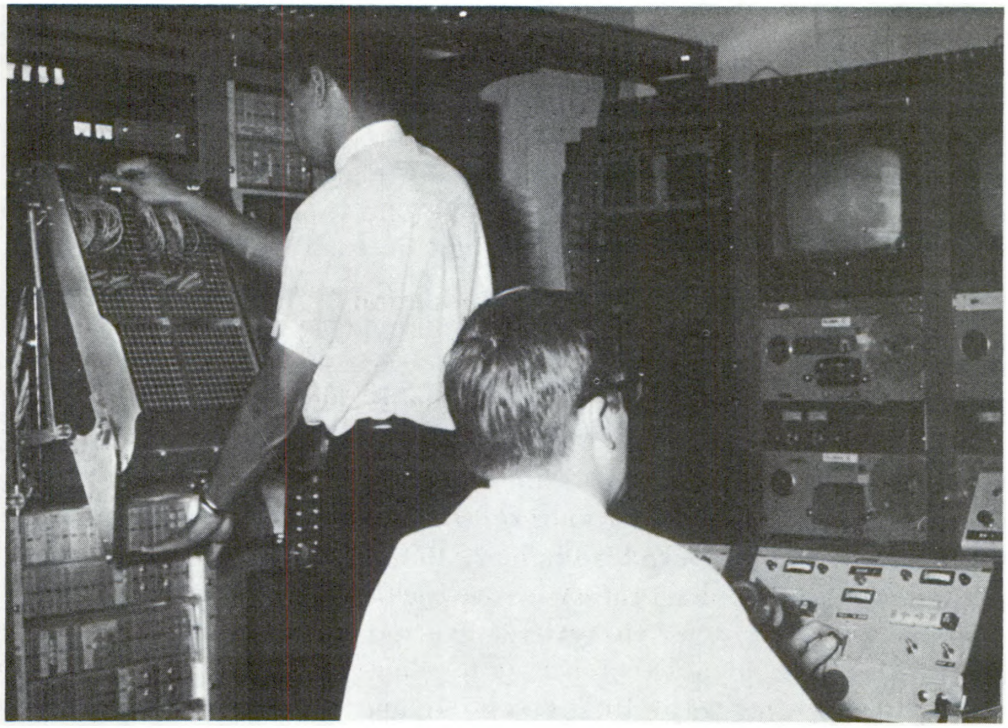
Stimulus Reduction

Most isolated duty assignments provide a lower degree of stimulus variety than that which is normally available. Feelings of boredom and monotony, which are associated with stimulus reduction, have often been cited as causes of performance impairment in operational situations. In extreme cases, *e.g.*, a high altitude pilot on a routine night patrol, or a soldier standing a lonely nightwatch, there are almost no stimuli for the man to react to. Laboratory research on stimulus deprivation has reported extreme responses to such extreme degrees of stimulus reduction. These responses include hallucinations, claustrophobic reactions of fear and anxiety, detriments in perceptual and cognitive functioning, a heightened desire for almost any kind of stimulus, changes in sensory acuity, feelings of subjective stress, changes in EEG recordings, etc.

In this area, Project ARGUS has attempted to quantify these responses more precisely than has been done heretofore, determine individual differences in responses to stimulus reduction, and determine the efficacy of stimulus enrichment procedures in eliminating the undesirable effects. In the most recent, on-going study, individual subjects have been confined to small rooms under conditions of complete darkness and silence for seven days. They are then compared with other subjects, similarly confined, but with ad lib access to lights, reading material, television, AM-FM radio, recorded music, and conversation with another subject on a mutual desire basis. In this study, 19 out of 40 stimulus-deprived subjects were unable to complete the seven-day period of confinement. Only one out of 20 stimulus-enriched subjects were unable to complete it.

During the test, the differences between the two experimental groups in subjective stress and emotional symptomatology were measured. To assess stimulus hunger, subjects in both groups were permitted to listen to a very monotonous recording of an old stock market report. The subjects could trigger the recording by pulling continuously on a spring-loaded lever. There were no differences between the two groups at the outset of the experiment. However, by the last day, stimulus-deprived subjects were listening for more than two-thirds of the time the stimulus was available. Stimulus-enriched subjects were scarcely listening at all.

A vigilance task provided for subjects indicated that performance improved under conditions of stimulus reduction. This improvement was probably due to the increased stimulus hunger and the resulting arousal



Monitors in the central experimental control room

value of any stimuli that occurred. Responses to a symptomatology questionnaire indicated three distinct clusters of symptoms associated with stimulus reduction: tedium and monotony, worry and fright, and positive contemplation (a tendency to accept the situation and reflect on life in general, the meaning of things, *etc.*). Although stimulus-deprived subjects showed more of all three kinds of symptoms than stimulus-enriched subjects did, different subjects appeared to respond to the situation in different ways. It is expected that further research will reveal that, by studying a subject's personality characteristics, an experimenter will be able to predict how he will respond to stimulus reduction.

Data obtained to determine individual differences in tolerance to isolation included personality measures, physiological measures obtained during a pre-experimental baseline period, and restlessness indicators obtained during the first few days of exposure to experimental conditions. Analyses thus far completed indicate that individuals who are unable to endure prolonged exposure to conditions of stimulus reduction are those who normally enjoy a wide variety of sensations and experiences, have a relatively high level of serum uric acid prior to the experiment (and before they know to which condition they will be assigned), and evidence a high degree of restlessness at the very outset of the experiment. Further refinement of these predictive measures is expected to result in improved selection and psychiatric screening of personnel for isolated duty assignments.

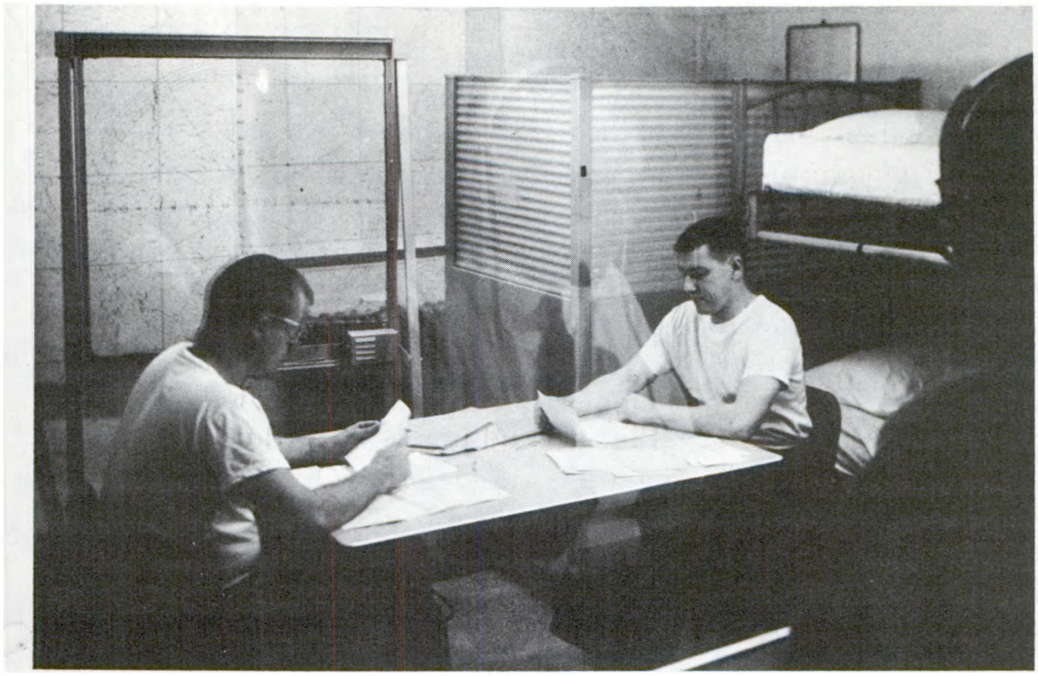
Crews in Isolation

The project's first laboratory study of isolated groups was aimed at determining the degree to which isolation and confinement affected group adaptation and performance, and the degree to which such effects were modified by crew composition considerations. Eighteen pairs of men were selected in such a manner that in each experimental condition, *i.e.,* isolation and non-isolation, one third was homogeneously high, one third heterogeneous, and one-third homogeneously low with regard to each of four personality variables: dogmatism, need achievement, need affiliation, and need dominance. The isolated pairs were assigned to spend ten days in a 12×12 room and perform scheduled tasks with virtually no contact with the outside world. Non-isolated pairs were assigned to work in identical rooms on the same tasks on the same schedule. However, they were free to leave the rooms between tasks, eat in the regular enlisted men's mess, sleep in the barracks, partake of routine recreational facilities, and, in general, live and work much like everyone else on the base.

Two of the nine isolated pairs were unable to complete the ten-day assignment and two other pairs displayed a high level of interpersonal hostility. In one such case, the experimenters were required to intervene to avoid serious physical conflict. None of the non-isolated pairs had any such difficulty. Responses to subjective stress and symptomatology questionnaires indicated that men in the isolated groups experienced considerably more stress than the non-isolated group members did. Also, members of the isolated pairs exchanged more varied and intimate personal information. This latter finding is consistent with anecdotal observations which indicate that men in isolated groups use each other as significant sources of stimulation and, in some cases, get to know each other too well too soon.

Although members of isolated pairs experienced heightened levels of subjective stress, they performed cooperative tasks better than their control counterparts did (as long as they were able to endure the assignment). An examination of the relationship between subjective stress and increased performance suggested that it was a function of an inverted U relationship, with increasing stress producing better performance up to moderate levels of stress. Both the stress and performance results indicated that hypothetically compatible pairs of men (*i.e.,* one man high and the other low on need for dominance, or similar personalities on the other three dimensions) experienced less stress under conditions of isolation than hypothetically incompatible pairs did.

Data were also obtained regarding the use subjects made of the space and objects in the room, and the degree to which they spent their free time in solitary versus joint activities. Analysis of these data indicated



Isolated pair working on a decoding task (distortion caused by taking picture through viewing glass)

that isolated pairs of men tended to withdraw from each other and establish clear-cut territorial preferences to a significantly greater degree than their control counterparts did. This was especially true of incompatible isolated groups with the nature of the incompatibility determining the nature of the social interaction and territorial relationship. For example, pairs who were incompatible on people-oriented variables (affiliation and dominance) tended to establish clear-cut territorial preferences, while pairs incompatible on dogmatism and achievement showed no such tendency. Also, pairs who were incompatible on egocentric variables (dominance and dogmatism) produced a high level of social interaction, while pairs incompatible on affiliation and achievement tended to withdraw from each other (*i.e.*, engage in more solitary than joint activity). These two interpersonal adjustment processes—establishing territorial claims and withdrawing socially—appear to be mechanisms for reducing interpersonal stress.

This study of isolated pairs of men indicated that the effects of isolation and confinement on social-emotional well-being and performance effectiveness were significant. It also demonstrated that the effects of isolation were significantly modified by crew composition, particularly as this factor related to interpersonal compatibility.

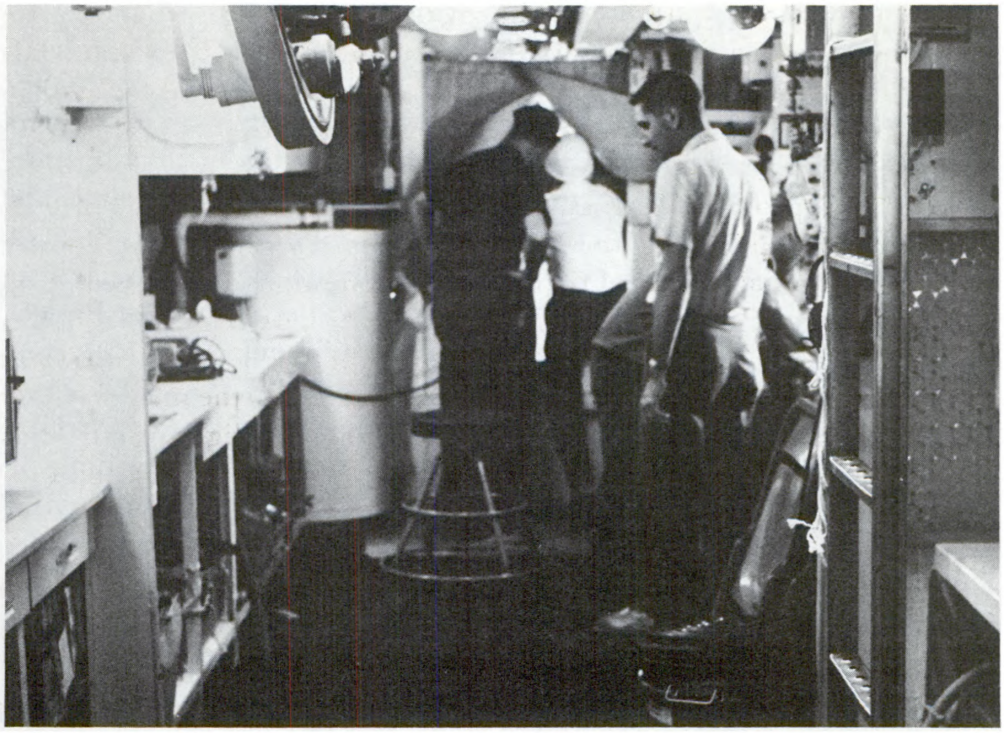
A second study of isolated pairs, recently completed, was addressed to the question of the degree to which modifying isolation conditions would affect the responses of group members. In this study, eight isolation conditions which differed in the degree of privacy permitted, the degree

of contact with the outside world provided, and the information given the subjects regarding the length of mission duration were examined. In half of the groups, both members of the pair were confined to the same room. In the other half, each man had his own room with a connecting door to his companion's room. Half of the groups in each condition of privacy were provided essentially no contact with the outside world. In the other half, there was not only voice contact from mission control, but also occasional playing of popular music, questions and answers from the Playboy Advisor column, and non-current news reports. In half of each of these four conditions, subjects were told that their mission would last four days. In the other half, subjects were told that the mission would last 20 days (the actual duration of all missions was eight days). Thus, the experiment was a two by two by two design, with eight conditions of isolation and at least three groups in each condition.

Although the data gathered in this study are still being analyzed, it is clear that the more austere conditions of isolation, as compared to the first study, produced a much higher rate of request for early release (53 percent of the pairs in the second study were unable to complete the assigned eight days of isolation). Furthermore, the different conditions of isolation produced different rates of aborting, and different levels of subjective stress and anxiety. The highest abort rates were produced by combinations of the no-privacy condition, no outside contact, and expectations of a 20-day mission duration. Further analyses are underway to determine the degree to which task performance, territorality behavior, interpersonal interaction, and other aspects of adaptation and performance were affected by experimental conditions. The results of this study are expected to contribute to improved guidelines for the design and manning of underwater vehicles and other Navy systems which involve a high degree of isolation and confinement.

Man-in-the-Sea

Before the results of laboratory studies can be applied in an operational Navy setting, they must be evaluated in field research. To this end, the Project ARGUS staff participated in Sealab where it was possible to obtain not only extensive demographic, personality, and experience data regarding the aquanauts, but also a wealth of data regarding the subjective and objective adaptation and performance of aquanauts to the Sealab condition. Analysis of the data collected during this experiment has yielded a highly reliable and useful measure of effective performance, which includes both task and social effectiveness, and incorporates both objective and subjective data. By analyzing the relationships between the characteristics of individual aquanauts and their performance in Sealab, a preliminary basis is provided for selection of future



Sealab II aquanauts were observed by closed-circuit TV

aquanauts. These preliminary results, in addition to complementing current laboratory research, provide a basis for further examination of laboratory results in a man-in-the-sea setting and a set of data to be considered for developing further laboratory investigations.

In addition to providing substantive data, research on Sealab II provided opportunities for methodological and conceptual developments. The study combined the use of closed-circuit television, microphones and official records with more conventionally employed measures, *e.g.*, sociometric ratings, leader ratings and self-reports, as data sources. Research results in Sealab promise significant advancement toward more complete and valid data collection for groups under extreme stress in field settings.

The increase in sophistication of electronic devices, such as television and transistorized transmitters, is part of the methodological revolution in psychology which was employed in part by Sealab research. High speed digital computers are essential to the conduct of such research because of the masses of data generated and the complexity of analyses required. Conceptual models employing more detailed and sophisticated data can be expected as a result of methodological advances. The report of research on Sealab II also adapted and developed theoretical concepts which provide the link between laboratory and field research necessary to the analysis, understanding, and prediction of behavior in stressful environments.

Group Processes and Modeling

Some of the phenomena important to an understanding of the behavior of isolated groups can best be studied in carefully circumscribed laboratory settings which abstract the phenomena under investigation and deal with them exclusive of other possible variables. These include various group processes which are especially important in isolated groups, but which can not be readily or economically investigated in long-term isolation studies or in operational field settings. The Project ARGUS program has therefore included experimental social psychological studies of the contagion of aggressive behavior, the social penetration or acquaintance process, the social comparison process by which men evaluate the adequacy of their task performance, the reactions of mature and immature character structures to different leadership styles, the contagion of generous behavior, and the relationships between territorial preferences and interpersonal compatibility.

In an effort to integrate the various findings of Project ARGUS studies in a single conceptual framework, an effort has been initiated to develop a computer model of small crew behavior. This model is intended to incorporate the major findings of a variety of studies, to provide a symbolic analog of crew processes, and, ultimately, to provide a tool for testing the sensitivity of system performance to variations in psychological parameters. The modeling effort is expected to be a continuing process, which will incorporate greater degrees of sophistication as better empirical data become available, and provide a core around which further research investigations will be centered.

Navy Awards Contract for SABMIS Study

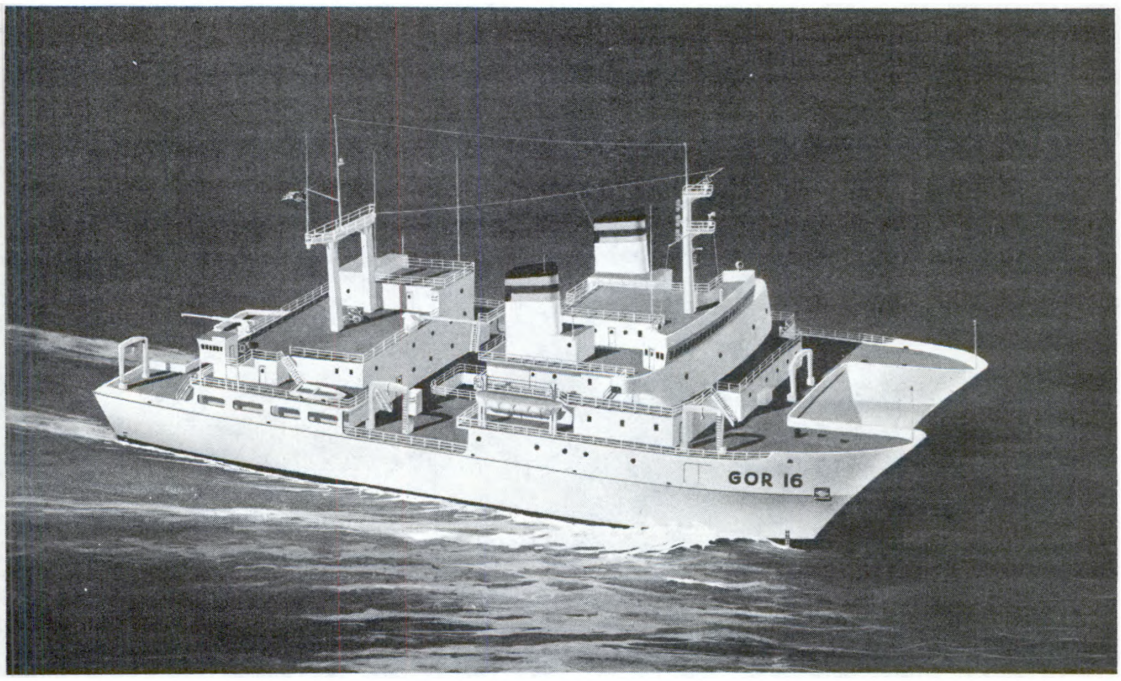
An industry team headed by the Hughes Aircraft Company, Fullerton, California, has been selected by the Navy to perform an advanced study of a Sea-Based Ballistic Missile Intercept System (SABMIS). The team also includes the Lockheed Missile Space Company, Sunnyvale, Calif. and the Newport News Shipbuilding and Dry Dock Company, Newport News, Va. The study, which will take about six months, will focus on a surface ship as a platform for the system.

A special Navy evaluation board reviewed proposals submitted by 23 companies. Bidders formed combinations of companies in order to meet the requirement that the SABMIS program must draw on experience in three fields: missiles, electronics (especially radar), and shipbuilding.

The study contract, which is a follow-on from previous SABMIS studies, is expected to lead to a preliminary design of a SABMIS system.

An Advanced Planning Briefing for Industry on Naval Ordnance and Missiles will be held at the State Department Auditorium, Washington, D. C., March 26-28. Additional information on this briefing, which is sponsored by the Naval Material Command and the American Ordnance Association, may be obtained from Mr. R. C. Lampert, Naval Material Command (MAT 032C), Washington, D. C. 20360.

Unique Catamaran AGOR for Hudson Laboratories



After several years of discussion and planning, the Navy has authorized the construction of a unique catamaran oceanographic research ship as a part of the FY 67 shipbuilding program. The ship will be used by Hudson Laboratories of Columbia University under contract to the Office of Naval Research.

The Hudson AGOR (Auxiliary General Oceanographic Research), one of the largest catamarans ever constructed, will be the first ocean-going catamaran research vessel. A number of smaller research catamarans and a slightly larger catamaran oil-drilling rig have been built. However, the Hudson AGOR will be capable of oceanwide operations, and is specifically designed and built as a catamaran with asymmetrical hulls rather than two symmetrical hulls built separately and then joined by a superstructure.

Hudson Laboratories provided the first preliminary characteristics for a 3200-ton AGOR as early as 1963. From those characteristics, it was estimated that a ship of approximately 4000 tons would be needed to meet the user's requirements. In October 1965, the Chief of Naval Research proposed that the Fleet Minelayer USS TERROR (MMF 5) be converted to an AGOR in order to provide a ship of this size within the monetary restrictions. However, because of excessive conversion costs, this plan was dropped and effort directed towards the design of a conventional hull AGOR.

In March 1966, during an informal meeting between representatives of the ONR Undersea Programs Branch and the Naval Ship Engineering Center, it was decided that feasibility studies should be made of a catamaran AGOR based

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on the hull design for the Submarine Rescue Ship (SCB Project No. 721.67). Review of this design by Hudson Lab and NAVSEC indicated that it exceeded minimum requirements.

The approved characteristics for the ship were promulgated by the Ships Characteristics Board on March 15, 1967. M. Rosenblatt and Son, Inc. of New York was selected to prepare the plans. It is expected that the contract will be advertised late in 1967, with construction to begin in early 1968 and delivery in 1970.

The following article describes the catamaran AGOR in detail. It appeared in the September issue of the Naval Ship Systems Command Technical News *and is reprinted with the permission of the Naval Ship Systems Command.*

—LCDR James C. Froid
ONR Underseas Programs

Preliminary Design of T-AGOR 16

J. J. Kleinheinz
Project Director, Ship Concept Design Division
Naval Ship Engineering Center

The preliminary design of T-AGOR 16 (SCB Project No. 726.67), now being developed into contract plans and specifications, will bring to the oceanographic community a ship of improved arrangement and scientific gear handling, and increased automation of propulsion machinery over present oceanographic research ships. The design utilizes a catamaran hull, the first ever employed for an oceanographic research ship this size, which provides a stable working platform with large areas for scientific use. In general, T-AGOR 16's design provided for all the increased requirements since the Navy's first oceanographic research ship was designed almost a decade ago.

That first design (SCB Project No. 185) delineated the T-AGOR 3 Class, a 208-foot, 1300-ton ship. It represented several years of study by the then Bureau of Ships, the Office of Naval Research, and other oceanographic oriented organizations.

Experience acquired in operating T-AGOR 3 indicated to oceanographers that a ship was needed with greater design flexibility and larger laboratory and scientific spaces. Such requirements as these led to the design of T-AGOR 14 (SCB Project 710.66), a 240-foot, 2000-ton ship.

From T-AGOR 14, the design of oceanographic research ships progressed to the design of the new T-AGOR 16. This ship has an area developed for laboratories and scientific stores more than double those of T-AGOR 14. In addition, the catamaran design permits a large increase

in open deck work area with enclosed spaces for the winch complexes. This space is essential as T-AGOR 16 will be used to conduct acoustic research for Anti-Submarine Warfare (ASW) application and considerable deck gear will be employed to handle large underwater sound sources and listening devices. The catamaran design also easily incorporates a center well between the two hulls for scientific gear streaming or handling of the deep research vehicles (DRV) at the point of minimum ship motion.

Heavy deck and scientific equipment can be handled in any location on the deck without excessive heel angles because of the high metacentric height associated with the catamaran hull design. The extensive separation of the hulls results in large separation of the controllable-reversible-pitch (CRP) propellers insuring excellent maneuverability at slow speeds. Also, the need for bow thruster units used in previous AGOR designs is eliminated.

Construction of the T-AGOR 16 has been authorized as the second catamaran design of the FY 67 shipbuilding program. The other is the submarine rescue ship ASR (SCB 721.67). T-AGOR 16 will be used by Hudson Laboratories of Columbia University under contract with the Office of Naval Research. Hudson participated fully in the design. They designated scientific equipment such as laboratory equipment, electronics, and deck gear. They defined scientific space requirements for laboratories, open deck work areas, and scientific stowage.

Principal Data on the Design of the New Oceanographic Research Ship T-AGOR 16

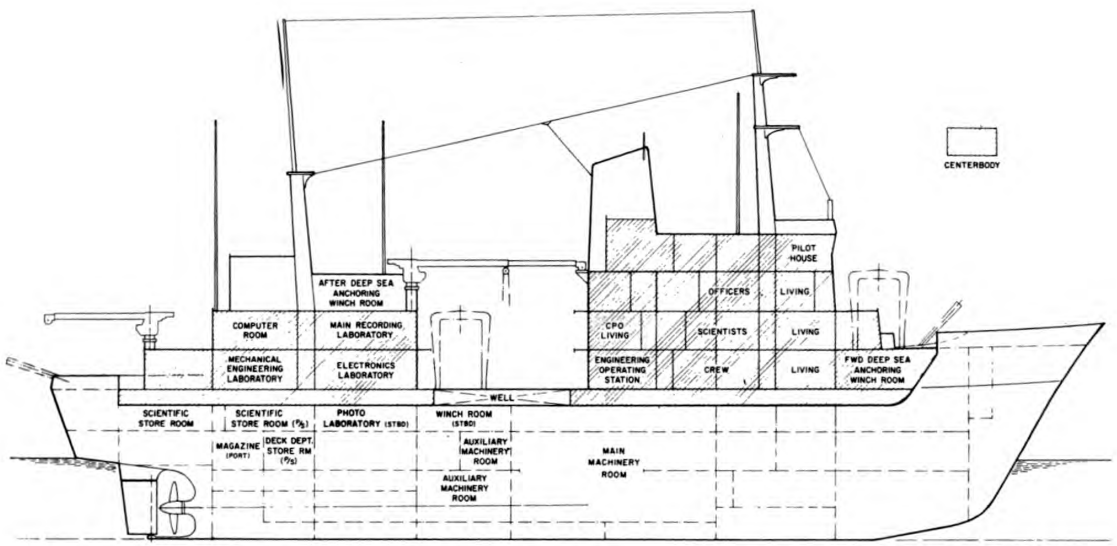
Length overall	246′-5″
Length at waterline	220′-0″
Beam, maximum	80′-0″
Beam, each hull	24′-0″
Draft, full load	18′-10″
Displacement, full load	3080 tons
Sustained speed	15 knots
Creep speed (w/aux. propulsion)	2-4 knots
Endurance at 13.5 knots	6000 miles
Accommodations	11 officers
	3 CPO
	30 crew
	25 scientists

T-AGOR 16 preliminary design plans were developed under the cognizance of the Ship Concept Design Division of the Naval Ship Engineering Center. M. Rosenblatt & Son, Inc., served as design agent.

Arrangement

The catamaran design permits an arrangement which represents a major improvement over earlier oceanographic research ships. It permits the scientific spaces to be segregated from the machinery and living spaces.

The scientific laboratories, research control center, computer and data processing spaces, and calibration and instrument test facilities are housed in the after superstructure. The scientific chill and freeze rooms,

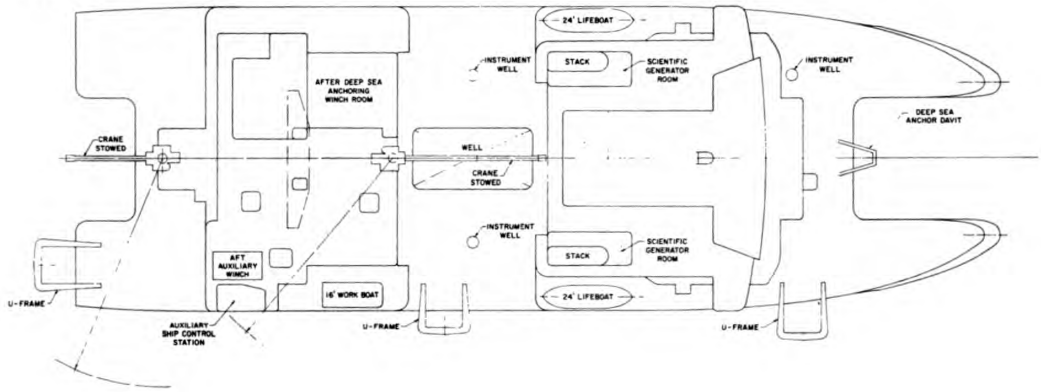


ARRANGEMENT IMPROVEMENT—The design of T-AGOR 16 provides for a forward and after centerbody structure in an arrangement which is a major improvement over earlier oceanographic research ships. After superstructure houses scientific laboratories, the research control center, computer and data processing spaces, and the calibration and instrument test facilities. Directly below, in the two hulls, large stowage areas for scientific equipment are located. In the forward superstructure the living spaces and main ship control spaces are housed. Shaded area of sideview diagram indicates centerbody.

and the scientists' separate radio facility are also housed there. This radio is separate and distinct from the MSTS requirements of the ship.

The main ship control, centralized machinery control station, and living spaces are housed in the forward superstructure. The pilot house, chart room, and radio room are on the 03 level. The wardroom country of the ship's officers is the 02 level. All the scientists are berthed on the 01 level.

MORE SPACE—In addition to providing a more stable platform, the catamaran hull design of T-AGOR provides a large increase in open deck work areas over current oceanographic research ships. The arrangement of handling equipment provides work areas forward, amidships on the starboard side, aft on the starboard side, through the center well, and through the bow and stern slots between the two hulls. The versatility of the design, evident in the topview diagram, provides deck space for vans and the use of the center well for scientific gear streaming or handling of deep research vehicles.



Scientific Gear Handling

The arrangement of scientific gear handling and deck equipment provides work areas forward, amidships on the starboard side, and aft on the starboard side. It provides for equipment handling through the center well and through the bow and stern slots between the two hulls. Space is designated amidships on the port side for carrying portable vans of scientific equipment.

The forward winch complex consists of a main traction winch and an auxiliary winch. The primary use of the traction winch is for deep sea anchoring in water up to 20,000 feet. It is required to provide a 50,000 pound pull at 80 feet per minute. Over 50 percent of the experiments performed by Hudson Laboratories require deep sea anchoring of their present ship, the USNS GIBBS.

The forward auxiliary winch will be used for handling armored cable for launching acoustic listening systems, or for taking sound velocimeter readings with the ship either at anchor or drifting. This winch will not be used at the same time as the forward traction winch because the same power pack is utilized. The auxiliary winch will be rated at 20,000 pounds at 125 feet per minute or 5000 pounds at 500 feet per minute.

The forward U-frame on the starboard is used for handling equipment through a ten-foot wide side port between the main deck and 01 level. Equipment is moved to the midship area by the monorail on the underside of the 01 level along the main deck passage.

The midship working complex consists of a U-frame rated at 20,000 pound load capacity to be used in conjunction with the auxiliary winch. This complex will be used for taking nansen casts and bottom cores. The winch can also be used for lowering relatively light equipment over the side or through the center well.

The aft winch complex located on the 02 level has a 50,000-pound capacity traction winch and a 20,000-pound capacity auxiliary winch. The traction winch will be used to handle heavy acoustic transducers and to provide a capability of deep sea anchoring by the stern.

The aft auxiliary winch is used for towing light acoustic systems from the stern and for handling floats for transducers when used in conjunction with the stern traction winch. The aft U-frame will be utilized for trailing out the armored electric cable when used in conjunction with the aft auxiliary winch.

There are three 36-inch diameter instrument wells. One well is forward in the port hull, two are amidships, one port and one starboard.

There are two electrohydraulic cranes with telescopic booms rated at 8550 pounds with an outreach of 48 feet. They are rated at 50,000 pounds when resting on a stop at 15 feet.

The stern crane used for lifting large transducers and coring equipment also serves as the fairlead for deep sea anchoring from the stern. The crane on the forward end of the after superstructure is for general loading and stores handling and service to the midship well.

Powering and Machinery

The speed power calculations of T-AGOR 16 are based on tests run at the David Taylor Model Basin with an early ASR hull model correlated to a 24-foot beam asymmetrical hull. Higher speed maneuvering tests have also been run on the same model. Results of the tests show a turning diameter similar to single hull ships of the same length. Since a single hull ship of the same displacement would be longer, maneuverability is superior when compared to a ship of the same displacement.

The main propulsion plant is geared diesel. There is a main propulsion unit rated at 2400 BHP, and an auxiliary unit rated at 165 BHP in each hull. The sustained speed of 15 knots is obtained when operating on the main propulsion engines only.

Low sustained speeds of 2 to 4 knots are obtained by clutching in the small auxiliary engines. At slow speeds the ship is able to turn in approximately its own length by reversing the pitch of one of the widely-spaced controllable reversible pitch (CRP) propellers.

The ship's service electrical plant consists of three 350 KW, 450 Volt, 3-phase, 60-cycle diesel generators. The two 75-KW generators, provided for scientific and essential services equipment, are located topside on the 03 level and are resiliently mounted to reduce the ship's self noise during silent ship operations.

A centralized machinery control station is provided to reduce manning requirements. It is located directly accessible to either machinery room or to the scientific generator spaces. Equipment is provided for starting and securing the main and auxiliary machinery, automatic paralleling of generators, remote readouts, alarms, and data logging.

The ship's speed and maneuvering control remains in the pilot house and secondary ship control space. The secondary ship control, in the starboard quarter deck house, provides good visibility to the working areas starboard and aft.

Structural Design

Structural design is one of the key areas in the design of a catamaran. The T-AGOR 16 structural analysis was patterned after the ASR design (SCB 721.67). The hulls are designed to ABS rules with class C ice strengthening and are transversely framed.

Load analysis tests were conducted for the ASR during its design development. The hydrodynamic model was used with instru-

mented bars at the torsional centers of the forward and the after superstructures.

The T-AGOR 16 cross structure is designed to withstand the loads of roll moment, the moment acting on the cross structure due to the roll of the ship; the shear force, the force acting on the cross structure due to the vertical motion of the ship on a wave; torsion, torsion acting on the cross structure when a wave may support one hull forward and one hull aft, or torsion caused by grounding or docking of the ship; dead-weight and live loads on the structure, and slamming load on the bottom of the cross structure in heavy seas.

The preliminary design on T-AGOR 16 exemplifies the cooperation between the Naval Ship Systems Command, the Naval Ship Engineering Center, the Office of Naval Research, and the user laboratory. The development of contract plans and specifications is now assigned to the Hull and Weapons Support Division of the Naval Ship Engineering Center. Ship management responsibility was assigned to Chief of Naval Material (CNM) Project Manager-5 as of 1 July 1967.

NOL Conducts Studies of New Molten Salt Electrochemical Systems

The Naval Ordnance Laboratory, Silver Spring, Md. is currently conducting studies aimed at developing thermal batteries capable of greater than 30 watt-hr/lb for discharge times of five minutes or less.

Fused salt batteries offer the most practical means of producing high electrical energy for short periods of time. However, it is presently possible to achieve only a small fraction of the theoretical energy from working thermal batteries.

A number of good anodes are available for an improved thermal battery. However, the cathode must be chemically stable in a molten salt electrolyte and still be able to undergo efficient multi-electron reduction in order to give products which do not inhibit the cell reactions. Compounds of the first-row transition metals in unusually high oxidation states offer a promising means of meeting such cathode requirements.

Molten salt spectroscopy is one of the most fruitful means of studying the stability and structure of chemical species present in a cathode-molten salt electrolyte system. A molten salt spectroscopy facility designed by Charles Root, chemist in the Electrochemistry Division, is now in operation. A Cary 14R spectrophotometer modified by the addition of a furnace designed and built at NOL is used to study molten salt solutions at temperatures from 50° to 1000°C under conditions similar to those found in thermal batteries.

Initial studies of copper in the unusual +3 oxidation state indicate that potassium fluorocuprate (III), K_3CuF_6, is stable and effective as a high energy cathode material when used in conjunction with a molten fluoride electrolyte. A test cell using K_3CuF_6 dissolved in molten LiF-NaF-KF eutectic as the cathode and electrolyte, an inert cathodic electrode, and a magnesium anode yielded 2.8 volts open circuit and 1.8 volts with a five ohm load. The cell operated for five minutes under load before a ten percent drop in voltage was observed.

Other "unusual" oxidation state compounds such as potassium fluoronicklate (IV), K_2NiF_6, and potassium fluorochromate (IV), K_2CrF_6, also appear promising as cathode materials and are currently being evaluated in test cells.

The Navy Science Cruise: A Diary

The Navy Science Cruiser Program was established by the Chief of Naval Operations in 1958 to encourage the nation's youth to develop an active interest in science. Specifically, it is aimed at encouraging outstanding high school students whose scientific projects and talents are of potential interest to the Navy. The Chief of Naval Research is responsible for the administration of the program.

The Navy Science Cruiser Award, which is given annually at approximately 225 regional and state science fairs, is a cruise/tour of five days' duration. During this time, the Cruisers take a daylight cruise on a Navy ship, and tour various naval and other research institutions. In this way, they are made aware of the Navy's applications of latest scientific and engineering developments. Naval facilities in the San Diego and Newport areas serve as hosts for the west and east coasts, respectively.

The following account of the 1967 Navy Science Cruise in the San Diego area was prepared by Miss Diane Oliver, ONR Public Affairs Office, who served as a representative for the Office of Naval Research.

Monday, August 14

Cruisers arriving at the San Diego International Airport, Lindbergh Field reported to the Military Information Booth, which served as a meeting place for the cruise winners. Here the Cruisers were issued a name tag and an information booklet describing the cruise and the San Diego area. A total of 96 Cruisers reported to the booth. Of this number, 82 were boys and 14 were girls. This is the first year that girls have participated in the Navy Science Cruise.

Special Navy buses were used to transport the Cruisers to their respective berthing facilities. The girls were taken to the Naval Training Center, Wave Barracks Number Four; the boys were berthed aboard the USS AEGIR (AS-23), which was docked at the Naval Inactive Ship Maintenance Facility, Naval Station, San Diego. Personnelman Third Class Janet Tarves, USN served as escort officer for the girls; Radioman Second Class Daniel Baker, USN and Interior Communications Technician Second Class Van Wahl, USN escorted the boys. Signalman First Class Howard Crews, USN acted as escort/coordinator.

After the Cruisers had settled in their quarters and eaten in their respective messes, they were offered a choice of evening's entertainment: movies at the Naval Station theatre or bowling at the bowling alley.

Tuesday, August 15

Today, the actual cruise/tour began. After breakfast, the boys and girls met at the Naval Station theatre. They were welcomed by CAPT Joseph

N. Williams, Jr., Public Affairs Officer, 11ND. He described the naval activities in the area and gave a slide presentation which depicted the types of work being conducted at these facilities. After the presentation, several of the Cruisers described their science projects.

At 0915, the Cruisers and their escorts boarded a Navy bus and proceeded to the pier area. This was an exciting time for the Cruisers, for they were about to embark on a Navy ship. They boarded the destroyer USS PREBLE (DLG-15) and were warmly welcomed by the officers and men. After PREBLE had steamed out of port, the Cruisers were split into groups of ten and escorted by crew members to various areas of the ship. They visited the radar control room, the pilot house, the engine room, the men's quarters, etc. Also, crew members demonstrated how missiles are made ready for firing in case of attack. Suddenly, in the midst of the tour, the ship's Captain announced over the loudspeakers: "Now hear this! All hands report on deck immediately for helicopter air evacuation and replenishment demonstration. That is all." The Cruisers were most interested in this demonstration. It was understood that visitors are rarely afforded this opportunity.

Lunch was served in the enlisted men's mess. The menu included steak, french fries, cole slaw, and fresh apple pie. The Cruisers agreed that the Navy cooks had done a good job.

After leaving the PREBLE (at 1400), the Cruisers boarded a bus bound for the Salk Institute for Biological Studies, San Diego. The institute is engaged in a program of research aimed towards understanding life at the molecular/cellular level. The Cruisers were welcomed by Mr. Allen Height, an institute researcher, who described the "Antibody Producing System" and some of the projects being conducted at the institute. Because of the limited time available, the Cruisers did not have an opportunity to go through the laboratory.

The next stop was the Scripps Institution of Oceanography, La Jolla. This oceanographic institution provided logistic support for the Navy's Sealab II experiment, which was held off the shores of La Jolla in the fall of 1965. After a short presentation about the institution's activities, the Cruisers toured its Aquarium.

The first day of the cruise/tour was over. It was time to return to quarters. After their evening meal, the boys attended the station theatre and the girls went swimming at the Naval Training Center.

Wednesday, August 16

The first thing on the agenda this morning was a visit to the Naval Command Control Communications Laboratory Center (formerly the Navy Electronics Laboratory), San Diego. A representative of the center described its activities and showed a movie entitled "Laser Research at

NEL." Next, Mr. G. I Voran, of the Public Affairs Office, took the Cruisers on a tour around the center. They learned how pictures are taken by meterological satellite recordings and how information is received by the center's 60-ft. diameter radio telescope. Also, they visited the Antenna Testing—Model Range where they saw many scale models of antennae and Navy ships, including the USS MISSOURI.

The deep-diving TRIESTE I, currently being refurbished, was the center of attraction at the Naval Undersea Warfare Center, San Diego Section (formerly part of NEL). Because of its present condition, the Cruisers were not able to tour the vehicle. They were told that, when completed, the TRIESTE is expected to go on display at the Smithsonian Institution, Washington, D. C.

After leaving the center, the Cruisers went to Point Loma. Here they ate their box lunches and inspected the Cabrillo National Monument, which commemorates the discovery of San Diego Bay—and California—by Juan Rodriquez Cabrillo in 1542.

After lunch, the Cruisers reboarded their bus and proceeded to the Deep Submergence Systems Project Technical Office, San Diego. They were welcomed by LT Lawrence T. Bussey, Training Officer, who showed them films of Sealab I and Sealab II. Warrant Officer Robert A. Barth and Torpedoman First Class Kenneth J. Conda, both of whom were aquanauts in Sealab II, were on hand to answer questions about the Sealab experiment and explain about the various types of equipment used. They told the Cruisers that the Sealab I habitat, which operated off the coast of Bermuda, was a converted mine sweeper. The Sealab II habitat was built at the San Francisco Naval Shipyard. The Cruisers especially enjoyed hearing about Tuffy, the porpoise, who had been taught to deliver mail to Sealab II, carry messages between the aquanauts, and do other errands. Tuffy is now in training to take part in Sealab III, which is expected to take place early next year.

The last event of the day was a visit to the submarine USS BASHAW (AGSS-241). A guide led the Cruisers through the submarine, explaining the functions of the various types of equipment and instruments.

After dinner, the Cruisers had an unexpected treat. They were taken to the San Diego stadium, where they saw an exciting double-header between the San Diego Padres and the Indianapolis Indians. The Padres won both games!

Thursday, August 17

Early this morning, the girls left their barracks at NTC and took a Navy bus to the Admiral Kidd Club boat landing. There they boarded a boat bound for the Naval Amphibious Base, Coronado. The boys came over by boat from the Naval Station.

CAPT W. C. Meyer, Commanding Officer of the Naval Amphibious School, welcomed the Cruisers and gave a slide presentation about the activities of the base. Also, the Cruisers visited the classrooms where men are taught by the aid of television and a huge war-game theatre which demonstrates various forms of amphibious assaults.

The Language Laboratory at the school proved very interesting to the Cruisers. The primary language being taught today is, of course, Vietnamese. Men are taught to speak this difficult oriental language so they may do a better job in carrying out their military assignments. The length of the course given depends on the type of duty the individual will perform. Students are taught by means of tape recordings, and can receive individual help from an instructor via an electronic hook-up. The Cruisers listened to some of the tapes to get an idea of how the Vietnamese language sounds.

A highlight of the visit to the Amphibious Base was a tour of a Fast Patrol Craft (PCF). These 50-ft. long "Swift" boats, which are armed with twin 50-cal. machine guns and a combination 81mm mortar and 50-cal. gun, can travel at speeds up to 28 knots. They are used for rivers, coastal blockage, and patrol.

The Cruisers were returned to their respective quarters for lunch and a rest period. Then, back on the Navy bus for a trip to the world-famous San Diego zoo. After touring the zoo, the Cruisers went to the zoo picnic area for a buffet dinner hosted by the Copley Press, publisher of the *San Diego Union* and *Evening Tribune*. After dinner, the group went to the zoo's Elmer Otto Auditorium where they had the privilege of hearing a speech by LTJG Dieter Dengler, the German-born Navy hero who was the first American serviceman to escape from the North Vietnamese.

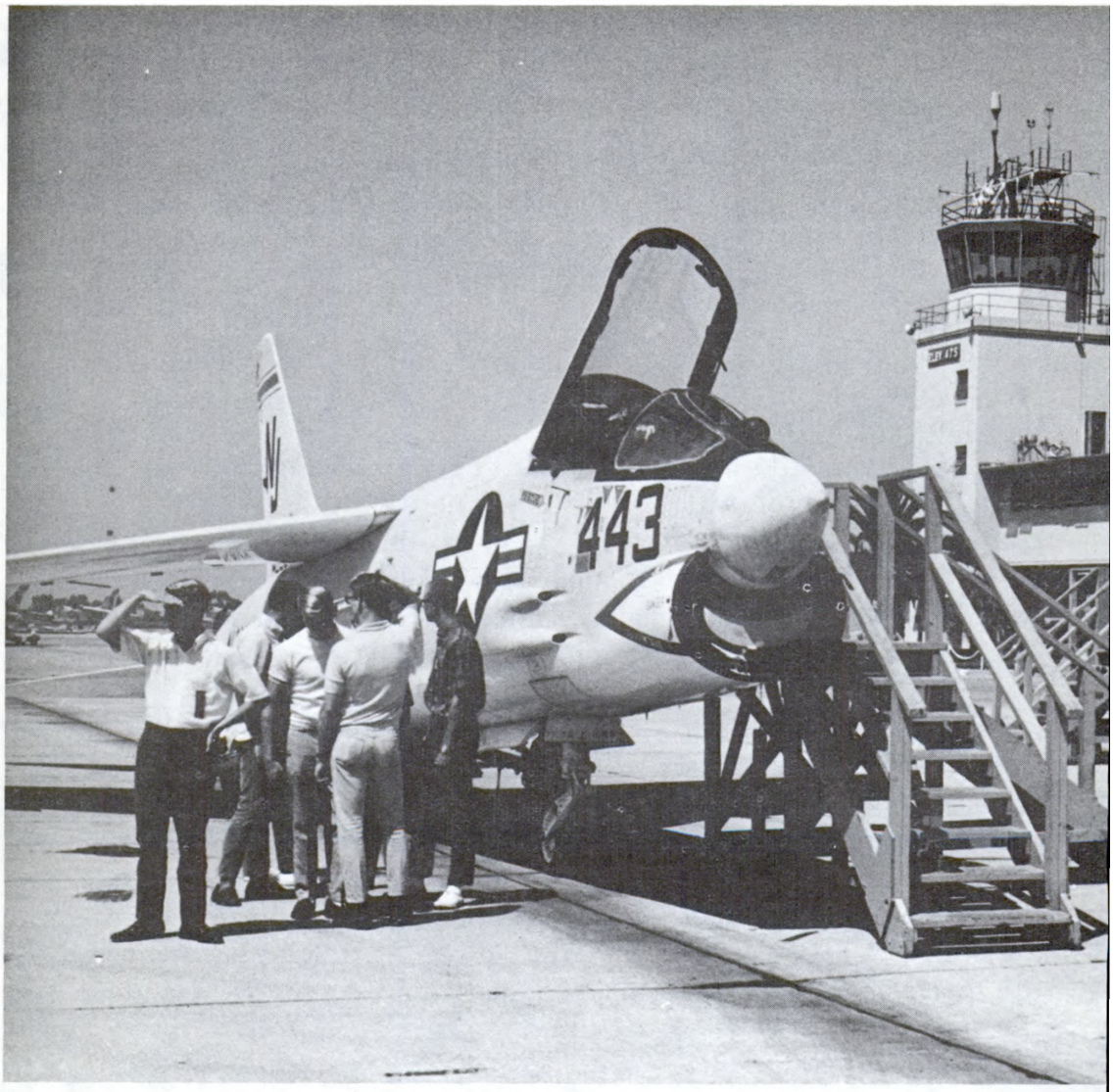
Friday, August 18

Today, the Cruisers visited the Miramar Naval Air Station. After a briefing and a short movie about Navy pilots, the group went on a tour of the station. They visited the air control tower, aircraft maintenance section, avionics section, training building, parachute loft, etc. One building housed a display of the various types of flight suits worn by Navy pilots. A pilot in the building demonstrated the pressurized flight suit.

The Cruisers were very interested in the two Navy jets that were on-station. Although they weren't allowed to go on board, Navy pilots were on hand to answer questions.

Lunch was served at the Miramar enlisted mess. After lunch, the Cruisers were permitted to shop for souvenirs in the exchange.

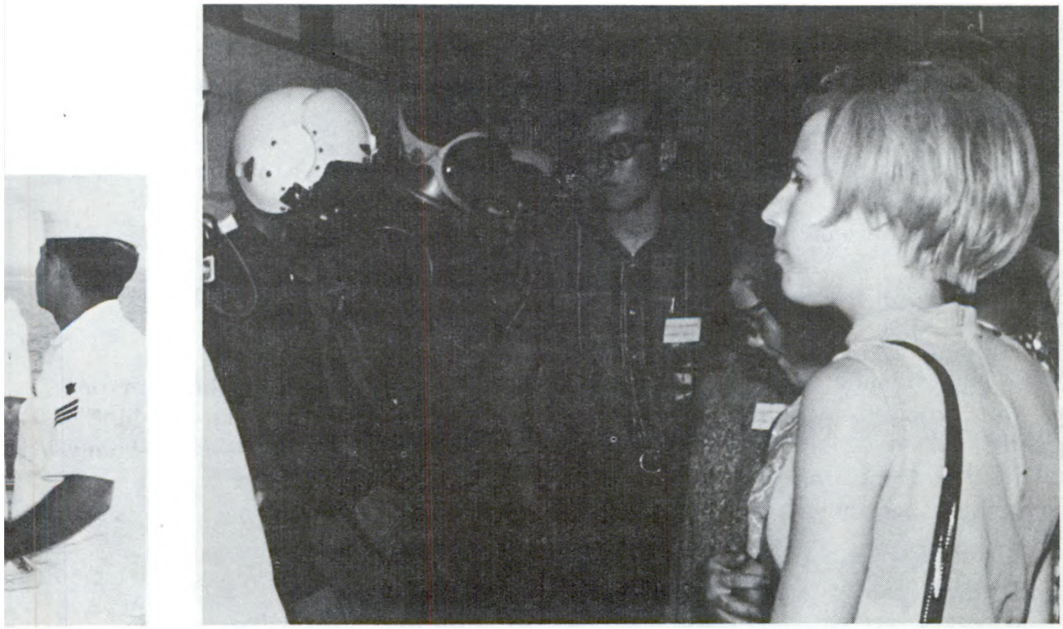
The afternoon was devoted to rest and relaxation. The Cruisers donned their bathing suits and went to Ocean Beach. This was a real treat—especially for those who had never seen the ocean before.



The Cruisers inspected Navy jets at the Miramar Naval Air Station

Crew members escorted the Cruisers to various areas of the PREBLE

They were interested in the helicopter air evacuation and replenishment demonstration on board the PREBLE



At NAS Miramar, the Cruisers saw a display of flight suits worn by Navy pilots

General Dynamics/Convair, Kearny Mesa hosted the Cruisers during the evening. They met in the Convair recreation building for a Junior Astronomy Science Workshop. Also, Dr. Theodore Walker, Scripps Institution of Oceanography, gave an illustrated lecture on a study being conducted on the migration habits of the gray whale.

During the week, the Cruisers were observed by their escorts and the ONR representatives for adaptability, range of interests, abilities, *etc.* The following Cruisers were selected as outstanding in this regard:

Patsy Breewick, Arnegard, North Dakota
Brent C. Brown, Topeka, Kansas
Jean Marie Campbell, Laredo, Texas
Jim Grummon, Glendive, Montana
Lynn Robert Horne, Shreveport, Louisiana
Roger L. Seymour, Big Bear Lake, California
Royetta Snider, Richmond, Missouri
Elaine Yamaguchi, Fresno, California

Saturday, August 19

Today was spent in packing and getting ready to go back home. A shuttle bus made regular runs to Lindbergh Field.

The Cruisers voted that the cruise on the Navy destroyer and the opportunity to hear LTJG D. Dengler's story were the highlights of the cruise. They felt they had learned much about the Navy and its role in science.

* * * * * *

Now, a few comments from the Cruisers themselves:

Rebecca Hutchison, Spearman, Texas, writes:

"Through this trip I felt that my work in science was well worthwhile . . . I deeply thank the Navy for giving me such an experience . . . This glimpse of the Navy and its workings has made me a very proud American."

Keith Redenbaugh, Oakdale, California got to know his fellow Americans:

"This was the most amazing trip I have ever taken . . . This Cruise brought me in contact with people from all over western United States. It has shown me that kids in this country are all the same whether they come from a farm in North Dakota, a wealthy family in Colorado, or a city like San Diego . . . The Cruise has changed my views on people entirely. I no longer judge people by how they appear . . . it has helped my life greatly."

Margaret Gibson, Illmo, Missouri, sums it up:

"The Cruise was a marvelous trip and experience which I will never forget."

Computers in Medicine: Where Do We Stand?

Arthur B. Callahan
Medicine and Dentistry Branch
Office of Naval Research

In this present technological age, increased utilization of computers is continually causing obsolescence of current data processing systems. Early computer systems enormously increased man's capability of handling data, making it necessary to develop faster and more versatile computers to keep up with scientific demand. Accordingly, time-sharing systems have been developed which permit multiple use of currently available computers and, consequently, increased user access. Another significant development is the analog-digital hybrid computer which allows the input signal to be preprocessed electronically before it receives final processing on the digital computer, with a resultant increase in speed. However, as evidenced by the vast amount of effort going into the development of both larger digital computer systems and special purpose computers, the technological appetite for increased computer capability has not been satisfied.

In this regard, the fields of biology and medicine have been as insatiable as all other scientific disciplines. An examination of the records of federal research granting agencies (by a computerized information retrieval system, of course) reveals that there are over 600 computer research projects in the biomedical field. When this "information explosion" is considered in terms of time, effort and expense involved, the questions which immediately arise are: what benefits are being derived from this effort, in what areas are the efforts being directed, and what are the envisioned results of these efforts? However, because of the widespread usage of computers and the great diversity of the research problems in which they are used, there are no clear-cut answers to these questions.

Computer Applications in Medicine

Medical computer applications have been classified into six areas: diagnosis, patient records, clinical laboratory analysis, patient monitoring, hospital communications, and facility utilization. A seventh area, statistical data handling, which could include most of the biological research applications, *e.g.,* curve-fitting, modeling, plotting, equation solving, *etc.,* can be arbitrarily established.

Although much has been published on the promises and potentials of computers in medicine, it must be admitted that computer application has not been as successful as had been predicted. It appears that computers have been most successful in the areas of clinical laboratory analysis and facility utilization, moderately successful in the areas of patient records and patient monitoring, and least successful in hospital communications and diagnosis. This arbitrarily established hierarchy of success parallels the decision complexity in the particular areas involved.

In the area of clinical laboratory analysis, the computer merely accepts a digitalized input signal from an instrument which measures a biological sample, *e.g.,* blood or urine, and records it in a standard laboratory record.

In the area of hospital facility utilization, computerization is primarily a bookkeeping function. Data pertaining to facility utilization, which includes patient population, housekeeping inventories, laboratory workloads, and the scheduling of treatment and diagnostic facilities, can constantly be entered into computer memory and then queried for status and availability. Such tasks obviously require minimal decisions from the computer.

The problem of automating patient record storage and retrieval has received intensive effort from the medical profession. Automated access to vast numbers of patient records would seem to provide a clinical investigator with an invaluable source of research material for diagnosis and treatment of illness. However, putting a patient's record into machine-readable form has presented a formidable problem. Efforts directed towards coding existing patient records have been hampered by the vast quantities of records available, the heterogeneity of the information, and the ambiguity of clinical notations. Non-quantifiable notations such as "apparently normal" or "probably abnormal" are enough to drive an information retrieval specialist into a state of being "somewhat disturbed."

Patient monitoring involves attaching transducers to the patient and recording and analyzing the electrical signals received from the transducers. These recordings, which may be continuous or intermittent, indicate the patient's physiological condition. The current status of this condition may be obtained by querying the computer or a trend analysis can be obtained from the physiological data recorded over a period of several days. In monitoring special clinical situations, *e.g.,* cardiac intensive care, the system may be required to give an alarm if the patient's recorded values should exceed normal physiological limits. In such cases, the computer monitor system must be able to discriminate between genuine physiological trends and transient artifacts or instrument drift. Thus, the complexity of the task required of the computer system is greatly increased.

A similar situation exists in the area of hospital communications. In the integrated hospital communication system envisioned, the head nurse on the floor will have instant communication with other departments of the hospital which relate to patient care: pharmacy, patient records, treatment and diagnostic services, *etc.* The hospital communications systems now in existence are of the entry-query type: information is entered or requested from a console located at the nursing station. The envisional system will be extremely complex because of the vast variety of information which must be handled and the redundancy which will be required to avoid errors in diagnostic information or treatment orders.

Patient diagnosis is the area where the least overall progress has been made. Those computer applications in diagnosis that are being made are limited to special types of diseases which usually have a small number of easily quantifiable clinical indications. In cases where a large number of variables enter into a diagnosis, the computer system is assigned a decision function in which the particular variables are assigned a conditional probability, thereby increasing the complexity of the required system.

In the past, computerized diagnosis has not always seemed palatable to many physicians, primarily because it impinges directly on the fundamental role of a physician. In recent years, however, the medical profession has accepted the concept that the computer can serve as a diagnostic aid in the same sense that any piece of laboratory apparatus does. Such thinking probably reflects a trend where computers are no longer considered as anthropomorphic entities; rather, the medical profession has begun to realize that computers do have limitations.

Benefits Being Derived

Although computer applications in medicine have not lived up to early glowing predictions of revolutionary innovation, they have been very successful in many areas. In the field of patient monitoring, the development of improved sensors has enabled the physician to monitor physiological parameters more accurately and over longer periods of prognosis. Also, the data reduction capability of computers has diminished the laborious job of plotting data and performing statistical calculations. In this area, the development of small special-purpose analog-digital computers designed to measure respiratory mechanics or cardio-vascular changes has proven of great value. Many large hospitals are already equipped with cardiac monitoring units, and the National Institutes of Health are funding efforts towards developing improved models. Also in the area of patient monitoring, the Bureau of Medicine and Surgery is currently developing an automated shock-patient monitoring system for use in Vietnam.

Much progress has been made in the area of patient records. To illustrate, the Permanente Group, a group health insurance company in California, records the results of its subscribers' yearly physical examinations by computer. Much of the patient clinical data is accumulated by automated laboratory techniques. Similar automated laboratories exist in several hospitals throughout the country.

Hospital communications systems have advanced to the point where at least two companies, General Electric Medinet System and Control Data Corporation Hospital Communication and Information Control System, are available commercially to hospitals which wish to subscribe.

As indicated previously, the introduction of computers in clinical medicine has required a more rigid quantification of diagnostic results for compatibility with computer requirements. However, this has not reduced the intangible science and art in medical practice; rather, it has introduced more rigid standards on which the physician can base his evaluation and diagnosis.

Much needs to be done before the early predictions become realities or before a national repository for medical records of all citizens which may be addressed from any hospital can be established. Computers have not substantially reduced the costs of medical care, nor have they been able to reduce hospital personnel. However, the impact of computers in medicine can be amply demonstrated to anyone who takes a behind-the-scenes look in any modern urban hospital. Practically every large hospital in the United States is using computers in at least one of the areas previously outlined and is actively exploring areas of increased computer utilization. Considering that the major effort in this field dates from 1959, it seems certain that even greater progress will be made in future years.

NRL Develops New Technique to Examine Dislocations by Optical Microscopy

A knowledge of the dislocation structure, a type of structural defect, of metals and alloys is essential to a complete understanding of their properties and mechanical behavior. Much has been learned from thin film transmission microscopy, but the technique is tedious, and is unsuitable for annealed structures, which have dislocation densities in the range 10^5-10^8 cm^{-2}. X-ray topography gives best results with low atomic number materials, excluding many metals.

For studying single and bi-crystals of niobium, a technique has been developed by NRL metallurgists to bring out the dislocation line structure in a surface layer up to 30 microns deep, which can be observed by optics and diffused in, so that the concentration of carbon near the surface is of the order of 50 ppm. A chemical etch then leaves the dislocations raised slightly above the surrounding area. The resolution of this method is better than one micron, so that dislocation densities above 10^7 cm^{-2} and subboundary nets up to at least one minute misorientation may be resolved. With this technique, dislocation structures in niobium single crystals have been examined, including subboundary nets, prismatic loops and helical dislocations.

On the Naval Research Reserve

Reserve Assistants Meet in Washington

RADM Owen addresses Reserve Assistants. From left to right are LT Wolfe, CDR Tilford, CDR Aulick, CDR Fowler, CDR Keniston, RADM Owen, Miss Kehoe, CDR Johnson, and LTJG Maurer.

RADM T. B. Owen, USN, Chief of Naval Research, opened the annual conference of Reserve Assistants for the Research Reserve Program at the Office of Naval Research, Washington, D. C., on September 6, 1967. Admiral Owen emphasized the value of the Research Reserve now and the need for it upon any mobilization. He also recognized the need for recruiting junior officers.

CDR R. W. Keniston, USNR, Special Assistant to the Chief of Naval Research (Research Reserve), chaired the conference, which was attended by the following Reserve Assistants of ONR Branch Offices: CDR D. M. Aulick, USN, Boston; CDR J. W. Tilford, USNR, Chicago; and CDR J. P. Johnson, USNR, Pasadena. Also in attendance were Miss Eleanor F. Kehoe, Training Officer for the Research Reserve; CDR R. R. Fowler, MC, USN, Program Officer, Naval Reserve Training Command, Omaha; and LTJG C. T. Maurer, USNR and LT D. A. Wolfe, USNR, Research Reserve Program Officers of the Fourth and Eighth Naval Districts, respectively.

All aspects of matters affecting the Research Reserve were explored during the two-day conference. The following topics were discussed: mobilization plans, recruiting, evaluation of Research Reserve companies, publicity, training programs, awards program, status and major objectives for fiscal year 1968, visits and annual inspections of units, and fitness reports. These matters will be discussed in future *Information Letters* and by Reserve Assistants on their regular visits to their companies.

NRRC 1-1 Presents Seminar

CDR Charles F. Davis, Jr., general chairman (left), prepares to introduce RADM Thomas B. Owen, Chief of Naval Research, at the mid-summer seminar sponsored by NRRC 1-1.

With an eye (and ear) to the underseas future, Naval Reserve Research Company 1-1, Boston, Mass. played host at the Naval War College, Newport, R.I. for a two-week seminar on Advanced Underseas Defense and Ocean Technology last July. Approximately 70 reserve officers from 20 states, most of whom are scientists or engineers in civilian life, attended on their active duty for training (ACDUTRA) time.

For their guest speakers, the Boston reservists lined up nationally known scientists from research laboratories and university oceanographic departments, as well as some of the Navy's top figures in submarine warfare and ocean resources. Special emphasis was placed on advances and potentials in submarine detection and on projected exploitation of the sea beds as future sources of food and minerals. Field trips were made to the Oceanographic Institution at Woods Hole, Mass. and to the Submarine Base at New London, Conn.

Flag officers among the speakers included VADM A. F. Schade, USN, COMSUBLANT; RADM Thomas B. Owen, USN, Chief of Naval Research; RADM Roy S. Benson, USN, Commandant, First Naval District; and RADM M. E. Garrison, USN (Ret.), Office of the Oceanographer of the Navy.

Brookhaven Briefs the Navy

A series of talks, with topics ranging from detecting art forgeries and tracing ancient commerce to producing high energy beams and sup-

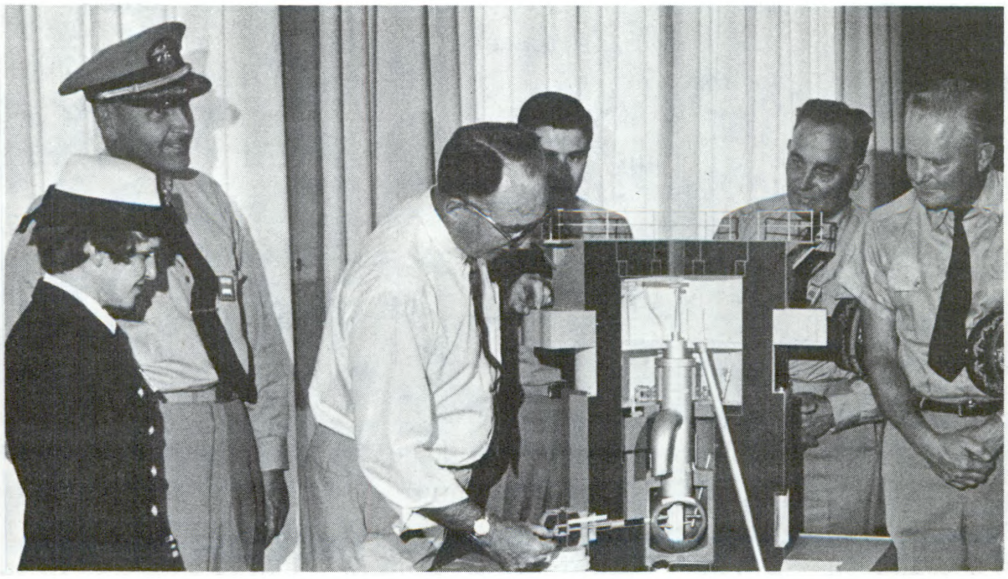
pressing luekemia, was presented at the Brookhaven National Laboratory, Long Island, to 42 naval reserve officers attending a weekend Research Reserve Seminar, on June 10-11, 1967. The seminar, entitled "Recent Advances in Nuclear Research," was presented under laboratory auspices and sponsored by NRRC 3-9, which holds its bimonthly drills at the laboratory.

Dr. Edward Sayre, of the laboratory's Chemistry Department, sparked a lively discussion on the methods of approximating the source and age of ancient artifacts. His methods have unveiled several counterfeits that had been considered genuine works of the masters. Also, he has been able to track forgotten trade routes here and abroad by tracing unique materials which can be distinguished only by irradiation. The Internal Revenue Service has frequently called upon Dr. Sayre to appraise the true value of purportedly valuable works of art which are donated to foundations and then become the subject of exorbitant claims for income tax deductions for their donors.

Dr. Robert Phillips, of the laboratory's High Energy Physics Program, described the workings of the world's most powerful generator of concentrated high energy, the Alternating Gradient Synchrotron (AGS), located at Brookhaven. Dr. Phillips led his listeners along the historical route of the development of atomic and nuclear experimentation, and enlivened the journey with many personal anecdotes. He capped his discussion with an on-stage demonstration of a miniature "spark chamber," which was similar to the 80-inch liquid hydrogen bubble chamber that sits astride the mammoth AGS.

Dr. E. Cronkite, of the Medical Research Department, defined the effects of radiation on blood—animal and human alike, and explained

Mr. Robert Powell, Head, Reactors Division, Brookhaven, shows model of High Flux Beam Reactor to seminar attendees



the uses of radiation in obtaining remission of leukemia in animals and humans. His presentation included a motion picture film which vividly demonstrated methods he helped develop to bring blood outside the body where it can be safely irradiated without damaging other body tissue. Dr. Cronkite warned against being overoptimistic, since no true cure of leukemia has yet been discovered. However, the work he and his colleagues have done, the results of which has extended the lives of the afflicted, should prove very useful in further research. Dr. Cronkite, a captain in the research reserve, is a member of NRRC 3-9.

On Sunday morning, Dr. George Woodwell, of the Biology Department, described the Brookhaven Ecology Forest. Part of the Brookhaven Radiation Ecology Project was initiated in 1961 in order to investigate the nature of changes which could be expected from low levels of ionizing radiation in a forest area. A 50-acre forested tract in the northeastern corner of the laboratory's land was selected as the site for the facility. By using a pulley mechanism, project managers can arrange the 9500-curie gamma source of cesium-137 so that it can be shielded or allowed to irradiate at will.

Mr. Robert Powell, Head of the Reactors Division, described the design and operation of the laboratory's newest addition in reactors—the High Flux Beam Research Reactor. The essential feature of the HFBR, which is housed in a three-story, pressurized hemisphere, is its compact core of enriched uranium fuel elements which operates at high-power density in heavy water. The heavy water serves as coolant, moderator, and reflector. With this facility, experimenters can use beams of high energy neutrons for both process monitoring and assimilation of data, thus permitting them to reach their objectives in a fraction of the time it would require by using older methods and equipment.

Mr. J. Denes, of the Mathematics Department, described Brookhaven's central computer facility and explained how large electronic digital computers have become an indispensable research tool at the laboratory. Since the first on-line computer physics experiments were conducted in October 1962, the use of on-line computers has spread rapidly. Early in 1965 a compact computer permanently mounted in a 40-foot trailer was added to the facility.

NRRC 5-2 Examines Communications in a Computer Age

In an age of highly developed technology, the efficient and effective delineation of problems to be solved and the rapid but accurate decision-making procedures to be utilized depend upon the precise use that mankind makes of the language symbols he manipulates, particularly those adaptable to computer programs and responses. Under the leadership

A visit to the computer center at Virginia Polytechnic Institute

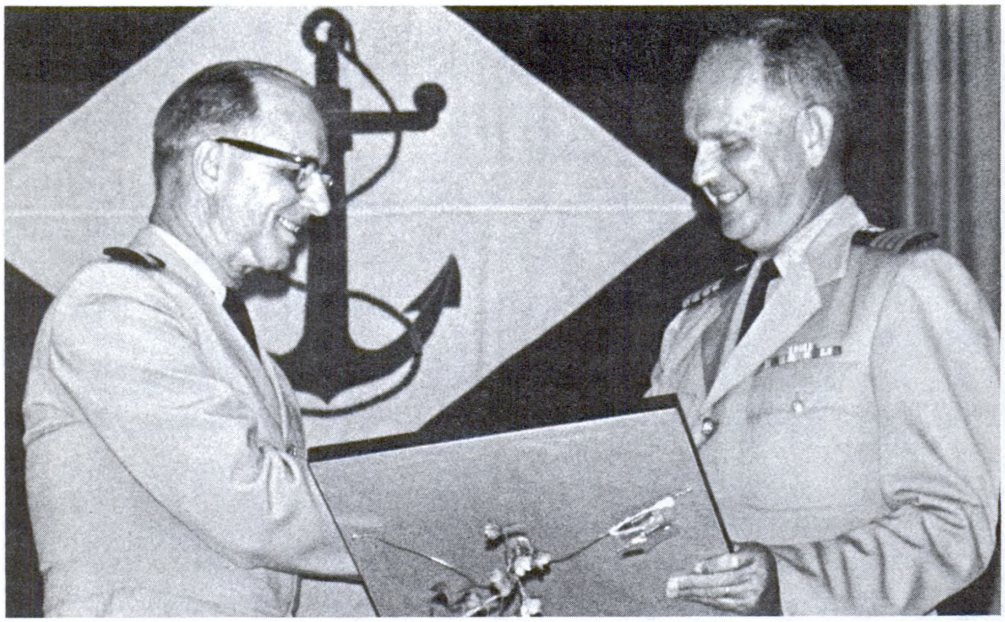
of LT William P. Harrison, USNR, Commanding Officer of NRRC 5-2, Blacksburg, Virginia, members of this research unit are examining in detail some of the functions and uses of computers in problem-solving.

A program organized around the theme of communications and the computer has been developed to include sessions devoted to the following topics:

- "Computer Languages" by Mr. Whitney L. Johnson, Director of the computing center at Virginia Polytechnic Institute;
- "The Basic Applications of Mathematics to Computer Research," by LT W. J. Kennedy, who recently participated in advanced research in this area;
- "Uses of the Computer in Analyzing Grammatical, Rhetorical, and Stylistic Characteristics of the English Language," by CDR Wilson Snipes, Head, Department of English, V.P.I.;
- "Computer Problem-Solving Techniques as Applied to Economic Issues," by Dr. James E. Martin, Head, Department of Agricultural Economics, V.P.I.; and
- "The Practical Applications of Computer Techniques to Information Storage and Retrieval," by Dr. Norman R. Thompson, Associate Professor of Dairy Science, V.P.I.

In addition, two members of the unit, CDR James N. Kincanon, USNR, City Attorney of Roanoke, Virginia, and LCDR William R. L. Craft, USNR, Attorney at Law, plan a presentation which will examine present and future implications of the computer as it affects the practice of law.

CAPT Housewright Receives Certificate of Merit



CAPT Riley D. Housewright, MSC, USNR (left) receives Certificate of Merit from CAPT Robert S. Herrmann, MSC, USN.

CAPT Riley D. Housewright, MSC, USNR, the Technical Director at Fort Detrick, Md., recently received a Certificate of Merit from the Surgeon General of the Navy. According to the records of the Bureau of Medicine and Surgery, CAPT Housewright is the first Medical Service Corps Officer on inactive duty to receive such recognition.

The award was presented during a dinner party held in CAPT Housewright's honor by NRRC 5-3, Fort Detrick, upon the occasion of his transfer to the U.S. Naval Reserve Retired List. The dinner, which was held at the Fort Detrick Officers' Open Mess, was attended by members of the Research Unit and their wives, associates from the U.S. Naval Unit, Fort Detrick, and other friends. LCDR Robert E. Boyle, USNR, Commanding Officer of NRRC 5-3, served as Master of Ceremonies.

CAPT Robert S. Herrman, MSC, USN, Chief of the Medical Service Corps of the U.S. Navy, presented the award for the Surgeon General. It was signed by RADM R. O. Canada, Jr., MC, USN, Acting Surgeon General of the Navy.

The certificate read in part:

"During more than twenty years of naval service, Captain Housewright has contributed materially to naval technical progress in research and development and has given outstanding service to the Medical Department, U.S.N., by his outstanding technical competence, broad professional experience and effective personal manner which reflect great credit upon himself and are in keeping with the highest traditions of the Medical Service Corps, U.S. Navy. It is a privilege to record here the Navy's appreciation and gratitude in recognition of a distinguished career in the service of our country."

CAPT Housewright also received a Certificate of Appreciation from NRRC 5-3 for his outstanding service, a commemorative plaque from the U.S. Naval Unit for his cooperation, and the Armed Services Reserve Medal.

Can You Top This?

Naval Reserve Research Company 5-10, Bethesda, Maryland, lays claim to having the largest number of college degrees per capita among all research reserve companies. The 65 officers in the unit have a total of 137 degrees—29 doctorate, 36 masters and 72 bachelors. Four officers have 4 degrees, 14 have 3, 28 have 2, and 18 have 1. One lone officer claims his lack of a degree is well compensated for by his proven technical competence.

Since there are 97 units in the Research Reserve Program, will we have 96 disclaimers?

Electronic Computers Seminar

The Fifth Annual Research Seminar on Electronic Computers was held at Texas A&M University, College Station, Texas, September 4-15. The seminar was sponsored by the Office of Naval Research in conjunction with the university and NRRC 8-3, College Station.

The seminar was attended by 47 officers of the Navy, Army, and Coast Guard reserves. Forty-one attendees were Navy, three were Army, and three were Coast Guard reservists. Twenty-one states and the District of Columbia were represented. The administrative and teaching staff for the seminar was composed of five officers (including two Army reservists) and two enlisted men.

At the luncheon session on the opening day, participants were welcomed to the Eighth Naval District by CAPT R. H. Ballinger, USNR, who served as the Commandant's representative and seminar administrator. President Earl Rudder welcomed participants to the university. A most stimulating keynote address was made by Mr. Richard H. Wilcox, Acting Director, Mathematical Sciences Division, ONR. He discussed the achievements of electronic computers to date and the challenges that remain.

CAPT W. H. Thames, Jr., USNR, served as seminar chairman. The instructional staff was composed of CAPT Robert Bower, Jr., USAR; LT R. M. Olson, USNR; and 1st LT Charles Seagraves, III, USAR. After participants had been given instruction in FORTRAN programming, they were assigned problems for which they wrote programs. These programs were then compiled and run on the IBM 7094 of the university's Data Processing Center.

Mr. Richard H. Wilcox, Acting Head, Mathematical Sciences Division, ONR (left), CAPT Robert Bower, Jr., USAR, seminar instructor, and CAPT W. H. Thames, Jr., USNR, seminar chairman

In addition to the instruction and workshops on programming, a variety of special topics, including computer applications, was presented. Emphasis, of course, was placed on military problems. Special topics included random-number generation, simulation, game theory, linear programming, PERT, remote terminals, time-sharing, computer graphics, and information retrieval. Computer applications, as discussed by authoritative speakers from the faculty of Texas A&M University, the U.S. Air Force, and IBM, included traffic simulation, crash dynamics, the use of computers in the military intelligence community, command and control computers, and computer applications at the Manned Spacecraft Center. Participants were encouraged to write programs on their own areas of interest, and some of them did so. The university's Data Processing Center provided both facilities and personnel in support of the seminar.

On the last day, seven participants gave special reports on computer applications in particular fields. Also, CDR Robert W. Keniston, USNR, Special Assistant to the Chief of Naval Research (Research Reserve), discussed the Naval Research Reserve Program.

A critique of the seminar, chaired by CAPT E. F. White, USNR, the senior officer at the seminar, was held on the last day. Participants had previously written a program compiling statistics on the group and the group's evaluation of the seminar. The latter showed strong enthusiasm and included a recommendation that this training session be continued in the future.

Fourth Naval Research Reserve Seminar in Applied Research

Fifty-seven Reserve Officers from 25 states attended the Research Seminar in Applied Research, held at Sandia Base, Albuquerque, New Mexico, in August. The seminar focused on the U.S. nuclear capability in terms of nuclear physics research, weapon concepts, design, manufacture, deployment, stockpiling, maintenance, and delivery methods. Medical effects of shock and radiation were also covered.

Naval Research Reserve Company 8-7 of Albuquerque, with the assistance of NRRC 8-9 of Los Alamos, has hosted all four of the seminars in applied research held in Albuquerque—a particularly appropriate site since so many research and nuclear-oriented facilities are located there. The schedule included high level presentations from the following agencies and commands:

Atomic Energy Commission, Albuquerque Operations, Sandia Base
Field Command Defense Atomic Support Agency, Sandia Base
Sandia Corporation, Sandia Base
Naval Weapons Evaluation Facility, Kirtland Air Force Base
Air Force Special Weapons Center, Kirtland AFB
Air Force Weapon Laboratory, Kirtland AFB
Air Force Radiobiology Laboratory, Kirtland AFB
Air Force Shock Tube Facility, Kirtland AFB
Air Force Missile Development Center, Holloman AFB
New Mexico Institute of Mining and Technology, Socorro
Los Alamos Scientific Laboratory
Lovelace Foundation
University of New Mexico

Samples of topics of some of the sessions follow: fission/fusion principles, blast and thermal effects, nuclear safety, subsurface and amphibious weapons, radiation and dosimetry measurements, aerospace isotopic power supplies, extreme physics, lightning research, radio-chemical research, and blast and shock biology.

The seminar was opened with a welcoming address by RADM R. A. MacPherson, USN, Chief of Naval Air Advanced Training. Accompanying the Admiral was a flight instructor and a student pilot who shared some of their experiences, not only in advanced training but also in actual combat conditions, with attendees.

The banquet closing the seminar gave the attendees a view of the lighter side of New Mexico. Mr. Ernie Blake, Taos Ski Valley Director, narrated a film entitled "New Mexico, Land of Enchantment."

In anticipation of its approval from the Office of Naval Research, plans are already underway in NRRC 8-7 for next year's seminar.

Selected Contract Research Reports

The contract research reports listed below have been extracted from U.S. Government Research & Development Report 67, No. 17 of September 10, 1967. Government agencies and their contractors who are registered with the Defense Documentation Center of the Defense Supply Agency may obtain *free* copies from the Center at Cameron Station, Alexandria, Virginia 22314. Abstracts of the reports are found in USGRDR 67, No. 17.

For non-DDC users, most reports may be purchased from the Clearinghouse for Federal Scientific and Technical Information, Department of Commerce, Springfield, Virginia 21151.

AERONAUTICS

Theoretical and Experimental Investigations on Three-Dimensional (Laminar and Turbulent) Boundary Layers, in Particular on Problems of Transition, Separation and Reattachment: Final Report; Poitiers Univ. (France); Eichelbrenner and Peube; AD-650 952

The Role of S-Shaped Crossflow Profiles in Three Dimensional Boundary Layer Theory: Final Report; Poiters U.; Eichelbrenner and Peube; AD-650 953

Measures of Carrier Landing Performance Under Combat Conditions; Dunlap and Associates Inc., Santa Monica, Calif.; Brictson et al; AD-654 563

ASTRONOMY AND ASTROPHYSICS

Observations of Galactic and Extragalactic Emission at 408 MC/S. The Determination of the Accurate Positions of Radio Sources by the Lunar Occultation Technique. Observations of Emission From Flare Stars Progress Report, Jul.-Sep. 1966; Manchester U., Macclesfield (England); Haslam et al; AD-649 720

ATMOSPHERIC SCIENCES

Study of the Temporal Variations of 40keV Electrons in the Magnetosphere During and After the Magnetic Storm on April 18, 1965; Iowa U.; Rao; AD-654 404

Simultaneous Satellite and Balloon Observations of the Same Auroral Zone Precipitation Event; Iowa U.; Oliven and Milton; AD-654 406

Behavior of VLF Ray Paths in the Ionosphere; Iowa U.; Shawhan; AD-654 409

A Review of Balloon Measurements of X-Rays in the Auroral Zone; Calif. U., Berkeley; Anderson; AD-654 500

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Generation and Approximation of Reach and Distribution of Frequencies; Carnegie, Pittsburgh; Charnes et al; AD-654 180

A Reference-Connecting Technique for Automatic Information Classification and Retrieval; Center for Naval Analyses, Wash., D. C.; Greene; AD-654 190

A Study of Pauses in Oral Reading of One's Native Language and English; Ohio State U.; Black et al; AD-654 947

Proceedings of the Conference on Computer-Related Semantic Analysis; Wayne State U., Detroit, Mich.; Josselson; AD-655 073

Dynamics of a Role Theory for the Worker's Judgment; Mo. U.; Trahair and Biddle; AD-654 894

Definition of Role Theory Categories for the Worker's Judgment; Mo. U., Trahair and Biddle; AD-654 895

Structural Role Theory and the Definition of the Worker's Situation: An Empirical Study; Mo. U.; Trahair; AD-654 908

Role Theory Classification for the Worker's Judgment; Mo. U.; Trahair; AD-654 910

Structural Role Theory and the Worker's Judgment of Organizational Leadership: An Empirical Study; Mo. U.; Trahair; AD-655 103

Transfer of Mental Abilities at Different Stages of Practice in the Solution of Concept Problems; Educational Testing Service, Princeton, N.J.; Guliksen and Bunderson; AD-654 202

Post-Training Performance Criterion Development and Application: Extension of a Prior Personnel Subsystem Reliability Determination Technique; Applied Psychological Services, Wayne, Pa.; Siegel and Miehle; AD-654 221

Can a Computer Adequately Administer a Complex Problem-Solving Task to Individual Human Subjects; Yale U.; Johnson; AD-654 188

Fear of Failure and Autonomic Responsivity in Achievement Situations; Bucknell U., Lewisburg, Pa.; Fischer and Teevan; AD-654 475

Arousal Levels and Thought Processes During Sensory Deprivation; Boston City Hospital; Rossi et al; AD-654 835

Member Reactions to Success and Failure of Task Groups; Ill. U.; Ninane and Fiedler; AD-655 101

A Consideration of Two Assumptions Underlying Fiedler's Contingency Model for the Prediction of Leadership Effectiveness; Ill. U.; Fishbein et al; AD-655 102

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A Survey of in Vivo Energy Sources; American Inst. of Biological Sciences, Wash., D. C.; Konikoff; AD-654 702

Batteries – For Biotelemetry and Other Applications; A.I.B.S.; Kuechle; AD-654 703

Current Books in Bioinstrumentation; A.I.B.S.; AD-654 704

Lengthening the Period of a Biological Clock in Euglena by Cycloheximide, an Inhibitor of Protein Synthesis; Princeton U.; Feldman; AD-654 474

Myopotential Patterns and External Control: Effects of Practice and Fatigue; Philco Corp, Willow Grove, Pa.; Wirta et al; AD-655 140

An Annotated Bibliography on North Pacific Albatrosses; Hawaii U.; Frings et al; AD-654 959

Ecology and Physiology of Soil Microorganisms in Polar Regions; Arctic Inst.; Boyd; AD-654 949

Chromosome Numbers of Vascular Plants From Arctic and Sub-Arctic North America; Arctic Inst.; Hedberg; AD-654 952

Ecotonal Plant Communities North of the Forest Border, Deewatin, N.W.T., Central Canada; Wisconsin U.; Larsen; AD-655 092

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Isomer Counts for Polynuclear Coordination Compounds; Pennsalt Chemicals Corp., King of Prussia, Pa.; Maguire and Block; AD-654 705

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An Advanced Planning Briefing for Industry on Navy Electronic Systems will be held at the Naval Amphibious Base, Coronado, California, November 14-16. Additional information on this briefing, which is sponsored by the Naval Material Command and the Electronic Industries Association, may be obtained from Mr. R. C. Lampert, Naval Material Command, (MAT 032C), Washington, D.C. 20360.

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Claffey, J. A., September
Clapp, Lewis C., November
Demboski, Henry, April
Denicoff, Marvin, September (coauthor)
Duda, Richard O., October
Farr, Marshall J., July (coauthor)
Finlayson, Bruce A., LT, USN, March
Fogel, Lawrence J., November
Graham, Robert F., September
Haythorn, William W., December
Hoerman, Kirk C., CAPT, USN, May-June (coauthor)
Jennings, Robert K., May-June
Johnson, Laverne C., August
Kirk, John J., LCDR, USN, July
Kronheim, Suzanne, May-June (coauthor)
Leydon, John K., RADM, USN, April
Libber, Leonard M., May-June (coauthor)
Lundegard, Robert, September (coauthor)
Malecki, Gerald S., July (coauthor)
Mark, Herman F., October
Meyers, Robert D., April
Miller, James W., July (coauthor)
Ostenso, Ned A., August
Paris, Alan A., August (coauthor)
Pruitt, Evelyn L., July
Prywes, Noah S., October
Reid, Roger D., May-June, November (coauthor)
Rollins, R. A., LTJG, USN, February (coauthor)
Smith, C. R., CDR, USN, February (coauthor)
Stein, Harry B., August (coauthor)
Sumner, Donald A., CDR, USN, January
Trumbull, Richard, November (coauthor)
Wennekens, M. P., April
Wulfeck, Joseph W., February (coauthor)

Random Noise

Dr. Richard Trumbull, ONR Research Director, has been named Chairman-Select of the Advisory Group on Human Factors of the NATO Science Committee.

Dr. Bert T. King, ONR Group Psychology Branch, has been appointed a permanent member of the Southeast Asian Development Working Group. This group, which is part of the Foreign Area Research Coordination Group, is concerned with planning and coordinating behavioral and social science aspects of political and economic development in Southeast Asia.

Subsequent to the untimely death of CAPT J. K. Sloatman, CDR William R. Preston has assumed command of the Naval Training Device Center.

Mr. Robert Alexander, ONR Geography Branch, has accepted a position as a Research Geographer at the U.S. Geological Survey.

Mr. Harold E. Dinger, a Consultant with NRL's Communication Branch, Radio Division, was recently honored by the IEEE Group on Electromagnetic Compatibility with a Certificate of Appreciation for "Outstanding Contributions to the Welfare, Administration, and Over-all Success of the Group." Mr. Dinger specializes in electromagnetic compatibility, vlf radio wave propagation, and frequency management.

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Project ARGUS was established to study the effect that prolonged isolation and confinement has on men in small vehicles or habitats. The ultimate objective of the program is to improve the cost effectiveness of future Navy underwater systems.

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As evidenced by the great effort directed towards the development of both larger digital computer systems and special purpose computers, the technological appetite for increased computer capability is far from satisfied. In this regard, the fields of biology and medicine have been as insatiable as all other scientific disciplines.

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NAVAL RESEARCH REVIEWS publishes highlights of research conducted by Navy laboratories and contractors and describes important Naval experimental facilities. Manuscripts submitted for publication, correspondence concerning prospective articles, and changes of address, should be directed to Code 109, Office of Naval Research, Washington, D.C., 20360. The magazine is listed for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C., 20402. Subscription price: $1.50 per year in the U.S. and Canada; $2.00 per year, foreign; $0.15 per individual copy. The issuance of this periodical approved in accordance with Dept. of the Navy publications and printing regulations.

NAVSO P-510

For most Cruisers, the highlight of the Science Cruise/Tour is a cruise aboard a Navy ship. This year the west coast group was welcomed aboard the USS PREBLE (DLG-15), docked at San Diego. See article beginning on page 16.