• MAY 1949

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RESEARCH REVIEWS

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- MALINGERING ON PERSONALITY TESTS
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- ON THE NAVAL RESEARCH RESERVE

OFFICE OF NAVAL RESEARCH
DEPARTMENT OF THE NAVY
WASHINGTON, D. C.

NAVEXOS P-510

COVER PHOTO: Pilot equipment used for blood pressure recording during surgical operations. Equipment developed later is much less bulky. The photograph shows the way in which the equipment is bound to the arm, while only the small catheter penetrates the artery. This equipment was an unanticipated development of a project to study "Physiological reactions to stresses imposed by high-speed aircraft."

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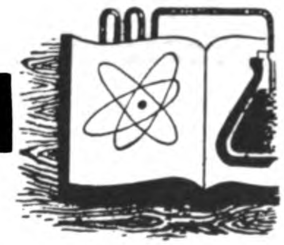
RESEARCH REVIEWS



● *Informs the Fleet of ONR-sponsored Research*

Editorial Notes

The expansion and reorganization of the Research Group of the Office of Naval Research on 1 April 1949 represents a program expansion that has been going on since the establishment in 1945 of the Office of Research and Inventions (now the Office of Naval Research).

The small staff that had been working for the Navy's Coordinator of Research and Development formed the nucleus of what is currently called the Research Group. This Group is responsible for the study and knowledge of research, for the coordination of research throughout the Department of the Navy, and for the technical direction of research contracts.

In the early stages of the development of the organization, to carry out these tasks, the work was divided among units formed according to fields of science and units established to meet Naval requirements. This pattern remains today. The earliest formal organization was divided into eight parts -- Medicine; Physics; Chemistry and Mathematics including Ordnance; Mechanics and Materials; Electronics; Propulsion; Flight; and Guided Missiles. These titles indicate emphasis at that time. As problems changed units were changed or new ones created. As more contracts were written and the program enlarged, the organization expanded accordingly.

A measure of this expansion is the increase from about 400 research contracts in 1947 to about 1000 in 1949, and rising annual expenditures from about $1,000,000 in fiscal 1946 to about $7,000,000 in fiscal 1947, to approximately $23,000,000 in fiscal 1948, and an estimated $30,000,000 in fiscal 1949.

During 1946 Chemistry and Mathematics were split apart, Nuclear Physics and Geophysics added, and units added for Naval activities in the areas of Armament, Amphibious, and Undersea Warfare.

Significant expansion occurred in the Medical Sciences in 1947-1948. This unit was subdivided into Physiology, Biochemistry, Microbiology, Psychophysiology, Psychology, Human Ecology, Biophysics, and Dental.

The current reorganization of the Research Group reflects the emphasis which is being placed by the National Military Establishment on research in geography, applied mathematics, and human resources. This emphasis is reflected in the newly established Earth Sciences Division, the Computers and Logistics Branches within the Mathematical Sciences Division, and a Human Resources Division containing branches for Human Relations, Psychophysiology, and Manpower.

The organization chart on the inside of the back cover shows the present organization of the Research Group.

Letters

USS TIRU (SS-416)

From: The Commanding Officer
To: Chief of Naval Research
Via: Commander Submarine Force, U. S. Pacific Fleet

"The Research Reviews pamphlet has proven to be one of the most popular and interesting pamphlets on board this vessel. At present it has been restricted to use in the officers' wardroom due to the fact that one copy is insufficient for both officers and chief petty officers. It is strongly recommended that one additional copy be provided for use by responsible petty officers. This is considered justified in view of the fact that the Navy, and particularly the undersea warfare branch is becoming more and more technical and scientific-minded. Petty officers who now assist ships' officers in performing the various technical jobs at sea are sorely in need of some type of basic training in the new problems associated with undersea warfare. The Research Reviews pamphlet is an inexpensive and simple means of attaining this end.

".... As a former member of the Office of Naval Research, the writer is strongly convinced that the individual ships at sea should be kept informed and interested in research trends. By this means, the various recommendations originating in forces afloat will be better coordinated with current trends and the Navy and the nation will receive optimum benefit."

C. N. G. Hendrix

From: Commander Submarine Force, U. S. Pacific Fleet
To: Chief of Naval Research

".... This Command agrees with the Commanding Officer of the USS TIRU (SS416) on the popularity and interest in Research Reviews and considers that publication to be a valuable contribution to the program of keeping personnel informed and hence interested in current research problems that affect the Navy...."

E. E. Yeomans
Chief of Staff

The Editors thank the Commander Submarine Force, U. S. Pacific Fleet, and the Commanding Officer of the USS TIRU for their encouraging comments regarding Research Reviews.

The number of copies of Research Reviews sent to each ship was increased from one to two, beginning with the April 1949 issue.

The Editors

STRONGER ORDNANCE MATERIALS

A. W. McReynolds
Institute for the Study of Metals
University of Chicago

Ordnance structures are rarely made of the strongest obtainable steel. This loss of potential strength, or alternately, the resulting excess weight for a given strength, arises solely from fear of fracture. An increase in resistance to plastic deformation is almost invariably associated with an increase in susceptibility to brittle fracture, and ordnance engineers are rightly reluctant to increase this susceptibility. Once the mechanism of fracture is understood, however, this susceptibility to fracture may be controlled, thereby allowing the use of stronger metallic components.

Once a sizable crack has started, it propagates simply under its own stress concentration. The mystery of fracture lies in its initiation. Some twenty-five years ago Griffith presented his classic study of the fracture of amorphous materials, and demonstrated that in such materials, fracture always started from small micro-cracks, which were present before any stress was applied. By controlling the size of these micro-cracks he was able to raise the fracture stress in glass to as high as 1,000,000 lb/in.^{2} Recent experiments at the National Bureau of Standards indicate, however, that in metals the crack nuclei are not initially present, but are actually introduced by plastic deformation itself. No matter how severe the conditions of stressing are made, such as by introducing triaxial tensile stresses and by lowering the temperature, some plastic deformation, of the order of magnitude of one percent, always precedes fracture.

The method by which plastic deformation initiates fracture is not difficult to understand in a qualitative way. It has long been known that plastic deformation is highly heterogeneous, deformation at any one instant being confined to highly localized regions known as slip bands. Each slip band propagates under the stress concentration existing at its advancing spearhead. If for some reason this spearhead encounters material which cannot undergo plastic deformation, then the stress concentration may build up to such high values as to initiate a small crack, which can then grow under its own stress concentration. This process is illustrated in Fig. 1.

From the foregoing it is clear that the problem of fracture may be resolved into the problem of the heterogeneous nature of deformation, and that any insight gained as to the mechanics of heterogeneous deformation will ultimately be reflected in ordnance material of increased strength. The present article describes a study which is being made of heterogeneous deformation in aluminum and aluminum alloys.

A. W. McReynolds, Research Associate in physics, Institute for the Study of Metals, University of Chicago, received his B. A. and M. A. degrees from Rice Institute, and his Ph.D. from the University of California (1945). During 1941-45 he was on active duty in the Navy with the U. S. Naval Proving Ground Experimental Department, and in 1946 he was Assistant to the Technical Director of Operation Crossroads.

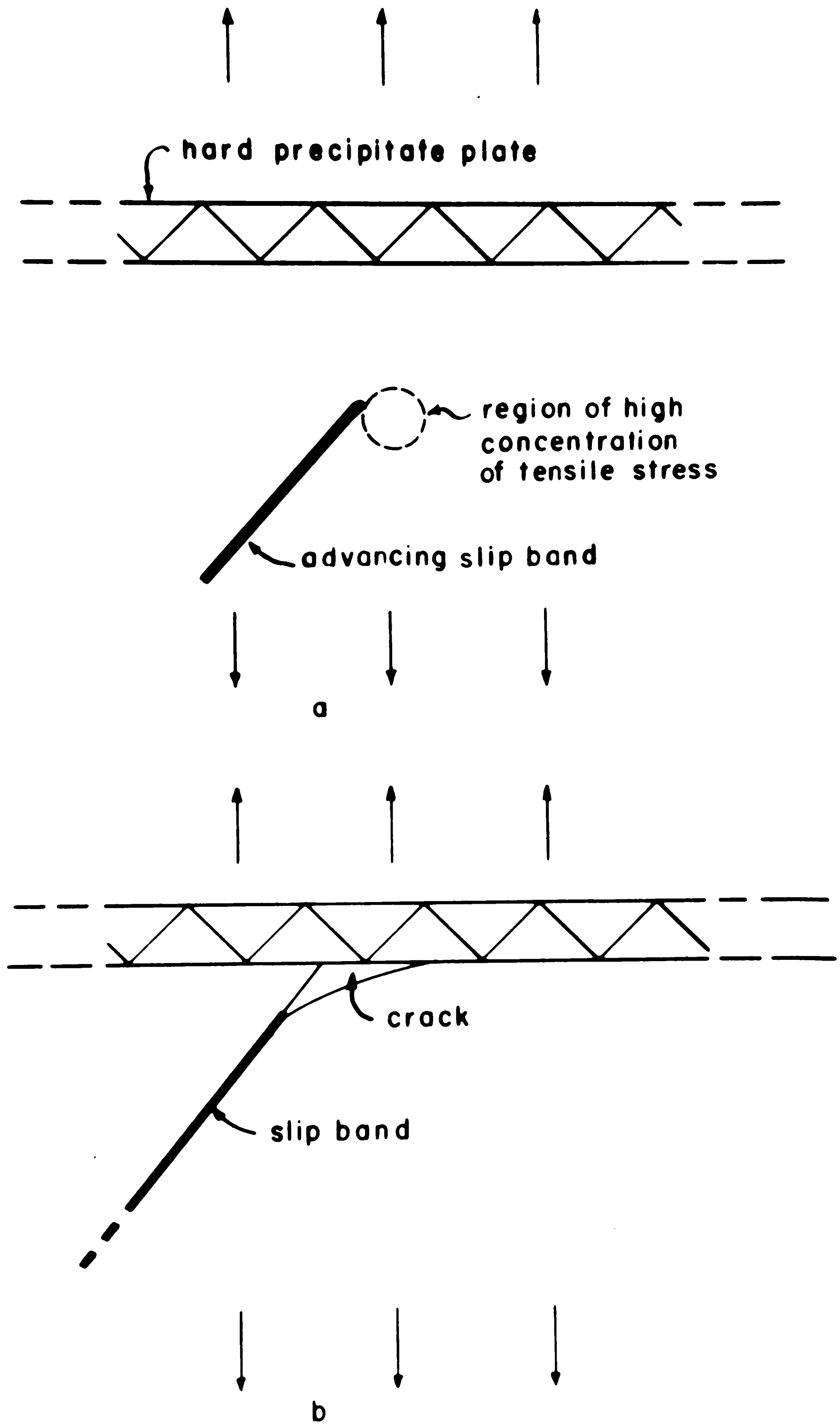


Fig. 1. Illustration of the way in which a slip band may initiate a crack upon striking a precipitate plate.

Although plastic deformation, viewed on a microscopic scale, is heterogeneous, this property is not usually apparent from macroscopic measurements. When increasing stress is applied to a test specimen and the changing distance between two points measured even to one part per million, the resulting stress-strain curve is found to be smooth. The large number of independent small slips, which occur on different planes, are too small to be individually observable but add up to a smooth curve. (See Fig. 2.) This is not surprising, since most metals are made up of very small crystallites, or "grains," and each slip is confined to a single grain.

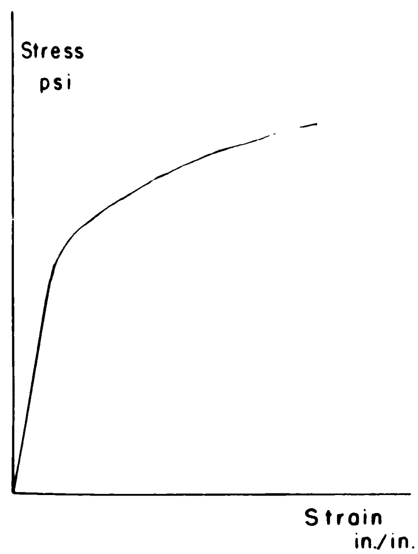


Fig. 2. Normal stress-strain curve.

The original objective of the present study was to examine the effects of various parameters on the portion of the stress--strain curve where plastic deformation is first initiated. To gain precise results, two important changes were made in the tensile testing procedure. The accuracy of strain measurement was increased to detect strains of 10^{-6} by cementing resistance wire-strain gages directly to the specimen and making a continuous record of their response. Also the tensile specimens were deformed by increasing stress at a constant rate, rather than by the more usual method of constant strain rate. Under such conditions, which are actually nearer to the conditions of metal structures in practice, a sudden yielding of the specimen can not relieve the stress.

The stress-strain curve obtained on polycrystalline commercial aluminum was found to be of a quite unexpected type. Instead of being smooth as had been previously observed, it took the shape of a staircase. (See Fig. 3.) That is, the specimen would suddenly yield and stretch about 0.05 percent within a few seconds, then cease to flow plastically for several minutes until another step occurred. On consideration of this phenomenon it seems improbable that it could be accounted for as single localized slip bands on which a large amount of deformation occurs. Such slip bands would have no effect on the remainder of the specimen and deformation would continue between their occurrence.

To investigate the size of the region in which the deformation occurred, several gages were placed at different points along the length of the specimen. (See Fig. 4.) Their records showed, according to expectation, that deformation occurred almost simultaneously at all points, or, more exactly, it occurred in rapid succession along the line of gages. It was thus demonstrated that each step corresponds to the propagation of a plastic wave through the entire specimen, strain hardening it so that no further flow occurs until arrival of the next plastic wave.

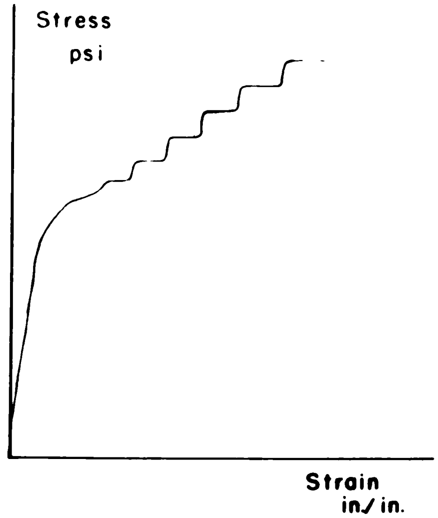


Fig. 3. Stepped stress-strain curve.

To gain insight into the nature of the phenomenon a systematic investigation was made of the effects of such physical parameters as type of metal, size of grains, amount of alloying elements, temperature of test, and rate of stress application. Results revealed that the effect is quite dependent on small amounts of alloying elements. For example, it was not observed in 99.99 percent pure aluminum but reappeared on addition of only 0.025 percent copper. It is not limited to fine grained metals but occurred even in single-crystal specimens. Perhaps most enlightening is the observation that the st: ess-strain curve becomes smooth again in tests conducted below -50°C and above about 100°C, depending on the alloy used.

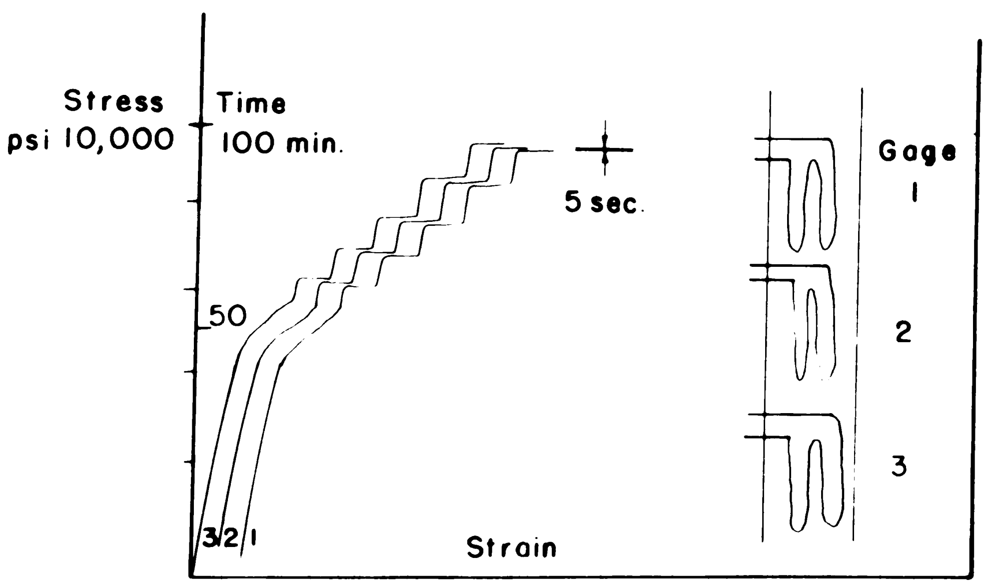
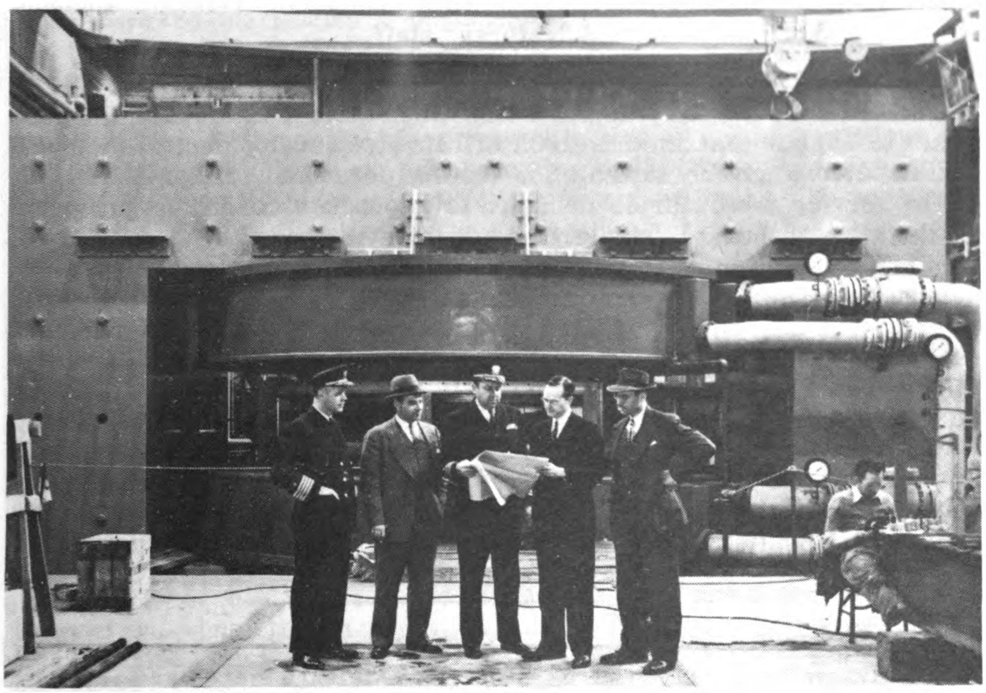


Fig. 4. Simultaneous records of three gages. (Curves are displaced horizontally for legibility.)

Although the detailed mechanism of the effect is not yet definitely established, these observations of temperature dependence can be interpreted qualitatively. Appearance of the steps apparently is a consequence of the hardening effect of the atoms of the alloying element in the lattice and must require diffusion of the atoms subsequent to each step. The diffusion coefficient of atoms in a solid decreases quite rapidly with temperature. Thus at low temperatures the atoms move too slowly to accomplish the hardening. At higher temperatures the effect is probably limited, not by diffusion rates, but by the fact that the impurity atoms no longer have the capacity to strengthen the lattice enough to prevent continuous plastic flow.

The type of deformation described differs from the more usual type in that it is heterogeneous on a macroscopic as well as microscopic scale. That is, the individual slips, although probably still individually small, no longer add at random but are mechanically coupled. Thus deformation may be thought of as starting in a single grain as a single slip band, which, however, initiates one or more slip bands in adjacent grains, until the deformation propagates through the specimen as an advancing wave of small slips. It is to be expected that this type of deformation wave is not limited to aluminum and brass, in which it has been observed, but will also be found in many other metals under appropriate conditions of factors such as temperature and alloy content.

Synchrocyclotron



A visit to Columbia University's 400,000,000-volt synchrocyclotron. Left to right: Capt. F. B. Eggers, USN, Commanding Officer of the N. Y. Branch Office of ONR; Dr. J. R. Dunning, Chief Investigator of the cyclotron project, ONR contract N6-ori-110, Task I; Capt. W. H. Leahy, USN, Assistant Chief for Research, ONR; Dr. E. T. Booth, Jr., Executive Director of the cyclotron project; and Mr. Irving Rowe of the scientific staff of the N. Y. Branch Office.

NEW METHODS OF MEASURING BLOOD FLOW AND PRESSURE

H. C. Bazett
University of Pennsylvania

There is often much discussion as to the relative merits of applied and basic research. The mere existence of such discussion indicates a lack of appreciation of the real character of research. Knowledge is knowledge, whether practically applicable or not. Applicability is a mere detail of secondary importance. Knowledge is none the worse because it happens to be useful, nor is it any less important because it happens for the moment to be useless. Applied research may at any time uncover information of real fundamental value. "Pure" research, so called, may at any time become impure by proving to be immediately useful.

The writer after the war accepted a contract to do research for the Navy on "physiological reactions to stresses imposed by high-speed aircraft." A moment's thought will impress the reader with the folly of attempting this problem in the academic atmosphere of a medical school, far removed from any aircraft, particularly those of high speed. The folly appears even greater because the work was planned to be undertaken in intervals between teaching heavy classes of "veteran" students with the aid of inexperienced "veteran" staff.

However, the folly appears less when a rider is found in the contract to explain that the research will involve development of methods, which later might be suitable for testing personnel, either in aircraft or in service laboratories designed to reproduce conditions prevalent in the air. Elaborate, stable, and accurate methods are needed to investigate conditions in man when travelling in a high-speed aircraft at hundreds of miles an hour, turning at speeds giving high centrifugal forces, and developing high temperatures in its walls as the result of frictional contact with the air or other causes. Such methods must therefore be established experimentally on the ground. They are likely also to prove extremely valuable for investigation in normal physiology and in the study of disease in man. As the methods are first developed, they are elaborate, but not stable or accurate. Only after they have been put to use, so that the "bugs" in them have been discovered and eradicated, do they attain a greater perfection. How better can such methods

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H. C. Bazett, professor of physiology since 1921 at the University of Pennsylvania, has served as consultant to the Office of Quartermaster General, and as a member of the British Medical Research Committee. The work he describes in this article is that of a group, two of which should be especially mentioned. L. H. Peterson and H. E. Tompkins assisted in the development of the manometer, while studying for their Ph.D. degrees at the University of Pennsylvania. Also credit should be given to Dr. I. Ravdin, professor of surgery, and Dr. R. D. Dripps, associate professor of anesthesiology in surgery, both of whom have been responsible for much of the work done in applying the manometer technique to the operating room.

be tested and perfected, than by being applied to the solution of those fundamental problems in the laboratory that urgently need elucidation?

Thus reasonable exploration in a definite field of applied research leads to a general and fundamental study of scientific principles and techniques, with practical application quite probably being made first of all in a field far removed from the primary objective of the work. It is a pleasure to be able to state that those responsible for the administration of naval medical research fully appreciated this point of view, and have throughout administered their funds according to such principles. In the personal experience of the writer, no administrators of research funds have conducted their administration with more liberal wisdom than have those in ONR. Consequently, it is possible to describe work undertaken to develop tools for the examination of air crew, in which no experiments have been concerned even remotely with aircraft.

The environment of a pilot in action, particularly in service aircraft, becomes more dangerous, more uncomfortable and more frightening. Consistently, the limitations of aircraft are determined more and more by the limitations of the pilot, rather than by those of the mechanical equipment. One of the great stresses imposed by high-speed aircraft depends on the effect of high accelerations, positive or negative, linear, angular, or centrifugal, on the blood in circulation. Centrifugal force may send blood to the feet instead of to the head and so cause visual "black-out" or even unconsciousness, or it may prevent the return of blood from the peripheral areas below the chest to the heart. In the latter case the heart pump is inadequately filled, and the whole circulation fails; again loss of consciousness is the most prominent symptom. The relative importance of these two factors in the genesis of symptoms has been much discussed, with little doubt that both are involved. Experimental methods are therefore needed to measure such conditions so that quantitative analysis can be made. One would like to know the exact blood pressures in vessels in different areas, as well as, if possible, the amount of blood expelled by the heart with each beat.

Measurement of Blood Pressures

Blood pressure in man is commonly measured, as readers of this article know, by impeding the circulation to the arm with an inflatable arm band. When pressure in the band exceeds that of the vessels, the latter are compressed and circulation ceases. Such a method is not applicable for the study of rapidly changing pressures, nor could it be used readily in a high-speed aircraft, nor even for an individual being whirled in a human centrifuge. Consequently, more direct methods have been developed in which the artery is connected by a tube with a pressure recorder. One method, developed especially at the Mayo Foundation, consists of a connection through a moderately large hypodermic needle to a "strain gauge" of a type familiar to aeronautical engineers. This method improves the scientific situation, though it does not permit accurate measurement of changes of less than 4/100 second. It does not provide great comfort to the aviator, since the insertion of a large sharp needle in a blood vessel does not add to the amenities of life, particularly in a centrifuge or high-speed aircraft under high centrifugal forces.

Consequently, in our own laboratory much attention has been paid to improving this situation. An electrical manometer was designed by

Dr. J. C. Lilly, when a student in 1941, for just this kind of problem. The pressure of the blood bends a metal membrane forcing it nearer to a second metallic plate. The two plates form an electrical condenser, and the change in the electrical capacity is used to measure the pressure. The actual movement of the plate can be infinitesimal, since the original gap is only about 1/1000 inch, so that any measurable movement implies a large percentage change in the gap. Consequently a fluid movement of 1/10,000 of a drop is able to cover the whole gamut of blood-pressure variations in man. The small volume displacements allow connections between the artery and pressure recorder to be reduced to a small flexible plastic tube of only some 0.024-inch external diameter, with a bore of only 0.008 inch. The tube can be introduced into an artery through a very small needle, which can then be removed so that nothing stiff or sharp is left in the vessel. The wearer is limited only by the wire cable connecting him to writing instruments, and he can move about, step up and down on a chair, or ride a bicycle, while records of all the pressure changes continue to be made. This system may not seem ideal to the wearer, but it is a great improvement over a large, stiff, and sharp needle.

Thus an improved method has been elaborated, mainly as the result of painstaking work by two senior students, L. H. Peterson in physiology and H. Tompkins in electrical engineering. Immediately the method was used to record blood pressures in patients undergoing severe operations. It has been used in hundreds of patients, has provided precise information, saving lives and allowing operations to be undertaken successfully, which would otherwise not have been attempted. The method is as yet neither sufficiently simple nor stable, yet such use is rapidly extirpating the "bugs," so that soon it may be only necessary to rebuild it in a form rigid enough to withstand high centrifugal forces. The growth from elaboration to stabilization and standardization is well on its way and commercial production of suitable instruments is just around the corner.

The cover photograph shows the general character of this early pilot equipment as used in an operating room on a patient. Equipment developed later is much less bulky. The photograph shows how the equipment is bound to the arm while only the small catheter penetrates the artery.

Fig. 5 illustrates the kind of record obtained during an operation. The great fall in pressure accompanying the manipulation of the liver is obvious. This operation was one which would not have been attempted without such records as an aid. The knowledge thus obtained contributed considerably to the successful outcome of a very dangerous operation.

Measurement of Blood Flow

Measuring the stroke of the heart is much more difficult. The normal method of measuring blood flow is the determination of the carrying capacity of the flowing blood for oxygen or carbon dioxide. Many methods have been used, but all are now distrusted, except one which relies on a catheter, some two or three feet long and about 1/8 inch in diameter, passed along the veins into the right heart, through which the mixed blood in the heart may be sampled. Thus the difference

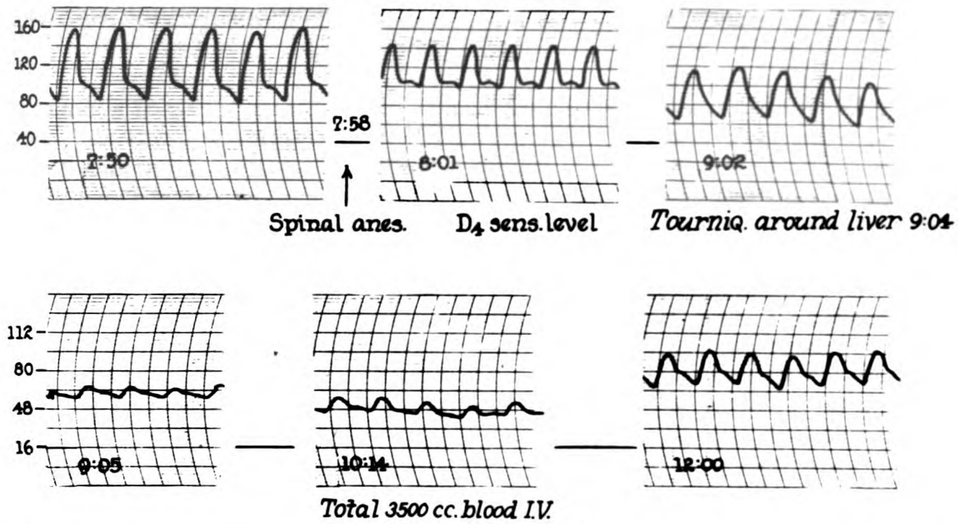


Fig. 5. Blood pressure records from a patient as follows: Brachial artery tracings from a female 45 years of age, about to undergo operation for partial removal of the liver. 7:50, preanesthetic pulse. This patient had an oral temperature of 101-1/2° F. and was receiving chemotherapy and penicillin preoperatively. 7:58, pontocaine hydrochloride, 12 mg given subdurally. No pressor drug. 8:01, the base line in this section is at the bottom of the paper, whereas the base line of all other tracings are 5 mm from the bottom. The first scale of pressure holds for upper three tracings, and the second for the lower. Thus the diastolic pressure is 80 mm Hg, and systolic pressure is 124 mm Hg. Abolition of pin prick sensation at D_4. 8:05, patient wheeled into operating room; 9:02, prior to this tracing, the pressure level had fallen and methedrine had been given; 9:04, tourniquet placed around liver and tightened thirty seconds later. The pressure fell from 130 systolic and 100 diastolic to that seen in the 9:05 tracings. 10:14, 3500 cc blood had been given intravenously. 12:00, end of operation.

in oxygen content of the venous and arterial blood can be measured. If the oxygen consumption is known, the blood flow can be deduced. This is not a method applicable to men in airplanes. However, the tiny catheters used for measuring blood pressure could also be used to remove blood, for they are resistant to wetting and blood does not readily clot within them. These small catheters could be introduced through needle holes, but could only remove minute quantities of blood. Adaptation of this method is being attempted to obtain adequate analyses on much smaller quantities of blood. Even so, the method could not be made capable of measuring rapid changes in flow, such as those accompanying centrifugal stresses, for determinations could only be made in periods lasting many minutes. Nevertheless, the attempt goes on, for small catheters could be left in place even during violent maneuvers, and even inadequate information would be better than none.

Other methods of measuring blood flow and cardiac output are unsatisfactory for the most part and hence discarded. Some of these also are being further explored, one with considerable promise of success. Should success be attained a method would be provided for studies of the normal subject and of heart disease. While this method does not offer promise of being valuable for study in the air, it may permit conditions to be understood, even if they cannot be analyzed. These investigations of the circulation are backed not only by a Navy contract, but also fostered by funds made available by the Life Insurance Research Fund.

Advances in any field are likely to affect other areas of research. During the war protection of aviators' hands against cold had been a great problem, since gloves were usually inadequate. Questions arose as to the degree of cooling that takes place in blood, as it flows down the arm to the hands. If the heat loss here was great, it would seem that great benefit might be derived from better protection of the arms. Studies were made by the research staff working at the University of Pennsylvania and at the Quartermaster's laboratory at Lawrence, Mass., on the actual cooling that occurred in the arteries in the arms. It was found that even in moderately cold conditions arterial blood at the wrist might be 27°F or more below the levels commonly considered blood temperature. These studies could be made only with difficulty, since the needle thermocouples used for measurement could not remain indefinitely in the arteries and veins.

Development of the small catheters for measuring blood pressure revolutionized this work. Thermocouple wire could be inserted within fine catheters and these could then be threaded into blood vessels, and be left in place for hours. The blood vessels provided ready paths through which such catheters might be threaded to reach otherwise inaccessible places. They could be passed from the groin up veins or arteries for distances of 10 inches or more, until they lay in the abdominal aorta or inferior vena cava. They have been placed also in the large bulb of the jugular vein as it leaves the base of the skull carrying blood back from the hypothalamic centers, in which the center controlling body temperature is situated. Thus a whole new exploratory field is opened up. Thermocouples of this type are illustrated in Fig. 6, which represents an x-ray of two such couples in place in vessels in the arm, one nearest to the surface in a large arm vein and the other in the brachial artery. The position of the latter is similar to those of the plastic tubes used for obtaining blood pressure records as shown in Fig. 5. The thermocouple, however, has been introduced a longer distance.

This field of exploration of thermal gradients and levels of blood temperature proved the easiest application of the small catheter technique, but one of the most fruitful. Not only was the common concept of a single, more or less uniform, blood temperature demonstrated to be a myth, but also the idea that blood cooled in transit down the arm because of exposure to cold on the surface of the arm was shown to be erroneous. The main factor cooling the blood in its flow down the arm is the return of cooled blood in adjacent veins; the main cause of the cooling is the exposure of the hand, not the arm, to cold. Thus arterial temperature is most affected by the temperature of the skin distal, not central, to the point of measurement.

The advantage of such an arrangement is quite simple; it is merely a duplication in reverse of a principle commonly used in water stills. The water leaving the still is cooled in a condenser and the water used for cooling is also used to supply water to the still for distillation. Thus heat is economized, since some of the waste heat of condensation is salvaged. Under cold conditions the body needs to supply the hands or feet with blood carrying oxygen, and it is not necessary for this blood

Fig. 6. X-rays of thermo-couples in the upper arm in man.

to be at body heat. The blood is therefore cooled by the blood returning from the extremity, and thereby the returning venous blood is warmed. The precooled arterial blood loses less heat in its later passage, and its earlier cooling is attained by a simple internal exchange. Obviously such a system ceases to be efficient in a tropical climate, when the individual has to lose all the heat he can. Under such circumstances blood is returned along superficial veins, far away from the arteries, and the precooling is avoided. A whole new field awaits investigation, since the mechanisms, by which this shift in paths is accomplished and regulated, as yet have not been investigated or described.

Older theories of temperature control are probably correct, but they are based on poor experimental evidence and inaccurate assumptions. The whole field needs to be recharted. There is no likelihood that these newer techniques will be of value in estimating thermal stresses in the air. There is, however, every probability that a clearer understanding of the basic principles will clarify also the practical problems. In any case the basic situation is now fluid. Much interesting work remains to be done in this field, where improvements in basic information have grown from research in applied physiology.

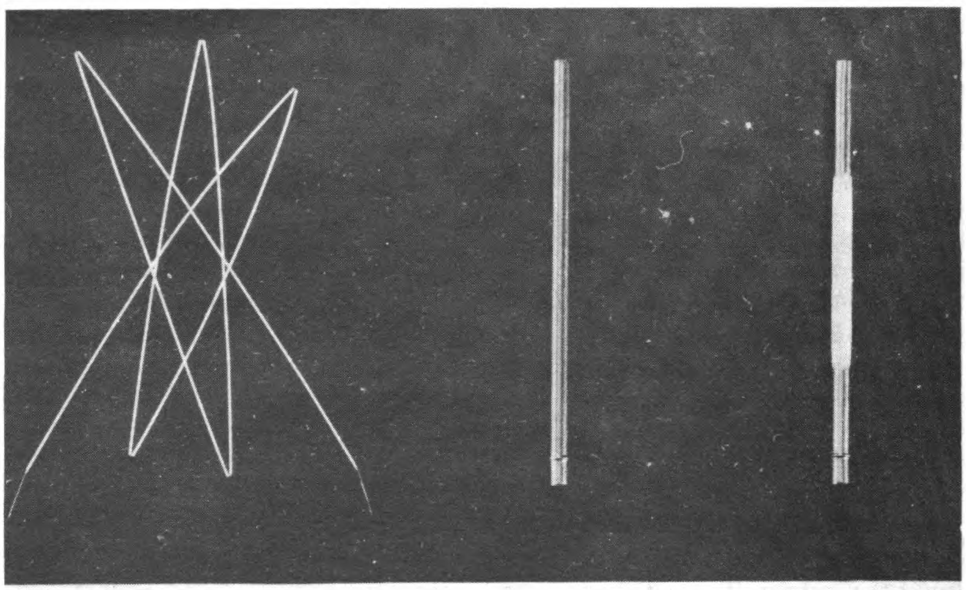
IMPURITIES INFLUENCE CATHODE EMISSION

James Cardell
Raytheon Manufacturing Company

When enclosed in a partially or wholly evacuated structure, a heated body will lose negative electrons through evaporation. This process is called thermionic emission and the heated body is then an emitter.

In the radio tube industry there are many different types of emitters but the one most commonly used is composed of three essential parts which we shall describe briefly.

First, there is the so-called "heater" which is a length of tungsten wire coated with fused aluminum oxide or alundum. This coating insulates the wire so that it can be pressed together and inserted into the top of the cylinder shown in Fig. 7. The insulation serves to keep the



HEATER CATHODE CYLINDER COATED CYLINDER

Fig. 7. Three parts of emitter.

James Cardell is an engineer with the Chemical and Metallurgical Department of the Raytheon Manufacturing Company. His activities have been in the field of materials used in radio tube construction. He received his A. B. degree from Middlebury College in 1918. Associated with him in the work described in this article are M. L. Anderson, R. L. McCormack, G. Szekely, M. H. McDonald, and chief consultant to the group is Dr. W. B. Nottingham, Department of Physics, Massachusetts Institute of Technology.

wire from short circuiting the heating current on itself, and also separates the wire electrically from the cathode cylinder. The electric current passing through the total length of the wire will heat the metal sleeve just as one would heat a pan over an electric hot plate.

Over this heater a nickel cylinder is fitted. This cylinder is to be the cathode of the radio tube and must be very thin walled and of definite dimensions depending upon the electrical characteristics that will be required of the finished assembly. This sleeve serves several purposes. It supports the heater assembly, provides a surface for the coating, and also furnishes metallic agents which must be available in order to activate the coating which in turn furnishes the negative electrons.

The coating on the nickel sleeve is the third component of the emitter. This coating is composed of the white, crystalline powders of barium (60%) and strontium (40%) carbonates. The powder is applied as a spray and must be controlled as to its weight, density, and texture.

This heater assembly or emitting source is then mounted inside a tube envelope as shown in Fig. 8. The plate or anode surrounding the heater unit is the collector for the evaporated electrons.

For many years the industry has used barium and strontium carbonates as a raw source for emission. These carbonates have always been of extremely high purity, whereas the nickel cylinder onto which they are applied has been of a controlled purity. That is to say that minor additives such as silicon, titanium, and magnesium have been specified and demanded. That is as it should be because the carbonates must be converted by heat (in the partially evacuated tube) to the oxides and then the further processing of the tube, essentially free from gas, will cause the silicon, titanium, and magnesium to take up some of the oxygen from these oxides to liberate free barium metal. It is this free barium metal which, in the final analysis, provides the negative electrons.

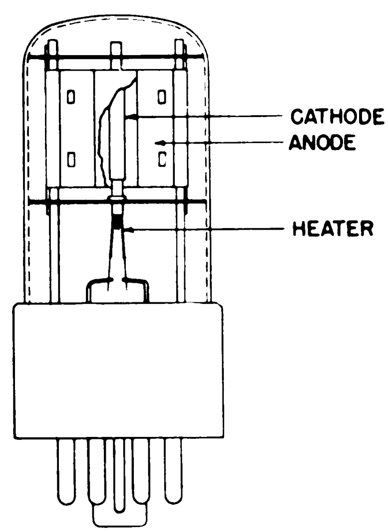


Fig. 8. Heater assembly is mounted inside a tube envelope.

There are other unavoidable impurities present in the nickel cylinder such as copper, manganese, carbon, and iron. Limits as to content of these impurities have been established mainly through usage and experience. The fact that a Committee of the American Society for Testing Materials has been engaged in the study of the relative effects of these impurities on emissivity indicates that there is much yet to be learned in this particular field.

For the past nine months our laboratory has been engaged in doing some basis research for the Office of Naval Research* on the study of the effects of impurities wittingly added to the raw barium and strontium carbonates. Using techniques, raw materials, parts, and equipment that practically guarantee positive control of all factors, we have conducted tests in which the only known variable has been the salt or element added to the barium and strontium carbonates. These additions are not mere mechanical mixtures but co-precipitations or occlusions, and the parts preparation, tube assembling, processing and testing have been done in a special laboratory set aside for that express purpose. A standard control suspension has been run with each test so that we may properly evaluate the results obtained in each individual case.

The following suspensions, all composed of barium and strontium carbonates but with the indicated additives, have been run:

Additive	Element	Element in Percent by Weight
Strontium silicate	Si	0.09, 0.22, 0.90, 1.78
Iron carbonate	Fe	0.58, 1.15
Magnesium carbonate	Mg	0.41, 0.83, 1.70
Manganese carbonate	Mn	0.17, 0.86
Copper carbonate-hydrate	Cu	0.06, 0.16
Carbon powder (occluded)	C	0.10, 0.50

The silicate additive series was conducted on three different types of nickel cylinder or cathodes. The results obtained were of the same fundamental order in each case so that all subsequent tests have been confined to a single nickel cathode melt representative of the grade most commonly used in receiving tubes.

Readings were taken on each tube as follows:

1. Under low cathode temperature constant drain conditions with an anode voltage of only 4.0 volts. The cathode temperature was about 350°C.

2. Under relatively high cathode temperature pulse test conditions. In this test, emission is drawn from the cathode in pulses of only 1 microsecond duration at a repetition rate of 200 times per second with an anode voltage of 1000 volts. The cathode temperature was about 600°C.

*Contract N7onr-389.

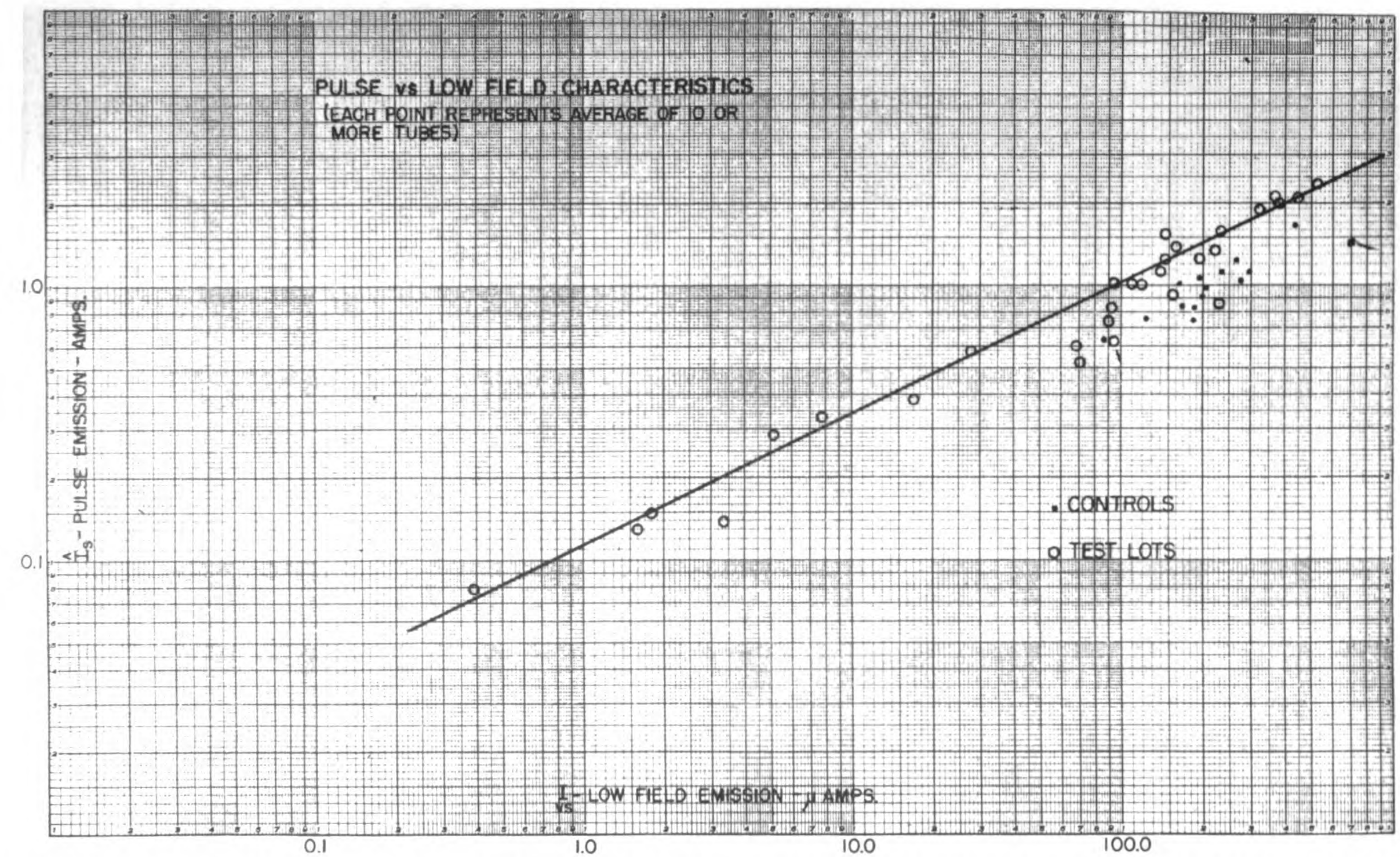


Fig. 9. Results of emission measurements on processed tubes, made under low cathode and high cathode test conditions.

In both tests, the emission current drawn is the total emission current available from the cathode at cathode temperature specified for the particular test. These two emission test conditions were chosen because it was believed they would provide information relative to the surface properties of the oxide cathode.

The results obtained for emissive activity of the series just cited were as follows:

Additive	Results
Strontium silicate	Depresses emission initially and throughout life.
Iron carbonate	Depresses emission initially but improves on life.
Magnesium carbonate	Not injurious to emission in low concentrations (0.41%).
Manganese carbonate	Depresses emission - definitely detrimental.
Copper carbonate-hydrate	Mild emission depressant in higher concentrations (0.156%).
Carbon	Mildly beneficial.

Since each tube processed has emission measurements made under the two test conditions previously listed, valuable information is obtained by plotting the results of these measurements. (See Fig. 9.) If there are 12 tubes in a given lot, then the "low field emission" is measured on all 12 and an average taken. In a similar manner the "pulse emission" is observed on all of the tubes in a given lot and the average taken. A single circle or dot on Fig. 9 is located on the graph by finding the scale number along the horizontal scale that represents the average of the "low field emission" observed, and at the same time the scale number corresponding to the average "pulse emission" is also determined and the combination of those two determines the location of the dot or circle. Both of the scales used in Fig. 9 are logarithmic scales and on such scales equal distances correspond to increases by a given factor such as a factor of 10. Thus the whole range of emission current shown on the single figure represents differences from the lowest to the highest by a factor of over 1000.

The lower points of the graph are those corresponding to precipitates with strontium silicate and iron carbonate additives, and the greater their concentration, the lower the activity, that is, the smaller the current observed.

When results of this kind were found for the first time, it became of interest to try to explain the meaning of the general trend of points as they were correlated by the straight line shown on the graph. An analysis of the experiment indicated that the slope or steepness of this straight line depends primarily on the difference in temperature used for the two tests. The thought that there is such a correlation also shows that both tests measure an electron emission that is predominantly determined by the same properties of the cathode. Thus it has been demonstrated that pulse emission on the one hand and direct current or steady emission on the other are governed by many of the same surface phenomena, and the conditions that give high pulse emission are also favorable to give high steady or direct current emission.

Future work will involve the life testing of the tubes we have made with the additives in the carbonates. We shall endeavor to follow the migration, if any, of the additive with the idea of trying to differentiate between malignant and transient poisoning agents of emission. Search for a more efficient emitting coating will be continued.

Seapower

Admiral W.H.P. Blandy, USN, in an address at the recent commissioning ceremonies of the U.S.S. NEWPORT NEWS said: "Will modern long-range air weapons make the Navy obsolete? I do not believe so. Strategic bombers, guided missiles, and atomic bombs, (unless the latter are some day successfully outlawed), already have or probably will have their place in warfare, but they will not eliminate armies or navies. Ships and troops are poor targets for atomic bombs compared with cities, because of their capacity for dispersion. And atomic attacks on cities, while they will inflict damage on war production plants, and casualties among the civil population, will not alone bring a strong enemy to his knees. There must be other factors also working to cause his surrender: primarily, either an actual invasion, as in Germany in World War II, or the certainty that one was coming and would succeed, as in Japan. For us, to invade enemy territory requires sea forces as well as ground forces. It should be remembered, too, that even if long-range bombers now, and giant guided missiles in the future, cross oceans and continents to strike an enemy country, they can strike more effectively, with heavier bomb loads, less fuel and less failures, from bases much closer to their targets. Here again, the seizure, defense and supply of those bases will call for the Army, the Navy, and the Marines. Meanwhile, the Navy itself will be launching guided missiles from its ships and its planes, against enemy aircraft, ships and shore targets.

"There are only two things that will ever make the Navy obsolete: the complete outmoding of sea transportation or the effective abolition of war. The one calls for revolutionary discoveries in science, the other for equally revolutionary improvements in international morals.

"I do not expect either of these striking improvements to be achieved in the near future. So, in spite of the ever-increasing importance of airpower, the new 'push button' weapons, and the increasing use of airborne troops, I think sea power will continue to be an essential part of this country's security and prosperity for as long as you are concerned with the matter, and far into the distant future."

MALINGERING ON PERSONALITY TESTS

Charles N. Cofer
University of Maryland

In the psychiatric screening process carried out with some of the recruits during the last war, it was not feasible for qualified personnel to spend much time interviewing each recruit, because the number of such personnel was limited. Therefore, to some extent, several questionnaires were used. These questionnaires were designed to elicit information that would be of value in discovering those recruits who possessed neuropsychiatric symptoms, which would make them unsuitable for military service. Recruits so identified by the questionnaire technique were then subjected to more intensive study by specialized personnel, and their symptoms were evaluated. The majority of recruits who took the questionnaires did not give indications of disabilities, and thus were not subjected to further study at the time of induction. In this way it was possible to concentrate the time of the available psychiatrists, psychologists, and social workers on those persons whose questionnaires revealed possible psychoses.

The practice of using questionnaires, as outlined above, is theoretically sound and produces fairly firm results. However, there are a number of limitations in personality or adjustment questionnaires which prevent them from being as effective as is desirable. One such limitation is that the answers to questions can be falsified. A person can answer the questions either to conceal symptoms which he has or to create the impression of being neuropsychiatrically handicapped. This falsification is one form of malingering, and methods are being studied to develop ways to control or to detect it.

One investigation at the University of Maryland, is being done under contract with the Office of Naval Research. So far two approaches to the problem have been utilized, and they will be discussed in this report.

The first attack was based on a well-known observation that emotional reactions are often accompanied by physiological changes, for example, by sweating, or changes in heart action or breathing. It was thought that malingering might be accompanied by such physiological reactions, and that their occurrence might be a useful indicator of falsification. It was necessary, first, however, for us to determine to what extent physiological reaction was an indicator of a significant emotional response to a personality test or questionnaire item, when the person was not malingering. The physiological measure used, the psychogalvanic response, is correlated with resistance changes to the

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passage of minute amounts of electric current through the skin; this varies with the amount of perspiration produced, and so it is the amount of perspiration which is the physiological indication of emotion. It was found, however, that the personality test items did not produce verbal emotional responses which showed any constant relationship to the physiological change. That is, a significant emotional response obtained from a subject (as determined by a comparison of his psychogalvanic and verbal response to an item) might or might not be accompanied by a physiological response. Hence, it was concluded that physiological measures would not readily yield an index of honesty of response, at least in the light of the results we have obtained.

Our second approach to the problem has given more promising results. The design of these studies was as follows. The subjects were asked to take a personality questionnaire honestly and also, at a second session, to take it dishonestly. We then tried to develop techniques which would allow us to pick out the false from the honest tests. In the inventory which we used, there are several scoring keys designed to show whether the test is valid, and we have studied these as well as attempting to develop new keys to detect malingering. In the development of a new key, we determine those items on the inventory that are susceptible to malingering and those that do not change much under the conditions of malingering as above described. Our data show that by using scoring keys derived from these items, it is possible to pick out false records with a good deal of accuracy, though some errors will be made. This work will require further research with other subjects and with other conditions of malingering before its full implications for the problem of malingering can be evaluated.

The approaches presented above are but two of several which can be used. They have been outlined because they are the ones with which our research has been concerned. Other techniques may be used. For instance, the subject may be required to select from two statements the one which most applies to him. The two statements appear to the subject either as equally "bad" or equally "good." In other words, the subject cannot make himself appear good, because the two statements from which he must choose seem favorable. Nor can he make himself appear abnormal, because both statements apparently indicate abnormality. Although to the subject either statement in the pair appears to be equally bad or good, one of them is known to be significant of maladjustive tendencies, whereas the other is not. Therefore, the subject may reveal his poor adjustment by the statement which he picks, but it is impossible for him to decide for himself which one will yield a good or bad picture of himself.

Another technique which has some promise is the use of the so-called "projective" tests. These tests utilize ambiguous stimulus material like ink-blots. The subject is asked to say what they might be. He does not know beforehand what the "correct" answer is, or rather what a normal or an abnormal answer is. Hence, it is relatively more difficult for him to falsify his answers to such tests than it is in cases in which ordinary questions are used, the intent of which is reasonably apparent.

These examples will indicate some of the procedures which are presently being used or investigated to counteract tendencies to falsify a person's responses to questionnaires in the screening situation. None of them, at present, is infallible, and further research is needed to improve them and to determine the conditions in which they may be maximally useful.

"Adventures in Science"

The "Adventures in Science" radio program sponsored by Science Service presented recently, over the Columbia Broadcasting System, Dr. Elliott Montroll, Head, ONR Physics Branch, and Mr. Lawson McKenzie, also of the Physics Branch, who discussed work in low-temperature research. In explaining the theory that energy could be passed through helium by means of a temperature wave, advanced by Prof. Laizlo Tisza now of Mass. Inst. of Technology and verified by the Russian scientist, Peshkov, Dr. Montroll said: "Sound was used during the war to detect submarines. A device on the Navy ships sent out through the water a bundle of energy in the form of very high-frequency sound waves. This energy bounces off the target, and the return echo is received, amplified, and presented on a screen so that it can be seen. The energy involved in this sound detection device is propagated as pressure waves. Now the new kind of wave effect predicted by a Hungarian scientist in France and discovered by a Russian is a temperature wave called second sound. The interpretation of the mechanism propagating this temperature is not clearly understood, but research supported by the Office of Naval Research is getting at the problem." Discussing superconductivity, Mr. McKenzie explained how the discovery had been put to work in a limited way. He said: "During the war you will remember there was a device that allowed our soldiers to see in the dark by detecting the heat waves given off by men and objects even on the darkest of nights. This device is based upon what is called a bolometer, a heat measurer. It is the heart of the apparatus. One such substance which is sensitive to infra-red or heat signals is a metal in the superconducting state. The superconductivity of the metal is destroyed by impinging heat radiation. This permits use of superconductivity as a heat detector and is one of the most sensitive heat-detecting elements known. Johns Hopkins University developed during the war under government contracts a detecting device built around a superconducting responsive element, for use in detecting the heat waves given off by hot motor exhausts, smoke stacks of warships, and factories. Recently these same detectors have been found to be responsive to radio signals."

In closing the discussion, Mr. Watson Davis, Director of Science Service, explained the part ONR is playing in low temperature research: "The Office of Naval Research is supporting very extensive research and experimentation at these low temperatures at more than a dozen universities throughout the country. I am told that the Navy's support of low-temperature research is part of its broad plan of making it possible for scientists and research institutions to do work that they are best fitted to do with the assurance that out of such fundamental experiments will come many things that the Navy and the other armed services will need to keep ready for war and efficient and up-to-date in peace."

ATTACKING THE BEHAVIOR OF METALS

Andrew Dravnieks and Hugh J. McDonald
Illinois Institute of Technology

Introduction

Behavior of metals and alloys in hot gases may be considered from several points of view. To the designer of jet engines, the scaling or other forms of destructive attack of metals caused by the combustion of gases are often simply annoying realities, which limit the materialization of ambitious dreams. The practical metallurgist, hard-pressed by the designer, strives to improve the heat resistance of alloys by a skillful combination of components and phases.

From the point of view of physical chemistry, the surface of the metal and the scale formed on it by reaction with the hot gas are a stage on which several rather fascinating processes occur. The physical chemist thinks about these events in terms of crystal lattices, atoms and ions migrating through the lattices, and reaction at interfaces. He does not search for the most heat-resistant alloy. Rather, he raises the question--why does one metal undergo less destruction by the action of the gas than another? Whether his answer may be appreciated by the metallurgist only many years hence, or find almost immediate

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Andrew Dravnieks received the degree of chemical engineer from the University of Latvia, in Riga, in 1938. During the period 1936-1944, he was associated with the University of Latvia. From 1938-1939 he worked as a chemical engineer with the staff of the Latvian Army. From 1941-1944 he was also technical manager in charge of the development laboratory of the Riga Chemical and Paint Company. In 1946, he studied, with the aid of an UNESCO fellowship, at Philipps University, Marburg, Germany, being associated with the State Institute for the Chemistry of Metals. Since 1947, he has been associated with Illinois Institute of Technology as research associate in the Department of Chemistry. Mr. Dravnieks has worked in the fields of high-temperature corrosion, polarography, varnishes and paints, and the chemistry of lubricants and oils.

Hugh J. McDonald is professor of physical chemistry and chairman of the Department of Chemistry in the Stritch School of Medicine, Loyola University, Chicago. He received his B. Sc. degree in chemistry from McGill University in 1935, and his M. S. and D. Sc. degrees from Carnegie Institute of Technology.

In 1939 he went to Illinois Institute of Technology, leaving that institution as professor of chemistry in November 1948, to accept his present position. This article was prepared while he was still associated with the Illinois Institute of Technology.

He was editor of the theoretical section of "Corrosion and Material Protection," a member of the Board of Directors of the National Association of Corrosion Engineers, chairman of the Corrosion Division of the Electrochemical Society, and Secretary-Treasurer of the American Coordinating Committee on Corrosion. He is the author of numerous papers in the fields of physical chemistry, electrochemistry, and corrosion.

application, one thing which he believes firmly is that a knowledge of fundamental processes which participate in the destruction of metal in hot gases is of ultimate importance in the long-range development of heat-resistant alloys.

Background

The gas-metal reactions, responsible for the corrosion of metals in hot gases, have been a subject for serious studies for almost three decades. High points of the past development have been (1) the finding that very frequently scaling reactions proceed by the migration of metal, through the scale covering it, towards the gas, so that the scale grows outwards; (2) the postulation of an electrochemical theory of scale formation, which treats the metal-scale-gas system as a galvanic cell with metal and gas electrodes separated by the solid electrolyte, namely, the scale substance itself; (3) the finding that a correlation exists between the rate of scale growth and such electrical properties as ionic and electronic conductance of the scale; and (4) the establishment of certain correlations between the change of gas pressure, temperature, and scale-growth rate, indicating that the rate of oxidation of most metals changes only slightly with change in oxygen pressure. This was, briefly, the literature heritage, scattered throughout more than 300 scientific papers in several languages, and the foundation upon which to build further.

Experimental Program

The experimental research program started with an investigation of the electrical potentials which develop across scales growing on various pure metals in atmospheres of oxygen, chlorine, bromine, and iodine at elevated temperatures. A wire was welded to the sample, and a platinum or carbon electrode probe was used to touch gently the surface of the growing scale. The potential, developed between the sample and the electrode probe, was measured. As simple as it sounds, it was still quite a complicated experimental set-up; all-glass gas purification trains, pre-heaters, thermostats, furnaces, and an array of meters grew around the metal sample and electrode probe.

The potential measured in this way depends on two factors: (1) the free energy change in the over-all scaling reaction, thus being a function of gas pressure and the dissociation pressure of the scale substance, and (2) the mode of transport of electricity through the lattice of the scale substance. Generally speaking, electrical current in matter can be carried by cations (positive ions), anions (negative ions), and electrons. If only electrons participate in conduction, no potential will be developed across the growing scale. If, however, cations or anions also migrate through the scale in some measurable fraction, one may expect, from theoretical considerations, that a definite potential will be built up across the scale. So the larger the mobility of ions in the lattice of the scale solid, the more likely it is that a considerable fraction of current will be carried by ions, and the larger the electrical potential which will develop. In the ultimate case where only ions migrate and the electrons are almost immobile, a potential equal to the full value of the free energy change in the reaction will be observed.

It is evident that the measurements of potentials by means of the electrode probe represent a valuable method for determining the

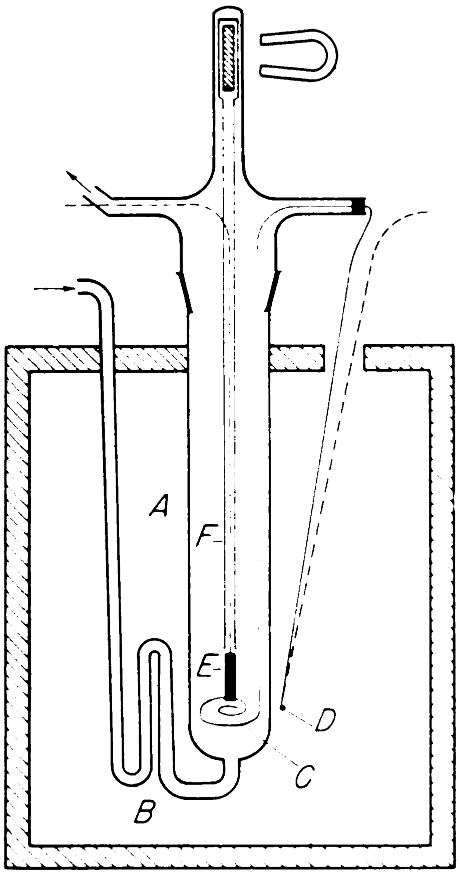

Fig. 10. Typical arrangement to measure potential differences which develop in growing scales on metals. F is the electrode probe, consisting of a rod of graphite E and a platinum wire, shown as the broken line. The electrode probe may be lifted or lowered by means of a magnet (horse-shoe magnet at the top of the figure). The metal sample, in this case a copper wire, is formed into a spiral C, and connected to another platinum wire (broken line) by the junction D; the junction is placed in the same furnace (the box around the glass apparatus A) so that it is at the same temperature as the contact between the copper wire C and the electrode probe. The gas, in the present case a nitrogen-iodine mixture, loaded with iodine at a prescribed partial pressure by means of an iodine column in a thermostat, enters the vessel through the glass spiral B and leaves through the tube at the left top corner. Copper iodide forms on the spiral C and the potential difference between the copper wire C and the electrode probe E-F, is measured by means of a vacuum tube potentiometer connected to the platinum wires (broken lines).

relative mobilities of electrons and ions in scales. The method was tested on silver and lead chloride and bromide, and on copper iodide scales; the mode of conduction in these substances has been thoroughly investigated by other methods, so that the results obtained by the electrode probe method could be readily analyzed. The results obtained were in good agreement with the theory which pictures the scale as a solid electrolyte. In this way, assurance was gained that the sets of equations and correlations derived from this theory could serve adequately as a ready-to-use mathematical instrument.

The electrode probe method was then applied to oxide scales. The results showed that in oxide scales the fraction of current carried by ions is negligible; all scales examined were electronic conductors. Therefore, in the treatment of oxidation reactions, the effects arising from electrical potentials such as those existing in ionically-conducting scales may be disregarded. For instance, a short-circuiting of metal and the scale surface would not cause an accelerated scale formation in the case of oxidation of metals, as it does in the case of the reaction between silver and chloride. Also, it became evident that in the consideration of metal oxidation rates under usual conditions, the electrochemical theory of scale formation does not offer any definite advantages over a simple diffusion theory.

An excursion into the region below the scale now seemed necessary. If, as has been established experimentally in many cases, the metal

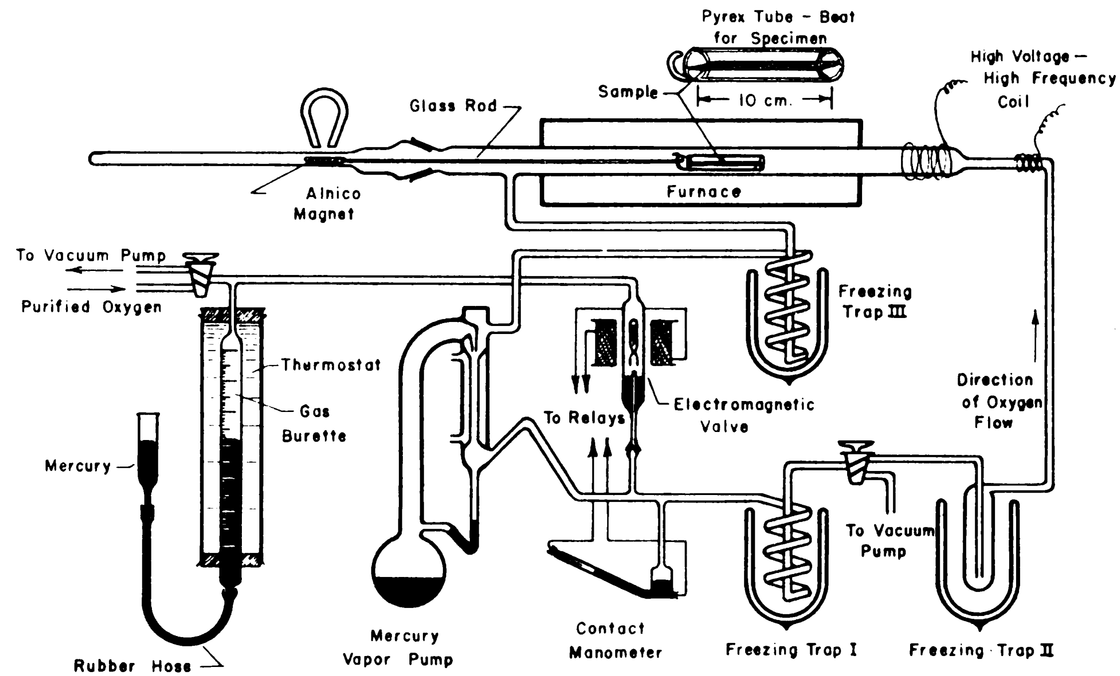

Fig. 11. Typical set-up to measure rate of oxidation of copper in activated oxygen. From a gas burette, oxygen is fed through an automatic electromagnetic valve into an all-glass circuit, in which the pressure of oxygen is maintained at a low value; this state is achieved by the action of a contact manometer and the above valve. The oxygen is circulated through the sample tube in the furnace by the mercury vapor pump, and the mercury vapor is prevented from entering the sample tube by three freezing traps cooled by liquid nitrogen. The oxygen is activated by an electrodeless discharge produced by a high-frequency high-voltage (Tesla) coil. A magnetically activated device is used to introduce or remove the sample boat from the hot zone of the furnace, so that the experiment can be precisely timed. As oxygen reacts with the sample, the pressure in the circulatory system drops and the electromagnetic valve feeds fresh oxygen in small portions into the circulatory system. The amount of oxygen consumed is read from the gas burette.

is migrating through the scale towards the scale surface, and combines there with gas to form new scale on the outside, are there holes left between the metal and scale? By what mechanism do the metal and scale maintain contact, if the metal migrates out? To clarify these questions, the processes, which may be responsible for the extension of the scale into the zone of metal phase consumption, toward the retreating metal surface, were examined from the standpoint of their thermodynamic feasibility. This comprised a study, largely theoretical in nature; however, an x-ray investigation on layers of cuprous iodide formed on copper in an iodine atmosphere served as a useful illustrative example. The conclusion was reached that most scales grow in both directions, outwards and inwards; that recrystallization is frequently met with in growing scales; and that under certain conditions the inability of the scale to grow towards the metal may retard the scale growth considerably. (See Fig. 10.)

Attention was then turned to the events which transpire on the surface of the scale and in the gas. If the oxygen molecules have to be built into the oxide crystals making up the scale, they must first dissociate into atoms or ions. This process occurs on the surface of the scale. A certain number of oxygen atoms will therefore always be present in the transition from molecular oxygen to the chemically bound form such as in the oxide. This number of oxygen atoms determines also the degree of inner orderliness of the oxide crystals in the scale underneath. The degree of orderliness in turn influences the rate with which the metal ions can arrive through the scale phase from the metal. It was reasoned that if the conditions in the gas are upset artificially, the extra atoms or ions from the gas can be adsorbed on the surface of the scale and alter the fraction of oxygen atoms on the surface, influencing, as a result, the rate of scale growth. In combustion gases, during and right after the combustion, the gas phase contains an assortment of various ions, free atoms, and radicals (molecular fragments). This "non-equilibrium" gas comes to equilibrium after a short time lapse. However, the corrosion of metal exposed to the "non-equilibrium" gas may differ greatly from that in normal combustion products. This seemed a fertile field for investigation, and one well worth studying. An experimental attack was started by heating copper samples in a simple "non-equilibrium" gas, namely, activated oxygen. The latter was activated by electrical discharge, which provides a good means of creating free atoms and ions in low-pressure gases. (See Fig. 11.) The rates of oxidation, the products formed, and the general mode of attack were studied; proper experimental methods and gadgets were devised. The equipment became more and more complicated and many difficulties had to be overcome. By now, it is possible to state that "non-equilibrium" oxygen may change the oxidation rate of metal, and that the behavior of the scale may be quite different from that observed in a low-pressure normal oxygen atmosphere.

Among the ONR Contractors

Capt. Donald H. Menzel, USNR, Associate Director of Harvard College Observatory, addressed the Naval Research Reserve Units W-1 and W-2, Washington, D. C., 21 April 1949. The subject of his talk was "The Sun's Corona." He discussed the solar prominence research at Harvard Observatory's station at Climax, Colorado, and the application of this research to problems in naval communications.

ON THE NAVAL RESEARCH RESERVE

BuPers speedletter Serial F428 dated 21 March 1949 amends NRMAL 54-48 so that the wearing of uniforms is optional and not mandatory at Volunteer Research Unit meetings.

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Commanding Officer, Volunteer Research Battalion W-1, is Comdr. F. C. Wiesner, S, USNR. Comdr. Wiesner started as commanding officer of the first Research Reserve Unit (W-1). Under his able leadership Volunteer Research Battalion W-1 is now composed of four units, W-1, Naval Research Laboratory Unit, Special Devices unit, and the Enlisted Research Reserves.

Volunteer Research Reserve Unit 3-4, Rochester, N. Y. This unit was recently activated and on the occasion of the first meeting, Capt. W. H. Leahy, USN, Assistant Chief for Research, ONR, spoke to them giving suggestions as to ways in which the group might help for, as he said, the Research Reserves are the men on whom the nation's scientific effort depends. His specific suggestions were (1) to organize study groups around a particular Naval problem, chosen after a literature search of ONR's contractors' progress reports for ideas; one example might be a study of high temperature materials to meet Naval needs; (2) to organize study groups on a strictly engineering basis and here again by a study of contractors' reports, new means might be found for improvement of the tools of research; one example would be redesigning a crucible for the synthetic production of mica; (3) to form special contact groups to reach the research directors of industry for the exchange of scientific information; one example would be the sending of compiled information emanating from industrial laboratories to ONR branch offices for transmittal to ONR contractors.

Volunteer Research Reserve Unit 9-1, Northwestern University, Capt. Geo. G. Lamb, USNR, Commanding Officer, organized in January 1949, has held scheduled meetings twice a month. One program included the showing of the British motion picture, "Atomic Energy." ONR contractors have been the speakers at the other meetings. They are all leaders in their fields. Prof. S. K. Allison, Director, Institute for Nuclear Studies, University of Chicago, spoke on "Nuclear Physics Today." The title of the lecture by Prof. W. A. Hunt, Dept. of Psychology, Northwestern University was "Neuro-psychiatric screening." Prof. L. L. Thurstone, Distinguished Service Professor of Psychology at the University of Chicago, discussed mechanical aptitudes. In several instances the speakers have been accompanied by assistants, which permitted dividing the audience into groups for discussion after the main lecture and a group leader for each.

The program planned for the next quarter is similar to that for the quarter just completed, with emphasis on seminars with speakers conducting ONR-sponsored research in the fields of weather, chemistry, physics, and special devices.

The unit plans to meet on the second and fourth Tuesdays of each month. Visitors planning trips to the Chicago area are welcome to attend, and are invited to discuss before the group any matter of interest to the ONR program. Detailed information may be obtained from the ONR Branch Office, 844 Rush Street, Chicago, Illinois, or by telephone to Mohawk 4-3300.

Volunteer Research Reserve Unit 9-2, University of Illinois, Lt. Comdr. A. C. Williams, Jr., USNR. This Unit has organized sub-groups to encompass the particular fields of the members of the unit. The subgroups have held individual meetings and obtained speakers in their fields. A few of these will serve to illustrate the manner in which they are organized. The Mathematics Sub-group heard Prof. K. Zarankiewicz, University of Illinois, speak on "Conformal mapping of multiple domains." The Electrical Engineering Sub-group heard Milton Crothers, University of Illinois, speak on "Problems in Fire Control." The Mechanics Subgroup heard Morris E. Childs, University of Illinois, speak on "Warm air heating research program."

Volunteer Research Reserve Unit 9-3, University of Michigan, Comdr. C. M. Davis, USNR, Commanding Officer. This Unit has had a number of stimulating and interesting topics for discussion at their meetings. The unit is composed of advanced students and faculty members of the University.

The officers of the unit have given thought to joint projects but have been unable to formulate one broad enough to engage the interests of the diversified membership, which ranges from the zoologist to the astronomer. Their programs have followed the "scientific society" type of meeting, discussing such topics as that presented at one meeting by Capt. Jesse Ormondroyd, USNR, "Naval Research Establishments in the U.S.," who described briefly Naval establishments for research and type of work carried on at each. Another topic, "Radioactivity and plant growth," was discussed by Prof. W. C. Steere, who described an investigation of mutations in plants near the Great Bear Lake uranium deposits. This was a Navy project done in the summer of 1948.

Volunteer Research Reserve Unit 9-4, Columbus, Ohio, Lt. Comdr. K. E. Krill, USNR. This Unit has decided to devote one meeting each month to a detailed study and criticism of the course material offered in NavPers 10775, Naval Correspondence Course on Elementary Nuclear Physics. The other meeting during the month will hear speakers from within the group and then other available speakers in the area on their fields of research. These latter speakers should provide a fertile field from which the group may select subsequent study projects.

Volunteer Research Reserve Unit 1-1, Boston, Mass., Capt. J. W. Hammond, USNR, Commanding Officer. The Reserve program officer, Lt. Comdr. H. W. Rohrman, USNR, has announced the Unit's programs, indicating that this Unit is taking advantage of the large amount of scientific talent available in the Boston area. Dr. Richard Morse, President, National Research Corporation, spoke on recent developments in the field of the high vacuum tube. Prof. S. C. Collins, Mass. Inst. of Technology, spoke on 20 April on low-temperature physics, and a program scheduled for May will present Prof. G. Kistiakowsky of Harvard who will discuss the physical chemistry of detonation.

NOTE TO RESEARCH RESERVE UNITS

Send your reports of meetings, your accomplishments, and your plans to Director of Research Reserve, (Code 104) Office of Naval Research, Department of the Navy, Washington 25, D. C. The Washington office and other Research Reserve units are interested in accounts of activities.

If you are working on an ONR-sponsored research contract and desire to inform other workers and naval groups about your methods of procedure, your problems, or your findings, write an article on the subject for Research Reviews, addressing Code 254, Office of Naval Research, Department of the Navy, Washington 25, D. C.

VOLUNTEER RESEARCH RESERVE UNITS

Designation	Type	Meeting Place	Commanding Officer and Mail Address
1-1	Composite	Auditorium, Bldg. 60 Navy Headquarters, Boston, Mass.	Capt. J. W. Hammond, USNR 495 Summer St. Boston, Mass.
1-1 (sub)		Amherst College Amherst, Mass.	
1-2	Composite	Brown University Providence, R. I.	Cdr. C. J. Fish, USNR Oceanographic Institute Woods Hole, Mass.
3-1	Composite	Cornell University Medical College New York 21, N. Y.	Cdr. J. D. Hardy, USNR 1300 York Ave. New York 21, N. Y.
3-2	Special Devices	Special Devices Center Sands Point, Port Washington Long Island, N. Y.	Cdr. L. E. Yoder, USNR Sands Point, Port Washington Long Island, N. Y.
3-3	Composite	U. S. Naval & Marine Corps Reserve Training Center Buffalo, N. Y.	Lt. Cdr. Ralph Bloom, Jr., USNR 184 Connecticut St. Buffalo, N. Y.
3-4	Composite	University of Rochester Rochester, N. Y.	Cdr. H. C. Sheve, USNR NROTC Unit University of Rochester Rochester, N. Y.
3-5	Composite	Yale University New Haven, Conn.	
4-1	Composite	Princeton University Princeton, N. J.	Lt. Cdr. Paul Busse, USNR Princeton University Press Princeton University Princeton, N. J.
4-2	Composite	Franklin Institute Philadelphia, Pa.	Lt. Cdr. W. G. Amey, USNR Franklin Institute Electronics Section Philadelphia, Pa.
W-1	Composite	Dept. of the Navy, Bldg. T-3 Washington, D. C.	Cdr. W. M. Richardson, USNR Office of Naval Research Dept. of the Navy, Bldg. T-3 Washington 25, D. C.
W-2	Composite	Naval Research Laboratory Washington, D. C.	Lt. Cdr. H. A. Tanner, USNR Bldg. 8, Room 152 Naval Research Laboratory Washington 25, D. C.
W-3	Composite	Dept. of the Navy, Bldg. T-3 Washington 25, D. C.	Lt. Cdr. A. W. Stevens, USNR Office of Naval Research Bldg. T-3, Room 1815 Washington 25, D. C.

Designation	Type	Meeting Place	Commanding Officer and Mail Address
5-1	Composite	University of Virginia Charlottesville, Va.	Lt. (jg) P. B. Buck, USNR 4 Copeley Hill Charlottesville, Va.
5-2	Composite	Virginia Polytechnic Institute Blacksburg, Va.	Lt. Cdr. E. D. Harrison, USNR P. O. Box 575 Blacksburg, Va.
6-1	Composite	Georgia Institute of Technology Atlanta, Ga.	Cdr. J. E. Boyd, USNR Georgia Institute of Technology Physics Building Atlanta, Ga.
6-2	Composite	Alabama Polytechnic Institute Auburn, Ala.	Lt. J. E. Land, USNR Alabama Polytechnic Institute Dept. of Chemistry Auburn, Ala.
6-3	Composite	Oak Ridge National Laboratory Oak Ridge, Tenn.	Lt. Cdr. D. J. Mallon, USNR P. O. Box P Oak Ridge, Tenn.
6-4	Composite	University of Florida Gainesville, Fla.	Lt. J. S. Johnson, USNR University of Florida College of Engineering Gainesville, Fla.
8-1	Composite	Tulane University New Orleans, La.	Lt. Cdr. J. M. Scott, USNR Tulane University Dept. of Chemistry New Orleans, La.
8-2	Composite	Louisiana State University Baton Rouge, La.	Lt. Cdr. W. R. Edwards, Jr., USNR Louisiana State University Dept. of Chemistry Baton Rouge, La.
8-3	Composite	Texas A & M College College Station, Texas	Lt. Cdr. N. F. Rode, USNR 502 W. Dexter Drive College Station, Texas
8-4	Composite	NROTC Building Rice Institute Houston, Texas	Lt. L. S. Money, USNR 3819 Arbor St. Houston 4, Texas
8-	Composite	Galveston, Texas	Lt. (jg) T. N. Tackett, III, USNR 1410 12th St. Galveston, Texas
8-	Composite	University of Texas Austin, Texas	Lt. Cdr. G. H. Ayers, USNR 3307 Perry Lane Austin, Texas
8-	Composite	Stillwater, Okla.	Lt. O. H. Hamilton, USNR 503 Pine St. Stillwater, Okla.
8-	Composite	Bartlesville, Okla.	Lt. Cdr. E. O. Box, USNR 1642 Hickory St. Bartlesville, Okla.
9-1	Composite	Chicago, Ill.	Capt. G. G. Lamb, USNR Technological Institute Northwestern University Evanston, Ill.
9-2	Composite	University of Illinois Urbana, Ill.	Lt. Cdr. A. C. Williams, USNR University of Illinois Psychology Dept. Gregory Hall Urbana, Ill.
9-3	Composite	University of Michigan Ann Arbor, Mich.	Cdr. Charles M. Davis, USNR University of Michigan Geography Department Ann Arbor, Mich.
9-4	Composite	Ohio State University Columbus, Ohio	Lt. Cdr. Karl E. Krill, USNR 2324 Jefferson Ave. Columbus 3, Ohio
9-5	Composite	Iowa State College Ames, Iowa	Lt. Cdr. O. C. Kreider, USNR Iowa State College Math. Dept. Ames, Iowa
9-6	Composite	University of Minnesota Minneapolis, Minn.	Lt. Cdr. J. A. Wise, USNR University of Minnesota 220 Exper. Engineering Bldg. Minneapolis, Minn.

Designation	Type	Meeting Place	Commanding Officer and Mail Address
9-7	Composite	Purdue University Lafayette, Ind.	Lt. L. M. Baker, USNR Purdue University Biol. Annex, Lafayette, Ind.
9-8	Composite	Washington University St. Louis, Missouri	Cdr. R. N. Varney, USNR Washington University Dept. of Physics St. Louis, Mo.
9-9	Composite	Missouri School of Mines & Metallurgy Rolla, Mo.	Cdr. R. A. Cooley, USNR
11-1	Special Devices	Los Angeles, Calif.	Lt. Cdr. H. J. Pedersen, USNR 510 W. 6th St. Los Angeles, Calif.
11-2	Composite	Pasadena, Calif.	Lt. Cdr. J. H. Biggar, USNR 680 E. Colorado Drive Pasadena, Calif.
11-3	Composite	University of California Los Angeles, Calif.	Cdr. L. P. Delsasso, USNR University of California Physics Dept. Los Angeles, Calif.
12-1	Composite	San Francisco, Calif.	Cdr. J. E. Laurance, USNR 801 Donahue St. San Francisco, Calif.
12-2	Biological Sciences	University of California LeConte Physics Lab. Berkeley, Calif.	Lt. Cdr. Nello Pace, USNR University of California Medical Physics Lab. Berkeley, Calif.
12-3	Composite	Stanford University Stanford Univ., Calif.	Cdr. L. S. Jacobsen, USNR 668 Cabrillo Ave. Stanford University, Calif.
12-4	Composite	Fresno State College Fresno, Calif.	Cdr. R. A. Jack, USNR 3617 Harvey Ave. Fresno 2, Calif.
12-5	Composite	University of California Berkeley, Calif.	Cdr. C. F. Garland, USNR Univ. of Calif. Berkeley, Calif.
13-1	Composite	University of Washington Seattle, Wash.	Cdr. H. S. Bennett, USNR 3966 Union Bay Circle Seattle 5, Wash.
13-2	Composite	Richland, Wash.	Lt. W. W. Gonder, USNR 95 Atkins Ave. Richland, Wash.

PROSPECTIVE RESEARCH RESERVE UNITS

Branch Office	Unit
U. S. Navy Office of Naval Research Branch Office 495 Summer Street Boston 10, Mass.	Dartmouth College Hanover, N.H. University of Maine Orono, Maine Clark University Worcester, Mass. Worcester Polytechnic Institute Worcester, Mass.
U. S. Navy Office of Naval Research Branch Office 50 Church Street New York 7, N. Y.	Pennsylvania State College College Station, Pa. Cornell University Ithaca, N. Y.
U. S. Navy Office of Naval Research Branch Office, Southeastern Area Department of the Navy, Building T-3 (Code 104) Washington 25, D. C.	University of North Carolina Chapel Hill, N. C. Duke University Durham, N. C.
U. S. Navy Office of Naval Research Branch Office 844 No. Rush Street Chicago 11, Ill.	University of Kansas Lawrence, Kansas

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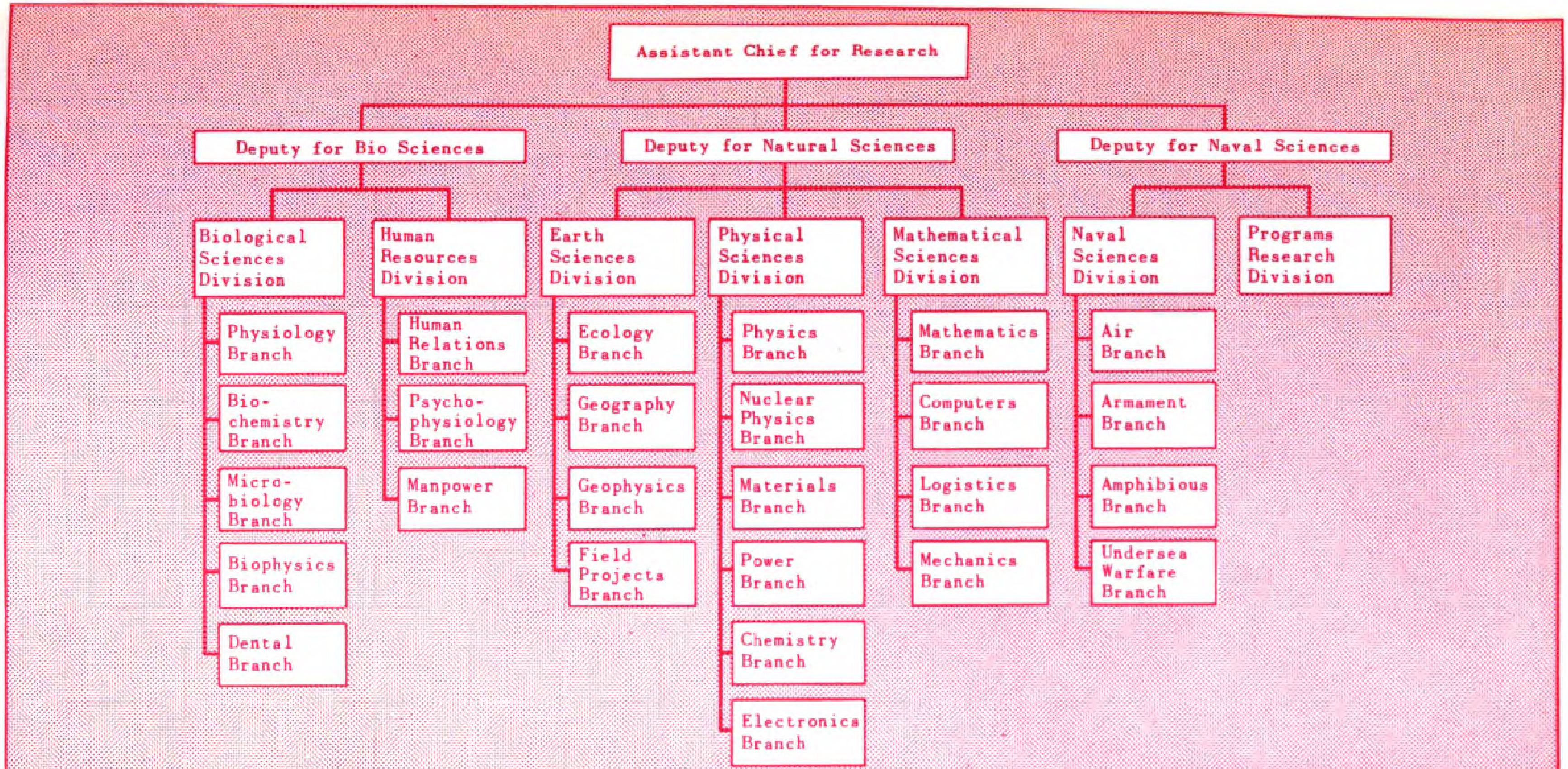

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