US ONR

NAVAL RESEARCH REVIEWS

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH

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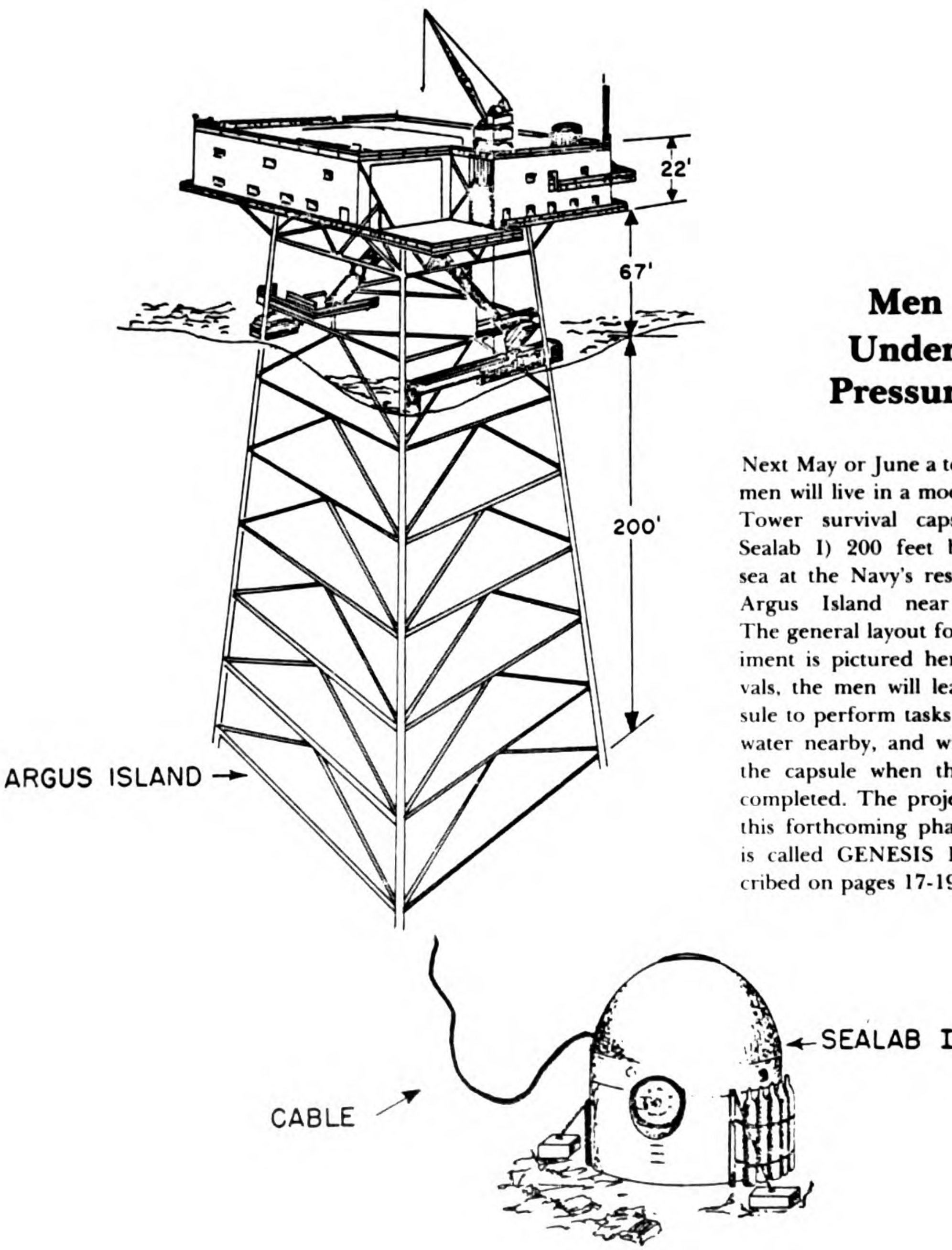

Men Under Pressure

Next May or June a team of Navy men will live in a modified Texas Tower survival capsule (called Sealab I) 200 feet beneath the sea at the Navy's research tower Argus Island near Burmuda. The general layout for the experiment is pictured here. At intervals, the men will leave the capsule to perform tasks in the open water nearby, and will return to the capsule when their work is completed. The project of which this forthcoming phase is a part is called GENESIS I. It is described on pages 17-19.

Guiding Missile Weapons by TV

LCDR Stuart D. Kearney
Air Programs
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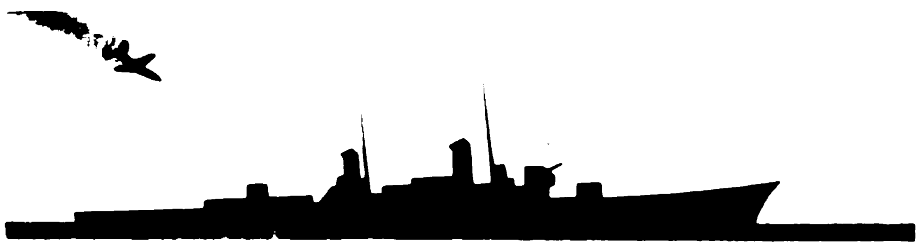

If the pilot of an aircraft armed with air-to-surface missiles is to have a good chance of surviving an attack as he approaches his target, he must have the ability to launch his weapons at a greater distance from the target than is now possible. One way this striking range can be increased is by relying on sensors located in the nose section of the missile to provide the information the pilot needs to orient the missile and to identify the surface target. Of course, for the pilot to receive information from the sensors, a link has to be set up between the aircraft and the missile. This can be done by means of a TV display mounted in the cockpit and a corresponding TV camera located in the missile.

At the close of World War II, radar and television were both being employed in development stages for homing systems which would greatly increase the terminal accuracy of a guided missile. However, a difficulty common to all of these systems was encountered when the missile came within the vicinity of a target that was not readily distinguishable from its surroundings. Such targets must be recognized at an early stage of the missile's flight to avoid excessive command-link corrections during the latter stages. The general conclusion of investigators as a result of these early trials was that television could provide a limited capability in guiding a missile over enemy terrain, but that it did not give accurate enough control when the missile was within close range of the target. Malfunctions of the television equipment and of the auto-pilots available at that time caused the missile designers to rely more heavily on radar techniques, which had reached a higher degree of sophistication and reliability. The TV approach to missile guidance was set aside after problems were encountered with the picture tube, video data, and radio transmission links, and after numerous inconclusive test flights had been made.

Further attempts were made to develop TV missile guidance during the Korean War, but the progress achieved was insufficient to warrant recommending television for a guided-missile system. Basically, these later test programs consisted of determining the design parameters of a system by monitoring off-the-shelf closed-loop television circuits installed in either a drone or an aircraft. Although the basic conclusion reached was that the use of television for missile guidance was both attractive and feasible, design engineers were left in doubt as to the basic parametric requirements for the TV system.

Effective new methods have been emerging since the early experimental days which now can be used to achieve rapid improvement of designs for missile-guidance systems. These methods are economical, as compared to past procedures, which culminated in a series of costly experiments in which prototype missile systems were test flown to their destruction, all too often unsuccessfully. These new methods are:

- The analytical approach, in which mathematical tools inter-relate such technologies as aerodynamics, propulsion, ballistics, and servo-mechanism.
- The simulation approach, which involves interactions that cannot be described mathematically. The human operator in the control loop usually substitutes for such arrangements.

This discussion concerns the second method.

Participation by a human operator in a system has always presented a problem. For the past year the Norair Division of the Northrop Corporation, under support and sponsorship of Air Programs, Office of Naval Research, has been studying the extent to which the human operator can effectively close the missile servo-loop between his control station and the missile; under what conditions the human operator can effectively participate in the terminal phase of guided-missile control; and the extent to which the operator can augment a guidance and sensor mechanism by interpreting and supplying information relating to a missile's terminal stage of flight. The initial phase of this current ONR program has been directed toward the development and refinement of a terminal-guidance simulator whose basic elements would be sufficiently flexible and versatile to permit scientific analysis of the man-machine relationships involved in missile guidance. The basic simulator has been designed. It consists of an analogue computer, an electro-optical projection system, a closed-circuit television, and display consoles to monitor the missile's flight.

The terminal-guidance simulator will simulate a majority of the variables that are encountered by the pilot in his attempt to keep a missile on the desired line of flight as it approaches its target. These factors include the missile's position with respect to the target (in three dimensions and in real time), field-of view, line-of-sight distance between the missile and the target, missile velocity, and the missile's maneuverability. The simulator is designed to incorporate major significant factors affecting guidance control, such as illumination, contrast of the target image, spurious noise, and various other operational and environmental elements.

During the mission-simulation phase of the program now underway, the man-machine relationship of the problem is being investigated. Automation of the operator's various functions is being studied carefully and is being evaluated to determine at what point during the approach to a target he can best concentrate on guiding a missile. The performance of different operators is being determined on a statistical basis, and the manner in which the reactions of each alter the conduct of various missions are entered into the simulator. The objective of the human-factor studies is to minimize the operators' reaction time for area recognition and target identification. Although the human eye is capable of

Continued on Page 14

The Encouragement of Naval Research in Latin America

RADM L. D. Coates
Chief of Naval Research

[*On July 10, RADM Coates met in the Panama Canal Zone with the Chiefs of Naval Missions of U.S. and Latin American countries to discuss ways in which naval research programs might be instituted in Latin American nations, and ways in which cooperation between the navies of America might be extended. Partly as the result of U.S. encouragement and assistance, a fine naval research prográm is already underway in Brazil (it is described on pages 5-7 of this issue). The article beginning on this page is a portion of RADM Coates' presentation to the Chiefs of Naval Missions in July.*]

Our traditional ties with Latin America, especially with the Latin American navies, have much more than historical interest. The Monroe Doctrine established a policy from which we have never deviated, but which was not challenged until recent years. The Cuban crisis highlighted the urgency not only for Western Hemisphere solidarity but also the requirement for close, effective cooperation between the United States and Latin American navies.

Much progress has been made toward that objective. Many Latin American officers and enlisted personnel have been trained by the U.S. Navy. Strenuous efforts have been underway for many years to standardize naval material and naval operations to achieve the most effective coordination among the collective navies of the Western Hemisphere. There is one critical area, however, which needs attention. No modern navy can hope to function effectively unless it exploits the latest technology. On the other hand, even a small navy which makes use of the most advanced equipment, techniques and weapons can all but wipe out the disadvantage of a limited number of ships. In order to achieve this, a navy must be constantly aware of and take advantage of the continuous flow of new scientific knowledge that pours forth from scientific research.

Unfortunately, it has become quite apparent that the navies of Latin America are not making effective use of their manpower resources available to provide new scientific knowledge. This has been ascertained by the Office of Naval Research in its efforts in recent years to bring about closer cooperation between United States scientists associated with ONR and their Latin American counterparts. As a matter of fact, it is obvious that very few of these navies are conversant with the major problem of bringing basic research to bear on the solutions of some of their problems. This is an ironic situation considering that the collective scientific manpower resources in these countries, especially in the biological sciences, is impressive both in quality as well as in numbers.

It is vital that these scientific resources be utilized and exploited in the interest of both the United States and the Latin American navies. We are happy, of course, to share with these navies the knowledge and technological know-how developed in this country. However, we ourselves are rapidly approaching our maximum effort both in manpower and available funds. Any contribution by

Latin American scientists to the storehouse of knowledge, upon which we are continually drawing for further advances, would help all of us. Furthermore, technological know-how can only be acquired on a do-it-yourself basis, and a navy can only be an effective fighting force if it is backed up by its own native technical capabilities.

That is why ONR is now planning the First Inter-American Conference on Basic Research, with the biological sciences as the first area to be high-lighted. The objective of this conference will be to encourage the representatives of these navies to become better informed of the importance of sponsoring basic research oriented toward naval interest and application.

ONR has already engaged in a cooperative effort with Latin America. An excellent example is the scientific cooperation with Argentina in the study of the Antarctic which has been continuing since 1954. This research program has yielded fundamental information on marine biology, physical and chemical oceanography, meteorology and associated areas of benefit to both countries.

A dramatic illustration of what can be achieved through greater participation by the Latin American navies in oceanographic research is the long-sought goal of charting every square mile of ocean. To understand and use the oceans both for peaceful and military purposes, we first must map them. Through the ages man has mapped the land areas in ever increasing detail, but accurate maps of the ocean basins exist only for portions of their shallow rims. Only the gross features of shape and structure are known of the 90 percent of the ocean floor that lies beyond the continental shelf. Today's maps of the ocean basins compare in accuracy and detail to 18th century maps of the land.

World-wide, deep-ocean surveys are needed to make such maps. No one country has enough ships and men to do the whole job within the foreseeable future, the United States alone could not expect to have such a large number of oceanic survey ships nor the scientific and technical personell needed to operate them. However, such a survey could be accomplished in about a ten-year period by the participation of all the major maritime powers, including the Latin American countries, which means that the navies of those countries would have to take the lead in such a project.

This is why it is urgent that we convince the Latin American navies of the value of conducting their own fundamental research programs. Our goal is to establish a sympathetic rapport between them and their own scientific communities, leading to indigenous naval research programs supported by the navies of the individual countries.

It is obvious that this result would be in the best interests of the U. S. Navy. It would pay off in that the navies of these countries would learn to rely on their own scientific resources in producing an effective naval force for our mutual defense. Not only would this be of considerable aid to us in carrying out our major role in our own nation's defense effort, but it would also cement the traditional bonds between the United States and the maritime nations of the Western Hemisphere.

Alphonse Chapanis, Projessor of Psychology at The Johns Hopkins University and for many years an ONR contractor, received the Franklin V. Taylor Award "for outstanding contributions to the field of engineering psychology" at a meeting of the Society of Engineering Psychologists held in Philadelphia in September. The award was instituted in memory of Franklin V. Taylor, formerly head of NRL's Engineering Psychology Branch.

Naval Research in Brazil

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The first new laboratory building of the Brazilian Naval Research Institute.

The Instituto de Pesquisas da Marinha Brasileira, which in English means the Brazilian Naval Research Institute, is South America's counterpart of the U.S. Naval Research Laboratory. It is located in Rio de Janeiro, on Ilha do Governador (Governors Island), which is connected by highway with the mainland. Like many other establishments in scenic Rio de Janeiro, the Institute overlooks beautiful Guanabara Bay. The nearby waters, the distant mountains, and the moderate climate give the Institute a pleasant setting.

In origin and operation, especially, but also in other ways, the three-year-old Brazilian laboratory is similar to the 40-year-old Naval Research Laboratory in Washington, D. C. For example, twelve years passed between the time the idea of creating NRL was conceived and the time the laboratory was actually put into operation, while seven years passed between comparable events in Brazil. Also, the early budgets of NRL and the number of people employed during the formative years parallel very closely those of the South American counterpart.

United States naval scientists have contributed a great deal to the establishment of the Brazilian Naval Research Institute. In November 1954, at the invitation of the Brazilian Navy, Dr. Emanuel R. Piore, then Chief Scientist of the Office of Naval Research, spent a week in Rio de Janeiro studying Brazil's need for a laboratory. His recommendations, based on that study, are contained in his report of January 15, 1955. He strongly recommended that a laboratory be established to meet the research and development requirements of the entire Brazilian Navy. Dr. Piore also recommended that a foreign scientist be brought in as a consultant to help plan the physical facilities, scientific program, and organization of the new institute.

In accordance with Dr. Piore's recommendations, planning for the laboratory was begun, and the Brazilian Navy requested, through the Mutual Defense Assistance Program, that a U.S. scientist be assigned to help with this work.

*Presently on loan to the NATO SACLANT ASW Research Center, La Spezia, Italy.

I was fortunate in being selected for this job, and as a result was attached to the U.S. Naval Mission to Brazil for about a year and a half, beginning in early 1956. The many recommendations made during my residence in Brazil are contained in 13 reports, written in English and also translated into Portuguese. Both versions have been bound in book form by the Brazilian Navy. In response to one of the recommendations, LCDR Robert D. Skorheim was attached to the U.S. Naval Mission as a sonar advisor in 1961. For two years he worked full time at the Institute, where he initiated the sonar research and development program.

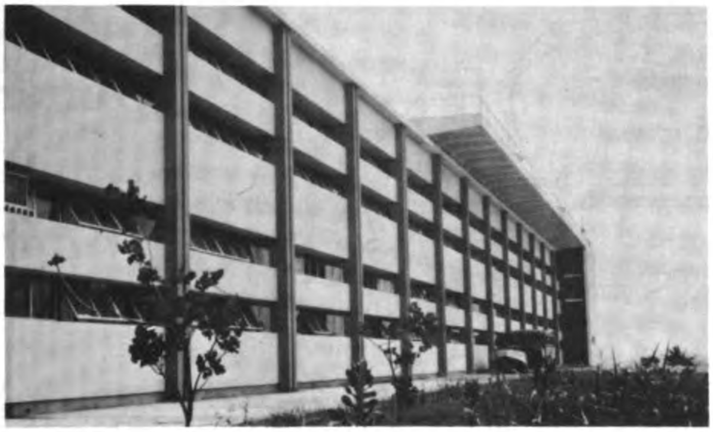
In the fall of 1962, the writer returned to Rio de Janeiro, at the invitation of the Brazilian Navy, to review the progress of the Institute and advise on its current problems. The brief descriptions of the Laboratory and its facilities, and the outline of its programs, which are given in the following paragraphs, are reported as I saw them on that visit.

The first new laboratory building, containing about 41,000 square feet of floor space, has been completed. Occupation of this modern, well-designed, two-story structure started during the first part of 1961. Also completed and recently occupied is a new support building containing an excellent kitchen and cafeteria, maintenance and garage facilities, and space for environmental testing equipment. Some costly items, such as the environmental testing equipment and a large digital computer, have not yet been obtained. An excellent cooperative arrangement has been worked out with the Catholic University of Brazil, however, for use of its digital computer for the solution of scientific problems of the Institute. A major asset of the Institute is an excellent technical library, which was started in 1955 as a part of the Diretoria de Eletronica (Bureau of Electronics) and transferred to the Institute in 1961.

As of October 1962, the Brazilian Naval Research Institute had a total of 152 employees in Rio de Janeiro and eight additional people at a field station at Guarapes, near Natal, about 1,200 miles away. The field station is located about 6 degrees south of the Equator, where especially interesting ionospheric measurements are being made.

The scientific program at the main laboratory in Rio de Janeiro is starting to expand in the areas of communication, sonar, mechanics, chemistry, oceanography, methodology, nucleonics, and automation. The first technical report of the Institute, dated July 1962, covers work done for the Brazilian Navy Hydrographic Office. A program has been developed for the computer at Catholic University to make coordinate transformations for maps automatically. Automation of the process reduces the time required to complete a transformation from about 45 days to about 1 hour.

A problem in methodology under study for the Brazilian Bureau of Naval Personnel is concerned with taking illiterate young adult naval recruits and training them quickly to perform shop work, operate mechanical and electrical machines, and do simple accounting work, planning, and scheduling. People trained by the navy along these lines are valuable not only to the navy, but to the general Brazilian economy after they leave the navy. The Institute is making a study to determine the best method for selecting illiterate adults who will learn quickly. A related study being made concurrently seeks efficient methods for quickly teaching individuals selected for training to take their places alongside persons having a more favorable cultural background. In April of this year, a paper entitled, "Acceleration of Education and Training of Adults of



Modern facade of the new laboratory building.

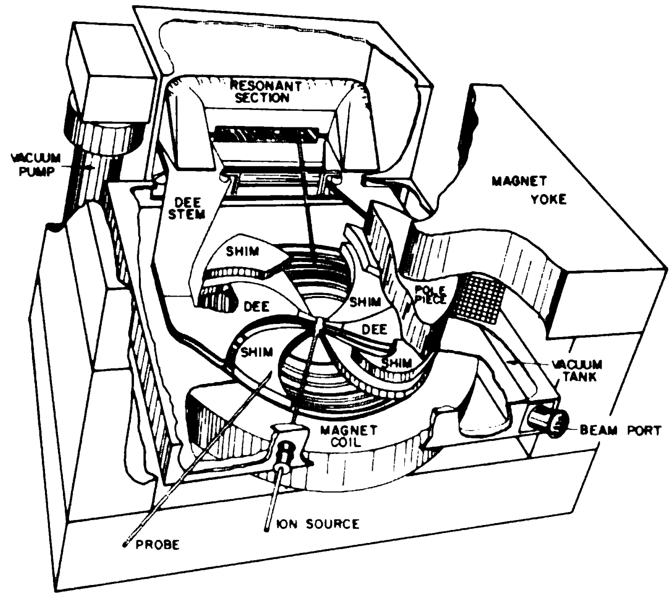
Low Cultural Level," by Joao Baptista Mango de Carvalho, Chief of the Research Department of the Institute, was presented in Geneva, Switzerland, at the UNESCO Conference on Application of Science and Technology for the Benefit of Underdeveloped Countries.

A 10-meter square and 5-meter deep anechoic sonar test tank, with laboratory space above, is being constructed for sonar research and development. No other facility of this kind exists in South America. The establishment of this facility and the knowledge being generated by means of it may encourage and guide Brazilian industry to produce reliable echo sounders and sonar equipment, not only for the Brazilian Navy but for the important fishing industry as well.

Many high-ranking Brazilian naval officers have strongly supported the Institute. It is impractical to name them all, but three very capable officers, who have been intimately involved in guiding the Institute's development since its inception, should be pointed out. They are Vice-Almirante Paulo Esperidiao Correia de Andrade, the first Chief of Research; Capitao de Mar e Guerra Jose Claudio Beltrao Frederico, the first Director; and Capitao de Mar e Guerra Carlos Ernesto Mesiano, the first Vice Director. The present Director is Vice-Almirante Amaury Costa Azevedo Osorio.

Already the Institute has been visited by a number of distinguished North Americans. On September 20, 1961, Dr. J. Robert Oppenheimer, Director of the U.S. Institute for Advanced Studies, Princeton, New Jersey, discussed relations between the military services and the scientific activities of a country at the new laboratory in Rio de Janeiro. On July 21, 1962, RADM L. D. Coates, Chief of the U.S. Office of Naval Research, visited the Institute and discussed the importance of naval support for basic research. [See article on page 3, this issue, for a more recent discussion of this subject by RADM Coates.]

It is not possible to predict precisely what the Brazilian Naval Research Institute will bring forth in the future, just as it was impossible to foresee the spectacular productivity of the U.S. Naval Research Laboratory when it was three years old. But based on the experience of NRL, we can expect that the Brazilian Navy and the Brazilian industry of the future will be repaid many times over for the support that is now being given the Instituto de Pesquisas da Marinha Brasileira.



Cutaway drawing of the U.C.L.A. spiral ridge cyclotron.

A New Generation of Particle Accelerators

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Recently, the University of California at Los Angeles placed in operation a 50 Mev cyclotron, the first of a new generation of particle accelerators. The new machine, like its predecessors, is being used to investigate the atomic nucleus, which can only be observed through its interactions with other nuclei. Such investigations are accomplished by bombarding the nucleus with faster and faster protons—hence the nickname "atom smasher" for the accelerators used.

The design and construction of the new machine was supported in part by a program of the Office of Naval Research and the Atomic Energy Commission. For the past two years, ONR has provided the only outside support for the program, and it will continue this sponsorship in the future.

Before describing the U.C.L.A. particle accelerator, a brief account of the evolution of cyclotrons may be helpful.

Conventional Cyclotron

The original way of giving a charged particle energy was to inject the particle into the space between two metal plates which are maintained at different electrical potentials. The resulting electrical field between the plates accelerates the charged particle toward the plate having the charge opposite to that of the particle. The unit of energy used in nuclear physics—the electron volt—is the kinetic energy that an electron would gain in being accelerated from the negative to the positive plate, across which the difference of potential is one volt. The energy that a proton or electron would acquire after falling across one million volts is called a Mev. A proton energy of 50 Mev corresponds to a velocity of 60,000 miles per second.

Energies of this magnitude cannot be obtained in one step. It is impossible to hold such high voltages. E. O. Lawrence realized that protons could be accelerated by passing them through the same potential repeatedly so that they would acquire an energy corresponding to many times this potential. A repeated passage can be obtained between the poles of a magnet, where a charged particle feels a force at right angles to the direction of motion and to the matnetic field, so that it tends to travel in a circle (Fig. 1). The voltage is then applied to electrodes, called dees, which are placed in a vacuum tank so that the particle motion is not blocked by air molecules. An alternating voltage is used so that a proton is accelerated twice during each revolution. The additional energy acquired at each passage between the dees forces the particle to a larger radius, so that it spirals outward. Increased velocity combines with the longer path so that the time around is constant, and the accelerating voltage can have a constant frequency. The total length of the spiral path from the center to the outside of the magnet is often several miles, and the proton must remain continually in the inch or so gap allowed by the dees. Therefore, the particles must be directed, or focused, to the middle plane of the cyclotron by the use of a magnetic field which decreases with increasing radius (conventional cyclotron, Fig. 2).

The Synchrocyclotron

The conventional approach is limited to about 200 Mev per proton by the relativistic increase* of mass in the higher energy range. At such high energies, part of the energy acquired is converted to mass; consequently, the velocity does not increase as much as it otherwise would. The particles then get out of step relative to the applied voltage. The first success in removing this difficulty came with the realization that the driving frequency could be decreased to allow for the increase in mass. The frequency is modulated so that it takes one pulse of protons from the center to the outside, and then returns for another. A machine utilizing this technique, called a "synchrocyclotron," can achieve high energies, but is limited to low average beam currents, because only one group of protons can pass through the accelerator for each frequency modulation cycle.

Under these conditions, many problems of interest to cyclotron users cannot be approached. As is indicated in Fig. 3, an isochronous accelerator — one whose magnetic field increases with radius so as to allow the particle to remain in step with the applied voltage — would not focus the particles to the median plane, and they would be rapidly lost from the circulating beam.

Achieving Higher Energies

The first method found for obtaining higher energies and high currents used iron wedges in the magnetic field to create alternate regions, or sectors, of high and low field (Figures 4A and B). The particle curves more in a strong field than in a weak field, so that the path is slightly scalloped rather than circular,

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*According to Einstein's Theory of Relativity, the inertial mass (resistance to acceleration) of an object increases with the object's speed. This effect becomes experimentally observable only at very high speeds, approaching that of light.

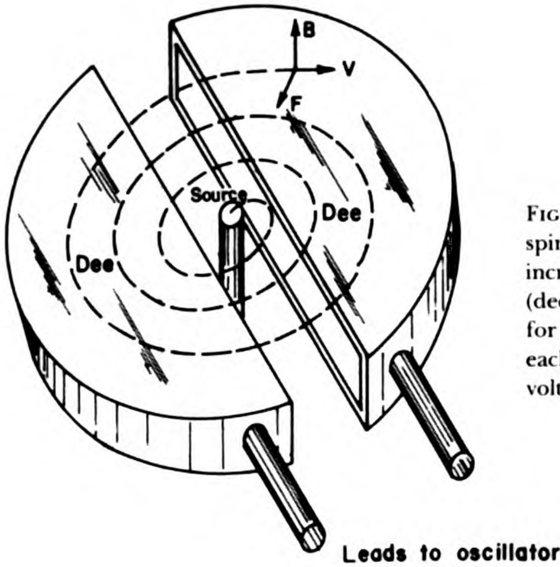


FIGURE 1 – Conventional cyclotron. Particles spiral outward from source. Their velocity increases as voltage is applied to electrodes (dees). The increased velocity compensates for the longer path so that the time taken for each circuit is constant, and the accelerating voltage can have a constant frequency.

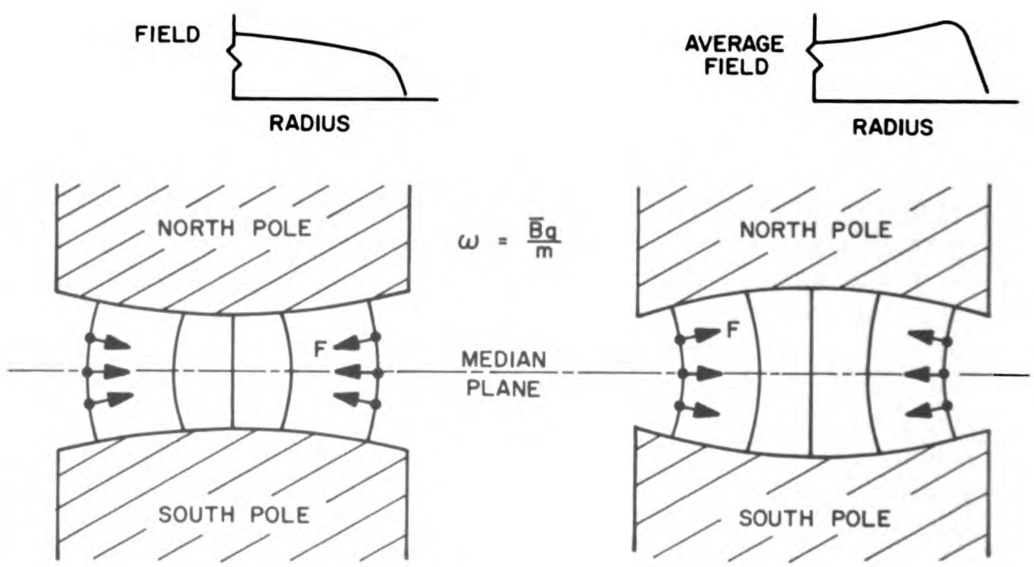


FIGURE 2 – Conventional cyclotron. The magnetic field decreases with increasing radius. Particles are focused.

FIGURE 3 – Isochronous cyclotron. The magnetic field increases with radius. Particles are defocused.

FIGURE 6 - Alternate gradient focusing. A particle passing through alternat focusing and defocusing regions, such as at the entrance to and exit fr spiral wedges, under the proper conditions, will experience a net focusing ward the median plane.

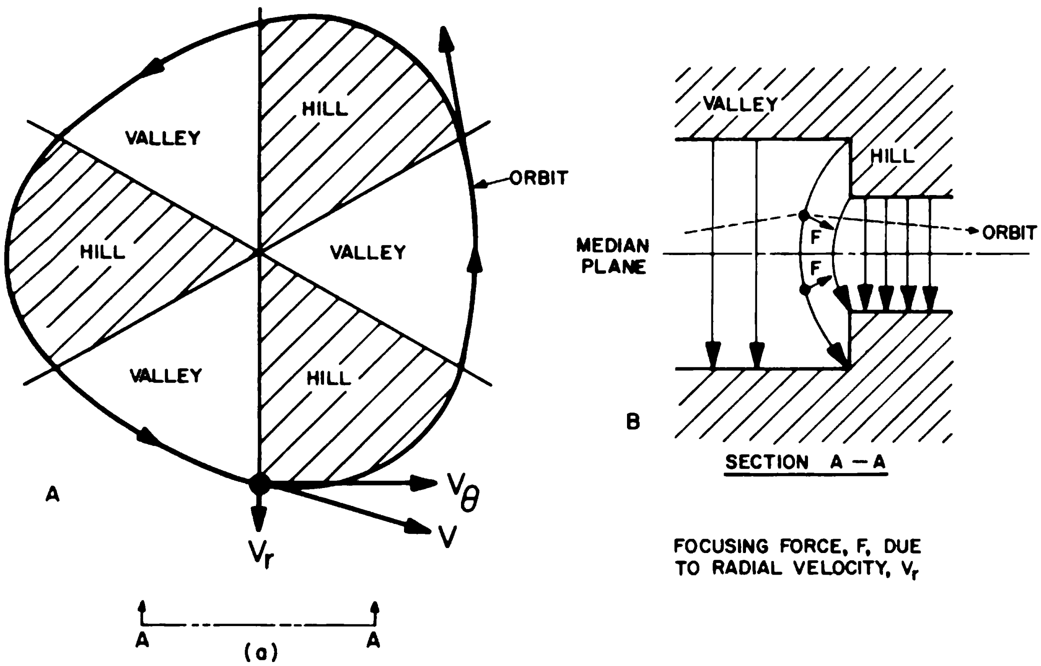
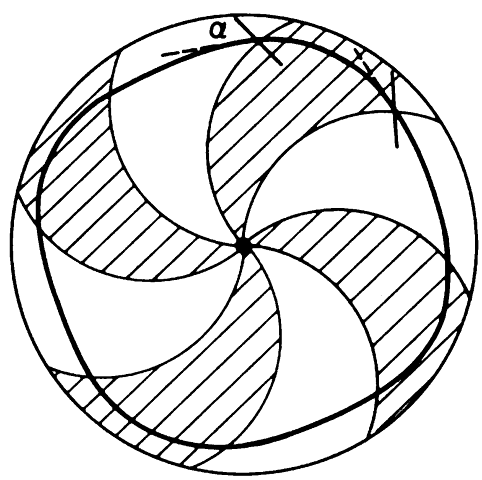
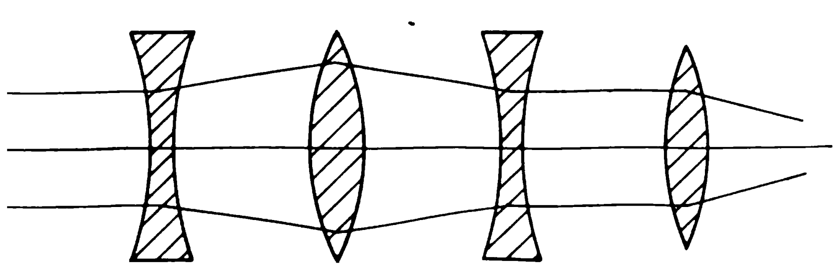


FIGURE 4 — The effect of placing iron wedges in the magnetic field is illustrated in these two diagrams. Alternate regions, or sectors, of high and low field are created. "Hill" indicates a region of high magnetic field, and "valley" indicates a region of low magnetic field. As a result of this arrangement, the radial component of velocity combines with the magnetic field to give a focusing force (F). Figure 4B provides a view in the median plane of section A-A of Figure 4A.

FIGURE 5 — Spiral sector focusing. The focusing force on the convex side of each sector is stronger than the defocusing force on the concave side, and the net focusing becomes larger as the spiral angle increases.





and the particle crosses the boundary between high and low fields at an angle. The radial component of velocity combines with the magnetic field to give a focusing force.

Later work showed that the focusing effect is increased if the sectors are spiraled. The focusing force on the convex side of each sector is stronger than the defocusing force on the concave side, and the net focusing gets larger as the spiral angle increases (Fig. 5).

A third method, called alternate-gradient focusing, is based on the fact that a particle is subjected to a larger force as it moves farther away from the median plane. A particle passing through alternately focusing and defocusing regions, such as at the entrance to and exit from spiral wedges, under the proper conditions, will experience a net focusing toward the median plane. This focussing is illustrated in Fig. 6.

The Spiral Ridge Cyclotron

Such developments have permitted the energies of constant-frequency cyclotrons to be increased considerably. Machines have been constructed which can be operated in the range from 20 to 100 Mev, and proposals have been made for models capable of operations at 900 Mev. These machines can be exemplified by the UCLA cyclotron, which was the first constant frequency cyclotron to operate at relativistic energies.

The UCLA spiral-ridge cyclotron, as it is called, was built within a magnet originally acquired for a 50 Mev synchrocyclotron. Spiral iron "shims" were placed in the magnet gap, and the average field was made to increase with radius by decreasing the gap between the shims so that the field is increased only in these regions. This arrangement allowed a very small gap to occur at large radii so that conventional 180° dees could not be used; the dees were narrowed from a "D" shape and placed in the valleys between the shims. The two dees were connected outside of the magnet so that they formed a resonant system which could be made to oscillate by an ordinary transmitter tube. On page 8 is a cutaway drawing of the machine viewed from the experimental side. The machine operates with approximately 60 kilovolts between each dee and ground, or 120 kv dee to dee. Some of the features of the beams produced by the cyclotron are listed on page 13.

The UCLA cyclotron is located in a vault so that the surrounding areas are shielded by five foot thick concrete walls and fourteen inches of steel (surplus armor plate furnished by the U.S. Navy). The shield is designed to reduce the maximum possible radiation that could be produced in the vault to a safe level by the time it penetrates the walls. Slits are located in the vault walls so that the proton or neutron beams can be directed to the appropriate experimental areas.

Exploring The Atomic Nucleus

A cyclotron such as this one is basically a tool for examining the atomic nucleus. After the protons are accelerated, they can be used in a number of ways

INTERNAL BEAM:

Particle	protons
Energy	50 ± 3 Mev
Current	100 microamperes

EXTERNAL BEAMS:

Particle	protons	*Particle*	75% polarized protons
Energy	20 to 45 Mev	*Energy*	30 to 50 Mev
Current	One microampere	*Current*	10^9 protons/cm^2/sec at target
Particle	Neutrons	*Particle*	30% polarized protons
Energy	10 to 50 Mev	*Energy*	30 to 50 Mev
Current	1.5×10^6 neutrons/cm^2/sec at target	*Current*	2×10^7 protons/cm^2/sec at target

toward unraveling nature's puzzles. The following list of experiments planned with the UCLA machine covers almost the entire field of low energy nuclear physics and demonstrates the versatility of this type of accelerator.

- NUCLEAR REACTIONS. When a very energetic proton hits a nucleus, the nucleus absorbs this energy and then emits one or more particles immediately, so that we are left with a different nucleus. A study of the number of times that a given reaction happens and of the angular distribution of the emitted particles gives us information about the processes involved and about the nucleus itself.
- ELASTIC SCATTERING. Sometimes the incident particle is scattered with no energy loss. The angular distribution of scattered particles tells us about the size and shape of the nucleus.
- TOTAL CROSS SECTION. Information about the size of the nucleus can also be obtained by observing the fraction of incident protons that undergo nuclear reactions.
- PRODUCTION OF RADIOISOTOPES. The nucleus left after a nuclear reaction often has a small amount of excess energy. This can be removed by the emission of a gamma ray or of an electron (beta decay). The study of the time of emission of the particles and of their energies leads to knowledge of the structure of the nucleus. Radioisotopes can also be produced for use in biological and chemical investigations.
- NEUTRON PRODUCTION. Most nuclear reactions produce neutrons. If a very light nucleus, such as deuterium, is bombarded with protons, a beam of fast neutrons is produced which can then be used in many of the same ways as a proton beam.
- DOUBLE AND TRIPLE SCATTERING. Nuclear particles can be described as having a spin. If an unpolarized beam of particles, whose spins are orientated in random direction, is scattered, the particles which then move in a given direction often are polarized—a majority of them spinning in one direction. The relative intensities of particles moving in various directions after a second scattering depends upon the polarization of the particles. Sometimes it is even desirable to cause a third scattering to see what changes of polarization were introduced by the second scattering. Studies of this type help us to understand the dependence of nuclear interaction upon the particle spin.

• **Scattering from Polarized Targets.** It is possible to line up some of the nuclear spins in a crystal at low temperature. Protons or neutrons can then be scattered from this crystal, providing another approach to nuclear interactions.

• **Radiation Damage in Solids.** A beam of very energetic particles hitting a material can cause a great deal of damage. Studies of this damage in semiconductors is of interest from many points of view and can be easily examined with the help of the cyclotron.

The Machine's Versatility

The versatility of the U.C.L.A. cyclotron results in part from the many ways that the original internal protons can be used for experiments. Neutrons and scattered protons can be produced over a considerable energy range by allowing the circulating current to intercept targets placed at various radii within the machine. The internal or external beam can be made to fall directly on a substance for the production of radioisotopes. If these are very short lived, they can be sent to the experimental apparatus by means of a pneumatic system. A very nice beam of protons can be obtained externally by accelerating negative hydrogen ions to a desired energy and then stripping the two electrons off in a thin foil: the remaining protons curve out of the magnetic field so that they can be directed to the desired apparatus. All of the features of this cyclotron indicate the great increase of research potential inherent in the new generation of high current, constant frequency cyclotrons.

Guiding Missile Weapons by TV — Continued from Page 2

assimilating many millions of bits of information, just which elements in the visual field, displayed electronically on a TV monitor scope, are responsible for recognition stimuli are not known.

The initial phase of this study program is nearing completion. Sufficient runs have been conducted on the simulator, utilizing Naval pilots from Pt. Mugu, California, to obtain the basic information to establish the criteria for further and broader coverage of research on the guidance of missiles during terminal flight. Some factors which initially were believed to be significant have shown themselves, in the simulator tests, to have little effect on an operator's ability to recognize targets. However, additional trade-offs in system-design parameters have begun to appear which were not anticipated at the outset of the program and, in some instances, opportunities for simplifying design are now becoming evident.

These studies of fundamental factors influencing the human operator's ability to control effectively the terminal phase of a missile's flight have provided information on the requirements for adequate control, and these can now be incorporated in system design. With this work as a background, comprehensive design parameters can now be provided that will permit the orderly development of future missile systems employing electro-optical terminal-guidance mechanisms.

A New Heart-Lung Machine

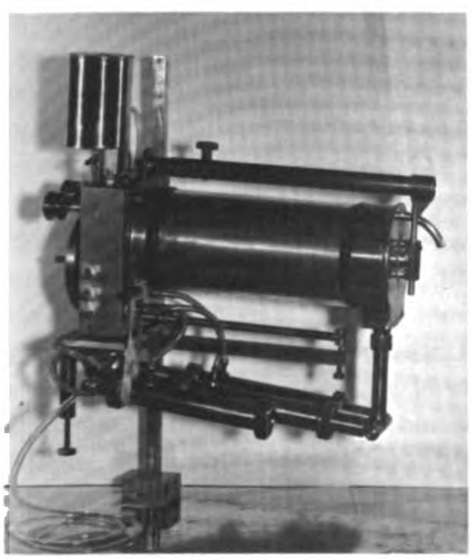
It Weighs Only 50 Pounds, Occupies Only 1.5 Cubic Feet of Space

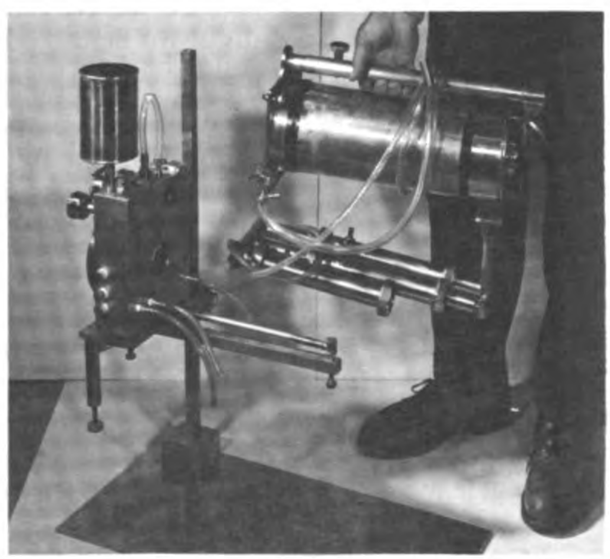
The development of a simple, cheap and easily operated pump-oxygenator or heart-lung machine has been completed for the Navy by the Massachusetts Institute of Technology under a contract with the Office of Naval Research. The machine, which must undergo clinical testing before it can go into general use, weighs only 50 pounds and takes up 1.5 cubic feet of space. This makes it particularly adaptable for use aboard naval ships and at small field hospitals.

Among the chief advantages of the new machine are that it can be operated easily by one person, and that it needs only one liter of blood for priming as compared to three to four liters for current machines. Its low cost, about $1000, would make it available to many hospitals which cannot afford the expensive machines now used.

The pump-oxygenator is highly reliable and does not require electricity for its operation, thereby removing the danger which arises during operation of present machines if the power fails. The entire machine can be sterilized in its assembled state immediately after an operation and then held ready for instant use, eliminating the time necessary to prepare current machines for use, which can be critical in an emergency operation. Another feature of the simple design is that it can be quickly adjusted for use either on an infant or an adult merely by varying the oxygen rate.

One purpose of the research program which led to this development was to design a heart-lung machine that would prolong the period of safe bypass of the heart and lungs. Moreover, present machines are not entirely satisfactory for myocardial infarcts (heart blocks), severe shock, massive pneumonia, congestive heart failure and pulmonary edema.





The pump-oxygenator. Left, the unit is assembled and ready for use. Right, a technician holds the small, portable sterilized unit.

The machine's oxygen-driven engine is mounted on a platform supported by a post rising from an aluminum base. When the machine is to be used, the completely assembled, sterile package is unwrapped and attached to the engine block by merely adjusting two screws. Three short plastic tubes are then slipped into place. They supply oxygen pressure to the pumps and to the surge chamber.

A stationary glass cylinder houses a slightly smaller, rotatable stainless steel cylinder. Inside the latter is a nest of open-ended stainless steel cylinders and then a closed-end cylinder. When the outermost stainless steel cylinder rotates, the other cylinders roll on each other in an attempt to remain in the lowest possible position in response to gravity. Thus, although the blood level may be low, all surfaces become filmed with blood.

Blood from the oxygenator flows through a metal valve into a blood pump, inside which is a silicone rubber tube 1-1/8-inch in diameter and 8 inches long. Oxygen under pressure enters the space between the tube and its metal housing. Blood is expelled through a valve at the other end of the tube. A surge chamber, similar to the tube except that it has no valves, softens the blood's pulsations. A gauge on the engine block shows the rise and fall in pressure in the surge chamber.

After the machine has been used, everything that came in contact with the blood (oxygenator, pumps, surge chamber, and piping) is cleaned and completely reassembled. The equipment is wrapped, sterilized and remains in that condition until needed.

When the machine is needed again, it is charged with sterile saline, then with blood. A special float valve brings the system to an even keel. Venous blood enters the oxygenator by gravity. Inside the stationary cylinder, rotation causes the other cylinders to dip into this pool of blood, where they are filmed. Oxygenation can be increased by increasing the number of cylinders or the rate of rotation.

The blood goes from the oxygenator down through a U-tube and up through the pump's inlet valve. This gravity-controlled valve can be opened only by a head of liquid of 8 inches or more. Thus air cannot enter the pump so there is no need for a large supply of blood to be stored in the oxygenator.

The blood flows through the pump's outlet valve to a surge chamber. This compartment has a filter, an outlet at the top to release air bubbles, and an outlet at the bottom through which blood flows to the patient. During each cycle of the pump, a pressure gauge registers systolic and diastolic pressures.

Two small air pumps, called coronary suckers, are located in the engine block. They siphon leakage blood from the operating area and deliver it to the oxygenator.

In charge of the research was Dr. Samuel C. Collins, Department of Mechanical Engineering of the Massachusetts Institute of Technology. The machine was built at MIT's Cryogenic Engineering Laboratory. Dr. Ernest M. Barsamian assisted Dr. Collins on the project. In addition to ONR, the National Institutes of Health and the Massachusetts Heart Association provided support for the research. Laboratory and clinical tests were conducted at the Sears Surgical Laboratories and the Harvard Surgical Service at Boston City Hospital.

A by-product of this research program was the development of a new infusion pump for use in chemotherapy. This pump is already being produced and used.

Men Under Pressure

LT BULL, Chief Quartermaster Barth, and Chief Hospitalman Manning emerge from Climate-Altitude Chamber upon completion of successful test. Questioning them are CDR W. F. Mazzone, MSC, and CAPT G. F. Bond, MC.

The Story of Project GENESIS I

Genesis I, a study of man's reactions to conditions existing at simulated ocean depths as great as 200 feet, while the subjects breathe from an artificial atmosphere, has been underway at the Naval Medical Research Laboratory, New London, Connecticut, for more than a year. The following article, a slightly modified version of an account that appeared in DOLPHIN, *September 13, 1963, of the U. S. Naval Submarine Base, New London, describes the five phases of the project that have been concluded, as well as a forthcoming test, scheduled to be conducted in the Atlantic Ocean next May or June.*

Phase "E" of Project GENESIS I ended successfully on September 7, as a Navy medical officer and two chief petty officers emerged from a pressurized tank at the Naval Medical Research Laboratory, New London, Connecticut, after living 12 days at a simulated ocean depth of 200 feet while breathing from an artificial atmosphere. The experiment was one of a series that has been conducted by MRL to discover man's reactions to a new kind of undersea life now being envisioned.

Experiments probing man's adaptability to the undersea world are basic to the development of many mobile and fixed underwater vehicles and laboratories of the future. From such stations, scientists, engineers, and military personnel might advantageously be deployed to perform a variety of underwater tasks: explorations of the physical and biological features of the ocean bottom, and the erection, operation and maintenance of submerged equipment are only a few examples. CAPT George F. Bond, Director of MRL and principal investigator of the project, selected "Genesis" as the name for the series of experiments with such consequences in mind—because through them an important step will be taken toward attaining that "dominion over the sea" promised in "Genesis," the first chapter of the first book of the Bible.

LT John Bull, a doctor from the submarine ABRAHAM LINCOLN; Chief Quartermaster Robert A. Barth, an instructor at the Submarine School's escape and rescue tank; and Chief Hospitalman Sanders Manning, a member of the Submarine School's staff, were exposed to the ocean-depth pressure of 200 feet and an artificial atmosphere consisting largely of helium in MRL's newly installed Climate-Altitude Chamber. This facility is unique in a number of its capabilities. In it, pressures ranging in occurrence from an ocean depth of 250 feet to an altitude of 200,000 feet can be simulated, a wide range of atmospheres can be introduced, and good control over temperature, humidity, sound levels, light levels, and other conditions can be maintained.

The Climate-Altitude Chamber in process of installation at MRL in July 1963. The tank weighs 25 tons. Its inside dimensions are 9 feet by 9 feet by about 7 feet (height).

During the Navy men's sojourn in the chamber, their physiological states and conversations were monitored constantly. Blood samples were taken, electrocardiograms were analysed, body temperatures were controlled, lung conditions were studied, and voice and hearing tests were given. During the entire period, the subjects kept a watch schedule, one man always remaining awake and on duty. Outside, a medical officer and two chamber operators were in constant attendance.

All of the medical tests given to the men during Phase E indicated that their bodies functioned normally in the unnatural environment of the tank. The condition of the men was also normal when, after spending more than 27 hours undergoing decompression, they emerged from the chamber. They had even gained weight.

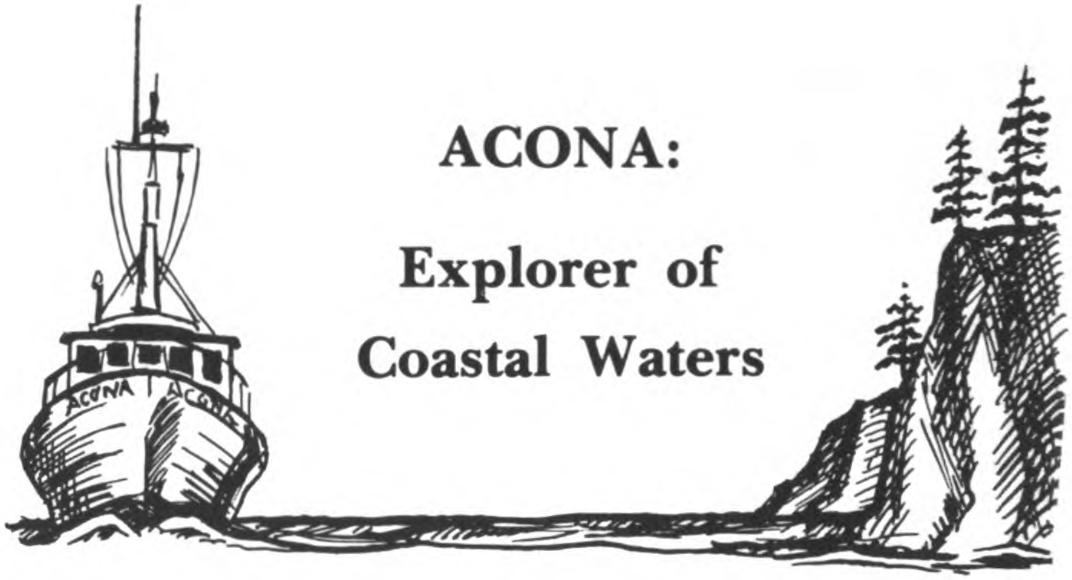
Four other phases of Genesis I were completed successfully before Phase E was undertaken. Phase A and Phase B concerned the reactions of experimental animals, and Phases C and D, of human volunteers. The work with animals occupied many months. White rats, guinea pigs, squirrel monkeys, and goats were studied. During the first series of tests, the animals breathed a mixture of helium and oxygen at one atmosphere of pressure—essentially that pressure at which we live. The second series, Phase B, involved exposing the animals to seven atmospheres of pressure for two weeks. Phase B established the fact that although the test animals could not survive a high pressure of normal air for more than 35 hours, they could tolerate an equivalent exposure to high pressure while breathing a selected synthetic mixture. The animals lived under these conditions for two weeks without showing any signs of deterioration.

Phase C was the first test that involved human subjects. Two Naval medical officers and a chief petty officer were exposed to the helium-oxygen breathing mixture at one atmosphere of pressure for six days late in 1962. The atmosphere consisted essentially of 79 percent helium and 21 percent oxygen. Throughout the test period, observations were made of the physiological states of the men, as well as of visual acuity, color perception, auditory abilities, voice communication, and psychomotor phenomena. The capacity of the men to talk intelligibly to each other under the influence of helium for long periods was a subject of considerable interest. As has long been recognized, the breathing of helium changes the sound of a person's voice, raising its timbre and creating what is familiarly known as a "Donald Duck" effect. In an MRL report on this subject, Dr. Russell L. Sergeant, of the Laboratory's Acoustics Branch, observed that the subjects experienced difficulty understanding each other's speech during the first two days, but that by the fourth day they had adapted their voices to some extent to the breathing medium and were able to communicate more easily.

The Phase D experiments of GENESIS I were performed in April of this year at the Experimental Diving Unit, Washington, D.C. This time the subjects were three chief petty officers from the Escape Training Tank at the New London Submarine Base. They lived in a two-section chamber, breathing an artificial atmosphere composed largely of helium. The men's only regular contact with the outside was via a couple of tiny, thick glass ports, and over an "intercom" system. The chamber included a "dry" compartment, 12 feet long and 6 feet high. This room was linked by a passageway to a cylindrical "wet" room, 10 feet in diameter and 18 feet deep, filled partly with water. The men could drop into the "wet" room to swim underwater and do special energy-consuming work under the chamber pressure, which was roughly equal to four times normal atmosphere, or to that existing under 100 feet of sea water. In the "dry" room, they underwent a continuous series of medical and psychological tests similar to those of Phase C. Most of their food was canned, but they did not have to eat it straight from the container as the tank was equipped with a stove and refrigerator. Fans kept the air circulating at a comfortable temperature. Reading matter and games were supplied for recreation.

Phase E is expected to conclude the project's series of laboratory tests involving humans. Plans now call for the next experiments—operational testing—to take place at ONR's Research tower Argus Island, located near Bermuda, next May or June. At that time, teams will live in a pressurized habitation—actually a Texas Tower survival capsule—180 feet below the surface of the ocean (see inside front cover). The capsule is now being modified for this use at the U.S. Submarine Base. The men will work on specific projects, returning to the pressurized tank at night. The teams that completed the recent laboratory tests are expected to be the first of several small groups to conduct the experiment off Bermuda. CAPT Bond has reported that information now available gives every indication the undersea tests will be carried out safely.

Approximately 75 percent of the earth's surface is covered with ocean water. Of this submerged land, 14 percent lies at a depth of 600 feet or less. From the water covering these shelf areas comes a yearly harvest of fish and other forms of marine life that feed many people. On the ocean floor at these relatively shallow depths are vast stores of vital materials—concentrated mineral deposits, petroleum deposits, and 20 percent of the fresh water stores of the earth. To date, man's efforts to retrieve these riches have been sporadic, very limited, and rather clumsy. It is hoped that GENESIS I and the investigations which are sure to stem from it will help toward achieving a fuller utilization of the underwater world's vast potentialities.



ACONA:
Explorer of Coastal Waters

Since its commissioning on May 3, 1961, the R/V ACONA of Oregon State University has cruised almost 30,000 miles—primarily in Oregon coastal waters—conducting valuable investigations in physical, chemical, biological, and geological oceanography. Perhaps as significant as the research carried out aboard the 80-foot ship is the training she affords for a large contingent of future oceanographers, much in need by the United States (see NAVAL RESEARCH REVIEWS, *Sept. 1963*, a special issue on oceanography). Currently, 55 students are majoring in oceanography at OSU, and another 50 are taking the subject as a minor specialty.

At the time of her launching, the ACONA was the first oceanographic ship specifically designed and built for research in the United States in almost 30 years—since the completion of the ketch ATLANTIS of the Woods Hole Oceanographic Institution. Construction costs of the ship were paid for by the Geophysics Branch of the Office of Naval Research, and some of the vessel's special scientific equipment was provided by the National Science Foundation. Operating costs of the ACONA's voyages are shared equally by ONR and NSF, and many of the scientific programs carried out aboard her are supported by both of these organizations and by the Atomic Energy Commission, Public Health Service, and the Air Force.

Equipment carried aboard the ship includes --

- A bowthruster mounted in the bow, consisting of an independently operated diesel engine, shaft, propeller, and rudder. It is used to provide ship maneuverability at slow speeds. The unit holds the vessel's head into the wind while sampling devices are over the side, enabling hydrographic stations to be occupied in winds up to 35 knots.
- A deep-sea winch with 18,000 feet of 3/8-inch wire rope, allowing scientists to handle weights up to a ton.
- A specially designed hydraulic crane for lifting research equipment weighing as much as 3000 pounds, on and off the vessel.
- An all-plastic aquarium through which sea water flows, allowing rare animals to be taken to shore alive.
- A precision depth recorder for obtaining exact depth determinations.

• A white line "fish finder" echo sounder especially designed for locating and finding marine life in the water.

• A full set of electronic gear consisting of two ship-to-shore radios, a direction finder, three Loran navigating sets, and a high-powered Decca radar.

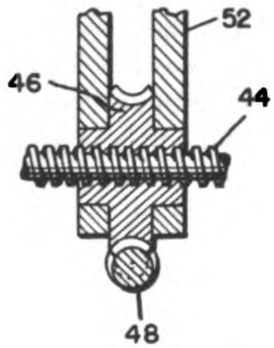
As has been made very clear in the Long Range Oceanographic Plan, issued by the Interagency Committee on Oceanography and outlined in NAVAL RESEARCH REVIEES last month, the science of oceanography is due to experience a great expansion in the decade ahead. In response to the urgency of more rapid and thorough investigations in this field, and of preparing many more students for research at sea, OSU is now building a $1 million Marine Sciences Laboratory at Newport on Yaquina Bay with support from the Area Redevelopment Administration. The school has also arranged, through the National Science Foundation, for the acquisition of a larger research ship—180 feet in length—to take the place of the ACONA.

Although the ACONA will soon leave OSU, she is by no means through with her work at sea. Sometime next year, ONR will turn her over to another ocean-oriented institution. From her new base, she will continue to ply the coastal waters on research and training missions.

SHIP STATISTICS:	Length, feet	80	Main Engine	300 hp.
	Gross Tonnage	154	Bow Thruster	130 hp.
	Speed	10 knots	Quarters, Crew	7
	Range	500 miles	Scientists	10

In the glare of a floodlight, cast upon her for effect against the somber sky, the ACONA cruises by her dock at Newport, Ore. See also front cover.

The Navy's Patent Organization



INVENTIONS

The Navy's far-flung research and development program—carried out in Navy laboratories as well as at universities and other institutions, including many industrial establishments—delves into virtually every field of science and branch of engineering. Of course, many of the steps taken to meet the Navy's needs in this burgeoning field involve inventive concepts. As the Navy stands in no different position from that of any U.S. citizen with respect to the right to use inventions, a Navy patent organization is an essential component of the total research and development complex.

Such an organization, handling patent legal affairs for all of the Navy, has existed since 1947 as part of the Office of Naval Research. The Navy's patent organization is now headed by the Assistant Chief for Patents, ONR—CAPT J. C. Davis—and a civilian Patent Counsel—Mr. A. H. Helvestine. These men direct the patent legal services rendered to ONR, the Bureau of Ships, Bureau of Weapons, and to all of the Navy's non-material bureaus. The more important services include patent soliciting, procurement counseling, and review and settlement of claims of infringement. This work is performed not only at ONR and the main bureau offices, but also at 21 branch offices located throughout the United States and in London, England.

This NAVAL RESEARCH REVIEWS feature, which is planned to appear monthly, will describe some of the more than 2000 invention disclosures handled by the Navy's patent staff each year. Patents will be selected for reporting on the basis of their usefulness and novelty, as well as their importance to the Navy in terms of the technologies concerned.

Magnetic Squeezing of Hot Gases

Over the period of the last several years, a number of patents have been issued by the U.S. Patent Office covering inventions emanating from the work of Dr. Alan C. Kolb and his associates at the Naval Research Laboratory relating to controlled thermonuclear reactions. This work has led to the production—for a few millionths of a second—of an atomic environment like that of the sun. Its purpose is to increase our understanding of the thermonuclear reactions that take place within the stars, and eventually, it is hoped, to the harnessing of such reactions for peaceful uses (NAVAL RESEARCH REVIEWS, *Oct. 1961*).

Patent No. 3,089,831, entitled "Method of Producing High Gas Temperatures," which was issued to Dr. Kolb on May 14, 1963, is one of the more interesting of this group of patents. The invention was devised as an improvement over devices utilizing the magnetic pinch effect. Deuterium, the gas NRL is using for most of its experiments, is the hydrogen isotope found in heavy water. To get the gas into a plasma state, it must be heated to an extremely high temperature. The heating is done by magnetic compression—squeezing the gas in an intensely strong magnetic field. The magnetic envelope also keeps the white-hot plasma away from the fragile walls of a quartz shock tube.

The essential features of the invention are pre-heating and pre-ionizing of the gas in an evacuated chamber by a high-current discharge into a coil about the chamber. An axial magnetic field is produced in the ionized gas, then a second magnetic field is produced thereby "trapping" the first field, compressing the ionized gas, and raising its temperature.

The device has aroused considerable interest as a producer of high gas temperatures, as an X-ray source, and as a neutron source.

Firing Artillery by Compressed Air

Until the idea behind Patent No. 3,088,225 was developed, men learning to fire artillery pieces used live or blank ammunition, with the result that artillery training was a rather expensive procedure, and seomtimes even a dangerous one. Recently, Mr. E. Henry Amistadi of the Naval Training Device Center, Port Washington, N.Y., was granted Patent No. 3,088,225 covering a system for firing projectiles from artillery pieces by compressed air. Mr. Amistadi's invention, called "Subcaliber Howitzer Trainer," consists basically of a cylinder of compressed air, which is secured to the operational gun barrel.

While operating a gun equipped with the compressed air cylinder, trainees follow the same procedures they would follow before firing an operational gun. They estimate the range of the target, make adjustments to the artillery piece in elevation and azimuth, and select the power increment or charge number required to hit the target. Dummy cartridges or powder bags and a dummy projectile are then loaded and rammed into the breech of the gun. After calculating the air pressure required to shoot the range, the gun is fired.

The use of compressed air in this way is providing realistic training for artillery recruits as well as increasing the margin of safety during practice sessions.

Escaping a Submarine Beneath the Sea

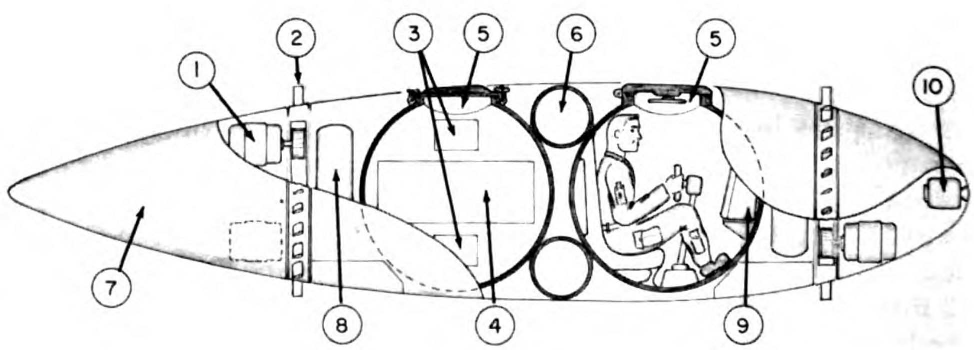
In the past, when a submarine was disabled beneath the sea and had to be abandoned, each crew member made his escape by means of a life jacket and a deep breath of air taken just before departing the escape lock. Unfortunately, by this method, a man could not count on making it to the surface without coughing or choking—if there happened to be either smoke or chlorine gas in the escape lock at the time he took his final breath—or without exhaling at the proper rate, which could cause air embolism or drowning.

When LCDR Harris E. Steinke, Director of the Submarine Escape Training Tank at the Submarine Base, New London, Conn., designed an "Escape Apparatus" that avoided these problems (NAVAL RESEARCH REVIEWS, *May 1961*), trapped submariners were enabled, literally, to "breathe easy," on the way up and reach the surface with little danger. Last March 12, Patent No. 3,080,586

CDR Haselton and RADM Coates. The admiral presented the inventor his patent and said that it was through "the efforts of officers like yourself that the Navy continues to achieve significant gains through research and development."

Some general features of the "Escape Apparatus." 1, life jacket or preserver; 2, hood; 3, transparent window; 4, pressure relief valves connecting hood and jacket; 5, air inflation tube; 6, snorkel tube which permits normal breathing before and after ascent.

Artist's concept of an 18-foot tandem propeller vehicle. 1, D.C. oil-filled motor; 2, propeller and blades; 3, instrumentation; 4, batteries; 5, pressure spheres; 6, air tank; 7, superstructure hull; 8, ballast tank; 9, information display for operator; 10, TV camera.



was issued to LCDR Steinke to cover his invention, which is actually a modification of the submarine life jacket or preserver previously in use. The life jacket is provided with a hood which encloses the wearer's head. By means of a passage and a valve, air in the jacket, which expands as the submariner ascends, is progressively released into the hood to provide a stream of fresh air in that enclosure, thus enabling the wearer to breathe normally during his escape.

The "Escape Apparatus" has now been adopted as standard equipment aboard submarines. Currently, more than 15,000 are being purchased by the Navy.

The Tandem Propeller

In "Propeller of Promise," a story which appeared in a recent issue of Naval Research Reviews, the author, CDR F. R. Haselton of Undersea Programs, Office of Naval Research, describes a unique method for driving submarines. The system, which he originated, involves the use of a pair of propellers that completely encircle the ship's hull—one forward and the other aft. As the propellers rotate in opposite directions to each other and have variable-pitch blades, they give to the submarine a degree of maneuverability not previously possible.

By regulating the two propeller motors and the pitch of the blades, an operator can cause the submarine to ascend or descend while the ship is in a horizontal attitude, to move forward in the same manner as a conventional submarine, to back up, drive sideways, roll, turn in any direction without moving forward at the same time, and even to stand on its "tail." The system is described in greater detail in Naval Research Reviews, *Feb. 1963.*

On August 29, the original grant of U.S. Patent No. 3,101,066, covering the basic concepts of the tandem propeller system, was presented to CDR Haselton by RADM L. D. Coates, Chief of Naval Research. Through issuance of the patent, broad protection has been afforded the Government in an area of considerable importance to the National defense.

WORLD DIRECTORY OF HYDROBIOLOGICAL INSTITUTIONS

Compilation of the World Directory of Hydrobiological and Fisheries Institutions, a guide to organizations around the world that are working in these fields, was completed last July. The publication was prepared with support from the Office of Naval Research.

The task of compiling information on the world's hydrobiological and fisheries institutions was begun in 1959 by the Directory's editor, Dr. Robert W. Hiatt, Dean for Research, University of Hawaii. Previously, Dr. Hiatt prepared the only other directory of this kind, which concerned North America. This compilation, which has now been superseded, was also sponsored by ONR.

The new directory contains more than 700 major entries, which include reports on the scope of activities, season and area of operation, and facilities of each institution. It can be obtained from the AIBS, 2000 P Street., N.W., Washington, D.C., 20036, at the price of $9.00 per copy.

ON THE NAVAL RESEARCH RESERVE

Electronics Computers Seminar

The first Research Reserve Seminar on Electronic Computers was held at A&M College of Texas, College Station, Texas, from August 25 to September 7. The seminar was sponsored by the Office of Naval Research in conjunction with the college and Naval Reserve Research Company 8-3, College Station.

The seminar was attended by 53 officers of the Navy, Army, and Air Force Reserves. Forty-two attendees were Naval reservists (including one on extended active duty), seven were Army reservists, and four were Air Force reservists. Nineteen states were represented. The administrative staff for the seminar was composed of two officers and one enlisted man.

The seminar was opened by CAPT R. H. Ballinger, USNR, who served as Commandant's Representative and seminar administrator. The keynote address was made by CAPT W. E. Berg, USN, Assistant Chief of Research, Office of Naval Research. CAPT Berg pointed out that the importance of electronic computers to the Navy is illustrated by the fact that almost every major weapon and piece of equipment in the Navy needs a reliable electronic nervous system for its operation. He discussed projects being conducted by the Office of Naval Research for the application of computers to various tasks.

CDR B. C. Moore, USNR, served as seminar chairman and chief instructor. The seminar was conducted as a working session. The participants were given instruction in FORTRAN programming and were assigned problems for which they wrote programs, which were compiled and run on the IBM 709 of the University's Data Processing Center. In addition to the instruction and workshops on programming, a wide variety of special topics and computer applications was presented. Special topics included random numbers, simulation, game theory, linear programming, PERT, and impact of computers on statistics. Applications of computers to artillery fire, supply and inventory problems, t, industrial operations, and scientific research were presented by authoritative speakers from Fort Huachuca, Arizona; Tinker Air Force Base, Oklahoma; faculty members of Texas A&M University; and industry. Participants were encouraged to write programs on their own subjects of interest, and many of them did so. These programs were also compiled and run. The University's Data Processing Center provided both facilities and personnel for the support of the seminar.

A field trip to Houston, Texas, included visits to the computer facilities of the NASA Manned Spacecraft Center and to a commercial computer facility.

On the last day, Miss Eleanor F. Kehoe (CDR, USNR), from the Office of the Special Assistant for Research Reserve, Office of Naval Research, discussed the Naval Research Reserve Program. A critique of the seminar followed. Participants had previously written programs compiling statistics on the group and the group's evaluation of the seminar. The latter showed enthusiasm for the seminar and a strong recommendation that this training session be continued in the future.

CAPT W. E. Berg, USN, center, interjects a note of humor at the Electronic Computer Seminar. Duly appreciative are two seminar coordinators, CDR B. C. Moore, USNR, left, and CAPT R. H. Ballinger, USNR, right.

Another Stripe

Dr. Henry A. Imus, promoted recently to Captain, Medical Service Corps, U.S. Naval Reserve, was honored at a ceremony at the Naval School of Aviation Medicine, Pensacola, Florida. CAPT C. P. Phoebus, MC, USN, Commanding Officer, officiated. Dr. Imus was honored by the Aerospace Medical Association with the Longacre Award for his contribution to psychological research. Also, he was elected to membership in the International Academy of Aviation Medicine.

CAPT Imus is well-known to the Research Reserve. He organized and conducted Research Reserve Aviation Medicine Seminars for several years. More recently, he updated this seminar by presenting the first Aerospace Medicine Seminar at Pensacola, Florida.

Congratulations, CAPT Imus!

CAPT C. P. Phoebus admires the new captain shoulder boards of CAPT Imus.

National Commanding Officers Conference

On Wednesday, September 11, representatives of 104 Research Reserve Companies arrived in New Orleans from all parts of the United States for the National Research Reserve Commanding Officers Conference. Also attending were Reserve Assistants of ONR Branch Offices and representatives of ONR Washington. Host of the conference was RADM C. H. Lyman, USN, Commandant, Eighth Naval District. Excellent administrative services were provided by two members of the staff of Headquarters, Eighth Naval District—CDR V. S. Radlinski, USNR, coordinator, and CDR G. A. Fuderer, USNR, Research Reserve Program Officer. Serving ably as seminar coordinator for ONR was LCDR Idas W. Lohman, USNR, a member of NRRC 8-1, New Orleans. Conference meetings were held at Headquarters, Eighth Naval District, and officers were billeted at either the BOQ or the Hotel Montelone in New Orleans.

CAPT J. W. Jockusch, Jr., USNR, Commanding Officer, Office of Naval Research Branch Office, San Francisco, was the official representative of the Chief of Naval Research at the conference. CAPT Jockusch, formerly Special Assistant for Research Reserve, presided over the preliminary meeting of Reserve Assistants on Wednesday afternoon; this meeting was held prior to convening of the Commanding Officers Conference.

The conference convened at 10 A.M. on Thursday, September 12, with an invocation by CAPT S. B. Bennett, USN, District Chaplain. CAPT H. C. Spicer, Jr., USN, Chief of Staff, Eighth Naval District, welcomed the conferees on behalf of the Commandant. The mayor of New Orleans, Mr. V. H. Schiro, proclaimed the week of the conference "Naval Reserve Research Week." On behalf of the mayor, Mr. W. Robert, Executive Assistant to the mayor, presented the proclamation and a key to the city of New Orleans to CAPT Jockush.

The welcome of RADM L. D. Coates, USN, Chief of Naval Research, as well as a paper "Research Builds the Navy of the Future" were read for him, because circumstances prevented him being there in person. A presentation on sea power by LT Robert L. Willard, USNR, a member of Public Relations Company, concluded the morning session.

The afternoon session was opened with a Keynote Address by CAPT Jockusch who needed no introduction because he is well-known to the Research Reserve Program. The remainder of the afternoon was devoted to a panel discussion of recruiting by all Reserve Assistants, which included lively participation of the other conferees. A "happy hour" and buffet dinner concluded the day's session on a pleasant note.

Speakers from the ONR Offices discussed the following topics: Personnel Matters, Training Program of the Research Reserve, Scientific and Technical Studies by the Research Reserve, Naval Reserve Group Commander Concept, and the Naval Reserve Manpower Center at Bainbridge and Its Effect on Mobilization Planning for Research Reserve. Mr. J. O. Richardson, Head, Contract Administration Department, ONR Chicago, made a most informative presentation on "Contract Administration." CDR I. A. Fossberg, USNR, a member of NRRC 8-1, New Orleans, discussed an interesting subject, "Some Psychological Aspects of Brain Washing." With members of the NASA Michoud Operations in New Orleans, the conferees were privileged to hear Mr. James Stamy, Deputy

General Manager, discuss "NASA Michoud Operations and the Saturn Vehicle Program."

The last afternoon of the conference was devoted to group meetings of Reserve Assistants with company commanding officers of their particular Naval Districts. At the conclusion of the conference, enthusiastic approval was given to consideration of holding another national conference next year.

Research Reserve commanding officers from the four corners of the U.S. From left to right, CAPT R. C. Hoffman, NRRC 6-15, Fort Walton Beach, Fla.; CAPT F.A. Wiggin, NRRC 13-1, Seattle, Wash.; CDR R. K. Stoughton, NRRC 1-1, Boston, Mass.; and CDR Burton E. Jones, NRRC 11-1, Los Angeles, Calif.

W. Robert presents proclama-
ınd key to city of New Orleans
APT Jockusch.

CAPT Jockusch, right, greets the commanding officers of the two newest Research Reserve companies – LCDR J. N. Echternach, left, NRRC 11-12, Santa Ana, Calif.; and CAPT J. K. Sterrett, NRRC 9-26, Colorado Springs, Colo.

IN THIS ISSUE

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EDITOR: Richard D. Olson

NAVEXOS P-510

As the R/V ACONA approaches the dock at Newport, Ore., a floodlight, turned on the ship for effect, causes her to glow, ghost-like, against the somber sky. The 80-foot vessel was built under ONR spon-