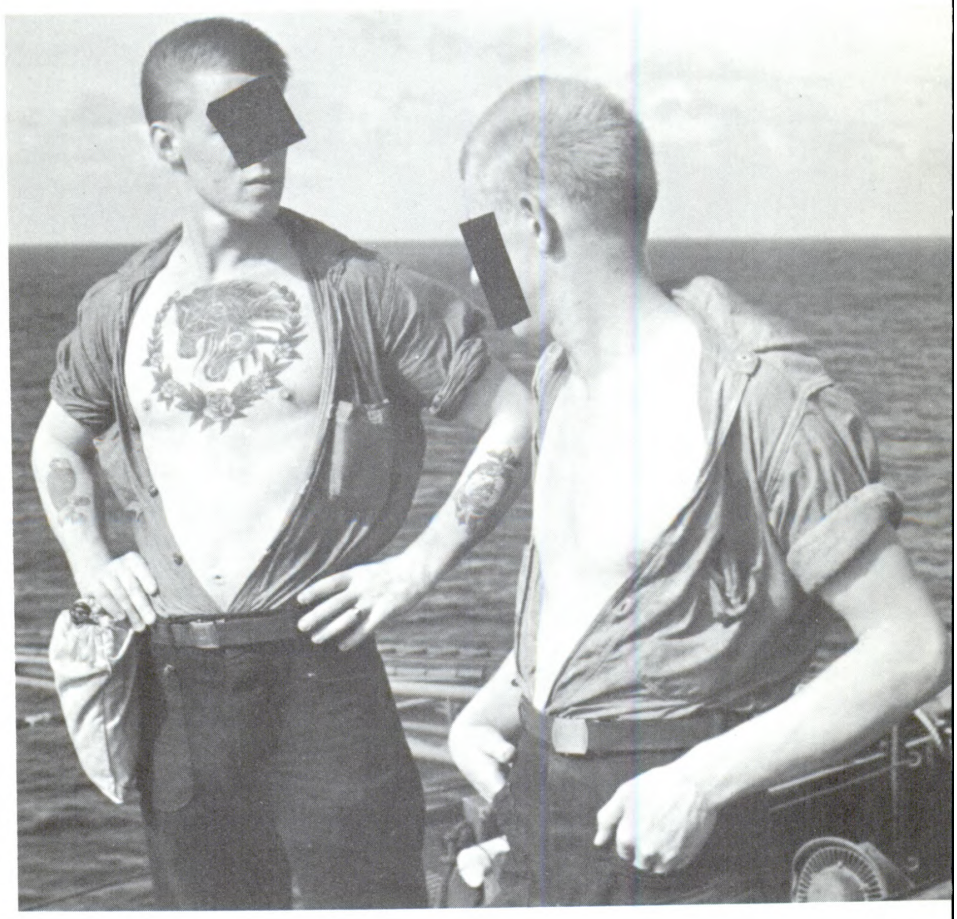
Much-tattooed sailor and buddy working on a new tattoo.



Tattooed sailor being admired by shipmate.

Tattoos and Personal Adjustment*

Richard P. Youniss, LT, MSC, USNR

Dept. of Psychology
Catholic University of America
Washington, D. C.

There has been considerable speculation about the psychological significance of tattoos, but practically no attempts have been made to investigate objectively this aspect of human behavior. The presence of tattoos is, perhaps, a characteristic more commonly found among Naval personnel than any other major segment of the United States male population. Although a frequently observed phenomenon among U.S. Navy enlisted men and one common characteristic of the descriptive stereotype of the sailor, it is not, of course, a universal Navy trait.

Are there any psychological attributes which differentiate the tattooed from the non-tattooed sailor? There are both arm-chair speculators and persons with considerable naval experience who would answer in the affirmative. As to the postulated meaning of tattoos, below are listed some of the opinions obtained by the investigator from an informal poll of Navy personnel and civilian employees at a Naval Station. The sailor who gets tattooed is: "emotionally immature; proving that he is a tough guy; attempting to gain some indelible, evidence of his identification with a rough-and-tumble masculine group; mixed up emotionally; the impulsive, over-aggressive type; in the lower intelligence range." In general, most of these speculations imply an over-all level of psychological adjustment which is somewhat less adequate than the average.

A few previous brief studies conducted by others (in a World War II induction station, a VA hospital, and a prison) indicated that, in general, tattooed men seemed to be more personally and socially maladjusted than those without tattoos. So an objective study was undertaken—at the U. S. Naval Medical Research Laboratory, Submarine Base, New London, Conn.—to answer the question "Do enlisted volunteers for Submarine School who have tattoos show a poorer level of personal adjustment than those without tattoos?" For the purpose, two large groups of Submarine School candidates were tested independently.

FINDINGS

In the initial study, 202 candidates were administered the Personal Inventory Barometer (or PIB, a test developed at MRL and modeled after the Taylor Manifest Anxiety Scale). They were also asked to indicate the number of tattoos they had obtained. It was found that those

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*Adapted from a report prepared by the author while on active reserve duty at the U. S. Naval Medical Research Laboratory, Submarine Base, New London, Conn.

subjects with more than one tattoo obtained scores indicative of significantly greater personal maladjustment than the scores of subjects with no tattoos or with only one tattoo. The PIB scores of individuals with only one tattoo were found not to differ significantly from the scores of non-tattooed subjects. Contrary to popular speculation, no significant difference in mean intelligence level was found between the tattooed and non-tattooed men.

The second study (in part, a cross-validation of the initial findings), involving 446 candidates and utilizing the PIB as a measure of personal adjustment, also made use of a tattoo questionaire which obtained detailed information about present tattoos and the desire for additional tattoos in the future. The results of the analysis of the data obtained from this group were essentially the same as for the first group. Again it was found that the P.I.B. scores of the non-tattooed group and the one-tattoo group did not differ significantly, and for purposes of statistical analysis these same groups were combined in this second study. It was found that the group with two or more tattooes scored significantly higher in the direction of greater personal maladjustment than did the combined group with one tattoo or more. In addition, the test scores of both tattooed and non-tattooed men desiring further tattoos showed a significant increase in personal maladjustment and conflict as compared with those men of both groups that showed no desire for additional tattoos.

As a point of interest it is noted that approximately 28% of the first sample possessed at least one tattoo, and 30% of the second group had been tattooed.

DISCUSSION

A significant relationship was found between scores on an index of personal adjustment and the incidence of tattoos. Although the concept of personal adjustment is broad and vague and the PIB test in its present state (1959) of development can only provide a gross indication of personal adjustment, still the test appears to possess reasonable validity when its origin, construction, and its correlations with factors on other accepted personality questionaires are considered. Therefore, it is concluded that enlisted Navy men with multiple tattoos admit to more anxiety and personal conflict than do non-tattooed enlisted men. Since both studies showed no significant difference in personal adjustment between men with no tattoos and those with one tattoo, it is possible that a "one-time fling" with tattooing may be a phenomenon of only transient psychological significance and not indicative of strong underlying anxiety or personal conflict.

Highly significant differences in level-of-adjustment scores were found between individuals who desire or actively intend to obtain tattoos in the future and those who deny such a wish. Expression of a desire for a tattoo may indicate the presence of unresolved personal conflict and anxiety. It is possible that obtaining tattoos is an attempt to resolve, deny, or symbolically ward off anxiety. The high frequency of sexual and aggressive symbols depicted in the tattoos of the individuals

in this investigation suggests that the obtaining of, or desire for future tattoos frequently reflects the presence of unresolved sexual and aggressive conflicts which are causing current anxieties.

In any case, this study raises many questions regarding the psychological significance of tattoos. Further research in this area would seem to be justified. An analysis of information about tattoo content and reactions to tattoos, such as that contained in responses to various items of the Tattoo Questionaire employed in this study, could yield enlightening results. Additional knowledge about this rather unexplored area of human behavior may well prove to be psychologically revealing and diagnostically significant.

New Award Established For Scientists

The Secretary of the Navy has announced the establishment of a new award, to be known as the Navy Award For Distinguished Achievement in Science. The award is designed to recognize pioneering scientific achievements by civilian employees of the Navy which are of significiant nature and which contain a potential of far-reaching consequence.

The basic characteristics of achievements qualifying for this award will be as follows:

- An achievement of such magnitude as to be recognized within the scientific community as opening the way to exploration of previously unexplored scientific fields.

- An achievement of a nature which establishes an important scientific principle, formula, or doctrine.

- An achievement of extraordinary importance and value to the nation and to the world and which is recognized as significantly beyond normal expectations.

The award consists of an appropriately designed medal, lapel emblem, and certificate and a cash award of not less than $5,000. There is no limit imposed on the number of awards which may be granted.

ASROC

The Navy's newest antisubmarine weapon, ASROC (antisubmarine rocket), became operational in the Pacific Fleet recently when it was fired by the guided missile frigate USS MAHAN (DLG-11), operating some 50 miles off San Diego, California. ASROC is an integrated system consisting of four major parts: sonar underwater detection equipment, fire-control computer, a launcher holding eight missiles, and the missiles themselves. The new weapon is an important step, for with ASROC, destroyers no longer must close to within a few hundred yards of an enemy submarine before launching an attack.

How a Fish Really Swims

How does a fish swim? Only very recently have scientists realized that they didn't know the complete answer to this seemingly simple question. For the common belief for centuries was that fish swam by flipping their tails and using their fins as paddles.

Then biologists discovered that fish are able to swim almost as well without their tail and fins as with them. Also, the researchers found that, in general, the swimming speeds attained by fish and mammals were way out of proportion to their available muscle power. For instance, in studies of salmon swimming up the Columbia River to spawn, it was discovered that the total energy requirements for the journey far exceeded the amount of energy produced by the food taken in and the amount of fat lost enroute. This discovery brought forth some questions: How efficient is the propulsion system of fish? Can oscillating propulsion compete with the propeller? Is oscillating motion or soft skin responsible for low frictional drag? Perhaps these questions might lead to a new understanding that could point the way to the designing of faster ships and other vehicles.

Seeking answers to these questions, some scientists invited small fish into their laboratories. Others worked with larger fish, or sea mammals such as porpoises. Dr. T. Yao-tsu Wu, associate professor of applied mechanics at the California Institute of Technology, went at the problem by studying the hydrodynamics of living swimming bodies.* He came up with some theoretical results he believed relevant to answering the questions but, like other theories, this one needed testing. Meanwhile, an experimental program had been undertaken by Howard R. Kelly, aeronautical engineer at the Naval Ordnance Test Station, China Lake, Calif. For this purpose, Glenn Bowlus, engineer at the Pasadena office of NOTS, designed and built a machine that could simulate the wave motion produced by any fish. The experiments with the device were carried out by Kelly and his colleagues in a water tunnel at the Caltech hydrodynamics laboratory.

The motion of the mechanical fish was produced in a pliable foil of copper—or other flexible material—about four inches wide and 12 inches long, by seven crank rods working off gears on a drive shaft. A fish's swimming was simulated by varying the frequency of the undulations of the foil which was immersed in a water tunnel, where the velocity of the stream of water could be varied. To make the resulting flow visible, a purple dye was released at the front edge of the foil, where it was transported by the flow along the foil surface and was finally mixed with the resulting eddies in the wake.

Then, a major portion of Dr. Wu's theory was tested in this device. By comparing measured thrusts, it was found that his theory was in good agreement with the experimental result. Having established the

*Work supported by the Office of Naval Research.

Dr. T. Y. Wu and Howard Kelly with the mechanical fish. A wake of purple dye is visible just behind the fish. (CalTech Photo)

soundness of his theory, Dr. Wu is now applying it in calculating the most efficient form of the motion under various swimming conditions.

THE EMERGING CONCEPT OF HOW A FISH SWIMS

The fins do not produce propulsion. They serve to control and stabilize the side and vertical motion, much as ailerons serve the same purpose in airplanes. Instead, the main propulsion comes from the fish's body. The wiggling motion produces a pressure difference across the two sides of the fish. Forward thrust is achieved when the body is angled so that the side of greater pressure pushes the fish forward. However, this thrust must overcome the viscous drag created by the water flowing over the body surface, if the fish is to maintain its swimming speed. Of course, the fish must expend energy in keeping up the undulating motion of its body. A part of this energy goes into useful work (which is equal to the thrust multiplied by the swim speed); while the remaining part is spent in energizing the flow and creating eddies in the water. The ratio of the fish's output of useful work to it's input of total energy gives the efficiency of swimming. The theory indicates that, in order to put out enough thrust to efficiently overcome the viscous drag of the water, the waving body motion of the fish should travel from it's head to it's tail with a wave speed that exceeds the swimming speed. Also, the breadth of the wave should grow larger as it travels down the body. For the mathematical equivalent to this statement, the quantity called reduced frequency (which is defined as the length of the fish multiplied by the frequency of the tail beat and divided by the speed of the swim) should be greater than one.

Observations on swimming trout provide this information:

trout length	tail-beat frequency	speed of swim
1.5 inches	24 per sec.	26.4 inches per sec.
11 inches	16 per sec.	114 inches per sec.

The reduced frequencies of these two cases are, respectively, 1.36 and 1.55. Since both numbers are greater than one, they are well in support of the conclusion of Dr. Wu's theory. For wide varieties of fish, this quantity is perhaps not much greater than one. From the foregoing, it is not difficult to realize that the tail-beat frequency is roughly proportional to the swim speed, as has been noted by several observers. At slow and moderate swimming speeds, the theory indicates that efficiency can be quite high—of the order of about 80 to 90 per cent.

From his study of the structure of the whirling wake (vortex) behind the fish, Dr. Wu also found (in an idealized picture) that, by neglecting the viscosity of the water, the vortices shed by the swimming fish result in a jet of water that moves quite rapidly downstream from the fish when it develops a forward thrust. This backward jet current brings with it a backward momentum. Hence, by the jet-propulsion principle that each action produces a reaction, a forward thrust results as the reaction. In reality, this jet is slowed down by the viscosity of the water and virtually disappears when the fish cruises steadily on. However, the jet should be observed if a fish is fighting hard to get off a hooked line.

Another question concerns the viscous drag experienced by a swimming fish. Many observers contend that fish and sea mammals apparently experience unusually low drag. A possible explanation, according to Dr. Wu, is that the pliable skin or the waving motion of the fish may maintain a laminar (layer-on-layer) flow and prevent the development of turbulence in the water along its body. This turbulent flow produces friction and drag that are several times greater than that produced by laminar flow. Recently, Dr. Wu added, scientists have discovered that turbulence is suppressed in water that flows over a pliable rubber wall covering a rigid surface, if there is also water between the wall and the rigid surface.

On the other hand, Thomas G. Lang, aeronautical research engineer at the Pasadena NOTS office, found in experiments with a trained porpoise that the drag of the porpoise is essentially the same as that of an inanimate body of the same size. Whether this finding will completely let off the steam of this highly attractive subject remains to be seen, Dr. Wu said.

FRESCAN

The first single-antenna, seaborne radar providing simultaneous information in range, bearing, and height on air targets is planned for installation on all Navy cruisers and guided missile frigates and destroyers. Called FRESCAN, the powerful lightweight, all-weather radar was developed by the Navy and Hughes Aircraft Company. The system uses a single antenna, transmitter and receiver and eliminates former heavy stabilization equipment. It automatically transmits information to the ship's combat information center and weapons control station.

Radioactive Fission Products in the Lower Atmosphere

L. B. Lockhart, Jr.

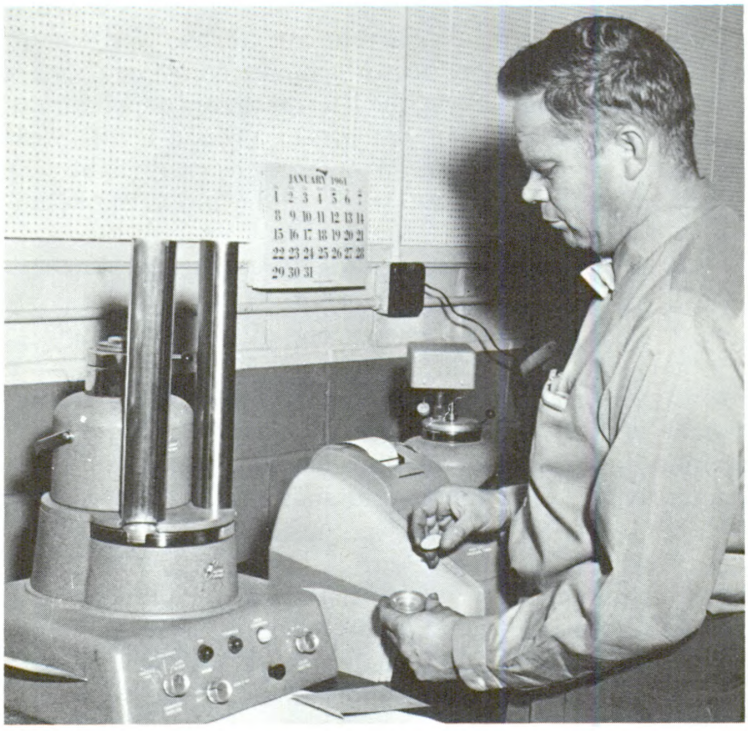
U. S. Naval Research Laboratory
Washington, D. C.

The interest in "fallout" and associated radioactivity measurements has declined in the past year in direct proportion to the levels of radioactivity being reported. However, measurements of radioactivity in the air, in rain, in fallout on the ground, and in various foodstuffs are still being continued.

The program of measurement of fission-product activity in the air along the 80th Meridian (West), initiated in 1956 by the U. S. Naval Research Laboratory (in cooperation with the U. S. Atomic Energy Commission, the U. S. Weather Bureau, and interested agencies in Canada and South America), is still underway and is expected to continue through 1962. At the present rate of decrease of airborne fission products, it will be extremely difficult to get meaningful collections of activity for analysis after that time. Meanwhile, however, the opportunity does exist to continue the documentation of the seasonal variations in stratospheric deposition and to determine if there is any appreciable interchange of stratospheric air across the equator. While some direct measurements of stratospheric concentrations of radioactivity are underway elsewhere, the NRL program depends on measurements of the concentration in the air at ground level. Stratospheric air movements are thus inferred from the pattern of radioactivity found in the air at the ground-level sites along the 80th Meridian.

One method of presenting the radioactivity results is in terms of the "burden," or total quantity of radioactivity, in the lowest portion of the atmosphere (the troposphere) at any one time. This simple, perhaps naive, approach assumes that the concentration of radioactivity per unit-volume of air is constant at a given point from ground level to the upper boundary of the troposphere (the tropopause) and that the measurements obtained from the collection network along the 80th Meridan are representative of all other meridians. The calculated tropospheric burdens of gross fission products in the Northern and Southern Hemispheres and the dates of nuclear tests are shown in Figure 1. Of interest is that during this period debris from only two nuclear test series evidently crossed the Equator: the U. S. HARDTACK tests of April-July 1958 and the French nuclear test of February 1960. Debris from the latter was found in measurable amounts at Guayaquil, Ecuador, 2° 10' south of the Equator, but not at Lima, Peru, 12°06'S.

The rate of decrease of airborne radioactivity in the Northern Hemisphere during the summer of 1959 is consistent with a tropospheric half-residence time not exceeding 30 days. This determination is based



Processing of air filters received from field stations. Top: filter-paper ash is compressed to thin wafer. Below: radioactivity of compressed samples is determined by a beta-counter

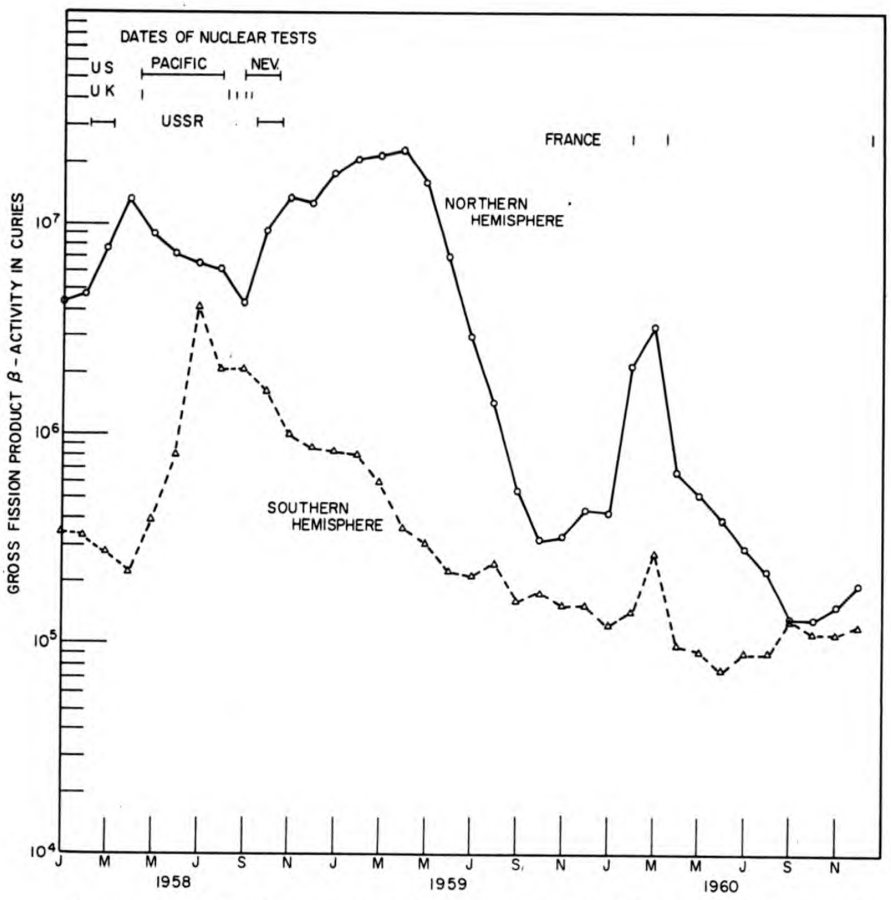


Figure 1 - Burdens of gross fission-product activity in the troposphere. (Activity counted two weeks after collection, but not corrected for decay).

on the assumption that negligible stratospheric debris descended into the troposphere during the period May-September 1959. No such rapid decrease is evident during the Southern Hemisphere summers, possibly because of some transequatorial mixing of tropospheric debris from the Northern Hemisphere. Differences in the radioactive decay rates for debris in the two hemispheres cannot account for the great difference found.

The larger seasonal responses in the Northern Hemisphere are probably related to the high concentration of activity introduced directly into the Arctic stratosphere, from whence it migrates south. In the Southern Hemisphere, on the other hand, any contamination in the Antarctic stratosphere must necessarily have resulted from the migration of debris from lower latitudes to the north. Some confirmation of this was seen in the decreased seasonal effect in the Northern Hemisphere during 1960, following depletion during early 1959 of the large arctic reservoir of debris resulting from the Soviet tests of October 1958.

It may be stated qualitatively that the rate of deposition or "fallout" of activity in the Southern Hemisphere in the past has been considerably greater than the rate of cross-over from the Northern Hemisphere,

except in the instances noted above. It is apparent, however, from the different rates of change of activity burdens with time in the two hemispheres that, if deposition mechanisms can be assumed to be equivalent in the two areas, there must be some loss of fission products from the Northern to the Southern Hemisphere.

A similar study is being made of the burdens of such isotopes as Strontium-90 and Tungsten-185 in the troposphere, which should lead to more detailed information on atmospheric mixing processes.

More Accurate Time Signals

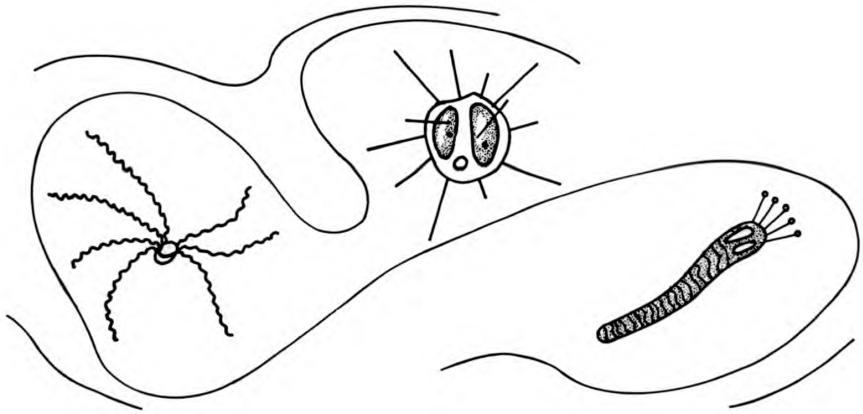
Scientists at the Naval Observatory report that the transmission of time signals from the very low-frequency radio station at Balboa in the Canal Zone are being held constant to one part in ten billion. A "perfect" watch set to match this constancy would lose less than a hundredth of a second in three years.

This high degree of accuracy depends upon a system of atomic time established by the Naval Observatory in 1958. Through international cooperation, it has been increased. Such high-precision broadcasts of time and frequency will permit more accurate tracking of artificial satellites, improved naval communications, and improved radio navigation. They will also improve time-sharing techniques used in transoceanic and transcontinental communications networks.

Control is achieved in the following manner: Time signals are transmitted continuously from radio station NBA in the Canal Zone. The frequency of the carrier wave is compared at Washington with the Naval Observatory's atomic clocks. If, upon comparison, Observatory scientists find the frequency varies from atomic time by more than one part in 10 billion, NBA is directed by radio message to correct its transmission frequency.

Stabilization is achieved at NBA by using very precise quartz-crystal oscillators, preferred for this purpose because they are easily regulated and can run for years without stopping. The atomic clock, however, serves as the master control.

When additional quartz-crystal oscillators of sufficient precision are made available to the Navy by manufacturers, they will be installed at the Navy's other very low-frequency stations in Maryland, Washington, and Hawaii, and at one being constructed in Maine. When such installation is complete, the Navy will have a transmission system providing world-wide coverage and an emergency backup capability. These stations will provide constant frequency without interfering with normal communication functions.



Marine Microbiology

Carl H. Oppenheimer

Institute of Marine Science
University of Texas
Port Aransas, Texas

Marine microbiologists are scattered sparsely throughout the world and at present they not only have no common meeting group, nor do they have any single representative outlet for publication of microbiological research. Growing problems in pollution, deterioration, and food resources will create an increasing need for the expansion of the field of marine microbiology. To stimulate interest in marine microbiology through open discussions of current research and to delineate areas which need more active research, the Office of Naval Research is sponsoring the First International Symposium on Marine Microbiology—to be held in Chicago April 20 to 24. Among the topics planned for discussion are ecology, heterotrophy, distribution and function, mineralization, and perspectives in marine microbiology.

SOME PERSPECTIVES IN MARINE MICROBIOLOGY

Over the past 70 years microbiologists interested in the marine environment—such as Certes (1884), Fisher (1888), Issatschenko (1914), ZoBell, Waksman, etc.—have shown that bacteria are widely distributed through the oceans in those areas which are favorable to their growth. Although marine microorganisms function in a manner similar to terrestrial microorganisms, the marine types differ in that they grow in a milieu containing of an average of 3.4 percent salts and hydrostatic pressures up to 1100 atmospheres. Sea water contains almost every known element: almost two percent of the salt is sodium chloride, with the other common elements in order of abundance being magnesium, sulfur, calcium, potassium, bromine, and carbon.

The microorganisms found in marine environments are bacteria, fungi, viruses, unicellular algae and protozoa. These small organisms

have one property in common: they have a large effective surface-to-volume ratio and therefore may fall into the colloidal range. Regardless of the internal function of the cells, the external surface may be affected physically by surface and interfacial tension, oppositely charged colloids or particles, and changes in the salt content. This surface effect may overcome the mass or biological activity causing the microorganisms to be carried to surface slicks, adsorbed onto larger particles, clumped together (agglutinated) or precipitated because of a change in the surface potential. Very little is known about the effects of salts on the metabolism and the ion transport through membranes of marine microorganisms. It may well be that the only difference between marine microorganisms and terrestrial microorganisms is that the former are more efficient in their use of energy and can thus compensate for the harmful osmotic effects of the salts to the cell. The adsorption properties of bacteria favor their persistence in dilute nutrients. However, very little organic matter is in solution in the open sea, and metabolizing bacteria must be attached to food particles for survival. The ionic charge attraction between the particulate food and the bacterium acts as a concentration factor. Also, inorganic particulate material will adsorb colloids, soluble organic matter, and microorganisms.

CONTROVERSY

At present, there is considerable controversy over the existence of true marine microorganisms. For example, when bacteria are washed from the land into the sea, they immediately encounter the osmotic forces of an increased salinity. Some microorganisms, notably the disease-producing types (including coliforms), are killed within a few day's or month's exposure to sea water. The microorganisms which survive may precipitate to the bottom, associate themselves with other organisms, or remain independent within the water. In this environment they are subject to upwelling, wave action, hydrostatic pressure, and the action of filter-feeding animals, (i.e., some whales). In addition, they may concentrate on various surfaces or may be adsorbed onto the food of larger organisms. Those surviving this ordeal should be entitled to the name marine microorganisms. Some say that a true marine microorganism is one which will grow only in a sea-water medium. But the fact is that many marine microorganisms can adapt themselves to a fresh-water medium and vice versa. It is not known whether the metabolic changes involved in this adaptation are genetic or adaptive in origin. Regardless of whether there are true marine bacteria or not, the fact remains that the marine environment is populated with marine microorganisms. Either living or dead, the organic matter of the sea immediately becomes covered with microorganisms and the influences of microbial activity soon appear.

The primary over-all function of marine microorganisms in cycles of life in the sea is their heterotrophic role in the mineralization of organic matter, and, of course, in the perpetuation of their cells. In other words, they obtain their energy by breaking down complex organic matter into simple elemental substances. During their metabolism,

Marine organisms were responsible for much of the damage to these pilings. (Photo by R.D. Reid, ONR)

essential plant nutrients are released into the environment; larger pieces of organic matter are broken down into smaller pieces, or molecules; oxygen is consumed; toxic hydrogen sulfide is produced; trace elements are concentrated; heat and vitamins are produced; the acidity is changed; some surface active agents are consumed and others are produced; and many geochemical changes take place. The rate of metabolism depends upon the kinds of microorganisms involved, the type of organic matter, and the physical aspects of the sedimentary and water environments.

Bacteria and other microorganisms have been found in almost all natural samples of sea water and sediments which have been analyzed. However, the only human-disease-producing organism persisting in the sea is Erysipelothrix, which causes skin lesions. Many other marine organisms are destructive to protein, and thus may cause skin infections in man. The distribution of microorganisms is quite sporadic because it follows certain hydrographic features and available nutrients. Generally, more microorganisms are found near land, especially where a stirring of the bottom sediments occurs. Sediments normally contain several times more bacteria than the overlying water; thus upwelling, waves, and storms may move the bacteria from the sediments into the water column. In addition, terrestrial run-off adds bacterial populations to the sea. Masses (blooms) of floating plants or schools of fish stimulate the growth of bacteria, and even ocean currents have been tentatively identified by their bacterial content, suggesting that discrete water masses have characteristic microbial populations. Although only seven percent of the total oceanic area is less than 200 meters deep, it is estimated that the attendant microbiological activity exceeds the remaining 93 percent of area. On the other hand, the open ocean usually contains fewer microorganisms.

In spite of almost no available data, it is often said that autotrophic microorganisms—those that manufacture their own food through photosynthesis—may be important in the sea, especially at depths where little organic matter survives the long fall to the bottom. Also, larger

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organisms on the sea floor at great depths may live primarily on organic matter produced by autotrophic means.

As marine microorganisms decompose organic matter, certain by-products of their activities affect mankind adversely by causing the deterioration of man-made structures and marine food products, and by influencing the geochemical environment. Microorganisms also play an intimate role in the fouling of submerged surfaces; the corrosion of iron; the deterioration of wood, rubber, and cordage; and even in the destruction of concrete through changes in acidity.

Geologists study present-day conditions as a key to the past. Therefore, the metabolic activities of microorganisms become important for they directly affect sedimentary processes by altering compaction; by solubilization and precipitation of cations; by changing the oxidation-reduction (redox) potential and the acidity; by production of gases; and by solubilization and precipitation of carbonates, sulfur compounds, silica, iron, etc.

An extremely interesting but relatively untouched aspect of the microbiological field is the study of the organization of populations, and the succession and distribution of species within these populations. At the unicellular level of life, one sees many types of microorganisms living in apparent harmony. A novel way of looking at this is to assume that large populations of many species may function as an organism, with each different species functioning collectively as a tissue. This may be especially true in shallow marine embayments where the temperature is high and the microbial population exceeds 10 million cells per milliliter. Perhaps one can learn much about multicellular organizations through studies of mixed microbial populations. The first attempts to understand such phenomena have been a by-product of recent studies of antibiotics in situ in marine environments.

In conclusion, one can say that the ultimate basic function of marine and terrestrial microorganisms is similar, but that perhaps because of the difference in environment, the pathways are different. Man should be interested in understanding the basic mechanisms of marine microbial action, for such knowledge will help him in future production of food from the sea and in the control of harmful as well as helpful microbial metabolic functions.

Frozen Fish

How dead is dead? According to researchers who examined fish found in the Ross Ice Shelf and flown to The McMurdo Sound base, it's all of 1,100 years. Over 50 specimens—frozen in various stages of decomposition were chipped from the ice. A theory advanced to explain their presence at the top of the shelf is that the fish were caught in the ice when the shelf touched sea bottom. They were then slowly pushed to the surface as new ice formed at the bottom and the top layer was melted by Antarctica's day-long summer sun.

Research Notes

Two-Faced Owls vs. Seagulls

Seagulls were considered along with other environmental problems when the Navy Electronics Laboratory's oceanographic research tower was still in the planning stage. For it had long been anticipated that seagulls would seek out such a convenient structure—installed in the open sea in June, 1959, about a mile off Mission Beach, near San Diego, Calif.—as their favorite roosting place, litter it, and make it look like the white rock farther up the beach called "Bird Rock." Consequently, methods to repel these pests were investigated. Publications on the subject were consulted, and numerous individuals offered advice. As far as could be determined, seagulls, starlings, sparrows, albatross, and other birds have been pests to generations of men, but no completely successful means of repelling them had yet been devised. Not that people hadn't tried, for over the years many deroosting methods have been devised. These include making noises, electric shocks, obstructions, moving objects, flashing lights, repellent paints, pushing or shooting, or the introduction of natural predators. While some of the methods may be effective in certain situations for short periods, the majority of them were impractical for use on the NEL oceanographic tower mainly because they would interfere with operations or be too objectionable to personnel.

The problem was how to keep the gulls away when the tower was not manned, for when people were aboard, the birds stayed away. One proposed method was the use of living predators such as dogs, cats, or sea hawks, but these creatures are impractical to maintain on a tower, which is not continuously manned, and their introduction could resemble, to coin a phrase, the bringing in of Beelzebub to drive out the devil. So it was decided to investigate the use of commercially available imitation owls. These are made of papier-maché, have a face on either side, with prominent, glaring glass eyes, and stand about 12 inches high.

Two of these counterfeit predators were installed on the north and south sides about 3 feet above the upper deck of the four-deck tower. The owls were left in place for a period of 5 weeks during which time personnel were not continuously aboard. Inspections, made several times a week, revealed no fresh gull litter, so it seemed that the owls had been a success. However, during the ensuing month, when the owls were removed, the gulls still did not return. Two weeks later, when a strong wind storm took place, the gulls again swarmed back to the tower.

One owl was put back on the north rail of the top deck. Shortly thereafter a fresh gull trace was found a few feet from the owl and within a week the litter began in earnest, with a gull seen sitting on an upper rail near the owl. At this impasse, both owls were installed and a coincidental increased human activity began, but still the structure was usually unoccupied from 3 p.m. to 9 a.m.

It was from this point on, however, that the gulls did not return as before and the tower had been miraculously free of gulls and their litter for a year. Nevertheless, one imitation owl that was later lent to the Naval Air Station on nearby North Island was returned after two weeks with a "dishonorable discharge," for he had shown no effect on their roosting gulls.

It has still not been established clearly how effective the owls were in scaring away the gulls. Other factors could conceivably be involved, such as the winter decrease in the gull population of the area because of migration habits and the reduced sport fishing. However, even after another summer and winter, the tower is still free of gulls. From observations of gull roosting habits, it would appear that the birds form a habit of seeking out the same roosting place each time they land, a built-in survival factor. On the NEL tower, however, such a habit became hard to form because of constant interruptions to seagull routine caused when unwelcome people or alarming owls were present. Therefore, the imitation owls could have figured importantly as an added element of horror for seagulls in search of a safe landing strip for gracious living—free of tension and crowds.

It is believed that such a method to rout gulls from a sea tower will have to be used shrewdly; i.e. the owls should be relocated frequently and removed periodically, for a permanent, acquiescent owl would not for too long be adjudged by any intelligent seagull to be a

E. C. LaFond and gull-scaring owls on NEL's oceanographic tower.

menace. It might even be smart to mechanize such owls to permit movement of wings or beak, or wire them for hooting noises. To supplement the work of the imitation owls, the periodic broadcast of tape-recorded gull distress calls is also assisting in creating gull inner tension against selection of a tower where important research is in process. Such cries of seagull anguish, taped by Dr. Hubert Frings of the University of Pennsylvania, are being amplified and broadcast for 3 minutes every hour.

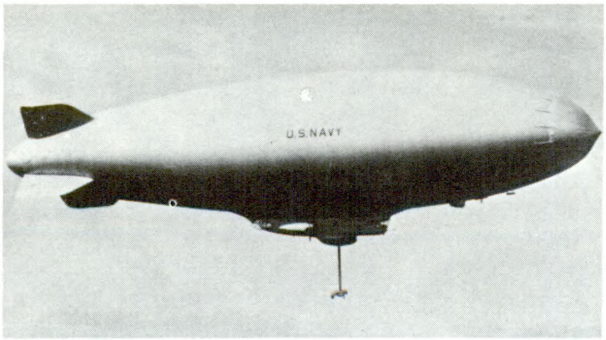
It thus seems clear that imitation owls, along with other agitations, have succeeded in breaking the apparently ingrained habit of seagulls to seek out the same roosting place. What with frightening images of owls, tape-recorded seagull S.O.S. messages, and human activity, the NEL oceanographic research tower has been free for Navy research for the past year. Although perhaps no one factor broke the seagull obsession with the tower, the imitation owls appear to have loomed largest. - E.C. LaFond, U.S. Navy Electronics Laboratory, San Diego 52, Calif.

Navy Airship Serves as "Flying Wind Tunnel"

A new use for the Navy airship as a "flying wind tunnel" has solved the frustrating problem of testing models of vertical-takeoff and short takeoff and landing (VTOL-STOL) aircraft. Professor D.C. Hazen, of Princeton University, has found that Navy ASW airships can be readily converted to accomplish cheaply and efficiently what would otherwise require large expensive wind tunnels. A program for operating the ZPG-2 airship as a flying wind tunnel is now underway under the joint sponsorship of the Office of Naval Research and the Bureau of Naval Weapons. The first flight is scheduled for April.

The basic problem in developing VTOL-STOL machines is that there is a negligible amount of data available on low-speed aerodynamics because large, powered models are needed to test these types of aircraft, and there are few wind tunnels large enough to accommodate them. Further, those that do exist are not generally designed to simulate low speeds, and attempts to modify them have been unsatisfactory. Also, the more complex configurations of the VTOL-STOL cause severe disturbances in present tunnels. The only solution until Prof. Hazen thought of using an airship was the construction of new tunnels of huge size which would be expensive both to build and to operate.

An exploratory program at the Airship Test and Development Department of the U.S. Naval Air Station, Lakehurst, established the feasibility of using Navy airships to test VTOL-STOL models for control and stability. The models were hung beneath the car (often called the gondola) of a ZS2G-1 by means of a retractable strut 33 feet long. The airship can remain motionless or attain a forward speed exceeding 60 knots. Other advantages of the airship as a flying wind tunnel are a smooth, steady flight at all speeds, a capacity for heavy loads, a lack of vibration, sufficient space for instrumentation and test personnel, and the ability to make long test runs.



Artist's concept of a Navy airship in use as a "flying wind tunnel" to test models of VTOL-STOL aircraft.

Models with wing spans up to 10 feet and fuselages up to 14 feet in length have already been tested in the program, and it is anticipated that models twice as large can be handled. Since weather seldom hampers operation, wind-tunnel flights can be scheduled all year round. In four months of continuous testing with the ZS2G-1 flying wind tunnel, no flights had to be delayed or postponed because of weather. The system is designed to measure lift, drag, and pitch of powered or unpowered models and to simulate both takeoff and landing. Models can be exchanged during flight, permitting a wide range of testing on one trip.

Keel Laid for Navy Hydrofoil

The keel for the Navy's first operational hydrofoil patrol boat, the PC(H) was laid in Tacoma recently. Actual construction of the prototype hydrofoil—being built by Boeing for the Navy—was begun in a short ceremony at the J.M. Martinac Shipbuilding Corporation yard. The 115-foot, 110-ton aluminum boat, to be completed sometime next year, will be used for antisubmarine and patrol work.

The specifications and general configuration were made by the Navy, but many detailed technical problems, such as an autopilot to control pitch, heave, and roll and a method of raising and lowering the retractable foils and propeller nacelles, were left to the contractor. Some of the structural details of the vessel already have been constructed and are awaiting installation. The contract calls for delivery of the finished hydrofoil craft by late in 1962.

A hydrofoil boat rides on wing-like foils submerged in the water. Their lift raises the craft's hull clear of the water surface; thus drag is reduced and high speed is possible. Most hydrofoil vessels built in the past have employed curved, partially submerged foils which extend below the boat in a wide arc. The PC(H) will have flat, completely submerged foils. The stability inherent in surface-piercing foils will be supplied by flaps on the foils, controlled by an autopilot. A similar foil was successfully tested several years ago by the Navy on a five-ton boat. The PC(H) is the next step forward. Top speed of the craft is expected to be about 50 knots. Of equal importance is its high speed over rough water, in which existing patrol boats are limited to a maximum speed of 15 knots.

New Arctic-Tropic Suit

An air-conditioned suit that will keep the wearer comfortable in the bitter cold of the Arctic and the extreme heat of the tropics has been developed by the U.S. Navy and Westinghouse Corporation (See front cover). The suit was designed for high-heat conditions, such as those encountered in ship engine rooms under battle conditions with all ventilators closed. But it can also be adapted to meet conditions of extreme cold by pressing a single switch. The suit itself weighs 13 pounds; the thermoelectric unit mounted on the back weighs 45 pounds.

Design and fabrication of the protective garment, installation of the air-conditioning system, and testing of the finished suit were done by the Clothing and Textile Division of the Navy Supply Facility, Bayonne, New Jersey. The air-conditioning unit was designed and built at the Westinghouse laboratories in Pittsburgh, Pennsylvania. The only moving parts in the system are two small fans which circulate the air around the wearer. Batteries permit the suit to operate freely for one hour. For longer use, the suit can be plugged into a d.c. electrical outlet.

Heating or cooling of the suit is done by passing a current through thermoelectric couples. The efficiency of the thermoelectric systems is independent of size, and they can be built in any desired capacity simply by putting together the required number of thermoelectric couples. The heating or cooling is done automatically, depending upon the temperature inside the garment. Tests show that a temperature of about 80 degrees Fahrenheit is maintained when external temperatures vary from 40 degrees below zero to 135 degrees Fahrenheit.

Experimental air-conditioned suit provides 80-degree comfort in 135-degree heat of test chamber that melts stick of butter (in hand). Battery pack in front provides power, thus making the suit completely portable.

Completely air tight, the suit is made of an insulated aluminum-coated fabric. Air for breathing is supplied through a face mask connected to the side of the suit helmet, where incoming air is heated or cooled by a small heat exchanger.

New Training Device for Photographer-Pilots

"It was all done with mirrors," may well be the credit line describing the success in training future Navy photographer-pilots. A uniquely designed training device has been built by the Aeronautics Division of the Chance-Vought Corporation. It presents realistic visual terrain and targets primarily for training F8U-1P Crusader photographic pilots. It was scheduled for delivery to the Navy in February, according to the Corporation's biweekly, "The Vought Vanguard."

Through the use of a system of lenses and mirrors, various aerial photographic images and flight paths are seen by the student pilot. The terrain and targets presented cover an area of 150 square miles between Pensacola, Fla., and Mobile, Ala. This area is represented on a positive film image 36 inches in diameter, which is mounted on a computer-controlled, servo-operated moving platform. The platform motion, programmed and free to move in four directions, also receives control inputs from the trainer operator and student pilot, thus giving the pilot a realistic "over-the-ground" moving image in his viewfinder. A fan-cooled 1,000-watt, projection device illuminates the aerial film and projects the picture through the series of lenses and mirrors onto a screen in front of the pilot's viewfinder. The trainer-operator can influence, through movement of the film, such aerial factors as aircraft velocity and direction and wind velocity and direction.

Two electronically controlled lenses in the trainer present terrain area as it would be seen from either 10,000 or 30,000 feet. The trainer can simulate flights at speeds of from 200 to 600 knots and wind velocity up to 60 knots from any direction. Variable light intensities permit the trainer to simulate bright or dark days. Although designed to supplement existing F8U-1P cockpit and camera trainers, the new models also may be used in conjunction with other types of photo aircraft.

More than thirty potential contractors have been invited by the Bureau of Naval Weapons to submit proposals for a small number of VTOL aircraft for operational suitability testing. The contractor will be selected by July.

Major characteristics and performance goals of the VTOL are: operation from unprepared sites and amphibious assault ships with an 8000-pound payload, maximum speed at sea level of 300-400 knots, cruise speed at sea level of 250-300 knots, and a hovering capability of ten minutes.

Solid-State Memory Device for Computers

A solid-state device which can store electrical energy and holds promise as an improved memory for computers has been demonstrated in the laboratory. Developed by Professors Hartmut Kallman and J. Rennert of New York University with support contributed by ONR, the device exploits the phenomenon of persistent internal polarization (p.i.p). This permits information to be conveyed to a polarized plate by a beam of light, stored for long periods of time, and released at will by the application of light. P.i.p., which has several applications, can be used as a computer memory by polarizing small spots on a plate which has a thin phosphor-photoconductive surface layer. Information can be impressed on the plate either by applying a voltage together with a light flash across the entire photoconductor layer and then selectively irradiating desired locations or by irradiating the entire phosphor plate and selectively applying voltage and light.

In the laboratory, by applying a voltage and a two-microsecond light flash to the plate concomitantly, a single spot about one square millimeter in size on a p.i.p. plate is polarized. This process is called writing. Reading the information is done by detecting either the presence or absence of a polarization voltage on the surface of the phosphor memory. This is accomplished by exposing the plate to a light flash or scanning beam in the absence of external voltage. By measuring the strength of the released signal, a "yes" or "no" answer on the presence of the information is obtained. In the laboratory demonstration information has been impressed on a phosphor plate or released in a fraction of a microsecond. The most modern computer, on the other hand, requires about one microsecond to gain access to information. The information stored on the plate can be viewed on a cathode-ray oscilloscope similar to a television picture tube. A bright fluorescent signal corresponds to locations or spots which have been written on and darkness corresponds to unwritten locations.

Since a useable signal can be obtained from the polarized area several times, information once impressed by the polarization method can be retrieved a number of times. In addition, the written information can be readily erased completely either by radiation, heat, or electrical fields. An error in writing can be corrected or the same polarization plate may be used for writing any number of different messages. The memory can operate at room temperatures and has a wide temperature stability. Since no complicated circuitry is required, its reliability should prove to be greater than any existing memory-storage technique. It also has the inherent possibility of high-speed operation since light, which travels faster than any other form of energy, is used to write or read. Another advantage is that a p.i.p. plate can potentially achieve a high degree of information density (bits per unit volume). The NYU project is sponsored by the Information Systems Branch of ONR as part of its program of research to develop new concepts and techniques for improved computers and information systems. The use of p.i.p. as a memory device is one of the more promising ways to increase the storage capacity, speed of operation, and reliability and to reduce the complexity and cost of advanced computers.

Miniature Rocket-Borne Weather Station

A one-pound rocket-borne weather station designed to probe the earth's stratosphere and radio back weather findings at altitudes up to 40 miles has been developed by the Naval Ordnance Laboratory, Silver Spring, Maryland. The miniature weather collector is designed for use with NOL's High Altitude Sounding Projectile (HASP), a supersonic antiaircraft missile converted into a routine weather-data collector used by naval ships at sea (See picture on inside back cover).

The weather collector consists of an 11-inch radio sonde, only an inch and a quarter in diameter, suspended from a 6-foot metalized parachute. The sonde contains a sensitive temperature-measuring thermistor and a tiny radio transmitter powered by a small 6-volt battery. A gauge to measure the stratospheric pressures will be added to the package in the near future. Designers of the small weather-collector say this is the smallest radio sonde yet developed for high-altitude weather observation.

During recent tests by NOL at the National Aeronautics and Space Administration's Wallops Island facilities, the instrumented payload was rocketed to an altitude of over 20 miles, where it consistently

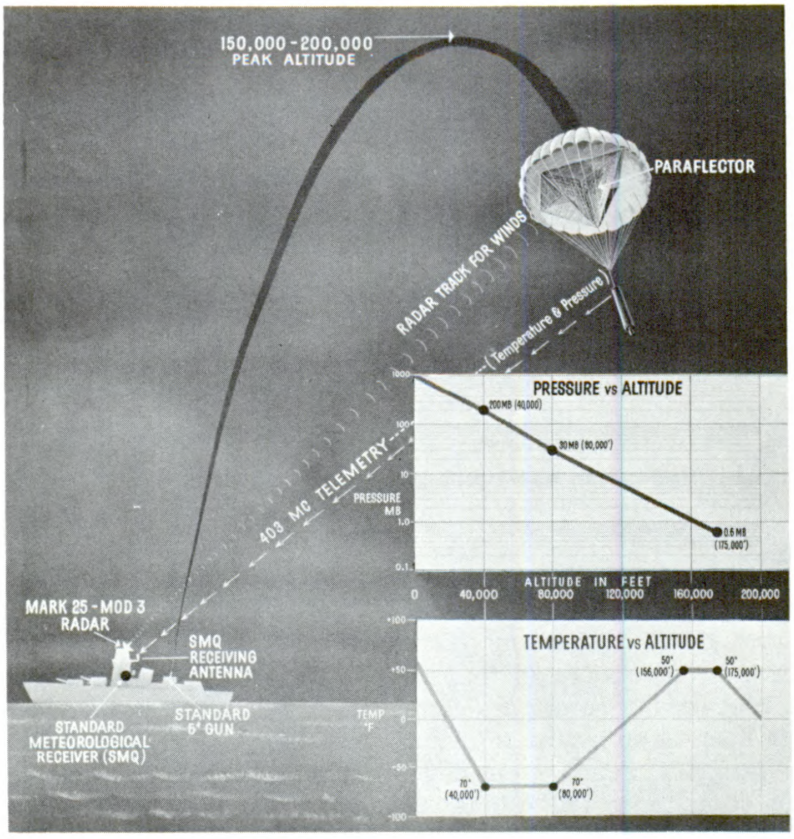


Diagram of the instrumented weather rocket descension, and tracking from shipboard.

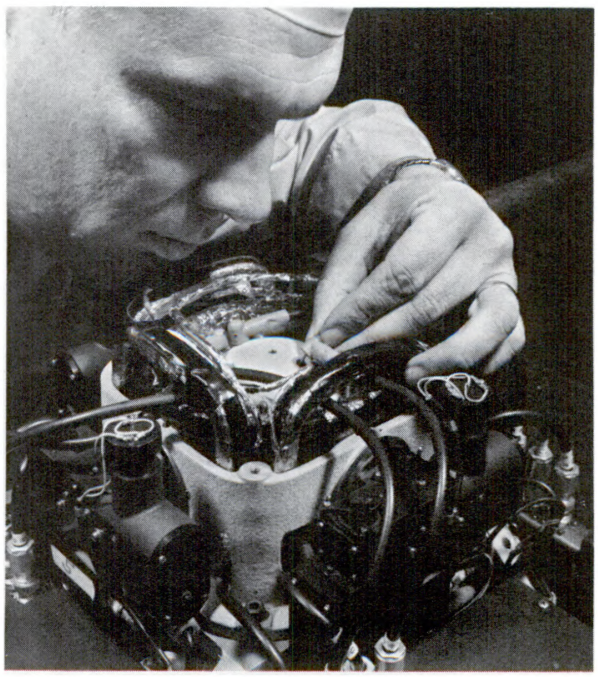
broadcast accurate stratospheric temperatures during its 30-minute earthbound journey. Tests with the payload in the not-too-distant future are expected to double this altitude and collect air-pressure data as well.

The HASP rocket with its weather-gathering payload requires no special launchers, tracking equipment, or meterological receiving and recording equipment. When used aboard ship, the solid-fuel HASP rocket is launched from the ship's 5-inch gun to hurtle aloft at 3000 miles per hour. With the gun-director radar locked on target, the HASP rocket is automatically tracked as it streaks into the stratosphere. Upon reaching maximum altitude the instrumented payload is ram-ejected from the rocket to float back to the earth on the metallized chute at the rate of 50 feet-per-second.

Wind direction and velocity are determined by the path and speed of the parachuted payload as it is tracked by radar. At the same time, the payload's radio sonde measures the environmental temperatures and pressures, continually transmitting this information to the waiting ship below. According to the HASP project manager, weather data collected by the instrumented package will be correlated with that of the lower atmosphere to give more accurate long-range forecasts. This information will be of invaluable aid in firing long-range ballistic missiles or determining fall-out patterns if nuclear missiles are ever used in war.

Electrically Suspended Gyroscope

The recently developed prototype of Minneapolis-Honeywell's "electrically suspended gyroscope" marks a major step toward the day



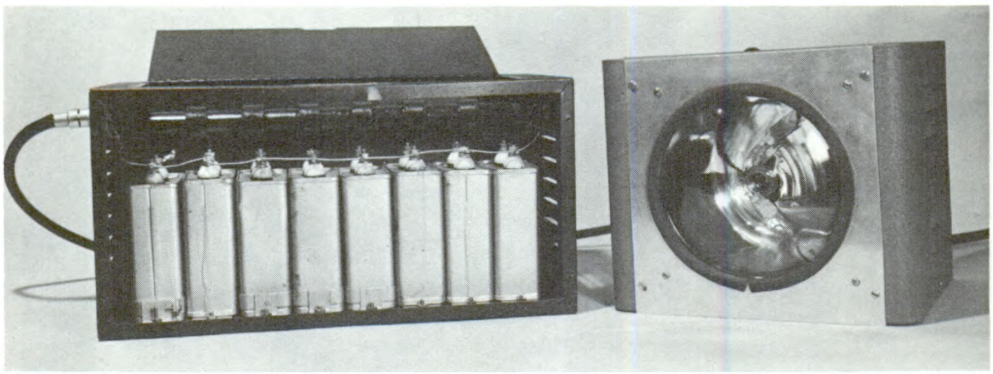
A technician attaches a high-voltage lead to a connector on the prototype of an electrically suspended gyroscope. (Photo by Minn.-Honeywell)

when the ESG principle will be evaluated under operational conditions. Foil-wrapped coils around the gyro create the magnetic fields used to bring the rotor up to operating speed and then are de-energized, allowing the rotor to operate in a "coasting" condition. High-voltage leads carry the current that provides the electric fields in which the gyro's spherical rotor is suspended. The units mounted on each side of the gyro casing are "optical pickoffs," which provide information on the gyro's orientation. The ESG is being developed by Honeywell's Aeronautical Division under contracts to the Navy. It is scheduled for use in the Polaris submarine navigation system.

Self-Shuttering Electronic Flash

A self-shuttering electronic flash of high intensity has been developed to solve a major lighting problem in Navy missile research. The flash instantaneously achieves and maintains the peak intensity of 10 press-camera flashbulbs before suddenly shutting off without an afterglow. The new electronic flash was developed by three scientists at the Naval Ordnance Laboratory in Silver Spring, Maryland. It consists of a gaseous discharge tube coupled with an artificial transmission line made up of a number of capacitors.

When the flash unit is used in testing with missile models, its charged capacitors are discharged, allowing alternating current to flow through the transmission line. This keeps the tube's arc burning evenly for three thousandths of a second. At the end of this time, the voltage across the discharge tube abruptly drops to zero, causing the light to cease shining immediately without any afterglow. During the time the missile model is illuminated, a high-speed, continuous-writing camera takes 82 equally exposed pictures of it as it reacts to a shock wave. Data from these pictures help to determine the aerodynamic stability of the full-scale missile.



New self-shuttering electronic flash unit of high intensity. Left, an artificial transmission line of capacitors that furnishes the power. Right, a gaseous discharge tube - the unit's light source.

NOL's new self-shuttering light source solves a major lighting problem in the photographing of high-speed motion which lasts only a split second. Negatives exposed with other illumination systems, such as chemical flash lamps and flash bombs, contained only a few properly exposed frames. These were always found in the system's mid-intensity light range. The remaining negative frames were always either under-exposed because of insufficient light as the illumination system commenced and ceased its glow, or over-exposed when the light reached its peak brilliance. Also, the afterglow of these systems caused the high-speed camera to double-expose a number of the negative's frames. As a result, the scientists experienced difficulty in abstracting detailed data from the finished pictures.

New Volume to Honor Soviet Mathematician

An English edition of a volume of invited papers on mechanics is being prepared by Professor J.R.M. Radok, of the Polytechnic Institute of Brooklyn, to honor the Soviet mathematician, Nikolai I. Muskhelishvili, on his 70th birthday on February 16. A Russian edition of the volume will be published simultaneously by the Institute of Mechanics of the Academy of Sciences of the USSR.

The volume will contain 50 papers from the following countries: the USSR, 28; the United States, 7; England and Poland, 4 each; China, 3; and Holland, India, Italy, and Sweden, 1 each. All seven papers from the U. S. were written by scientists engaged in ONR research. One, entitled "Plane Problems of Linear Viscoelasticity," was prepared by Professor Radok. He also translated most of the papers not written in English. The volume is being prepared on behalf of the Society for Industrial and Applied Mathematics, with support from the National Science Foundation. — ONR, N.Y.

Fifth Navy Science Symposium

Approximately 500 high-ranking civilian scientists and military officers were expected at the Fifth Navy Science Symposium at the U.S. Naval Academy, Annapolis, Maryland, from April 18-20, 1961. The meeting was sponsored by the Office of Naval Research to encourage the exchange of ideas on naval research problems.

The theme of this year's symposium is "Naval Research," and 84 technical presentations were programmed on subjects in most scientific fields of interest to the Navy. Among the topics presented were the results of research in: de-icing naval vessels, boundary-layer control in porpoises, teaching machines, nuclear submarine habitability, and numerical weather prediction. In addition to the technical presentations made by the Navy, there were general papers on the research programs of the Department of Defense, the Army, and the Air Force. Highlight of the meeting was a scheduled speech by Admiral Arleigh Burke, USN, Chief of Naval Operations, at a banquet on Tuesday evening, April 18.

On the Naval Research Reserve

NRRC 9-7 Places Second

During the Annual Inspection of Naval Reserve Research Company 9-7, Purdue University, the Commandant's Award (for having placed second among NINTH Naval District Research Reserve Companies during Fiscal Year 1960) was presented to the Company.

CDR W. J. Stadelman, USNR (center), C. O. of NRC 9-7, receives the award plaque from CDR L. P. Hoskins, USNR, Asst. for the Research Reserve, ONR, Chicago, CDR K. C. McLaughlin, USNR, Company Executive Officer, is at the left.

Commanding Officer, NRRC 9-10 Active in Astronomy

LCDR Karl G. Henize, USNR, Commanding Officer of Naval Reserve Research Company 9-10, Evanston, Illinois is, in his capacity as Associate Professor in the Astronomy Department at Northwestern University, helping to direct an expanded program in the field of astronomy. The training program of NRRC 9-10 has also benefited by way of some interesting and informative discussions on this subject.

Prior to this year, LCDR Henize was for three years a senior astronomer at the Smithsonian Astrophysical Observatory where he established and supervised the photographic tracking of U.S. and Soviet artificial earth satellites at twelve observatories located around the earth.

Dr. J. Allen Hynek, chairman of the department at Northwestern and LCDR Henize hope to increase sharply the number of students majoring in astronomy to help eliminate a critical shortage. Only fourteen doctorates in astronomy are granted annually in the U.S. All

but two of these are needed to replace those leaving the field. To increase interest in astronomy, the University is intensifying its program of astronomy education and of research. In order to increase his mobilization potential, LCDR Henize performed his latest active duty for training at the U.S. Naval Observatory, Washington, D. C.

Pass the Word

The "Research Reserve" section of Naval Research Reviews is intended as a medium of exchange of information for companies of the Research Reserve Program. But in order to provide for this exchange we need to hear about newsworthy happenings within the companies. These happenings may concern company activities or individual Research Reservist's accomplishments. You may have an outstanding or unusual training program in progress; your company may be working on a company research project; or some member may have performed an outstanding service or received special recognition. Let us hear about them.

Reporting is easy. Just send the item to the Chief of Naval Research (Code 120), Office of Naval Research, Washington 25, D. C. If a photograph is available, send it along too. The deadline for the following month's issue is the 5th of the month.

TRANSIT

Central operations control of world-wide tracking stations for the TRANSIT navigational satellites has been assigned to the headquarters of the Navy's Pacific Missile Range at Point Mugu, Calif. These precisely located tracking stations will supply information that will ultimately permit ships and aircraft to use the TRANSIT system for precise all-weather navigation.

The TRANSIT program is under the direction of the Navy's Bureau of Naval Weapons with satellites currently being launched into orbit from Cape Canaveral. Locations for seven portable TRANSIT stations are: Argentia, Newfoundland; Seattle, Wash.; Las Cruces, New Mexico; Sao Jose Doa Campos, Brazil; South Point, Hawaii; Salisbury, Australia, and San Miguel in the Philippines. The newly selected ground receiving stations will be operated and maintained by personnel under Navy contract to the Pacific Missile Range.

A patent has been granted to Mr. Sol Domeshek, of the Naval Training Device Center, for the development of a rangefinder with an adjustable reticle. Mr. Domeshek's invention concerns a pocket-size ranging device, capable of directly measuring the distance between an object and the observer, and covers particularly the presentation of a ranging reticle which may be adjusted to line in the same plane normal to the visual axis and the object being viewed. By suitably calibrated means, the distance is then read directly.

Selected for Admiral

RADM H. H. Hess, USNR

Another of the new RADM selectees from the Research Reserve Program hails from the FOURTH Naval District. CAPT Harry H. Hess, USNR, a charter member (1949) of Naval Reserve Research Company 4-1, Princeton, New Jersey, began an association with the Navy thirty years ago as a civilian scientist in the old World War I submarine S-48.

CAPT Hess is a graduate, Class of 1927, of Sheffield Scientific School, Yale University. His earlier interest in electrical engineering changed to geology, and for the two years following his graduation he was engaged in mineral exploration in Northern Rhodesia. In 1932 he received a Ph.D. degree in geology from Princeton University and in 1934 he was appointed to the faculty. His duty in submarines followed—first as a civilian scientist and later in uniform as a LTJG, U. S. Naval Reserve.

When World War II started, he was assigned to the operations department, Eastern Sea Frontier, with the task of predicting the position of enemy submarines. Shipboard duty followed in the USS BIG HORN, a submarine decoy ship which operated with the Atlantic Fleet. More shipboard duty followed—on the USS CAPE JOHNSON—but this time in the Pacific Area. On this ship he served as navigator, executive officer, and later as commanding officer. An additional assignment while serving as commanding officer was his designation as convoy commodore.

A few days before the Japanese surrender, he became operations officer of Transron 20 and took part in the occupation of Japan. After his tour of duty in Japan he returned to the Hydrographic Office, where his Naval career had started.

He returned to civilian life, and to Princeton, in June 1946. From 1949-1950 he was an exchange professor at the University of Cape Town. Upon his return to Princeton in 1950 he was appointed full professor and chairman of the department, the position he presently holds. He has served in the grade of CAPT since September 1953 and is an active member of NRRC 4-1.

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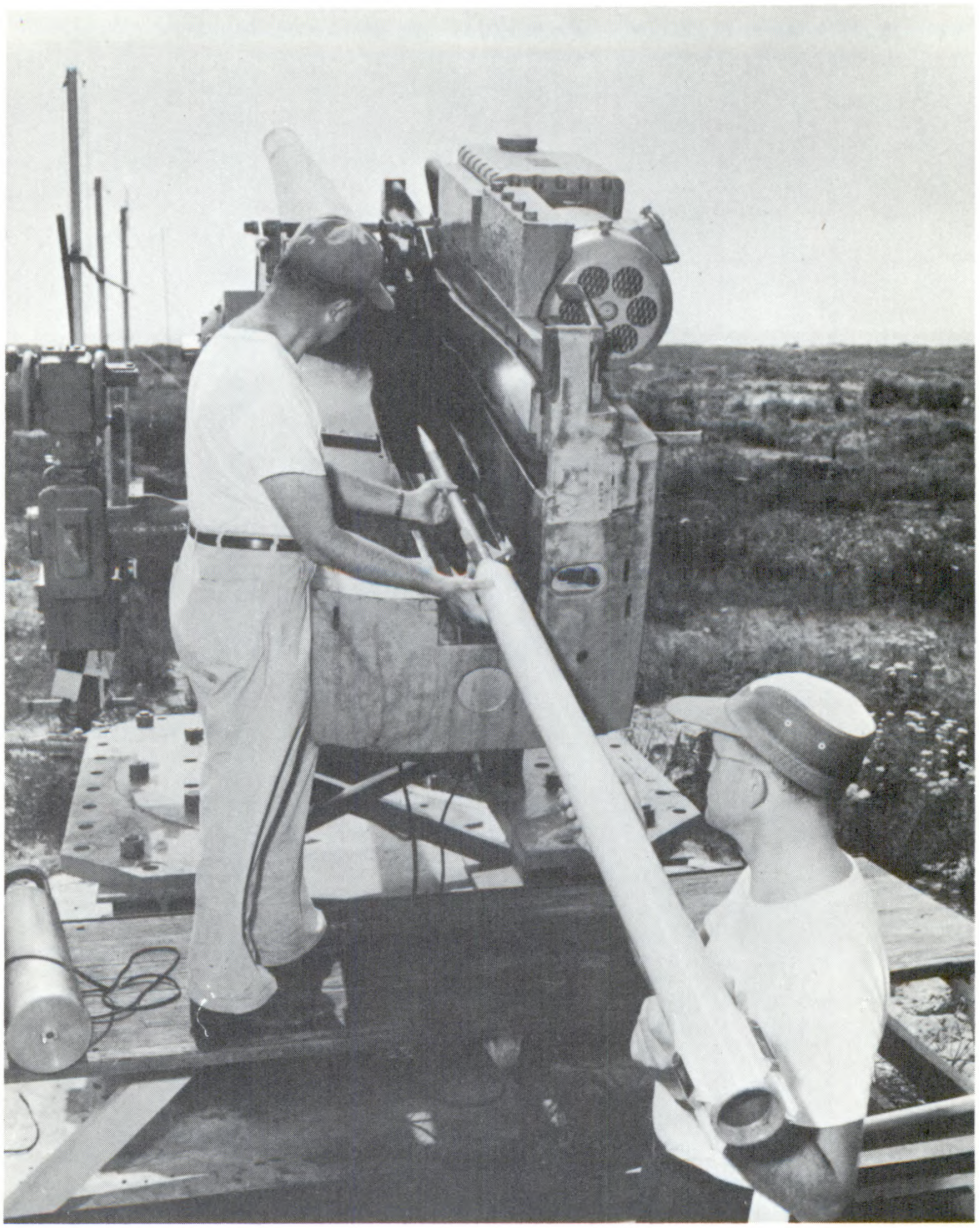

NOL's new one-pound rocket-borne weather station, in being placed in a 5-inch gun ready for launching. The empty shell casing is used to adapt the rocket to the breech and incorporates the firing device.

IN THIS ISSUE

NAVAL RESEARCH reports highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. The magazine is listed for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Subscription price: $1.50 per year in U. S. and Canada; $2.00 per year, foreign; $0.15 per individual copy. Changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. The issuance of this publication approved by the Secretary of the Navy on 1 March 1961.

It's 40 below zero, but the temperature could be a sweltering 135 degrees Fahrenheit and the man in this newly developed suit would still be comfortable. (See the story on page 19).