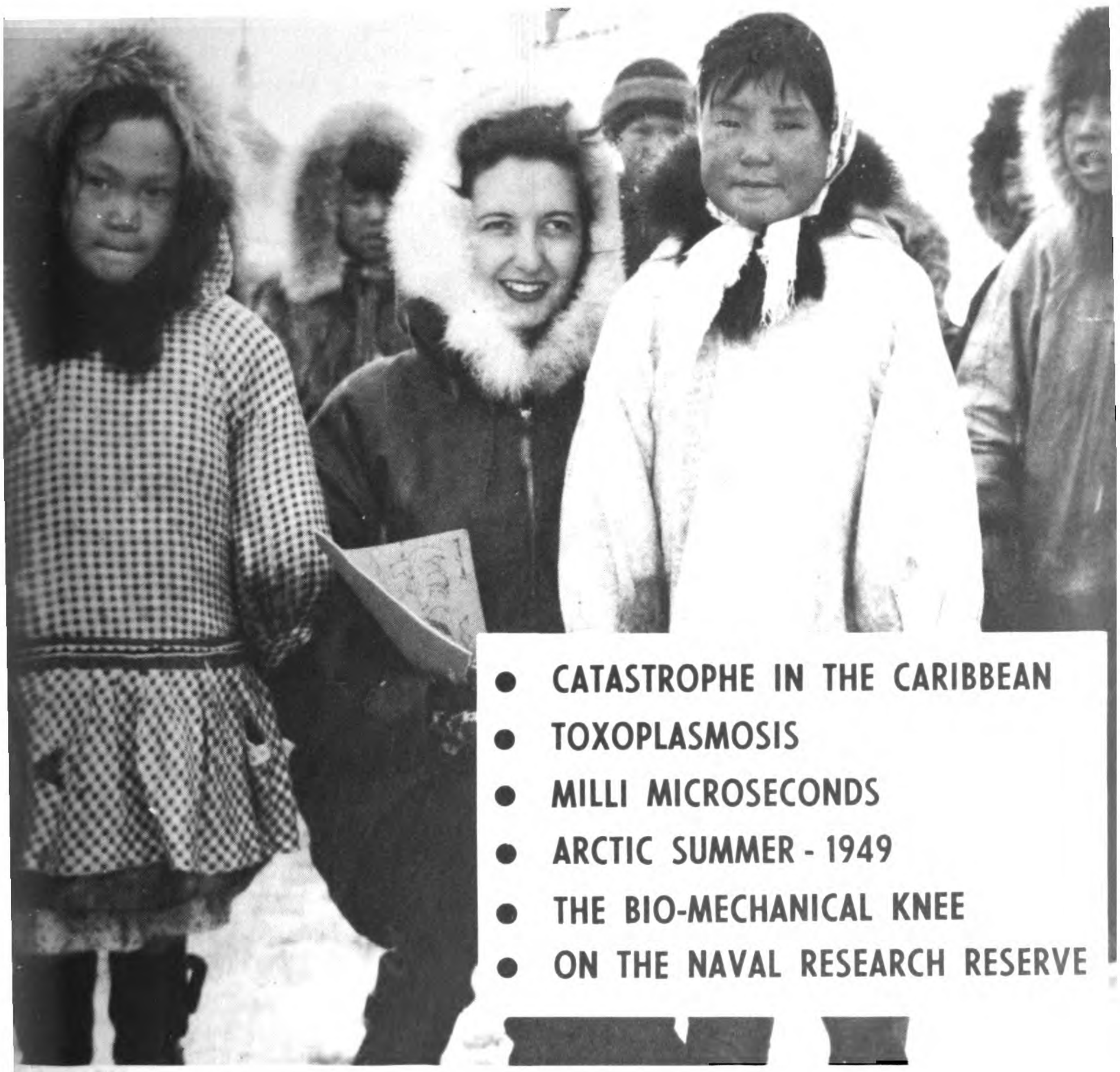
• FEBRUARY 1950 FOR OFFICIAL USE ONLY

RESEARCH REVIEWS



- CATASTROPHE IN THE CARIBBEAN
- TOXOPLASMOSIS
- MILLI MICROSECONDS
- ARCTIC SUMMER - 1949
- THE BIO-MECHANICAL KNEE
- ON THE NAVAL RESEARCH RESERVE

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

NAVEXOS P-510

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

COVER PHOTO: While on a visit to the science laboratories at Point Barrow, Alaska, Mrs. Yvonne Ramey stopped for this "north-of-the-circle" photograph with a group of Eskimo children. Mrs. Ramey is the administrative assistant to the Executive Secretary of the Arctic Research Laboratory Advisory Board.

Approved by Bureau of the Budget, 13 April 1948.

RESEARCH REVIEWS

Informs the Fleet of ONR-sponsored Research

Contents

FEBRUARY 1950

DEPARTMENT OF THE NAVY ★ OFFICE OF NAVAL RESEARCH ★

THE CASE FOR BASIC RESEARCH—

A Letter to the Editor

Recently the newspapers reported that a group of scientists had declared that the United States is scientifically bankrupt. They felt justified in making this alarming statement because universities do not have enough money for the support of basic research--the search for scientific truth for its own sake.

This recalled other comments made on the subject of basic research. For example, Mr. Lammot du Pont, back in 1944, said, "What is fundamental research today is applied research tomorrow." He was well aware that apparently "useless" research frequently turns out to be of most practical use to society in a way that is entirely unexpected. The late Thomas Midgeley, Jr., while President of the American Chemical Society and an executive of several large industrial organizations, realized that the growth of industry is dependent upon the progress of fundamental scientific knowledge. Speaking before a forum on industrial research, he said, "I am of the opinion that as time goes on, more and more research of a fundamental type will be necessary." And in Science, May 13, 1949, Dr. Detlev W. Bronk, President of The Johns Hopkins University, wrote: "Our future welfare requires that a goodly number of scientists be free to study nature without regard for the practical needs of the moment."

It is, therefore, pleasant to point to a bright spot in the research picture. This time a quote from Fortune of October 1948: "The smartest and most carefully organized of the new military agencies is the Office of Naval Research, which is stepping into the breach and is spreading about $20 million a year chiefly among universities for pure research, with no strings attached and a maximum of freedom for working scientists. Without this support, basic research in the United States would be at its lowest ebb in history, for private funds have dried up at an alarming rate."

The necessity for a well established and amply supported fundamental research program in a progressive and ever growing society has been unequivocally stated and ably defended by America's outstanding businessmen and scientists. This philosophy has been at the core of ONR's thinking and the incentive to its establishment. We are now at the stage of our development where we must defend this philosophy more than ever before. In spite of temptations and pressures to do otherwise, we must abide by these principles.

Roger D. Reid
Head, Microbiology Branch, ONR

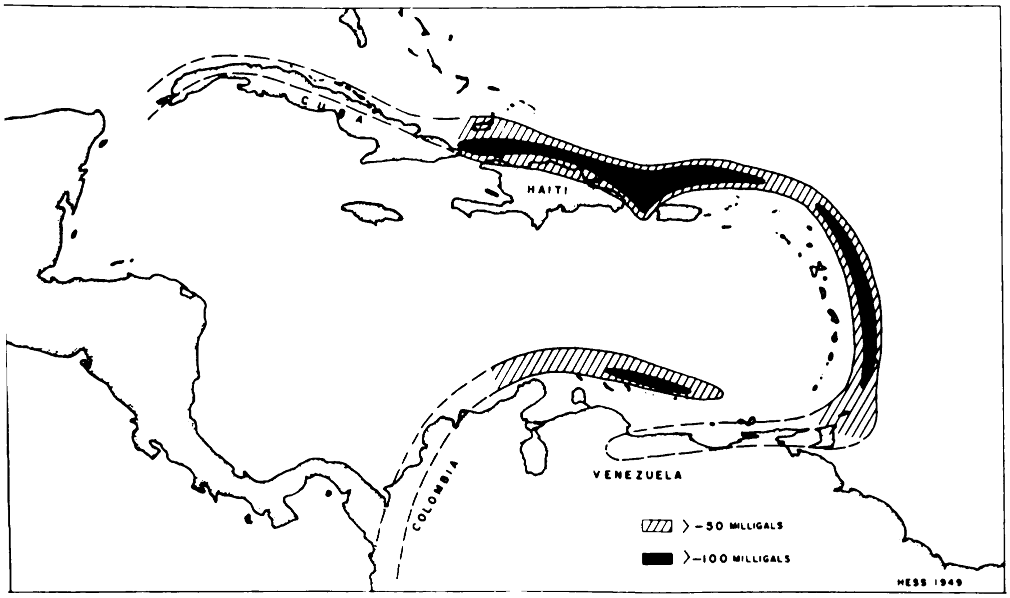


Figure 1. Caribbean negative gravity anomaly belt in milligals. A gal is equivalent to a dyne, which is a unit of force such that under its influence a particle whose mass is one gram would experience during each second an acceleration of one centimeter per second. A milligal is gal/1000. The anomalies indicate the locus of buckling of the Earth's crust.

Castastrophe in the Caribbean

by
H. H. Hess
Princeton University

Several times in each decade earthquakes of great destructive violence strike some portion of the Caribbean region. Less frequent but perhaps more spectacular are the eruptions of its encircling volcanoes. These outward manifestations of deep-seated activity are common knowledge to anyone familiar with the Caribbean. Many more subtle manifestations of inner-earth activity are detectable by geophysical measurements. From such data and from a study of the geological structure and history, it is possible to explain how the Earth's crust is being formed and to get some glimmering of the origin and nature of the forces that are at work.

The most productive of the geophysical methods thus far used has been the measurement of gravity (see "The Configuration of the Earth," by J. L. Worzel, Research Reviews, March 1949). In island arc areas such as the Caribbean, East Indies, Marianas, and the Aleutians, the Earth's gravity field shows very large deviations from normal—deviations

H. H. Hess, professor of geology, Princeton University, received his B.S. degree from Yale in 1927. In 1932 he received his Ph.D. from Princeton. Dr. Hess participated in gravity-measuring cruises in the Caribbean aboard the U. S. submarines S-48 and BARRACUDA in 1932 and 1936.

which are termed "gravity anomalies." A belt of strong negative gravity anomalies is found along the outer, convex, side of the arc and this is flanked on either side by belts of positive anomalies. This phenomenon of the island arc areas was discovered in the late 1920's in the East Indies by the eminent Dutch geophysicist, Dr. F. A. Vening Meinesz. The negative gravity anomaly belt of the Caribbean is shown in Figure 1. A negative anomaly means a deficiency of density in the underlying rocks.

Large gravity anomalies may, as a rule, be correlated with anomalies of density in the Earth's crust below the point of observation. The width of the anomaly belt gives a fair indication of the maximum depth of the disturbing factor. In the case of island arcs the width of the negative anomaly belt suggests a disturbing factor within 50 miles of the surface. It is known that the density of the materials of the Earth's crust and subcrust must lie between 2.6 and 3.3 and that the density generally increases with depth. About the only means of producing a belt of such large negative gravity anomalies as those found in island arcs is by buckling the lighter uppermost part of the crust downwards as shown in Figure 2. Model experiments were carried out by Kuenen and also by Griggs to determine whether the crust under horizontal compression would buckle in such a manner. A sketch of Kuenen's experiments is shown in Figure 3 and Griggs' in Figure 4. Both sets of model experiments indicate that downward buckling would occur. Griggs considered the potential forces available to produce the compression that causes the buckling and concluded that the only likely energy source must be related to thermal convection currents in the interior of the Earth. These currents need only be of the order of magnitude of a few inches a year to produce the necessary results. The material in which the currents flow is unquestionably solid, not liquid, as deduced from

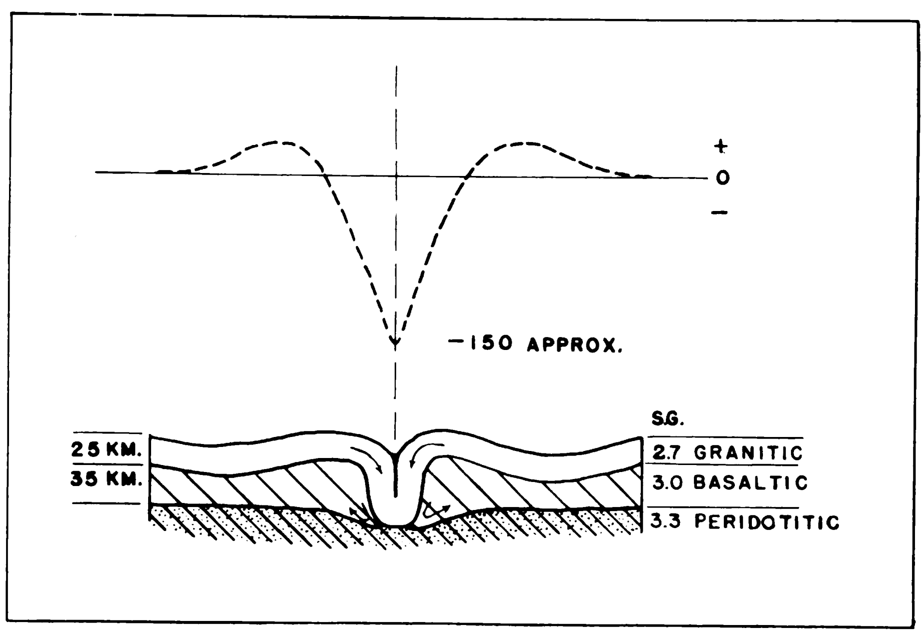
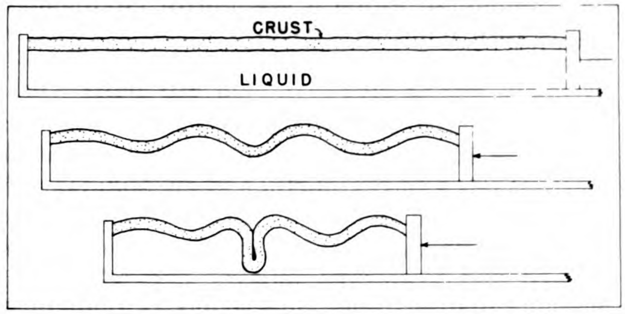


Figure 2. Interpretation of the gravity anomalies in terms of crustal structure. The size of the buckle and density distribution necessary to account for the anomaly curve are shown. Slight variations in assumptions as to density, thickness of crustal layers, and shape of the buckle are possible, but would not change the interpretation qualitatively.

Figure 3. Kuenen's experiments (right). "Crust" in this experiment had strength and consistency of jam; substratum was liquid. Horizontal compression first caused development of gentle waves in "crust." Further compression always resulted in buckling and deepening of one and only one of the troughs.



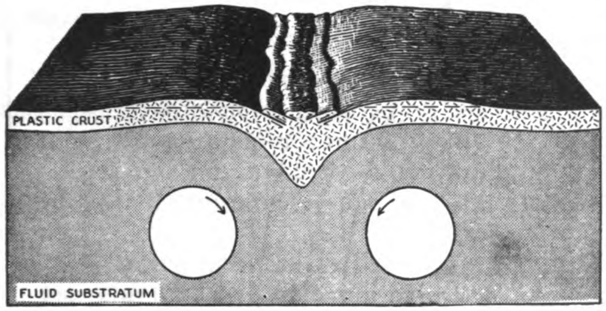


Figure 4. Griggs' experiments (left). Force applied is derived from the rotating cylinders which cause simulated convection currents in substratum. Viscous drag of currents on "crust" produce buckling. Note upsqueezed material in the trough over the buckle and the analogy to the "Barbados Ridge" in Figure 5.

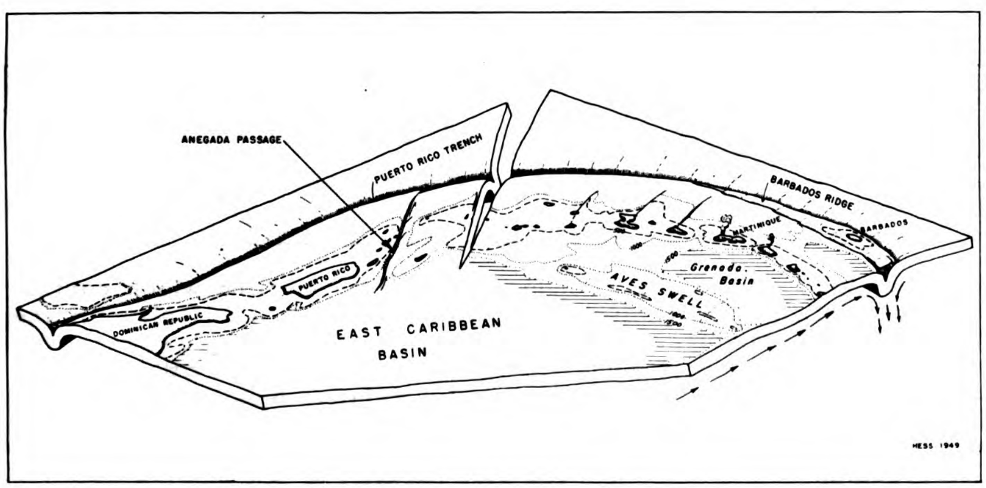


Figure 5. A generalized diagram of the northeastern sector of the Caribbean, showing the relations between topography, volcanism, shearing, and buckling of the crust along the anomaly belt. Underlying convection currents in the substratum shown by arrows. Anegada Passage is the most prominent shear zone.

the manner in which it transmits earthquake vibrations, so the nature of the flow must be "pseudo-viscous" which is analogous to ice flowing in a glacier.

The idea of crustal buckling in the Caribbean is found to fit the available information very well. The relations are shown in a diagrammatic sketch of the northeastern segment of the Caribbean in Figure 5. The upper surface—the topography—conforms reasonably well to the postulated buckled structure. The movement of large crustal plates toward and downward into the buckle results in some lateral shearing between plates. One such shear is indicated along the northern margin of the Anegada Passage. Earthquakes are caused by vibrations set up during such shearing as one block moves past another. The main lines

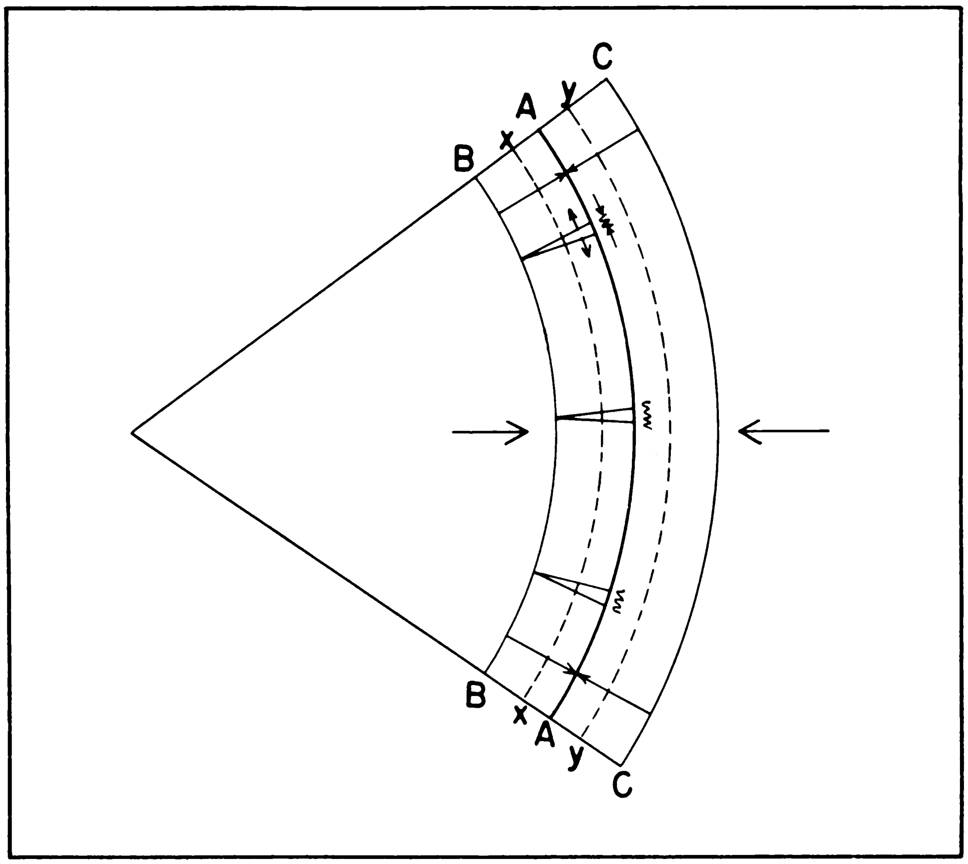


Figure 6. Mechanical relationships in zone of buckling which control the localization of volcanism. A-A represents the axial plane of the down-buckled structure. If arc BB is moved toward and downward into the buckle AA, its length must be slightly increased since BB is shorter than AA. Therefore, on the concave side relative tension exists in the direction parallel to AA. On the other hand, if CC is moved to AA it will have to decrease in length to be accommodated so that relative compression exists on the convex side parallel to AA. In the belt between XX-YY, very severe deformation takes place, resulting in rock flowage which keeps potential fractures closed. Thus egress of molten material through crust to the surface is limited to the narrow belt between BB and XX where relative tension exists and open fractures are possible. This accounts for the localization of volcanism on the concave side, some distance inward from the axial plane of the buckle.

of shearing show up both in the topography and in the concentration of earthquake epicenters along these lines.

Volcanism is active only along the concave side of the negative gravity anomaly belt. This is well exhibited by the arc of volcanic islands of the Lesser Antilles. The explanation of the volcanism as well as its localization on the concave side also correlates nicely with the supposition of buckling (Figure 6). The light upper crust carried downward into the core of the buckle is brought into an environment of much higher temperature and becomes partially molten. The molten material finds its way back to the surface along radial fractures on the concave side of the buckle and is the lava which forms and issues from the volcanoes. An analysis of the mechanics of a curved buckle shows that potential vertical tension cracks can develop perpendicular to the buckle on the concave side. On the convex side vertical planes at right angles to the buckle will be under compression. This supplies a satisfactory explanation for the occurrence of volcanoes only on the inner side.

Research of the character described above is aimed primarily at the establishment of general principles. Nevertheless, many unsought practical developments often result. The gravity measuring cruises of U. S. submarines over the past twenty years have resulted in improvement in instrumentation and tactical employment of submarines.

With the above very brief summary of the salient dynamic features of the Caribbean and their causes, one can cruise in these waters or walk upon the islands with a certain confidence which comes of knowledge. If buried beneath a crumbling building in an earthquake or blown skyward by a volcanic eruption, it would be comforting in the face of catastrophe to be able to reflect and say to oneself, "I know 'who-dun-it'."

* * * * * *

Toxoplasmosis

by
Joy Barnes Cross
University of Texas

Toxoplasmosis is a disease that was first reported from Africa in a rodent in the early 1900's. Since that time it has been found in a very large number of species of animals, and in the late 1920's it was recognized as occurring in man. Within the last 10 years there has been a growing interest in this disease, and it still presents a number of extraordinary problems.

In the adult, symptoms simulate atypical pneumonia, typhus, or spotted fever—all infections that create havoc in barracks or ship's quarters. Contrary to these diseases, however, Toxoplasmosis does not seem to be highly infective. No accidental laboratory infections have been reported during the almost 50 years it has been known. It is a dangerous disorder, however, for its cure is problematic. Sulfapyridine has been the remedy of choice for some time, but in experimental mice the symptoms are only suppressed and death eventually follows after treatment is stopped. Among other drugs we have tried recently, but which have not been effective are Streptomycin, Chloromycetin, Para aminosalicylic acid, and Sulfamylon.

Toxoplasmosis is known to be transmitted from the mother to the child before birth, and one of the commonest reports has been its association with hydrocephaly or megalocephaly in the newborn. Probably other modes of transmission exist to account for its occurrence in adults and several have been suggested but none has been thoroughly substantiated.

Serological and neutralization tests are useful diagnostic tools at present, but it is only in a comparatively small number of reported cases that positive reactions have been indubitably confirmed by the recovery of the parasites from the host's tissues. Since the parasite has been found in almost every tissue of the body, recovery is to some extent a matter of luck. More explicit knowledge of the habits of *Toxoplasma* should increase the chances of discovering the parasite and improve the diagnostic situation. In the infant there does seem to be a predilection of the parasite for the brain and eye. Experimentally, reports indicate that *Toxoplasma* occurs rarely periodically, or not at all, in the blood stream.

Joy Barnes Cross has been a research associate at the Medical Branch of the University of Texas since 1944. She received her A.B. degree in premedical studies at the Municipal University of Wichita and her M.A. and Ph.D. degrees (1943, Zoology) at the University of California. More specifically, her training has been in the microscopic aspects of anatomy, protozoology, and parasitology. She had been working with Dr. Ludwik Anigstein on the problems of toxoplasmosis for two years prior to her contract with ONR in September, 1948. As an encouragement to others with defective hearing, it is noteworthy that it has been necessary for Dr. Cross to use a hearing aid during the entire period of her training and subsequent employment.

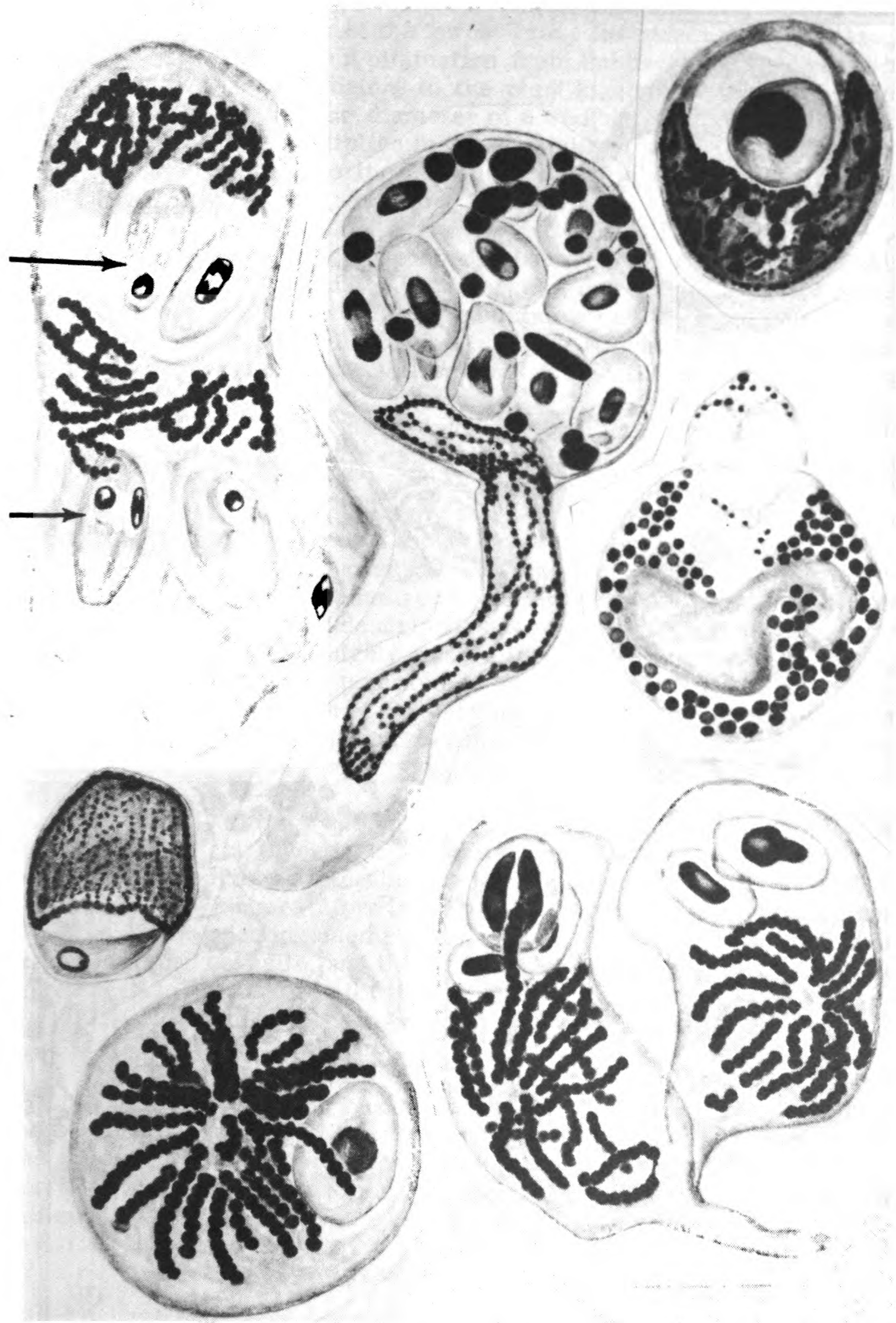


Figure 1. These drawings show parasites found in mice which were injected intra-abdominally with an emulsion of the brain of a mouse on the verge of dying of toxoplasmosis. (The arrows in the top left-hand illustration indicate the locations of parasites within the host's cell.)

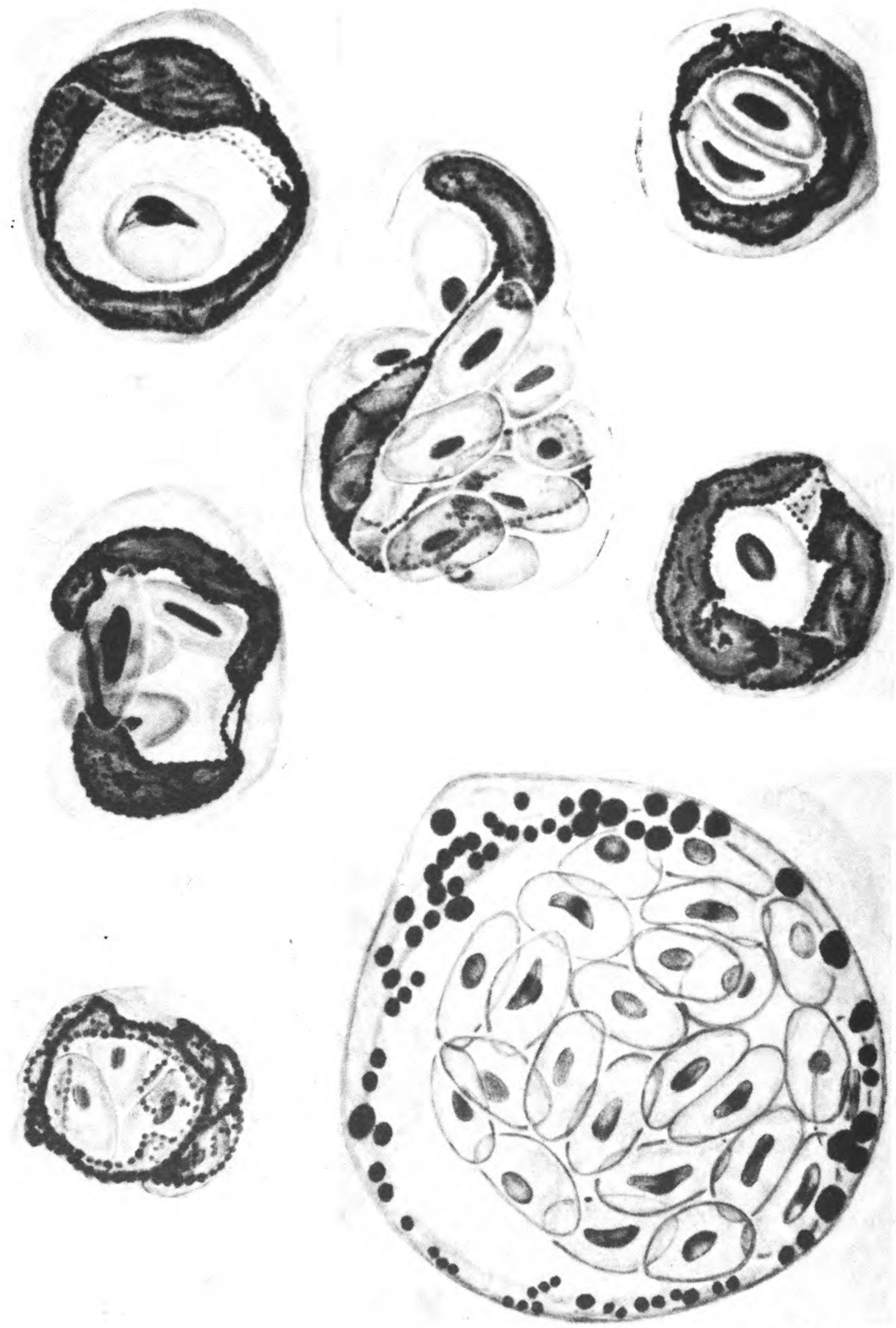


Figure 2. Drawings of parasites from same source as those shown in Figure 1. Drawings were preferred to microphotographs, because they permit greater magnification (here about 2500) with consequent greater clarity of detail.

In view of the fact that it is difficult to grow Toxoplasma on artificial media, the infection is routinely carried in mice. The strain which is being used here is from Sabin, and following intracranial or intra-abdominal inoculation, kills in about four days. Mice survive about eight days after subcutaneous inoculation, and this slower rate is utilized in connection with our chemotherapeutic tests. Like Malaria, Toxoplasma is a protozoan, a member of the lowest group listed in the animal kingdom. This is an important distinction from the bacteria which may be equally small but which belong to the plant kingdom. In length, Toxoplasma is shorter than the diameter of a red blood cell. The parasite invades, grows, and multiplies in the specialized defending cells of the mouse (the macrophages of the reticulo-endothelial system and the white blood cells).

A few days after mice are injected intra-abdominally with an emulsion of the brain of a mouse on the verge of dying from toxoplasmosis, a considerable amount of fluid accumulates in the abdominal cavity. This fluid has been very useful for studying because it contains large numbers of parasites, both solitary and inside the numerous floating cells from tissue and blood. Figures 1 and 2 show drawings at a magnification of about 2500 which demonstrate the affinity of the parasite for the nucleus of the host's cell and the manner in which the parasite divides inside a single host's cell to produce commonly 2,4,8,16, or 32 daughter cells, or rarely, as many as 90. The specimens figured were stained with Feulgen's method following fixation with Flemming's solution. Studies of the living parasite utilizing the phase contrast microscope are in progress now and verify the pictured findings, but indicate an additional and as yet undescribed stage in the life cycle of the parasite. Why this stage and highly mobile forms appear only sporadically is not known, but tissue culture studies are being carried out in an effort to find an answer. Growth of Toxoplasma in the chick embryo has been tried but was less promising because the parasites occur in less abundance.

In order to learn what happens when Toxoplasma invades a new host, chronological investigations of the omentum (the cellophane-like tissue that supports the intestines) have been made successively at 4, 8, 12, 24, 48, and 72 hours after inoculation in mice. The omentum is not damaged by the injecting needle so that trauma cannot alter the behavior of the infecting parasite, and the tissue is so thin and flat that sections do not need to be cut for microscopic examination. It is planned to repeat this investigation also, using living cells in tissue cultures.

It is hoped that with the accumulation of such basic factors governing the character, behavior, and well-being of the parasite more certain techniques for assisting diagnosis and more effective methods of therapy and control may be devised. The disease is seemingly rare, but actually may be wide-spread and escape recognition because of diagnostic difficulties.

* * * * * *

Milli Microseconds

by
Ernest C. Pollard
Sloane Physics Laboratory, Yale University

At Yale in the Physics Department we stretch time out in long tubes, coil it up, and lay it down on the floor where visitors trip over it. Because of this stretching, we can talk of measurements of times as short as a few milli-microseconds. With the help of these coils of time, a particle in a cyclotron beam has been timed down a yard-long tube, and the speed of action of a discharge avalanche and of production of light in a crystal have been measured. In erudite terms, we call this a method of delayed coincidence.

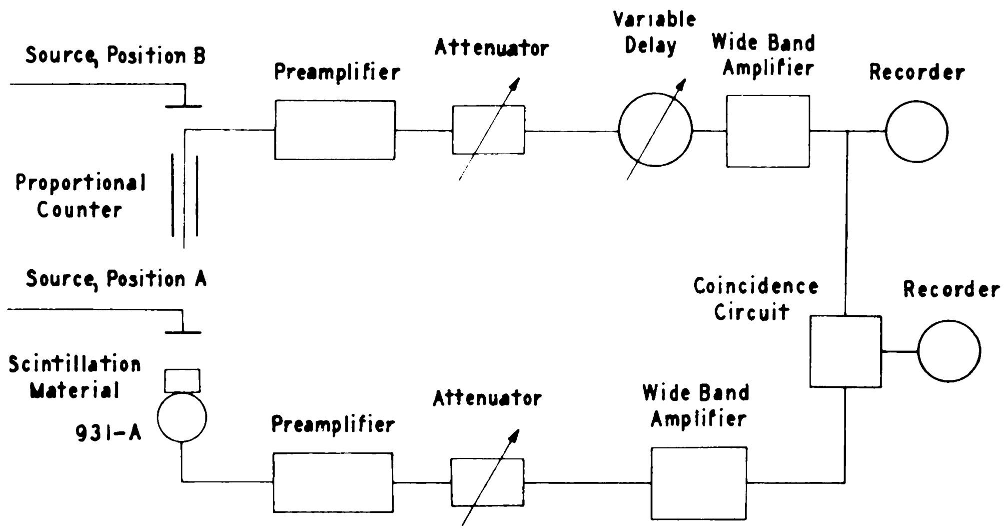


Figure 1. A block diagram of the coincidence circuit. This enables the effect of introducing delay into events which should be time coincident to be studied. A short time process, such as radioactive decay occurring in milli-microseconds can then be measured.

The original idea in this work is not new. It was used spectacularly by Rosetti to measure the half life of the μ meson. We have tried to stretch time out farther, and we think we can use the method to measure time intervals tenfold shorter than has been done previously.

Ernest C. Pollard, Professor of physics at Yale University, received a B.A. (1928) and a Ph.D. in Physics (1932) from Cambridge University in England. During World War II, Prof. Pollard was a staff member of the Radiation Laboratory of the Massachusetts Institute of Technology where he worked on ground and ship radar and participated in the research which led to the S.G. Radar. Prof. Pollard is a Fellow of the Physical Society and has been a member of the Yale University faculty since 1933, working on nuclear physics and in particular on nuclear energy levels. His work on short time observation, discussed in this article, was conducted jointly with Professor H. L. Schultz.

The apparatus works as follows. A pair of nuclear particle counters is constructed. These are then attached to amplifiers with a very wide band-width (23 megacycles) so that as little distortion as possible is perpetrated. The two sharp pulses from the counters that appear through the amplifiers are then sent into a pulse transformer where two primaries are wound on one core with a single secondary. These pulse transformers are wound on special hypersil cores and preserve all the sharpness of the two pulses. If two of these pulses appear at once—exactly—the secondary of the transformer produces double the size voltage jump. If there is any delay between the two, the voltage is less. By setting a recording circuit to pick off only the true double voltage pulses, the circuit can detect exact coincidences.

The question arises "how exact?", and the answer is that a deviation from exactness of two or three milli-microseconds can be detected.

Figure 1 shows a block diagram of the whole apparatus which easily fills a good size relay rack.

Now, if it should happen that the two events detected in the counters occur at different times, there will not be a registration of coincidence. Here is where the coils of time come in. Suppose the second counter is slower. Then the pulse of the first counter is sent down a transmission line (where it travels with a speed of 2 x 10^{10} centimeters a second) and again put through the pulse transformer. At the correct length of line, a coincidence is now registered.

This can be seen in Figure 2. Here B. G. Farley has recorded the number of coincidences found when a deuteron passes through one counter and then, after a flight of a yard, goes into a second counter. The second counter is actuated later, and coincidences cease. Now with a delay of 4.5 x 10^{-8} second coincidences pulses start in again and are back at their old value when 6.5 x 10^{-8} second delay is introduced. The speed of the deuteron is then distance divided by time, or 92/6.5 x 10^{-8}= 1.41 x 10^{9} centimeters per second. This is the first time such a speed has ever been measured directly with accuracy. It is known very accurately by indirect means, by measuring magnetic deflection. The two check. Farley went on to study the nuclear reaction.

$$_{4}Be^{9} + {}_{1}H^{2} \rightarrow {}_{4}Be^{8} + {}_{1}H^{3}$$

in which H^3 or <u>tritons</u> were thought to be produced. He showed that slow tritons are indeed formed. Since they are heavier they go more slowly, and this slow character was actually found.

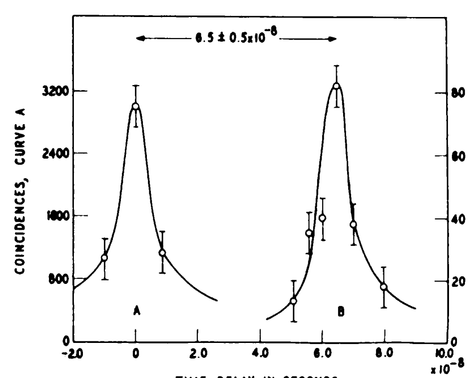


Figure 2. Time of flight of a deuteron. The coincidences recorded when a deuteron traverses two counters. In position A the counters are close together; in B they are separated by a yard. It can be seen that a delay has to be introduced in order to restore coincidences in the second case. This measures the time of flight of deuterons.

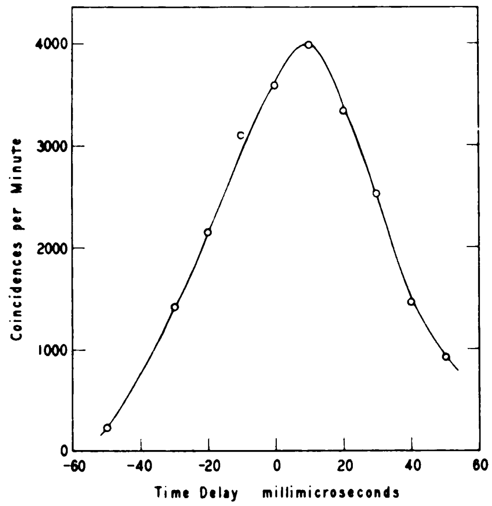


Figure 3. Distribution of coincidences recorded by two proportional counters. The fact that this is not perfectly sharp is due to the time taken by the discharge process in the counter.

The application to a discharge process can be seen in Figure 3. Here two proportional counters are placed close together and an electron fired through both. Delays are now introduced in either counter, and it can be seen that the discharge process in the proportional counter is not an instantaneous matter, for delay of either counter does not remove coincidences. J. MacIntyre finds that the half width, for small cylindrical counters, seems to be about 30 milli-microseconds.

In Figure 4, is shown the result when a series of scintillation counters replaces one of the proportional counters. They are, in order polystyrene, naphthalene, and calcium fluoride. Here the fast electron generates light in a solid. It can be seen how widely the process of production of light differs. For polystyrene it is fast—as fast as for a well-made proportional counter, possibly faster. For anthracene this process is known to be somewhat slower. For naphthalene it is found to be still slower, and for calcium fluoride there is a definite "tail" on the curve which means that after

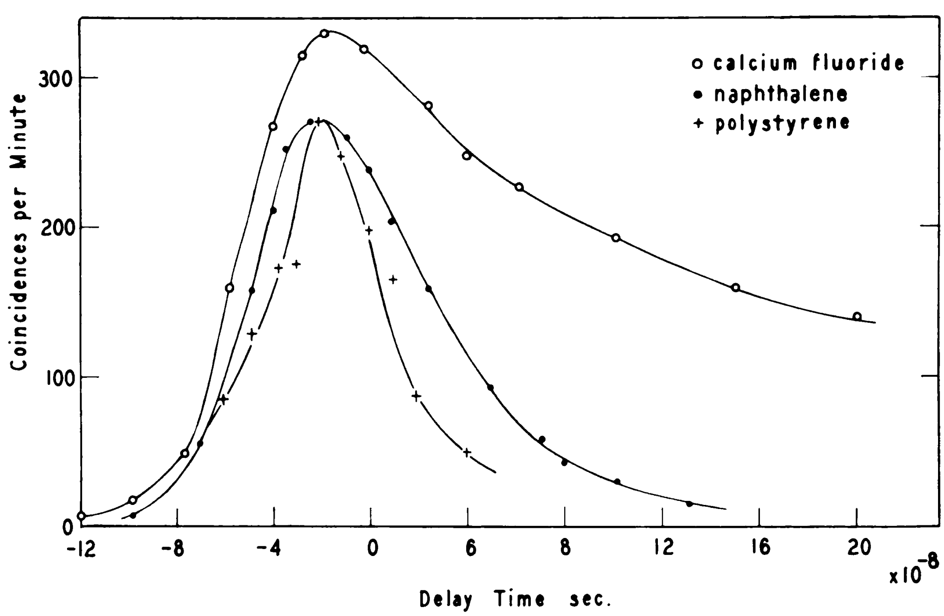


Figure 4. Delay curves taken with three scintillation counters. It can be seen that polystyrene emits light over a short time only while calcium fluoride has a definite decay time.

the fast particle has cut its swath through the calcium fluoride crystal there still remains excitation which gradually dies away with a half life of 150 milli-microseconds.

In Figure 5 are shown data taken by J. MacIntyre for an attempt to measure nuclear gamma-ray half lives. It is known that many gamma rays require for their emission a considerable structural change in the nucleus, involving a change in its angular momentum. Where this change is large, very long half lives are found and these are the reasons for nuclear isomerism. The question arises—can we measure shorter half lives where only a little change in angular momentum occurs? To try this MacIntyre has put a source which emits beta and gamma rays between a proportional counter and a polystyrene counter. The proportional counter detects the beta ray and the polystyrene the associated gamma ray. Now if there is anything like the calcium fluoride half life for the gamma ray case we should still see coincidences when the beta ray counts are delayed. For Na^{24} and Mn^{56} as can be seen in Figure 5 there is no evidence of a half life. For Au^{198} going to Hg^{198} there seems to be a possibility of a half life. This seems to be 20 milli-microseconds.

In Figure 6 data taken by the author and J. MacIntyre are shown. Here the particle sent through the beta ray counter was a positron and

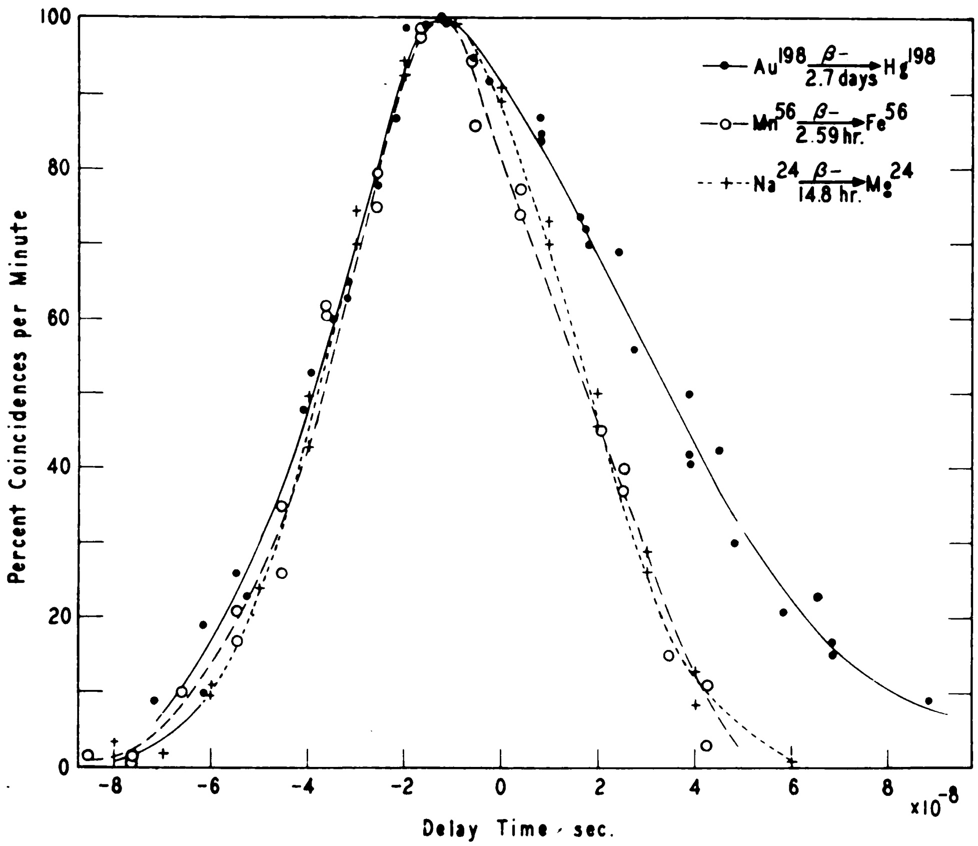


Figure 5. Delay curves for coincidences between beta and gamma rays for three radioactive elements. It seems likely that the case of Au^{198} differs from the other two and that there is a metastable state.

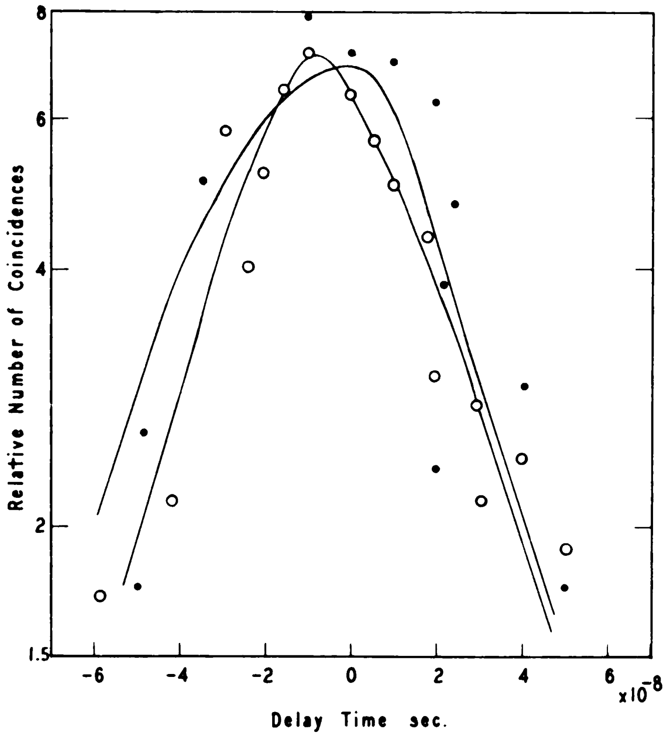


Figure 6. Delay curves for annihilation of positrons in lithium (black dots) and lead (open circles). The fact that there is no observable difference within the limits of the experiment means that the annihilation time of the positron is less than 20 milli-microseconds.

the gamma ray was produced by the annihilation of the positron, first in lead and second in lithium. No difference in the behavior when the positron count is delayed can be seen. So the annihilation time of the positron must be very short—even in lithium it is less than 15 milli-microseconds.

We hope to find more short half lives. Coincidences between protons and gamma rays will be studied by D. Binder using the cyclotron. With amplifiers of greater band-width and better counters we may be able to measure even shorter time intervals. In the meantime we are looking within milli-microseconds of time to see if we can catch the nucleus doing things we didn't suspect.

* * * * * *

Arctic Summer 1949

by
M. C. Shelesnyak
Arctic Research Institute of North America

Early in 1946, the Arctic Institute of North America initiated a program called, at that time, the fellowship program, sponsoring investigators interested in carrying out field work in the Arctic. Since 1947, by contractual arrangements between the Office of Naval Research and the Arctic Institute of North America, an increasing number of interested and competent investigators have been conducting field research in the Arctic. This is a report of the activities during the summer season of 1949.

Scientists and their helpers ranged across the northern sections of the western hemisphere from the westernmost island of the Aleutians eastward off the coast of Labrador and Newfoundland and from Point Barrow, Alaska on the Beaufort Sea and Devon Island in the Canadian Archipelago as far south as the Juneau icefields and the southern tip of Newfoundland. Let us make a flight—an imaginary flight—and drop in on the various scientific teams to take a quick look to see where they are and what they are doing in the summer of 1949.

At Attu, we find Dr. William S. Laughlin, who in 1949 was associated with the Peabody Museum of Harvard University and who is now Professor of Anthropology at the University of Oregon. With him are two colleagues, Donald Marsh, student of linguistics from Columbia University, New York, and a student assistant, F. A. Milan, from the Department of Anthropology of the University of Alaska. They are engaged in anthropological and ethnological studies of the Aleuts. Their work has taken them from Attu to Atka and Adak, uncovering archeological findings and conducting studies on the Aleut language, blood grouping, and anatomical folklore, in addition to other ethnological studies. They tell us that although the data is not yet conclusive, blood type examinations seem to indicate that the Aleuts are more Eskimo than Indian, since the frequency distribution of AB and NM types is definitely like that of the Eskimo. Moreover, it is interesting to find that of the three dialects of the Aleut language which the investigators are working out, the one most closely akin to Eskimo is the dialect used at Attu, the westernmost island.

Leaving Atka, we fly northeast to the Pribilof Islands, where we meet Dr. C. G. L. Bertram, who has come from the Scott Polar Research Institute at Cambridge, England, to conduct a study on the ecology of the

Dr. Moses C. Shelesnyak recently became Director of the Washington-Baltimore Branch of the Arctic Research Institute of North America. Dr. Shelesnyak received his B. A. from the University of Wisconsin in 1930 and his Ph.D. from Columbia in 1933. From 1942 to 1946 he served as a Lieutenant Commander at the Naval Medical Research Institute at Bethesda, Md., and subsequently became Head of ONR's Human Ecology Branch, where he was active in food studies and stress physiology research and served as Executive Secretary of the Arctic Research Advisory Panel.

fur seal and the seal industry. Bertram, a renowned biologist interested primarily in ecological studies, has done a great deal of work in the Arctic. He reports with great enthusiasm the remarkably efficient management operations that are being conducted, but is somewhat concerned about the fact that fundamental biological studies have not been keeping pace. Bertram raised the question that although the seal herd has increased remarkably over the past several decades, it appears now to have reached a biological plateau. The group at the Pribilof Islands are in the midst of their annual seal slaughter as we leave them to fly northeast to Cape Denbigh on Norton Sound.

At Cape Denbigh, Professor J. Louis Giddings of the University of Alaska, his wife, and a student assistant are redigging and extending their archeological field work of previous seasons. More new material seems to point to the existence of an extremely early man on the Alaskan shores. It suggests Yuma and Folsom sites. While studying the early relics, Professor Giddings continues his tree-ring dating program. By this method, he is able to date with relative accuracy many of the early historic and prehistoric events and conditions which have taken place in the north country.

The weather clears and an opportunity presents itself for us to leave Cape Denbigh and fly due east along the Yukon to the Tenana and then up the Tenana to Fairbanks. At Fairbanks, we drop in to see Professor D. B. Shimkin from Harvard University. He has been conducting a comparative geographic study of the Alaskan area. With the wholehearted cooperation of the Alaskan officials, he has collected a tremendous amount of economic and geographic material. From his preliminary surveys, he believes that the three most important problems in Alaska at present are: (1) the high cost of living, (2) the very poor and inadequate housing, and (3) the extremely inadequate medical facilities.

We depart from Fairbanks early the next morning by courtesy of the Officer in Charge of the U. S. Naval Petroleum Reserve Number IV and the Arctic contractors, and fly to Barrow, Alaska. At Point Barrow, the U. S. Navy has a large Naval Petroleum Reserve Number IV Field Headquarters. The Office of Naval Research has also established an Arctic Research Laboratory at Point Barrow which is available to competent scientists interested in Arctic research. At the Arctic Research Laboratory four scientists are supported by the Arctic Institute of North America. Here, Dr. X. J. Musacchia from the St. Louis University is carrying out physiological studies on the metabolism of fat of Arctic animals. This is a continuation of work which was started a year ago when he was at Point Barrow with his professor, Charles G. Wilber. Dr. George A. Llano of the Smithsonian Institution is working up cryptogamic botany of the regions and is making an extremely thorough and comprehensive collection of lichens, fungi, and mosses of these regions and other parts of the 37,000-square-mile area known as Petroleum Reserve Number IV. Lloyd A. Spetzman of the University of Minnesota, who is working under the guidance of Professor William Cooper and is now in his second year at Barrow, is collecting botanical information and specimens for further study on the university campus. Dr. Spetzman has had the good fortune to have a number of collections presented to him by people in the region who have been botanizing the area. The senior scientist of the group, Professor Neal Weber of Swarthmore College, who is spending his second summer in this area, is amassing

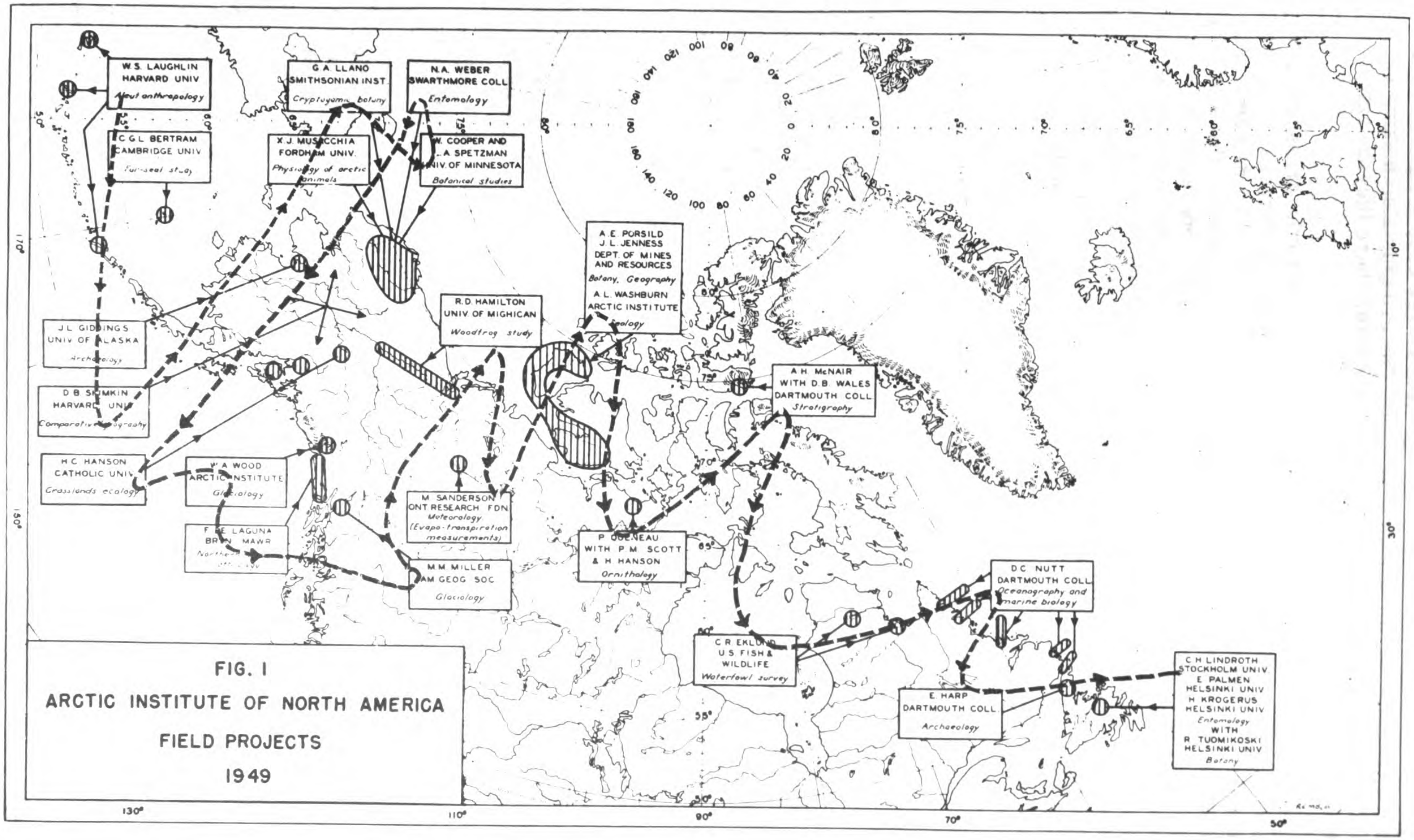


FIG. I
ARCTIC INSTITUTE OF NORTH AMERICA
FIELD PROJECTS
1949

a tremendous amount of new information specifically about insect forms and insect life in the Arctic and in general a large body of natural history information. As we prepare to leave, the group is also making ready for a trip—a flight back into the Brooks Range, where they are extending their studies.

Flying south again through Fairbanks down to the grasslands, we stop to see Professor H. C. Hanson of the Catholic University who has been collecting material to study grassland ecology. To determine the chief kinds of grasslands, the composition of the vegetation, the relationship to topographical soil and climatic factors, the geographic distribution of each kind and the successful sequence values for grazing and farming and general wildlife management, Hanson has visited and collected at many sites. Among these are: Homer, Matanuska Valley, Talkeetna Mountains, Goose Bay, Upper Matanuska Valley, Big Delta, Tenana River, Eagle Summit, Kotzebue, Healy, Mount McKinley Park, and nine stations in Kodiak.

We leave Hanson and his grassland studies to join the Snow Cornice Glaciological Research Station at the Alaska-Yukon Boundary on the Seward Glacier. Here, under the guidance of Walter A. Wood, Director of the New York office of the Arctic Institute of North America, a field party of over 20 members has been established for the second year to conduct glaciological, geophysical, geological, and botanical investigations in addition to correlative studies. Their Norseman aircraft with modified ski-wheels has been extremely active and as we are about to leave the glacier, the Norseman returns from a seven-station survey conducted in one day. Dr. Robert Sharp of the California Institute of Technology is the scientist in charge and he busies himself not only with the coordination of the various researches, but with his own geophysical investigations into the depth and movement of the glacial ice. ("Glacier, Historian of the Weather," by Robert P. Sharp, Research Reviews, July 1949.)

Down from the glacier and along the Alaskan Highway, we find Frederica de Laguna, anthropologist from Bryn Mawr, who is associated with the University Museum of the University of Pennsylvania. She is conducting ethnological studies among the northern Tlingit Indians.

Up again on the Juneau Ice Cap, we drop in on Maynard M. Miller of the American Geographical Society, who is a member of a team studying the glaciological behavior of the Juneau Ice Cap. The western hemisphere glaciers are not as adequately studied nor as well known as those in the eastern hemisphere and, to validate Hans Von Ahlman's important glacial theories, western hemisphere glaciers need more study. This is part of that program for the study of the western hemisphere glaciers.

North again over the mountains to the Alaska-Yukon Border, where we find Mr. R. D. Hamilton of the University of Michigan conducting his ecological study on the wood frog. In his second season, he is following the habits and behavior of a uniquely sensitive frog, in order that the relationship of microclimate to biological responses can be better understood. He tells us among other things that following this summer's work, he is planning to join Dr. MacGinitie at the Arctic Research Laboratory at Point Barrow and spend the entire year carrying out Arctic research.

South and east again to Norman Wells, where, at Fort Norman, Marie Sanderson of the Ontario Research Foundation is conducting meteorological studies. The evapotranspiration measurements and methods developed by Thornthwaite of Johns Hopkins University at Seabrook Farm, N. J., are being checked for their validity in northern climates. The equipment is well set and operating. It is too early to comment on the findings.

We leave Norman and fly to Aklavik and on from Aklavik to Holman Island, where Dr. A. L. Washburn and Mrs. Washburn are carrying on geological investigations in an attempt to clarify glacial and geomorphological problems in general and certain problems of ground frost in particular. Polygons and frost phenomena are holding the Washburns' attention. However, in addition to the geology, Mrs. Washburn finds time to botanize and collect material for her friends at the Ottawa Museum.

Good weather gives us an opportunity to fly across most of Victoria Island and down Queen Maud Gulf and land at Perry River. At Perry River, Paul Queneau, Peter M. Scott and H. Hanson are conducting a combined waterfowl and geographical study. Queneau has spent several seasons in the Arctic, primarily interested in the breeding of waterfowl. Hanson, from the University of Illinois, is the geographer of the party and is carrying on studies within the sea coast, particularly studies of a quadrangle bounded by Ellice River, McAlpine Lake, and Armark River. Particular emphasis is placed on the area immediately surrounding the lower reaches of the Perry River. Terrain reconnaissance, solar position fixes which are being made indicate that substantial additions and corrections are required in existing maps of the region. Meteorological observations have been taken and ice conditions studied and reported. Hanson tells us that the ice conditions on Queen Maud Gulf were the most severe in living memory. The third member of the party, Peter Scott of Slimbridge, England (son of Scott of the Antarctic) was the second ornithologist in the group. Most of the time is being devoted to wild geese and ducks, but the small mammal population studies are also being done on the ground squirrel, some lemmings and the red-backed mouse. This red-backed mouse was not previously known to occur on the Arctic coast.

From Perry River we fly north and east to the seventy-fifth north latitude, where at Devon Island Donald B. Wales of Dartmouth College is doing a geological and stratigraphic study. Wales joined the Task Force for the Resupply of the Weather Stations and is now spending two very intensive weeks on the ground. He has collected over 250 lithologic samples and fossils from 26 horizons. These fossils represent fauna from the middle and upper Cambrian and lower and middle Ordovician periods.

As we leave Devon Island, we have an opportunity to fly down between Greenland and Baffin Island and as far south as Crystal One, Fort Chimo, Ungava, and then back over to Payne Lake on Ungava Peninsula. Here we find Carl Eklund of the U.S. Fish and Wildlife and his biologist pilot, Leonard Pool, who are conducting a waterfowl study and a general biological survey of this poorly known peninsula. Eklund and his pilot have just completed an aerial census of the Black Duck and are collecting blood samples from various birds for the study of leucocytozoans. The mosquitoes are fierce, but we are enjoying testing some of the new repellants that Eklund has with him for evaluation. By good fortune, we run across Professor Nicholas Polunin of McGill University, who joined Eklund's party for a few days to aid in the identification of various plant material.

After we leave Ungava Peninsula, we fly down to see E. H. Kranck of McGill University, who is on a geological survey of the Labrador region.

We join, in the Strait of Belle Isle, Commander D.C. Nutt, skipper of the schooner "Blue Dolphin". This hundred foot, three-masted schooner has been converted by him to an Arctic research vessel. This is his first cruise in this vessel and is in a sense a "shake-down" cruise. Aboard the vessel, Mr. Nutt is carrying a crew of 20, of whom 17 are devoted to scientific investigation: oceanographic, marine biological and littoral, in addition to hydrographic measurements. As we sail down to Corner Brook, Newfoundland, we are joined by Elmer Harp and his student assistant from Dartmouth College, who were on an archeological expedition, part of the combined program of the "Blue Dolphin". Earlier during the summer, Harp had been debarked and worked his way down collecting interesting information about archeological sites, the study of which will probably give us a clearer picture of the movement of man across the Strait from the mainland to Newfoundland.

We leave the good ship "Blue Dolphin", now homeward bound early in September, and meet with a team of four scientists who came to Newfoundland from Europe and who conducted a coordinated entomological and botanical study in Newfoundland during the summer. They had spread and traversed many sites in Newfoundland and now having rejoined prior to returning to their homes, we had an opportunity to see the tremendous amount of material which C. H. Lindroth of Stockholm and E. Palmen, H. Krogerus, and R. Tuomikoski of Helsinki had collected. Their enthusiasm about the summer's work was high and they had the strong feeling that they had enough material to devote at least a year to working up, sorting, studying, collecting, and analyzing. They felt that much of it was new and heretofore unrecorded.

Here we ended the survey of the field projects supported by the Arctic Institute of North America in the summer of 1949. As we look back, we are aware of the fact that almost all of these were supported by funds made available by the Office of Naval Research, but not all. The exceptions were Walter Wood's glaciological study "Snow Cornice", of which only Robert Sharp's work was supported by the Office of Naval Research, Dr. A. L. Washburn's geological study on Holman Island, and Marie Sanderson's meteorological study at Fort Norman.

The summer work leads naturally to working up and analyzing the data during the coming winter and spring. As time goes on, each investigator, and each team will prepare and submit a full report. The writer, however, returns from his imaginary aircraft to his real desk and finds over 40 new applications for grants-in-aid in order to conduct research in the Arctic in the summer of 1950. Planning has begun.

* * * * * *

The Bio-Mechanical Knee

by
Lawrence Edwin Abt and Adassa Whitman
New York University

In 1946 it did not seem to be an unreasonable task to investigate locomotion and the available artificial limbs in an effort to construct better prostheses for the ever-growing amputee population. After a careful study and survey of the question in terms of engineering principles, however, it became apparent that construction of a sound prosthesis would involve contributions from several fields of research.

And so, the Bio-Mechanical Knee Project at New York University invited the help that psychology, medicine, limbmakers, and training specialists could offer. It was quite clear that the development of a better artificial limb requires not only a sound prosthesis, but an understanding of the person who must wear it. This re-orientation prompted a new direction in the research in terms of what the psychological, medical, and training problems are that come into play before the amputee can utilize a new device to its maximum advantage, and what mechanical device would best meet the needs of a person who has an above-the-knee amputation.

At this time three trends within the project were clearly discernible—first, the basic engineering research, second, the fundamental psychological research, and last, the convergence of these two in the practical service testing of newly developed devices. It is the preliminary development in each of these areas with which we are concerned.[1]

The core of the investigation from the engineering point of view was to determine the static and dynamic balance of the human body during locomotion as related to the leg and knee, and to incorporate the conclusions from this research into a device for above-the-knee amputees; hence, the name, bio-mechanical knee.

---

[1]The investigations reported here are derived from the exploratory study conducted at New York University, the Research Division of the College of Engineering, under contract to the Office of Naval Research.

Lawrence Edwin Abt, research associate, College of Engineering, New York University, received his Ph.D. in Psychology from that University where, since January 1947, he has directed the psychological research projects of the Research Division, College of Engineering. At present he is working on a human engineering project for the Special Devices Center, Office of Naval Research. During the war, he spent four years as an officer in the Naval Reserve.

Adassa Whitman, is a research aid, and holds a B.A. degree from Hunter College. New York City.

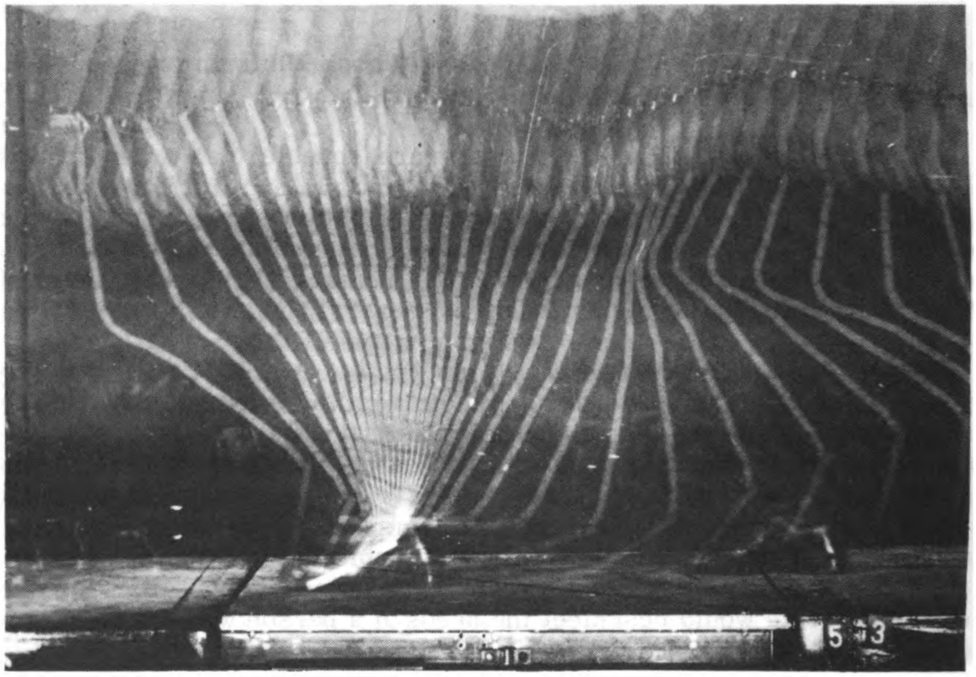


Figure 1. Stick diagram of an above-the-knee amputee walking across Force Plate.

A force plate was developed to measure ground reactions during walking. Fifty-eight above-the-knee amputees who participated in the intensive study were analyzed in terms of force plate data (Figure 1). The information obtained from this study included the amount of restraint in the knee and the variations of forces and moments during walking.[2] Once having accumulated this basic information, the staff applied the theoretical implications to a mechanical unit. Having met this practical test, the mechanical unit was to be incorporated in an artificial leg and given to a professional pilot wearer for testing.

The psychological studies were, for the most part, considered a pioneering effort in the field and were exploratory in nature. The experiment was designed to test the validity of a number of hypotheses in many areas of human behavior in an effort to provide workers in the field with practical and useful data which could be subjected to further experimental validation. This approach seemed advisable and desirable since information about an amputee's adjustment to an artificial limb was not available. Any attempt to test a single hypothesis that might result in fruitless data would leave the field relatively barren.[3] The psychological study, therefore, concerned itself with (a) a survey of amputees, limbmakers, and orthopedic surgeons to investigate some of the

[2]Supplementing this study the engineering unit was concerned with time and motion characteristics of amputee gait, the relation of the knee center to gait, and toe and ankle motion. Also under consideration for study was the adaptation of power motivation and the possible materials for the construction of artificial limbs.

[3]"Proposals for Change in Experimental Design of Amputee Project": Interoffice communication, New York University, College of Engineering, Research Division, May 27, 1947, by Sidney Fishman.

agreements and differences of opinions of the problems of amputations, and (b) an intensive study of forty-eight above-the-knee male amputees to determine the personality and behavior characteristics that characterize good adjustment to a prosthesis. Good adjustment in this study was defined in terms of the amputee's attitudes toward the surgeons, limbmakers, family, and to jobs held or sought, as well as in terms of adequate use of an artificial limb.

This dichotomy in the intensive study permitted a thorough investigation which incorporated accepted psychological principles. In one study the Wechsler-Bellevue Intelligence Test, the Bell Adjustment Inventory and the Seitz-McFarland P-S Inventory were used as well as such projective techniques as the Rorschach, Thematic Apperception Test, and Draw Two Men and a Woman Tests. The results were correlated against efficiency of gait as determined by a board of experts. The experts were a physiotherapist, an orthopedic surgeon, and an anatomist. A neurologist conducted complete neurological examinations for each of the amputees before his acceptance in the intensive study to insure the adequacy of the sample and the control of the experiment. The study of attitudes consisted of a specially devised sentence completion test, vocational rating blank, and amputation questionnaire along with a clinical interview and the judgments of gait analyses for each subject.

After investigating the field, the engineers analyzed the data, applied theory to practice, tested and discarded certain new devices, tested and improved other devices, and developed an artificial leg for above-the-knee amputees embodying several of the recommendations indicated by their research. Although it was generally maintained that the prosthesis based on the principle of the rotary damper is to be preferred, the expense of production and the need for an oil of proper viscosity with the necessary temperature-viscosity gradient, which is as yet unavailable, precluded the fabrication of this type of device for testing by a pilot wearer. The piston damper is therefore used in place of the rotary damper. Positive restraint, automatically controlled, is maintained about the knee, and an effort to reduce untimely locking must be provided. This is of real importance since an amputee cannot keep his balance without a stabilizing moment about the knee joint, but to do this without a stabilizing device he must maintain himself in a certain position contrary to good walking characteristics.

Another recommendation for an improved prosthesis is an ankle push-off mechanism with the motion produced by the artificial leg itself rather than from the stump of the amputee. Similarly a toe pick-up device would also improve the efficiency with which a prosthesis may be used, while reducing the effort on the part of the wearer. The position of the knee center also influences the gait of an amputee. When the knee center is placed forward, the leg is easier to move but more unstable, and when the position is back, the reverse is true.

Research on the mechanical damper and on the power leg indicated such disadvantages that they have been excluded from further consideration in these prosthetic studies.

A material which proved to be better than wood in the construction of improved artificial limbs is Fiberglas. However, the expense of the preparation of a mold for each man would be too great to justify its acceptance over wood.

Along psychological lines certain problems worthy of further investigation became obvious. The questionnaire surveys revealed a number of divergent conceptions of the problems involved in prosthetic services by the groups who must work so closely together. Some interpretations of the data follow.

The possibility that the limbmaker is not using adequate means for conveying information to the amputee or that he may offer only descriptive information concerning the troubles encountered with artificial legs without providing suitable suggestions concerning the manner in which these obstacles may be overcome.

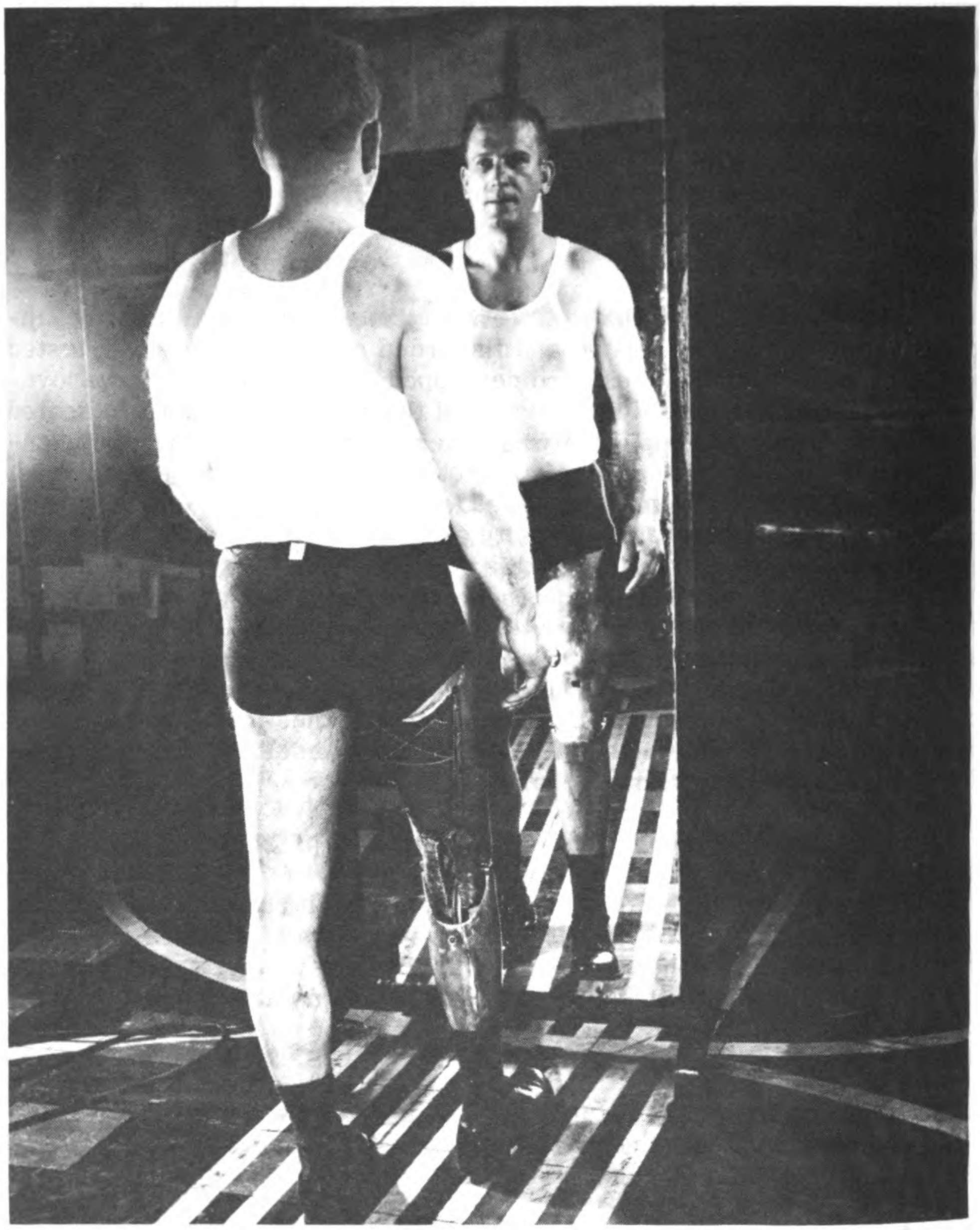


Figure 2. Amputee examines new leg. The mechanical knee contains suction pockets.

Figure 3. Above-the-knee amputee testing an experimental knee stabilizing device.

Ample opportunity may not often be made available to the amputee to consult with the surgeon following the amputee's initial period of hospitalization.

The training program is a vital phase in the over-all process of efficient application of and adjustment to a prosthesis.

The prestige of the surgeon greatly over-shadows the position of the limbmaker or limbfitter. Consequently the expressions of aggression are directed toward the limbmaking group rather than toward the medical profession.

There seems to be an over-all need on the part of the limbmaking and surgeon groups to develop a program of close cooperation which would permit both groups to pool their resources in order to provide the amputee with the most efficient services in the areas of amputation and prosthetic fit.[4]

[4]Project Staff: "Problems in the Fitting and Servicing of Prosthetic Devices for Above-the-Knee Amputees," New York University, College of Engineering, Research Division, December, 1948.

From the intensive study utilizing the Rorschach Test it was learned that the efficient walkers in the amputee group are more productive of responses than the inefficient group; that the efficient group is characterized by more energy, drive, and ambition; that the efficient subjects have greater affective adaptability, and exercise more effective rational control in the face of emotion pressures upon them. It must be borne in mind, however, that the efficiency of these subjects was determined by a board of experts who evaluated the gait of each amputee in terms of the normal criteria of good walking. They used the medium of motion pictures with little control of the difficulties inherent in this procedure. Also cautious application of the Rorschach Test is advised in this area until such time as standards for interpretation of Rorschach Test protocols for physically deviant persons are developed.[5]

Of the predictions of behavior which have been made in the study of attitudes, 40 percent have been proved correct. In terms of the dynamics of self-concept it was learned that psychologists are able to predict the behavior of an amputee, and therefore his adjustment to a prosthesis when considering his behavior in relation to his job, his prosthesis, his amputation and to other people. While all this has been scientifically validated, there exists as yet no explanation of the failure to predict accurately for the other amputees in the study. One significant result of this investigation, however, is that regardless of the excellence of over-all rehabilitation, the amputee's most difficult adjustment is to the physical disability itself.

While for basic research criteria either of these inquiries, the engineering and psychological, meets the requirements of good scientific investigation, the real contribution develops from their merger in a service testing program. This is a study designed to test new devices and to determine their advantages and disadvantages in daily living activities. It is conducted concurrently with the fundamental research, and engineers, psychologists, training specialists, limbfitters, surgeons, and professional amputee pilot wearers each evaluate the new devices before they are recommended for general use. The rigid requirements of each of these specialists insure the adequacy of any new prosthesis from its construction to its performance in daily activities via training and amputee cooperation. Experiential facts in this way become available and serve to challenge theoretical data resulting in maximum efficiency for improving artificial limbs.

[5]Project Staff: "The Personality Characteristics of Forty-Eight Above-the-Knee Amputees," New York University, College of Engineering, Research Division, October, 1948.

On the Naval Research Reserve

New Reserve Unit at Dartmouth

Naval Research Reserve Unit 1-7 was activated at Dartmouth College on December 13, 1949. Members of the new unit, which will keep naval reservists informed of the latest developments by the Office of Naval Research, include residents of Hanover and Lebanon, N. H., and Springfield, White River Jct., Windsor, and Woodstock, Vt.

Pictured above at the activation ceremonies are, left to right: Dr. John Sloan Dickey, president of Dartmouth; CAPT C. L. Westhofen, USN, head of the Air Branch, ONR-Washington; CDR George Z. Dimitroff, USNR, professor of astronomy at Dartmouth and commander of the new unit; LCDR Sumner S. Atherton, USNR, of West Lebanon, N. H., executive officer of the new unit; and LCDR H. Wray Rohrman of the First Naval District, who represented CAPT A. L. Pleasants, commander of the ONR Boston Branch. (Dartmouth College News Service Photo)

TRAINING DUTY FOR RESERVISTS AUTHORIZED

Annual training duty with pay and allowances is again available to volunteer reservists. The Commandants have already been allocated funds for this quarter covering such duty and it is anticipated that limited funds will also be made available for next quarter.

The provisions governing eligibility for training duty, and other pertinent information are contained in the authorizing letter from the Chief of Naval Personnel (Pers 423 b - mjc-jmf) dated 10 January 1950.

Members of the Naval Research Reserve Nuclear Sciences Seminar held at Oak Ridge, Tenn.
November 30-December 13, 1949.

Nuclear Sciences Seminar at Oak Ridge

Fifty-four officers of the Naval Research Reserve reported for duty at Oak Ridge, Tennessee on November 30, 1949 to attend a nuclear sciences seminar.

The seminar opened with a greeting delivered by CAPT J. B. Pearson, Deputy and Assistant Chief of Naval Research, and continued for a two-week period with demonstrations, inspection trips, and lectures by top experts of the Oak Ridge Institute of Nuclear Physics, operating contractors and the Naval Medical Research Institute. Opportunities were afforded for both laboratory and field experimentation.

The lectures were fresh and stimulating and the participation in the discussion was active. It was the concensus of opinion of the visiting officers that both program and arrangements exceeded all reasonable expectations. This was due in large measure to the acumen and industry of the members of the Volunteer Research Reserve Unit 6-3 located at Oak Ridge and its Commanding Officer LCDR David J. Mallon. There being no naval activity at Oak Ridge, fourteen members of the local unit went on active duty to handle the arrangements and stand watches.

The seminar group is pictured on the opposite page. The members are, reading from left to right:

Front Row: LTJG W. G. Stockdale, LTJG A. V. Faloon, LCDR D. A. Danford, LCDR W. S. Waddel, CDR M. E. Jansson, Dr. R. T. Overman, LCDR D. J. Mallon, CDR F. J. Trost, CDR W. H. Sachs, Jr., CDR E. P. Tomlinson, LTJG G. Morelli.
Second Row: LCDR P. Busse, LCDR L. T. Miller, CAPT V. J. Linnenbom, LTJG R. W. Robinson, LTJG J. Morris, LT W. V. Miller, LT T. B. Dowd, LTJG W. A. Pryor, ENS F. K. Iverson, LTJG C. C. Nathan, LTJG L. P. Robertson, Jr.
Third Row: LCDR W. H. Davenport, LCDR C. F. Muckenhoupt, LTJG A. L. Solomon, ENS C. R. Bruce, LTJG S. E. Turner, LTJG L. Loeb, LTJG W. R. Smith, III, LTJG F. M. Bensey, Jr., LT R. H. Shaw, LTJG R. M. Gabrielson, LT A. D. Bogard, LT D. E. Howell, ENS K. W. Robinson, LCDR H. R. Hudson.
Back Row: LTJG L. M. Pease, LT W. M. Kincaid, LT R. W. Hurn, LTJG C. E. Little, LT J. L. Anderson, LTJG J. T. Holloway, CDR A. H. Tuthill, LTJG R. E. Bittle, LTJG E. W. Burdette, LTJG R. A. Chapman, LT A. Hoersch, Jr., ENS W. C. Benzing.

Third Annual Seminar Approved

The third annual Naval Research Reserve Seminar has been approved by the Bureau of Naval Personnel and will be conducted at the Office of Naval Research, Washington, D. C., 7-20 June 1950.

This Seminar will give 100 carefully selected Reserve Officers a comprehensive review of the activities of the Office of Naval Research along with indoctrination as to how a broad research program is administered. The Seminar will follow the general outline of the 1948 and 1949 seminars, which proved most successful. The program will consist of lectures by ONR Department and Division Heads, lectures by representatives from other bureaus and offices of the Navy Department, and field trips to nearby naval activities. The subject matter will include the organization, and function of the Office of Naval Research as well as present program planning. Training programs for Volunteer Research Reserve Units will be emphasized.

Inasmuch as this seminar is established for the purpose of providing appropriate training for members of the Research Reserve, it is contemplated that membership in a Volunteer Research Reserve Unit will be a requisite for receiving orders to training duty at the Seminar.

Fresno VRRU 12-4 Visits Inyokern VORU 11-1

Twelve members of Fresno VRRU 12-4 recently made an interesting week-end training trip to the Naval Ordnance Testing Station at Inyokern, Calif., a distance of about 230 miles. The members of VORU 11-1 served as hosts, guides, and lecturers.

This training tour was initiated by a request from the Commanding Officer of VRRU 12-4 via the Commanding Officer, ONR Branch Office, San Francisco, Commandant Twelfth Naval District, Commandant Eleventh Naval District, to the Commander, U. S. Naval Ordnance Test Station, Inyokern, and made possible by the endorsement, approval, and cooperation of all concerned.

Highlights of the first day's visit were: a sound motion picture, in color, of the various activities of NOTS; a lecture, "The Research Program of the Station," by Dr. N. A. Renzetti; a tour of the nine-acre Michelson Laboratory, a visit to the Laboratory shops; and an exhibit and commentary on rockets.

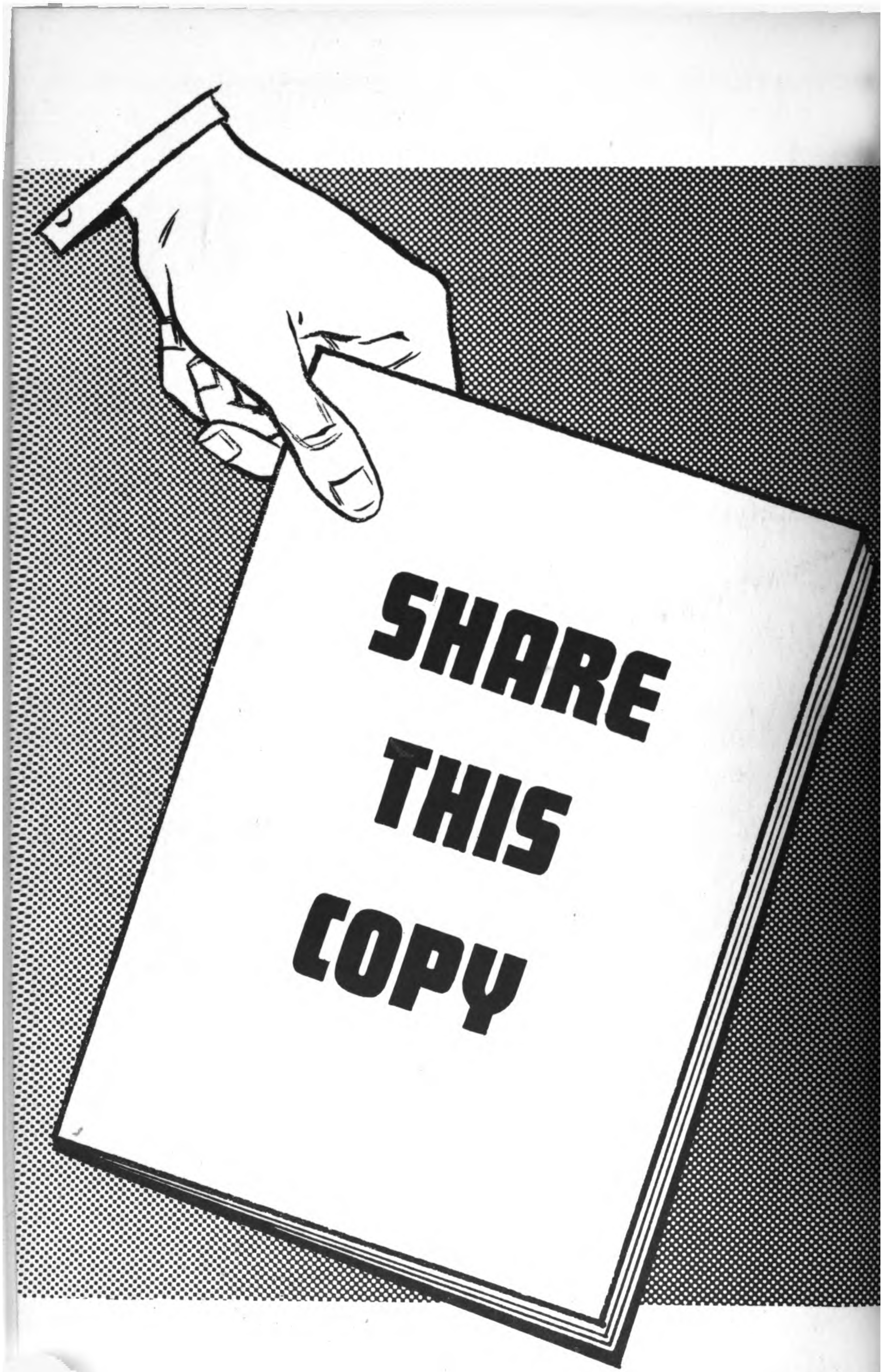
A visit was also made to the Michelson Museum which contains models of many of the famous devices and research methods developed by Albert A. Michelson, as well as copies of his numerous awards including the Nobel prize for physics.

On the second day, from 0820 to 1330, a tour of various ground and aircraft ranges and the theodolite stations was made by station bus.

The members of VRRU 12-4 were enthusiastic about this well-organized training tour and the efficient manner in which it was conducted.

Members of Volunteer Ordnance Reserve Unit 11-1, Inyokern, Calif., with their guests, Volunteer Research Reserve Unit 12-4 on an inspection trip to the theodolite camera station at U. S. Naval Ordnance Testing Station. Standing on the platform are, left to right: LCDR S. J. Gay, in charge of the Inyokern unit, RT 2/C J. P. Bowers, LCDR Forrest G. Lackland, LT A. W. Nelson, LCDR S. H. Herzog, LT Charles C. Huey, LT Donald K. Winslow, LCDR Henry Madden, LCDR Burle Claton, LT D. P. Post, LT James A. Ryles, CDR D. M. Patterson, CDR Ralph A. Jack, CO of unit 12-4, LT Elizabeth Landrum; on the steps, LT R. M. Warner, LTJG Raymond E. Fagan, and, in front, LCDR Owen F. Foin.

U. S. GOVERNMENT PRINTING OFFICE: 1950 O - 872249


SHARE
THIS
COPY