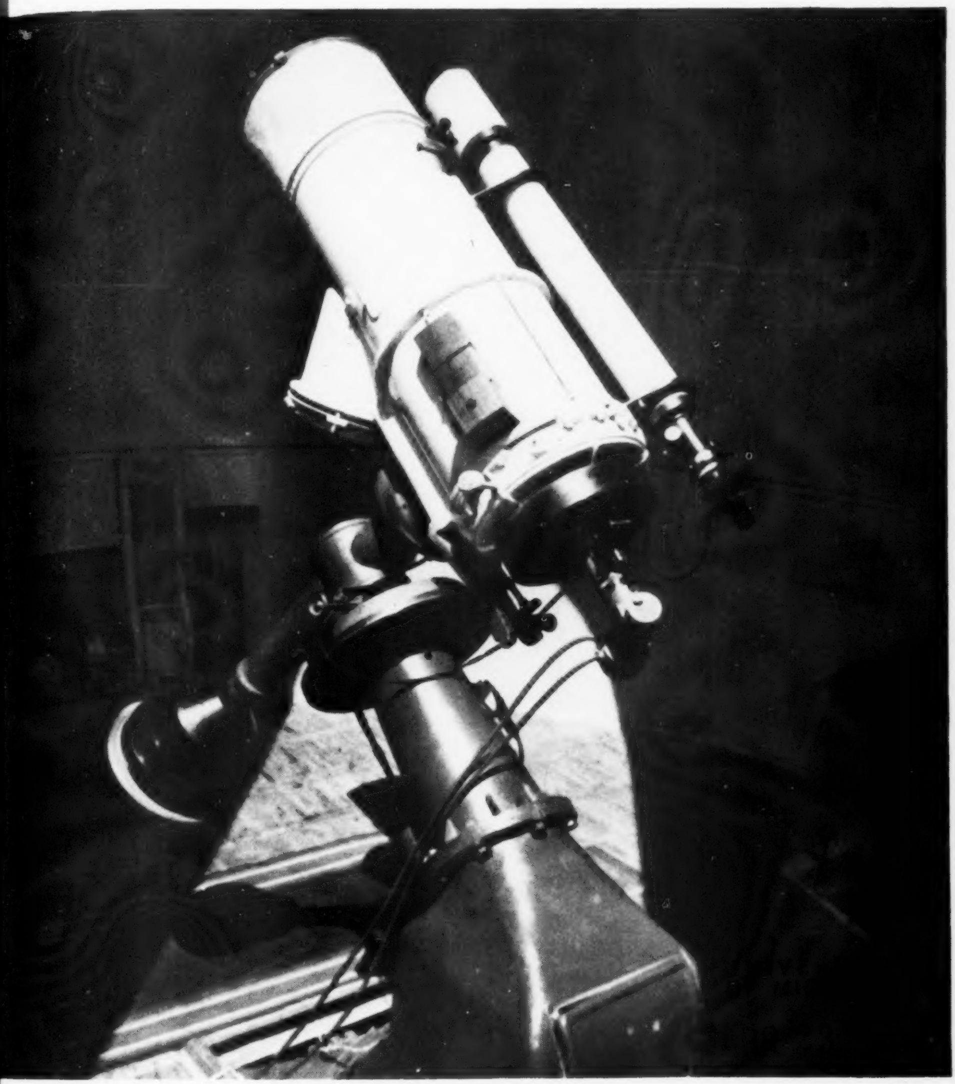
OFFICE OF NAVAL RESEARCH APRIL 1957

RESEARCH REVIEWS



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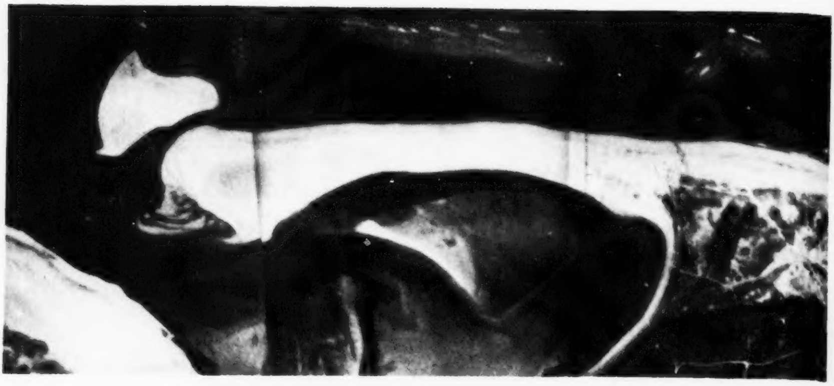

A, June 15, 1955.

B, July 14, 1955.

C, August 20, 1955.

Landward movement of a bar off Nauset Inlet, Cape Cod, Massachusetts. All photographs taken at low tide. Scale, 1/2 inch = about 175 yards.

Time-Lapse Photography--An Aid To Studies of the Shoreline

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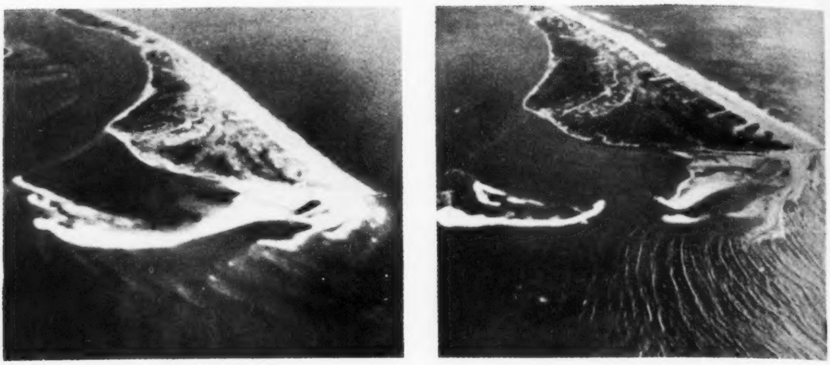
What changes do beaches undergo from day to day and from season to season? Do offshore bars come and go, and if so, why? Do inlets migrate back and forth for no reason at all or do they behave systematically? Is it possible to predict the configuration of a specific beach weeks in advance? These are some of the questions which are being studied by a group at the Woods Hole Oceanographic Institution on Cape Cod in Massachusetts. The group has found that beaches change somewhat with every tide and that every aspect of beach research must be studied in terms of changes. Even the forces of change (wind and waves) change, themselves, in complex ways. How, then, can all of these changes be observed and plotted without enormous expenditures of manpower?

Many types of periodic observations of shoreline features are being tried with varying degrees of success or failure. One of these utilizes photography. After all, photography is an inexpensive and fast method of recording changes, considering the amount of information one gets. Of course, the number of pictures to be taken depends on what is being studied. Studies of wave characteristics, for example, require more pictures than those of the movements of sand bars. The beach-studies group, therefore, has experimented with photography as a tool to aid them in describing changes which take place along the shoreline. Essentially four classes of pictures have been obtained:

- Single photographs of specific beach features.
- Aerial photo-mosaics of coastal features (inlets and bars rephotographed every few weeks to record changes). (See frontispiece.)
- Time-lapse pictures (one every two seconds for several hours) of storm waves pounding a beach. The results can be shown as a movie.
- Time-lapse aerial photographs in color (two per second) of the entire coastline of the United States from Eastport, Maine, to Brownsville, Texas. Results shown as a movie. Flights repeated at least once a year.

Of the techniques utilized to obtain these classes of pictures, only the aerial time-lapse method will be discussed here.

The camera used is a 16-millimeter magazine-loading Bell and Howell Model 200. The time-lapse triggering mechanism, which was designed by Dr. William S. von Arx of the Woods Hole Oceanographic Institution, is a simple cam and lever device operated by a 12-volt Magnetorc (Hanson Manufacturing Co.) motor. By changing the gear ratio of the motor, which is driven through a gear train, large changes in cam



A B

Figure 1 - Changes in the shape of Fire Island Inlet, Long Island, over a period of about 6 months. A, April 28, 1956; low tide. B, October 19, 1956; half tide. Tide range, 4.1 to 5 feet.

speed can be made. Small changes in speed can be made by increasing or decreasing the voltage applied. Power is supplied by standard dry-cell batteries. The motor will operate satisfactorily through a range of from 9 to 15 volts.

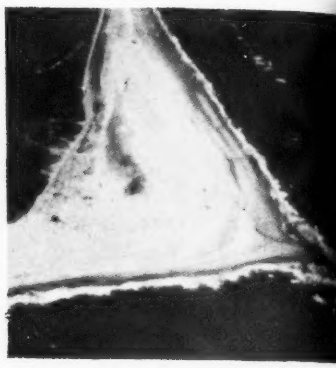


Figure 2 - Changes in the shape Cape Hatteras, North Carolina, o a period of about 6 months. A, A

The camera mount was designed so that the camera can be used from the tail hatch of the aircraft (PBY). Thus the camera looks backward. Although it is ordinarily tilted about 20 degrees downward, the degree of tilt can be changed to suit the needs of the operator or to accommodate the type of lens being used at a particular time. The camera and motor, as a unit, are fastened to a movable plate which can be rotated on a vertical axis through about 75 degrees of arc, making it possible to follow an indented coastline with the camera or compensate for minor errors in the flight course. The axis of rotation is directly under the optical center of the lens. The number of pictures to be taken per second is an important consideration. Enough pictures should be taken to show whatever changes are being studied. However, the number should not be so small as to cause jerking or jumping of the movie, or so large as to make the resulting movie excessively long. These problems have several aspects:

- Projection speed: Some projectors can be slowed down or speeded up through wider ranges than others.
- Speed of aircraft: All aerial work thus far has been done from a Navy PBY flying at a speed of 110 knots.
- Altitude: This is dependent upon weather and the characteristics of the coastline. A broken coast, such as that of Maine, is generally photographed from an altitude of 5,000 feet; a straight coast, such as that of Long Island, from an altitude of 2,500 or 3,500 feet.

The film speed for all aerial photography done by the group thus far has been two frames per second. At this rate, a 50-foot magazine (2,000 frames) is used up in 1,000 seconds (about 17 minutes), a period of time during which the PBY flies about 30 nautical miles along the coast. However, the time taken to view the movie depends on the speed at which the film is projected; at a normal speed of 16 frames per second, one sees the 50-foot reel, or 30 nautical miles of coast, in 125 seconds, or as if one were flying at a speed of about 850 knots. If the projection speed is slowed down to 10 frames per second, the apparent flying speed is about 540 knots. Of course the flying speed appears to increase if the plane flies below the desired altitude, nearby objects moving by much faster than objects farther away. If the plane flies below an altitude of 1,800 feet, as it is often forced to do by clouds and other conditions that reduce visibility, this movement becomes objectionable; individual pictures on the reel are useable, however.

A wide-angle lens (58 degrees) having a focal length of 9.5 millimeters has been used for most of the coastal photography. This lens has an advantage over the conventional 16-millimeter movie camera lens (25-millimeter focal length; 24-degree angle) in that the same ground area can be covered from an altitude only three-eighths of that which would be required by the 25-millimeter lens. Thus it is possible to continue photographing even when clouds or bad weather force the aircraft down to 1,800 feet. This means that the number of days lost on a field trip because of poor flying conditions is greatly reduced. Another advantage of low-altitude wide-angle photography is that ground haze (present to a degree even under the best of circumstances) seldom becomes a serious obstacle.

, 1956; 1 hour before low tide. October 19, 1956; 2 hours after tide. Tide range, 3.5 feet.

Figure 3 - Changes in the shape of Cape Fear, North Carolina, over a period of about 6 months. A, April 29, 1956; low tide. B, October 19, 1956; 3 hours after low tide. Tide range, 4.5 feet.

A B

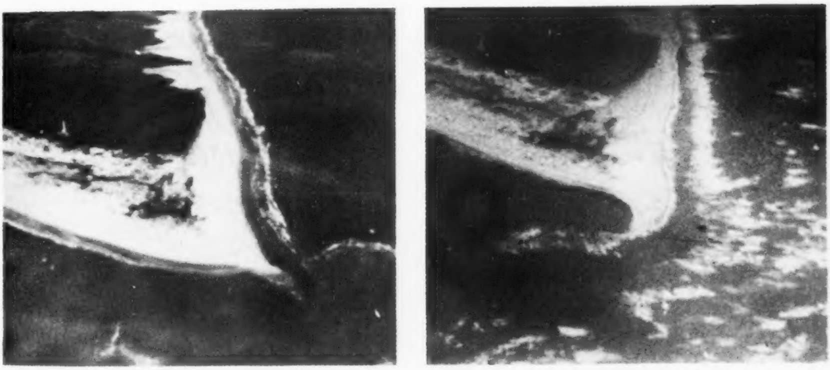


Figure 4 - Near-shore bars, Massachusetts.

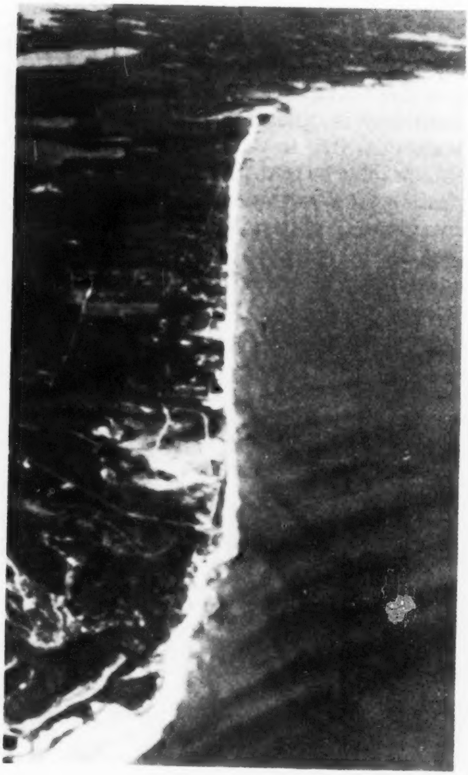
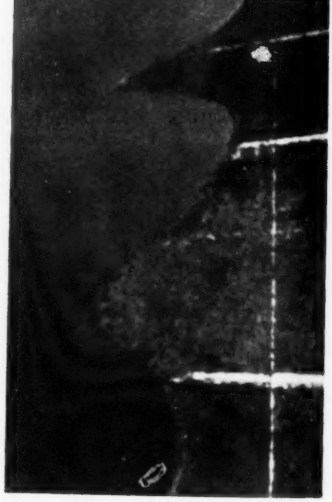


Figure 5 - Ripples diagonal to shore, Eastham, Massachusetts.

Figure 6 - Cuspate shore, Indian River, Florida.



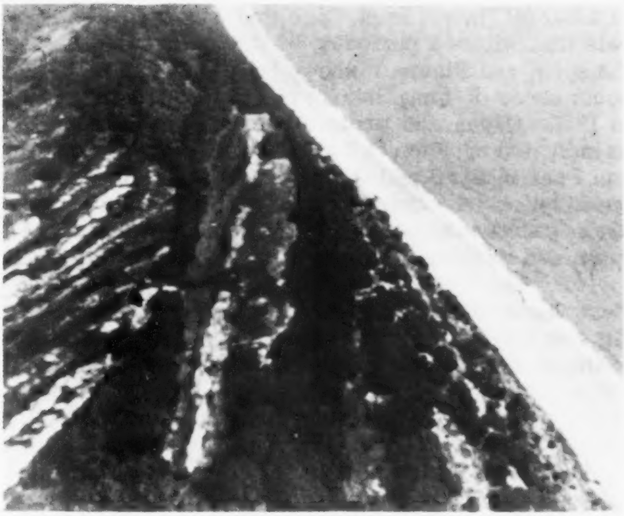


Figure 7 - Beach ridges, Georgia.

Two flights have been made along the Atlantic and Gulf coasts of the United States. On the first flight, made in April 1956, the coast was photographed from the Canadian border to a point on the west side of Florida near Venice. On the second flight, made in October 1956, the coast was photographed from Montauk Point, Long Island, to the Rio Grande in Texas, except for some of the islands off the Georgia coast. Future flights are planned for at least once each year.

Although the reasons for changes that occur along coasts are not always revealed by aerial photographs alone, the photographs do tell us what changes are taking place. Here are a few examples:

Inlets change more often and more spectacularly than any other large features of coasts. The frontispiece shows the landward movement

Figure 8 - Land reclamation near Naples, Florida.

of a bar off Nauset Inlet, Cape Cod, Massachusetts (the photographs indicate that within a period of 2 months this bar coalesced with the tip of the spit), and Figure 1 shows how the shape of Fire Island Inlet, on the south shore of Long Island, changed during a period of about 6 months in 1956. Capes and promontories change in many complex ways, too, as indicated by Figures 2 and 3, which show the shapes of Capes Hatteras and Fear in April and October of the same year. Although beaches respond quickly to changing sea conditions, the effects of such changes are not always apparent on small photographs and as yet have not been examined on the films.

Time-lapse aerial photography also provides a means of comparing similar features that occur at different geographic locations. For example, comparisons can be made of near-shore bars (Figure 4), giant ripple patterns (Figure 5), cuspate shores (Figure 6), and beach ridges (Figure 7). Although comparisons of such features merit fuller treatment that can be given them through time-lapse aerial photography, it is entirely possible that fruitful lines of investigation may result directly from what can be seen in the time-lapse movies.

The photography is expected to serve several professions. It hardly needs to be pointed out that the choice of locations and designs for engineering structures in and near inlets or other coastal features depends very much on what changes are known or are believed to have occurred in the past. Therefore, engineers who design such structures can benefit by referring to movies of the coast taken periodically. Economic geographers can benefit from the work, too. By reference to the films, they will be able to observe changes in the pattern of land utilization which take place from year to year and thus gain an insight into future problems. Of particular interest to geologists who have seen the photographs of Florida are the many reclamation projects (Figure 8). As a part of these projects, marsh areas have been filled by material pumped from the bays. Each of these developments will cause changes in water circulation and perhaps, in turn, cause changes outside the developed areas.

Thus far, most of the problems encountered in the aerial time-lapse photography have been operational, such as in maneuvering the aircraft along the coast in such a way that the tail camera can be trained on the shore, and in determining quickly the altitudes at which to fly and the approaches to make over the areas to be photographed. Most of these problems have now been overcome.

The "Cool Flame"

For years, engineers have observed a brief flicker that precedes the steady burning of a hydrocarbon fuel. The formation of this cool flame, as it is called, is directly related to the spontaneous ignition temperature, thus governing the suitability of fuels for use in diesel and gasoline engines. Recently, chemists at the Naval Research Laboratory developed a technique by which the super-quick cool-flame phase can be slowed down and analyzed. Out of this basic study, scientists are acquiring important new knowledge on the entire process of combustion.

The Influence of Communications On Opinions

Walter Weiss
Boston University

The assertion is sometimes made that greater success will be achieved in influencing the opinions of an audience if the communicator does not state explicitly the viewpoint he wishes adopted, but provides the appropriate facts and arguments and leaves it to the audience to draw the desired conclusions. The basis for this view is the belief that people resist being propagandized and, therefore, are more likely to be persuaded of a viewpoint if they feel they have arrived at the conclusion on their own and were not "pushed" into it.

But is the assertion correct?

This question and many others that might be asked concerning the influence of communications on opinions have, for the past 3 years, been the subject of a program of research sponsored by ONR and directed by the writer. Little formal justification for such research is needed. Attempts are constantly being made to influence the opinions and attitudes of all types of individuals and groups. Whether or not they are successful often has an important bearing on the welfare of the individual (which might be you) or the group (which might be your townspeople, social group, or nation). Obviously, then, an understanding of the factors that determine the development, maintenance, and change of opinions is of great practical and theoretical significance.

A gross, though reasonable classification of significant determining factors would provide for two general categories: factors considered to be external to the individual and those considered to be internal (intrapersonal). A few examples of the former are mass communications, social groups, institutions, and family; and of the latter, personal needs and motivations, values, general attitudes, and consistent reaction styles.

CONGRUENCY

Two of the early studies that were made were concerned with the effect on opinions of congruency between communication appeal and certain motivations in individuals. One of the communications contained coherent and cogent arguments for the adoption of a policy of punitiveness toward juvenile delinquents; the other appealed for a policy of leniency and understanding toward America's allies. Aggressive motivation (that is, the desire, need, or inclination to express oneself aggressively) was the intrapersonal attribute examined. In one study, the presence and degree of aggressive inclinations in individuals were determined by the use of psychological tests; in the other study, aggression was experimentally provoked in half of the people and an ego-satisfying experience was provided the other half. The results of both studies indicate that the opinion-change effectiveness of the "punitive" communication on juvenile delinquency was greater for those persons having a strong, active aggressive inclination than for those having a relatively weak aggressive motivation. However, the effectiveness of the appeal for leniency and understanding toward our allies was greater for the latter group than for the former one. Thus, it would seem that congruency between communication factors and relevant intrapersonal attributes and motivations enhances the effectiveness of a communication and that lack of such agreement reduces the effectiveness. However, even when congruency does not exist, the communications still may produce significant persuasive effects. It was further observed that the arousal of an aggressive motivation was not sufficient by itself to produce changes in opinions on either of the two topics dealt with by the communications. Apparently, such instigations predispose a person to adopt a more aggressive opinion on a social issue; but to produce a major change in viewpoint an external factor, such as a communication, is required to provide the focus for the expression of aggression.

The general hypothesis concerning the significance of congruency received additional confirmation from the results of two other investigations. In one, it was found that highly anxious people were more influenced by an appeal to consider the United States as quite capable of defending itself against biological attack than were less anxious individuals. Anxiety was measured as a general personality characteristic in this research. The data of the second investigation indicated that emotionality, or "ease of emotional arousal," is positively related to the extent of opinion influence of a communication containing a high proportion of emotionally toned words. Specifically, it was found that those individuals whose emotions are in general more easily aroused were more affected by a negative emotional description of a person than were those with a higher threshold for general emotional arousal.

DIRECT AND INDIRECT APPEALS

Will a communicator meet with more success in influencing the opinions of his audience if he provides the appropriate facts and arguments and leaves it to the audience to draw the desired conclusions? Or will he meet with more success if he states explicitly the viewpoint he wishes adopted? Recently, attempts were made by other researchers to answer this question. The results of their investigations were not consistent with each other, however, so a new experiment was undertaken by the writer's group. The results of our research indicate that an explicit statement by the communicator of the desired conclusion was somewhat more effective in changing opinions on the topic of biological warfare than was the presentation of the facts and arguments followed by a request that the reader draw his own conclusion. Furthermore, even the attribution of the communication to a disreputable source did not reverse the advantage.

THE COMMUNICATOR'S REPUTATION

There is much evidence in the research literature to support the contention that trusted communicators have greater influence on opinions than poorly regarded communicators do, even when they deliver the same communication. The data obtained from one of our studies (biological warfare) did not confirm this belief; no difference in opinion-change effectiveness was found between a credible and a noncredible communicator. This data led to the after-the-fact hypothesis that under certain circumstances the cogency of the presentation or the very nature of the appeal might be sufficiently attractive to break down the audience's distrust of the source. Confirmation of this hypothesis would clearly be of major significance.

"FLOGGING THE DEAD HORSE"

In a "natural" communication setting, an audience is often exposed to appeals from the same communicator on a variety of issues or topics. The purpose of some of these appeals may be to persuade the audience to adopt a new viewpoint; of others, to express agreement with the audience's position. It was therefore conjectured that an untrustworthy communicator would be more successful in convincing people to adopt his viewpoint on a particular issue (fluoridation of drinking water) if he expressed agreement with their position on some other topic (academic freedom) before projecting his main persuasive appeal. (This propaganda technique has been metaphorically referred to as "flogging the dead horse.") The results of our research confirmed the effectiveness of this strategy. Other data of the study indicated that a "boomerang" effect on opinions did not result from the initial statement of opinion agreement. That is, it has been thought that when people learn that a highly disreputable source holds the same viewpoint they do on a topic they will be likely to change their opinions on that topic. At least for the topic used (academic freedom) this did not occur.

EMOTIONAL LANGUAGE

The assumption that differences in emotional arousal can be effected through differences in the "emotionality" of the language used in communications was also examined. The data obtained indicated that when the arousal of negative feeling and unfavorable judgments was desired, an emotional presentation was not more effective than a nonemotional one. However, some of the evidence obtained indicated that when favorable feelings and judgments were sought, a nonemotional presentation was more effective than an emotional one. This finding, if it is confirmed in other settings with more heterogeneous audiences, will have important application in communications activity. At the very least, it discourages the adoption of the simple assumption of a one-to-one relation between the use of emotional language in a message and the arousal of emotions in the audience.

AUDIENCE JUDGMENTS

The audience not only comprehends a communication appeal but also judges it in terms of certain values. Among the many attributes that can be studied in these terms, we have been concerned with the following three: the judged fairness or one-sidedness of a communication, the judged truthfulness or untruthfulness of the content, and the judgment that the communication is or is not a piece of propaganda. It should be kept in mind that these judgments are made by the audience; consequently, they need not necessarily be in agreement with those of well informed persons. For example, a well informed person might regard a particular assertion by a communicator as being a "big lie" or sheer fabrication; yet the audience, by virtue of limited knowledge or inability to test the communication objectively, might regard it as a true report. Conversely, an objective truth may be considered a lie. Ignoring this consideration can (and does) lead to naive assumptions concerning the efficacy of "objective truth" in communications.

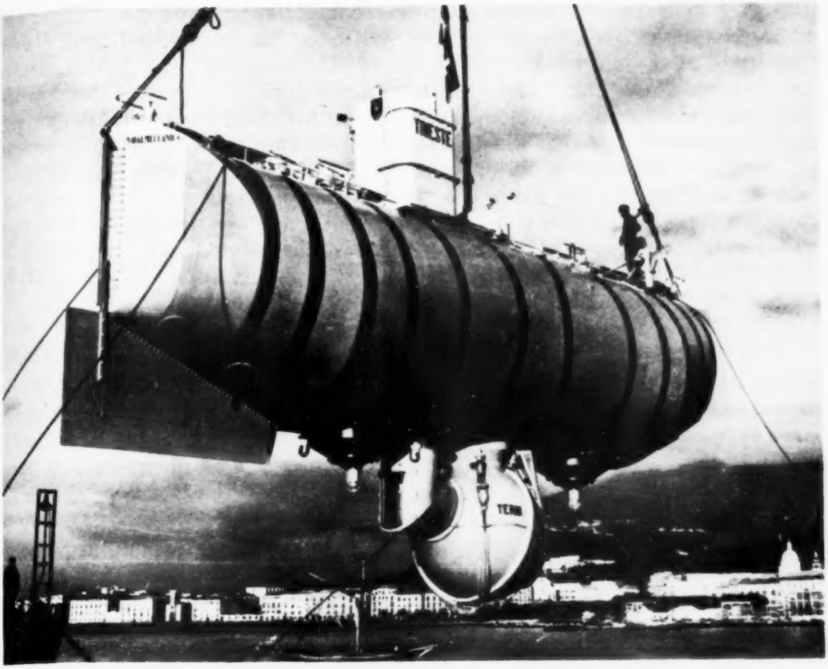
Data from some of our studies have indicated that the extent of opinion change following exposure to a persuasive communication is closely related to judgments of fairness and truthfulness. That is, people who said that the communication was fair rather than one-sided in its presentation or that the content was mostly true changed more in the direction of the communicator's point of view than did those who did not make these favorable judgments. Interestingly, the judgment that a communication is or is not a piece of propaganda is not as closely associated with the degree of communication effectiveness. There is some evidence from one of our studies that the labelling of a communication as "propaganda" is equivalent to asserting that the communicator has an "ax to grind" or that his primary intent is to persuade the audience to adopt his viewpoint. But inasmuch as these characteristics are imputed to all communicators who present with force an opposed point of view on an issue, the obtained weak relation between opinion change and judgment of propaganda is understandable.

THE IMPLICATIONS

Results so far accumulated have some interesting implications. Our findings indicate that a message is not rejected by being recognizable as propaganda or as the output of an unreliable source. The content of the message itself is a determining factor. Our results here agree with the person, quoted by the New Yorker magazine, who said, "It isn't authentic, of course, but it was worth reading just for the information in it."

The message, to be most acceptable, should not use overly emotional language, should at least appear fair, should make its point explicitly, and, most important of all, should be congruent with basic tendencies already active in the individual. Influence by association can occur when the appeal of one communication is strengthened by combining it with another known to be strongly congruent with audience desires.

If people are to be taught to resist the effects of communications, it is often urged that they should be trained to recognize the presence of "propaganda" and the use of persuasive "stratagems." However, our findings indicate that people seem to expect persuasive communications to be propagandistic in orientation and strategy. Furthermore, whether or not they label a communication as propaganda does not seem to be as intimately connected with the influence of the communication as are judgments concerning its truth and fairness. Consequently, it would seem that emphasis should be placed on improving people's abilities to distinguish between true and untrue communications. This can be accomplished not so much by learning to recognize stratagems as by acquiring the background information necessary to evaluate effectively the truth and fairness of the message.



Blimp of the Deep

One of the investigations to be carried out under ONR sponsorship during the IGY will feature a craft that looks like it might have been built to journey both in the sky and underwater. The bathyscaphe, as it is called, was designed by the famous Swiss, Professor Auguste Piccard. Although the name "Piccard" does not suggest which way—up or down—the craft is intended to go (Piccard has designed ships that go in both directions), the word "bathyscaphe" does, for it means "deep craft." As used here, "deep" means about 20 times the depth a conventional submarine can reach.

During the IGY, Auguste's son Jacques will make a series of about 15 dives in the bathyscaphe TRIESTE (pictured above) in the Mediterranean Sea near Italy. It will not be the purpose of these dives to establish depth records; in fact, the depths of the sea around Italy preclude such an effort. Primarily, they will be made to gather scientific data. In this undertaking, oceanographers from Italy, Switzerland, and other European countries, as well as from the United States, will participate. The exact nature of the scientific program has not yet been determined, but emphasis probably will be placed on marine geological and geophysical observations.

Piccard's experience with bathyscaphes goes back many years—to the 1930's, when he began work on the TRIESTE's prototype, the FRNS-2.*

*The FRNS-1 was Piccard's stratosphere balloon.

Although construction of this ship was begun before World War II, it had to be postponed because of the war and was not completed until 1948. The tests of the ship, which were made off Dakar with the assistance of the French Navy, consisted of an unmanned dive to a depth of about 4,600 feet and a manned dive to a depth of 82 feet. Although the dives themselves were successful, the ship was found to be unseaworthy while at the surface, particularly in heavy seas and while being towed. In 1950, the FRNS-2 was turned over to the French Navy, which replaced the ship's original flotation hull with a new one capable of withstanding the rigors of rough water and long tows. Also, the French rechristened her the FRNS-3. About 30 dives have been made in the FRNS-3, one of them (in 1954) to a record depth of about 13,300 feet.

With Italian and Swiss assistance, Auguste and Jacques Piccard began building a new bathyscaphe—the TRIESTE—in May 1952. Fifteen months later they had completed work on the ship and had made their first dive. During the latter part of 1953 and during 1954, the TRIESTE made 15 dives, one of them, off Naples, to a depth of about 10,300 feet. The craft is now based at a private shipyard near Naples.

In principle, the bathyscaphe is closely analogous to a lighter-than-air ship such as a balloon, or, more accurately, to a blimp, which is maneuverable horizontally. It consists of a heavier-than-water manned sphere capable of resisting the great hydrostatic pressures of the deep ocean and of a hull fitted with gasoline to provide buoyancy. By allowing sea water to enter the gasoline compartments of the hull the bathyscaphe operator can keep the internal pressure of the hull the same as that of the sea around it without losing the buoyancy the ship will need to rise to the surface when its mission is completed. Buoyancy can be further reduced by jettisoning some of the gasoline, by filling an air chamber with sea water, or by cooling or compressing the gasoline. It can be increased by jettisoning iron shot ballast. Buoyancy can be so precisely controlled that the craft can be made to rest on a guide chain on the bottom without, itself, touching the bottom.

The overall size of Piccard's two bathyscaphes was determined by the weight and size of their cabins, or spheres. These weigh 10 tons, their inside diameter is about 6-1/2 feet, and the thickness of their walls is 4 inches, increased to 6 inches near the ports, lead throughs, and entrance hatches. The primary

Auguste and Jacques Piccard

difference between the cabins of the two ships is in their crushing strength, the TRIESTE's being greater because it was forged out of high-quality fatigueless steel, whereas that of the FRNS-2 and -3 was cast. According to calculations, the TRIESTE's sphere can withstand the ocean's pressure to depths of about 45,000 feet, at which level it will collapse. Thus the craft is considered perfectly safe for dives to depths of 13,000 feet and reasonably safe for dives to depths of 19,000 feet.

Twelve openings have been built into the TRIESTE's cabin. Two of these are occupied by snorkels, by means of which air can be pumped into the cabin before the craft submerges, two others are plugged and reserved for scientific equipment, and the remainder are fitted with cables. Shorts have rarely developed in these lines, and as yet no water has leaked through the openings into the cabin.

The TRIESTE's crew observes the weird realm at the bottom of the ocean through two plexiglass windows, 6 inches thick, seated in cone-shaped ports 4 inches across on the inside and 16 inches across on the outside. One of the windows faces forward and slightly downward and the other, which is set in the access hatch, faces aft and slightly upward. The seal between the plexiglass and the cone-shaped portholes is effected by the sea itself, the pressure of which forces the plexiglass so firmly into the ports that not a drop of water enters the cabin. The Piccards claim that the ports will withstand a pressure equivalent to that occurring at a depth of 90,000 feet before yielding; thus they have a safety factor of 5 at the greatest depth to which the TRIESTE is expected to dive.

To give the TRIESTE the buoyancy it needs—enough to lift from 25 to 30 tons—about 2,750 gallons of white gasoline is poured into 12 compartments in its hull. The bulkheads between these compartments are made of corrugated steel so as to yield to compression and expansion without rupturing. Even though one compartment should be ruptured and the gasoline escape, the craft retains enough overall buoyancy to return to the surface. An additional safety feature is the provision for jettisoning ballast. If for any reason the ballast outlet becomes plugged, the entire bin of ballast, which is suspended by chains from the cabin, can be unloaded at once. In the event of power failure the bin is jettisoned automatically.

By means of the bathyscaphe, oceanographers will be able to carry out investigations that were either difficult or impossible to conduct before the craft was built. Here are a few of the ways they will use it.

- To make direct observations of the ocean bottom, of bottom currents, bottom organisms, and of the deep scattering layer.
- To study sound propagation and light penetration in the deep sea.
- To explore deep-sea canyons, sea mounts, and other underwater features.
- To examine the orientation of sediment samplers, current meters, bottom corers, and other such instruments lowered to the ocean floor from ships.

Although the bathyscaphe is still an experimental prototype and its operation is still far from routine, its future already looks bright, for it holds out the promise of making "inner space"—the vast depths of the ocean—readily accessible to man.

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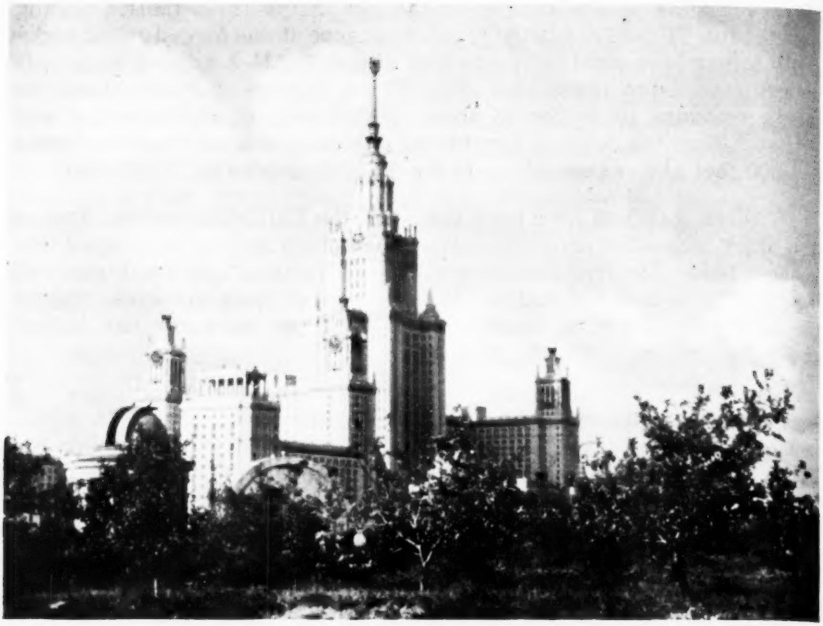


The science department of Moscow University with the Sternberg Institute in the foreground. The outer towers of the main building provide apartments for the professors.

The coelostat at the Sternberg Institute, with the mirrors covered.

Impressions of an American Astronomer In the U.S.S.R.

Nancy G. Roman
Atmosphere and Astrophysics Division
Naval Research Laboratory

By tradition, scientists are internationally minded, and in astronomy, in which a relatively small number of specialists are engaged (there are 900 members in the International Astronomical Union), international cooperation has been particularly extensive. It is not surprising, therefore, that the emphasis placed recently on cultural exchange by Russia has embraced this science. In 1954, the Russians invited a large group of astronomers from Western countries to attend the rededication of the Pulkova Observatory, which was completely destroyed during the last war. And in the summer of 1956, they arranged at least three visits for a smaller number of Western astronomers, perhaps a dozen in all.

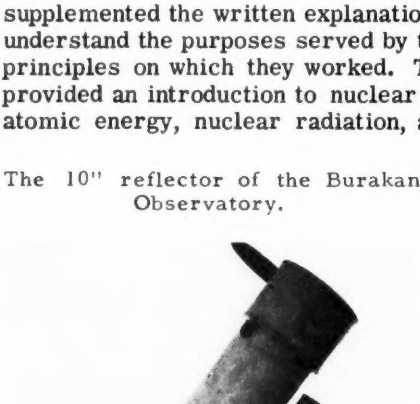
The Russians have also been holding numerous symposia for astronomers (and, presumably, for other specialists) from the satellite countries. The main purpose of these meetings seems to be to help train scientists who are just beginning to work in a field. By this means Russia is able to support the development of science in the satellite countries at relatively little cost. In addition to being of educational value, the conferences increase the self respect of those invited and, of course, add personal ties to the political ones that exist between the countries.

In late July of 1956, I received an invitation from the Academy of Science of the U.S.S.R. to participate in a symposium on nonstable stars which was to be held September 19-24 in connection with the dedication of the Burakan Observatory near Erevan, Armenia. If any single piece of work led to my invitation, it was a short paper I had once published about a star whose spectrum I discovered to be both peculiar and variable. However, my work on star clusters and associations and on the spectroscopic characteristics of stars having different space motions was in fields which are of particular interest to Professor Ambartzumian, the director of the Burakan Observatory. Also, I had corresponded with him and with other Soviet astronomers in my work as editor of a symposium on galactic structure that was held during the Dublin meeting of the International Astronomical Union in 1955.

I arrived in Moscow on September 16, and with two other astronomers from the United States and one each from Mexico, France, and Yugoslavia, spent two days in the capital before flying to Erevan for the symposium. To me, the most interesting place we visited in Moscow was the All-Union Trade and Agricultural Exhibition, the pavilions of which are devoted to each republic in the Union and to many phases of industry and agriculture. Two pavilions were particularly worth seeing—the atomic pavilion, which housed a working reactor, and the machinery pavilion, which contained an exhibit of optical and associated electronic equipment. By reference to the many models and drawings that

The main building and observing domes at the Burakan Observatory. The main building houses the library, lecture room, offices, and some laboratories. The domes to the right and left of the main building contain the 8" - 12" and the 21" - 21" Schmidt reflectors, respectively.

supplemented the written explanations for each exhibit, we were able to understand the purposes served by the equipment and often the physical principles on which they worked. The exhibits at the reactor building provided an introduction to nuclear physics, isotope chemistry, uses of atomic energy, nuclear radiation, and isotopes, and ways of handling "hot" materials. Apparently, Russian leaders are trying very hard to educate the lay public in the rudiments of science; and judging by the interest the public showed in the exhibits we visited, their efforts are meeting with success.



The 10" reflector of the Burakan Observatory.

The Sternberg Institute, which is essentially the astronomy department of Moscow University, recently moved into a building near the new science department. Some of the Institute's astronomical installations can be seen in the foreground of the photograph on the upper half of page 14. The largest of these—which is also the largest in Moscow—is a 19-meter solar tower, the equipment of which includes the coelostat pictured on the lower half of page 14. The coelostat consists of two mirrors, one of which (on the left in the photograph) continually reflects an image of the sun on the other, which reflects the image to the base of the tower, where it is studied. As the Institute is intended primarily for teaching, and as the Moscow climate does not justify a large outlay for astronomical equipment, the instruments in use at the Institute are varied but small. To compensate for the limitation imposed on the Sternberg faculty and students by the Moscow climate, a new observing station is now being built for them near the Crimean Observatory.

Our group, which consisted of six visiting astronomers, an interpreter, a translater, and several astronomers from Moscow, left the Moscow airport for Erevan early on the morning of September 19. Upon our arrival at Erevan we were photographed and interviewed by a large number of newsreel and newspaper photographers and reporters. We were then taken on a tour of the city, and finally were driven to the observatory, which is located about 30 kilometers northwest of Erevan near the small village of Burakan on the side of Mount Alagez. Russia's famous cosmic-ray observatory is located on the summit of Mount Alagez, but we did not see it. I understand that it cannot be reached by road.

The University of Erevan has had a small telescope for teaching purposes for a number of years, but it is too small and too poorly situated for modern astronomical research. Activated by a desire to strengthen Armenian astronomy by obtaining good observing facilities, Professor Ambartzumian began, 10 years ago, directing the construction of a new observatory near Burakan. This observatory, which is now in use, is fitted out with many moderate-size instruments of types that are suitable for research on stellar statistics, gaseous nebulae, and stellar

Some of the participants in the Burakan symposium. From left to right: Mr. Shetinin, interpreter; Dr. Greenstein, Mt. Wilson and Mt. Palomar Observatories; Dr. Schatzman, Institut d'Astrophysique, Paris; Mr. Mirzoyan, Burakan Observatory; Mr. Shen, Purple Mountain Observatory, Nanking; Dr. Haro, Tonanzintla and Taccubaya observatories, Mexico; Dr. Kung, from Nanking; and a young astronomer of the Burakan Observatory.

evolution. At present Professor Ambartzumian and his colleagues are interested primarily in the study of extragalactic nebulae (particularly distorted ones and those having peculiar emission features) and discrete radio sources.

The largest optical telescope at the observatory is a 21" - 21"* Martsutof Schmidt having a focal length of 180 centimeters (F/3.5) which is being used to photograph extragalactic nebulae. Of the six other instruments used at Burakan, the largest is an apparently well-designed nebular spectrograph, and the smallest, a 5-inch astrograph. A 1-meter Schmidt telescope and a moderate-size long-focus reflector are planned for the future.

In the Soviet Union, as in the United States, astronomers are now placing greater emphasis on radio astronomy. Although the Russians have at least two large radio observatories, they are not limiting their radio-astronomy program to these facilities; they are also making radio studies at each of their optical observatories. At the Burakan and Abastumani observatories simple equipment is being used to observe the sun and the brighter radio stars at several meter wavelengths.

The 3-day scientific session at Burakan was devoted to a detailed discussion of nonstable stars. Ambartzumian has suggested that the same mechanism accounts for the emission from these stars as accounts for solar flares and for that from radio stars. On the basis of the observations of polarized light from the Crab Nebula, he makes the reasonable assumption that radiation from very fast electrons moving in a magnetic field is responsible for the radio stars. A large part of the Soviet participation in the symposium was devoted to a discussion of this hypothesis. Although the idea has some merit, its application seemed too indiscriminate. Ambartzumian also emphasized the relation between cometary nebulae and T Tauri stars, ignoring other equally frequent types of nebulae. Nevertheless, the symposium amply fulfilled its purpose. A great deal of observational data was collected and many theories were examined critically.

The 8"-12" Schmidt reflector of the Burakan Observatory.

On the Sunday following the scientific session we were taken on a tour of Armenia. We visited

*These figures refer to the sizes of the correcting plate and the mirror, respectively.

the mother church of the Armenian Orthodox church during a service, a local religious shrine, and two groups of ruins. The following day we went by bus to Tbilisi and thence, by overnight train, to Akhaltsikhe, near the Abastumani Observatory in southwestern Georgia. Our reception at Akhaltsikhe, for which about 200 townspeople turned out, was more impressive than that given us by the press at Erevan. However, the arrival of any group of foreigners would probably be an important event in this small town.

The observatory is located at an altitude of 1,700 meters on a pine-covered mountain near the health resort of Abastumani. The surroundings form a striking contrast to the arid region in which the Burakan Observatory is situated. This observatory was started in 1936 by Kharadze, its director, and has been active in the field of photometry. Several moderate-size and small instruments are being used for both photographic and photoelectric photometry, for measuring the polarization of the moon, and for making solar observations.

Unlike most of the instruments at Burakan and Abastumani, the new 70-centimeter meniscus telescope at Abastumani appears to be well-designed and well built. The control console and some of the automatic features resemble those of the new Schmidt telescope of the Hamburg-Bergsdorf Observatory. The spectra photographed with this instrument are some of the best objective prism spectra I have seen.

On our return from Abastumani to Moscow, we passed through Gori. The contrast of this city, with its new houses, parkways, and well-made streets, to the other villages we had seen took me by surprise. But when I realized that Gori is Stalin's native city, the difference was understandable. We were told that Stalin's birthplace was "a few blocks that way" but were not taken out of our way to see it. In Moscow, we revisited the fair and the university, and toured the GUM department store, a book store, and part of the Kremlin. At the bookstore the emphasis on science was again noticeable.

The observatory libraries are excellent. I examined the one at Abastumani Observatory carefully. Although this observatory is new and moderate in size, its library contains almost every astronomical publication of importance. It also contains a large number of periodicals, many of which are of foreign origin, devoted to physics, mathematics, electronics, and general scientific subjects. The astronomical publications were originals, but the foreign publications on other subjects were obviously reprinted for distribution in the Soviet Union, probably by a photo-offset process. Many advanced American astronomy books have been translated into Russian and the translations have been distributed instead of the originals, although every astronomer whom I met reads English. Presumably, literature from other countries is handled similarly; I noticed a few translations of French and German books. The practice of translating and reprinting books has angered some authors because the Russians do not request their permission. The Russians satisfy their own ethical code by setting aside an appropriate sum of rubles for the author of each book translated. If the author visits Russia he can collect the money, but he probably won't be able to take it out of the country.

Each year about 20 students graduate from Moscow University with degrees in astronomy. The amount of work required of students to qualify for these degrees is probably greater than that required for our M.A. degree, but less than that required for our Ph.D. degree. Before graduating, a student must have spent a year at an active observatory doing practical work, in addition to having completed his course work and observational training at the university. Upon graduation he is given the degree of Candidate and is eligible for a scientific research position under the supervision of a more experienced scientist. The degree of Doctor is granted much later on the basis of an outstanding piece of research. Considering the number of students graduating in astronomy each year from Moscow University, and considering the fact that students are also graduating in this field from Leningrad University and other schools, it would appear that the Soviet Union is producing half again as many astronomers as the United States is. However, many of these students are trained in geodesy, which in Russia is classified as a branch of astronomy.

At the Sternberg Institute and at the observatories, the scientific staffs are at least three or four times as large as those at comparable American institutions. Most of the additional people are probably semi-research workers, that is, men and women who have college educations in astronomy but who do not have the background and experience to do independent research work, and computers. The top astronomers in the Soviet Union earn about 20,000 rubles per month. Also, each receives from the government a car and chauffeur, at least one house, and additional amounts of money for writing textbooks, technical reviews, and popular articles, and for giving talks. In contrast, the average Russian wage is about 800 rubles per month. An educated, trained, nonscientist, such as a high school teacher or a translator, earns about 1,000 rubles per month, and a computer receives from 1,000 to 1,500 rubles per month. The relatively low wage of computers probably accounts for the fact that so many of them are employed at the Soviet observatories. It may also explain why the Russians undertake many extensive routine programs—for example, the cataloguing of variable stars and of asteroids, a program which they took over from the Germans. Such investigations are necessary, but astronomers at our observatories are reluctant to begin them because the work involved is usually more than their small staffs can handle.

Although I was disappointed by some of the scientific content of the symposium and by the quality of some of the instruments at the observatories I visited, I was pleased to meet and become better acquainted with Soviet astronomers. I had the impression that they feel severely confined by the Iron Curtain and that they are very eager for personal contact with Western scientists. They are anxious for the 1958 meeting of the International Astronomical Union, which will take place in Moscow, to be a large and successful one. Although this hope stems partly from national pride, it seems also to arise from a strong desire to exchange scientific ideas.

ONR Symposium Highlights

For two full days last month—the 19th and 20th—the Office of Naval Research spotlighted the Navy's achievements in research. The occasion was the Office's 10th anniversary, and the medium was its anniversary symposium, "Ten Years of Basic and Applied Research in the Navy." Here are a few summaries of unclassified talks given during the first day's sessions:

THE TISSUE BANK

"Death, and what it means to your life," was the way G. W. Hyatt of the Naval Medical Research Institute, Bethesda, Md., described the implications of work being done at the Navy's tissue bank—a storehouse of tissues obtained from human cadavers. Begun in 1949 with 4 cubic feet of freezer space, the bank has grown in size and now meets many of the Navy's needs for tissues. By drawing on the bank, Navy surgeons can replace damaged skin, bone, cartilage, ligaments, arteries, and even the covering of the brain. Medical researchers are bearing in mind the fact that in the future greater demands will be placed on the bank, and are, therefore, conducting experiments in growing new cells from tissues obtained from living human beings. The prophesy for tomorrow is that we may be able to supply some of our needs for tissues by such artificial means.

SHIP MOTIONS

The speed of a ship moving through rough water is determined not so much by the power of its motor as it is by the motions and pressures to which it is subjected. Therefore, the study of the sea's surface, which gives rise to these motions and pressures, is a very important one. M. St. Denis, of Carderock, Md., who discussed this subject, said that the sea's surface can now be mapped in the same way topographic features of the land surface can be mapped—by means of contours. Information derived from these maps and from other studies made of the seaway can be converted into mathematical terms by means of which many of the motions to which different types of ships are put at sea can be predicted. Such analyses provide a basis for estimating the capacity of the stabilization equipment a ship needs to function efficiently and of the stresses the ship's structure must be designed to withstand.

IMPROVED CONTROL SYSTEMS

H. P. Birmingham of the Naval Research Laboratory discussed the design of improved control systems for complex modern machinery being studied at NRL. Most of the control systems that have been developed thus far by other designers take advantage of man's ability to adjust. But scientists at NRL are taking the opposite approach; that is, they are developing systems that require man to make as few adjustments as possible. Thus NRL's improved control systems are greatly simplified ones from the point of view of the operators. As well as promising more precise control, the systems will unburden the operators, allowing each to carry out several tasks simultaneously.

BURGEONING RESEARCH

An example of how research in one field can send out branches into many other fields was given by CDR Dean Farnsworth of the Naval Medical Research Laboratory, New London, Conn. When researchers discovered that many of the dot plates that were being used to test color blindness during World War II were faulty (tests given with some of the plates were, in fact, being failed by more normal-vision persons than color-blind persons) CDR Farnsworth's group began developing a fool-proof system. But in doing so, they found themselves being drawn into many other fields of research. For example, they were asked to determine the colors certain pieces of equipment, such as life rafts, should be painted to best serve their purposes, and to make job analyses in terms of color blindness. Inasmuch as the study of color goes hand in hand with that of light, it is not surprising that the group was asked to investigate lighting problems aboard ships, particularly submarines (the near-perfect lighting system installed on the SEAWOLF was developed by this group). Nor was it surprising that the group was drawn next into the field of interior decoration, of which lighting is a part, and finally into the study of habitability, in which interior decoration figures prominently. In carrying out studies of habitability, such as of air mattresses and food, the group had strayed about as far from its original undertaking as it could go.

ACCELERATION STRESS

In tests carried out on the Navy's centrifuge, chimpanzees have withstood acceleration stresses of 40 G's for 15 seconds without experiencing permanent injury, and human beings have withstood stresses of 15 G's for 15 seconds without experiencing permanent injury. LCDR B. F. Burgess, Jr., of the Naval Air Development Center, Johnsville, Pa., who described the tests, said the burden put upon a man's heart when he is subjected to an acceleration stress of 16 G's is such that the blood being circulated by the heart is equivalent in weight to mercury. The significant fact revealed by the tests is that man can withstand greater stresses than many of our present-day aircraft can.

The 2-day symposium consisted of 11 sessions, 3 unclassified and 8 classified. Titles of the unclassified sessions were Opening Session and Survey of Naval Science (2 sessions). Titles of the classified sessions were Medical and Psychological Sciences (2 sessions), Physics, Chemistry, Earth Sciences, Electronics and Acoustics, Mechanics and Engineering, and Metallurgy.

The 15 Army, Air Force, and Navy leaders and Navy scientists who, together, spoke for 6 solid hours in unclassified sessions held on the first day of the symposium, were followed by 68 scientists who spoke in classified sessions held the next day. But even this impressive array of research talent was able to do little more than scratch the surface of Naval research. Considering, however, that the Navy is responsible for a very large portion of the research done by the Defense Department, it is not surprising that a thorough accounting of the ways it is carrying out its research task would require many more hours and the participation of many more men.

A helicopter pilot carries out a difficult assignment—that of hovering a few feet above the ocean while trailing at the end of a line a device for detecting enemy submarines.

Flying Helicopters by Instruments

LCDR W. C. Casey, USN
Bureau of Aeronautics
Naval Air Test Center
Patuxent River, Maryland

Many important naval helicopter missions, such as anti-submarine warfare, plane guard, and evacuation, have in the past been impossible to conduct at night over water or during the day when visibility is poor because helicopter instruments do not provide the pilot with adequate control of the plane under such conditions.

When the helicopter is moving forward at moderate or high speed it has much the same instrument-flight capability as fixed-wing aircraft have, and standard flight instruments and navigational aids and procedures can be used to control such movement satisfactorily. However, when the pilot attempts to utilize the unique capabilities of the helicopter—that is, when he attempts to fly at very low speeds or to hover—he is faced with several difficult control problems. These problems are intensified if the helicopter is flying near the surface and if it must be held motionless horizontally and vertically.

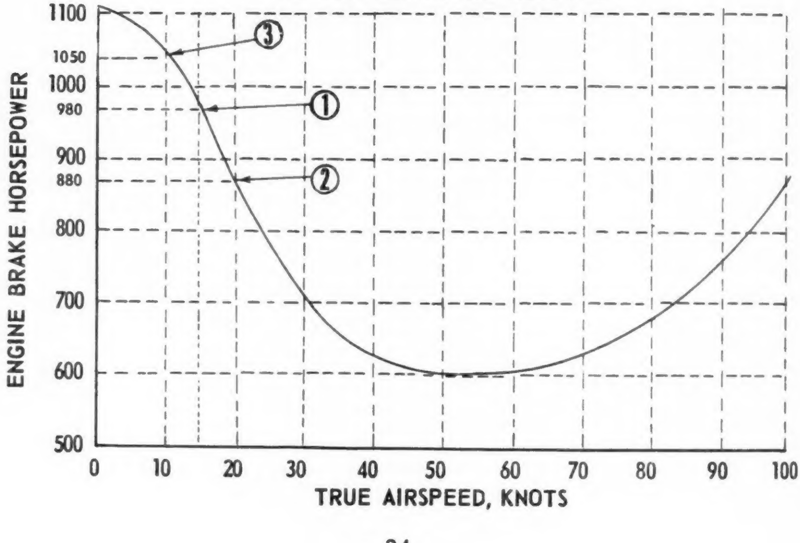
INHERENT LATERAL, DIRECTIONAL, AND LONGITUDINAL INSTABILITY

The three main types of helicopter rotors—tandem, single main rotor, and synchropter—affect helicopter stability differently, and each type provides a different degree of stability for models of different configuration. But the three rotors do have one thing in common—all fail to provide the stability that is characteristic of fixed-wing aircraft. Although efforts have been made to improve helicopter stability—for example, vertical and horizontal stabilizing fins have been incorporated into the aircraft and modifications have been made of some of the components of the control system (such as stick-trim devices, bobweights, and aerodynamic trim controls)—hovering by means of instruments is still like balancing oneself in stocking feet atop a huge, free-moving polished ball bearing.

The development of automatic stabilization equipment (ASE) has contributed greatly towards the attainment of an instrument hover capability. This equipment is now an integral part of the flight-control system of the HSS-1 and is intended for use in all modes of flight to maintain stabilization of heading, pitch, roll, and altitude. The pilot operates the system through the standard flight controls. For example, to bank the helicopter, he moves the cockpit cyclic control in the usual manner and presses a trim button; the stabilization system then maintains the bank. Another feature of the system is that the control it exercises is limited; that is, the pilot is able to overpower it manually whenever he wishes.

REGULATING ENGINE POWER

The engine power required to maintain various modes of flight is indicated by the graph. The graph shows that minimum power is required in the slow-cruise range of 40-70 knots and that maximum power is required at an air speed of zero. To hover—that is, to remain over a point on the ground—the pilot must compensate for the wind speed, which is equivalent to the air speed. He does this by increasing or decreasing the horsepower. For example, to hover into a 15-knot wind,



980 horsepower will be required (point 1 on the graph). If the ground-speed error is 5 knots forward, the air speed will be 20 knots and the horsepower required (shown by point 2) will be 880. If the error is 5 knots rearward, the air speed will be 10 knots and the horsepower required (indicated by point 3) will be 1050. Thus if the pilot maintains engine power constant, the helicopter will either ascend or descend. Obviously, such movements close to the surface are hazardous.

To overcome this difficulty it will be necessary to develop sensory devices that will measure ground speed, altitude, and vertical motion precisely. By reference to information yielded by these devices, the pilot will be able to make power adjustments as soon as the need for them arises and thereby to hold the helicopter nearly motionless. Eventually, the intelligence derived from the sensors might be fed directly into the ASE to provide automatic hovering.

INADEQUACY OF STANDARD FLIGHT INSTRUMENTS

The problem of helicopter control by instruments arises because most of the instruments used are the same types as those installed in fixed-wing aircraft. At forward air speeds greater than 30 knots these instruments provide satisfactory information, but at lower speeds they do not. The first instruments to become unuseable at low forward speeds are the pitot instruments, which are affected by the increased rotor downwash. Because of this downwash the air-speed meter cannot record forward speeds accurately and the rate-of-climb instrument functions much too slowly. While the helicopter is hovering, the barometric altimeter is rendered useless also.

The conventional artificial horizon presents helicopter attitude regardless of the plane's speed or direction of flight. However, if that attitude is disturbed by a gust of wind the helicopter may climb 50 feet before it can be restored. Changes in attitude that must be made to maintain a hover are so precise that a small artificial horizon display is unduly restrictive. The turn-and-slip indicator is quite meaningless during hover.

HUMAN FACTOR

Most of the missions proposed for naval helicopters flown by instruments call for long periods of operation under conditions wherein the allowable margin of error is very low. Because human factors are extremely important to the success of these missions, programs are being initiated to increase the instrument-flight proficiency of helicopter pilots. First, pilots will be trained for precision in the use of familiar fixed-wing instruments, then in airways and cross country procedures, and lastly in flying by instruments at low altitude and low air speed.

Of course, new problems will be encountered as instrument flying by helicopter is increased. One problem that is rapidly becoming more serious is the overcrowding of airways and terminals. Another stems from traffic procedures, which were established to meet the needs of the fixed-wing aircraft, not those of helicopters. The helicopter can operate side by side with fixed-wing aircraft, but to avoid competition for airways space between the two types of planes and to permit the full utilization of the helicopter's unique capability, traffic procedures specially designed to accommodate helicopters must be established. Omnirange radio-navigation equipment, by means of which aircraft are able to approach a terminal from any one of several directions, and TACAN (Tactical Air Navigation), which permits pilots to determine more accurately their bearing and distance from a terminal, may well serve as the basis for such procedures.

The use of helicopters for military, commercial, and private purposes has increased greatly in spite of the fact that the full capabilities of the aircraft have not yet been realized. When they are—that is, when the helicopter is given the proper instruments and the airways space—it will surely be called upon to undertake a much larger portion of air assignments. A start has been made—a few helicopters are operating on the airways under instrument-flight conditions now.

Navy Honors Dr. Alan T. Waterman

The first annual Captain Robert Dexter Conrad award, established by the Office of Naval Research, was presented on March 19 to Dr. Alan T. Waterman, Director of the National Science Foundation. The award is made in recognition of outstanding technical and scientific achievements in research and development for the Navy. It is named for CAPT Conrad, who, as first head of the Planning Division of ONR, was the primary architect of the Navy's basic research program.

Dr. A. V. Astin, Director of the National Bureau of Standards, presented the medal and citation to Dr. Waterman at the Raleigh Hotel in Washington during ONR's 2-day symposium, "A Decade of Basic and Applied Science in the Navy."

Dr. Waterman joined ONR in 1946, at its inception, and under his guidance and leadership, ONR became a laboratory for developing effective relationships and procedures between government and science. His reputation for integrity and his forthright views on freedom of scientific direction, coupled with his standing in the scientific community, silenced scientists' fears that government support would mean a loss of scientific freedom. This pioneering work in government-science relationships has resulted in an expansion of scientific support by other government agencies. Dr. Waterman also realized the great need for scientific manpower and in the ONR contract research program emphasized advanced technical training and assistance to graduate students in developing their scientific careers.

The transition of the scientific and technological potential of ONR from wartime development to peacetime research was smoothly accomplished under the direction of Dr. Waterman. When he left ONR to join the National Science Foundation, he left behind a robust and effective scientific agency.

On the Naval Research Reserve

Program Officers Conference

A Program Officers Conference was held at the Office of Naval Research from 18-20 February 1957. CDR Horace Burr, Special Assistant to the Chief of Naval Research (Research Reserve), was the conference chairman. The conference was attended by program officers from the branch offices of ONR; and by CAPT James M. McCoy, new Special Assistant for Research Reserve; CDR John K. Hicks, Training Officer; and Miss Eleanor Kehoe, Training Specialist.

The following items were discussed: mobilization procedures, curriculum for the Research Reserve Program, active duty for training, personnel accounting, and the future of the non-pay programs. Entering into the discussions were representatives from the Bureau of Naval Personnel and the Chief of Naval Operations; these included Mr. Ralph Parker from the Naval Reserve Training Section, BuPers; LCDR B. D. Slaymaker, from the Mobilization Plans Section, BuPers; CDR D. N. Morey, from the Special Programs Branch, BuPers; and CDR E. B. Myers from the Special Programs Section, OpNav.

Eligibility for the Department of Defense Reserve Award

The Department of Defense Reserve Award, established in 1955, is given as evidence of the appreciation of the Department of Defense to those civilian organizations which are rendering outstanding cooperation in their policies toward Reservists and Reserve activities. Any organization employing Reservists, regardless of the number, is eligible for the award.

Evidence of outstanding cooperation on the part of the organization may be shown by such policies as the granting of annual military leave in addition to the normal vacation, awarding of full pay or differential during training, rearrangement of work schedules to fit training times, and the donation of company facilities and of space in company magazines.

A recent Department of Defense Award was made to Brookhaven National Laboratory, Upton, Long Island, New York (Research Reviews, March 1957). Awards sponsored by the Navy have been presented to universities, boards of education, newspapers, radio and television networks, shipping lines, power companies, banks, oil and chemical companies, hardware companies, telephone and telegraph companies, distillers, aircraft corporations, and publishing houses.

Recommendations for the award should originate with Reservists. These recommendations are forwarded on DD Form 869, "Reserve Award Recommendation," to the Secretary of the Navy via the Company Commanding Officer and the District Commandant. DD Form 869 is available at District Publications and Printing Offices and Naval Reserve Training activities, and additional information is contained in OPNAV INSTR 5061.1.

Extra Dividends

LCDR Norman

LCDR Robert M. Norman, USNR, a member of Naval Reserve Research Company 11-2, Pasadena, California, has made a tour of training duty pay good dividends, for both himself and for the Reserve Program. In addition to the conventional benefits derived from the training duty he has received certificates of appreciation from the Altadena California Lions Club and the Department of Engineering and Technology, Pasadena City College. Here is what he says about these rewards.

"The fascinating subject of the atom as presented by the ONR Seminar at the Brookhaven National Laboratory is a source for many worthwhile speaking engagements. In the past six months, I have talked before about 400 people—about one third at Reserve meetings and the remainder at civilian gatherings. It is a pleasure to disseminate fresh special information learned from naval training duty. Its like telling a new good story.

"Navy talks were arranged through the ONR Training Officer and my Program Officer. The editor of the house organ of Hycon Manufacturing Company, where I am employed as a senior mechanical engineer, was glad to publish an offer to speak. This sparked off a chain of engagements—one led to another with increasing ease. It was a wonderful experience.

"I believe that all training duty of this type should encourage—even prepare material for—those in attendance, so they may multiply the effect of this information many times by public speaking in their own areas after attending the meetings. A good speech not only provides vital information, but also increases the importance and prestige of the Navy. The Navy needs positive cooperation from the public. Much strength lies in knowledge. A public well educated to understand the general technological status of modern weapons and science may be a must if we are to survive as a democracy."

When you have a unique experience on training duty and feel that it would be of interest to your neighbors, tell them about it! Thus they will better understand what you are giving to and getting from the Program in the interest of a healthy Service and a strong Nation.

U. S. GOVERNMENT PRINTING OFFICE: 1957 O - 421850

Research Reservist Receives Jaycee Award

Dr. Manuel F. Morales, a lieutenant in the Naval Reserve and a member of Naval Reserve Research Company 5-10, Bethesda, Maryland, was one of the 10 Federal employees selected by the Junior Chamber of Commerce as the outstanding young men of the year in Government. These men were selected as winners of the ninth annual Arthur S. Flemming Awards, named after the former Civil Service Commissioner and recently resigned Defense Mobilizer.

Dr. Morales is the Chief of the Physical Biochemistry Division, Naval Research Institute, Bethesda, Maryland. He was honored for his superior work on the nature of muscle action and physico-chemical biology, which has received national and international acclaim, and for his outstanding work as a biophysicist.

Seminars Scheduled for the Remainder of the Fiscal Year

Three Research Reserve seminars remain to be conducted during this fiscal year. These seminars are: Research Reserve Seminar in Aviation Medicine, Pensacola, Florida, on 13 May 1957; Nuclear Science Seminar, Brookhaven National Laboratory, Upton, New York, on 27 May 1957; and Research Methods Seminar, Columbus, Ohio, on 17 June 1957.

The schedule of Seminars to be held in Fiscal Year 1958 will be published by the Bureau of Naval Personnel in the next change to BuPers Instruction 1571.4, which is expected to be distributed in April 1957.

CDR Roy W. Drier, USNR Eligible for Retirement

CDR Roy W. Drier, USNR, a member of Naval Reserve Research Company 9-3, Ann Arbor, Michigan, will be eligible for nondisability retirement under Public Law 810 on 6 June 1957. CDR Drier, a member of the faculty of the Michigan College of Mining and Technology at Houghton, Michigan, has shown a continued and sincere interest in the Naval Reserve Program during the years of his association with it.

In This Issue

COVER PHOTO: The 16-inch reflector at the Burakan Observatory, Armenia, U.S.S.R. The observatory is described in article beginning on page 15.

RESEARCH REVIEWS endeavors to report briefly highlights of technical progress in research by Navy laboratories and contractors and the development of important naval research facilities. Articles which meet these broad criteria and possess a good degree of readability are welcomed. Manuscripts and changes of address should be sent to Code 740, Office of Naval Research, Washington, D. C. . . . Research Reviews is listed for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Subscription price: $1.50 per year in U. S. and Canada; $2.00 per year, foreign; $.15 per individual copy.

Approved by Bureau of the Budget, 28 February 1955