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COVER PHOTO: These two scientists aboard the Scripps Institution of Oceanography vessel HORIZON are fishing, but not for fun or food. They are more interested in studying the biological life collected by the Isaacs-Kidd Midwater Trawl. The trawl is a recent invention designed to capture creatures from the mid-depths of the ocean, a relatively neglected region when earlier studies were concentrated on the surface layers and the bottom. It has caught several species of fishes new to California and some of them new to the literature. For more about this research, see "SHELLBACK Expedition," by LTJG J. A. Knauss, USNR, pages 1 to 6.

Research Reviews endeavors to report briefly highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. Articles which meet these broad criteria and possess a good degree of readability are welcomed. Manuscripts and changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C.

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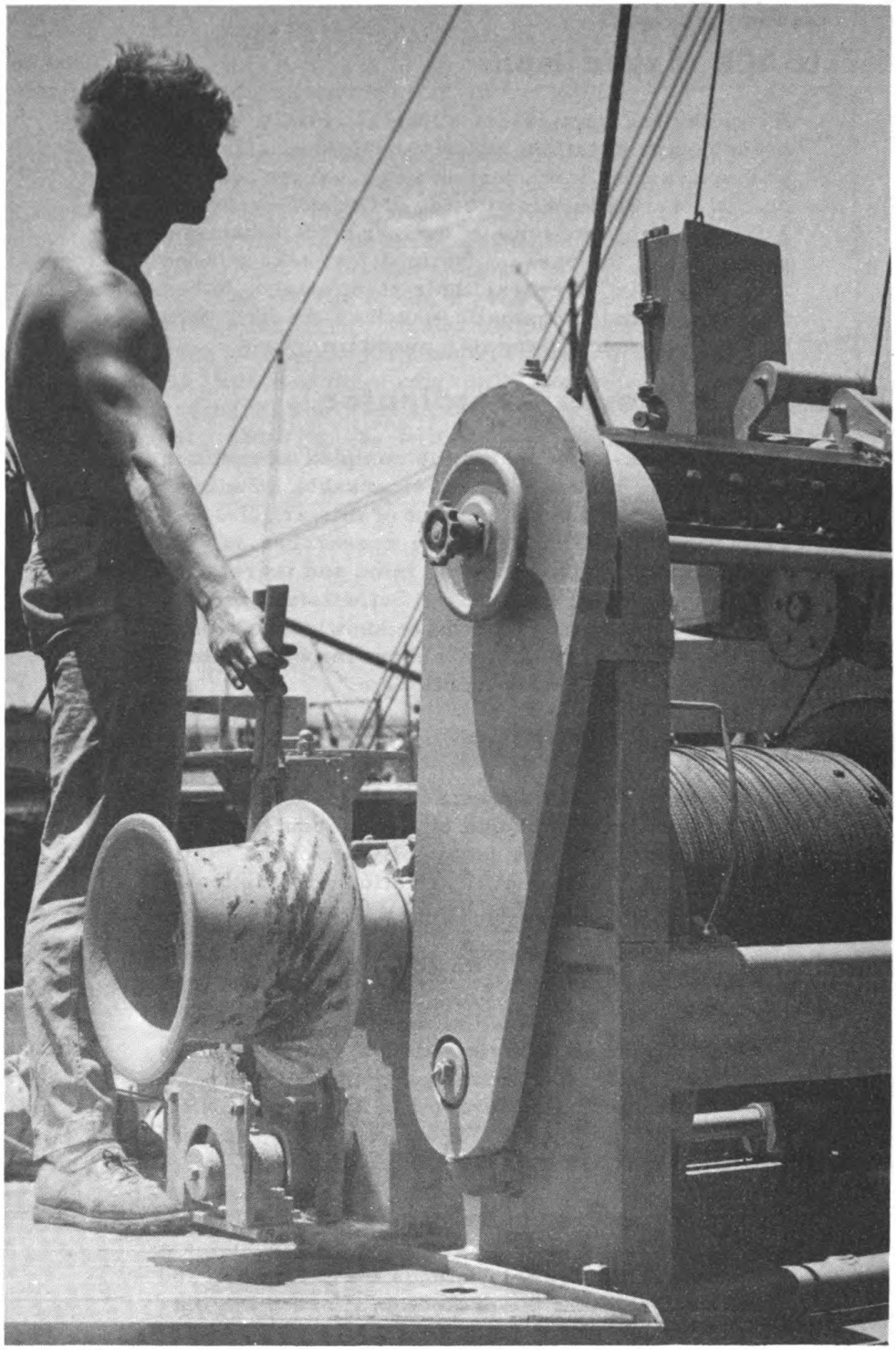
In This Issue



In the study of the oceans, man is largely dependent upon instruments that can be lowered to a predetermined depth to transmit information or bring back actual samples of the water or of the plants and creatures that live in the water. Thus the winch, which lowers these instruments on the end of a steel cable to the desired depth, is an integral part of an oceanographic vessel.

SHELLBACK Expedition

LTJG J. A. Knauss, USNR

...of the Geophysics Branch, ONR, participated in the SHELLBACK expedition as an oceanographer. He is working on his Ph. D. in this field at the University of California.

Since 1949 the Scripps Institution of Oceanography of the University of California has conducted, in cooperation with the Navy, a series of exploratory oceanographic cruises in the Pacific Ocean. Now, certainly the Pacific has been explored before. From the British CHALLENGER expedition (1873-76) to the Danish GALATHEA in 1951 and 1952 (Research Reviews, October 1952), various ships and scientists have studied the Pacific Ocean. But of necessity nearly all of these expeditions have had to sample sparsely. It has been the aim of the Scripps cruises, on the other hand, to study certain areas of the Pacific in some detail.

The tracks of the four Scripps cruises made to date are shown on the graph on p. 2. Essentially these expeditions have been of two different kinds. MIDPAC and CAPRICORN have been primarily geophysical and geological while NORTHERN HOLIDAY and SHELLBACK have been more concerned with what might be termed the classical studies in physical oceanography, that is, currents and water mass structure. However, regardless of the primary object, the ships are always crammed with as many additional scientists and their equipment for special projects as can be handled without disrupting the primary program.

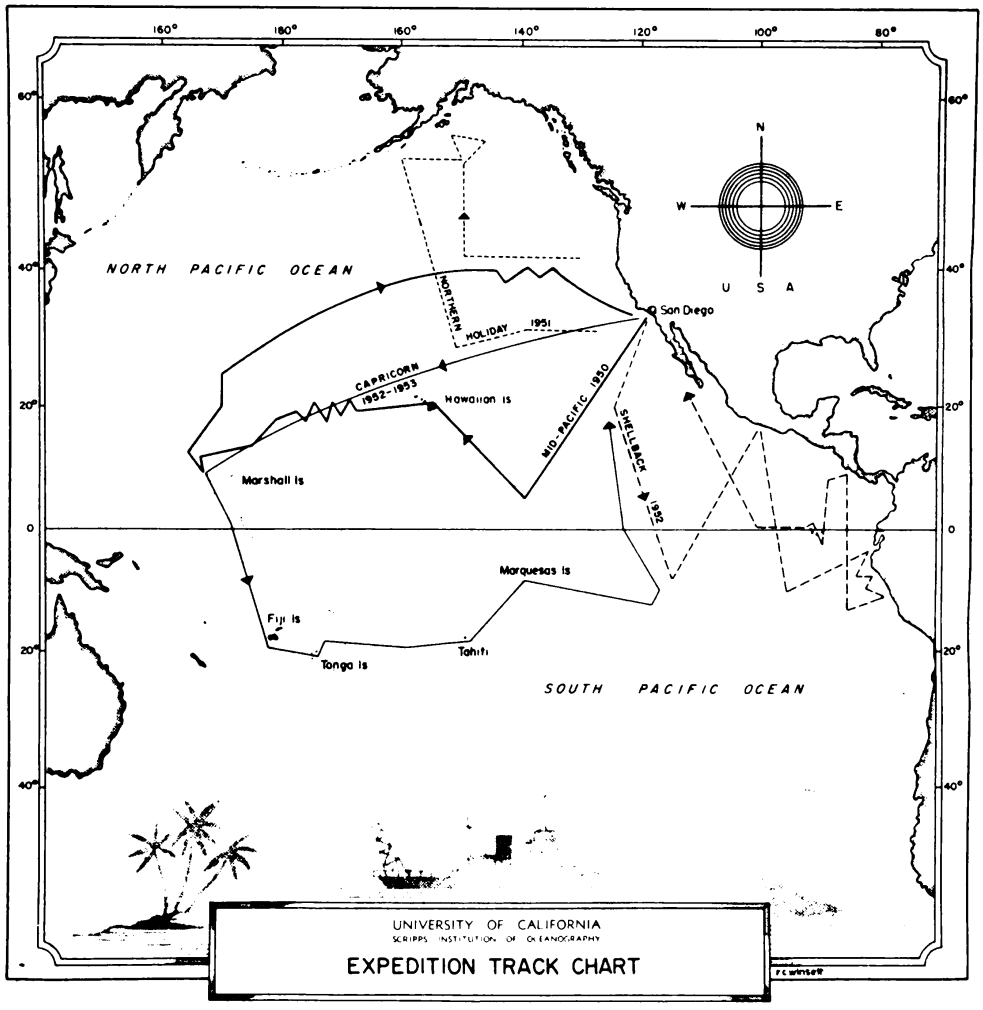
The one Scripps vessel which has participated in all four of these expeditions is the research vessel HORIZON. The HORIZON is a 143-foot, 700-ton former ATA (auxiliary tug). The institution sails her with a crew of eighteen and has living accommodations for an equal number of scientists. This ratio (or a higher one) of scientists to crew is one which all private oceanographic vessels in this country try to maintain, since generally speaking the greater the ratio of scientists to crew, the less the "overhead" costs of an expedition.

The SHELLBACK cruise, in which the author participated, was not in any sense a single-institution operation. While the HORIZON was operating in the area shown on the chart, the U. S. Navy Electronics Laboratory's research vessel, the EPCE(R)857, was making measurements to the north, and the U. S. Fish and Wildlife Service, Pacific Oceanic Fisheries Investigation, which operates out of Hawaii, was making a series of stations to the west. Members of the oceanographic branch of NEL worked aboard the HORIZON, and several of the Scripps staff were aboard the EPCE(R). Also aboard the HORIZON were members of the Inter-American Tropical Tuna Commission and the U. S. Weather Bureau. In addition, one of the staff members from Scripps,

with the assistance of the U. S. Air Force in Panama, made aerial reconnaissance studies over the operating area. The whole joint expedition was aptly dubbed Operation CO-OP.

The HORIZON left San Diego on May 17 and returned on August 27, 1952. During this period it steamed some 14, 580 miles. Eight times it crossed the equator while sweeping back and forth across an area of four million square miles. Its speed of advance, however, was slow because the ship stopped 216 times (every sixty miles) for about two hours to make an oceanographic station. These stations were the real heart of the SHELLBACK cruise, and it might be well to discuss in some detail what measurements were made and what is expected from them.

The essential piece of equipment is a Nansen bottle and its rack of deep sea reversing thermometers. Some 10 to 15 such bottles are spaced along a wire and lowered in an open position down to a depth of about 1500 meters. After the bottles have reached the desired depths, a "messenger" (a small brass weight) is slid down the wire until it hits a lever on the first bottle. It reverses the bottle and thermometer rack and closes the valve on the bottle; in this way a liter sample of water from that depth is trapped inside. As the bottle is reversed it releases



The HORIZON

a second messenger which in turn slides down the wire to trip the second bottle and release the third messenger; and so on until, barring misfires, all bottles have been tripped and water samples collected. At every other station, depth of water permitting, two such "casts" were made, a shallow cast at 1000 meters and a second at 1000 to 3000 meters.

By means of a delicate capillary system within the thermometer, turning the thermometers upside down cuts off the thread of mercury so that the thermometers can be brought to the surface still showing in situ temperatures. These thermometers are accurate to plus or minus .02 degrees centigrade.

For this accuracy to be attained, corrections must be made for the difference between the expansion coefficients of glass and mercury. However, because of this difference in expansion, it is possible to calculate the pressure and hence the depth from the difference in apparent temperatures of two thermometers attached to the same bottle—one in which the thermometer stem is protected from the outside water pressure and one in which it is not. This method of determining depth, which is good to about plus or minus five meters, is considered more accurate than simply measuring the amount of the wire out and correcting for the observed wire angle.

Water from the Nansen bottles was analyzed to determine its content of dissolved salt, oxygen, phosphate, and silicate ions. A network

of closely spaced stations such as those made on SHELLBACK allows one to construct charts showing a three-dimensional distribution of salinity, temperature, oxygen, etc. It is then possible, using the temperature and salinity data, to construct charts showing density structure and, from this, to calculate the average current system and water transport. From analysis of the distribution of variables such as these, oceanographers gain insight into some of the large-scale dynamic processes of the ocean. Charts of this type are analogous in some respects to the preliminary mapping that geologists must do before they can begin to study possible causal relationships.

Supplementing the oceanographic stations, an even tighter network of temperature observations in the top layer of the ocean was provided by the bathythermograph, which was used about once every two hours as the ship traveled between stations. This instrument gives a continuous trace of temperature versus depth in the upper 900 feet, where the most rapid changes in temperature take place.

The method described of computing the ocean current structure from an analysis of the density gradients is not entirely satisfactory. The distance between stations, plus the several simplifying assumptions that have to be made in the calculations, mean that the current structure derived at best is only an average one, and that short period variations in time and in space are apt to be masked.

Therefore, another method was used on SHELLBACK to give a more instantaneous picture of the surface currents. Measurements as a function of the electrical voltage of the water were made every twenty miles. These voltage measurements can be related to the velocity of the surface waters but require assumptions as to the ratio of current width to depth. The truth of the matter is that no completely satisfactory method of measuring currents has been devised.

Along with the study of the water masses and ocean current characteristics, there is considerable interest in studying how life within the ocean is affected by changes in these factors. At each station two nets were lowered to sample the biological life. One, which was towed at a depth of 300 meters for twenty minutes, had a mouth one meter in diameter and a recording mechanism that measured the amount of water filtered during the tow. Observations of this type give a measure of variations in the total amount and in different types of plankton (floating-organisms). The other net used regularly was a small one with a 17-centimeter mouth, and with mesh openings of less than a tenth of a millimeter. This net, which was towed vertically through the upper 50 meters, collected even smaller organisms loosely classified by marine biologists as microplankton.

An additional 12 net hauls were made at a depth of about 4000 feet using a large net (with a mouth area of somewhat less than 100 square feet). Tows at this depth with large nets have been made but rarely in the past, and major interest in these hauls was in new or seldom collected species and in the occasional finding at these relatively great depths, of species thought to be indigenous to the surface waters.

On 37 stations water samples were drawn and treated with radioactive carbon. Some time later the sample was filtered and the amount of "carbon uptake" by the residual plankton was measured. These techniques are still in the experimental stage, but it is hoped that they will furnish a quantitative means of measuring plant productivity in the ocean.

Preparing to lower a sampling bottle to obtain data on temperature and salinity at great depths. (Photograph, courtesy of Scripps Institution of Oceanography)

Although, as stated earlier, the primary purpose of SHELLBACK was the study of currents and water masses, both geological and meteorological study programs went along simultaneously. The Weather Bureau personnel made regular surface and upper-air pilot balloon and radiosonde observations, which served two general purposes. They were coded and sent out over the Weather Bureau circuits to be added to the daily weather maps, but, of more lasting importance, they provide a series of upper air sections through the intertropical convergence in an area where few if any such sections exist.

Although no stops were made for coring or dredging the bottom, the ship's two echo sounders were kept running to give a continuous trace of the ocean floor. Occasionally when an unusual feature like a large seamount was passed over, the ship would turn and retrace its tracks, cutting the feature from several angles so that a general contour chart could be drawn. The amount of new information that marine geologists have gathered during and since the war about the morphology of the ocean basins is staggering and will be treated as a separate article at some future time in Research Reviews.

In oceanography, as in all sciences, the feeling of surprise about a new discovery is usually tempered by the long analysis and study that brings it forth. But there are dramatic exceptions. On SHELLBACK one quiet afternoon the echo sounder was etching a steady trace at 2300 fathoms when the pen began to rise, slowly at first, then more swiftly until, before it began to sink, it had traced the profile of a 12,000-foot mountain—a mountain that comes to within 268 fathoms of the surface, a mountain that no one had ever known about before, and which would still be unknown if the path of the HORIZON had been some twenty miles away in either direction.

The ship was gone from San Diego 103 days. During that time it stopped four times to take on fuel and provisions and to exchange passengers. Open house was held aboard the HORIZON at its stop in Lima, Peru. More than 200 guests came aboard at various times to inspect the

vessel and its equipment. They represented the Navy, the fisheries and Guano industries, as well as the University of San Marcus and scientific societies. At Ecuador a delegation from the ship paid a visit to President Gallo Plaza, an alumnus of the University of California. Both in Peru and in Costa Rica informal discussions were held with government representatives concerning the Institution's oceanographic work and its relation to their fisheries resources program.

Planning for an oceanographic expedition of this kind, of course, begins many months before its departure, and analysis of the observations made goes on for several years after the ship returns home. As is almost inevitable in such a study, more questions were raised than answered. The results of SHELLBACK will be appearing as individual publications in scientific periodicals for the next few years. It is not fair at this time to anticipate the authors with any preliminary review of the results. As a matter of fact, those conclusions that appear obvious at the time they were made often turn out to be not very obvious after all. As somebody answered a question about results on the day the ship returned, "All I can tell you is how many tons of data I've collected."

Instructional Film Research

Five years ago the Special Devices Center asked the Pennsylvania State College to undertake a program of experimental research to determine the value of motion pictures as a mass training medium and what factors make for successful training films. At present 35 reports have been published under this contract, which is sponsored jointly by the Army and the Navy.

One of the outgrowths of this program is a report on Instructional Film Research from 1918 to 1950. The purpose of this report was to bring together in one source the findings growing out of the many and widely scattered investigations in the area of training through motion pictures. It provides a summary of existing knowledge which may be useful in the planning and production of instructional films.

One of the major objectives of instructional films is training individuals to develop perceptual-motor skills, that is, to coordinate body movements with sensory impressions. A sampling of the results obtained from these studies clearly indicates the economy and effectiveness of this medium of instruction. For example, one test was set up to find out if students could learn a physical skill, simply by watching it being done on a film ("mental practice" vs "physical practice" of physical skills). The particular skill tested was tossing a basketball through a goal. Interestingly enough, it was found out that twenty periods of mental practice were as good as fourteen periods of physical practice. When the two methods were used to supplement each other—movies interspersed with practice sessions—the results were far more effective than either one alone....SDC Monthly Report, November 1952.

The Brain—A Master Coordinator

Ebbe Curtis Hoff

...M.D. and Ph.D., is Professor of Neurological Science at the Medical College of Virginia, and Medical Director of Alcohol Studies and Rehabilitation of the State Health Dept.

The profound wonder and mystery of human life confronts us when we examine the intricate way in which mind, body, and environment are ever coordinated one with another. Here we find stimuli producing body responses, complex chemical and physical reactions always in process within the body, energy exchanges miraculously balanced. And all this goes on in a dynamic state of equilibrium. The internal environment, we say, is kept remarkably constant.

This internal constancy—"homeostasis" it has been called—is so characteristic of our human organism that we recognize it as the chief sign of bodily health and fitness. The temperature, measured under the tongue, does not vary much from 98.6 degrees Fahrenheit; the number of red corpuscles remains normally at about five million in each cubic millimeter of blood. If we measure the sugar level, the electrolyte content, the hydrogen ion concentration, the hydrostatic pressure, or any of scores of other chemical and physical characteristics of body fluids and tissues, we similarly find quite definite limits of normal variation. As these limits are exceeded, the body is in trouble.

A major focus of study for the physiologist is to uncover and describe the governing and coordinating mechanisms by which these equilibria are preserved. This is no narrow academic interest restricted to the confines of the laboratory. Whenever and wherever man is subjected to the stresses of disease (such as the invasion of viruses, bacteria, or parasites), or of environmental extremes such as the rare atmosphere of high altitudes, the increased pressure of the sea bottom, the violent acceleratory and deceleratory forces of modern aviation, the well-nigh intolerable cold, heat, humidity or the countless other fatiguing and punishing exertions of today's warfare—wherever these stresses threaten man's safety and effectiveness, the physiologist finds problems urgently calling for solution.

When we turn to those experiences which we call mental and emotional—which we are sure of only in our own species, but which are discernable to some extent by inference in higher sub-human animals—we face new mysteries. All that we learn about mental and emotional experiences places them in close juxtaposition to chemical and electrical processes in the brain, especially in the cerebral cortex and the nuclei of nerve cells closely connected with the cortex such as those in the hypothalamus. From a human subject we can record, by means of electrodes fastened to the skin over the skull, continuous

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streams of interlocking electrical brain waves whose form and frequency reflect in their pattern our subject's sleeping or waking state, his mental activity. Taking alcohol induces profound changes in mood and judgment. With sedatives or anesthetics such as barbiturates or ether, we can depress the sensorium or even blot out consciousness altogether. There are now powerful drugs like lysergic acid which in minute doses taken by mouth will temporarily cause deterioration and disintegration of personality with disorientation, hallucinations, delusions, and other changes reminiscent of the symptoms of a schizophrenic patient.

We can go still further in our attempt to set the brain in relation to psychological phenomena. If we remove from a chimpanzee the foremost parts of the cerebrum on both sides (the "prefrontal areas" of the brain), we find that afterwards our animal shows rather subtle but demonstrable defects in the higher aspects of behavior. There seems to be a persistent fault in recent "memory", and a change in the way oncoming stimuli are met in the light of immediately past experiences. The animal is less skillful in executing various tests such as opening a problem box to obtain the reward of a grape or piece of banana or selecting his reward from one of two cups following a delay period after he sees the cup baited. There is no motor defect but rather some alteration in comprehension of the problem. He makes more frequent mistakes and is more distractable than before the operation, but, in spite of the fact that each mistake may bring with it the punishment of an electric shock, he seems not to be worried. This is in striking contrast to the severe "neurosis" that may result when an unoperated animal is faced repeatedly with problems too difficult to solve.

It was the seeming equanimity of the prefrontal lobectomized animal that suggested the operation of disconnecting the prefrontal areas by a knife-sweep through the two sides of the brain (prefrontal lobotomy) in human patients suffering from disabling and intractable anxiety, depression, and other major psychological symptoms. Thus, a now well-known brain operation, damaging in its character, results in important personality changes which in favorable cases may render the mental and emotional life more bearable for the patient.

Let us look for a moment at still another way in which we can, by imposition of a highly artificial circumstance to the brain, alter the psychic processes and so sometimes change the course of psychiatric disease. By passing electric currents through the brain, usually repeatedly in many sessions with or without accompanying convulsions, it is possible to bring about an improvement in some neurotic or psychotic patients. Convulsions or near-convulsions induced by insulin, carbon dioxide, anoxia, or other means may be followed by similar results.

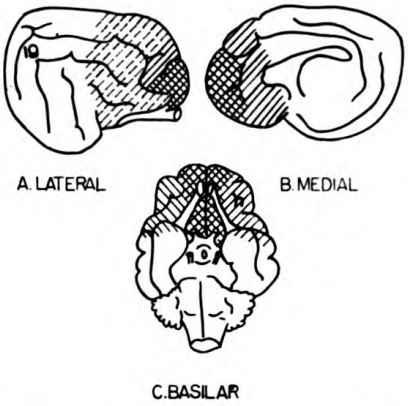
We have nothing like a satisfying understanding of just how lobotomy or sub-shock or shock procedures influence mental mechanisms any more than we are really convinced that we know how drugs like alcohol and lysergic acid affect the mind as they do. In a deep sense, we must confess that the precise relation between mental and emotional experiences on the one hand and neuro-physiological action on the other continues to elude us. The mechanisms of the brain and the mechanisms of the mind are not conformable—so far as we can yet see—to a single pattern. The liaison between the physical and the psychic is a secret.

We find it impossible to translate the terms of the one into the terms of the other. On one side, we measure the changing electric potentials of the brain, its chemical and other energy relations; on the other side, we explore a succession of mental experiences, related, but how, if at all, conjoined to energy relations? The mind lodges in the brain and especially in the cortex, but is not imprisoned there. It is unaware of the nerve impulses and chemical reactions that are the brain's characteristic action and seems to transcend them.

So we have an age-old mystery that has fascinated many great thinkers. Some would say there is no key to the mystery, no bridge between the two orders of phenomenon. Others would postulate a larger, overlying unity drawing together all facets of the human being. Is this an empty, sterile problem suitable only for arm-chair speculation? I think not. Practical issues, vital now to survival, are at stake. For psychological as for physical processes, we recognize equilibria and limits which may not safely be transgressed. Psychological breakdown is a formidable sequel to overstress in warfare. Combat fatigue, so-called, is more an affair of the overtaxed mind than the physiology of exhausted muscles, but both are involved. Thus the mystery of the mind-body liaison confronts us at the firing line of life. Consider how psychological factors, such as motivation or its lack, may throw out of kilter the physiologist's neatly controlled studies of tolerance to and performance under physical stresses—altitude, high carbon dioxide concentrations, heat, cold. Or consider the illnesses of the body that may have their genesis in pathological processes operating within the mind—how neurotic anxiety, chronic and unrelieved, may be linked with disorders of the heart and circulation, of the kidneys, the alimentary tract, and other organs or body systems.

All points to the nervous system as a coordinator. When we remember that the brain is connected via the hypothalamus to the pituitary gland, master of the hormone glands (the endocrines), we see what potent influence the nerve-endocrine complex must exert in the integration of the organism.

Turning our attention now explicitly to the nervous system, we see its integrative work in the regulation of body movement and posture (somatic functions), and in the control of the heart and blood vessels, the smooth muscles of the viscera, and the secretory glands (autonomic functions). At the cortical level of nervous action, the somatic motor functions have received richly of the experimental physiologist's attention. By exploring the surfaces of the cerebral cortex with stimulating electrodes, it has been possible over the years to establish a localized excitable "motor" area from which isolated skeletal movements can be elicited. This motor area lies on the convexity of the cerebral hemisphere in the frontal lobe just in front of the central groove or "sulcus", as it is called, of the hemisphere. Within this motor area, body movements are represented contralaterally and inverted, that is to say, movements of the left side of the face and mouth parts are evoked by stimulating the most lateral and inferior portion of the right motor area while movements of the lower parts of the body are called forth by stimuli to the mesial and upper part of the area.

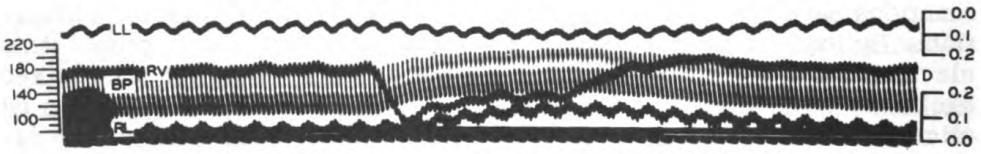


These three surfaces of the cerebral cortex of a cat show areas yielding pressor and depressor responses to electrical stimulation. Cross-hatched areas: rise of blood pressure, lowest threshold; solid lines: rise of blood pressure, highest threshold; broken lines: fall of blood pressure.

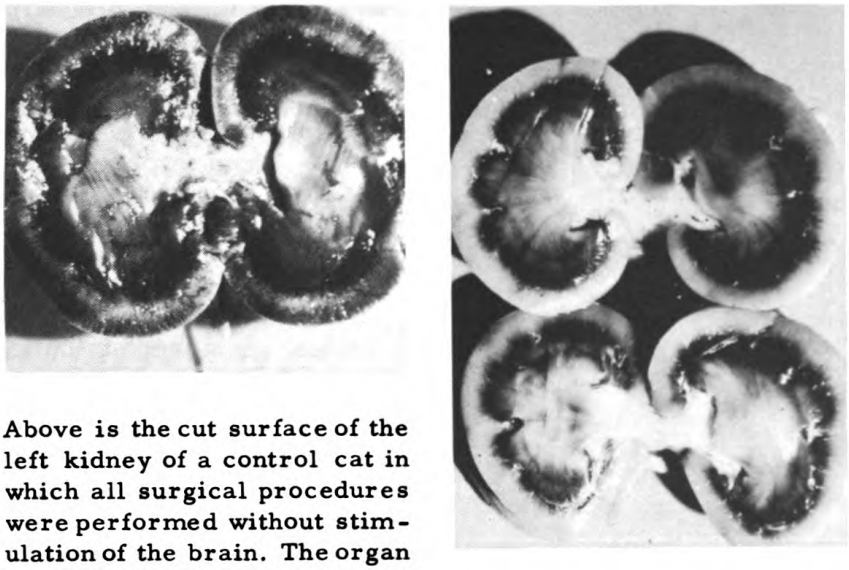
In front of this classical motor area are regions of the frontal lobe especially concerned with movements of the eyeballs, and auxiliary motor foci are also found on the medial surface of the hemisphere. More rostrally still is the prefrontal area which we have already mentioned and which seems inexcitable so far as skeletal movements are concerned. The map localizing motor responses corresponds with motor deficits and disturbances observed clinically and experimentally (in animals) in specific lesions in the cortical motor areas.

Just behind the motor area a somatic sensory region has been defined by methods of stimulation and study of deficits due to lesions. In the temporal lobe is an area similarly related to auditory responses, and at the back of the hemisphere (the occipital pole) is a region which is especially concerned with visual effects.

The heart and blood vessels, the smooth muscles of the viscera, and the secretory glands (unlike the skeletal muscles) are all capable of action even when disconnected from the central nervous system. They are profoundly influenced by certain hormones circulating in the blood, and their activities are very definitely regulated by central nervous mechanisms. The central nervous control of these organs and tissues (supplied by nerves called "autonomic") has generally been held on older experimental grounds to utilize only those nervous levels at the hypothalamus or below.



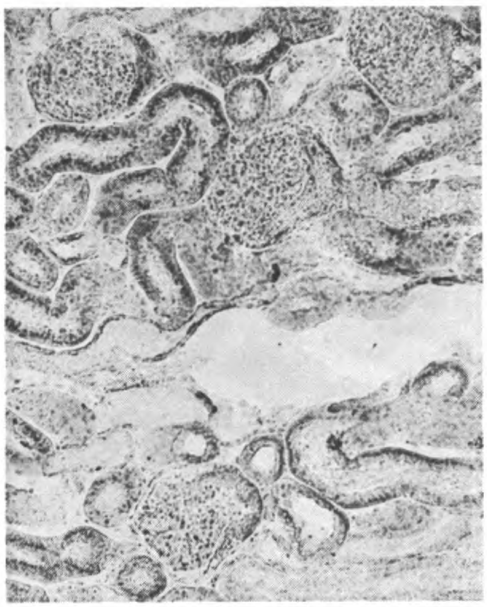
Simultaneous dilatation of the forelimbs, reduction of kidney volume, and elevation of arterial blood pressure from stimulation of a cat's cortex. LL = left foreleg, ↓ = increased volume; RL = right foreleg, ↑ = increased volume; RV = kidney volume; BP = arterial blood pressure. Left scale = millimeters of mercury; right scale = magnitude of volume change in cubic centimeters.



Above is the cut surface of the left kidney of a control cat in which all surgical procedures were performed without stimulation of the brain. The organ is well-filled with blood. At right are the kidneys of a cat subjected 20 times, during an acute 2-hour experiment, to localized electrical stimulation at a point on the pressor region of the cortex. In contrast with the control kidney, the cortex and medulla are pale and bloodless. The juxtamedullary region is well-filled with blood.

There now exists a considerable body of experimental evidence that autonomic activity is also represented at the level of the cerebral cortex, and a major research interest of mine for many years has centered around the effects of cortical stimulation and ablation (removal of portions of the cortex) upon arterial blood pressure and the circulation of the blood in the internal organs. Electrical stimulation of the motor area, the prefrontal area, and certain parts of the inferior and medial surfaces of the frontal lobe, as well as the forward tip of the temporal lobe, in the monkey, cat, dog, and other experimental animals is followed by transient rise in arterial blood pressure.

This pressor response is independent of skeletal movement since it occurs even though the skeletal muscles are paralyzed by the South American Indian arrow poison, curare. Moreover, the effects are not due to spread of the stimulating current to lower brain centers below the cortex. This is known because the responses are no longer obtained after the excitable cortical focus is anesthetized by the local anesthetic, dibucaine, applied to the cortex; or if the cortical focus is undercut to sever the descending nerve pathway while preserving electrical conductivity to deeper regions. The drawing (top, p. 10) shows in the brain of a cat the cortical regions yielding pressor responses (cross-hatched areas, low threshold; solid lines, higher threshold). As this drawing illustrates, there is in the cat a widespread cortical region (broken lines) lying behind the pressor region from which transient falls of blood pressure are elicited by electrical stimulation.



Cortex of the left kidney of a cat subjected to 10 stimulations of the brain 7 days before sacrifice. There is severe degeneration of the tubules. The glomerular tufts are swollen and the glomerular spaces are filled with exudate and cellular debris.

A typical pressor response is shown in the next figure. Here we see that the rise in blood pressure is associated with a simultaneous increase in limb volume (LL and RL) as well as a reduction in the volume of the kidneys (RV). These experiments permit us to conclude that there are nervous pathways originating in the motor cortex and nearby regions of the frontal and temporal lobes, whose excitation results in a redistribution of blood. It decreases the supply to certain viscera (like the kidneys) and increases the supply to those skeletal parts made active by simultaneous excitation of motor pathways from the cortex. So the integrative work of the cortex seems to comprehend both autonomic and somatic functions. The cortex has jurisdiction over both.

We have devoted considerable attention to the effects of cortical stimulation upon several visceral organs. Some of these experiments may be mentioned briefly. The photographs (page 11) show cut surfaces of the left kidney of a control cat (the organ is well filled with blood as is normally the case) and of the two kidneys of a cat subjected to localized electrical stimulation at a point on the pressor region of the cortex. In the latter, the outer layer (renal cortex) of the kidneys and the inner portion (medulla) are pale and devoid of blood because of the constriction of the blood vessels. Between these two layers is a crescent-shaped strip through which the blood still flowed freely.

If we pass electric currents through the brain of animals according to techniques and schedules resembling therapeutic electric shock for human patients, we find that the kidneys suffer degenerative disturbances which remind us of a condition known as nephrosis, a grave kidney complication of battle wounds. Shown above is a microphotograph of the outer layer of the kidney of a cat given ten electric shock therapy type stimulations of the brain seven days before it was sacrificed. The tiny spherical blood vessel tufts (called glomeruli), which help elaborate the urine, are swollen and damaged, and the small tubules leading from them, also concerned with urine formation, are degenerated. In these animals, there are disturbances of the blood supply in other organs including the stomach and intestines, the lungs, the spleen, the adrenal glands, and even the brain itself. It is likely therefore that therapeutic electric shock acts, not only through the effect of the electric current directly upon brain tissues, but also through excitation of brain autonomic

mechanisms which affect the circulation and hence the metabolism of widespread organs of the body.

Truly then we may look upon the brain as a master coordinator. We have here inspected two main areas of the brain's controlling and coordinating work: (1) skeletal movement and posture, and (2) activity of the heart, blood vessels, smooth muscle of viscera, and the secretory glands. Within the cortex, both are coordinated. Autonomic activity is the servant of and is subordinate to skeletal activity, and, over all, the mind—defying precise physical, chemical, or physiological definition—presides. The mind utilizes intricate energy mechanisms while largely unaware of them. Yet, from the research physiologist's study of these mechanisms and, hopefully, from the research psychologist's and research psychiatrist's examination of mental processes, come data most valuable to our survival in health and disease.

Wash Primers—A Coordinated Program

During World War II, prefabricated ship parts and other steel structures had to be around in the open, sometimes for weeks and months, before they could be fitted into the final assembly. They would have been ruined by corrosion, of course, had they not been protected from the weather by a rust-preventive coating.

An excellent material was produced by the American paint industry—notably, the Bakelite Corp.—under Navy contract. Now termed a wash primer, it could be quickly applied with a brush or paint spray and could provide positive protection for months and even years. Better still, it was found that it made an ideal undercoat or primer for ship hulls. When used with a conventional overcoat of paint, it outperformed every then-existing paint system. It was both durable and adhesive, it lasted as much as 100 percent longer, and it wouldn't chip or crack.

The substance, a chemical mixture of polyvinylbutyral, zinc tetroxychromate, and phosphoric acid was developed by guess and good luck rather than by systematic research. Consequently not much is known about its chemistry. Empirical evidence indicates that there are complex reactions between the various components when mixed, and with both the underlying metal and the finishing paint, that provide a tough, salt-water resistant film. But why?

A great deal of fundamental information is needed on the inorganic reactions that take place and the polymer binding actions that are involved in order to improve the effectiveness of this treatment and to apply it successfully to aircraft. This need has prompted ONR's Chemistry and Metallurgy Branches to sponsor a coordinated program of study on the nature of protective films on metal—not just the one wash-primer. NRL, which is already working on other methods of protection, will be a participant, and research contracts have recently been negotiated with Brooklyn Polytechnic Institute and Rutgers University. (ATD)

The "Artificial Mouth"

Ward Pigman

...Associate Professor of Biochemistry, University of Alabama Dental School and Medical College, is reviewer and referee for a number of scientific journals.

Ideally, conditions of experimentation are such that all influencing factors are known and can be either varied at will or kept constant. This situation is readily reached in much chemical and physical research, but is achieved with difficulty, if at all, in most research on biological problems. While primary interest in medical and dental research is usually in a disease process or metabolic disturbance in human beings, systematic experimentation on humans is often difficult or impossible. The diets, living conditions, and activities of humans cannot be arbitrarily and compulsorily enforced, and even in voluntary cooperation there is no assurance of adherence to the desired conditions. Although the situation is somewhat improved by the use of experimental animals, the number of possible influencing factors is still large. Many factors are unknown or uncontrollable, the relation to actual human conditions is difficult to establish, and the individual variation is often great.

In research on the nature and cause of tooth decay (dental caries), experimentation on both humans and animals has been used. Although significant results have been obtained, there are conflicting observations, and no experimentally established concept of the nature and cause of the carious process has been sufficiently developed to explain many of the related phenomena, such as differences in individual resistance. On the other hand, there is considerable experimental work and almost universal agreement that the carious process results from localized bacterial attack of some kind on tooth surfaces.

The concept of an external attacking force operating on a tooth surface only secondarily affected by systemic factors offers an ideal opportunity for testing the current ideas of the nature of dental decay. If systemic factors are minor or of secondary importance after the tooth is formed, it should be possible to reproduce the carious process outside the mouth on extracted teeth. Hence, although systemic effects may have been of great importance during the period of tooth formation and in establishing the basic resistance of teeth, the factors affecting the decay process itself should be capable of demonstration and study outside the actual oral environment. Such in vitro studies, although difficult, offer the great advantage of possible determination and control of the numerous influencing factors.

Dental investigators have long realized the advantage of this approach and have attempted to produce dental decay in vitro. One of the early workers in the field, E. Magitot, a French dental research

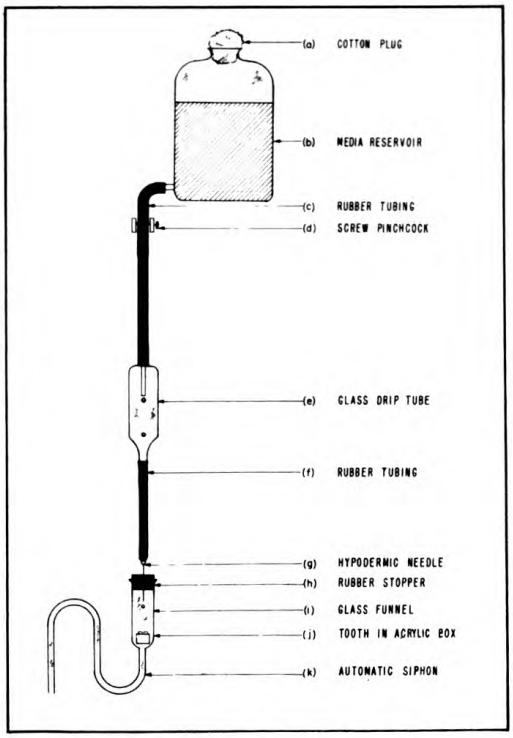
worker, around 1870 described what he considered to be the development of carious-like lesions in extracted human teeth which had been placed in bacteriological media for long periods of time. He also mounted sound crowns of extracted teeth on sound roots of decrowned teeth in human mouths; these "dead" crowns were said to develop carious lesions. W. D. Miller and other research workers later extended these studies. Most of these workers agreed that carious-like lesions could be produced in vitro, but some described the attack as simple decalcification. Much of the work carried on by these investigations merely involved placing extracted teeth in bacteriological media inoculated with saliva.

Method of mounting teeth

These investigators were confronted with several important questions. How could a true natural carious lesion be uniquely described so that an artifically produced lesion could be compared? How could the results be reported so that readers of the published articles could make an independent judgment of the nature of the lesions? How close did the selected experimental conditions simulate essential actual oral conditions?

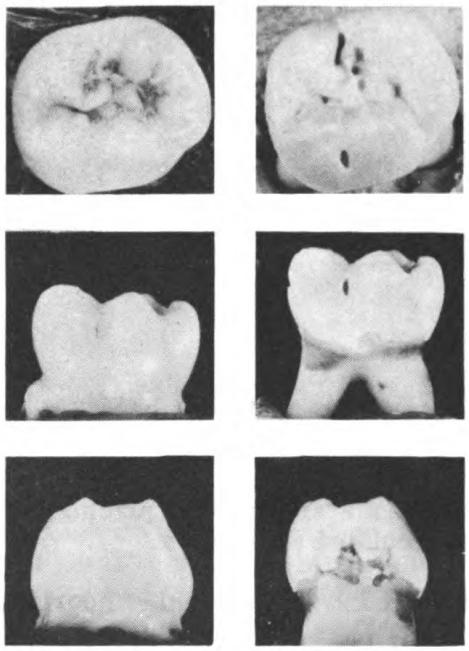
Recently a new procedure has been developed at the University of Alabama, Dental School and College of Medicine, with the support of the Dental Branch of the Office of Naval Research.* An apparatus, called the "artificial mouth," has been developed which helps to simulate actual mouth conditions much more closely than previously. Whether the essential oral physiological conditions are closely simulated is still debatable, but interesting preliminary results have been obtained.

The new method and apparatus in the simplest form are as follows. Freshly extracted



The artificial mouth

*For a preliminary report, see W. Pigman, H. C. Elliott, Jr., and R. O. Laffre, J. Dental. Res. 31, 627 (1952).



Changes occurring in a deciduous molar after 67 days in the artificial mouth. At left, are the original surfaces; at right, the same surfaces after 67 days.

teeth are examined carefully, photographed, and then mounted in cubical plastic boxes (page 15, at top), which in turn are placed in cylindrical glass funnels (see drawing on p. 15). The funnels are closed with rubber stoppers, through which a hypodermic needle is thrust. The needle is connected by rubber tubing to a reservoir of bacteriological medium, which is allowed to flow drop-wise on the occlusal surfaces of the teeth. At weekly intervals, the teeth are inoculated with samples of pooled saliva. Many variations and modifications are possible.

The early work with the artificial mouth has been essentially qualitative in nature—observation with the purpose of determining the principal operative factors. Several important factors influencing the rate and localization of attack on the teeth have been established. One of the most important influences in localizing attack seems to be mechanical cleansing. When the teeth are brushed well twice daily, the cleansable surfaces remain hard and unchanged for long periods of time. Uncleansed surfaces rapidly soften, then show localized pits, and eventually the entire enamel layer is lost. Uneven and rough enamel surfaces, possibly because of the difficulty of cleansing, are rapidly softened. This effect is very pronounced and presumably, under normal conditions in the mouth, mechanical cleansing of tooth surfaces by tongue, cheek and masticatory action is extremely important in preserving the teeth.

In the artificial mouth, teeth which are brushed frequently show a pattern of attack generally similar to that in the human mouth. The bottoms of grooves and pits are softened; uncleansed surfaces between adjoining teeth are rapidly affected; and the cervical enamel near the enamel-cementum line is preferentially attacked often with the formation of oval pits closely resembling class 5 natural cavities.

A typical pattern of attack on a deciduous molar from a 2-1/2-year-old child can be seen in the photographs above. The surfaces of the tooth, which was brushed twice daily, are shown before and after 67 days of exposure to a medium containing 0.5% glucose, 0.2% yeast extract, 0.5% tryptone, and 0.025% calcium hydrophosphate. The occlusal surface shows definite softening and widening of pits and grooves. The buccal surface shows loss of enamel at the bottom of the crown just above the cementum. The distal enamel surface which had been in contact with another tooth during the experiments shows extensive softening.

On the other hand, the cleansable smooth surfaces were generally quite hard after this same period.

Considerable difference in the resistance of individual teeth to attack is apparent. At this stage of the work, it seems that young and unerupted teeth are more susceptible to enamel destruction than teeth which have been exposed in the human mouth for a considerable period of time. Some evidence has been obtained that partially softened enamel surfaces may reharden under new conditions. These observations, which can be studied systematically in the artificial mouth, seem important as a lead to the origin of differences in individual resistance to dental caries and also point to the possibility of prophylactic treatments.

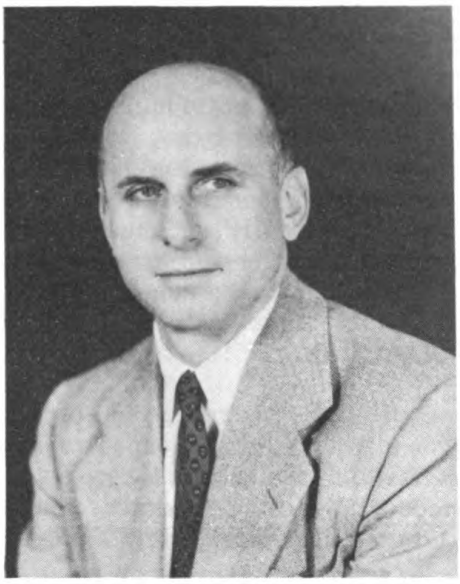
The composition of the bacteriological medium coming in contact with the teeth is an important factor. The medium in these experiments takes the place of saliva in the mouth. Enamel attack has taken place only under conditions such that streptococci and/or lactobacilli would grow. The amount of carbohydrate in the medium appears to be one of the important factors, and it may also direct the attack preferentially to enamel or dentin.

Many of the effects observed in the artificial mouth have been previously suspected from clinical experience. Use of the artificial mouth, however, appears to provide a method of systematic variation and control so that the carious process can be studied and the influencing factors demonstrated. Because of the many possible factors, the method, although promising, will require much time and effort before the complicated interrelations can be unraveled and unequivocally demonstrated.

Information Released on Guided Missile

Information has been released on the Regulus, a guided missile developed by the Chance Vought Aircraft Division of United Aircraft Corporation for the Bureau of Aeronautics. The missile, about 30 feet long and resembling a conventional, swept-wing jet fighter (see inside back cover), is designed for launching from submarines, surface ships, and shore bases. Developed in 1948 and first flown in 1950, it is equipped with a tricycle landing gear for recovery after flight.

The TUNNY, a converted World War II submarine recommissioned on the West Coast on March 6, has been specifically modified to launch the Regulus. The launching equipment actually can be installed in a short time on several types of vessels at relatively low cost and with only slight modifications to the ship itself. A small group of officers and enlisted men on the TUNNY have been specially trained during the past year at the Naval Air Missile Test Center at Pt. Mugu, California, in the operation and maintenance of the missile.



Dr. O. T. Marzke

Who's Who in Naval Research

The bigger the job, the more unassuming the scientist who holds it seems a pretty close approximation to the truth. Whenever such a statement is made, we immediately think of exceptions. But Dr. Oscar Theodore Marzke—Consultant to NRL's Director of Research, Superintendent of the Metallurgy Division at NRL, and Head of the Metallurgy Branch at ONR—is not an exception. His dual affiliation with ONR and the Naval Research Laboratory is definitely enough to keep two men busy; nevertheless Dr. Marzke keeps both offices running at full speed. And it keeps Dr. Marzke running between NRL and ONR so that his time is always in demand. Dr. Marzke, who has been Head of the Metallurgy Division at NRL since 1946, was chosen as ONR branch head in 1951, not only because he was the best man for the job, but also to bring about closer coordination between the two activities. His appointment as Consultant to the Director of Research of NRL in the fields of chemistry, electricity, mechanics, and metallurgy is a recent tribute to his ability.

A native of Lansing, Michigan, Dr. Marzke received his Bachelor of Science degree in 1929 from Michigan State College. From there he went to M. I. T. for graduate work. He was working on his M. S. when it was suggested by the Head of the Metallurgy Department that he come to NRL to work under Dr. R. F. Mehl, first Superintendent of the Metallurgy Division. So, back in 1930, Dr. Marzke spent several months at NRL. The same year he decided to continue his research back at M. I. T., where he was awarded the Doctor of Science degree in 1932.

For the next 14 years Dr. Marzke was employed by the American Steel and Wire Company in Massachusetts and Illinois. Here he conducted research and development and did plant metallurgical work to meet the needs of industry. The experience gained in those years on how to improve products, lower costs, and increase yields has no doubt given him a realistic approach to the problems he faces today.

In his spare time Dr. Marzke likes to relax on the golf course or to play the piano—classical music. During his school days, however, his musical talent paid off in more than just relaxation—he worked his way through graduate school by playing the organ in churches. The Marzkes live in Arlington, Virginia, have a young daughter in elementary school and a son in high school who is also something of a musician. (SGF)

In Defense of Safety Belts

Eugene F. DuBois

. . . M. D., Emeritus Professor of Physiology at Cornell University Medical College, is a Consultant to the Cornell Crash Injury Research Project.

In 1942 the Crash Injury Research program was established at Cornell University Medical College under the auspices of the National Research Council Committee on Aviation Medicine. During World War II, the work was supported by OSRD and since then has been carried on by pooled funds from the Army, Navy, and Air Force under a contract with ONR. Directed by Hugh De Haven, the project was housed in the Department of Physiology, until my retirement as head of the department in 1950. It is now an activity of the Department of Public Health and Preventive Medicine, headed by Dr. Wilson G. Smillie. Here, it functions to establish the causes of needless and excessive injuries in aircraft and automobile accidents. Most certainly, it belongs to preventive medicine since accidents are by definition preventable.

Early in the study of survivable crashes in airplanes, it became evident that safety belts were saving many lives, if they were strong and if they were attached to strong seats. When they held in a crash, the body and legs jack-knifed forward and there was no serious injury, unless the head or legs hit something hard. In spite of previous fears, there were extraordinarily few injuries to the body from the belt itself. An extensive report on the injury potential of safety belts, based on a survey of about 500 crashes, will appear in a few months.

Of course, it was apparent that a shoulder harness in combination with a safety belt was much better than a safety belt alone. Despite evidence on this point, it has been difficult to induce passengers and civilian pilots to wear anything more elaborate than a belt. However, things were going well in the campaign to encourage the use of stronger belts and attachments in civil aircraft, until an article by Dr. Donald Teare appeared in the British Medical Journal in 1951. He had studied the injuries sustained by the victims of a Viking crash at London Airport, and stated as one of his conclusions, "The immediate cause of death in more than half of the victims was acute flexion of the body over the safety belt."

This statement was picked up by several journals, and in December, 1951, Scientific American published a short note headed "The Dangerous Safety Belt." Its opening sentence read, "When an airplane crashes, the safety belt that passengers are required to fasten around their waists, may become a deadly hazard. . . ." Apparently this item was widely read, and as a result, many passengers in America would not fasten their belts.

Obviously, it was necessary to make a careful analysis of Dr. Teare's statement. The distinguished pathologist had made autopsies on all of the 28 victims in this one disaster, and his study was the most complete and careful analysis of crash injuries ever recorded. Through the kindness of the British authorities, who have always cooperated most heartily with Cornell's Crash Injury Research, we received detailed reports of the Viking accident and of the autopsies. Our analysis appeared in the British Medical Journal in September, 1952 under the title, "Safety-Belts are Not Dangerous," but it will take a long time to reassure passengers who were frightened by the repercussions from Dr. Teare's conclusions.

This analysis starts with a review of our own and German studies on possible injuries from safety belts. In the United States it was found that early belts stressed to hold 1,000 pounds broke quite often, and now the minimum requirement is 3,000 pounds.

Cornell's Crash Injury Research has recently made a survey of 800 survivors in serious crashes in which the occupants were wearing seat belts. The belts were stronger than those in the Viking crash, most having a holding capacity of 2,000 pounds. There were 704 survivors with injuries of the head, 641 with injuries of the legs, and

Crash of National Airlines DC 6 at Elizabeth, N. J. In the center background is the top of the building struck by the plane. The wreckage of the wings, engines, and forward half of the cabin is strewn in the open field. In the foreground is the rear half of the cabin, broken in two by its impact with a large tree. Thirty-two passengers survived, 27 were killed. All but four of the strong belts held, and there was no evidence of injuries attributable to belts.

250 with injuries in the combined areas of the lumbar spine, abdomen, hips, pelvis, sacrum, and perineum. On the other hand, injuries in the region of the belt (usually bruises) were sustained by a mere 32 survivors, and evidence of intra-abdominal injury was found among only 23 of the 800 survivors. Obviously, injuries from belts played a minor part in these crashes, in which exposure to belt injury was great because the belts were strong. It is not the belt that causes injury if the body jerks forward and strikes dangerous objects in the plane. Little evidence regarding belt injury can be obtained in severe crashes when the belt or its attachments break, allowing the victim to shoot forward into a mass of wreckage.

Rear half of the cabin partially shown in picture on opposite page.

In Germany in 1941, Ruff tested men in a swing that was stopped abruptly. With a maximum snubbing effect of 2, 204 pounds (about 14 G), there was violent jack-knifing but no evidence of injury of the chest, abdomen, or spine. In fact, no ill effects resulted except in the case of one man who had a slight nausea which lasted about an hour.

The basic facts of the case upon which Dr. Teare based his conclusions were derived from the following evidence: October 31, 1950, a Viking aircraft crashed in a thick fog at London Airport. There were no witnesses; the stewardess and the one passenger who survived have no accurate recollections. Both were seated in the rear of the cabin. There were marks at the edge of the runway indicating that the craft hit the ground at an angle of about 20 degrees and a speed of 120 knots as judged from scars left by the propellers, though some estimates are as low as 80 knots. The plane bounced and then was airborne for about half a mile, possibly out of control, before it struck the edge of a concrete runway with the right wing while flying in a right-wing-low attitude. The right wing was crushed and sheared off just outboard of the engine. The right tail plane and elevator (stabilizer) were also found in this vicinity. The ship cartwheeled, bounced, or slid 350 feet, hit a pile of "asbestos-type" water pipes, and came to a stop. The aircraft caught fire, structures and bodies were badly burned, and much evidence was destroyed.

The nature of the crash has an important bearing on the causes of the injuries. The first glancing impact could have caused little strain on the belts. The second and principal crash impact on the right wing

must have thrown the passengers heavily to the right side. Dr. A. Buchanan Barbour, Chief Medical Officer of British European Airways, points out that the main force was towards the lateral aspect. The arm-rests of the chairs, being higher and more rigid than the lapstraps, may have been responsible for some of the intrathoracic, liver, and spleen injuries. It is impossible to say just when the seats broke loose, but they were stressed against almost 12 times gravity (11.7 G) in a forward direction and considerably less, approximately 5.85 G, laterally. After this second impact there was much tumbling of victims and plane contents, with a final sliding impact against the pipes. There was no great force from the belts themselves, since they had a holding capacity of only about 1,300 pounds, or about 7.6 G, when installed.

In order to find out what happened to the victims in this accident, we tabulated all the injuries found by Dr. Teare in his 28 autopsies. There were 13 fractures of the skull and 20 cases of hemorrhage in the brain or on its surface. This agrees with CIR findings that in severe crashes, head injury is the most frequent type of fatal lesion. There were 7 fractures of the spine, and 17 out of the 28 had fractured ribs with a total of 155 fractures. The lungs showed injuries in all but 5 victims; there were many cases of rupture of the liver, kidneys, and spleen, many fractures of the extremities and 8 of the pelvis. In sharp contrast to the great damage to the upper two-thirds of the torso, there was no report of injury to the stomach, intestines, or pelvic contents. Here then is the picture of the type of destruction found when bodies break loose from their seats and are hurled forward.

Dr. Teare was much impressed by the fact that there were 7 cases of rupture of the aorta, a lesion which in his large experience had been encountered in only three other autopsies, 2 in traffic accidents, one in an airplane. The aorta is a large tough artery which, as it arches upward, is suspended in the upper thorax. It curves backwards and then lies in close proximity to the spine. Inasmuch as there were many fractures near the arch of the aorta, it would seem natural to ascribe the ruptures to punctures or crushing force in the upper third of the body. The lap belt force is applied at a much lower level.

In analyzing Dr. Teare's findings, we were fortunate in securing help from Dr. Milton Helpern, Deputy Chief Medical Examiner for the City of New York. In his experience, rupture of the aorta is quite common in automobile accidents and falls from heights. For example, in New York in the year 1950, there were 15 victims of automobile accidents and 3 victims of falls in whom rupture of the aorta was given as a cause of death, to say nothing of many more cases in which it accompanied other multiple causes of death.

The evidence indicates that in the Viking crash, the safety belts were stressed to tolerate relatively low G forces, and that they gave way too easily to exert much force on the abdomen. There is no evidence that any of the injuries were due to the direct effect of the belts. Our own evidence in severe crashes, where much stronger safety belts were used, indicates that injuries of the abdomen are insignificant in contrast to the protection afforded. It must be remembered, however, that a safety belt does little to stop the velocity of the head, which can fly forward and strike a hard, dangerous object, if the plane designer has placed such objects within range.

On the Naval Research Reserve

Program Officers' Conference

Pictured above, with officers of ONR Washington, are the Program Officers of the Naval Research Reserve Program who attended a three-day conference in Washington, on 24, 25, and 26 March. From far left to right and around the table are: CDR F. L. Edmondson, Director of the Research Reserve Program; CAPT C. G. Grimes, Deputy and Assistant Chief of Naval Research; RADM C. M. Bolster, Chief of Naval Research; CAPT A. B. Cook, Director of Military Services Division; CDR H. Wray Rohrman, ONR Branch Office, Boston; LCDR W. L. Robison, ONR Branch Office, Chicago; CDR Joseph H. Graham, ONR Branch Office, San Francisco; LCDR E. S. Churchill, Washington Training Officer; and LCDR Walter P. Warren, Southeastern Area Program Officer. Others who attended the conference but are not shown in the picture were: LCDR George R. Rae, ONR Branch Office, New York, and LCDR Raymond R. Nicolay, ONR Branch Office, Pasadena.

RADM Bolster greeted the officers, and further opening remarks were made by CAPT Grimes and CAPT Cook. CDR Edmondson was general chairman. Among the subjects discussed were the Armed Forces Reserve Act, recent changes in the mission of the Research Reserve Program, training duty, seminars, the Inactive Status List, and the uses of Research Reserve personnel in time of mobilization.

One of the highlights of the program was the presentation of a plan for carrying out projects in the Research Reserve companies. The need for help from the Research Reserve, in the form of projects, training duty, etc., was outlined by CAPT Gilbert and LCDR Finley from the Office of the Chief of Naval Operations, and by CAPT Williamson and

Dr. Dailey from the Research Division of the Bureau of Naval Personnel.

All officers in attendance at the conference agreed that it was a very successful meeting which would be beneficial to the whole Program.

Psychological Warfare Course Begins

The first meeting of the Psychological Warfare Course was held Wednesday, 1 April, at San Pedro, Calif. with approximately 85 present. Dr. Raymond B. Allen, Chancellor of U. C. L. A. and former Director of the National Psychological Strategy Board, did his customary excellent job in addressing the group on "The Total Problem of Psychological Warfare." Interest was very high and there was considerable participation by the audience in the discussion period.

Atlanta Company 6-1 Has Interesting Tour

On 5 March the members of Naval Research Reserve Company 6-1 (Atlanta) were guests of the Southern Bell Telegraph and Telephone Company in Atlanta. The program, which was called one of the most interesting of the current year, consisted of a lecture demonstration and a tour of the Eastern Air Lines 81-C-1 Teletypewriter Switching System at the Municipal Airport.

Reservist Writes Book

Congratulations are due LT Rollin H. Baker, NRRC 9-20 (Lawrence, Kansas) whose book has just come out on The Avifauna of Micronesia, Its Origin, Evolution, and Distribution. The publisher is the University of Kansas Publications.

LT Stallings Travels 168 Miles to Meetings

We learn from his letter of 9 February 1953 that LT James C. Stallings, NRRC 8-4 (Houston, Texas) travels 168 miles roundtrip every two weeks to his Company meetings! LT Stallings, who is Professor of Organic Chemistry at Sam Houston State College in Huntsville, Texas, says:

"I am not offering myself as an example of any sort, but merely to back up such 'doings' of the Navy, which I feel are necessary for its continued growth. While being a sea-going 'sailor' during World War II, doing a bit of a turn in the Pacific on an APA, I now feel that my

profession is more advantageous to the Navy in our present program. I, of course, would rather not go back to sea again, but certainly I am not considering myself 'too good' for such tasks.

" More power and growth to the Office of Naval Research. No progress of the sea-going Navy is possible without some type of ' braintrust ' like this."

New Company in Washington

A new Naval Reserve Research Company staffed by Reserve Officers primarily qualified in the field of aviation electronics was added to the ranks of the Research Reserve when the Commandant of the Potomac River Naval Command authorized the activation of NRRC 2-6 as a component of Research Batallion W-1. The effective activation date of the Company was 5 March 1953. At the first official meeting on 17 March, CDR F. L. Edmondson, USNR, Director of the Research Reserves and CAPT F. C. Wiesner, USNR Commanding Officer of Research Batallion W-1, were present to assist the new Company in getting underway.

CAPT F. G. Kear, USNR

CAPT F. G. Kear, USNR, is the Commanding Officer of the new Company which is meeting twice a month at the Office of Naval Research, Building T-3, 17th & Pennsylvania Avenue, Washington, D. C. A program has been established emphasizing the preparation of reports and recommendations on projects as assigned by the Office of Naval Research.

CAPT Kear is a member of the firm of Kear and Kennedy, Washington. He received his degree of Doctor of Science in Electrical Engineering from M.I.T. in 1933. His major was electronics, and he has had extensive experience both military and civilian in this field.

ONR Washington Seminar

Applications are now being accepted for the ONR Washington Seminar, which begins 14 June (prior to 1800) and continues through 27 June (0800) 1953. Officers are directed to report to BOQ Receiving Station, Anacostia, D. C. for logging in at 0800, 15 June.

Promotions to Lieutenant Commander

Promotions to Lieutenant Commander have been announced as follows:

CORPS	1 April 1951 Naval Reserve Register Number of Junior Officer in Zone	Convening Date
LINE	58915	10 March 1953
MC	1722	10 March 1953
SC	5071	10 March 1953
CHC	675	10 March 1953
CEC	1986	10 March 1953
DC	1695	10 March 1953
MSC	421	10 March 1953

Listed below in alphabetical order are the officers of the Medical Service Corps who are included in the promotion:

File No.	Name	Company
228328	Rollin H. BAKER	9-20
353235	Harvey J. CARLSON	12-1
353681	Hamblin H. CROWELL	13-5
259741	Perry T. CUPPS	12-6
152659	Seton N. EDSON	6-4
247720	Edwin GUD	4-9
234940	Robert W. HARRISON	1-2
281969	Erwin P. VOLLMER	W-5
228927	Ralph C. WANDS	9-6

Battle Fatigue Studied in Korea

Five members of NRRC 12-5 (University of California, Berkeley) were placed on active duty last fall to go to Korea with Army and civilian scientists to study the effects of battle fatigue. LCDR Nello Pace headed the team, and the other Naval Reservists were: LTJG Muriel E. Johnston, LTJG Elaine L. Walker, LT Frederick Schaffer and LT John H. Kilbuck. The project was set up by the Army's Operations Research Office of Johns Hopkins University. The physical and psychological tests were the first to be made under front-line conditions by Americans, and should produce some interesting results.

The 40-odd tests, the first to be made under frontline conditions by Americans, were given to 106 infantrymen of the Seventh Division. They were both physical and psychological and included use of radio-active isotopes for tracing the movements of fluids through the body.

U. S. GOVERNMENT PRINTING OFFICE : O—1953