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RESEARCH REVIEWS

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DEPARTMENT OF THE NAVY
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COVER PHOTO: Located on this scenic point in California is one of three stations making up the Northeast Pacific Sofar Network. This station, with one at Point Arena, California, and another at Kaneohe on the island of Oahu, forms part of a vast air-sea rescue system. Based on the existence of an undersea "sound channel," the system will furnish information on the location of ships in distress at sea. For more about it, see "Sofar in the Pacific" on pages 15 to 22.

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 250, Office of Naval Research, Washington, D. C.

In This Issue

Determination of decay resistance is one of the screening tests applied to tropical woods. The graduate student-technician above is placing specimens of wood under exposure over pure cultures of brown-rot and white-rot fungi.

The Evaluation of Tropical Timbers

Arthur F. Muschler

...is coordinator and supervisor of research on tropical woods for the Navy at the Yale University School of Forestry.

An increasing scarcity of suitable domestic timbers, particularly of so-called specialty woods, has in recent years centered considerable interest on the resources of the tropics. While European countries with colonial interests have for some time been concerned with the utilization of timber found in tropical areas, the vast resources of Central and South America have remained virtually untapped.

The tropical forest presents many obstacles to intelligent exploitation. Not the least of these is the extreme diversity of the forest cover and the fact that one species may be scattered far and wide. Within the limits of our own country are found some one thousand tree species (of which only ninety are considered commercially important). On the other hand, botanists estimate that there are more than 10,000 kinds of trees in the tropical forests of the Western Hemisphere. Hundreds of species are generally scattered throughout a given forest area, an individual species, or group of species, seldom comprising more than a small percentage of the total timber volume. Thus it results that highly valued timbers are being hunted down as individual trees and logged until the supply is exhausted.

Efficient utilization of the resource requires, first, identification of the many species involved and, second, an understanding of the characteristics of these timbers. It has been suggested that, during extensive logging operations, species be grouped according to a use classification. However, until the individual species have been evaluated, such a segregation could only be based on density, a rather superficial criterion. Whatever methods may be devised for the rational harvesting of the tropical timber crop, they will certainly have to await extensive laboratory studies of mechanical and physical properties of the species involved. Extensive investigations of domestic timbers have provided the groundwork for an evaluation of potential substitutes from among the tropical species.

The Navy Department is concerned with the increasingly limited supply of high-grade timber of the traditional species. White oak, because of its outstanding strength and bending properties, is valued as a framing wood. Teak, a tropical species from Asia, is seemingly unexcelled as a decking wood because of its low shrinkage, durability, and superior weathering qualities. Critical shortages are now being faced in the case of both species. In addition, interest centers on finding highly durable, insect-resistant woods for tropical construction, as well as timbers showing resistance to marine borer attack for use as piping material.

Yale University for more than 30 years has been engaged in the study of tropical timbers. This study has largely been restricted to identification, classification, and research on cellular structure. It has resulted, however, in the accumulation of the world's largest collection of wood specimens: 50,000, representing 243 families and 13,374 species. Identification is, of course, basic to a detailed study of tropical woods. Recognizing this fact, the Office of Naval Research in 1947 contracted with the Yale School of Forestry to conduct screening tests on a limited number of woods from the American tropics. This study included determination of mechanical properties, density, shrinkage, decay resistance, rate of moisture absorption, resistance to weathering, and other characteristics relating to seasoning, paint holding, machining, gluing, and steam bending. The Institute of Paper Chemistry, Appleton, Wisconsin, has conducted tests to determine the chemical composition of some of these woods, and, at the New York Naval Shipyard, other tests have included determination of resistance to fire and abrasion. Certain woods are also being exposed to determine their resistance to marine-borer attack through arrangements with the William F. Clapp Laboratories, Duxbury, Massachusetts. This general project, since July 1951, has been supplemented by another agreement with the Navy whereby the more promising species are being evaluated for specific uses.

Since the screening was begun, 320 test logs representing 115 species have been received at New Haven. Additional material for test has been provided in 94 logs mainly originating from the residual portion of the individual trees sampled. Mechanical testing of material in both the air-dry and green conditions has been completed on virtually all test logs. In addition, basic physical properties have been determined, with progress continuing in the case of more specialized studies. Significant

Seasoning studies are an important phase in screening tropical timbers.

Crude methods prevail in logging Possumwood in Surinam.

data have been published for 55 species.[1] The table on page 4 gives a brief summary of results on 25 of these. Results have been obtained from special studies made by graduate students on moisture absorption, weathering characteristics, gluing properties, steam bending, and the calibration of moisture meters for use with certain tropical species.

Certain basic characteristics of tropical woods and their relation to the behavior of domestic timbers have been highlighted by tests thus far completed. It has been found that volumetric shrinkage for tropical species is consistently less than would be expected from the shrinkage-specific gravity relationship developed for domestic woods. Results vary from an average of roughly 20 percent less volumetric shrinkage for the lower-density woods to an average decrease as high as 40 percent for the more dense woods tested.

Equally interesting observations can be made of mechanical test results. In general, tropical woods tested in the green condition exhibit greater strength than would be expected based on the strength-specific gravity relationships determined for domestic woods. Values for modulus of rupture range from 20 to 25 percent higher, the greatest divergence being shown by the more dense woods. Data for modulus of elasticity, crushing strength, and a number of other properties exhibit a similar relationship.

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[1] "Properties and Uses of Tropical Woods," Tropical Woods: Nos. 95, 97, 98, Yale School of Forestry, June 1949, Nov. 1950, June 1952, respectively.

PHYSICAL AND MECHANICAL PROPERTIES OF TROPICAL WOODS COMPARED WITH WHITE OAK

Species	Specific Gravity (green volume)	Volumetric Shrinkage	Bending Strength (modulus of rupture)	Stiffness (modulus of elasticity)	Shock Resistance (work to max. load)	Maximum Crushing Strength
Bulletwood*	142	106	209	216	117	244
(Manilkara bidentata)†			179	194	193	156
Goncalo Alves*	140	63	146	155	58	185
(Astronium graveolens)†			109	125	70	139
Black Kakeralli*	136	91	214	233	115	218
(Eschweilera Sagotiana)†			154	183	165	151
Guayacan						
(Tabebuia guayacan)*	136	85	232	188	198	244
(Tabebuia heterotricha)†			164	148	165	157
Piquia*	120	82	150	145	73	177
(Caryocar villosum)†			112	121	107	113
Mylady*	118	91	170	200	77	187
(Aspidosperma cruentum)†			137	155	114	150
Courbaril*	118	80	156	147	126	163
(Hymenaea courbaril)†			128	121	119	128
(Hymenaea Davisii)*	112	94	150	166	73	156
†			127	165	130	126
Tatajuba*	113	65	175	184	98	222
(Bagassa guianensis)†			132	145	97	155
Masa*	112	88	149	132	86	155
(Tetragastris balsamifera)†			106	106	90	113
Nargusta*	107	80	146	161	105	155
(Terminalia amazonia)†			117	129	111	128
White Oak*	**100**	**100**	**100**	**100**	**100**	**100**
(Quercus alba)†			**100**	**100**	**100**	**100**
Angelique*	100	89	138	147	104	157
(Dicorynia paraensis)†			114	123	103	118
Yellow Sanders*	98	61	121	117	76	144
(Buchenavia capitata)†			85	93	55	100
Hububalli*	93	70	113	134	66	132
(Loxopterygium Sagotii)†			90	98	72	100
Frijolillo*	93	48	99	96	79	110
(Pseudosamanea guachapele)†			71	65	41	88
Teak (plantation-grown)*	93	32	120	108	94	134
(Tectona grandis)†			88	78	70	91
Rajate Bien						
(Vitex Cooperi)*	88	66	113	119	62	134
Flor Azul						
(Vitex Kuylenii)†			85	88	61	94
Determa*	87	66	94	117	41	105
(Ocotea rubra)†			69	102	43	78
Roble Blanco*	87	60	130	116	101	138
(Tabebuia pentaphylla)†			91	90	85	999
Vaco*	83	71	103	135	56	101
(Magnolia sororum)†			94	111	73	106
Cedro Espino*	75	64	91	101	76	97
(Bombacopsis quinata)†			69	79	62	76
Laurel Blanco*	73	58	109	102	83	113
(Cordia alliodora)†			80	85	66	85
Mahogany (plantation-grown)*	70	42	101	91	63	98
Swietenia macrophylla†			68	65	51	76
Cedro Granadino*	68	65	91	105	61	95
(Cedrela Tonduzii)†			76	81	63	84
Primavera*	67	58	86	79	62	99
(Tabebuia Donnell-Smithii)†			63	58	43	75

* Green wood

† Air dry wood

Ratios of Air-dry to Green Strength Properties
for Tropical and Domestic Hardwoods

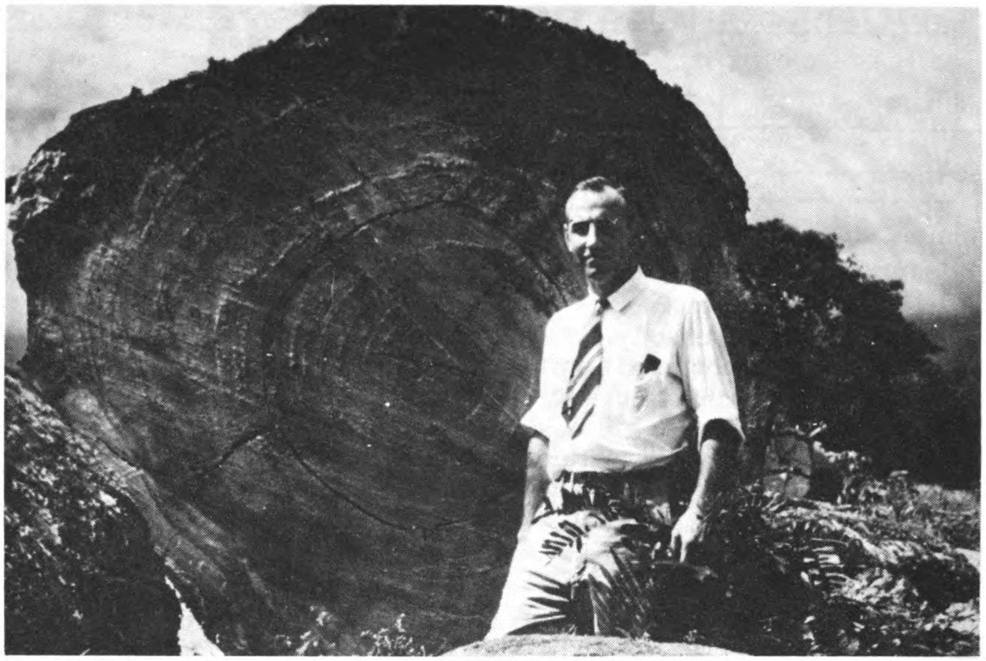
Property	Tropical Woods	Domestic Woods*
Static bending		
Fiber stress at proportional limit	1.52	1.80
Modulus of rupture	1.44	1.59
Modulus of elasticity	1.16	1.31
Work to proportional limit	1.98	2.49
Work to maximum load	1.42	1.05
Compression parallel to grain		
Fiber stress at proportional limit	1.58	1.74
Maximum crushing strength	1.63	1.95
Modulus of elasticity	1.13	---
Hardness		
End	1.36	1.55
Side	1.17	1.33
Compression perpendicular to grain	1.51	1.84
Tension perpendicular to grain	0.86	1.20
Shear	1.24	1.43
Cleavage	0.85	---

*Forest Products Laboratory, Madison, Wisconsin

It is obvious, however, from the table above that, except for one value, the tropical species do not exhibit as great an increase in strength upon drying as do our native species. The result is that the superiority of tropical woods in the green condition is no longer so apparent following drying. In fact, it appears that the strength-specific gravity relationships derived for air-dry domestic woods are reasonably valid for tropical woods. Data for modulus of rupture generally parallel such an exponential curve while averaging slightly higher, perhaps 6 to 8 percent.

Only in work to maximum load, indicative of shock resistance, do tropical woods show a greater strength increase upon drying. However, the effect of drying appears only to raise this value to a level more nearly comparable to domestic woods since unseasoned tropical timbers are generally relatively low in shock resistance. This improvement is apparently related to the fact that stiffness and compressive strength of tropical woods are among the properties least affected by drying in comparison with increases shown by our native species.

Extreme examples of properties which do not show the expected increase on drying are tensile strength across the grain and cleavage resistance. Domestic woods are themselves characterized by rather low ratios of air-dry to green strength in these properties, though an increase upon drying still results. In the case of the tropical species, however, these ratios are less than unity. The cause for this is not clearly understood. The possibility cannot be disregarded that minute, perhaps microscopic, checks develop even under mild conditions of air drying and subsequent conditioning.



Under optimum growth conditions, logs of Possumwood reach great size.

A survey was made of results obtained with paired specimens, radial and tangential, which are required under standard testing specifications. In cases where actual strength loss in the two tests was encountered upon drying, results were considered on the basis of individual logs. In the tension and cleavage tests this was the case for roughly 70 percent of the logs. However, the resulting determination of average strength loss per log of tangential and radial specimens showed no significant difference. Since checking is characteristically associated with the radial plane, it would seem that the possibility of seasoning defects affecting results could be discounted. A logical explanation of the phenomenon must await further study.

Canal Zone Corrosion Laboratory

The Canal Zone Corrosion Laboratory has been established at Miraflores, C. Z. as a centralized activity for material exposure research projects of any U. S. government agency. The Naval Research Laboratory has been assigned technical management control of the new activity, which is supported jointly by the Panama Canal Company, the Army's Engineer Research and Development Laboratory, and NRL. This integration of activity will insure continuity of the exposure program begun by the Panama Canal as well as continued availability of facilities for study of problems peculiar to the tropics. Research and development work here will be coordinated with that of the existing NRL Tropical Exposure Site at Coco Solo, C. Z.

The Navy's Contributions to Radio Communications

RADM William B. Ammon, USN

... Director of Naval Communications, gave the following paper before the Washington Chapter, Armed Forces Communications Association, November 12, 1952, in Washington, D.C.

With regard to present and future developments, Naval Communications is always in some danger of acquiring the title "Silent Service," properly claimed by our submarine personnel. The inherent security aspects of our operations make this inevitable. However, as I look at the record of the last half century of radio communications, I find much to which the Navy can openly point with pride. The Navy's contributions have involved both independent development and cooperation with the radio industry. A guiding principle which has been followed is that the United States should be self-sustaining with respect to the industrial, technical, and operational features of radio.

The Navy's first introduction to radio took place in 1899, when Marconi tested some of his wireless equipment aboard the U.S. Ships NEW YORK, MASSACHUSETTS, and PORTER. As a result of these tests, a trial installation of Marconi equipment was made in 1903. Its success during these maneuvers furnished convincing proof that the new medium of communications was here to stay. Six experimental shore stations were built and a special wireless operators' school established at the New York Navy Yard.

During tests of De Forest equipment between Washington and Annapolis, Mr. De Forest happened to be at Annapolis when the then Secretary of the Navy visited the Naval Academy. As the Secretary's carriage entered the Academy grounds, the gun salute in his honor frightened the horses. They ran away, heading straight for the river. The Secretary decided to abandon ship just as the carriage made a sharp turn. Catapulted out of the door, he skidded across a patch of ice and came to rest in a stunned condition. While others rushed to the Secretary's aid, Mr. De Forest rushed to the radio station and sent the first radio press bulletin. This historic bulletin reached the Washington newspapers two hours before the report via landline.

By 1904, the Navy had taken such an active part in the development of the new field that President Theodore Roosevelt vested control of wireless telegraphy in the Navy Department. In half a year, the Navy had 18 shore stations and 33 ships equipped with wireless. In 1905, the Navy first commenced the regular transmission of weather information and time signals. Completion of the West Coast chain of Navy radio stations was accomplished in 1906, and by 1907, radiotelephone had been introduced into the Navy. All battleships and most cruisers were now equipped with wireless, and so were 39 shore stations.

Some of the difficult conditions prevailing during our pioneer days in radio are illustrated by the experiences of Colonel Robert B. Woolverton, U.S. Army, retired, who served as a Navy radio electrician from 1904 to 1908. The equipment he found in use was a 25-cycle spark transmitter and a coherer type receiver. With the assistance of a fellow operator named Guthrie, he improvised an electrolytic detector for the receiver from a miniature light bulb and made a high-frequency interrupter for the spark transmitter. A patent suit later established their claim to the first use of high-frequency spark in radio communication.

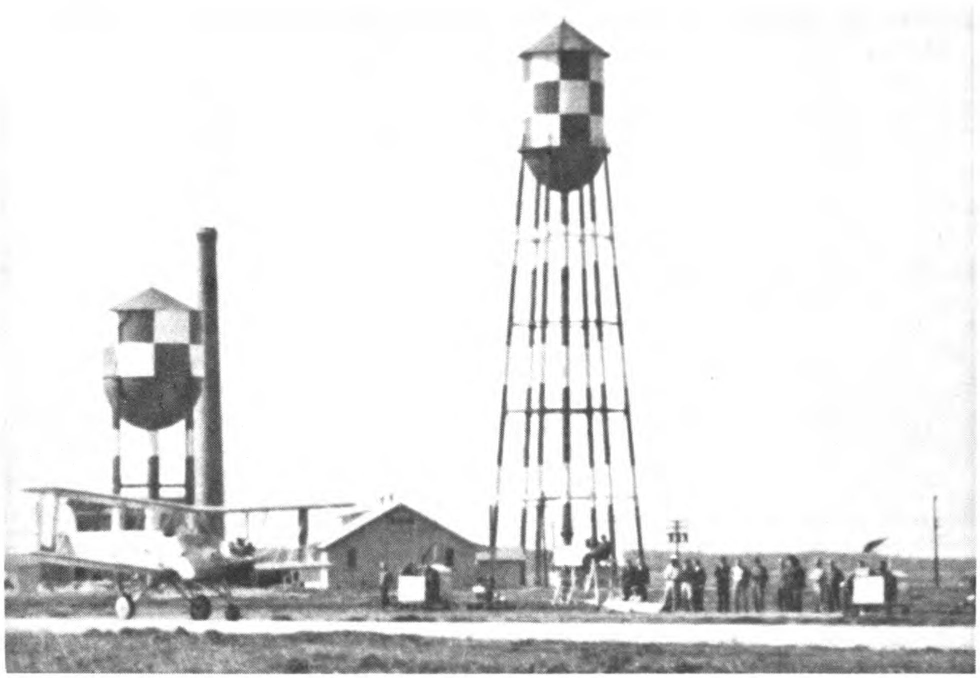
The shock-proof specifications of modern Navy electronics equipment must have had their origin in Woolverton's experiences in the USS KENTUCKY. Guthrie and he volunteered to man the radio shack while the 13-inch guns were being fired. As he described it: "The big brass lock on the door was torn off, the after bulkhead bulged in, and the rivets shot across the room like bullets. The concussion we felt was terrific. We were both partially stunned, and everything in the room that was not bolted down was adrift, including the operators! The acid was blown out of the electrolytic detector cup, but this was anticipated. We had the supply bottle handy and immediately refilled the cup, and except for a pardonable half minute of 'stunned silence,' the flagship was unaware of any interruption to our communication."

Much of the repair work and development of new equipment in those days was done by the operators themselves. The radio operator in the USS ALABAMA is reported to have used most of the glass from the pilot house windows to repair his glass plate condensers. Woolverton tells of increasing the power of his transmitter by rewinding the primary of the spark coil, making a new spark gap, and providing a bigger and better condenser. Apparently the Navy had not issued any orders concerning the alteration of standard equipment.

Trans-Pacific communication was established in 1908 and the USS CONNECTICUT, enroute from Hawaii to New Zealand, was able to exchange messages with Navy Radio Point Loma—a distance of 2900 miles. In the same year, the Navy asked Congress to pass legislation regulating radio. The following year saw the Navy launching out into higher frequencies as the USS SALEM and BIRMINGHAM carried on tests during their cruise across the Atlantic. Portable equipment for landing parties was tested in 1910 and further tests of radio were made aboard ship under battle conditions.

Congress passed legislation providing for the regulation of radio telegraphy in 1912. One noteworthy feature of this measure was the Navy's obligation to open its facilities to commercial traffic. The Naval Radio Service commenced actual operations when this legislation became effective on December 13, 1912. This date may well be considered the birthday of Naval Communications as it exists today.

In 1913, a 100-kilowatt transmitter was commissioned at Radio Arlington, Va. That same year the Arlington-Eiffel Tower experiments



Naval Research Laboratory experiments with radio-controlled aircraft at Cape May, N. J., in 1938. In 1923, NRL had achieved the first pilotless flight in this country, using an old Navy seaplane.

concerning the velocity of ether waves were commenced. The cruiser SALEM made a trip across the Atlantic carrying on continuous communications with the United States. Two years later, a 200-kilowatt low-frequency transmitter was installed at Darien, Canal Zone—the first of a scheduled chain of similar naval radio stations. In the same year, a demonstration of long-distance radiotelephone was conducted by the American Telephone and Telegraph Company and the Western Electric Company between Radio Arlington and Radio Honolulu. In 1916, the world's first distant-controlled radio station was installed and operated by the Navy from the State, War, and Navy Building in Washington. Naval aviation entered the radio field when signals were transmitted to the USS NORTH CAROLINA from a plane at a distance of 20 miles. The year 1917 produced the forerunner of the radio beacon when the Navy provided a radiophone fog-warning device at Point Judith, Rhode Island. Experimental development of radio-controlled aircraft was commenced in 1918. Further progress was made in the field of high-power radio that year when the 500-kilowatt naval radio station was established at Annapolis, Maryland.

The Director of Naval Communications from 1919 to 1921 was Rear Admiral William Bullard. During this time he was instrumental in preventing the sale to foreign interests of the patent rights to the Alexanderson alternator. Admiral Bullard was later appointed by President Coolidge as Chairman of the National Radio Commission. He was one of those who counseled the formation of the Radio Corporation of America, as a means of protecting the U.S. position in the international communication field.

In 1920, transmitter power went still higher with the Navy installation of a 1000-kilowatt station at Radio Lafayette, near Bordeaux, France. The Navy became involved in regularly scheduled broadcasting in 1920 and made the first public broadcast of a presidential address when President Harding dedicated the Lincoln Memorial in 1922.

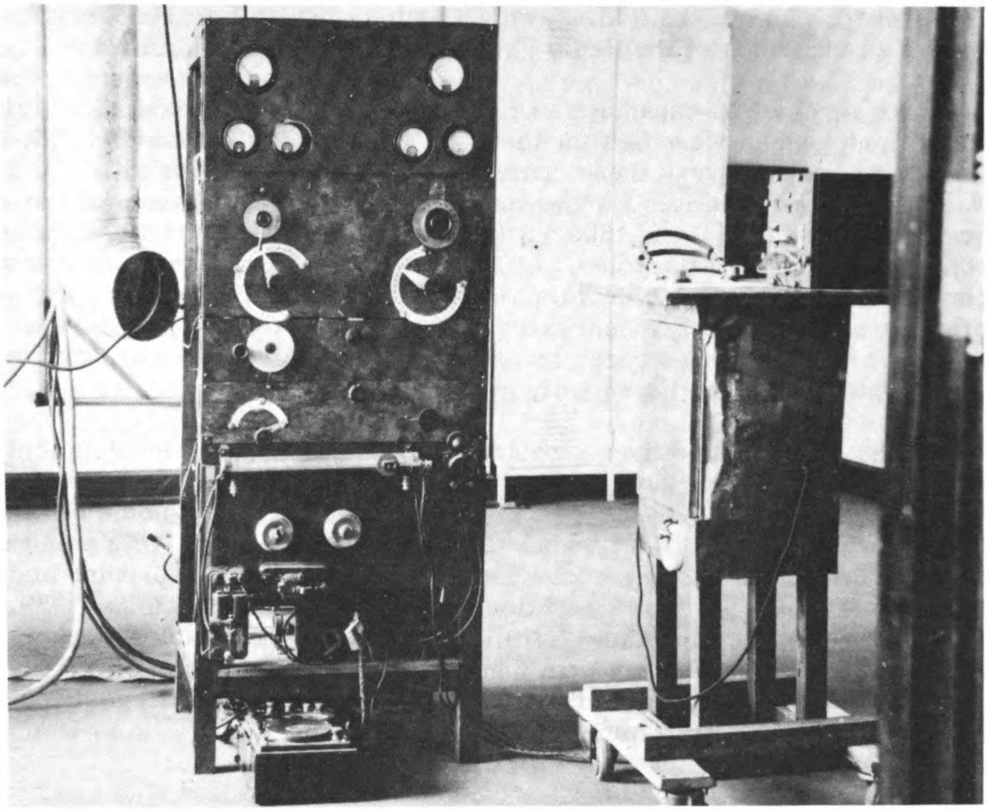
The Naval Research Laboratory made its debut in radio communications in 1923 and has been playing an important role ever since. Radio control of aircraft was first achieved in this country in 1923 when personnel from the Naval Research Laboratory succeeded in controlling the flight of an old Navy seaplane entirely by radio remote control.

Probably the most important service of the Laboratory's Radio Division in the early days was the "selling" of the HF program to the Navy and, indirectly, to the radio communication industry. In November 1923, the Division had started exploration of frequencies from 2000 kilocycles upward, in spite of the fact that existing theories indicated that such frequencies would be of no use for practical communications. The first airborne high-frequency installation was a transmitter and receiver which NRL provided for the rigid airship SHENANDOAH for her flight across the continent and back. With this equipment she was able to maintain practically continuous communication with the Laboratory. The culmination of the selling campaign came when high-frequency transmitters were placed in the USS SEATTLE, the Flagship of the Fleet which visited New Zealand and Australia in the summer of 1925. Thanks to this high-frequency equipment, the flagship was able to maintain daily contact directly with Washington.

With increased use of high frequencies, accurate frequency control became important. The first high-power crystal-controlled transmitter in the world was built in 1924 and installed at the Naval Research Laboratory. For a long time it handled nightly traffic from the Navy Department to the American Embassy in London. This transmitter put ten kilowatts into a quarter-wave vertical antenna on 4015 kilocycles.

Measurement of the height of the ionosphere was undertaken in 1925 by NRL jointly with the Carnegie Institution. This work is now of interest because it marks an early practical use of the radio-pulse technique. Cooperative experiments by NRL with radio amateurs disclosed the now familiar "skip" characteristics of high-frequency radio. As a result of these experiments, Dr. Hulburt and Dr. Taylor, of the Laboratory, published a paper in the Physical Review for 1926 which laid the foundation for modern high-frequency wave-propagation theory. The year 1926 also saw the introduction of high-power vacuum-tube transmitters at the Navy radio station when an 80-kilowatt transmitter was installed at San Diego.

Among numerous other developments at NRL at this time were the absolute altimeter, and the first application of vertically and horizontally polarized beacons in the landing of aircraft. The transmission of signals from NRL and the recording of these signals, after they had made two trips around the world, had been accomplished in 1928 and 1929 by Taylor and Young. Information obtained in these tests was valuable in eliminating interference from bothersome double signals.



Experimental model of intra-Fleet stable master oscillator, power amplifier type, high-frequency (3,000 kc) transmitter, used by the Naval Research Laboratory in its early high-frequency wave propagation work. Over this equipment, NRL sent trans-Atlantic signals in November 1923.

During the 1930's, much valuable work was accomplished by NRL in the field of precision frequency measurements. This was at a time when the National Bureau of Standards was unwilling to guarantee the measurement of any frequency closer than one-tenth of one percent, whereas the needs of the Navy required measurement better than one-100th of one percent. Work was also commenced on precision variable-frequency control systems to obviate the use of crystals. As a result, the Navy was able to enter World War Two with a remarkably efficient set of continuously variable transmitters.

Because the Navy has played such an important part in radio-frequency allocation, I am taking this up separately and out of chronological sequence. Early in 1920, an Allied committee met in Paris for the purpose of consolidating, in the form of recommendations to the Allied and Associated Powers, the experience gained in radio communications during World War One. The recommendations contained the nucleus of a radio-frequency allocation plan, designed to minimize international interference and to maintain effective world-wide radio communications ashore and afloat. Later the same year, a preliminary conference met in Washington to draft an International Communications Convention to serve as a basis for discussion at the International Communications

Conference. One of the U.S. Navy delegates, LCDR T.A.M. Craven. served as chairman of the Radio Frequency Allocation Committee.

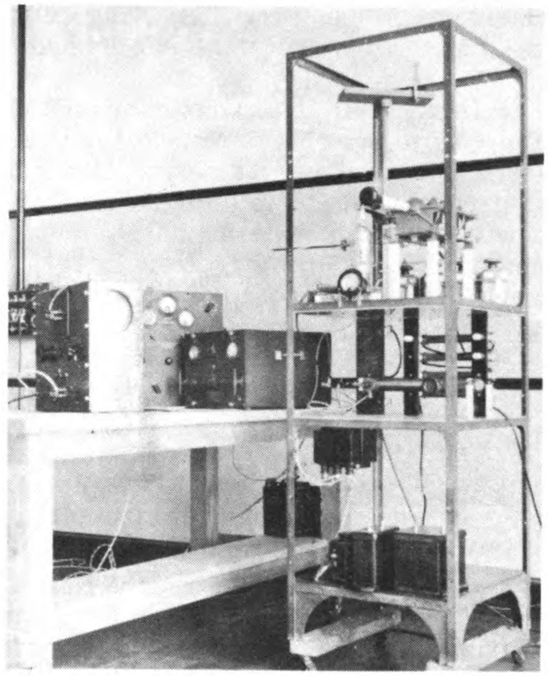
As a result of expansion of radio broadcasting, several national radio conferences were held in the U.S. between 1920 and 1925. The Navy's representative at these conferences exerted strong influence and was partially responsible for the compromise in the assignment of frequencies between 550 and 1500 kilocycles to broadcasting, rather than commencing at 200 kilocycles. In 1927, a conference of world powers convened in Washington to draft an International Radio Convention. Several representatives were sent as technical advisors to the U.S. Delegation, by the Navy, whose recommendation for radio-frequency allocation was adopted almost in its entirety by this conference.

The Navy has endeavored not to overlook any new radio development which might be of value to communications. Radiophoto is such a development. In the early 1920's, the Navy investigated and tested some of the facsimile equipments of that period. In the late 1920's, a two-year period of intermittent testing was conducted between fixed point-to-point and shore-to-ship installations. Additional tests were made in 1938 and 1939. The present Navy radiophoto-facsimile activities were established early in 1945 for the use of Navy public information. Later that year, the Secretary of the Navy made this service available to all naval activities, as a part of the Naval Communication System.

This summary would not be complete without mention of the early days of radar, although radar is no longer considered a means of communication. In 1922, while Dr. Taylor and Mr. Young of NRL were making radio field measurements across the Potomac, they noted that a ship passing through the high-frequency field was detectable on the radio receiver. In 1930, during similar measurements, it was noted that an airplane could be detected at a considerable distance by high-frequency communications apparatus. As a result of these discoveries, the Bureau of Engineering gave financial support to a project entitled "The Location of Enemy Vessels and Aircraft." About a year later, a detection system, using a directional continuous-wave 30-megacycle transmitter, proved capable of locating airplanes 50 miles away.

By 1932, the Laboratory's radio engineers had learned enough about radio-location-and-detection techniques to take the next big step—the use of radio pulse echoes. In the period between 1935 and 1941, the radar program was probably the most important research project of the Laboratory. By 1936, an 80-megacycle pulse radar had been worked out which got satisfactory echoes on airplanes at ranges up to 40 miles. In 1937, a 200-megacycle equipment was improvised which seemed good enough to test aboard the destroyer LEARY. This test furnished the first definite proof that radar could be used on a naval vessel without seriously interfering with other equipment.

Within a few months following the LEARY tests, a vastly improved 200-megacycle system was developed which allowed the use of a single antenna for both transmission and reception. By the fall of 1938, the improved system had been well tested, and had obtained reasonably good bearings and ranges on airplanes as far away as 100 miles. A newer model of this equipment proved the worth of radar to the Navy in extensive sea trials aboard the battleship NEW YORK early in 1939. Meanwhile, a 400-megacycle set had been built by RCA using designs and specifications furnished by NRL. As a result of the tests in the NEW YORK, twenty radars were ordered from RCA and were installed by December 7, 1941.



Experimental radar pulse transmitter in use at the Naval Research Laboratory in 1933. By 1936 an 80-mc pulse radar had been built which got satisfactory echoes on airplanes at ranges up to 40 miles.

In November 1943, the Director, Naval Communications requested procurement of two complete mechanical multiplex terminals. In the summer of 1944, the first multiplex system to be tested on a long-distance radio circuit was put in operation between Hawaii and Washington. By May of 1945, thirty sets of terminal equipment had been procured from the Western Union Telegraph Company and placed in operation at key points in the Naval Communications System.

The success of the mechanical multiplex led the Bureau of Ships to approach the Teletype Corporation of Chicago with the idea of designing an electronic multiplex. In January 1950, the first production model was delivered to the Navy. Electronic multiplex has now replaced all the mechanical multiplex sets used in the Naval Communications System.

The Navy has also taken a leading role in the investigation of communications in the polar regions. Under Navy sponsorship, the Byrd Expeditions to the Antarctic have supplied valuable information on this subject. Because of the erratic propagation characteristics of high-frequency radio in both the Arctic and Antarctic, the Navy has placed increased emphasis on very-low frequency stations. The Navy's experience in high-power, very-low-frequency radio extends over almost half a century and will reach a high point when the million-watt transmitter at Snohomish County, Washington, goes into full operation.

In recent years, the existence of many government and commercial agencies in this field has relieved the Navy of complete dependence on its own technical resources. Here the Armed Forces Communications Association plays a major role in bringing the military services and the communications-electronics industry closer together.

CAPT Tatom

Who's Who in Naval Research

Captain Eugene Tatom, USN, is the new Director of the Research Group's Naval Sciences Division, having relieved Capt. E.O. Wagner in January. He comes to the position with exceptionally appropriate experience behind him; he is a naval aviation careerist who has held lengthy and varied assignments in research and development.

Captain Tatom entered the Navy in 1926 as a boot, but before long traded his seaman's uniform in for a midshipman's. After his graduation from the Naval Academy in 1931, he went to sea in the USS PENSACOLA (CA 24) and then to flight training at NAS Pensacola. He pinned on his Naval Aviator wings in 1934 and reported to the old LANGLEY (CV-1) for assignment to Fighter Squadron VF-3.

Following this duty, LT (jg) Tatom served as gunnery officer of Patrol Squadron SEVEN during a period of Alaskan and Aleutian Surveys and was selected for postgraduate training in Ordnance Engineering as modified for aviators. After three years PG work he returned to sea as Senior Aviator of the Battleship COLORADO in 1940. In October 1941, he was ordered to VP-12 as Executive Officer, succeeding to command of that squadron (redesignated VP-24) in 1942.

From squadron duty he was transferred to the staff of ComFleetAir-Wing TWO as Gunnery and Training Officer, a duty that kept him in Hawaii for the next eighteen months. In 1943, he was sent to Washington to head the Armament Research and Development Section of BuAer. He remained in that key position until the war was almost over. He finally got out to the Western Pacific—as Exec of the light carrier CABOT—only two days before VJ-Day.

He later took over command of the CABOT and ultimately put her in moth-balls. Then he went back to the Pacific as Executive Officer of NAS Agana, Guam. From there, back he came to Washington for duty as Head of Aviation Ordnance Research and Development in BuOrd. After a voyage to the Persian Gulf as skipper of USS VALCOUR, he was ordered to his last previous assignment: Chief of Staff and Aide to the Commander, Naval Task Group 132.3 for Operation Ivy—the 1952 AEC tests at Eniwetok.

The new Director is a native of Pensacola, Florida. He has a wife and a 19-year-old daughter, who is an undergraduate at Mary Washington College. Their present home is in Alexandria...A.T.D.

Sofar in the Pacific

M. H. Sheehy

. . . is Head of the Sofar Section, Marine Propagation Branch of the Navy Electronics Laboratory. His field of research for a number of years has been underwater sound.

During the past several years the Navy Department has installed a Sofar network to cover the eastern North Pacific Ocean area, and operational tests of the network have been completed. For those unfamiliar with the subject, we will review briefly the meaning and purpose of Sofar. The word itself is a contraction of the phrase "Sound Fixing and Ranging" and the Sofar network is employed to furnish information on the location of anyone in distress at sea. It is thus intended to be an important part of an air-sea rescue system.

Ships and aircraft operating in areas covered by Sofar networks would be equipped with bombs containing four pounds of TNT and having a suitable fuse mechanism. Whenever a distress situation arose, one of these bombs, set for detonation at 2, 000 feet for the Pacific or 4, 000 feet for the Atlantic, would be dropped into the sea. The sound produced by the explosion of the bomb would be received by shore stations and the location of the explosion determined by triangulation procedures based upon differences in times of reception at the stations. Air-sea rescue teams could then be directed to the scene without the necessity for time-consuming searches of extensive areas.

Perhaps the first question one naturally asks about Sofar is how the transmission of the sound signals is accomplished over long enough ranges to make the method operationally worthwhile. The graph on the next page may help to clarify the matter. In deep oceanic waters the speed of sound decreases with depth to a point several hundred fathoms beneath the surface, and then increases with depth from this point to the bottom as shown in simplified form in the left hand side of the graph. If a sound originates near the level of minimum velocity, the sound rays departing at angles both above and below the horizontal will be refracted back toward the level of minimum velocity. Thus sound rays propagated from a certain central angle will not be reflected from either the surface or the bottom, but will instead be refracted back and forth across the level of minimum velocity, called the "sound channel axis", as shown in the right hand side of the graph.

The intensity of this channelled sound will thus decrease only as the first power of the distance, instead of as the second power of the distance as would be the case in an infinite, ideal medium and, since absorption losses are very small in the low-frequency region, it is possible to detect the low-frequency components of an explosive signal in the ocean at great ranges.

To the writer's knowledge, the first experiments on the transmission of sound from a source near the sound-channel axis to a receiver similarly located were carried out in November 1933 (1)*, and again in January 1935 (2), by the U.S. Coast and Geodetic Survey Ships PIONEER and GUIDE under the operational command of LCDR O.W. Swainson. Although not specifically attempting to achieve long ranges, the investigators detected signals from one-half pound explosive charges at a range of more than 56 kilometers, and it was mentioned that from theoretical considerations much greater ranges might be obtained.

In 1937, Dr. Maurice Ewing, while carrying on geological surveys in the deep ocean, interpreted some of his results as indicating that signals from small explosive charges deep in the ocean could be detected at horizontal ranges of thousands of miles, provided reflections from the ocean bottom were eliminated and sensitive receiving equipment used.

Following further oceanographic and theoretical studies carried out at Woods Hole Oceanographic Institution during the early years of World War II, Ewing proposed to the Bureau of Ships, in July 1943, that practical use be made of the long range underwater sound transmission made possible by the existence of the deep sound channel. Early in 1944 the Woods Hole Oceanographic Institution and the Columbia University Division of War Research, located at the U.S. Navy Underwater Sound Laboratory, under Ewing's guidance, commenced experiments. The tests carried out indicated that it would indeed be feasible to use the long range transmission of explosive signals in the ocean for air-sea rescue purposes, and the Navy Department decided in late 1945 to install a network in the eastern North Pacific with the Bureau of Ships as the cognizant agency.

The installation of the three stations presently forming the Northeast Pacific Sofar Network was completed in September 1948 (3). The stations are located at Kaneohe on the island of Oahu, and at Point Sur and Point Arena on the coast of California.

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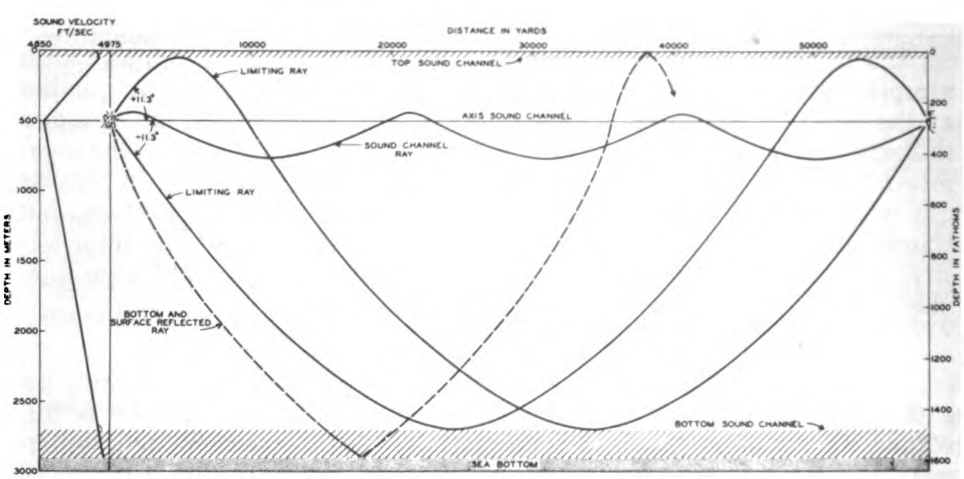
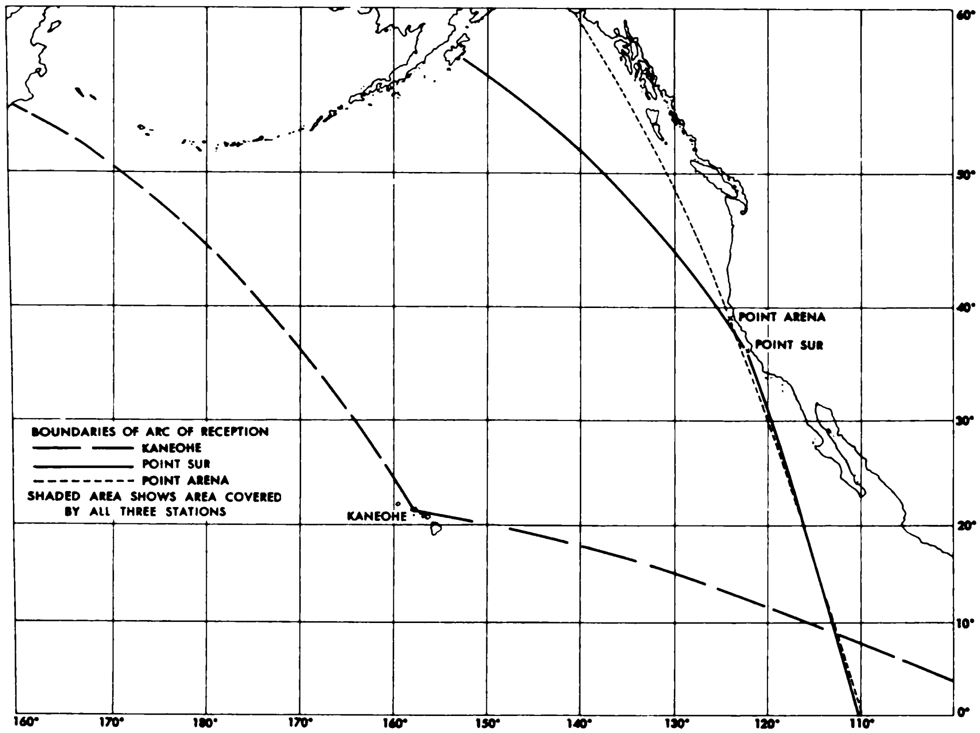
*See references at end of text.



Ray paths for sound-channel transmission



Arcs of reception and area covered by Sofar network

At each station a group of crystal hydrophones are mounted in a stainless steel cage in the form of a regular tetrahedron situated on the ocean floor at a depth of approximately 2,000 feet, i.e., near the depth of minimum sound velocity. The hydrophones are connected to the shore equipment by means of several miles of Navy Type 115P submarine cable. Upon arrival at the shore end of the cable, the incoming signals are amplified, filtered, rectified, logarithmically compressed, and are then recorded as power levels on a large sheet of paper mounted on a revolving drum. The drum type of recording makes possible the continuous visual monitoring of the signals for four-hour periods. The signals are also routed to a loudspeaker system so that oral monitoring is possible, and a timing trace is recorded adjacent to the signal trace so that signal arrival times can be accurately determined. The timing trace is calibrated daily against official radio time signals in order to synchronize the stations.

Following the installation of the three stations, the Navy Electronics Laboratory embarked on a series of cruises during which Sofar signals were dropped throughout the eastern North Pacific area in order to determine the network boundaries, the accuracy of location of the bomb-drops, the reliability of signal reception at the stations, etc.

These tests showed the area covered by the network to be that indicated in the map above. The results (4) of some 1200 bombs dropped by NEL during the period from September 1948 to August 1949 indicated that more than 99 percent of the bombs detonated within this area were received at all stations, and that the location of the signal source could therefore be determined by triangulation.

The depth of detonation was not found to be critical. Although the sound channel axis is at a depth of approximately 2,000 feet, signals originating as shallow as 900 feet and as deep as 4,000 feet had peak intensities at the stations only a few decibels lower than the signals detonated near the axis.

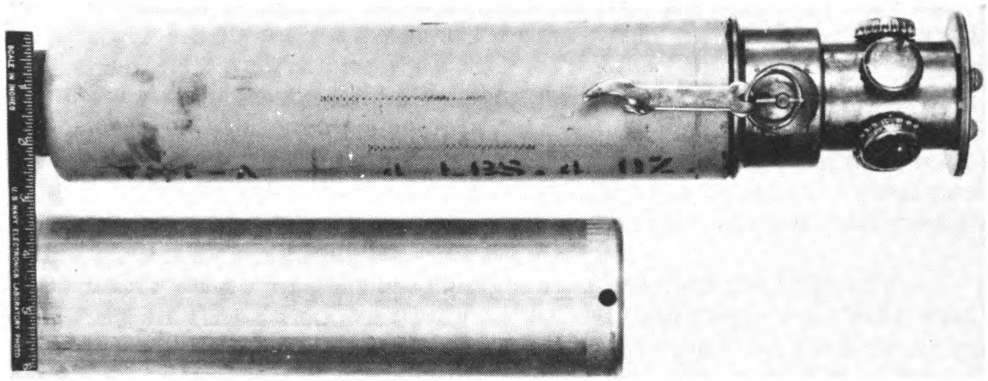
As might be expected from a consideration of the location of the three stations, the accuracy of locating signal-source position within the network varies somewhat with position. To determine accuracy, we compare the source position as determined by Sofar techniques with that given by the navigator of the ship from which the bomb was dropped. In the southeasterly portion of the network the accuracy is in the order of 10 to 20 miles, because of the poor triangulation baseline offered by the location of the Point Sur and Point Arena stations. Partly for the same reason, the accuracy in the far northern regions, above approximately 48° North Latitude, is somewhat worse, ranging from 20 to 100 miles. An additional reason for the large error in the Gulf of Alaska and near the Aleutians, however, is that the signals received from these regions do not have the usual sharp cutoff typical of long-range signals, but are instead more symmetrical in shape. It is therefore more difficult to determine the time of arrival as exactly as that of signals originating in the mid-latitude waters.

In the latter region, between the West Coast and the Hawaiian Islands, the accuracy is good, of the order of three miles. This is considered a good measure of the inherent accuracy of the Sofar network, and is believed to be comparable to any other present long-range navigational technique.

As another part of the systematic tests carried out by NEL, it was determined that a four-pound charge of TNT was entirely adequate to insure reception of signals originating within the network. The Bureau of Ordnance had been assigned the task of designing and testing a bomb for ultimate operational use within the network. Accordingly, a bomb, designated the Mark 22, Mod. 0 and 1 Underwater Sound Signal (5), containing four pounds of TNT was developed by the Naval Ordnance Laboratory (see picture, top of next page). Because of the ring of bottle caps around the fuse mechanism, it was soon given the name of "the bottle-cap bomb."

The bottle caps provide a convenient method for setting the detonation depth, which can be varied from 1,500 to 4,000 feet at 500-foot intervals simply by removing the appropriate cap. The bomb is an exceptionally good Sofar signal; it is not only reliable but is also safe, since both the arming and firing mechanisms depend upon hydrostatic pressure for their operation.

In July 1950, the Sofar network entered an operational evaluation phase with NEL serving in a consulting role. This evaluation gave further evidence that the accuracy of location of Sofar signals was perfectly adequate for air-sea rescue purposes, and that in general the reliability of reception and identification of Sofar signals was good.



Mark 22 Mod 1 Underwater Sound Signal. In the Mod 0 version, which would be carried by aircraft, the cylindrical tail vane shown is attached to the lower end of the bomb.

More recently, NEL was given the opportunity of using the NE Pacific Network for research studies on long range underwater sound transmission from explosive sources, and much of the research carried out thus far has been concerned with features which might be of immediate operational value. As examples, studies have been made on the factors which influence the shape of received signals (4, 6); on the matter of anomalous background noises, and how they might affect the reception and identification of Sofar signals (7); and on probabilities of incorrectly triangulating source positions when several signals originate within the network in a short time (8). Space will not permit a detailed discussion of this work, but a few high-lights can be touched upon.

Tests made in the Atlantic showed that a typical long-range Sofar signal began as a low rumble and gradually increased in intensity until a peak level was reached, at which time the signal abruptly ceased. By some observers the sound has been likened to that of a kettle-drum crescendo. An application of ray theory to the long range transmission in the deep sound channel shows that the rays which cross the channel axis at the highest angles actually travel with the largest mean horizontal velocity and thus reach the receiver first, whereas the last energy to reach the receiver is that which has traveled along the channel axis at the lowest mean horizontal velocity. The duration of the signal actually gives a good indication of the range of travel in the Atlantic, making use of a factor of approximately 12 seconds per thousand nautical miles (9); i.e. a signal 24 seconds long would have originated about 2,000 miles away.

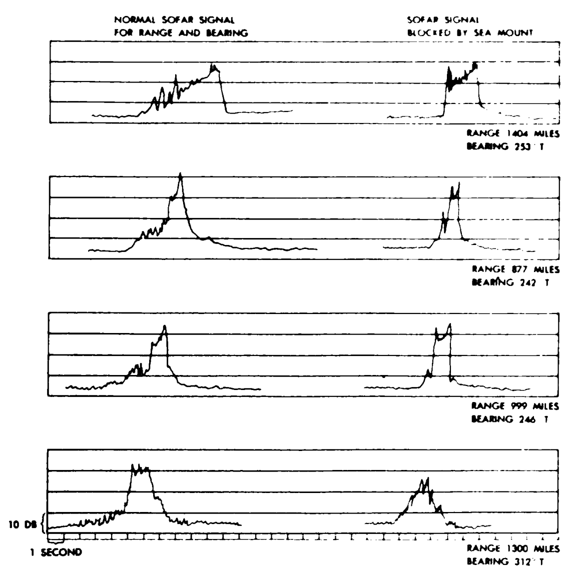
In general, transmission experiments in the Pacific did not yield so ideal a picture. It was found that the duration, and general shape, of Sofar signals here depended upon many factors other than range and that, in particular, bottom topography along the transmission path and at the receiving station played a large role in determining signal shape (6).

The graph on the next page shows the distortion produced in a signal by passage over a seamount extending up into the sound channel. The left-hand side shows the typical Sofar signal expected for the range and approximate bearing from the station, and the right-hand side shows the distorted signal. It will be noticed that in the top three cases the effect of the seamount has been to remove the front portion of the signal, i.e. the energy transmitted along the high-angle ray paths. The fourth case is a signal detonated off the sound channel axis in northern waters. From a ray-theory point of view the signal is made up primarily of energy propagated along the high-angle ray paths, and thus the effect of the seamount has been to reduce the amplitude of the entire signal rather than simply to remove the front portion.

The effect of the bottom topography in the immediate vicinity of a receiving station is illustrated in the diagram opposite. This shows the duration rate, defined as the increase in signal build-up-time with range, as a function of the bearing from the Point Sur station. It will be noted that the duration rate decreases sharply as the bearing approaches the arc-of-reception limits of the station. These minimum duration rates occur at each station at the bearings for which the bottom slope is a minimum. In general, this minimum slope is associated with a slant-wise traverse up the continental slope. Here again, then, the effect of the sloping bottom is to remove the energy carried along the high-angle ray paths.

It has also been found that the sound velocity structure of the ocean along the travel path affects the signal shape somewhat, but space limitations will not permit a discussion of this feature here. In general, the shape of the received signal agrees well with what would be predicted on the basis of ray theory.

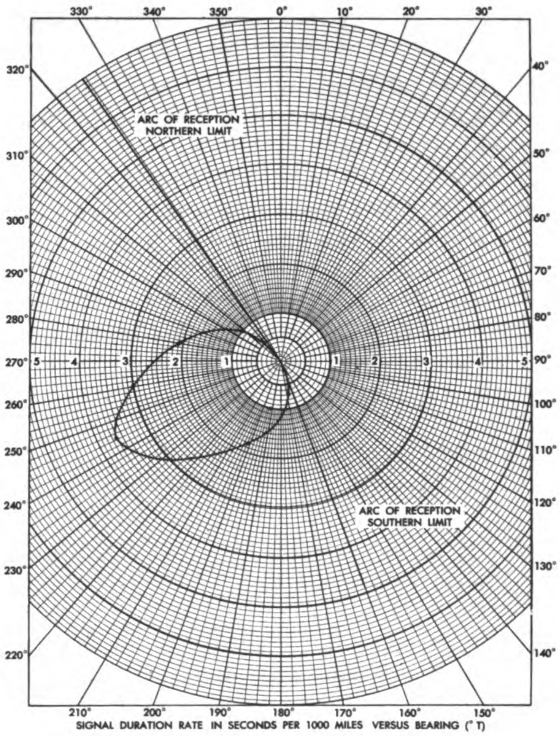
The maximum range at which the four-pound Sofar signals can be detected when detonated near the sound channel axis is not yet established. In the spring of 1951 the USS PRESIDENT JACKSON (APA 18) dropped Sofar signals while enroute from the United States to Japan, and those dropped at a range of 4340 nautical miles were received well above background noise. It was evident that greater ranges could be accomplished, but no direct effort has been made to determine the maximum detection range.



Distortion of Sofar signals by seamounts

One of the most impressive things to anyone associated with deep sound channel studies is the wide variety of extraneous background noises. All frequencies above 500 cps are usually filtered out at the receiving station, so that the typical quiet background is heard as a continuous low-frequency rumble. It is not at all unusual, however, to have this background interrupted by a wide variety of bumping and scraping sounds, tappings, hoots, howls, grunts, groans, etc. Explanations can be offered for some of these noises, but the sources of many remain undetermined.

At the Kaneohe station the most frequent anomalous background noise in the spring of the year consists of an assortment of animal-like noises that are compared favorably by many observers to the noise output of a well-populated barnyard. The sounds are very obviously being produced by marine animals and, since their period of occurrence coincides with the season when whales and porpoises are most numerous in the area, the current belief is that they are being produced by these mammals (7). Further study, however, may prove some other marine animal to be the source.



Polar diagram of signal rate at Point Sur

A frequent year-round background disturbance at all stations consists of bumping and scraping noises similar to those which might be made by a group of furniture movers of the old Mack Sennett school. Investigation indicates that they are being produced by spider crabs scraping against and walking over the hydrophones and hydrophone cages. These crabs have frequently been found when the cages have been raised for replacement of hydrophones, and marine biologists have stated that spider crabs would welcome the shelter offered by the hydrophone container, particularly during their moulting stage. Similar noises can be produced by scraping the rubber window of the hydrophone with a fingernail.

Fortunately, none of these background noises are serious from an operational point of view, since none of them have the sound of explosive signals. They are sometimes annoying, however, and certainly future Sofar-type installations should not contain submerged components that offer attractive sanctuary for marine life.

Other types of year-around background noises, but of less frequent occurrence, are caused by seismic disturbances. Many of these have not been associated with known events, and are believed to be due to small, local disturbances near a Sofar station. It has been established (10), however, that some of these sounds result from earthquakes whose origin is such that low-frequency acoustic energy is coupled into the deep sound channel and transmitted over great ranges.

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NRC Committee on Hearing and Bio-Acoustics

Under an ONR contract with the Central Institute for the Deaf (St. Louis, Mo.), a committee is being established on the physical effects on man of vibration, sound, and ultrasound. This committee, with the cooperation and assistance of NRC and joint support from the Army, Navy, and Air Force, will bear the official title: Armed Forces National Research Council Committee on Hearing and Bio-Acoustics. Any agency of the Department of Defense can receive consultation services from the committee, which will also serve to find answers to specific problems immediately upon demand.

Brain Surgery by Sound

William J. Fry

... is Head of the Bioacoustic Laboratory at the University of Illinois, where he is investigating ultrasound as a tool for studying the structure and function of biological systems.

Brain and spinal operations are among the most delicate which the surgeon is called upon to perform, for death or paralysis can result when even a small volume of vital nerve tissue is destroyed. Moreover, with even the most expert of modern operating procedures, such injuries sometimes are unavoidable; cutting out a deep-buried growth, for example, may involve the laceration of surrounding healthy tissue. For this and other reasons, our work in applying ultrasonic waves to neurosurgery may open new possibilities for successful brain surgery.

Brain surgery, up to the present time, has involved either direct cutting of brain tissue or the coagulation of the tissue by the insertion of electrically excited probes into the region to be destroyed. A program at the University of Illinois partially supported by ONR, has shown that much finer and more delicate operations may be performed by subjecting the region of the brain requiring treatment to a focused beam of inaudible (ultrasonic) sound. Such "surgery" has already been accomplished on animals and its extension to humans awaits only the construction of an instrument suitable for hospital use.

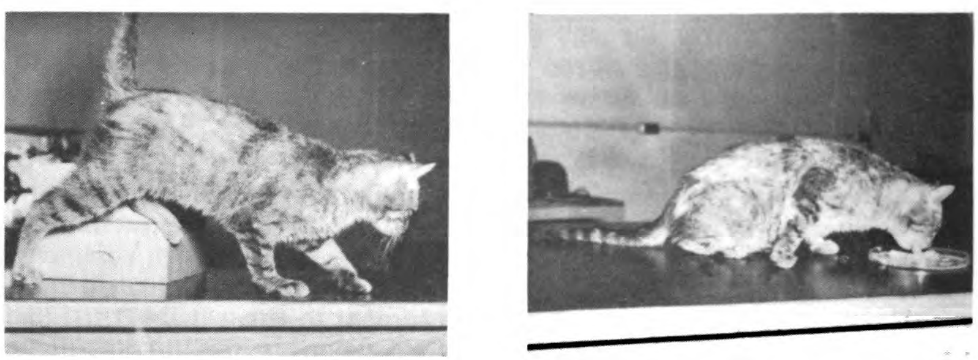
When research was started, we did not actually envision any such immediate practical application, but were merely investigating the possible effects of inaudible sound on nerve tissue. Frogs were used in our first experiments, which subjected to high-intensity sound the region of the back immediately over the portion of the spinal cord containing the nerve cell bodies which control the muscles of the hind legs. The sound, transmitted to the frog through water, produced permanent paralysis of the legs after a brief exposure. The minimum time required to obtain this effect was dependent on the sound intensity—that is, as the intensity increased, the time required for paralysis decreased.

There was a minimum intensity, however—a threshold value—below which no paralysis occurred no matter how long the animal was subjected to the sound. This threshold intensity is very high compared to the intensity of audible sounds. If a frog is exposed to sound above the threshold value, but for a time insufficient to cause paralysis, the frog is more easily paralyzed by a second exposure which takes place minutes later. This increased susceptibility has been found up to 15 minutes after an exposure.

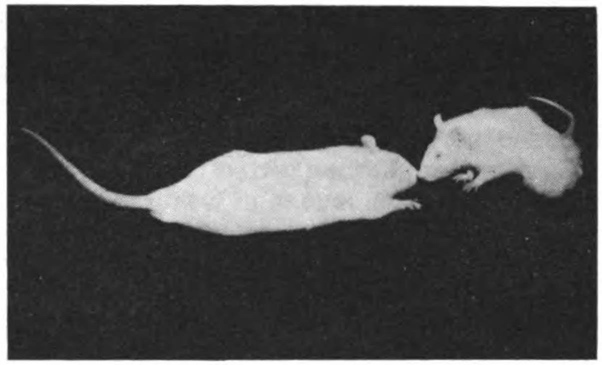
In subsequent investigations various portions of the brains of cats and monkeys have been irradiated by focusing the sound beam on the selected region. In this way very small sections, of the order of a few millimeters in linear dimensions, can be affected without disturbing the neighboring tissue. In the studies on cats and monkeys, an opening is made in the skull through which the sound beam is passed. This procedure is necessary because high-frequency sound is greatly absorbed in bone. After the animal recovers from the anesthetic it is examined for changes in muscle control, coordination of movement, etc. Following this phase of the investigation, which may require a period of months, the animal is sacrificed and the changes in the brain produced by the sound are studied microscopically.

The determination of the underlying mechanism was an objective of the program. Why did the sound produce such effects on nerve tissue? It was at first thought that the temperature changes produced by the high-intensity sound might account for these effects. The amount of heating produced in the tissue was therefore determined by direct measurements made with imbedded thermocouples. However, these showed that the effects produced by the sound occur well below the region of damaging temperature levels. Temperature changes, then, are clearly not responsible for the changes in the brain tissue. Additional evidence of this is obtained from studies made with frogs subjected to multiple exposures of the sound. The time interval between exposures can be chosen so that the temperature of the tissue returns to normal between exposures. Permanent changes in the nervous system can nevertheless be produced.

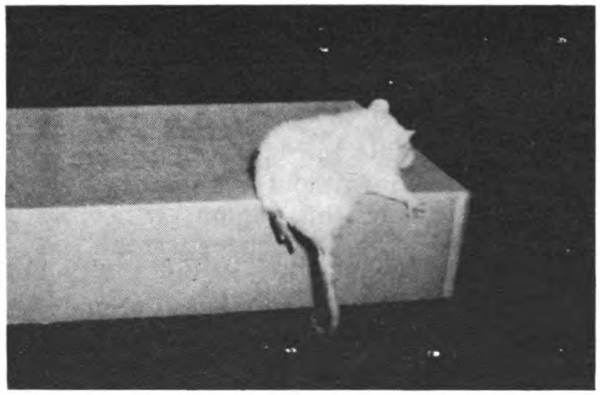
The changes made by the sound may possibly stem from its direct action on large molecules or higher organizations in the individual cells of the tissue. This could, perhaps, account for the great differences in the susceptibility of various types of tissue to change by sound. It is possible, for example, to arrange the dosage to destroy nerve cell bodies in any desired region of the brain or spinal cord without deleterious effects on the blood vessels or nerve tracts in the same region. It is even possible to depopulate a region of large nerve cells and not change appreciably the population of the small nerve cells in the region. Such selective action furnishes an ideal technique for studies on brain structure and function.



A portion of this cat's anatomy has been subjected to a focused beam of sound, causing a permanent motor deficit. Note the abnormally raised hind leg (left) and the awkward position of the front legs (right).



The adult rat above, subjected to a sound dosage just after birth, was left with hind legs paralyzed. Note, above right, the small size of this rat as compared with a normal rat. Picture at right shows another with paralyzed tail as well as hind legs.



The great advantage of this method as compared with direct cutting away or coagulation of brain tissue is the range of susceptibility of the components of the brain to action by the sound. In cutting and coagulation, all tissue in a given region is destroyed: nerve cells, nerve fibers, and blood vessels. Thus there is obviously no possibility of differentiating between different types of nerve cells or of producing a partial depopulation of the nerve cells in a region. Even more serious, parts of the nervous system not directly connected with the region being operated on are affected because of the interruption of the blood supply and fiber tracts. Moreover, with these older methods, the production of a lesion of a special shape in the nervous system also presents difficulties. When a suitably controlled focused beam of inaudible sound is used to produce lesions, all of these difficulties are surmounted.

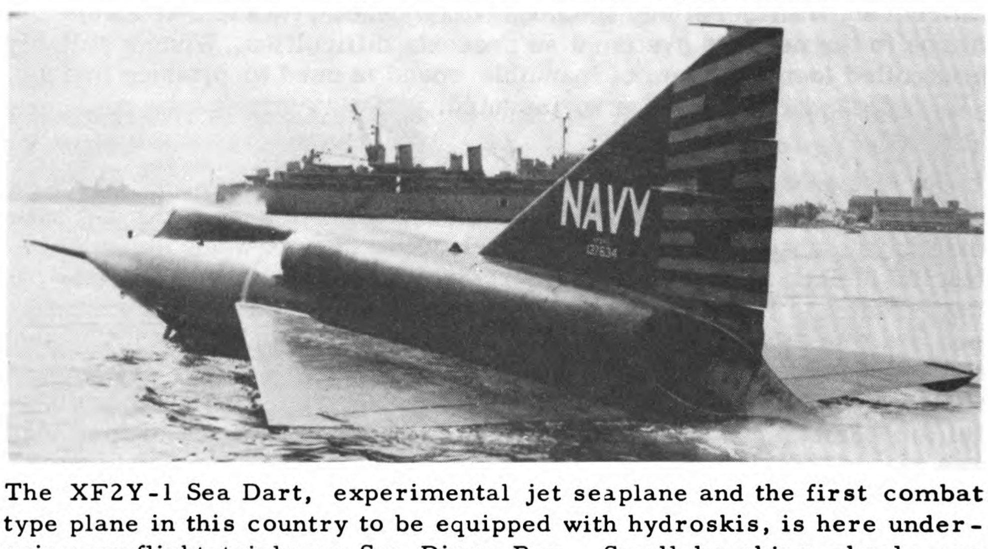
As a specific example of the work currently in progress on the structure of nervous systems and its relation to function, we can describe briefly the changes in behavior which occur in cats when the bulboreticular inhibitory formation is subjected to a focused beam of sound. All cats treated in this way showed a permanent motor deficit with a resting posture of extended fore limbs and slightly flexed hind limbs. Although the pattern of muscle movement and control (and the goose-step walk of the fore legs) are best illustrated by motion pictures, still shots are useful for some aspects. The first picture shows how the cat's hind legs are raised abnormally in walking, as if it were continually stepping over an obstacle. The awkward position of the fore limbs as the cat eats is shown in the second picture. The legs are displaced laterally and toward the rear of the animal, which appears indifferent to being placed in clumsy positions.

Some effects of irradiating regions of the spinal cord with sound are illustrated in the pictures of adult rats which had been subjected to the sound just after birth. The first picture shows the position of the paralyzed hind legs as the animal moves about. The tail, unaffected, is used normally. The marked longitudinal compression of the posterior region of the treated animal can be seen in the second picture. Note also the small size of this rat in comparison with the normal rat. The next picture shows an adult female rat which was subjected one day after birth to a sound dosage which paralyzed both hind limbs and tail.

Our work up to the present time has been accomplished with a single beam-focusing sound source, which produces lesions small in cross section but relatively long. To obtain lesions small in all three dimensions, a multiple-beam instrument, now under development at this laboratory, will be used. The conditions of the irradiation will be chosen so that only in the region where the beams intersect will the sound level be high enough to produce permanent changes in the nerve tissue. Thus it will be possible to reach any desired region of the brain and produce a change therein without damage to tissue through which the sound beam must pass to reach this region. It is visualized that this type of apparatus may be used in human neurosurgery.

It is expected that the use of inaudible sound in the treatment of disorders of the nervous system may bring within the scope of medical therapy a wide variety of pathological conditions which can not now be treated successfully. In addition it appears that, because of the nature of the changes produced by the sound, including the non-interruption of blood vessels, many conditions now handled by standard neurosurgical practice could probably be better treated by the use of focused inaudible sound.

Sea Dart Equipped with Hydroskis



The XF2Y-1 Sea Dart, experimental jet seaplane and the first combat type plane in this country to be equipped with hydroskis, is here undergoing preflight trials on San Diego Bay. Small beaching wheels are built into the retractable hydroski gear.

On the Naval Research Reserve

Eminent Speakers to Participate in Psychological Warfare Course

Judging from the high caliber of the speakers who have agreed to take part in the Psychological Warfare Course being organized by LT Lawrence L. Whiteneck, NRRC 11-4, San Pedro, Calif., the lectures promise to be extremely worthwhile. The program, which follows, will cover the principles of psychological warfare from the viewpoints of the Navy, Army, Air Force, State Department, and National Strategy Board.

April 1:	"The Total Problem of Psychological Warfare," Dr. Raymond B. Allen, Chancellor of U. C. L. A. and former Director of the National Psychological Strategy Board
April 15:	"Navy Operations and Psychological Warfare," speaker to be arranged
May 6:	"Psychological Air Operations," Col. James A. Anderson, USAF, Chief of Psychological Warfare Branch, United States Air Force
May 20:	"Methods of Research in Psychological Warfare," Dr. Victor Hunt, RAND Corporation; former Associate Director of the Voice of America
June 3:	"Army Operations and Psychological Warfare," Brig. Gen. Robert A. McClure, USA, Chief of Psychological Warfare, Special Staff, United States Army
June 17:	"Policy Making Problems in Psychological Warfare," speaker to be arranged

Interest in the course has been high. The Army is ordering some 100 officers from Psywar units and base company to attend the entire series as an integral part of their training program. The Air Force is also sending a number of officers

Special Devices Seminar

Applications are now being accepted for the Special Devices Seminar, beginning 19 April (at 1600) and continuing through 2 May (0800) 1953, at the Special Devices Center, Port Washington, Long Island, N. Y.

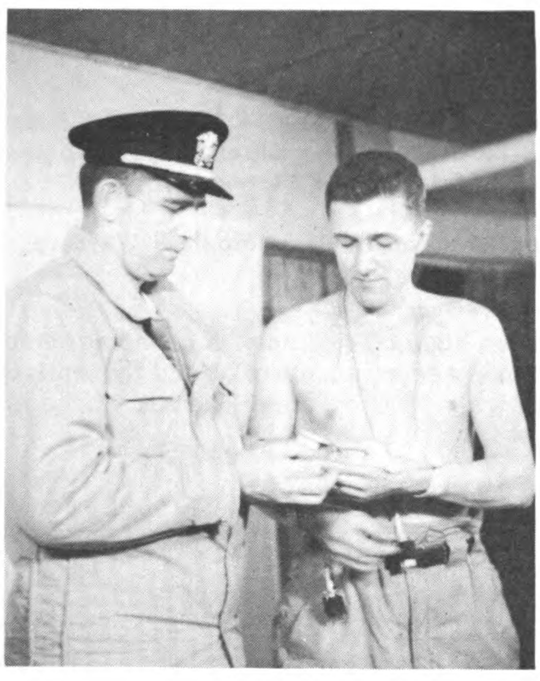
Testing Arctic Clothing on Mt. Washington

LT Richard C. Dunham, USNR

Member, Washington Research Reserve Program

The enthusiastic training duty report given here describes LT Dunham's two-week tour at the top of frigid Mt. Washington. We believe that, after reading it, more Reservists will want to prove their salt by participating in this really rugged duty, at the same time performing a valuable service for the Navy. The Navy Clothing Supply Office would like to have five scientifically trained Research Reserve officers, for each of two-week periods through April, to test and evaluate Arctic clothing. These officers should report to the Clothing Depot, Gorham, N. H. to receive instructions.

As the first Naval Reservist to receive two weeks active training duty (January 5 to 19, 1953) at the Mt. Washington installation of the Navy Clothing Supply Office, Brooklyn, I may have something of interest to relate to other Reservists. This activity was set up to test cold-weather clothing developed by the Research and Development Division of the Supply Office. My duty began on Monday, January 5 at the Office in Brooklyn where I spent two days becoming familiar with the organization. I met Navy and civil service personnel there, examined some of the cold-weather clothing, and toured the various laboratories and testing rooms.



To measure changes in skin temperature, thermocouples are attached to LT Dunham's right hand.

On Wednesday I went by train to North Conway, New Hampshire, where I was met by Messrs. Corona, Mazzeo, Della Ratta, and Kendall and was driven to the Glen House where I was assigned a comfortable room. The next day we went to the halfway house where we stayed through Sunday. The carpenters had finished the basic remodeling of the building, but very little equipment had been taken up the mountain and the rooms were bare and unpainted. There was no water supply and the electric cable and field telephone wire from the Signal Corps base (approximately 1000 feet further up the mountain) had broken. The only heat was from a butane gas cook stove in the kitchen.

Our first step was to shellac and paint the rooms; a bench was constructed; a wind direction and velocity indicator was installed on the roof; equipment was brought up from the valley and uncrated; thermocouples and cables were constructed. After spending a day in bad weather trying to repair the electric cable, Mazzeo and I were forced to give up because it was buried by several feet of snow and shoveling it out would have been an impossible task. The Signal Corps later ran another light line and also a new wire for the field telephone.

Since the Edward R. Murrow, CBS television show, "SEE IT NOW", was scheduled to make a film of our activities on Thursday, January 15, it was necessary to rush all our activities. In spite of the difficulties, every one made a maximum effort and we were able to have the facilities ready in time. I cannot say enough for the hard work put in by Messrs. Zemme, D'Amico, Corona, Mazzeo, and Della Ratta and for the fine spirit they displayed. It was a real pleasure to be associated with them during my tour of duty. Various publicity people (from CBS, the New York Times, Esquire, Inc., and the First Naval District, Boston) were on hand Thursday to record our activities. Everything went off more or less according to plan, and the Navy should have some good publicity as a result.

As Naval Reserve training duty, this was one of the most pleasant, profitable, and stimulating tours I have ever had. Since my duty coincided with the beginning of the operation when the halfway house was in the process of becoming a going concern, most of my time was devoted to electronic work. This included making a large number of thermocouples and cables, and checking out potentiometers and other instruments. Future duty on the mountain should be considerably easier now that most of the basic work has been completed. I am somewhat concerned about the lack of water at the halfway house, but this situation can probably be eased once a definite schedule is arranged for hauling up the cans. Installation of a storage tank will also help.

LT Dunham, dressed in test outfit, steps out of the car at halfway house.

I believe that the actual testing would be an extremely interesting and profitable experience, and I wish I might go back long enough to see more of this phase of operations. The clothing seems to me to be excellent; the boots are especially fine. I wore the A-1 and A-2 outfits, singly and together, while working in the open and I was most favorably impressed. The only things I did not like were the gloves, which, although warm, were made of material which caused everything to stick to them, including snow, with the result that ones hands quickly became wet and dirty. These gloves are satisfactory when used inside the heavier mittens, but they are not too practical when worn separately while working. Other than this I have no complaints!

I have been telling members of our ONR Naval Reserve Company here in Washington about the interesting program being undertaken on the mountain, and I hope there will be other recruits for this unique and worthwhile duty.

Congratulations to CDR Boyle, NRRC 1-7

It never rains but it pours--this is what CDR Frank Boyle, Springfield, Vermont, is finding out! In his case, it was a most welcome rain, as evidenced by the following letter:

Dear Commander Edmondson:

Thank you very much for your kind note. Promotions are splendid things but this one certainly gives me a big lift.

The letter arrived this afternoon. After reading it noisily I handed it to my wife. She read it, made appropriate remarks, then said "You'll need more troops as a Commander, so let's go!" As directed, I took her to the hospital. This was at three this afternoon. At 6:30 tonight our second child, first son, was born--9 pounds 2 ounces--both doing nicely, thank you.

Bet you didn't realize what a chain of events that note would start. Thanks again for your kindness.

Frank Boyle

Commanding Officer of NRRC 3-1 Retires

CAPT Robert H. Griffin, USNR, Commanding Officer of Company 3-1 (New York), has retired after 35 years in the federal service. A former special assistant to the Chief of Naval Operations, CAPT Griffin was assigned during the early part of World War II to speeding up production of submarine torpedoes. CAPT Howard B. Stevens, USNR, of Ridgefield, N. J. is the new Commanding Officer.

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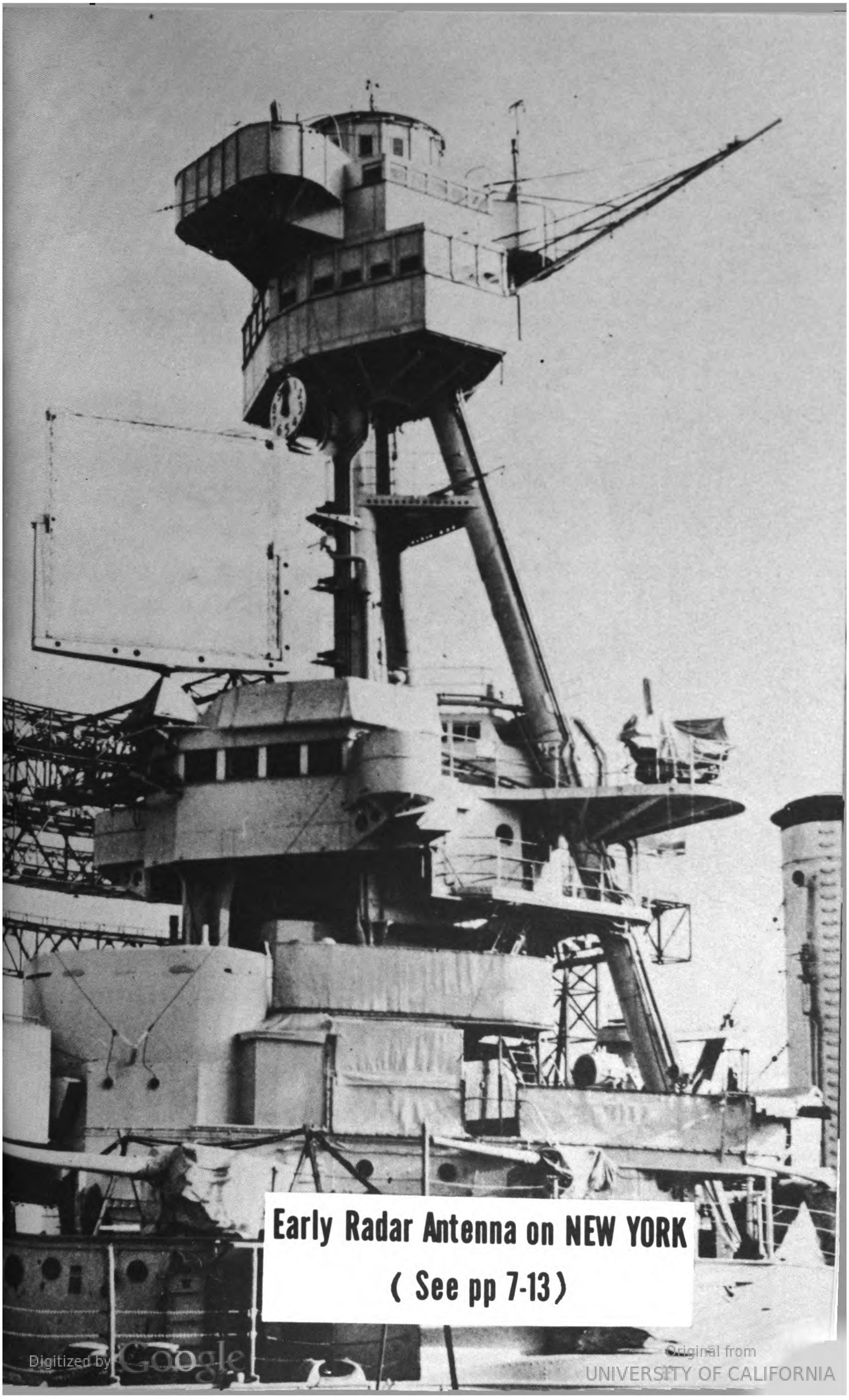
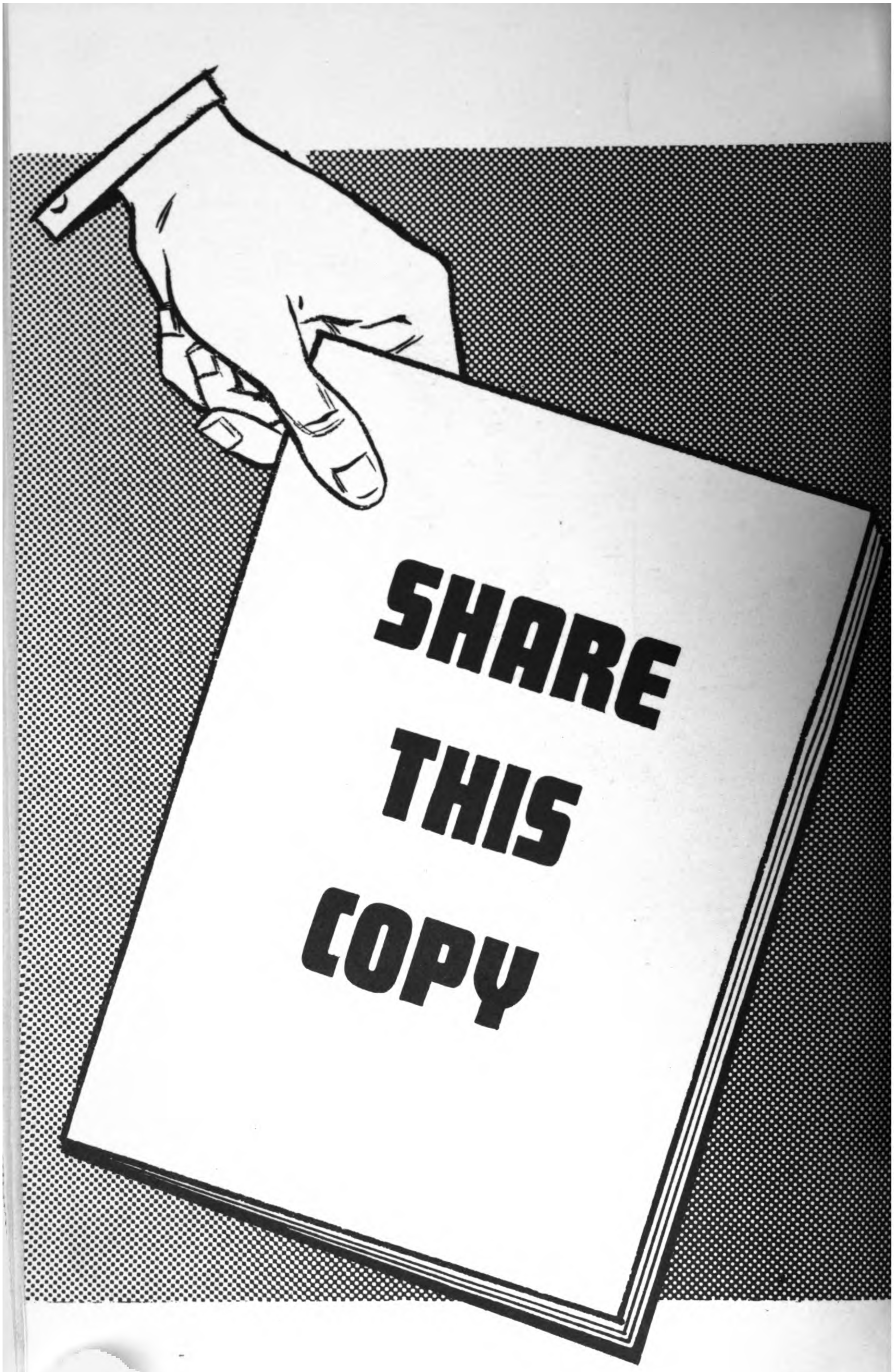


Early Radar Antenna on NEW YORK

(See pp 7-13)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