

ADVANCEMENT OF MARINE SCIENCES—MARINE SCIENCES AND RESEARCH ACT OF 1961

JUNE 20, 1961.—Ordered to be printed

Mr. MAGNUSON, from the Committee on Commerce, submitted the following

REPORT

[To accompany S. 901]

The Committee on Commerce, to whom was referred the bill (S. 901) to advance the marine sciences, to establish a comprehensive 10-year program of oceanographic research and surveys, to promote commerce and navigation, to secure the national defense, to expand ocean, coastal, and Great Lakes resources, to authorize the construction of research and survey ships and laboratory facilities, to expedite oceanographic instrumentation, to assure systematic studies of effects of radioactive materials in marine environments, to enhance the public health and general welfare, and for other purposes, having considered the same, report favorably thereon with amendments and recommend that the bill as amended do pass.

INTRODUCTION

S. 901 is a bill to establish a national program of oceanographic and Great Lakes research, comprehensive in its scope.

To assure continuity of progress in this national effort, the bill would extend the program over a period of 10 years.

The bill would also provide for—

1. Coordination of the program, in which 6 departments in the executive branch, 3 independent agencies, and 15 bureaus, offices and services of the Federal Government would participate;
2. Participation in the national effort by educational and scientific institutions and laboratories, State agencies, associations, organizations, industries, and qualified individuals who would, in the opinion of contracting or granting authorities of our Government, contribute to our scientific knowledge of the oceans and the Great Lakes;

3. Construction of ships and shore facilities required for biological, physical, chemical, geological and related research in the oceans and Great Lakes;

4. Development and acquisition of new and improved scientific devices, instruments, and tools for marine exploration and research;

5. Education and training of marine scientists, among them biologists, geophysicists, chemists, geologists, meteorologists, bacteriologists, pharmacologists and taxonomists, required to achieve the objectives of, and the anticipated benefits from, the 10-year national oceanographic program;

6. Formal and reciprocal cooperation with other nations in marine research and oceanographic surveys of national or international significance.

Enactment of S. 901 is recommended by your committee in the conviction that national, state, institutional, individual, and international benefits would accrue from the oceanographic and Great Lakes research and surveys which the bill would authorize.

Similar belief was expressed by witnesses who testified at hearings on the bill held March 15, 16, 17, and May 2, 1961; of scientists from every section of the Nation who have written to the committee about the bill, and of State officials, university presidents, and spokesmen for associations, organizations, and industries who have communicated with the committee in advocacy of the program authorized in this proposed legislation.

Evidence and expressions were offered that the proposed coordinated program of expanded marine research and surveys would produce, among others, the following benefits:

1. Increase our security from enemy sea or undersea attack.
2. Augment the efficiency of our own undersea forces.
3. Advance underwater acoustics and communications.
4. Improve commerce and navigation and safeguard it against disruption in the event of a national emergency.
5. Increase the accuracy of long-range weather forecasts.
6. Ultimately enable mankind to foresee climatological changes of world significance.
7. Afford greater protection to lives and property from ocean-bred hurricanes and other violent storms.
8. Restore and expand our fisheries and reduce costs to both fishermen and consumers.
9. Alleviate the protein deficiency in the diets of millions of undernourished children and mothers in the underdeveloped nations of the world.
10. Reveal ocean deposits of scarce and strategic minerals and develop methods of recovering and processing them.
11. Expand our knowledge of the fossil fuels that lie beneath the oceans.
12. Diminish pollution dangers from atomic and other wastes.
13. Facilitate discovery of many new medical and pharmacological weapons in the eternal war against disease.
14. Safeguard waterfront property from beach erosion.
15. Diminish damage to docks, piers and vessels from marine boring and fouling organisms.

S. 901 is a resources bill, a defense bill, a health measure, an education and training bill, and a science bill, titled the "Marine Sciences and Research Act of 1961."

The bill is offered in the national interest and, as one distinguished scientist testified at hearings on it before your Committee: "The Nation's interest is as boundless as the sea itself."

The report following will detail the objectives and magnitude of the program, the requirements to achieve these objectives, the authorizations proposed to meet these requirements, and the agencies, offices, services, and institutions which would carry out the program to the Nation's benefit.

MARINE SCIENCE—THE NEGLECTED FRONTIER

The basic purpose of S. 901 is to increase our knowledge of the world ocean and the Great Lakes, the life within them, and the dynamic forces which stir and move them.

Waters of the ocean or of the Great Lakes border 31 of our 50 States, and affect the Nation's vitality, welfare, and security.

The world ocean is the dominant physical feature of this planet and within the solar system is unique to this planet.

The Great Lakes form the largest body of fresh water in the world and no other continent has a similar inland waterway system.

Scientific or systematized knowledge of the ocean and the Great Lakes is limited and to a large extent superficial. To oceanographers and limnologists both represent a neglected frontier.

One reason for this neglect is that man, whose habitat is terra firma, has concentrated his scientific attention on his immediate environment and the space above it which he can vision.

A second reason is that the world ocean, and to a lesser extent the Great Lakes, have confronted man with an area or field of overwhelming and, until very recent years, impossible magnitude.

A corollary reason is that human vision does not penetrate more than 300 feet below the surface of deep waters, and, until the development of electronics and certain technological advances, man could only grope in the depths with primitive equipment "like a blind man making a butterfly collection," as one oceanographer, Dr. Athelstan Spilhaus, puts it.

Today science has revealed enough about the ocean and its relation to life to know that further knowledge is imperative if civilization is to continue to exist and progress.

The task is enormous in scope and complexity. The ocean is earth's largest laboratory. The Great Lakes are earth's largest fresh water laboratory. To probe them will require the talents of scientists trained in many disciplines—marine biologists, geophysicists, chemists, geologists, meteorologists, climatologists, and others.

The magnitude of the task is such that many more scientists must be trained in these specialized fields, ships for research and surveys must be constructed, shore facilities must be constructed, new instruments must be developed and provided, research and findings must be coordinated and accomplishments evaluated.

To achieve this will require a national effort and program. No single agency of our Government can do it. No State or institution alone can do it.

If done at all the Nation must undertake it as a national program.

And it must be done. Other nations are engaged in a national oceanographic effort. Great Britain has a national oceanographic program. Canada has a national program. Australia and Japan have national programs.

But the most massive oceanographic effort of all nations is that of Soviet Russia which is operating more research ships than the entire free world, and is operating them in all oceans. Moreover, the Soviet scientific ships are larger, better equipped, have more laboratories, and accommodate more marine scientists than those of any other nation.

Soviet research ships carry a bronze plaque of Nicolai Lenin with this quotation: "In order to spread world communism, it is necessary to use the fields of science and technicology."

To spread communism throughout the world, Russia must make use of the oceans, and thus the seas are very important in the Kremlin's scheme of world domination.

It is the concept of the materialistic philosophy that guides Russia's rulers that scientific leadership is concomitant to world leadership.

To deny the principal competitor of the free world this leadership is earth's largest laboratory—the world ocean—is a duty and responsibility of the democracy which potentially is most capable of unlocking the ocean's secrets—the United States.

The United States, even with a national coordinated program, cannot accomplish this mission in 1 year or 2 years or 5 years.

The ocean is too vast, its mysteries too profound, too complex, and too numerous.

At least 10 years of vigorous, continued, amply supported, and systematic research will be required in the opinion of the Nation's outstanding oceanographers, who consider the ocean an unparalleled frontier for scientific exploration. Why?

Ocean waters cover 71 percent of earth's surface at an average depth of more than 12,400 feet. Land above sea level has an average elevation of 2,747 feet.

The world ocean contains earth's longest mountain ranges, highest peaks, and deepest canyons yet less than 2 percent of this vast underwater terrain has been charted.

In contrast, 60 percent of the moon's surface has been photographed and mapped in detail; 100 percent if we accept Soviet claims.

On land exposed above the ocean only the surface is inhabited.

Life in some form exists in the ocean at all levels.

Life as we know it, plant or animal, in fact could not exist on this planet without the ocean.

The moisture in the atmosphere that falls on the land—and lakes—as rain or snow is almost entirely water evaporated from the sea by the energy of the sun.

Much of the energy that drives the winds and carries this moisture across the land originates from this evaporation process which, from the 300 million cubic miles of water in the ocean, draws annually 80,000 cubic miles of water later to be released as rain or snow and still later flow back to the sea.

Columbus O'D. Iselin, senior oceanographer of the Woods Hole Oceanographic Institution, Woods Hole, Mass., likens the interchange between the ocean and the atmosphere to a great machine; "in many respects similar to a steam engine."

"Between them they receive energy from the sun and radiate heat back to space." he states in a report to the Committee on Oceanography of the National Academy of Sciences, of which he is a distinguished member.

Winds and rain, hurricanes and typhoons represent the working of this great machine. To understand this sea-air steam engine we must learn far more than we know now, not only about processes in the atmosphere, but also about the currents beneath the sea surface and the sluggish circulation in the deep waters.

Man's destiny is inseparably linked to the oceans, atmosphere, and sun, and the interchange of energy between them.

Dr. F. G. Walton Smith, director of the University of Miami Marine Laboratory, in a letter to the Commerce Committee supporting S. 901, stated:

The ocean which absorbs and stores the greater part of the sun's heat falling on this planet and which is the reservoir of atmospheric moisture is a major part of the weather machine.

Prediction and eventually the human control of weather and destructive phenomena such as hurricanes are inescapably dependent upon our improved understanding of the ocean itself.

Spectacular advances in recent years and months have been made in studies of the atmosphere, the troposphere, and stratosphere. Hundreds of millions of dollars are being spent to explore outer space and add to man's knowledge of the universe.

But the ocean that surrounds us, its depths stirred by mighty forces still unexplained, continues to retain most of its age-old secrets.

S. 901 authorizes a program to help unlock them.

MINERALS FOR THE FUTURE

The world ocean contains, in solution, all identified natural elements, 40 of them in measurable amounts.

The most common elements, sodium and chlorine, combine as the salt that seasons and preserves our food. All of it is of marine origin. Ten million tons are evaporated directly from the sea each year by man. Fifteen million tons are extracted from mines that are merely the beds of ancient, vanished seas.

Magnesium, an important component of light alloys and with many other uses, is produced from waters of the ocean. So is bromine, an ingredient of high-octane fuels and dyestuffs, and potassium for chemicals and fertilizers.

But most of the elements and combinations of elements in the ocean, an inexhaustible reserve, remain untouched.

Vast areas of the deep ocean floor are carpeted with concretions of manganese and iron in first-size and larger nodules. The manganese nodules contain cobalt, nickel, and copper in notable amounts and in smaller ratios rare earths, vanadium, molybdenum, and other metals.

"The Soviets are currently very active in the field of sea floor mineral surveying and have recently published a map showing the location of many manganese nodule deposits, even some deposits close

to our shores," John L. Mero, research engineer for the University of California Department of Mineral Technology, this week advised the Commerce Committee.

Mero is considered by scientists to be one of the Nation's outstanding authorities on these nodules and has been engaged in a university program to recover and process them. He continued:

Although proposals have been submitted to Federal agencies for the past 2 years to obtain minimal support to keep our program alive here at the University of California, we have received no support as yet.

It seems strange that the U.S. Government will invest hundreds of millions of dollars to develop ore deposits in places such as Cuba—only to lose the entire investment—but cannot spend a few hundred thousand over the years to help develop the vastly greater in size and richer in grade deposits on the ocean floor. In addition to being politically free, these deposits would be royalty-free ores for us.

We obtain the bulk of our manganese and cobalt from foreign sources which are sometimes politically unstable. Some of the countries from which we obtain metals contained in the sea floor ores seem to be politically stable.

However, as these countries industrialize they will tend to consume their minerals themselves and try to sell the United States manufactured products rather than the raw materials. Such is already happening in the case of India and South Africa which are forcing us to take an increasing amount of ferromanganese rather than the manganese ore itself.

At shallower depths than the manganese-cobalt-nickel nodules, rich phosphate deposits lie on the ocean floor, in some areas as much as 30 pounds to the square foot. Extensive beds along the southern California coast are only 40 miles from shore. The United States annually imports at high cost more than 150,000 tons of crude phosphates for use on the Nation's farms.

Beneath the ocean the petroliferous sediments of the Continental Shelf hold an estimated 400 billion barrels of crude oil, a treasure as yet scarcely tapped.

The oceans are the world's great reserves of minerals, chemicals, and liquid fuels. No nation owns them because beyond the Continental Shelf the seas are international—and neutral. As land resources in ores and oils eventually become exhausted man will inevitably turn to the oceans to meet his needs.

When this time comes the taking will be on the basis of "first come, first served," and by the nation or nations with the necessary scientific knowledge of where these mineral resources are, their composition and values, and the technical ability to extract them from the oceans.

Two agencies of our Federal Government have the capability of assisting in this endeavor—the Geological Survey and the Bureau of Mines.

The Geological Survey, however, is restricted under present statutes to the national domain, which does not include the deep ocean.

Section 5 of S. 901 would do away with this statutory limitation imposed on the Geological Survey.

In doing so it follows a formal recommendation of the Committee on Oceanography of the National Academy of Sciences, which reads as follows:

The Committee on Oceanography believes that the U.S. Geological Survey should have authority and should be encouraged to conduct basic and applied geological research on a worldwide basis as well as within the continental limits of the United States.

At present statutory limitations under which the Geological Survey operates are unrealistic. Many of the geological features of vital importance to the mission of the Survey were originally of marine origin. Similarly, many geological features (including potential petroleum fields) extend from the continental United States into the Continental Shelf.

The Geological Survey has a long history of significant and respected scientific accomplishments in geology. To continue in this fine tradition and to assume its rightful place in the developing national program in marine sciences, the Survey must have the authority to conduct scientific investigations without regard to arbitrary geographical limitations.

The Committee on Oceanography strongly recommends that appropriate legislation be enacted to revise the U.S. Geological Survey charter accordingly.

The Department of the Interior also wants these limitations removed.

Studies of the geological structure of the ocean floor will be of value to inland as well as coastal States.

This was pointed out in a letter with reference to S. 901 sent to Senator John A. Carroll, of Colorado, by 16 members of the faculty of the Colorado School of Mines, Golden, Colo. The letter stated:

DEAR SENATOR CARROLL: We the undersigned individual members of the faculty of the Colorado School of Mines are vitally interested in the future of the marine sciences in the United States. To this end we believe that the passage of legislation such as that introduced in the Senate by Senator Magnuson, of Washington, as the Marine Sciences and Research Act of 1961 (S. 901) is essential to the continued growth of the marine sciences during the next decade. There is a critical lack of knowledge concerning the oceans, and that lack must be overcome.

Although the State of Colorado is far removed from the oceans, the marine sciences are not without direct application to the problems of the State. Many of the rocks, for instance, which are exposed in Colorado were originally deposited beneath the waters of oceans which covered the continents during past geological ages. A better knowledge of the processes which are going on in the oceans today will enable us to interpret the conditions under which the rocks of Colorado were laid down. This interpretation in turn can lead to greater development of the mineral resources which are so abundant in our State.

We solicit your support for legislation concerning the marine sciences in the Senate (Congress) of the United States, and ask that you do all within your power to insure its passage.

Sincerely yours,

(Signed) Robert J. Weimer, Associate Professor; John D. Haun, Associate Professor; Peter C. Badgley, Associate Professor; Warren D. Mateer, Assistant Professor; Harold Bloom, Instructor; Robert H. Hutchinson, Associate Professor; John R. Hayes, Professor; Fred A. Moore, Assistant Professor; Harry C. Kent, Instructor; David W. Trexler, Assistant Professor; Rudy C. Epis, Assistant Professor; Leonard Bryner, Assistant Professor; Donald H. Johnson, Instructor; Laurence Ogden, Assistant Professor; M. A. Klugman, Assistant Professor; L. W. Leroy.

THE UNFENCED PASTURES OF THE SEA

Living resources of the sea are equally if not more vital to man's future than the ocean's untapped mineral wealth.

Swimming in the sea or nestled in its estuaries and shallows are incalculable stores of rich protein food.

Earth's human population is exploding at a rate faster than the herds and flocks of protein-producing land animals can be increased.

A world deficit in animal proteins exists now. This deficit totals 1.8 million metric tons, according to a special task force of the Department of Agriculture which recently completed a world survey of the problem.

A metric ton is 2,204.6 pounds. The world animal protein deficit, therefore, is 3,968,280,000 pounds. Half of the world's deficit, or 900,000 metric tons, the task force reported, is in the non-Communist Far East. Communist Asia has a deficit of 755,000 metric tons. The deficit in Africa was stated as 115,000 metric tons.

"For the free world the critical area is the Far East," the task force commented. "Also a considerable deficiency appears for certain of the populations of Africa."

To meet this deficit man is turning more and more to one of the richest sources of protein food—the sea.

From 1948 to 1958—the last year for which complete data is available—the world catch of fish and shellfish increased from 19.4 to 33.7 million tons, or more than 70 percent.

What will the world require in the year 2000 when its present population approaching 3 billion has doubled to 6 billion people?

What will the United States require in 1980, when its population has reached 230 million?

President Kennedy in a letter to Vice President Johnson on March 29, 1961, stated:

Within two decades our own Nation will require over a million more tons of seafood than we now harvest.

Can the ocean supply these needs?

Scientists say it can provided there is sample research and exploration on the high seas, conducted from adequate and scientifically equipped ships; modernization of commercial fishing vessels and adoption of improved techniques.

Without these, their answer is, "No."

Can the ocean supply world needs?

The answer is the same.

The nation which has taken the lead in fisheries research and exploration is not the United States. It is Soviet Russia, which since the war has built a huge fleet of large exploratory and research ships, trained hundreds of marine biologists to accompany them, and has constructed the world's largest and most modern fisheries fleet to harvest the fish these scientists find.

Soviet scientists on Soviet research ships equipped with advanced scientific instruments are exploring the Pacific south of Alaska and the tropical mid-Pacific, and the Atlantic from the Bay of Biscay to Cape Horn and from the African gulf to Brazil.

Earlier they explored the Grand Banks off Newfoundland, historic fishing grounds of New Englanders, Canadians, Portuguese, French, and English for over 300 years.

Last year Russian fishermen took 10 pounds of fish there to every pound caught by U.S. fishermen, and more fish than every other nation except Canada, which is adjacent to the fishing grounds.

In the Bering Sea off Alaska, according to testimony at hearings on S. 901, Russia is operating a fleet of 60 to 90 trawlers, 15 to 20 large refrigerator ships, and 3 to 4 factory ships.

"Our American seafood industry must compete on the high seas with its Soviet counterpart as well as with the fishing industries of many other nations, both friendly and unfriendly to our way of life," Mr. Milton E. Brooding, chairman of the U. S. section of the International North Pacific Fisheries Commission, testified before the committee at hearings on S. 901.

Many of these nations are far ahead of ours in the study of oceanography.

Our lack of knowledge of marine sciences, is, quite frankly, appalling. If we can learn more about the effects of various natural phenomena upon fish movements; we can reduce the time required for the catch, and, thereby, reduce significantly our costs of production. The lower the cost per ton of production by our fishermen, the lower will be the cost per can of fish to the housewife.

The U.S. fisheries research fleet is small, overage, obsolete, and has been shrinking instead of gaining during the past 3 years.

Witnesses at hearings on S. 901 were caustic about the decline in U.S. facilities for fisheries research.

Dr. Wilbert M. Chapman, who has held high Government, State and university posts and is now Director of the Resources Committee of San Diego, Calif., testified that the Nation's research fleet is now in a worse condition than it was 5 years ago. He stated:

We had two research vessels working in the Gulf of Mexico. Now we have one working off the State of California. The reason for this is that the bottom fell out of our (California) research ship. We just couldn't fix it up. So the Bureau of Commercial Fisheries * * * were kind enough to loan one of those vessels to the State of California. That leaves you (Florida) one short.

In the State of Hawaii they had three vessels working out there. One of them they put out of commission entirely, the *Manning*. The second one they didn't have money to operate, the *Smith*. She has been donated to the Scripps Institution of Oceanography because the Bureau of Commercial Fisheries didn't have the money to operate it.

We have the *Black Douglas*, an old beat-up yacht from prewar days, and she is being used about two-thirds of the time because there isn't money for it.

Dr. Milner B. Schaefer, Director of the Inter-American Tropical Tuna Commission and a member of the National Academy of Sciences Committee on Oceanography, testified:

The Committee on Oceanography recommended construction of 14 new ships for research on marine resources, 7 to replace existing overage and obsolete craft.

Funds have been appropriated to construct one new vessel. Meanwhile three have been removed from the service of the Bureau of Fisheries, and one other is being operated with a short crew and lack of adequate maintenance. It would appear that we are losing ground.

The Bureau of Commercial Fisheries presently operates 14 vessels, displacing from 9 to 518 tons, with the average displacement 164 tons. Of the six ocean-going ships, the oldest is 35 years old, the largest 24 years old. Four are used for exploratory fishing, two for biological research.

Russia, Japan, Canada, South Africa, West Germany, England, Scotland, Norway, and France, all have new and larger fisheries research ships than ours, and Russia and Japan in considerable numbers.

S. 901 includes the recommendations of the Committee on Oceanography that new U.S. ships for fisheries research and exploration be constructed.

Your Committee concurs with the Committee on Oceanography that our fisheries research and exploratory fleet must be rehabilitated and modernized if the United States is to share in reaping the bounty of seas to assuage the needs of a protein-hungry world. It must do so even to feed its own.

There are other implications also in this contest to harvest the riches of the ocean.

They were expressed in a statement to your Committee signed by 10 members of the faculty of the College of Fisheries, University of Washington. In part this statement read:

The United States cannot afford to surrender control of the fisheries off its coast to Soviet Russia, or to any other country, first because of the potential direct threat of the presence of large fleets of foreign fishing vessels off our coast, as well as from the aspect of world production of food.

Further it must be recognized that control of marine fisheries can be used by Russia to exert economic or political pressure on any country which is dependent on marine fisheries.

Senate bill 901 recognizes the need for the United States to study the ocean and its fisheries. It is especially im-

portant in that it provides for the study of the economic and technological, as well as the biological aspects of the fisheries. It is a pleasure to support this bill and to express the interest of the faculty of the College of Fisheries in its passage.

Food from the sea also can improve relations between nations and peoples, Dr. J. E. Lipp, corporate director of development planning, Lockheed Aircraft Corp., Burbank, Calif., advised this committee in a letter strongly indorsing S. 901. Dr. Lipp stated:

Although the sea is man's oldest ancestral environment it is also his newest, and is receptive to massive technical and industrial penetration in the next few decades. There is now little doubt of our basic ability to improve economic and living standards the world over by energetic exploration and development of the oceans.

The United States must lead this trend, for its own progress as well as to assure stability and peace for future generations. A world with adequate water, food, and materials supplies will be a world of reduced tensions, reduced warfare, increased welfare.

The United States is not progressing in the production of food fish; it is slipping backward.

In 1941 American fishermen caught and harvested 3,062 million pounds of fish for human food. War came in December of that year. The Navy acquired 285 of the finest fishing vessels on our coasts for use as minesweepers, tenders, lighters, patrol ships and for other purposes. Neither the Atlantic, Pacific, gulf, Alaska, nor Hawaiian island coasts were spared from this Navy draft of fishing vessels, a draft that could hardly be repeated in another war because of the deterioration and obsolescence of the Nation's fishing fleet.

Despite this withdrawal from the industry of its largest and best oceangoing ships American fishermen all through the war harvested more food from the seas than in any of the past 4 years, and averaged a quarter billion more pounds annually than in 1960.

At the end of the war and with the return of some of their ships American fishermen caught more than 3 billion pounds annually for 7 straight years, with the record catch of 3,307 million pounds in 1950. In 1952 the catch dropped to 2,778 million, in 1953 to 2,519 million, and since then it has held fairly stable. These figures all represent the fish taken for human consumption. Preliminary figures give the 1960 catch as 2,497 million.

The American demand for fishery products has not receded. It has, in fact, expanded. With the decline of American fisheries, the demand has been met by imports. In 1940 these imports totaled 302 million pounds with a value of \$29,073,000. In 1950 imports amounted to 405 million pounds valued at \$76,434,000. By 1955 imports had risen to 771 million pounds and the value to \$208,051,000. In 1959, the last year for which data is available, 1,113,624,000 pounds of food fish were imported for which \$311,033,000 American dollars went to foreign countries.

This is nearly three times the total amount the Committee on Oceanography considers would be required for the 10-year program of ship and laboratory constructions research and exploration it has recommended to restore the American fisheries industry to the historic role it once held in the Nation's economy.

HEALTH FROM THE SEAS

The sea as a source of food has been known ever since Stone Age man left shell mounds on the shores and Brazilian aborigines hammered fishhooks out of gold, a metal for which they knew no other use.

Life in the sea other than fish, shellfish, and such huge marine mammals as whales, walruses, and seals, until recent times was considered useless, if not possibly a menace.

Then a few—and a very few—inquisitive scientists began to wonder what fish feed on and to trace the chain of life that exists in infinite and complex variety in the ocean.

The chain leads down from large fish who eat smaller fish, who in turn eat lesser fish and on down the ladder of life to the minute zooplankton, which feed upon microscopic diatoms and phytoplankton.

Marine microbiology, bacteriology, and toxicology, which treats of poisons and their antidotes, became suddenly important branches of biology, divisions which may become as useful to mankind as study of the fishes that it eats. Many of the organisms in the seas hold clues to remedies for man's ills.

This was recognized by the American Medical Association last year when it published in its magazine *Nation's Health* a report on the discovery of "an antibiotic of marine origin which in the test tube is effective against hospital-plaguing staphylococcus aureus." The discoverers: Dr. John M. Sieburth of the Narragansett Marine Laboratory, Kingston, R.I., and Dr. Paul R. Burkholder, Director of the Kitchawan Research Laboratory on Long Island.

Titled "Miracle Drugs from the Sea," the article cited a number of other specific discoveries from the ocean and added: "The sea may be an untapped reservoir to answers to scores of medical problems."

Medical implications of marine research are vast.

Dr. Dixy Lee Ray, consultant in biological oceanography to the National Science Foundation, testified before the committee at hearings on S. 901 in part as follows:

A number of potentially important antibiotics are known to be produced by marine micro-organisms, and recently an effective antiviral agent has been found in the muscles of abalone.

Vitamins, health foods, blood extenders, are all known to be produced by a variety of marine plants and animals.

Carrageen, extracted from certain seaweeds—*Chondrus crispus*, or Irish moss—appears to be effective in the treatment of stomach ulcers.

Some marine animals harbor no enteric bacteria. Whether this is due to production of antibiotic or lysing agents by the digestive tissues is not at present known, but if it could be determined, the information might have implications for treatment of bacterially caused digestive ailments in man * * *.

One of the most active fields of medical research today involves studies of tissue compatibility and the nature of immunity. Here animals we call sponges are especially useful experimental material for their tissues can be separated into the constituent cells that then are capable of re-aggregating to form the typical animal once more.

The eggs and embryos of marine invertebrates also contribute to this field. Their study is even more important in learning about the factors that stimulate cell division and control its rate—information that is basic in unravelling some of the perplexities surrounding the growth of cancer and neoplasms.

Dr. Ray stated further that while cancer afflicts many species of vertebrates, not a single case has ever been discovered in any marine invertebrate. If scientists can discover why the invertebrates are immune it may suggest methods of combating cancers that afflict mankind.

Dr. Harry Sobotka, director of the Department of Chemistry, Mt. Sinai Hospital, New York City, also touched on cancer.

In a letter to the committee he stated:

The study of the chemistry of marine life will contribute to the physician's arsenal in the fight against cancer and other disease.

Dr. Carl H. Oppenheimer, marine microbiologist with the Institute of Marine Sciences, in a letter to the committee commending it for including in S. 901 a broad research program into medical implications of oceanography, stated in part:

The rather few scientists in our field cannot begin to cope with the important aspects of our field which need immediate attention.

Our expanding population daily introduces new aspects of marine microbiology which cry for understanding and possible control.

Deep sea microbiology is almost nonexistent in the United States, and the only major effort in this field is being made by Russia.

Dr. Ross F. Nigrelli, director of the Laboratory of Marine Biochemistry and Ecology, Brooklyn, NY., in a letter to the committee listed seven important biochemicals that have been isolated from the tissues and body fluids of fish and marine invertebrates.

Attention also was called to an important compound found in invertebrates which other scientists have stated "may well become a capital clue to the biochemistry of sanity and insanity."

Finally [Dr. Nigrelli concluded] I would like to point out one area in which a pharmaceutical product derived from a fish is playing a well-established role in national defense.

Studies of the physiology of the electric eel, first initiated in the laboratory of the New York Aquarium, led to the discovery that this fish contains large amounts of cholinesterase (or acetylcholinesterase), which is an enzyme vital to the transmission of nerve impulses.

This enzyme is now being extracted and purified in quantity. With this and the electric eel as an experimental animal, it was possible for Dr. I. B. Wilson to synthesize an antidote for nerve gasses called PAM. Although the electric eel is at present the primary and most available source of the enzyme, there are several marine fishes that could be also used as a source.

What facilities do these marine biologists and microbiologists probing the seas for new contributions to health need to pursue their vital research?

Dr. Ray answered this question in her testimony before your committee on S. 901. She said:

To explore the medical aspects of oceanography means that there must be permanently established marine laboratories, located near the ocean shore, equipped with continuously operating sea water systems that deliver adequate supplies of fresh, unpolluted sea water on a year-round basis.

For medical investigations, the marine laboratory must also have modern research equipment. The number of such marine stations, compared with the total number of laboratories in which medical research with terrestrial organisms can be carried out is small indeed.

Great laboratories are built to investigate questions of health and disease, and these medical research centers are vitally important, but most of them are far from the sea and none have provision for exploiting the rich reservoir of experimental organisms that live in the marine environment.

If we look to the open ocean where important medically oriented experiments could be carried out on shipboard, we find that only now are research vessels in the United States being planned to provide adequate research biological laboratories.

Without these facilities, on shore and afloat, in which carefully controlled modern research can be carried out, progress in the medical aspects of oceanography will be very slow.

From far off Hawaii, our 50th State, and only State completely surrounded by ocean, Dr. Philip Helfrick, Acting Director of the Marine Laboratory at Honolulu, wrote the committee as follows:

In the past, research relating to the discovery and determination of medically and pharmacologically important substances from marine organisms has been restricted by limitation of funds, facilities, and to some extent by the availability of trained personnel.

Senate bill 901, as proposed, particularly sections 9 and 10, would greatly encourage and facilitate such research.

Dr. Burkholder, previously mentioned in this report, wrote the committee in a similar vein. He said:

The real significance of marine biology to mankind in the future will only become known through fundamental studies of all kinds of sea life, their kinds, their functions, and their products.

It is believed that S. 901 will provide the means for training technical personnel and carrying on effective researches in marine biology and in other phases of oceanology that will be important in the future.

THE MENACE TO HEALTH FROM THE SEAS

While man searches the sea for organisms and substances that will improve man's health and alleviate his ills, man also is flooding the margins of the seas with substances which peril man's health and threaten to create new ills, thus placing a double burden on marine biologists.

As some scientists center their research on discovery of "new miracle drugs from the sea," others must concentrate on combating the effects of dangerous pollution.

Not only is the latter necessary to protect the health of those on land, but also to preserve in the fingers of the ocean called estuaries and along its borders the fish and shellfish that man consumes.

Dr. William J. Hargis, director of the Virginia State Fisheries Laboratory at Gloucester, Va., in a statement to the committee made in connection with its hearings on this legislation, sounded this warning:

Despite great present and future needs, man is despoiling the oceans and estuaries at an ever increasing rate. For example, pollution, e.g. radioactive wastes, industrial wastes, domestic wastes, soil, farm and house pesticides; * * * are wreaking their havoc.

Baldly, bluntly, the future of society depends on man's not ruining the sea. But pressures to do so are increasing as a result of the population explosion and the concomitant industrial explosion.

We must make wise use of our marine resources. This calls for knowledge—knowledge demands research. Greater research must be carried out. There is urgency for getting this work done because the race to wrest facts from the sea is slow and we fall behind more rapidly all the time. There is urgency—great urgency.

Dr. Lauren R. Donaldson, director of the Laboratory of Radiation Biology, University of Washington, testified on the phase of contamination with which he is most concerned. He stated:

The development of space programs using nuclear devices, of underwater nuclear powerplants and nuclear submarines, of nuclear-powered merchant ships, of harbor-excavation projects and of nuclear devices for creating new Panama Canals, all will require a much more precise knowledge of the means for disposing of radioactive wastes.

We need in the immediate future intensive work on such problems as the ultimate fate of radioactive materials in the sea, on the rates of sedimentation and the bonding upon bottom materials, on the biological recycling of radioactive materials, and on the selective uptake of materials by aquatic organisms.

Very urgently needed, too, is a broad educational program involving more trained high school and college instructors working in the special fields of radiation biology * * * The Marine Sciences and Research Act of 1961, if enacted into law, should go a long way toward coordinating the many

aspects of the marine sciences and provide the facilities and support so badly needed. We sincerely hope it will be passed by Congress.

THE HIGHWAYS OF INTERNATIONAL TRADE AND FRIENDSHIP

Oceans are the highways that link us with our friends and allies in Europe, Asia, Africa, South America, the commonwealths of the antipodes and all of Oceania.

They also are the sole surface routes to our 50th State, Hawaii, and to much of our 49th State, Alaska.

Over the highways of the sea the United States in 1960 exported American commodities valued at more than \$20 billion. From foreign countries goods valued at more than \$14 billion were transported to the United States.

Imports included 66 of the 77 strategic materials needed for our defense industries.

The United States also is dependent on ocean transportation for many consumer items, of which coffee, spices, tropical fruits, natural rubber, many fibers, and components of many medicinal drugs are examples.

Bulk shipments to all our bases overseas must be carried by water. Foreign aid cargoes, military, economic, or humanitarian, move by sea.

Without international commerce, without the open two-way highways of the sea over which to move this commerce, and without the ships, our own or those of friendly nations, to carry this commerce, our national economy as we know it would collapse, our international relations would disintegrate, and our defenses would be seriously impaired.

The highways of the sea are surface highways, but this surface, unlike that of land, varies at every point from day to day and at no point is ever stable. Today it may be smooth; tomorrow hazardous.

Despite the improvements science and technology have brought in ship design, navigation safety, and communications, 300 ships each year are lost on the high seas with attendant loss of life and property.

Ultimately, perhaps in the not too distant future, the surface highways of the sea will be supplemented by ocean subways, surface craft by subsurface carriers.

Undersea carriers and their crews will escape winds and storms raging over the surface of the ocean. Sea ice no longer will be a barrier to commerce in the high latitudes. New and shorter trade routes will be opened beneath the Arctic ice. Costly ship time will be reduced and commerce will move faster than at any time in history.

Before this occurs, however, scientists will want knowledge of subterranean currents, of the powerful and yet unexplained internal waves, of variables in magnetic forces, and of the contours of the rugged ocean bottom with its numerous hidden peaks that never see the sun. They will want undersea road maps and communication systems and, eventually, perhaps, undersea repair stations.

Knowledge is needed for potential subsurface commerce. For our military security the need is enormously magnified, as will be indicated later in this report.

Today, when ocean, intercoastal, coastal, and Great Lakes commerce all move on the surface, hazards are great and the protection of our shipping a national endeavor requiring the activities of several important agencies of our Government.

Much of this protection is required along our lengthy shores.

WHERE LAND AND OCEAN MEET—OUR 12,255-MILE COASTLINE

The first technical agency established by our Government, the Coast and Geodetic Survey, was created in 1807 primarily to safeguard our shipping by charting coastal waters and providing tables of tides and data on currents.

With the advance of science its duties have increased to include geomagnetic surveys, gravity observations, the recording of earthquakes, many of undersea origin, and the transmitting throughout the world of warnings of tidal waves.

States fronting on the ocean have a combined coastline of 12,255 statute miles; a tidal shoreline of 28,909 miles. Our Atlantic coastline, the most highly industrialized in the world, is 1,889 miles in length; the gulf coastline is 1,659 miles; Pacific coastline, 1,292 miles; Alaska coastline, 6,640 miles; and that of Hawaii, 775 miles.

To perform its many duties along this area where land and water meet, a coastline exceeded in length only by that of Canada and the U.S.S.R., the Coast and Geodetic Survey has 15 ships.

Only one is new, the 3,150-ton *Surveyor*, recommended by your Committee and Congress in 1957, completed in late 1960, and only recently assigned to deep ocean studies, and to surveys in the Chuckchi Sea, which borders Alaska on the north.

On May 10, 1961, the Comptroller General of the United States communicated to the Senate Committee on Commerce through its chairman a 74-page review of the Coast and Geodetic Survey. The review covers the years 1959-60 and, while just completed, does not include the *Surveyor*.

Comptroller General Joseph Campbell, with reference to the Survey fleet, stated:

At December 31, 1951, the Bureau, in carrying out its charting responsibilities, had 14 surveying vessels. The fleet consisted of (1) three major long-range vessels designed for operation in exposed waters, (2) one intermediate-range vessel designed also for operation in exposed waters, but with more limited surveying abilities, (3) two short-range inshore vessels with limited seaworthiness and operating abilities, and (4) eight small vessels having a still more limited scope of operations.

Prior to World War II, the Bureau had eight major vessels engaged in offshore surveys. Because of the nonreplacement of major ships transferred to the Navy during the war and the loss of one ship by disposal because of age and unfitness for future surveys, the Bureau will have only four major ships in 1961, including one under construction * * *

The last ship referred to, as previously stated, has now been completed.

The Comptroller General's report continued:

During fiscal year 1958, a special 3-man board, appointed by the then Under Secretary of Commerce and composed of representatives from the Department's Office of Budget and Management, the Maritime Administration, and the Coast and Geodetic Survey, made a physical inspection and study of the condition of 13 of the Bureau's survey ships.

The Board reported that, with the exception of three ships, none of the vessels inspected had any projected utilization in an extended charting program and that each of these vessels had only limited usefulness for varying short periods of operations at below normally accepted standards of efficiency.

The Board recommended that steps be taken toward the establishment of an efficient fleet capable of carrying out the requirements of the nautical charting program and that this be accomplished in a maximum of 6 years.

What the Comptroller General's report did not mention was the fact that prior to completion of the *Surveyor*, the Coast and Geodetic Survey had not had a new ship for 18 years, that one of its ships is over a third of a century old, and that the average age of all ships is 22 years.

While perils to our shipping have increased with the expansion of a competitor nation's submarine fleet, and while new demands have been made on science for greater knowledge of the waters that wash our shores and the bottoms beneath them, the floating facilities of the agency charged with charting these waters and the underlying terrain are smaller in number and less capable than before World War II.

How vital this may be to the Nation is told in a third report, that of a special committee of the National Academy of Sciences, submitted several months ago. It stated in part:

In the world of geophysics the Coast and Geodetic Survey has long been recognized as a world authority. The Survey's work in oceanography, astronomy (as applied to positioning), gravimetry, geomagnetics, and seismology has furnished an important contribution to the world's knowledge of these subjects.

* * * * *

Mankind is now standing on the threshold of the space age and a precise knowledge of physical characteristics of the earth is completely essential to the development of this era.

Scientific and engineering knowledge has expanded at an almost unbelievable rate during the past two decades, the expansion bringing new and complex instruments and devices, new processes, entirely new disciplines in science and engineering.

In this era of expanding knowledge it is impossible to stand still; a scientific and engineering activity, or a nation, either advances or regresses.

The Coast and Geodetic Survey, during its 153 years of service, has made splendid contributions to knowledge and

to the progress of the Nation and the world. It cannot exist on past accomplishments, but must move steadily forward in the fields of science and engineering essential to its activities. Because of the fundamental nature of its activities, the Survey must continue to play an important role in the destiny of the Nation and the world.

The bill would authorize 10 new survey ships for the agency; 4 large ships, which would bring it up to its prewar strength in that category, 4 medium-sized oceangoing ships, and 2 small ships.

From some quarters the question has been raised whether it would not be more practical and economical to acquire surplus ships from the Navy and convert them to survey uses.

The Comptroller General's report states:

The Bureau has attempted to acquire surplus vessels from the Navy and the Maritime Administration but has been unable to obtain any ship which could be economically modified to serve as a suitable survey vessel.

The Bureau states that, throughout the history of the Coast and Geodetic Survey, reasons of economy have made it necessary to obtain numerous naval vessels, yachts, and other craft for conversion to survey ships but that in every case such action has been a makeshift expedient, as it has been impossible to convert these vessels to completely effective units. Further, the delay in the ship replacement program has increased the requirements for repairs. This trend is expected to continue until the Bureau's present fleet of vessels having limited usefulness is replaced.

The Navy, too, has found that the conversion of old ships for surveys and research is uneconomical and that these ships are ill-adapted for oceanographic studies.

SERVICE AGENCY OF THE SEAS AND LAKES

The U.S. Coast Guard, created in 1790, has historic duties and responsibilities. Among these are:

1. Rendering aid to vessels in distress.
2. Operating lighthouses, lightships, weather ships, buoys and ocean stations.
3. Rescuing shipwrecked mariners and giving medical or surgical assistance to those stricken at sea.
4. Protecting seal and otter fisheries.
5. Promoting the efficiency and safety of the American merchant marine.
6. Patrolling the northern trade routes for ice hazards.
7. Extending health and welfare services to remote and isolated communities.

The Coast Guard has been rightly called the service agency of our seas and lakes.

In time of war the Coast Guard becomes an important arm of the U.S. Navy.

Coast Guard officers are trained at the U.S. Coast Guard Academy, New London, Conn., and Coast Guard ships are manned by highly efficient crews.

The Coast Guard operates 347 ships, some of them larger than any American research or survey vessel. Many of these ships are assigned to distant ocean stations.

But despite the Coast Guard's capabilities, archaic statutes prevent it from conducting oceanographic research or Great Lakes research except in connection with one activity, the international ice patrol.

In other words the Coast Guard has been denied the privilege of acquiring broad scientific knowledge of the environment it works in and with.

The Coast Guard considers this unrealistic. So does the President of the United States.

In his letter with reference to the marine sciences to Vice President Johnson on March 29, 1961, President Kennedy stated:

At present, the Coast Guard enabling legislation limits the extent to which the Coast Guard can engage in scientific research. Only the international ice patrol is authorized to make such studies. I recommend that the statutory limitations restricting the participation by the Coast Guard in oceanographic research be removed. With ocean weather stations, deep sea thermometers, and other data collection devices, our Coast Guard can make a valuable contribution to the oceanographic program.

S. 901 would remove statutory restrictions on Coast Guard participation in the national oceanographic and Great Lakes research effort.

S. 901 would authorize funds for equipping Coast Guard station vessels and offshore towers with instruments for scientific research, the collection, transmission and analysis of scientific data, and for training officers and personnel in oceanography.

The sections of S. 901 applicable to the Coast Guard follow recommendations of the Committee on Oceanography of the National Academy of Sciences, which stated in part:

The Committee on Oceanography believes that the U.S. Coast Guard should have authority and should be encouraged to conduct basic and applied oceanographic research, to install, maintain and use standard oceanographic equipment, to collect and analyze oceanographic data, and (in cooperation with other agencies) to engage in special studies and programs in oceanography.

The Coast Guard operates a series of lighthouses, lightships and ocean stations. Each is a valuable platform for the observation, collection of data and study of oceanographic phenomenon. The ocean stations and lightships (future light towers), because they provide for the possibility of obtaining long time series of oceanographic data from a single location, are of unique importance to the further development of oceanographic understanding.

Earlier the Eastern Pacific Oceanic Conference, in which scientists from the five Pacific States, Canada, and several Latin-American nations on the western slope participated, conducted an extensive study of research possibilities on ocean weather ships, benefits to be obtained, and costs of instrumentation and personnel for such research.

Findings were reported at the annual meeting of the Conference held last November. The meeting was attended by a staff member of the Senate Commerce Committee.

The findings read in part:

Time-series data from single locations in the ocean represent one of the most valuable research tools for increasing our understanding of the marine environment.

Time-series observations in the fields of geophysical and biological sciences often form the foundation for later fundamental research papers which never could have been prepared had not the observations been taken with only "the good of the science" in mind at the time.

But for more immediate application, time-series data in the ocean are invaluable in the interpretation of synoptic surveys in the surrounding area. They serve to indicate whether the synoptic survey was made at a typical or an atypical time or during the transition from one time to another.

Finally, time-series data establish the character of temporal fluctuations, the average conditions and magnitude and changes in variability. In this way they advance our ability to forecast the variations in oceanographic conditions which can be applied in numerous ways, e.g., (a) the prediction and availability of commercial fish species, and (b) the prediction of thermal structure and sound conditions in the oceans for military purposes.

The only significant contribution of this nature in the Pacific, the Conference noted, had been made by Canada at its weather station "Papa" in the Gulf of Alaska, and which Canada has conducted for the past 4 years.

Data obtained at this weather station, the report stated, has "benefited research at numerous west coast laboratories."

But [it added] the United States, which has the most vital interest in the Northeast Pacific of any country in the world, has been guilty of gross neglect in its failure to institute programs for obtaining time-series oceanographic data in this area.

The U.S. Coast Guard furnishes the ships and nonscientific personnel at this Nation's ocean weather stations, while the Weather Bureau supplies highly competent meteorologists.

Atmospheric and surface data has been sought, research below the surface neglected, not because the Coast Guard willed it so, but because it lacked statutory authority for deep sea research.

The United States maintains six weather stations. The Coast Guard supplies ships, officers, and crew. The Weather Bureau assigns meteorologists and technicians to these vessels.

Two of the weather stations are in the Pacific, one midway between the California coast and Hawaii, the other midway between Hawaii and Japan. Canada which, as previously stated, combines meteorology and oceanography, maintains the station in northern Pacific waters.

In the Atlantic the Coast Guard maintains four weather stations approximately 1000 miles off our shores and ranging from south of Greenland to east of Cape Fear.

The Coast Guard is aware of this potential for deep ocean studies. It is aware of many other potentials which will exist when legislation such as S. 901 is enacted.

These potentials, with a list of vessels and the areas in which they operate, was sent to the chairman of your Committee by Vice Adm. J. A. Hirshfield, Acting Commandant of the Coast Guard, last November.

Of large craft, Admiral Hirshfield reported, the Coast Guard has 36 cutters of over 200 feet, 55 buoy tenders of over 150 feet, 23 patrol craft of 100 to 200 feet, 31 lightships, 8 oceangoing tugs, and 5 ice-breakers.

With reference to the buoy tenders, the report stated:

It is reasonable to assume that since these are the only U.S. vessels capable of working buoys at sea, the future plans for increased use of oceanographic buoy systems will call upon the services of this type of vessel.

"Lightships provide a medium for marine research which is uniquely valuable," the report continued.

"Coast Guard ocean station vessels occupying weather stations in the Atlantic and Pacific Oceans year round represent a research potential significant even to the casual observer," the report stated elsewhere, adding that—

weather ships are not equipped with any instruments for research in the fields of oceanography except as occasionally provided by a cooperating agency.

Even the larger patrol craft and oceangoing tugs could be adapted for limited oceanographic projects, it was conceded.

Legislation such as S. 901 is necessary to include them in the national oceanographic effort.

WEATHER IN THE OCEANS

Day and night the U.S. Weather Bureau is in communication directly or indirectly, with virtually every citizen.

Through newspapers, radio, and television, it forecasts temperatures, humidity, and prospects of sunshine or precipitation.

These forecasts are based on data collected from thousands of individual observers stationed about the country, many ships at sea, and recently from TIROS satellites.

Farmers, fishermen, motorists, retailers, air and ship navigators, resort owners, shoppers; everyone, in fact, is guided by them.

The Weather Bureau is a dedicated service, staffed with highly trained meteorologists, and has been in operation since 1870.

Only two questions connected with this legislation concern the Weather Bureau. They are:

1. In view of the Bureau's statutory responsibilities, is it doing enough?
2. If not, why not?

How the oceans and the atmosphere combine in weathermaking through a mutual interchange of energies was told in testimony of two eminent oceanographers at the hearings on S. 901 as reported earlier in this report.

Dr. Francis W. Reichelderfer, Chief of the Bureau, gave similar testimony last year before the Subcommittee on Oceanography of the House of Representatives. He said in part:

The interplay between the atmosphere and the ocean is so intimate that the atmosphere and ocean can be considered as one medium, separated by a discontinuity in density and velocity.

The exchange of heat, moisture, momentum, gases (such as carbon dioxide and oxygen), and certain chemical elements (such as sodium, chlorine, potassium, calcium, and magnesium) has profound influence on the subsequent behavior of the atmosphere and ocean. In supplying the atmosphere, the oceans serve as a warehouse of nearly infinite capacity for heat, moisture, and other properties. In turn, the faster moving atmosphere supplies the oceans, particularly the top layers, with much of their momentum.

Dr. Reichelderfer urged intensified meteorological research as follows:

1. Investigations with regard to the exchange of heat, water vapor momentum, chemicals, and other properties across the atmosphere-ocean interface.

2. Study of the "feedback" mechanism whereby unusual weather conditions produce unusual sea conditions, particularly temperature changes, and the manner in which these, in turn, subsequently introduce atmospheric changes such as variations in path and intensity of storms.

3. Investigation of the various mechanisms contributing to a piling up of water against coasts during hurricanes and other severe wind-storms; improvement of storm-tide warning services now in operation along the Atlantic and gulf coasts, and their extension to the Great Lakes and other coastal area.

4. Study of coastal weather with particular emphasis on harbor and estuarine forecasting for nuclear-powered ships, where release of nuclear effluents, either by accident or design, might become serious for coastal communities.

Elsewhere, Dr. Reichelderfer said that "eventually 400 additional selected merchant vessels should be equipped for surface weather observations," and that "there are huge gaps in our observations of the oceans and the atmosphere over the oceans—gaps so large that the entire area of the United States could be 'lost' in the wide open spaces of some regions." He commended the report and objectives of the National Academy of Sciences Committee on Oceanography.

Statutory responsibility is placed on the Weather Bureau to record and describe the climates of the oceans, but the Bureau has been handicapped in meeting this responsibility by lack of funds for necessary instrumentation.

Yet the studies are so important in this scientific age that the Office of Naval Research (through contracts with institutions), the Navy Hydrographic Office, and the Bureau of Ships are undertaking them.

Office of Naval Research contracts include the following studies:

1. *Woods Hole Oceanographic Institution*.—Life cycles of trade wind clouds. The mechanism by which a cumulus cloud transfers water from the sea surface to the atmosphere. Source, distribution, temporal variation, and meteorological significance of sea salt nuclei in the atmosphere with relation to their involvement with rain and hurricane formation. Measurement of wind-generated waves and spectrum analysis of these measurements.

2. *University of Chicago*.—Interchange of heat, momentum, and moisture from the tropics to the temperate zone and the relationships between changes in the tropics to changes in the synoptic weather patterns in the temperate zone. These studies include that of storms at the ocean surface.

3. *Texas Agricultural & Mechanical College*.—Thermal structure of the upper layers of the oceanic water and heat transfer processes operative between the ocean and atmosphere with a view to developing techniques for forecasting changes in the thermocline.

4. *New York University*.—Development of the theory of ocean currents and waves and the problems of anomalous fluctuations of the stratification of the upper water layers.

In addition, the Office of Naval Research is carrying out, at its own Naval Research Laboratory, microseismic studies recording wave spectra and wind energy, and the relationships between these parameters and the origins and activity of ocean storms.

The Bureau of Ships is conducting a heat budget analysis at a field station at Nome, Alaska, in connection with studies of ice formation, movement, and degeneration.

The Navy Hydrographic Office is engaged in three major projects involving measurements of the thermal structure of the ocean and atmosphere, currents at many vertical positions of the atmosphere and ocean, weather phenomena, salinity, wave heights and duration. These are related also to the marine and geographic topography and to meteorology.

One of the projects is directed to obtaining more knowledge of ice formation, disintegration, distribution, and movements with a view to better forecasts.

A second is related to forecasting ocean waves.

A third considers the heat budget and results of energy exchange upon thermal structure of the ocean.

A joint panel on air-sea interaction was held in Washington on April 17, sponsored by the Committees on Oceanography and on Atmospheric Sciences of the National Academy of Sciences.

Texas A. & M. College, on May 8, presented to Government agencies two proposals for long-range studies of oceanographic-meteorological conditions in the Gulf of Mexico.

Program I would involve use of a network of fixed platforms 60 nautical miles off Cameron, La. Bottom depth in this area is 95 feet.

Objectives would be to obtain a direct evaluation of sea surface roughness and the vertical flux of heat and momentum, investigate internal wave characteristics and the energy spectrum of wind-generated waves, formulate predictions of the air-sea boundary, and collect data on ocean dispersion using water-soluble fluorescent dye.

Cost of the project, including instrumentation, was estimated by the college at \$3,085,252.

Project II would involve a network of buoys covering the entire Gulf of Mexico.

Ten buoys would be instrumented to measure a variety of meteorological and oceanographic parameters, including air and water temperatures, barometric pressure, wind speed and direction, and state of the sea.

From this the college would hope to obtain data relating to the climatology of the gulf, air mass modification over the gulf, variations in conditions within the upper layers of water in the gulf and conditions contributing to formation of hurricanes.

Costs of this project were estimated at \$821,862.

At approximately the same time a symposium was held at the Scripps Oceanographic Institution, La Jolla, Calif., on climatology of the Pacific Ocean. For several years waters of the Eastern Pacific have been warmer than normal, while those off Japan are reported to have been below normal temperature.

Causes and effects of these anomalies are under study.

The Weather Bureau, since September 14, 1960, has operated in the Gulf of Mexico a marine automatic weather station, which reportedly almost immediately detected the birth of a tropical cyclone, Hurricane Ethel.

The Bureau would like to have many more of these mechanical watchdogs of the sea.

The Bureau also has repeatedly requested funds for infrared thermometers, likewise useful in advance hurricane detection, to install on merchant ships, but has so far been unsuccessful. It already has one prototype. Cost of others would be \$2,000 each.

British and French weather ships have wave measuring devices. Those of the United States do not.

British and Norwegian ships have instruments with which to measure solar radiation in connection with the interchange of energy between oceans and the atmosphere. The U.S. ships do not have them.

Nor do the U.S. ships from which scientists of the Weather Bureau make their observations have anemometers to measure wind speed at the ocean surface.

S. 901 would inaugurate in the Weather Bureau a comprehensive 10-year study of the interchange of energy and matter between the oceans and the atmosphere and its implications in connection with long-range weather forecasting.

The bill would authorize infrared thermometers for measurements of sea-surface temperatures in connection with detection of incipient hurricanes, studies of wave acceleration and pressure, and measurements of solar radiation in the marine environment.

Other provisions would authorize development, construction, or acquisition of new and improved instruments and devices for use in Weather Bureau research, including marine automatic meteorological observing stations, and application to such stations of atomic power sources.

Weather Bureau studies authorized in S. 901 also could be carried out through grants to institutions or contracts with public or private organizations.

From the contemplated research by the Coast and Geodetic Survey, the Coast Guard and the Weather Bureau would come greater protection to commerce and navigation, added safety to those who go

sea or live on its shores, earlier storm warnings and long-range weather forecasts. These would be continuous benefits to the United States in times of peace and national emergency.

From this research also would come knowledge that will aid our defense arms in thwarting enemy attacks from the sea.

Submarines, missiles launched from undersea, and nuclear warheads have added a new dimension to ocean warfare. Never could an enemy sea attack be made against us with less warning than it could be now. And never could a sea attack be more destructive.

RESEARCH FOR SECURITY

Security of our Nation and the free world is irrevocably contingent on freedom of the seas.

The U.S. Navy has the responsibility of assuring this freedom throughout the oceans of the world.

This responsibility extends during peace as well as when the Nation is at war.

In time of peace the Navy stands guard to protect seaborne commerce by keeping the highways of the ocean open, and at distant stations serves as a deterrent to aggressive powers aspiring at conquest of the weak.

In time of war these responsibilities are magnified and, in addition, the Navy must defend the Nation from sea or undersea attack, invasion by sea or saboteurs, and protect convoys of troops, military equipment and supplies.

Prior to World War I these responsibilities required primarily that the Navy command the surface of the ocean.

With the exception of primitive mines, invented and used by Russia in the Crimean War, the only invisible menace to ships-of-war were obstructions created by nature such as rocks, reefs, and near-surface shoals.

The advantages of subsurface warfare, concealment, and surprise, have been known since Alexander the Great used glass barrels in a nighttime harbor attack at the siege of Tyre, 436 B.C.

David Bushnell, in 1776, frightened British sea captains in the Hudson River with a one-man, hand-operated submersible, the *Turtle*.

The first submarine to sink a ship was the Confederate Navy's *Hundley* in the War Between the States. The date was February 17, 1864. Despite this unprecedented exploit war at sea remained two dimensional. Not until 1900 did the U.S. Navy acquire its first truly operational submarine, product of the genius of two American scientists, John B. Holland and Simon Lake.

Advances in science and technology were still required to make the submarine an effective instrument in wide-scale operations, and meet such demands as complete submergence for long periods of time, high underwater speed and rapid maneuver, and most important of all, of remaining unseen while its officers and men could "see" the enemy.

In 1914 a German submarine sank three British cruisers in 1 hour. Naval warfare had become three dimensional, the third dimension extending both above and below the surface of the ocean, as aircraft also began the task of search and surveillance.

German submarines began sinking not only British warships but merchant vessels of neutral nations including the United States and

this flaunting of our freedom of the seas brought our Nation into the war on the side of the Allies.

The enemy submarines were few in number, small, could submerge only a short distance below the surface, and were required to surface frequently to recharge batteries. Yet they confronted our Navy with a menace that demanded action.

The Navy did two things. It moved troops and supplies overseas by convoy, and it called in scientists. The scientists invented the hydrophone which could detect the sound of a nearby submarine moving underwater. When located, our Navy surface craft could—and did—dispose of them with depth bombs.

Hydrophones, the first underwater detection device, were crude but they met the requirements of that era because submarines, too, were crude. They were slow, noisy, and, as previously stated, operated near the surface. The enemy undersea menace subsided.

Germany introduced better submarines in World War II and entered that conflict with 47 in active service. She increased her undersea tonnage as war progressed, and in 1942 sank more than 1,000 ships between the United States and Europe. In that year also she added 244 new submarines, her peak construction year. Submarines were diesel powered and operated no lower than 400 feet below the surface.

Our Navy again called on science. Scientists and technologists developed sonar. Sonar detects submerged objects by sending out sound pulses and noting the echo. The use of sonar in combination with depth charges, torpedoes and air power increased the enemy submarine losses and decreased the losses of allied ships. By 1944 the Germans were sacrificing one submarine for every allied vessel sunk, while 2 years earlier her submarines averaged 13 sinkings to every loss, and in the year before that the ratio was 16 to 1.

A fact that may have significance to world commerce, navigation and security is that at no time during World War II did Germany have as many submarines as Soviet Russia has today.

Russia not only has more than three times as many submarines as the United States; it has more than all the nations of the free world combined.

Most, if not all, of Russia's active submarines have been constructed since the war. They are modern, swift, submerge to greater depths and are far more quiet than those of World War II vintage.

Russia's older submarines have been scrapped or turned over to her satellites or to other nations which she seeks to woo into her orbit. Among her beneficiaries have been Egypt, Indonesia and Communist China. Part of this bounty also consists of early post-World War II craft which have been replaced by advanced Soviet submarines.

In brief, Russia today numerically is the world's No. 1 undersea power.

Vice Admiral John S. Thach, Commander of the Antisubmarine Defense Force, U.S. Pacific Fleet, in an article titled "The Silent Paths of Destruction" published in a recent issue of Navy magazine, stated:

The Soviets have over 100 submarines in commission in the Pacific. In addition to these, the Chinese Communists have the 4th largest submarine force in the world. As a matter of fact, the great majority of these submarines are new construction and their number has multiplied several-fold within the past 6 years.

Units of this combined Communist submarine fleet can be supported from bases stretching from the Bering Strait, just a few miles from the new State of Alaska, to Hainan Island in the South China Sea.

Some conventionally powered Communist submarines can operate unrefueled along the entire coastline of North America to the Panama Canal, the Hawaiian Islands, Indonesia and Australia, and well into the Indian Ocean.

Combined, the two Communist nations on the Pacific have more submarines operating in that ocean than the United States has in all waters of the world.

The Sino-Soviet submarine fleet is not alone a menace in the Pacific. It is a world menace. Soviet Russia, in addition to her submarines in the Pacific, has from 350 to 400 available for operation in the North and Baltic Seas, the Mediterranean, and the Atlantic Ocean.

Russia's concentration on submarines is clear indication that in any contest for control of the world ocean she intends to hurl her challenge not from the surface but from below it.

As further evidence two Soviet authorities may be quoted.

Soviet Premier Nikita Khrushchev, at a session of the Supreme Soviet, stated:

In the Navy the submarine fleet assumes great importance while surface ships no longer play the part they did in the past.

Admiral Golovko of the Soviet Navy recently told a Russian audience:

With the rapid development of nuclear and missile weapons as well as radar, submarine forces assume the greatest importance in the navy. They are capable of dealing powerful blows not only against enemy navies but also against objectives situated in remote enemy territory.

Golovko's statement is clear evidence that the motivation of Russia's massive submarine fleet is aggression extending into "remote enemy territory."

The mission of the U.S. submarine force is defense.

THE ROLE OF RESEARCH IN UNDERSEA WARFARE

Since World War II the problems of long and deep submergence and high speed under water have been answered through the development by American scientists headed by Adm. Hyman Rickover, USN, of the atomic, or nuclear-powered submarine. Many problems, however, including that of "seeing" while remaining unseen, have not as yet been solved.

The submarine commander must know at all times where he is and the obstacles or enemies around him. As a Navy spokesman observed:

The task of navigating a submarine at high speed and deep submergence without bottom information that is accurate and adequate can be compared with driving a 10-ton truck on the freeway blindfolded.

The submarine navigator has been required to substitute sound for sight, acoustics for vision. Scientists have invented instruments that send sound pulses to the ocean floor and record the echoes that bounce back. The time lapse indicates the depth of bottom. If the ocean floor has been well charted indicating elevations and depressions the charts can be used as a guide or roadmap.

President Kennedy referred to these charts in his March 29 letter to Vice President Johnson in which he stated:

Knowledge of the oceans is more than a matter of curiosity. Our very survival may hinge on it. Although understanding of our marine environment and maps of the ocean floor could afford to our military forces a demonstrable advantage, we have thus far neglected oceanography. We do not have charts of more than 1 or 2 percent of the oceans.

Submarine instruments also send out sound pulses to record obstacles in the path of the submarine or objects around it.

Sound transmission through the waters is complicated by the fact that sound beams are distorted by changes in water temperatures at varying ocean layers, by variation in salinity, by chemical content of the waters, by schools of plankton or other minute organisms, or by other phenomena, not all of it explained. There are mysterious noises in the ocean also to compete with the man-created sound pulses.

As he attempts to evaluate the sounds around him, the submarine commander will wish to avoid his own submarine being heard by a possible enemy. He will seek layers in the ocean—for the ocean has many layers of varying density although they are not constant—where he can best hear the enemy and where the enemy will least hear him. Or he may seek to adjust the buoyance of his submarine so that it can balance silently between different density layers of the sea.

Operations, therefore, require great knowledge of the ocean at all depths, and great knowledge of the floor beneath it. Knowledge demands research, as Dr. Hargis noted in his statement to the committee.

With its goal of naval supremacy based on submarines, Soviet Russia a very few years ago embarked on an unprecedented and massive program of oceanographic research.

Today, to complement its submarine fleet, Russia has the world's largest research fleet. Included in this fleet are many of the world's largest research ships, some new and some conversions, and new "floating laboratories" as the Russians call them, are being added annually.

Research on these ships is conducted by the world's largest corps of oceanographers. To supplement this corps the Soviet Government is training more oceanographers in its institutions than are being trained in any other nation.

Soviet research ships, as previously stated in this report, are operating in all oceans.

Soviet scientific efforts in the world ocean present a formidable challenge to the United States where, as President Kennedy has stated, oceanography has been "neglected."

Major military responsibilities for meeting this oceanographic challenge are vested in the Office of Naval Research, created in 1946

by act of Congress, and the Hydrographic Office which is under the jurisdiction of the Chief of Naval Operations.

Basic research is conducted, principally through contracts with research groups at universities and institutions, by the Office of Naval Research, which also supplies the ships or vessels used for research by the institution.

Basic research programs, as pointed out in a report of the Inter-agency Committee on Oceanography of the Federal Council for Science and Technology, include studies of—

current regimes in the ocean, growth and movements of the biological populations, conservative and nonconservative chemical concentrations and their determination, physical processes occurring about and through the air-sea interface, the shape and composition of the ocean bottom, long-term chronology of the physical and chemical characteristics of water masses through radioactive dating, and the effect of the physical, chemical, biological, and geological environments (and their changes) on the propagation of sound and electromagnetic radiation.

Studies relating to sound propagation, a major key to efficient submarine operation and defense as previously indicated, will be emphasized at most contract and Navy laboratories, the report adds.

Fifteen universities or oceanographic institutions have contracts with the Navy to carry out one or more studies under this program. They are:

Arctic Research Laboratory, University of Alaska.
 Chesapeake Bay Institute, Johns Hopkins University.
 Coastal Studies Institute, Louisiana State University.
 Florida State University.
 Hudson Laboratories, New York University.
 Lamont Geological Observatory, Columbia University.
 Marine Laboratory, University of Miami.
 Massachusetts Institute of Technology.
 Narragansett Marine Laboratory, University of Rhode Island.
 Oregon State College.
 Scripps Institution of Oceanography, University of California.
 Texas Agricultural & Mechanical College.
 University of Southern California.
 University of Washington.
 Woods Hole Oceanographic Institution.

Eleven of these institutions operate research vessels, but of these only six have ships for research in the open sea, the remainder having small coastal craft.

Although the Navy lists the present force level of oceanographic research ships at institutions as 30 vessels, operating schedules for the coming fiscal year are given for only 16.

One reason may be that 15 of these vessels displace less than 150 tons and 11 of them less than 100 tons. Only two displace more than 600 tons, and the 600-ton ship is a tuna clipper borrowed from the Bureau of Commercial Fisheries. The two exceptions are the 2,100-ton *Argo* and *Chian*, both converted World War II auxiliary vessels. Including these two ships the average displacement of the Navy's research fleet is 350 tons, and excluding these two it is 205 tons.

Soviet Russia is operating at least nine oceanographic research ships, of from 3,000 to 12,000 tons and reportedly added two new vessels, of approximately 4,500 tons this year. In addition the Russians have many smaller research ships, operate the only submarine adapted to oceanographic studies, and the world's only nonmagnetic ship.

In the past 4 years the Russians have constructed seven new research ships.

The 154-ton *Acona*, built under Navy contract for Oregon State College, is the first U.S. ship designed and built for oceanographic research since 1931, or 30 years ago.

All other ships in the U.S. research fleet are converted tugs, fishing vessels, coastal freighters, schooners, cutters or discarded naval craft.

The recently commissioned *Acona* was the first ship of over 115 tons constructed since World War II.

The oldest ship in the research fleet was built in 1923, and four others are more than 30 years old. The average age is 19 years.

Laboratory facilities for oceanographic research in the United States are equally inadequate and antiquated, according to surveys made by the National Academy of Sciences Committee on Oceanography and testimony at the hearings held on S. 901. Instruments for scientific studies of the seas also are lacking.

NEEDS FOR OCEANOGRAPHIC RESEARCH

Dr. Roger Revelle, director of the Scripps Institution of Oceanography, and a member of the national Committee on Oceanography, summarized at the hearings on S. 901, what the United States must do to meet the scientific challenge of the oceans. He said:

(A) We must build many new and carefully designed ships to replace old obsolete ships and to add to our total national fleet for exploring the oceans.

(B) We must build many new laboratories, instrument shops, piers, and classrooms to accommodate the present overcrowded marine laboratories and to make room for the many bright young scientists who are even now flooding our oceanographic centers with applications.

(C) We must develop and produce in quantity a whole arsenal of new instruments that will bring the best of modern technology to grips with the herculean task of understanding and exploring the seas.

(D) We must provide funds at once for training new oceanographers.

(E) We must plan and carry out a program of oceanwide surveys to map the ocean floor, the properties and movements of waters, and the distribution of living creatures. Our maps of the ocean floor, for example, are quite comparable in accuracy and in detail to the maps of the land surface that we had about the year 1720.

As so well stated in S. 901 [Dr. Revelle concluded], "there must be a coordinated, long-range program of oceanographic research and marine surveys." We are not proposing a crash program such as faced the Nation at the start of the space race. We are proposing instead a sustained and adequate growth to meet serious scientific, resource, and military needs.

THE NEED FOR LEGISLATION

Many witnesses at our hearings, and many of those who have written to your Committee with regard to S. 901, discussed the need or the value of this proposed legislation.

Dr. Virginia Withington, supervisor, ASW-USW research, Sikorsky Aircraft, Stratford, Conn., wrote the committee as follows:

Those of us who are attempting to develop effective undersea equipment have been drastically hampered by lack of knowledge of the environment * * *. This lack of basic information is seriously detrimental to our national defense, and is delaying the realization of accomplishments which would be technologically feasible if environmental factors were more precisely known.

For an industry whose primary competence lies in other areas to attempt independent investigations of undersea conditions would be inefficient and unnecessarily costly. It is probable that the climate of broad interests and activity which will be engendered by S. 901 will encourage cooperative endeavors leading to the performance of "applied" research simultaneously with the basic investigations authorized therein.

From many points of view, passage of S. 901 will benefit the Nation and, by the implementation of a training program and stimulating interest on many fronts, we can expect a cumulative accomplishment which will place the United States in the forefront of a most interesting and important field of knowledge.

Dr. Wayne V. Burt, chairman of the Department of Oceanography, Oregon State College, wrote:

Now the oceanography discipline finds itself with a good strong program in its inception, but with a need for more tools with which to work. Your bill (S. 901) would adequately furnish support for these tools (ships, laboratories, instruments, and operating funds).

Dr. Harry Sobotka, director, Department of Chemistry, Mount Sinai Hospital, New York, wrote:

Construction and provision of substantially enlarged facilities for marine science and research constitutes a vital and urgent need for national security and the vital issues of food supply and public health. Evidently, these needs can no longer be met to a satisfactory extent from private sources and require congressional appropriations beyond existing incidental support by the Office of Naval Research, National Science Foundation, etc.

Senate bill 901 adequately fills this gap in well organized form. I strongly urge its passage by Congress.

Dr. Paul M. Fye, Director of the Woods Hole Oceanographic Institution, advised the committee:

The report of the National Academy of Sciences and the Navy's TENCC plans, together with Senate Resolution 136

adopted by the 86th Congress, reflect the intensive study and careful collaboration of distinguished scientists, Government leaders and legislators. The implementation of these carefully considered programs is essential for their potential benefit to mankind and is mandatory to our national security.

Mr. James Snodgrass, research engineer for the Scripps Institution of Oceanography, in testimony given at the hearings on S. 901, said:

Since it appears that at least for a long time in the future oceanographic research will continue to be conducted by a fair number of different organizations and agencies, it would seem obvious that coordination is imperative. I do not mean coordination in the sense of control, but rather to assist in the major function of communication and exchange of information.

There does not presently exist any mechanism to accomplish this highly desirable and essential function. Such coordination would certainly reduce often unnecessary experimentation and in the long run make major cost savings.

Dr. Milner B. Schaefer, also a witness at hearings on S. 901, a member of the Committee on Oceanography and Director of the Inter-American Tropical Tuna Commission, testifying particularly on resources provisions of the bill, asserted:

Very little attention has been given to the development of unmanned instrument buoys, and practically none to the development of mesoscaphs and other new instrumentation for resources research. No action has been taken on the construction of laboratory facilities for the study of fish behavior or for the critically important studies of the survival of young states of marine organisms. Provisions of personnel to commence biological surveys of the oceans aboard vessels making cruises for other purposes has been negligible.

It is my firm opinion that the required program in resources research is not likely to be activated without further stimulation, and I am pleased to note that S. 901 authorizes appropriations to the Department of the Interior and other agencies for these purposes, and also provides for proper coordination of the work of the different agencies through a new Division of Marine Sciences of the National Science Foundation, having representation from other agencies concerned.

Dr. Chapman, in his testimony before the committee at hearings on S. 901, placed strong emphasis on why, in his opinion, the bill should be enacted. He said:

Heretofore and presently most of the Nation's ocean research facilities and agencies have been scattered through the structure of the executive branch in such fashion that most parts of them are small units in large agencies. Each of them gets starved by having larger entities in the agencies get all or most increases in appropriations. In consequence of this, the whole ocean research establishment of the Nation is undernourished and incompetent for its great tasks.

Although the United States, as the paramount leader of a confederation of nations held together by the sea, absolutely requires it to have (with its confederates), command of the sea and knowledge about how it works, it is being outdistanced in the rate of acquiring knowledge about the sea, and the use of the sea's resources, by its chief competitor, Russia and its allies.

Indeed—

Dr. Chapman continued—

within the confederation of the free world, smaller nations such as Japan, England, Denmark, Norway, Germany, and France—not the United States—have been noted heretofore for their ocean researches and have built the history of ocean research to which we have lately come.

Dr. Chapman stated that the ocean research establishment of this Nation is "very little better off for funding that it was 3 years ago," and added that "in certain respects it is worse off."

We view the primary purpose of this bill—

Dr. Chapman concluded—

to be the drawing together into one skein of all these threads of ocean research in the executive establishment so that that skein as a unit will bulk large enough to require budget officers to allow sufficient moneys to be allocated to the whole of the ocean research establishment in the Nation so that it can accomplish its appointed tasks and responsibilities.

Dr. Athelstan Spilhaus, director of the Institute of Technology at the University of Minnesota, a member of the Committee on Oceanography, and a distinguished scientist in the fields of both meteorology and oceanography, also touched on the paucity of funding for oceanographic research in his book "Turn to the Sea", stating:

Even though I was one of those who early urged that our Government should support the development of research vehicles such as satellites and rockets to probe space, I wonder now whether enthusiasm and the propaganda race in space are perhaps causing us to overemphasize outer space at the expense of understanding unknown reaches of the earth on which we live.

I do not suggest that we cut back materially the exciting exploration of space, but merely point out that for a comparatively tiny sum we could preserve a balance in investigating our own earth which, as I have stressed, is a most convenient and accessible laboratory to understand the problems of the universe.

Much of the undersea landscape, hidden from our eyes, is less well known than the face of the moon that we see. With minerals resting on it, nutrients sinking toward it, geologic history locked in the sedimentary layers, and petroleum beneath it, the sea's bottom is at least as interesting, and certainly more immediately useful to mankind, than the moon's back side.

If we are unfortunate to have to wage war in the next few years, the inner space of the ocean will be, without question, a more important battlefield than outer space. The better acquainted we are with this field, the better chance we have for survival.

If we are fortunate enough to live in peace, the same knowledge will lead to a greater abundance of things for living. What we need to do to investigate the sea can be done for a yearly cost which is a small fraction of what we now spend on space.

Dr. J. E. Lipp, corporate director for development planning, Lockheed Aircraft Corp., stated in a letter to the committee:

The proposed bill, S. 901, is a major step in declaring national goals in marine science, as well as erecting the program and finances necessary to achieve these objectives. In our opinion, every effort should be made in this session Congress to pass the bill, and to follow it with any steps necessary to place the program in effect. Further, we believe that public opinion will approve such a move as being in the interest of national welfare and security.

From another important coastal area of the Nation came the impressive comment of James E. Noblin, Jr., director of economic research for the Mississippi Industrial and Technological Commission, who regretted his inability to testify at hearings on S. 901 in person. He stated:

Through research we expect vaccines for measles and the common cold in 1961; greatly improved fuel cells and solar cells; stronger, harder, and tougher plastics; discovery of the 103d element; launching of the first nuclear-powered merchant cargo vessel; * * * dehydration of foods through freezer drying; greater understanding of the effects of radiation on life processes and of the cause of cancer; ultra-high-speed computer transistors and diodes—to name a few. And in outer space, we look for manned orbital flight; an unmanned soft landing on the moon; firing of the Centaur and Saturn superrockets; orbiting of a communications satellite and perfecting of photo and heat detector reconnaissance satellites.

But what do we expect in 1961 from research on inner space, i.e., our oceans—a few more ocean cruises; maybe a new addition to a particular phylum; some new theories but not many solutions to current problems or developments of a nature relative to other fields of endeavor.

Why this lack of progress in a field so vital to our national defense and our mutual welfare? All of the basic reasons revert back to lack of adequate financial support in the past. S. 901 attempts to attack this problem by allocating approximately \$65 million annually for a coordinated 10-year program of expanded ocean, estuarine, and Great Lakes research. This vitally needed appropriation would represent only 0.8 percent of the Federal Government's total research and development expenditures for 1961.

Second, the United States is lagging behind the U.S.S.R. in the important fields of oceanographic underwater research * * *. Are we going to wait until Russia's scientific achievements in inner space exploration pressure us into action as happened in outer space exploration?

From an industry which has made significant contributions of importance to our security, the committee received a strong expression on the need for enactment of S. 901.

Dr. Asa E. Snyder, director of research, Pratt & Whitney, Inc., West Hartford, Conn., wrote to the committee as follows:

As director of research for the Pratt & Whitney Co., an old New England manufacturing company which is now a division of the Fairbanks Whitney Corp., that is continually diversifying its activities, I would like to give you our opinion of the need for a bill like S. 901.

We believe that the future of mankind depends upon the ability of men to fully exploit and fully utilize the resources of our planet, particularly those of the ocean.

Believing this, the Fairbanks-Whitney family of companies has begun a series of planned, self-supported studies and developments to: economically desalt sea water, extract power from the ocean, explore and exploit the ocean's resources.

In these areas of marine and oceanographic activities, there is considerable justification for private enterprise to invest capital of its own, but in many other areas of marine research there is little justification for the investment of private funds and it is in these areas that S. 901 will serve a much needed purpose.

It is our belief, therefore, that S. 901 is a needed act of legislation which is for the good and welfare of the Nation. May we encourage you to continue your well-founded efforts in its behalf.

THE INLAND OCEAN

The Great Lakes lie in giant basins sculptured from the heart of the continent by successive ice sheets during the ice ages.

The five lakes, four of which we share with Canada, have a surface area of 92,280 square miles and a shoreline of 4,649 miles.

Scientists assert that were it not for these lakes and others in the area similarly created, Midwestern and Northeast States would be semiarid and far colder than they are at present.

Winds from the Pacific Ocean lose moisture as they blow across the continent and rainfall lessens as they pass over the dry Plains States. They renew their moisture in the Great Lakes region with the result that the area around them is one of the most fertile in the Nation.

The Great Lakes are unduplicated in magnitude by any of earth's fresh waters and are unparalleled in their importance to commerce.

With their short connecting rivers they are navigable for 1,156 miles to the St. Lawrence River. To reach the oceans, ships must proceed another 1,185 miles.

Eight of the Nation's leading industrial and agricultural States have one to three lakes on their borders.

Three of the Nation's largest cities are located on a Great Lake and a fourth on the waterway between Lake Huron and Lake Erie. These cities and 52 others share in the 120 million or more tons of domestic cargo moved annually over Great Lake waters. Because no reliable records of this domestic commerce are kept the value of these shipments is not available.

But the 31,300,000 long tons of shipments in foreign commerce in 1959 had a value of \$1,045 million, of which \$565,800,000 represented exports, and \$472,200,000 imports.

Chicago ranked second to New York in total waterborne tonnage, and in tonnage the shipments at Duluth-Superior exceeded those of any Pacific or gulf coast port although unlike those ports the Lake Superior cities are frozen in for many weeks each winter.

The U.S. Coast Guard maintains one of its five icebreakers on the Great Lakes to assist commerce, with Cleveland, Ohio, its Ninth District headquarters.

The Bureau of Commercial Fisheries, beset by the mounting problem of maintaining food resources in Great Lakes waters, has a laboratory at Ann Arbor, Mich.

The Weather Bureau has long puzzled over disturbances in the Great Lakes which cause sudden fluctuations in water levels.

Geologists are interested in the rock structure which is intensely deformed, presumably by pressure of enormous ice sheets, as well as in the minerals along lake shores.

Lake Superior, the world's largest fresh water lake, has a depth of 1,333 feet, almost identical with that of the Baltic Sea, and 600 feet deeper than Hudson Bay.

Lakes Huron and Michigan, which rank in area fourth and fifth among the world's fresh water lakes, are 750 and 923 feet deep, respectively. Lake Ontario, 13th in size among fresh water lakes, is 778 feet deep.

Bodies of water of importance to industry, commerce, agriculture, climate, and resources are important also to science. Yet, as in the oceans, scientific research in the Great Lakes has lagged.

"To date there has been relatively little basic research performed in these huge bodies of water," Dr. Francesco B. Trama, of Rutgers University, has written the committee.

This I know because I have been a research associate on the summer staff of the Great Lakes Research Institute for the past 4 years.

At the present time I am desperately seeking financial support for a very basic study of the primary productivity of the Great Lakes. The National Science Foundation was unable to support this research, not because it was unsound, but because their funds are limited and apparently distributed with respect to field of study and the geographic location of the study and institutions.

Your proposal to create a Division of Marine Sciences within the National Science Foundation and to include six scientists on the committee, is in my opinion, most intelligent and shows foresight.

Dr. David C. Chandler, director of the Great Lakes Research Division of the Institute of Science and Technology, University of Michigan, was more specific on the role of science with respect to the Great Lakes. In a letter to this committee he said in part:

The role of our Great Lakes in advancing the marine sciences is noteworthy, and I am pleased with the recognition they have received in your bill.

In several respects these large lakes are intermediate in characteristics between the small inland lakes and the oceans, and therefore lend themselves uniquely to certain kinds of investigations. Their evident lacustrine features are (1) possession of both inlets and outlets, (2) typical lake thermal characteristics, and (3) low salt content. Their oceanic characteristics are (1) visible effects of Coriolis force (the apparent tendency of wind-driven surface water to move to the right of the wind direction), (2) distribution of upwellings and sinking according to the relationship of current streamlines and the shore, and (3) the presence of distinct water masses.

The Great Lakes afford the following advantages in the conduct of marine research: (1) Their size and ready accessibility make investigations economical in respect to time and outlay of equipment; (2) most oceanographic phenomena exist in the Great Lakes and in such scale that the lakes may be considered as laboratory-sized oceans; (3) lack of pronounced tides and high salinities make many research problems simple and more readily solvable in these lakes than in the oceans; (4) low electrical conductivity of fresh water and its much less corrosiveness make possible a rapid and economical testing and development of instrumentation; and (5) the existence of scientific research and training centers in the Great Lakes States, such as the Universities of Michigan, Wisconsin, Minnesota, and Ohio State, which contribute to the national effort in marine sciences and are a source of trained personnel.

The committee commends this letter to the attention of all Government officials who may administer this program following the enactment of S. 901 and the appropriation of funds for research and surveys authorized therein.

The committee intends that the word "marine" in connection with research authorized in this bill shall be interpreted as applying to both oceanographic and Great Lakes research, and not in relation to the varying salinities of the waters.

The Great Lakes, with opening of the St. Lawrence Seaway have become an arm of the ocean reaching into the interior of the continent.

Organisms and species whose normal habitat is the oceans are appearing in the Great Lakes in increasing numbers.

Some, like pink salmon, a few of which have recently been noted in Lake Superior, smelt and white perch are beneficial, and alewives, the latter found in brackish waters and used largely in prepared pet foods.

Most destructive of the visitors from the oceans have been the lampreys, which apparently found their way into the upper lakes following the opening of the Welland Canal in 1931.

Since then, according to the Bureau of Commercial Fisheries, they have destroyed the lake trout in Lake Michigan and Lake Huron and reduced the catch in Lake Superior to 20 percent of that before the arrival of the lampreys.

The United States and Canada are conducting a joint effort to eradicate the lampreys, which in addition to destroying the lake trout have notably reduced the population of whitefish.

The two nations have jointly budgeted \$1,300,000 for the campaign against lampreys in the present year, costs being divided in proportion to the value of each nation's catch in the Great Lakes. This year the United States will pay 69 percent, Canada 31.

Officials of the Bureau justify this expenditure as necessary to counteract the serious losses the lake fisheries industry has experienced in recent years, largely attributable, in their opinion to the lamprey infestation.

Great Lakes fishermen in 1945 produced a catch valued at \$13,800,000. In 1948 value dropped to \$12,500,000; in 1950 to \$10,700,000; in 1955 to \$9,600,000. In 1958 the value had shrunk to \$8,500,000 and in 1959, the last year of record, the value was \$7,100,000.

In many countries lakes far smaller than the Great Lakes are an important source of food supply.

The Bureau of Commercial Fisheries has problems also in the Great Lakes other than the destructive lampreys. Pollution in Lake Erie is causing concern and may contribute to the grave oxygen deficiency in its deeper waters, which again depletes the fisheries.

In a letter to the Commerce Committee received as this report was being prepared, Mr. Howard Fast, executive director of the Great Lakes Commission, representing seven States, advised:

Canada has recently instituted an oceanographic program on the Great Lakes.

Mr. Fast also enclosed a report of the American Society of Limnology and Oceanography which in part stated:

Adequate ships are badly needed for research which should be done in the Great Lakes. Until they are available the opportunities for providing students with practical experience in the techniques of oceanographic investigation in this area will be limited.

S. 901 would authorize funds for improved facilities and expanded research in the Great Lakes area, not only with the objective of conserving and developing Great Lakes resources, but also to aid commerce and navigation, preserve health and welfare, and increase scientific knowledge of the world's largest fresh water laboratory.

GENESIS OF THE PROGRAM

In 1956, marine scientists employed in Government agencies, disturbed by the absence of coordination of their many and varied programs, and disturbed by the scant interest in, and funds for, oceanographic research, began holding informal monthly meetings.

Soon they became known as the Coordinating Committee on Oceanography, although among themselves it is frequently referred to as the "working committee," the members being civilian working scientists.

The committee is small because the number of marine scientists in Government agencies is small, and it is completely unofficial. The committee has no constitution, no bylaws, no officers, no dues, no treasury, or fund for expenses.

Once a month a member arranges to borrow a room in the agency in which he is employed, and usually presides over that particular meeting. The chairmanship rotates. As civil service employees and usually at the top of their classification, the members of this unofficial committee have had no hope of personal gain from their endeavors, but they have hoped and do hope to be able, with better facilities, to perform more and better research.

At the early meetings, as today, the scientists on the coordinating committee exchanged information on the activities, accomplishments, and programs of their respective agencies, and following these meetings reported this information back to their superiors in their respective agencies.

Neither the members of the so-called coordinating committee nor the group as a whole had any authority or power to coordinate any activities or programs; nor did their superiors. Perhaps the major accomplishment of the committee was to convince administrative officials of the various agencies of the need for a coordinated program.

In 1957, several Government agencies, aware that to achieve such a program would require an overall study conducted by an independent and objective non-Government scientific group, proposed that the National Academy of Sciences—National Resources Council create a Committee on Oceanography to undertake this major project. This was done.

Formal support, financial and otherwise, was given to the Committee on Oceanography, members of which were appointed by the National Academy of Sciences, by the following agencies:

Office of Naval Research, Department of the Navy.

Atomic Energy Commission.

Bureau of Commercial Fisheries.

National Science Foundation.

Subsequently the Coast and Geodetic Survey of the Department of Commerce also participated in the sponsorship.

Dr. Harrison Brown, professor of geochemistry at the California Institute of Technology and formerly with Johns Hopkins University, Baltimore, and the University of Chicago, was appointed chairman.

Eminent marine scientists from seven universities and oceanographic institutions affiliated with universities were named to the committee. New England, the Middle and South Atlantic States, the Midwest and Pacific coast each were represented. A former Commissioner of Atomic Energy, Mr. Sumner Pike, of Lubec, Maine, also was appointed to the committee.

All of the members are civilians. None are employed by the Government. None were selected for membership on the committee by any Government agency. The committee and each of its members possessed—and continue to possess—complete freedom to make a comprehensive study and report.

Committee members are: Dr. Maurice Ewing, Lamont Geological Observatory, Columbia University, Palisades, N.Y.; Dr. Columbus

O'D. Iselin, Woods Hole Oceanographic Institution, Woods Hole, Mass.; Dr. Fritz Koczy, Marine Laboratory of the University of Miami, Miami, Fla.; Dr. Roger Revelle, Scripps Institution of Oceanography, La Jolla, Calif.; Dr. Dixy Lee Ray, University of Washington, Seattle, Wash.; Dr. Gordon Riley, Bingham Oceanographic Laboratory, Yale University, New Haven, Conn.; Dr. Athelstan Spilhaus, University of Minnesota, Minneapolis, Minn.; Dr. Per Scholander, Scripps Institution of Oceanography; Mr. Pike, and Dr. Milner B. Schaefer, Inter-American Tropical Tuna Commission, La Jolla, Calif.

Each of the members has attained scientific distinction as a physicist, marine biologist, meteorologist, or marine chemist.

The Committee on Oceanography held its first meeting in November 1957. During the following year it visited major oceanographic institutions in all sections of the United States, conferred with scientists and officials of all Government agencies having an interest in the oceans or the Great Lakes, and appointed eight panels of scientists to assist in special studies. More than 60 scientists from private institutions and laboratories participated in these panels.

In January 1959, the Committee on Oceanography released its summary report and recommendations. It has since issued 10 more reports dealing with studies in separate fields, and has continued its survey of program needs.

The reports of the Committee on Oceanography have been the subject of an intensive study by your Committee and have inspired committee action on the program recommended.

Two conclusions of the Committee on Oceanography merit quotation at this point. They are:

(1) From the point of view of military operations there is no comparison between the urgencies of the problems of the oceans and those of outer space. The submarine armed with long-range missiles is probably the most potent weapon system threatening our security today.

(2) Our oceanographic research ships are inadequate for the job which must be done. Most of the ships are old and outdated. Many are obsolete and should be replaced by ships of modern design which will be more efficient to operate and from which a greater variety of scientific observations can be made.

Simultaneously with the study of overall marine scientific needs by the Committee on Oceanography, the Navy Department's Office of Naval Research prepared a survey and projection of the marine research needs and programs financed by the Navy in universities and oceanographic laboratories and institutions.

The Navy report, designated Project TENOC (10 years in oceanography), was issued on January 1, 1959, with the endorsement of Adm. Arleigh Burke, Chief of Naval Operations. The report noted that the total budget for marine research financed by the Navy in institutions during fiscal 1959 was \$7,600,000, and projected a graduated increase in funds for research ships, laboratories, and scientific personnel over a period of 10 years. The report has since been revised and updated, with the 10-year period advanced to 1961-71.

LEGISLATIVE BACKGROUND OF S. 901

The report of the Committee on Oceanography, titled "Ten Years of Oceanography" and the TENOC report came to the immediate attention of the Senate Committee on Commerce.

On June 22, 1959, the chairman and all members of your committee joined in introducing Senate Resolution 136 commending the report of the Committee on Oceanography and concurring in its recommendations that—

(a) Basic oceanographic research be immediately expanded.

(b) In the field of applied research fisheries exploration be intensified, migratory patterns investigated, greater attention given to genetics of fish and other marine organisms, biological surveys augmented utilizing new devices, a program on diseases and other toxic effects in the marine environment established, comprehensive studies made of the economic and legal aspects of commercial fisheries, especially in relation to other industries, and research stimulated on the nature of organisms in the sea on which marine life of commercial or sports value feed.

(c) Training of more oceanographic scientists in private educational and research institutions be encouraged and facilitated by the National Science Foundation and the Office of Education with the object of increasing the number of oceanographers at the doctor of philosophy level during the next 10 years.

(d) Systematic oceanwide and ocean-deep surveys be conducted by the Coast and Geodetic Survey and Hydrographic Office, Department of the Navy, to develop much broader knowledge of depths, salinity, temperature, current velocity, wave motion, magnetism, and biological activity.

(e) Research fleets of the various agencies and institutions engaged in basic or applied oceanographic research, of which most of the vessels are old and obsolete, be replaced by modern ships adapted to oceanwide scientific studies and furnished with advanced scientific equipment, and that the number of ships be increased substantially.

(f) Shore facilities commensurate with an expanded program of basic research be constructed in order to derive maximum knowledge from observations and collections made at sea.

(g) Development and utilization of deep-diving manned submersibles be expedited to facilitate maximum accomplishments in both basic and applied oceanographic research at all depths.

(h) Mineral research be undertaken on the ocean floor with a view to present or ultimate utilization of the untapped resources that lie beneath the ocean.

(i) Extensive scientific investigations be made on the effects of radioactivity in the oceans including the genetic effects of radiation upon marine organisms, the inorganic transfer of radioactive elements from sea water to the sediments, and the circulation and mixing processes which control the dispersion of introduced contaminants in coastal and estuarine environments and in the open ocean.

(j) Agency cooperation be developed.

(k) Cooperation between the United States and other nations in oceanographic research and exchange of data be considered on

a reciprocal but carefully supervised basis subject to approval by the President.

On July 1, 1959, Senate Resolution 136 was considered in executive session by your committee and unanimously ordered reported favorably with amendments. It was reported to the Senate on July 13 by Chairman Magnuson and on July 15 passed the Senate by unanimous consent.

On September 11, 1959, in the closing days of the 1st session of the 86th Congress, a bill to implement Senate Resolution 136, and to authorize the program recommended by the Committee on Oceanography and commended in Senate Resolution 136, was introduced by 14 U.S. Senators, of whom 11 are members of this Committee.

Hearings on this bill, S. 2692, 86th Congress, were held on April 20, 21, and 22, 1960, at which the chairman and seven members of the Committee on Oceanography, scientists heading special panels of the committee, and other scientists testified.

Members of the Committee on Oceanography who did not testify at the 1960 hearings testified this year on S. 901, the successor bill to S. 2692.

S. 2692 passed the Senate by unanimous consent on June 23, 1960, but the House of Representatives failed to act.

As a result of the House of Representatives not acting on S. 2692, 86th Congress, Senator Magnuson on February 9, 1961, reintroduced the proposed legislation, with supplementary provisions recommended by the Committee on Oceanography, for consideration by the 87th Congress. The new bill was designated S. 901.

Hearings were held on March 15, 16, and 17, at which a total of 18 witnesses, including members of the Committee on Oceanography, scientists representing oceanographic institutions and laboratories in 8 States, the Secretary of the Navy, and others testified.

Statements also were submitted by scientists and scientific groups in 11 States who were unable to attend the hearings.

The published hearings include the testimony, statements, and also communications concerning S. 901 received by your committee from scientists, institutions, industries, and associations in all parts of the country.

On May 23, 1961, the bill was considered in executive session and ordered reported favorably with amendments.

COST

Cost of the 10-year program was estimated by the Committee on Oceanography as \$651.41 million, or an average cost of slightly more than \$65 million per year. The Committee's breakdown of this estimated cost was:

	<i>In millions</i>
New research and survey ships.....	\$276.05
Shore facilities for marine research.....	90.90
Shore facilities for marine surveys.....	56.32
Marine resources investigations.....	87.31
New devices (and instruments) for marine research.....	100.40
Ocean radioactivity research and control.....	32.43
Education and training of marine scientists.....	8.00

The Committee's estimate of ship construction costs was based on a total of 70 new ships, of which 16 would be research ships for prospective institutional use, 14 research ships for fisheries studies, 20 survey ships, and 20 ships for military research and development. The latter 20 ships were not included in S. 2692, 86th Congress.

S. 901, however, includes six ships for acoustics and applied research as a result of testimony on the need for such ships by institutions and laboratories engaged in deep sea research with possible military applications, primarily acoustics studies, and in accordance also with a recommendation made in the Department of the Navy's new TENOC (Ten Years of Oceanography) program.

S. 901 authorizes a total of 61 ships, as follows:

Navy:	
For institutional use in basic research.....	15
For hydrographic surveys.....	8
For acoustics and applied research.....	6
Bureau of Commercial Fisheries: For fisheries research.....	14
Coast and Geodetic Survey: For surveys and research.....	10
National Science Foundation: For institutional use.....	4
Maritime Administration.....	4

Ships designed by the Maritime Commission would be available to institutions, and institutions also would have part-time use of several if not all of the Navy's acoustics and applied research ships authorized in S. 901.

Ship construction costs have risen since 1959. Ships estimated to cost \$3.8 million in 1959 are now estimated to cost \$4.2 million, an increase of approximately 13 percent. Although the number of ships authorized in S. 901 is fewer by 9 than the number recommended by the Committee on Oceanography in its report, it is estimated that costs today will approach that estimated by the Committee for its recommended program of 70 ships.

Authorizations for education and training in S. 901 have been increased from \$8 million to \$9.6 million, and for construction of shore facilities through grants by the National Science Foundation from \$8.25 million to \$16.75 million. Both of these increases are in accordance with recommendations of the Committee on Oceanography and witnesses testifying at hearings on S. 901.

Inclusion of the U.S. Coast Guard in the national oceanographic program, a major innovation in S. 901, would require over a 10-year period an estimated expenditure of slightly less than \$10 million for oceanographic instruments and equipment for marine research on Coast Guard station vessels, and a similar amount for other ships operated by the service, towers, and buoys.

S. 901, therefore, would authorize sums expected to total \$700 million for the entire program, an average cost when these sums are appropriated of \$70 million a year. This is approximately 5 percent of present requirements for the national program to explore outer space

ANALYSIS OF S. 901 BY SECTIONS

(Page and line designations below apply to the bill as reported to the Senate)

The title of the act, "Marine Sciences and Research Act of 1961, is given in section 1.

DECLARATION OF POLICY

Section 2 states the objectives of the Congress with relation to oceanographic and Great Lakes research and surveys.

The Congress would declare that a sustained program of such scientific studies and surveys, and the education and training of oceanographic scientists, are vital to—

1. Defense against attack from the oceans and to operation of our own surface and subsurface naval forces with maximum efficiency.
2. Rehabilitation of our commercial fisheries, and increased utilization of our marine resources, living, chemical and mineral.
3. Development of scientific knowledge and understanding of the earth's waters, life, and forces within them, and the interchange of energy and matter between the sea and atmosphere.
4. Expansion and security of the Nation's commerce and navigation.

Sound policy requires, section 2 continues, that in marine research and surveys the United States not be excelled by any nation which may presently or in the future threaten our general welfare, maritime commerce, security, access to and utilization of ocean fisheries, or contamination of adjacent seas by radioactive or other harmful wastes.

To meet this objective, it is stated that there must be a coordinated, long-range program of research and surveys similar or identical to that recommended by the Committee on Oceanography of the National Academy of Sciences-National Research Council.

Such a program would include:

1. Construction of modern, oceangoing ships for scientific research, surveys, fisheries exploration, and marine resources conservation and development.
2. Modernization or construction of laboratory and shore facilities for marine and Great Lakes research and oceanographic surveys.
3. Development of new and improved research tools, devices, and instruments for such scientific studies.
4. Recruiting prospective oceanographers from students of physics, chemistry, mathematics, biology, engineering, limnology, meteorology, and geology, and facilitating their advanced education in a long-range program which would include, where necessary, scholarships, fellowships, and other Federal assistance.
5. Greater development and utilization of living marine resources by studies of the occurrence, behavior, classification and potential uses of fish, shellfish, and other marine life.
6. Maintenance of a national oceanographic center to facilitate exchange of pertinent scientific information.
7. Development of formal international cooperation in the fields of marine research and oceanographic surveys under proper safeguards.

Section 2 declares further that a coordinated, long-range program of marine research and surveys requires establishment of a Division of Marine Sciences in the National Science Foundation, and that the divisional committee shall include representation from the appropriate Government agencies and marine scientists associated with universities, laboratories, industries or foundations.

This committee would be authorized and directed to develop and encourage a continuing national policy and program for the promotion

of research, surveys and education in the marine sciences; recommend contracts, grants, loans, or other forms of assistance to facilitate these programs, cooperate with and encourage the cooperation of scientists and educators, the National Academy of Sciences—National Research Council, and the appropriate government agencies; foster interchange of information, and evaluate the scientific aspects of marine research, surveys and related programs undertaken by the Federal Government, or those receiving assistance from the Federal Government in the program authorized by the act.

The declaration of policy substantially follows Senate Resolution 136, unanimously approved by the U.S. Senate during the first session of the 86th Congress, with the exception of the references to the National Science Foundation and the formation of a Division of Marine Sciences within that agency.

Provisions relating to the National Science Foundation and creation of a Division of Marine Sciences, however, were included in S. 2692, 86th Congress, a bill very similar to S. 901 and having identical objectives, which was approved by your committee during the second session of the 86th Congress and passed by the Senate on June 23, 1960.

The National Science Foundation was established by act of Congress in 1950 to promote the progress of science, advance the national health, prosperity and welfare and, among other purposes secure, the national defense.

Among its duties and responsibilities as set forth in the National Science Foundation Act are those of—

(a) Developing and encouraging the pursuit of a national policy for the promotion of basic research and education in the sciences.

(b) Initiating and supporting basic scientific research by making contracts or other arrangements for such research.

(c) Awarding scholarships and fellowships in sciences.

(d) Evaluating scientific research programs undertaken by agencies of the Federal Government.

(e) Correlating research programs of the Foundation with those undertaken by individuals and by public and private research groups.

(f) Providing a central clearinghouse for information involving all scientific and technical personnel in the United States and its territories and possessions.

(g) Initiating and supporting, at the request of the Secretary of Defense, specific scientific research activities in connection with matters relating to the national defense by making contracts or other arrangements for the conduct of such scientific research.

(h) Initiating and supporting a program of study, research, and evaluation in the field of weather modification.

The National Science Foundation is required to report regularly to the Congress and the President.

Duties of the agency relate exclusively to science and education in the sciences.

The Foundation has far-reaching responsibilities in initiating, forwarding, and evaluating scientific programs.

The organic act provided for certain divisions and divisional committees within the Foundation and for the establishment of new divisions and divisional committees.

Divisional committees include scientists affiliated with universities, institutions, organizations, and industry, thus affording the agency independent and objective counsels and advice.

At present the National Science Foundation has three divisions. These are: Division of Biological and Medical Sciences, Division of Mathematical, Physical, and Engineering Sciences, and Division of Scientific Personnel and Education.

A Division of Marine Sciences is required to meet the program and policy objectives of S. 901, otherwise the activities proposed in the contemplated long-range, national oceanographic and Great Lakes research and survey program will be dispersed in the three present divisions.

Dispersal means dilution of this national oceanographic effort, and continuing lack of cohesion and correlation.

In addition to its three divisions the National Science Foundation has an Office of Special International Programs, an Office of Special Studies, an Office of Scientific Information Service, an Office of Public Information, and an Office of Social Sciences.

In the absence of a Division of Marine Sciences, such as would be created by enactment of S. 901, the oceanographic or marine science program would be further dispersed within the Foundation and its effectiveness diluted.

A Division of Marine Sciences would include marine biologists, marine geologists, geophysicists, chemists, meteorologists, scientists in the fields of medicine, engineering and acoustics and others whose disciplines relate to oceanography and limnology, within the divisional committee where they could stimulate and evaluate activities and progress of the national program for the benefit of the Congress, the executive branch, and the Nation.

The Division of Marine Sciences would be authorized and directed in the act to do the following:

1. Develop and encourage a continuing national policy and program for the promotion of oceanographic research, surveys and education in the marine sciences.
2. Recommend contracts, grants, loans or other forms of assistance for the development and operation of the above program.
3. Cooperate with and encourage the cooperation of agencies of the Federal Government dealing with scientific or collateral problems relating to the seas or the Great Lakes, and cooperate with the National Academy of Sciences—National Research Council, and with administrators and scientists of all non-Government institutions receiving assistance from Federal agencies for marine research or education in the marine sciences.
4. Foster interchange of information among marine scientists in the United States and with those of foreign nations, the latter subject to the security provisions of the National Science Foundation Act.
5. Evaluate the scientific aspects of marine research, surveys, and taxonomy undertaken by Government agencies or by institutions receiving Federal assistance in these fields.

Committee amendments to section 2

1. Page 3, line 17, insert "for marine and Great Lakes research and oceanographic surveys and" following the word "facilities" and before the word "adequate". The purpose of this amendment is to specifically include the Great Lakes area in the facilities program.

2. Page 5, line 1, insert the word "chemical," after the word "fisheries" and before the word "hydrographic". This is a perfecting amendment in connection with types of data to be assembled and disseminated at the National Oceanographic Data Center.

3. Page 5, line 12, insert "shall be composed of scientists and" between the words "which" and "shall". This amendment, referring to the composition of the divisional committee which would be established in the Marine Science Division of the National Science Foundation, was made in response to a communication from Dr. Paul M. Fye, director of the Woods Hole Oceanographic Institution, Woods Hole, Mass. Dr. Fye expressed apprehension that some Government bureaus might name representatives to the divisional committee "with little or no experience in marine sciences, and perhaps with no contact with research at all," and pointed out that other divisional committees of the Foundation are persons with scientific ability in applicable fields. The amendment precludes a deviation from established procedure in this respect in designation by Government bureaus or agencies of representatives on the divisional committee.

4. Page 5, line 15, strike the word "oceanographic" and substitute the word "marine". This amendment relates to the designation of non-Government scientists to the proposed divisional committee of the National Science Foundation's Division of Marine Sciences. Such members of the divisional committee who are not connected with the Federal Government would be selected from educational institutions, laboratories, industries, or foundations. The Senate Commerce Committee was advised that in some areas or groups the word "oceanographic" is interpreted as applying specifically to the physical sciences in the marine environment. It is not the intent of this committee that this interpretation be followed, either in this section or in any other section of the act. However, to avoid any possibility of misunderstanding in the scientific community as to the intent of the committee, the broad term "marine" is here substituted in this early section of the act.

In order to dissipate any possibility of an erroneous interpretation in other sections of the act, the words "oceanographic" or "oceanography" when used in this act, are applicable to any or all scientific studies or any or all scientific aspects of the oceans, their boundaries, or their contents, and to ships, laboratories, instruments, devices, or other facilities for such studies. The Committee on Oceanography of the National Academy of Sciences so construed the two terms in its report recommending an expanded 10-year program of oceanographic research and surveys.

Page 5, line 16, insert the word "colleges" before the word "universities". Educational institutions which have marine scientists on their faculties include colleges as well as universities, and at some institutions colleges conducting marine research or studies exist within the university structure. It is the purpose of this act that non-Government representatives on the divisional committee of the Division of Marine Sciences may be selected from all institutions of higher education—and from other non-Government sources—or from components of such institutions and that selection be based on scientific qualifications of the selectees and not on the descriptive or official title of the institution.

Page 6, line 20, strike the words "universities and" after the word "all" and substitute the word "universities" and a comma. Insert the words "and organizations" following the word "institutions". The purpose of this is to broaden the field of cooperation between the divisional committee of the Division of Marine Sciences and Government agencies, the National Academy of Sciences—National Research Council, and non-Government recipients of assistance from the Federal Government or its agencies in undertaking research or education for the advancement of marine science.

DIVISION OF MARINE SCIENCES

Section 3 of S. 901 would amend the National Science Foundation Act of 1950 to include a Division of Marine Sciences and a divisional committee of this Division. Six scientists selected on a basis of competence from universities and other non-Federal institutions would serve on the divisional committee with representatives from designated Government agencies.

Committee amendments to section 3

Page 8, line 10, insert the words and punctuation "agencies, or industry" between the words "institutions," and the words "and designated". This amendment broadens the area from which non-Federal representatives on the divisional committee of the Division of Marine Sciences may be selected to include agencies other than Federal agencies, of which State fisheries departments might be cited as one example, and from industry. A number of industries are now engaging in extensive marine research and have employed professional oceanographic scientists of ability in connection with these research efforts.

AUTHORIZATIONS FOR NATIONAL SCIENCE FOUNDATION

Section 4 adopts the recommendations of the Committee on Oceanography in authorizing appropriations to the National Science Foundation of funds for development of the marine sciences over a 10-year period beginning with July 1 of the first fiscal year following approval of the act by the President, and would provide that these appropriations be in addition to other appropriations provided the National Science Foundation to carry out its statutory duties. Other sections of the bill authorizing appropriations contain similar language with reference to the effective date of the act and similarly state that appropriations authorized pursuant to this act shall be supplementary to other appropriations.

Authorizations would include \$9,950,000 for construction of research ships; \$12,440,000 for the operation of these ships over a 10-year period; \$37,200,000 for basic marine research activities with the proviso that expenditures in this category not exceed \$8 million in any one year; such sums as may be adequate for specialized oceanographic instruments or equipment for marine research and exploration with the proviso that expenditures for this purpose not exceed \$10 million in any one year of the 10-year program; funds for the construction of shore facilities for marine research, and \$4,800,000 for education and training in the marine sciences, of which not more than \$480,000 would be expended in any one year.

Training would be for the purpose of preparing selected students to become professional physical, biological, chemical, and geological oceanographers and would be extended to students beginning not lower than the senior level of undergraduate school and continuing through not more than 4 years of graduate training.

Committee amendments to section 4

Page 9, line 6, strike the figure "\$8,250,000" and substitute the figure "\$16,750,000". The authorization in this subsection of section 4 is for construction of shore facilities for marine research.

The amount of \$8,250,000 was recommended in the original report of the Committee on Oceanography, which has since revised its estimate of needs.

Dr. Roger Revelle, Director of the Scripps Institution of Oceanography, who represented the Committee on Oceanography, of which he is a member, at hearings on S. 901, testified that the Committee on Oceanography had grossly underestimated the amount needed for new marine research laboratories when it prepared its report. He stated:

In our report we simply thought about what would be needed to provide laboratories for the additional people to man the additional ships.

What we overlooked was the fact that very little oceanographic building has been done during the last 20 years. The result is that both the major and minor, or the bigger and smaller laboratories, are now very much overcrowded. It is literally impossible for most of them to expand at all in terms of people without additional space. People are sitting in each other's laps.

Dr. C. P. Idyll, chairman of the Department of Marine Sciences and chairman of the Division of Fisheries of the University of Miami, testified:

We find ourselves hanging from the rafters. We need immediately 10,000 more square feet to train the people that we have.

Dr. Donald W. Pritchard, director, Chesapeake Bay Institute, Johns Hopkins University, Baltimore, Md., told the Commerce Committee at hearings on S. 901:

Our present chemistry and biology laboratory space is less than one-third the 6,150 square feet of such space which is required for the program we are now capable of pursuing. We have no laboratory space which can be utilized for graduate student research.

Dr. Richard H. Fleming, executive officer of the Department of Oceanography, University of Washington, pointed out to the Commerce Committee during the hearings that despite the greatly increased needs for oceanographic training and research the Department is occupying the laboratory building that was provided the University under a grant of the Rockefeller Foundation 30 years ago.

The Committee on Oceanography has recently undertaken a review of its 1959 report with relation to laboratory needs, and although this report has not been completed it has reported to the Commerce

Committee that minimum immediate requirements for new marine laboratory space exceed \$33,500,000.

The Committee on Oceanography has recommended that the National Science Foundation supply, through grants, the funds for one-half of this portion of the facilities program, and that the Office of Naval Research, which assists certain institutions in acquiring new laboratory facilities, provide the remainder.

On the basis of these reports and recommendations your committee amended the amount authorized for construction by the National Science Foundation of shore facilities for marine research to \$16,750,000 to be expended during the life of the 10-year program.

Page 10, line 14, insert following the word "fellowships" the words and punctuation "training grants,". This subsection of section 4 relates to the education and training program in marine sciences which would be instituted by the National Science Foundation under the provisions of S. 901.

The bill proposes grants for fellowships and research apprenticeships to graduate students and postdoctoral fellows training to become oceanographers. The Committee on Oceanography, reviewing its previous recommendations, came to the conclusion that the designation "fellowships" was too limiting with respect to the proposed education and training program, and that it is subject to narrow usage by both certain institutions and Federal agencies.

Dr. Gordon Riley, of the Bingham Oceanographic Laboratory, Yale University, proposed the addition of the term "training grants," and this recommendation was accepted by your Committee.

Page 10, line 15, strike the word "apprenticeships" following the word "research" and substitute the word "assistantships". Use of the word "apprenticeships" in this subsection was a typing or typographical error and the word originally intended to be used was "assistantships".

DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY, BUREAU OF COMMERCIAL FISHERIES, AND BUREAU OF MINES

Section 5 of the bill would authorize and direct the Secretary of the Interior to undertake certain activities, studies, and research as part of the general 10-year program for development of the marine sciences.

The Department and its agencies have a primary responsibility to conserve and develop resources in order to meet the requirements of national security and an expanding economy.

Several agencies within the Department, notably the Bureau of Commercial Fisheries, Geological Survey, and Bureau of Mines, have an actual or potential direct interest in the resources of the oceans and the Great Lakes.

These resources include marine fisheries, metallic minerals, and offshore deposits of liquid fuels. To realize increased benefits from these resources an intensified program of ocean and Great Lakes research is required, both basic and applied.

Section 5 would authorize such a program, facilities to carry out such a program, and studies designed to augment the benefits to the Nation from increased utilization of the resources of the oceans and the Great Lakes.

Specifically, the Secretary of the Interior would be authorized and directed to—

1. Provide funds through grants to qualified scientists, research laboratories, institutions, or other non-Federal agencies, in furtherance of the purposes of the act.

2. Replace, modernize and enlarge the number of oceangoing ships being used for research, exploration, surveying, and the development of ocean and Great Lakes research by the Department.

3. Conduct and operate shore facilities and laboratories, including biological, technological and instrumentation laboratories adequate to support the above fleet.

4. Cooperate with other departments and agencies, including agencies of the several States, in the conduct of ocean surveys from which data relative to the study of ocean resources may be obtained.

5. Conduct studies of the economic and legal aspects of commercial fisheries and the utilization of marine products.

6. Cooperate with other departments and agencies, including agencies of the several States, in conducting studies of the effects of radioactive elements on marine life.

7. Determine reserves of metals and mineral resources in and beneath any accessible portion of the oceans, seas, gulfs and Great Lakes which have industrial, commercial or monetary value, and ascertain techniques and probable costs of recovery and extraction.

8. Cooperate with other governmental agencies, the States, educational institutions, laboratories, industries and other organizations and individuals who may be of assistance in furthering the development and utilization of ocean, estuarine and Great Lakes resources.

9. Encourage and assist in taxonomic studies of marine organisms and in providing facilities for their preservation and scientific classification.

10. Expand communications facilities and services to enable transmission of oceanographic and fisheries data between ships at sea and shore stations operated by the Bureau of Commercial Fisheries.

11. Establish with the National Science Foundation a program of education and training in the marine sciences.

12. Take such further action as the Secretary finds will accomplish the purposes of the act.

There can be no question but that all of these activities are necessary if the U.S. fisheries industry is to meet the aggressive competition of many other nations, including Soviet Russia, and to survive as a potent force in the Nation's economy.

Voluminous testimony was given during hearings on S. 901 of the handicaps the Bureau of Commercial Fisheries has had to endure in recent years while attempting to meet its statutory responsibilities.

Although the Bureau still retains many capable and dedicated scientists and technicians they have been frustrated in achieving maximum results by lack of suitable ships for research, lack of laboratory space, lack of scientific instruments, lack of operating funds.

The families of 128,000 American commercial fishermen, a decline of 33,000 in the past 10 years and 100,000 shoreworkers are directly dependent on the catches at sea for their livelihood, and the industry indirectly provides jobs for 300,000 other breadwinners. Fisheries are the basic support of many shore communities and contribute to the industrial welfare and economy of many port cities.

Committee amendments to section 5

Page 11, line 6, after the subsection designation "(a)" strike the words "Make grants of funds" and substitute the words and punctuation "Provide funds, by grants, including but not limited to long-range grants, contracts, or otherwise.". This amendment has two purposes, first to specifically provide for long-term grants, and, second, to embrace contracts or other forms of assistance to scientists, laboratories, institutions, or other non-Federal agencies who may contribute to the objectives of the program.

Much testimony was given during the hearing on S. 901 on the value of and need for long-term grants.

Dr. Clarence P. Idyll, of the University of Miami's Marine Laboratory, told the committee:

It is a very great necessity, if oceanography is to advance at the rate that we believe it should, that we have long-term grants and not year-to-year grants. In my capacity as head of the Fisheries Division at the University of Miami, I spend far too much time attempting to renew short-term grants.

The Bureau of Commercial Fisheries does not have the resources, and I am not certain whether it has the power, to give long-term grants as opposed to contracts.

We would like to suggest, sir, that the only part of the bill that seems to require modification is this; that the Bureau of Commercial Fisheries be authorized to set up a granting agency to give long-term grants as opposed to contracts so that organizations like ours will have long-term grants whereby we can apply ourselves to problems that need solution in the fisheries.

James A. Snodgrass, of the Scripps Institution of Oceanography, offered similar testimony, but from the standpoint of general application. He testified:

One of the major problems which confronts all of the oceanographic institutions at the present time is the fact that most research projects are funded over a short period of time. * * * At the Scripps Institution the effect of the short-term support has been to make nearly all of the research projects assume the nature of crash programs. From the support shop standpoint these crash programs have the effect of producing severe excessive peak demands which may require inordinate amounts of overtime and which besides being tremendously wasteful do not always by any means result in the construction of satisfactory instruments.

Mr. Snodgrass' particular field is the development of scientific instruments for oceanographic, including fisheries research.

The committee received expressions from other scientists in various parts of the country who also emphasized the need, in conducting fisheries research programs sponsored by the Bureau, of long-term grants or contracts. Presently the Bureau follows the contract procedure with but one or two exceptions and those in recent weeks.

In certain instances, your committee was told, institutions receiving a contract for a specialized program have increased faculty and staff and acquired supplementary equipment needed to carry out the program, only to have the contract terminated before the research had more than commenced. Absence of long-term grants or contracts has had a tendency to discourage applications to undertake programs for the Bureau, this committee was informed.

In view of these expressions and the above testimony, your committee amended subsection (a) of section 5 to provide funds, by grants, including but not limited to long-range grants, contracts, or otherwise, to qualified scientists, research laboratories, institutions, or other non-Federal agencies for research, equipment, or facilities.

This amendment will not only facilitate fisheries research, but should result in savings of time and costs.

Page 11, line 10, substitute the word "or" for the word "and", a perfecting amendment.

Page 11, line 11, strike the words "research programs" and substitute the word and punctuation "research,".

Page 11, line 12, following the word "facilities," and before the words "and for" insert the following:

the design, development, and production of new, and improved, research, biological survey, and communications instruments and devices, employment of scientists and personnel,

The development and utilization of new and improved specialized instruments and devices is one of the imperative needs of an expanded oceanographic and Great Lakes research program.

Improved instruments can in part compensate for the shortage of research ships and scientific manpower by enabling more scientific data to be obtained with the available manpower, ships, and laboratories. They also will have the effect of reducing ship time required for many research missions, and ship time is one of the most important cost factors in ship operations.

Moreover, many important phenomena in the oceans cannot presently be studied, and much of the marine life at lower depths cannot be collected for study, with the instruments presently available.

Development of instruments and devices for subsurface use in the marine environment has been slow for a number of readily understandable reasons.

One is that it is only in very recent years that man has felt a need to examine the waters of the ocean at depths far below the surface to observe the life within these depths and the forces that move these dark waters.

Very few scientists had a concept of even what instruments or devices might be useful and helpful to scientific inquiry at subsurface depths because there were very few oceanographic scientists, in fact less than 50 in the United States before World War II.

There was very little incentive for private industry to develop such instruments because even if it did so there was only a very limited market, a market perhaps restricted to one or two oceanographic institutions.

Many, if not most, of the research instruments in use today in marine scientific studies were designed and developed by scientists themselves, not with a view to profit or distinction, but in order to facilitate their own work.

Advances in potential uses of middepths and abyssal depths of the ocean for both defense and resource exploitation have intensified the need for new and improved instruments, and a number of private industries are now expending much time, talent, and effort to meet the increasing requirements.

In October 1960, the Hydrographic Office of the Navy, and the Office of Naval Research jointly conducted a symposium on oceanographic instrumentation, attended by experts in this field from institutions and agencies throughout the United States.

A program which envisioned 40 new and specialized instruments for oceanographic research was prepared and assignments given to institutions and laboratories to design and develop them.

A number of contemplated instruments are for biological oceanographic research.

To expedite the program and monitor its progress five panels were set up. Mr. Richard Van Haagen, at that time Director of the small but efficient Instrumentation Laboratory of the Bureau of Commercial Fisheries, Seattle, Wash., was named chairman of the panel on biological instrumentation. Mr. Van Haagen returned to Seattle to learn that the Bureau had ordered termination of the Laboratory, the only instrumentation laboratory operated by the Bureau, as of December 31, 1960, and on that date it was closed.

The Laboratory had acquired a reputation for development of many unique instruments for use in research by the Bureau and for the benefit of the fisheries industry, during the 4 years of its existence. At the time it was discontinued it was engaged in fulfilling contracts with the Coast and Geodetic Survey and the University of North Carolina for instrumentation development. It had recently completed contracts with the Office of Naval Research which held the Laboratory and its staff in high regard and had anticipated entering into new contracts with the Laboratory. The University of Washington was planning contracts with the Laboratory in connection with the unmanned telemetering buoy being erected on Cobb Seamount in the Pacific by the university under a grant from the National Science Foundation.

The amendment would authorize funds for continued instrument development by the Bureau of Commercial Fisheries. In connection with this amendment the Committee on Oceanography has transmitted to your committee a recommendation with respect to instrument development by agencies participating in a 10-year program of marine research, including the Bureau of Commercial Fisheries. The recommendation states:

Present funds to support the production of new oceanographic instruments are inadequate. New requirements for oceanwide surveys, underwater surveillance systems, oce-

anographic forecasting systems, etc., place rapidly expanding requirements for new oceanographic instrumentation. In the past, research funds have been used for the development of instruments in connection with specific research projects. Research funds have also been used for the production of a small number of "standard" types of instruments (for example the salinometer).

Modern technology has placed vastly improved capabilities within reach. Most oceanographic instrumentation and data-processing techniques are primitive in comparison with standard procedures employed in other fields.

Applied Navy problems are placing extensive pressures on data-collection analysis and processing requirements. Complete modernization of systems is needed.

Special separate funds should be provided to support the design and production in reasonable quantity (perhaps 50 to 200 units each), of new instruments. A reasonable percent should be set aside for design. Production contracts should be awarded to companies with proven capability; i.e., companies that have actually been involved at one state or another in preliminary development of the instrument in question. Contracts should not have to go to the lowest bidder.

Funds are needed for calibration and standardization. Special attention should be given to telemetering buoys.

In addition to the Navy, other agencies such as the Weather Bureau, the Bureau of Commercial Fisheries, the Coast and Geodetic Survey, the Atomic Energy Commission, the U.S. Coast Guard have specific requirements for the collection and accumulation of data. They, too, have specific requirements for special instruments and should budget appropriate amounts for their production. Duplication of effort is unlikely. Informal liaison should be sufficient to avoid duplication and allow for cooperative developments.

The phrase "employment of scientists and personnel" in this amendment is of a perfecting nature and to correct an obvious omission.

Page 11, line 24, following the word and punctuation "laboratories," insert "and provide related instruments and equipment". This amendment has reference to instrumentation at laboratories and shore facilities.

Page 11, line 25, following the phrase "to support effectively the" and before the word "vessels" on page 12, line 2, insert the following words: "basic and applied research programs authorized in subsection (a) of this section." The purpose of this amendment is to state the application of the amendment to page 11, line 24.

Page 12, line 7, following the word "States," insert the words "and with qualified laboratories and institutions,". The purpose of this amendment is to broaden the area of cooperation by the Bureau in connection with ocean surveys.

Page 12, line 2, following the word "States," insert the words "and with institutions and laboratories,". This amendment has the same object as the previous amendment but with relation to studies to

determine the effect of distribution of radioactive elements in the sea on living marine organisms.

Page 12, line 21, following the word "products" period, insert the following:

Such studies may be carried out through contracts with institutions, agencies, or organizations competent to make such studies, or by grants to such institutions, agencies, or organizations.

The studies referred to are those of economic and legal aspects of commercial fisheries and the utilization of marine products. The committee, through this amendment, wished to make it specific that the Bureau would not be required or feel obligated to undertake these studies itself, but may utilize the services of authorities in these fields.

Page 13, line 24, following the word "mapping.", insert the following:

Such examinations, investigations, research, surveys, and mapping may be carried out through contracts with institutions, agencies, or organizations competent to conduct such investigations, research, surveys, or mapping, or by grants to such institutions, agencies, or organizations.

The purpose of this amendment is identical to that of the previous amendment, relating, however, to research connected with the geological structure, mineral resources, and products in and beneath the oceans and the Great Lakes.

SECTION 6

Section 6 of the bill would authorize appropriations for the activities and studies authorized in section 5.

Such sums as are necessary would be authorized for construction of new ships for fisheries exploration and research. The amount is not specified as your committee, which has legislative jurisdiction over the agency, will wish to review from time to time the progress being made by the Bureau in the program.

Previously in this report an accounting was given of the status of the research and exploratory fleet operated by the Bureau of Commercial Fisheries.

The Bureau is compelled to rent ships to conduct fisheries research in Pacific Northwest waters and in the Unimak Pass area of Alaska and the Bering Sea, and has only a 10-ton, 38-foot boat of its own for operation in southeastern Alaska waters.

Russia has had well-equipped and manned fisheries research ships exploring these waters for several years and, as stated earlier in this report, is operating a massive fishing fleet in the Bering Sea.

The handicaps under which biologists of the Bureau of Commercial Fisheries work on vessels temporarily chartered by the Bureau for research in these waters have been reported to this committee by scientists who have worked on these boats.

No laboratory space at all exists on these chartered ships, the committee was told. Scientists must keep their equipment and records in their own bunks. The galley table usually is the only place on the vessels where they can spread their work, and it is

available then only a few hours per day as the crew has its meals there. Crews also complain when the scientists attempt to work at night as they assert the noise keeps them awake.

Scientists have been conducting research from these ships with what they call shoestring equipment. Last winter they obtained their first salinometer. Their deep sea thermometers are borrowed from the International Halibut Commission. The ships have one bathythermograph each. The Bureau in this area has only gasoline portable winches which are reportedly very unsatisfactory, being rusty and quickly filling with water. Each ship is allowed 15 Nansen bottles, the number usually used in one cast. If a cast is lost at sea there are no spare Nansen bottles.

The vessels can accommodate two scientists or one scientist and a technician. Canada has fisheries research vessels with accommodations for 35 scientists and technicians.

Despite the handicaps under which they must work scientist in the area claim that some remarkable results have been obtained and significant contributions made to knowledge of certain North Pacific fisheries.

Salmon fisheries, however, have undergone a drastic decline in recent years.

In 1951 the U.S. salmon pack was 222,987,000 pounds; in 1952 it was 214,289,000 pounds. This was the last year in which it has exceeded 200 million pounds. By 1957 the pack had dropped to 153,917,000 pounds and in 1960 it was 139,777,000 pounds.

Three years ago the Pacific regional office of the Bureau submitted a request for funds to make bimonthly cruises in Pacific waters off our northwest coast and Vancouver Island for the purpose of studying temperatures, circulation and salinity in connection with the yearly salmon cycle.

Each year since the request has been renewed, and each year it has been rejected. The amount needed is \$80,000. One of the reasons for the repeated rejections is the lack of a suitable research ship and instruments and equipment to conduct this study that scientists in the Bureau and the industry consider most important.

S. 901 would authorize funds for such studies.

While the Soviet Union, Communist China, Japan, Canada, Great Britain, France, West Germany, the Union of South Africa and other nations have enlarged their fisheries research fleets with new and advanced vessels, that of the Bureau of Commercial Fisheries actually has diminished, as previously indicated in this report.

The Committee on Oceanography, in its report on "Ocean Resources," tersely stated:

The principal Government agency with primary responsibility of research and development of living ocean resources—the Bureau of Commercial Fisheries of the U.S. Fish and Wildlife Service—is retrogressing rather than progressing in its ability to engage in broader, basic programs involving ship operations.

The Committee on Oceanography recommended that during the next 10 years the Bureau construct 14 research ships, 12 of 500 tons displacement and 2 of 1,200 to 1,500 tons displacement. It estimated the cost at \$27.4 million.

Lack of progress in fisheries research has been reflected in the total value of the harvest from the seas in recent years. Value (to producers) of the 1960 catch was estimated at \$347 million, \$1 million more than in 1959. But in 1958 it was \$371 million; in 1957, \$351 million; in 1956, \$362 million. In only 1 year of the past decade, 1955, was it less than in 1959 and 1960, when it dropped to \$336 million. In 1954 it was \$356 million; in 1953, \$352 million; and in each of the 2 years before that \$360 million.

During this decade the population increased, production in most fields of endeavor increased, values increased with inflationary pressures, but the fisheries industry remained static and the expansion of fisheries research was restricted by a paucity of research ships and facilities.

For operation by the Bureau of Commercial Fisheries of new fisheries research and exploration ships which would be constructed under provisions of this bill, section 6 authorizes such sums as are necessary, subject to the proviso that these operation costs not exceed \$3,400,000 per year.

It is also stated in subsection (c) of section 6 that, in programming operations of such ships, the Secretary of the Interior shall give full consideration to the needs for such operations in the Atlantic and Pacific Oceans, the Gulf of Mexico, Gulf of Alaska, Bering Sea, other marine areas of present or potential commercial importance, and the Great Lakes.

All of the seas around us and the Great Lakes which bound eight of our Northern States have a wealth of fisheries resources which can affect the economy and increase employment not only in the adjacent land areas but of the Nation. The Bureau of Commercial Fisheries, in the opinion of the committee, should give attention to all of these areas and seek, through research and exploration, to develop the rich fisheries resources nearby.

Authorized in this section also are such sums as are necessary for inaugurating, developing, or expanding new ocean resource studies and surveys and for expansion of facilities for fisheries research. These facilities would include oceanaria, laboratories, unmanned buoys for recording continuous ocean data, mesoscaphs for biological observations, and automatic continuous plankton samplers.

Soviet Russia and Japan both have bathyspheres which may be suspended by cable from a ship into some of the deeper layers of the ocean where fish may live, and Russia also has adapted a submarine, the *Severyanka*, for fisheries research.

A mesoscaph, like a bathyscaph, would not require cable suspension.

The Bureau of Commercial Fisheries operates 18 laboratories, some new, some occupying surplus buildings of other agencies, and some as antiquated as its research ships.

The one fisheries laboratory on the Great Lakes operated by the Bureau is housed in an ancient residence on the campus of the University of Michigan, which Bureau officials describe as a "ramshackle, overcrowded fire hazard."

The Bureau's radio biological laboratory at Beaufort, N.C., is lodged in the basement of an old building, and has been flooded five times by hurricanes. The last flooding caused damage and loss to instruments and equipment estimated at \$20,000.

The laboratory at Boothbay Harbor, Maine, is very old, a former State hatchery building.

The shellfish laboratory at Gulf Breeze, Fla., occupies a former Coast Guard station, but while the structure is old there is ample room for the assigned research activities. This applies also to the laboratory at Galveston, Tex., according to Bureau officials, where an old Army building is being used.

Legislation is pending in the Congress to replace the antiquated building at Milford, Conn., which houses the Bureau's shellfish research station there.

At Seattle, Wash., the Bureau's only biological laboratory between La Jolla, Calif., and Auke Bay, Alaska, occupies a wooden structure built in 1931 with only 21,000 feet of floor space. Even the corridors are filled with desks and equipment.

This laboratory, which 30 years ago was hardly large enough to accommodate the research workload then, conducts research in the North Pacific for the International North Pacific Fisheries Commission, investigates the abundance and high seas distribution of salmon, collects samples from distant parts of the ocean for qualitative determinations and origins, and has as an objective studies of the circulation and characteristics of water masses in the Pacific Ocean and the Bering Sea adjacent to the Aleutians.

Laboratory officials a year ago requested funds to build a 74,000 square foot addition, were told to reduce the request to a 30,000 square foot addition, did so, and got no addition at all.

The Bureau until December 31, 1950, rented 8,000 square feet of space in an unused Navy building for its instrumentation laboratory, which, as previously stated, has now been discontinued.

S. 901 would authorize funds for necessary Bureau facilities.

Section 6 would further authorize such sums as are necessary, not to exceed \$10 million per annum, for the operation of fisheries resource studies.

The studies would include marine population sampling, biological surveys, ecological mapping, taxonomy, genetics of marine organisms, microbiology, pond fish culture and brackish water fish farming, estuarine studies, marine radiation biology, artificial cultivation of marine organisms and selective breeding of food fishes, migrations and transplantations of life in the sea, nutrient research, and closed ecology systems using marine life.

The last, on which extensive research has been conducted in one or more laboratories, is viewed as a possible means of renewing food supplies during extended space flights.

Eleven million dollars would be authorized in section 6 for continuing studies over a 10-year period of the utilization of marine products and for the development of new uses. The investigation of mineral resources in the seas also would be included under this authorization.

The committee contemplates that through these studies increased uses would be found for marine products in industry, for fertilizers, and for organic chemicals or compounds, as well as for human consumption and animal feeds.

Funds for legal and economic studies of commercial fisheries would also be included in this authorization, and are particularly essential because of the international aspects of most of our fisheries.

Sums, not to exceed \$100,000 per annum, would be authorized to be expended by the Department of the Interior for education and training of prospective scientists in the disciplines necessary to pursue the authorized studies.

One million dollars would be authorized for operation and maintenance over a 10-year period of an instrumentation laboratory, need for which has been previously stated in this report, and such sums as are necessary would be authorized for expanding Bureau communications facilities and services.

A final subsection of section 6 states that products, processes, patents and other developments resulting from research or technological advances achieved by the Bureau through Government expenditures shall, with the exception of those limitations the Secretary may find necessary in the interest of national defense, be available to the general public. Nothing in this subsection, however, should be construed as to deprive the owner of any background patent relating to the rights to such patents, processes or other developments, the subsection specifically provides.

Committee amendments to section 6

Page 15, line 24, insert the following:

(a) Such sums as are necessary for the contracts and grants authorized and directed in section 5(a) of this Act.

This funding authorization, through error, was omitted from the bill as originally introduced, and the committee amendment corrects the oversights.

Page 16, line 1, change "(a)" to "(b)" and following the words "necessary for", strike the words "construction of" and insert "constructing and equipping". This amendment, relating to new fisheries exploration and research ships, perfects the language of the subsection and broadens the authorization to include equipment.

Page 16, line 9, change "(b)" to "(c)".

Page 16, line 19, change "(c)" to "(d)".

Page 17, line 1, following the word "buoys" insert the words "or other surface or subsurface facilities" a perfecting amendment.

Page 17, line 2, following the word "recording" insert the words "and transmitting". This also is a perfecting amendment required by the purposes of the section which relates to collection of data and its communication.

Page 17, line 7, change "(d)" to "(e)".

Page 17, line 20, change "(e)" to "(f)".

Page 18, line 1, change "(f)" to "(g)".

Page 18, line 12, change "(g)" to "(h)".

Page 19, line 6, change "(h)" to "(i)".

Page 19, line 9, change "(i)" to "(j)".

These changes are necessary because of amendment designating a new section (a).

DEPARTMENT OF COMMERCE

Section 7 would authorize and direct the Secretary of Commerce, with such funds as may be appropriated or otherwise made available to him, to undertake a 10-year program of study and research as part of the general program to advance the marine sciences in the United States.

Three agencies within the Department have direct responsibilities in connection with such a program. They are:

Coast and Geodetic Survey.

Weather Bureau.

Maritime Administration.

Under section 7 of S. 901 the Secretary would be authorized and directed to do the following:

(1) Request and obtain cooperation in the program from other Government agencies, and cooperate with educational institutions, laboratories, industries, and other public and private organizations and individuals who may be of assistance in the program.

(2) Initiate and carry out a program for the replacement, modernization, and enlargement in the number of oceangoing ships for use in ocean and coastal surveys and research by the Coast and Geodetic Survey.

(3) Construct and operate Coast and Geodetic Survey shore facilities adequate to support effectively the ships referred to in the preceding paragraph.

(4) Develop, construct, or acquire new or improved techniques, instruments, or equipment for ocean research or exploration. These would include specified instruments which would increase the effectiveness of the Coast and Geodetic Survey in its statutory responsibilities.

(5) Furnish maps, charts, and other publications and products of scientific value of the Coast and Geodetic Survey without charge to educational institutions, laboratories, and other public and private organizations and individuals when it is determined that to furnish such information is in the national interest.

(6) Inaugurate within the Weather Bureau a comprehensive, 10-year study of the interchange of energy and matter between the oceans and the atmosphere and the implications of this interchange in connection with long-range weather forecasting.

(7) Introduce or expand the use of infrared thermometers for measurement of sea-surface temperatures in connection with detection of incipient hurricanes, instruments for measurements of wave acceleration and pressure, and instruments for measurements of solar radiation in the marine environment. The bill stipulates that these studies, as well as that stated in the preceding paragraph, may be carried out by means of contracts with public or private organizations, or by grants to scientific institutions carrying on such studies.

(8) Expand investigations and studies by the Weather Bureau of the mechanism by which weather conditions lead to anomalies in ocean surface temperature and the manner in which these anomalies modify the subsequent weather; the basic mechanism of the transfer of momentum from the air to the sea, the relationship of wind velocity over water to that over land, and the extent to which wave pressure, as distinct from wind stress, contributes to the piling up of water against the coasts during severe storms and hurricanes. These studies also, section 7 provides, may be carried out by means of contracts with public or private organizations, or by grants to scientific institutions carrying on such studies.

(9) Develop, construct, or acquire new and improved instruments, techniques, or equipment for use by the Weather Bureau. These shall include, but shall not be limited to, infrared radiation thermometers, air-wind measuring equipment for use on moving vessels, marine

automatic meteorological observing stations, and the application to such stations of atomic power sources. In connection with the latter, nuclear batteries are under development which would power such stations for indefinitely extended periods.

(10) Require that the Maritime Administration, when requested by other agencies of the Federal Government, construct on a reimbursable basis such oceanographic research ships as may be required by the agencies, including ships of 500-ton displacement and a 1,200- to 1,500-ton displacement.

Design of such ships would take into consideration the needs of suitable arrangements for both laboratory space and living accommodations for scientists.

Attention also would be given to the design of such requirements as adequate space and power for winches and other auxiliary equipment, sea keeping and handling at low speeds, quiet operation, and the ability to proceed smoothly in all kinds of weather.

Since sound is rapidly becoming one of the principal tools used in oceanography, the advantages of a ship which radiates a minimum of noise into the water cannot be overemphasized—

the Committee on Oceanography report "New Research Ships" stated.

With reference to the Maritime Commission's participation in the construction of oceanographic research ships, the same report commented:

One agency in the Government should have continuing (although not exclusive) responsibility for the development of efficient research ships. The most suitable agency appears to be the Maritime Administration. This would insure that all such ships have some general capability for deep-sea oceanography in case of emergency and also that a systematic development program can be assured.

The report pointed out that "the design of research ships could become an important experiment in naval architecture." It did not discourage this activity on the part of the Navy but did suggest reasons why the Maritime Commission should have a leading role in this special field of research ship construction, stating:

Although the Navy is by no means uninterested in improving the seaworthiness of small ships, the military mission must dominate the design of Navy ships. Such factors as long life, costs of maintenance, and reasonable habitability are secondary considerations. Furthermore, the Maritime Administration already has considerable experience in the design of survey and charting ships and is experienced in commercial practices in ship construction. To design to commercial standards usually results in a less expensive ship than to adhere to Navy specifications arising from combat requirements.

11. Make available, at the discretion of the Secretary, research ships designed and constructed by the Maritime Commission, to other agencies of the Federal Government, nonprofit oceanographic research centers and, pursuant to negotiated contracts of grants, to

State institutions engaged in oceanographic research requiring such scientific ships, with preference to such agencies and institutions which have engaged in marine research prior to the act. Section 7 also provides that the research ships authorized to be constructed by the Maritime Commission are in addition to other ships authorized in other sections of the act.

12. Establish with the National Science Foundation a program of education and training in the marine sciences for selected students or employees beginning not lower than the senior level of undergraduate school and continuing through not more than 4 years of graduate training and research in such sciences. The Coast and Geodetic Survey now assigns a very limited number of its personnel to receive advanced instruction and training in fields of oceanography applicable to the duties of the agency, and has aspirations to expand this education program.

The importance of expanding oceanographic activities of the Coast and Geodetic Survey, and of greatly enlarging Weather Bureau research on the high seas, was emphasized earlier in this report.

A continued, coordinated, and cumulative effort by agencies within the Department of Commerce will strengthen that Department's ability to accomplish its statutory functions.

Committee amendments to section 7

Page 21, line 9, in the date given strike "June" and insert "January".

SECTION 8

Appropriations would be authorized by this section in such sums as may be necessary to accomplish the following:

1. Construction by the Coast and Geodetic Survey of 10 survey ships displacing from 500 to 2,000 or more tons.
2. Operations of these ships during the 10-year life of the program.
3. Construction of shore facilities for processing and evaluating oceanographic data obtained by the Coast and Geodetic Survey, and construction of an operations base for ships of the agency on both the east and west coasts of the United States.
4. Development, construction, or acquisition of equipment and instruments to meet engineering and scientific needs of the Coast and Geodetic Survey in oceanographic research. This would include wave measuring equipment, systems for reduction of data, manned and unmanned buoys for automatic continuous oceanographic recording, fixed observation stations in coastal waters to determine the short term, seasonal, and yearly changes in waves, currents, tides, temperatures, hydrography and salinities, vessel positioning and acoustic equipment, measuring devices for direct density and radioactivity, telemetering devices, current devices, tide gages, underwater cameras and television, seismic equipment, automatic continuous biological sampling devices, precision salinometers, precision echo sounders, towed and fixed temperature recorders, magnetometers, gravimeters, and other instruments and laboratory equipment the agency may require for oceanographic research.
5. Operations of Coast and Geodetic Survey shore facilities and coastal bases.

6. Establishment in the Weather Bureau of a 10-year study of the interchange of energy and matter between the oceans and the atmosphere and other studies authorized in section 7 of this act.

7. Development, construction, or acquisition by the Weather Bureau of new and improved instruments and equipment authorized in section 7.

8. Design and construction by the Maritime Administration of ships authorized in section 7.

9. Establishment of an educational and training program in oceanography for selected students and employees.

The last authorization includes two provisos.

One would limit Coast and Geodetic Survey expenditures on the above education and training program to \$100,000 per annum.

The other would require that persons who receive such education and training as beneficiaries of the above program shall agree in writing to continue employment with the Department of Commerce for 3 years for each year of training unless separated from the Department earlier for the convenience of the Federal Government. Present requirements are that following 1 year of training, employment shall continue for 10 years before another year of education and training may be provided. In particular cases the Coast and Geodetic Survey believes that more frequent training periods in advanced courses would be in the interest of the agency and its oceanographic activities.

Committee amendment to section 8

Page 24, line 22, following the word and punctuation "displacement," and before the word "survey" strike the word "two" and substitute the word "four". This would increase the number of survey ships of 1,200- to 1,500-ton displacement for which construction funds would be authorized by this section for use of the Coast and Geodetic Survey. The amendment follows the consensus of scientists who have advised this committee on construction of new research ships that more ships of large or medium size are needed for complex oceanographic studies. Funds for two survey ships of 500 tons displacement, primarily for use in coastal operations, and for four ships of 2,000 tons or more displacement would also be authorized for Coast and Geodetic Survey construction.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, OFFICE OF
EDUCATION, PUBLIC HEALTH SERVICE

SECTION 9

The Secretary of Health, Education, and Welfare would be authorized in section 9 to undertake a 10-year program for development of the marine sciences in the United States.

Responsibilities of the Secretary in this program primarily would be in two fields. These are:

1. Education.
2. Health.

In the field of education the Secretary would be authorized and directed to develop training programs, award fellowships, and assist in obtaining new faculty in oceanography and the marine sciences.

In the field of public health he would direct oceanographic, estuarine, inshore, and Great Lakes studies related to public health, and research in medical and pharmacological possibilities of marine organisms, elements, and substances.

Studies of ocean, estuarine, inshore, and Great Lakes waters would include use of these waters for—

- (a) Disposal of municipal and industrial wastes.
- (b) Disposal in open ocean areas of radioactive wastes.
- (c) Berthing of nuclear powered ships.
- (d) Fishery resources as they relate to the public health.
- (e) Future major sources of municipal, industrial, and recreational water supplies.

Extensive research in these waters would be authorized with a view to discovery, determination, production, or extraction of medically or pharmacologically important substances from marine organisms.

The Secretary, through the Public Health Service, also would conduct studies of parasitism in marine animals, physiological processes in the marine environment, knowledge of which may contribute to human health, and of substances produced by marine organisms which are toxic to man.

Section 9 would also provide that the Secretary of Health, Education and Welfare shall request and obtain cooperation from and cooperate with other governmental agencies having an interest in the marine sciences, with the several States, municipalities, educational institutions, medical institutions, laboratories, conducting marine, medical or pharmacological research, and with other public or private associations, organizations and persons who may be of assistance to the program.

All of the studies and research undertaken by the Secretary of Health, Education, and Welfare pursuant to section 9 of S. 901 may be carried out by means of contracts with public or private organizations, grants to scientific institutions, or grants to qualified scientists engaged in or engaging in marine and related research.

Because the object of the program delineated in section 9 is to benefit the health and welfare of all the people, it is stipulated that all information, uses, products, processes, patents, and other developments growing out of such research resulting from Government expenditures shall be available to the general public, subject only to the determination by the Secretary and the Surgeon General of the United States of its national and public health interest.

Earlier in this report the medical and pharmacological implications were stated in some detail. Testimony in this regard at hearings on S. 901 was far more extensive. The printed hearings contain many communications from many scientists who are exploring, and in some instances finding, substances which apparently have a beneficial effect in connection with some of the ills of man.

The testimony of Dr. Dixy Lee Ray, consultant in biological oceanography to the National Science Foundation, and associate professor of zoology at the University of Washington, from which excerpts were quoted earlier in this report, and which appears in full in the printed hearings, is particularly informative in this regard.

Important testimony also was given by Dr. John A. McLaughlin of the Haskins Laboratories, New York.

Dr. Albert Szent-Gyorgi, scientist and physician, and a Nobel Prize winner in medicine, expressed his support for S. 901 in a letter from Woods Hole, Mass., where he directs the Laboratory of the Institute for Muscle Research. Dr. Szent-Gyorgi and the committee have had previous correspondence with regard to this proposed legislation.

In his latest letter Dr. Albert Szent-Gyorgi stated in part:

There is one point, perhaps, which I may not have sufficiently emphasized in my earlier letter, and this is the unity of the living world and science.

For many decades the trend was to subdivide nature and science into new fields. Now we begin to understand the great unity of nature, which is built on a limited number of basic principles. The difference is very important.

Earlier, we thought we would be able to solve more complex problems, such as different diseases, by a direct attack, by shortcuts. Shortcuts have turned out to be blind alleys and we have learned that the only really safe and fruitful way is to go down, first, to the foundations of nature (this is basic research), and then come up with some newly won deeper insight to the specific areas.

To quote an example of my specific personal experience. I was always interested, exclusively in basic phenomena. All the same, unexpectedly, 30 years ago I discovered vitamin C, which, since, has saved many lives and has helped to build millions of healthy bodies.

Though not being a cancer researcher, I could make, lately, a very important contribution to cancer research, and I hope that, someday, my basic studies on muscle may yield a clue to dystrophy. I would almost be inclined to say that anybody who wants to solve cancer has little chance to do so, but anyone who studies basic phenomena of life does have a chance.

This is important to your problem, because the ocean, the cradle of life, offers innumerable possibilities for the approach of its most basic problems, a part from offering, also, solutions for more immediate needs.

Dr. Szent-Gyorgi expressed regret at not being able to attend the hearings on S. 901, explaining that on the dates scheduled he would be abroad.

OFFICE OF EDUCATION

Success of the 10-year program of oceanographic and Great Lakes research proposed in S. 901, in the report of the National Committee on Oceanography of the National Academy of Sciences, and in the TENOC (Ten Years of Oceanography) program proposed by the Navy and Defense Departments, will depend largely on the training and education of many more marine scientists—biologists, physicists, chemists, geologists, meteorologists, and those who have specialized in branches of these disciplines.

Education and training of men and women in these professions requires time, more time in fact, than building ships and laboratories.

The number of marine scientists in the United States is small. Many European countries, and Canada on this continent, have more oceanographers in proportion to population than the United States. Soviet Russia has 60 percent more marine scientists than the United States and is conducting an intensive training program.

The number of institutions in the United States in which a prospective oceanographer can receive advanced training is small. Only one institution of higher education, the University of Washington, has undergraduate courses in oceanography leading to a bachelor degree. Twelve universities provide graduate education in oceanography leading to a Ph. D. degree. Of these, four offer Ph. D.'s only in biological oceanography, four in one or more of the nonbiological fields such as physical, chemical, and geological, and four offer this degree in all fields of oceanography.

A total of about 150 educators are on the professional staffs of these institutions which offer education in oceanography but most of these are engaged in research instead of teaching. The Committee on Oceanography estimates that there are only about 50 persons in the Nation actively engaged in graduate teaching, or less than 10 percent of the 520 professionally trained oceanographers in the country.

To maintain adequate staff with which to train students in oceanography, many institutions have drawn on other nations, Norway, Sweden, Great Britain, Denmark, France, Italy, and Japan, where interest in the oceans dates back for centuries.

Many of the Nation's outstanding marine scientists, now, of course, American citizens, were born and received their education and training in foreign countries. This source of supply, institutions are discovering, is almost exhausted. The number of professional oceanographers in other countries, throughout the world in fact, is small, and many nations today are finding a pressing need for greater scientific knowledge about the oceans.

This means that the United States must more and more look to its own for faculty, advanced students, and professional marine scientists.

The Committee on Oceanography in its report stated that the 10-year program envisaged will require—

an approximate doubling of the number of professional oceanographers at the doctoral level and an increase of rather greater magnitude in personnel of lower categories over the next several years.

Obviously, this necessitates doubling the educational programs as rapidly as possible.

The committee recommended that the Office of Education conduct a program of encouragement and assistance to provide new faculty in oceanography at existing or new teaching centers, and that it also assist graduate students preparing to become oceanographers through a program of long-term fellowships.

Section 9 would authorize such programs.

Need for these programs also was expressed by witnesses at hearings on S. 901, and in communications from university officials to your committee.

Dr. C. P. Idyll, of the University of Miami, in his testimony quoted the report of the President's Science Advisory Committee, which was prepared near the close of the previous administration, as follows:

Whether the quantity and quality of basic research and graduate education in the United States will be adequate or inadequate depends primarily on the Government of the United States. From this responsibility the Federal Government has no escape. Either it will find the policies—and resources—which permit our universities to flourish and their duties to be adequately discharged, or no one will.

The report is titled "Scientific Progress, the Universities and the Federal Government."

Dr. Joseph L. McCarthy, dean of the Graduate School, University of Washington, in a letter to your committee, stated:

The need is great for additional scientists and technologists highly trained in the marine sciences. Therefore, it seems particularly important to provide arrangements for fellowships and assistantships to graduate students engaged in programs of study and research leading toward advanced degrees.

To carry forward an expanded program of teaching and research in oceanography and the marine sciences, expansion is needed in the number of faculty in these fields, and in financial support for these men. The universities are hard put now to provide for the needed increases in faculty personnel.

Committee amendments to section 9

Page 29, line 6, insert a new subsection as follows:

(e) Research contracted for, sponsored, cosponsored, or authorized under authority of section 9 of this act, shall be provided for in such a manner that all information, uses, products, processes, patents, and other developments resulting from such research developed by Government expenditure shall be, subject to the national and public health interests as determined by the Secretary and the Surgeon General of the United States, available to the general public: *Provided, however,* That nothing herein shall be construed to deprive the owner of any background patent relating thereto to such rights as he may have thereunder.

It is the opinion of many scientists that significant advances may be made in the fields of medicine and public health through the research program authorized in this section of S. 901. Such benefits should accrue to the Nation as a whole and the processes and products that may be developed through this research should be available to the public without restriction, except in the national or public health interest as determined by the Secretary and Surgeon General.

SECTION 10

Appropriations are authorized in section 10 to further the programs of research and education that would be authorized in section 9.

The sum of \$5 million would be authorized to carry out the educational fellowship and training programs, with the provision that not more than \$500,000 be expended for this purpose in any one year.

For studies or research relating to the discovery or extraction of medically or pharmacologically important substances from the marine environment or its organisms such sums as are necessary would be authorized.

Section 10 also authorizes such sums as are necessary to double, within the 10-year life of the program, research and studies of estuarine, inshore, and Great Lakes waters with relation to their use for municipal, industrial, and recreational water supplies; disposal of harmful wastes, and with relation to public health aspects of the fisheries resources within them.

Committee amendment to section 10

Page 30, line 20, strike subsection (d), which has been inserted as subsection (e) in section 9. This subsection, which relates to information, uses, products, processes, patents, and other developments resulting from research authorized in section 9, was misplaced in the original text of S. 901.

ATOMIC ENERGY COMMISSION

SECTION 11

For the purpose of determining the effects of radioactive contamination upon the oceans and life within the oceans, their estuaries, inshore waters, and the Great Lakes, section 11 authorizes the Atomic Energy Commission to conduct an intensive 10-year program which shall include:

1. Control and monitoring or radioactive waste disposal in the marine environment.
2. Studies of the circulation and mixing processes which affect the dispersion of introduced contaminants in coastal and estuarine waters, the Great Lakes, and the open ocean.
3. Research on the inorganic transfer of radioactive elements from sea water to sediments.
4. Investigations of the effect of radioactive elements on living organisms in the oceans, coastal waters, estuaries, and the Great Lakes.
5. Studies of the genetic effects of radiation on such organisms.

This section would also provide that with the exception of regulating and monitoring the introduction of radioactive material in the ocean the Atomic Energy Commission may carry out the above activities through contracts or grants to States and State agencies, institutions or laboratories equipped to undertake such studies.

Aspects of the program relating to regulating and monitoring the introduction of radioactive material in the ocean, however, shall be carried out by the Coast and Geodetic Survey or the Public Health Service, or both, with funds made available by the Atomic Energy Commission.

Section 11, except for one perfecting amendment which will be discussed later, is identical to a similarly numbered section in S. 2692, 86th Congress, the bill to authorize a 10-year oceanographic research program which was introduced in the 86th Congress, approved by this committee, and passed by the Senate without dissent.

During hearings on S. 2692 testimony was given by informed witnesses on the dangers of contaminating the oceans or its tributary waters with radioactive wastes.

Mr. Sumner Pike, former member of the Atomic Energy Commission and a member of the Committee on Oceanography, testified:

I feel, and Dr. Spilhaus does, that we ought to know what we are doing before we dump any amount of these wastes in the ocean. Once it is done it is irreversible. We ought to be very clear that if radioactive wastes are to be dumped in the ocean, they should be dumped in such places, at such times, and in such quantities only that we can prove to be completely harmless to the human race and indeed to other forms of life because after all, the human race depends upon other forms of life for its own existence.

Dr. Dayton E. Carritt, of the Johns Hopkins University, Baltimore, Md., who during the war was connected with the Manhattan project at Los Alamos, N. Mex., and who is a member of the Committee on Oceanography's panel on radioactivity in the oceans, testified:

I have the impression that a great many people in this country and abroad, both scientists and laymen, feel that so long as we do not deliberately add radioactive waste materials in the oceans, the oceans will remain free of all man-made radioactive contamination. I am firmly convinced that this is not so.

That choice was lost when we, or in fact any nation, embarked on a program utilizing the fission process as a source of power production.

Neglecting all considerations of fallout from the testing and use of atomic bombs, we still are faced then with the generation of large quantities of radioactive materials in present and proposed peaceful programs. These include the use of radioactive materials in science and technology, the development of land-based powerplants, and the development of nuclear-powered submarines and surface vessels.

As presently developed, and as far as I can tell there can only be minor changes in the foreseeable future, all of these peaceful uses will result in certain quantities of radioactive waste materials that must be released to our environment, and which will inevitably find their way into the oceans.

To be sure, the massive quantities of so-called high-level wastes are and can be contained on land and so kept out of man's immediate environment. Nevertheless, there remain rather large quantities, so far as bulk is concerned, of so-called low-level wastes that cannot be handled as are the high-level wastes. It is, I believe, safe to predict that regardless of all the safety precautions taken, accidents will happen in land-based powerplants, and nuclear vessels will be involved in collisions and sinkings, all of which will contaminate the world's oceans.

I am firmly convinced that the basic question that must be answered is not shall we or shall we not release radioactive

wastes to the sea, but rather how much can be safely released to the sea without jeopardizing our present and planned uses of the marine resources.

At hearings this year on S. 901, Dr. Lauren R. Donaldson, director of the Laboratory on Radiation Biology, University of Washington, added further evidence on the needs for thorough study of the effects of marine contamination by radioactive materials.

Dr. Donaldson and his laboratory staff have conducted investigations for the Atomic Energy Commission at many of the atolls in the South Pacific including Eniwetok, Bikini, and Kwajalein; in Marshall and Mariana islands areas, in equatorial waters, off the west coast of the United States and in the Chukchi Sea north of Alaska. He said:

The advance of nuclear technology will produce quantities of various kinds of atomic wastes under a wide diversity of conditions. The techniques of biological evaluation must not merely keep pace with these developments but must anticipate them, proceeding so rapidly that the evaluations may be elements of proper planning rather than programs born "too little and too late."

Committee amendment to section 11

Page 32, line -, strike the word "or" after "institutions" and insert a comma, and after the word "laboratories," insert the words "or public or private organizations". The purpose of this amendment is to broaden the area in which the Atomic Energy Commission may make grant or enter into contracts for carrying out studies authorized in this section.

SECTION 12

Section 12 would authorize appropriations to carry out the 10-year program of research, studies, monitoring, and control authorized in section 11.

Such sums as are necessary would be authorized for—

1. Engineering studies in connection with control and monitoring of disposal of radioactive wastes in the ocean, estuaries, inshore waters, and the Great Lakes, subject to a proviso that expenditures for this purpose not exceed \$37,000 in any one year of the 10-year program.

2. Control and monitoring operations as authorized in section 11, provided that expenditures for this purpose not exceed \$2,800,000 in any one year of the 10-year program.

3. Participation in international meetings of scientists and technical experts relating to international control and monitoring of radioactive waste disposals in the marine environment. Expenditures for this purpose are limited to \$30,000 in any one year of the program.

4. Research to determine circulation and mixing processes controlling dispersion of radioactive wastes introduced in deep waters of the open ocean. The limitation on expenditures for this purpose was placed at \$1,400,000 per annum in the original bill and has been amended by the committee.

5. Studies of the inorganic transfer of radioactive elements from sea water to the sediments.

6. Studies of the effects of the biosphere on the distribution and circulation of radioisotopes in the oceans, its seas, and the Great Lakes.

7. Studies of the genetic effects of atomic radiations on marine organisms.

8. Field experiments in confined bodies of water using or utilizing radioisotopes.

9. Two major open sea tests of radiological contamination at sea, its effects on marine life, and its potential effects on humanity.

Committee amendments to section 12

Page 33, line 24, strike the figure "\$1,400,000" and substitute the figure "\$2,800,000". This change, applicable to the authorization of appropriations for research to determine circulation and mixing processes which control the dispersion of radioactive wastes in deep waters of the open ocean, was made by your committee following staff consultations with atomic scientists.

Page 34, line 2, following the word "sediments," strike the colon and substitute a semicolon, and strike the words:

Provided, however, That expenditures by the Atomic Energy Commission for this purpose not exceed \$484,000 in the first year of the program or \$299,000 in subsequent years of this 10-year period.

This proviso was considered unrealistic by the committee following staff consultations with a representative of the Atomic Energy Commission.

Page 34, line 9, following the word "Lakes" strike the colon and substitute a semicolon, and strike the words:

Provided, however, That expenditures by the Atomic Energy Commission for this purpose not exceed \$968,000 per annum.

This authorization is for studies of the effects of the biosphere on the distribution and circulation of radioisotopes in the oceans, its seas, and the Great Lakes. The reason for removing the limitation is the same as given in the preceding amendment.

Page 34, line 13, following the word "organisms" strike the colon and substitute a semicolon, and strike the words:

Provided, however, That expenditures by the Atomic Energy Commission for this purpose not exceed \$100,000 per annum.

The authorization referred to relates to studies of the genetic effects of atomic radiations on marine organisms, and the committee, on the advice of scientists, deleted the limitation as unduly restrictive in the event of the occurrence of profound effects.

DEPARTMENT OF THE NAVY

Section 13 would authorize and direct the Secretary of the Navy, with such funds as may be appropriated or otherwise made available to him, to carry out the following activities:

1. Undertake a 10-year program of expanded oceanographic research and hydrographic surveys as part of the U.S. program for the development of the marine sciences.

2. Provide funds, by contract or otherwise, to scientists, Government and non-Government laboratories, or institutions for basic and applied research, purchase of equipment, acquisition or improvement of facilities, the design, development, and production of specialized new, and improved, oceanographic, research, survey, and communications devices, employment of scientists and personnel, and for other uses.

3. Initiate and carry out a 10-year program for the replacement, modernization, and enlargement in the number of ships for use in basic and applied research and hydrographic surveys.

4. Supply, when available, ships designed for basic research to nonprofit scientific institutions and laboratories, title to these ships to remain with the U.S. Government.

5. Construct and operate a sufficient number of shore facilities and laboratories and provide related instruments and equipment to support effectively the expanded program of basic and applied oceanographic research and hydrographic surveys authorized for the Department of the Navy to undertake under the provisions of S. 901.

6. Develop, construct, or acquire new or improved vehicles and instruments for ocean research and exploration.

7. Continue and expand the Navy's support of marine studies substantially as proposed in the Navy's TENOC program.

8. Conduct or facilitate under such security provisions as may be prescribed by the Secretary of the Navy time series oceanographic observations and research from radar picket ships or other suitable vessels.

9. Establish with the National Science Foundation of the National Academy of Sciences-National Research Council a program of scholarships beginning at the senior level in undergraduate school, and carrying through 4 years of graduate training and research in the marine sciences.

10. Conduct a systematic and expanded program of three-dimensional ocean surveys including measurements or studies of depths, salinity, temperature, current velocity, wave motion, magnetism, and biological activity.

11. Continue a policy of expanding assistance to support of existing civilian laboratories and universities engaged in basic oceanographic research.

12. Foster the establishment and growth of new civilian laboratories for applied oceanographic research needed by the Navy, giving consideration in their establishment to geographic location with a view of maintaining a balanced program.

13. Request and obtain cooperation from and cooperate with other Departments and agencies of the Government having an interest in or concern with the marine sciences.

14. Cooperate with the several States, and with educational institutions, laboratories, industry, and other private and public organizations and persons who may be of assistance to the Navy in scientific and technological fields.

15. Furnish maps, charts, and other publications and products of scientific value prepared by the Hydrographic Office to educational institutions, laboratories, and other public and private organizations and persons without charge when it is determined by the Secretary of the Navy that such action will be in the national interest.

Earlier in this report it was stated why the activities and studies above are imperative to the security of the Nation, how the United States has lagged in providing proper ships and facilities for such research and studies, and how it has neglected in the past the development of new scientific instruments and vehicles for subsurface research of intrinsic importance to effective antisubmarine warfare.

The quality and numbers of the existing research fleet was detailed, space and equipment limitations that handicap scientists in many of the Nation's marine laboratories was discussed, and the deterrents to education and training of marine scientists were considered earlier in this report.

This committee concurs in and commends the policy of the Department of the Navy in centering its basic research efforts in universities and colleges, marine laboratories, and other civilian institutions which have placed emphasis on oceanographic or Great Lakes research.

Scientists who today are making scientific studies of earth's deep waters were all trained, both in the United States and in other countries, in universities and colleges, or in institutions and laboratories affiliated with universities and colleges. Many of these institutions of higher education are inland and not a few of them are located by or close to the Great Lakes. But in all of these students received the inspiration to pursue careers in, or related to, the marine sciences, and the basic instruction.

It is in these institutions also where these scientists are concentrated.

As Dr. Maurice Ewing, Director of the Lamont Geological Observatory, Columbia University, stated in his testimony before the committee at the hearings on S. 901:

The major part of the research effort should be situated in academic institutions or in institutions or bureaus which have the broad interest and intellectual vigor which characterizes the finest academic institutions. It is very rarely that one finds such characteristics dominant in a Government bureau, and indeed, in general they probably are not the most desirable characteristics for a Government bureau. But they are essential to creative basic research.

This is the policy the Office of Naval Research has followed since its creation in 1946, but even the finest academic institutions cannot meet all of the Navy's research requirements with antiquated ships, obsolete instruments, or overcrowded and inadequate laboratories and facilities.

As Dr. Ewing testified:

We have seen the problems of Federal support of marine research from their infancy. Our research group has been built largely on the basis of Federal support. The most severe limitations on this development has been the difficulty of obtaining laboratories and shore facilities, and in establishing faculty positions.

Section 13 of S. 901 would authorize the Secretary of the Navy to undertake and maintain a long-range program of expanded support to civilian laboratories and universities in furtherance of basic research, and to provide these institutions the necessary facilities to conduct this research.

SECTION 14

Funds to accomplish the long-range program objectives of section 13 are provided in section 14. These include such sums as are necessary for—

1. Construction of nine research ships of 1,200 to 1,500 tons displacement, four of 2,900 to 3,000 tons displacement, and one of 300 tons.

2. Construction of four survey ships of 1,200 to 1,500 tons displacement and four of 2,000 or more tons displacement.

3. Operations of research ships constructed by the Navy under authorizations of S. 901 with a proviso that expenditures for operation of the 1,200–1,500-ton ships not exceed \$420,000 each per annum and that for research and survey ships of more than 2,000 tons displacement not exceed \$700,000 each per annum.

4. Modernization, improvement, and expansion of existing shore facilities and construction of new shore facilities for research and survey work.

5. Operations in basic research other than ships.

6. Engineering needs of the long-range program.

7. Development, construction or acquisition of new and improved vehicles, and instruments for ocean and Great Lakes research which may include bathyscaphs, mesoscaphs, self-propelled deep sea data collecting vehicles, other manned and unmanned submersibles, wave measuring equipment, manned and unmanned buoys for automatic continuous oceanographic recording, icebreakers and submarines modified or converted for scientific use, vessel positioning systems, seismic equipment, turbulence measuring devices, oceanographic sound-velocity meters, precision echo sounders, acoustic telemetering devices, navigation location transponders, audio-visual surveillance systems to monitor sources of biological noises in the oceans or in the Great Lakes, submarine oceanographic plankton samplers, hydrophotometers, fixed coastal acoustical-oceanographic monitoring systems, marine geophysical gravity meters, marine geophysical electron resonance magnetometers, systems engineering for reduction of data, shipboard wave meters and dye detector probes, marine remote sensing and recording systems, moored oceanic ambient noise monitoring buoys, expendable oceanographic sensor systems, oceanographic sonic and radio frequency marine tags for monitoring marine fishes and mammals, improved midwater trawls, ocean shipboard synoptic systems for use on weather ships, radar picket ships, and similar vessels assigned to ocean stations; marine radioactive water samplers, shipboard gamma ray detectors, marine geophysical underwater cameras, geophysical sea floor television systems, sea floor sediment samplers and analyzers, sea floor dredge winches, constant tension cable reels, moored oceanographic buoy systems for recording and transmission of important oceanographic and meteorological data in deep ocean areas, marine sea floor geothermal probes for determining heat flow characteristics and values, and other such devices, instruments, and systems as may be useful in studies of the current structure of the oceans, oceanic temperatures, bottom topography, sediments, heat flow through the ocean bottom, sound transmission and velocities, ambient noise, biological activity in the marine environment and specimens, water samples for salinities, phosphates, oxygen, nitrogen,

and other chemical or elemental components of the oceans, and for recording and communication of oceanographic data of scientific value.

8. Time series observations and research conducted from radar picket ships or other suitable vessels operated by the Navy. A proviso to this authorization, however, limits the expenditure for this purpose on such station vessels to not more than \$82,500 for each ship during the 10-year program authorized for this purpose under the previous section of S. 901, and that operation costs under this program not exceed \$58,000 per annum per ship.

9. Establishment of a program of scholarships and post-doctoral fellowships as authorized in the previous section with a proviso that costs to the Department of the Navy for this purpose not exceed \$300,000 per year.

Such a program, this committee believes, if faithfully carried out, will give the U.S. Navy and the Nation unchallenged leadership in basic scientific knowledge of the oceans and the Great Lakes, and in hydrographic knowledge of these waters and the earth beneath them as such knowledge relates to the defense of this Nation and operation of its subsurface craft.

"There never has been a time in our history when this particular field has been more vital to us," Secretary of the Navy John B. Connally asserted in his appearance before the committee at hearings on S. 901.

"History clearly shows that the nations which make maximum use of the oceans derive unequaled military and economic advantages," states the Navy's revised TENOC report in its opening paragraph.

Emphasis has been placed in S. 901 on new instruments and devices for marine research and communications. The new TENOC report states:

In order to fully and effectively utilize the oceanographic ships presently in operation and those planned for the future, a drastic improvement in oceanographic instrumentation, both in reliability and availability is required. * * * The need for applied engineering, including research, development, test and evaluation, to convert experimental instruments into reliable well-tested prototypes cannot be overemphasized.

The TENOC report also stressed the need for increased data on marine acoustics, stating that survey type data on sound propagation and ambient noise in frequency range from 5 cycles to 1 megacycle is desired.

"Information is needed now on waters to 200 fathoms in depth," the report states, "by 1970 to 3,000 fathoms with major emphasis on strategic harbors and approaches and on polar regions."

For the future interest in this field should center on the Greenland-Iceland-United Kingdom area, Norwegian Sea, Bering Sea, North Sea, Sea of Japan and Greenland Sea, the report added, commenting that detailed research data is required in some area; seasonal and long term data from the others. Key problem as given as that of understanding bottom effects on propagation.

Biological research also is given a prominent role in the long-range program advocated in the TENOC report. Research should be conducted, it states, on:

1. Biological interference with underwater acoustic systems.
2. Biological influences upon mine and mine countermeasure actions.
3. Biological deterioration of marine structures and equipment.
4. Bioluminescence.
5. Poisonous, venomous, and noxious marine organisms.
6. Biological orientation, detection, and target evaluation phenomena.

Extensive testimony on the importance of biological knowledge in connection with mine warfare was given at the hearings on S. 901 by Dr. C. J. Fish, director of the Narragansett Marine Laboratory of the University of Rhode Island, who made important contributions in this field during World War II.

Equally significant testimony was given by Dr. Joseph E. Henderson, director of the Applied Physics Laboratory of the University of Washington, on the importance of increased middepth acoustics research. He stated:

It is interesting to note that our present knowledge of the oceans is confined pretty much to the surface layers and, to some extent, the bottom area; the great midocean depths are the great unknown; yet here is where our important sonar beams travel.

Later in his testimony Dr. Henderson said:

We at APL are now doing work which will shortly require a seagoing vessel for about one-half its time. We have been making do with a vessel borrowed occasionally for a few days time from the 13th Naval District, and have also gone piggyback on the university's oceanographic ship, the *Brown Bear*. We will need much firmer arrangements if we are to leave Puget Sound for any timely, meaningful deep-sea work. This also implies the need for added shore facilities, including piers, staging areas, warehouses, laboratory space, et cetera, all of which will be a part of the general oceanographic effort at the University of Washington.

Something is needed to stimulate support of research in oceanography, to provide the basic knowledge on which the Navy's future effectiveness depends. We believe our own work to be especially exemplary of this fact. I urge that the appropriate legislation be speedily enacted.

Committee amendments to section 14

Page 40, line 11, strike the word "nine" and insert in lieu thereof the words "ten ships for basic research". This amendment increases by one the number of research ships of 1,200-1,500 tons displacement for institutional use for basic research. This increase is in line with recommendations in the revised TENOC report which proposes over a 10-year period, construction of two ships each of the above displacement for Lamont Geological Observatory, Woods Hole Oceanographic Institution, Scripps Institution of Oceanography, and one ship each of such displacement for Texas Agricultural & Mechanical College, the

University of Miami, Oregon State College, and the University of Washington, an increase of one ship in this category over the previous TENOC recommendation.

In this connection it may be noted that at present the University of Miami is conducting research in the Gulf of Mexico and the Caribbean Sea in a boat 75 feet long and displacing 135 tons.

Lamont Geological University is studying the North Atlantic and the South Pacific, the latter off the coast of South America, in a 38-year-old craft displacing 533 tons.

Texas A. & M. College is studying the Gulf of Mexico, West Caribbean, and Campeche Bank area in a 136-foot, 332-ton ship built in 1944.

The University of Washington, Dr. Wayne V. Burt of Oregon State College commented in a letter to the committee—

has done a heroic job trying to survey an important ocean area several times the size of the United States, with a small, wooden, 300-ton, 26-year-old converted Government vessel.

Page 40, line 13, strike the words "research ships". This amendment is required by the previous amendment which included the words "basic research" in connection with the same authorization.

Page 40, line 14, strike the word "four" and insert the words "two ships for basic research". This amendment is applicable to construction of ships of 2,000 to 3,000 tons displacement, and is made to conform to recommendations of the revised TENOC report.

Page 40, line 15, following the word "displacement" strike the words "research ships", which have been made redundant by the previous amendment. Also following the word "one" strike the word "research".

Page 40, line 16, following the word "ship", insert the words "for basic research". This is a perfecting amendment applicable to authorization of funds for construction of a ship displacing 300 tons.

Page 40, line 17, following the semicolon, insert the words "six ships for acoustics or applied research of one thousand two hundred to one thousand five hundred tons displacement". This is a major amendment by the committee to meet a need expressed in testimony at hearings on S. 901, and also to conform to recommendations in the revised TENOC report.

Acoustics and applied research is conducted by the Navy through contracts with institutions as well as at the Navy's own laboratories. The Navy recommends construction, over a 10-year period, of two such ships for east coast laboratories, two for west coast laboratories, and two for undesignated assignment.

Page 40, line 19, following the word "displacement" and the semicolon strike the word "three" and insert the word "four" and following the words "survey ships of" strike the words "two thousand to three thousand tons displacement; five survey ships of one thousand two hundred to one thousand five hundred tons displacement; two survey ships of approximately five hundred tons displacement" and insert the words "one thousand two hundred to one thousand five hundred tons displacement, and four survey ships of two thousand or more tons displacement;". The purpose of this amendment is to increase from three to four the number of larger survey ships authorized in S. 901 for construction by the Navy Department with funds authorized

in this section. The Navy TENOC report recommends use of large vessels for survey work. For this reason also the two 500-ton vessels for which funds were authorized in this section in accordance with the earlier recommendation of the Committee on Oceanography, are now eliminated.

Page 41, line 1, following the word "new" and before the word "research" strike the parentheses and the word "basic". This provision authorizes funds for operation of research ships constructed under the authorization of this section.

Page 41, line 6, following the word "displacement" and before the word "research" insert the word "basic". The amendment applies to operating costs of research ships of 1,200-1,500 tons, and the word "basic" not only implies that these ships are to be constructed for institutional use, but that the limitation to \$420,000 per annum of expenditures for operations shall not apply to the ships constructed for acoustics and applied research.

Page 41, line 8, following the word "for" and before the word "research" insert the word "basic". This amendment has the same purpose as the amendment above and applies to ships of 2,000-3,000 tons displacement.

Page 41, line 9, following the word "or" insert the word "for", a perfecting amendment. Also in line 9 of page 41 following the word "each" strike the words "per annum".

Page 41, line 10, strike the words "and that of new five hundred ton ships not exceed, or in other words the entire line". This phrase is redundant in view of previous amendment.

Page 41, line 11, before the word "each" strike the figure "\$250,000". This relates to the amendment of page 41, line 10, and is likewise redundant for the same reason.

DEPARTMENT OF THE ARMY

Section 15 would authorize and direct the Secretary of the Army, with such funds as may be appropriated or otherwise available to him, to undertake a 10-year program of study and research by the Corps of Engineers, through the Beach Erosion Board, related to the functions of the latter.

In addition to programs now underway, the Secretary would be authorized to carry out, in near-shore areas of the Atlantic and Pacific Oceans, the Gulf of Mexico, and the Great Lakes extending outward to the 50-fathom-depth contour, the following activities:

1. Undertake in coastal waters studies of the action of waves, wave currents, tides, tidal currents, and large-scale ocean and littoral currents.
2. Study and evaluate the interaction of the atmosphere, the sea, and the land as they affect the waves, currents, tides, surges, hydrographic contours, and hydrographic changes in the coastal zone.
3. Establish observation stations in coastal waters to determine the short-term, seasonal, and yearly changes in waves, currents, and hydrography in the area surrounding the station.
4. Develop, construct, or acquire instruments and equipment in furtherance of these studies.
5. Determine the sources of bottom materials in the coastal area, the rates and methods of movement of these materials, and the effects

on the coastal hydrography of changes in the rate at which these materials reach the coastal zone.

6. Study the mechanics and effects of density currents encountered in the coastal area on the current velocities, current patterns, hydrography, interchange of waters, and rates of sedimentation.

7. Contract with qualified scientists, research laboratories, research organizations, or educational institutions to undertake basic and applied research studies and experiments in the laboratories and in coastal waters, in furtherance of the purposes of this section of S. 901.

8. Request and obtain cooperation in these studies from other Government agencies having an interest in the marine sciences and ocean surveys, and cooperate with educational institutions and laboratories devoted to the marine sciences and oceanography, and with other public or private organizations and persons who may be of assistance.

Residents and property owners on our coasts are aware of the many changes which constantly can and do affect our shorelines and beaches, frequently causing great financial loss and destroying or damaging important recreational areas. In recent years the Beach Erosion Board has conducted research on the phenomena that causes these changes which also have a bearing on our coastal defenses.

Section 15 of S. 901 would authorize a comprehensive, 10-year program to expand these studies.

Committee amendments to section 15

None.

SECTION 16

For the purposes and activities stated in section 15 there would be authorized sums, not to exceed \$2 million per annum, for the following activities:

1. Investigations in physical oceanography in the near-shore zone.

2. Purchase, development, acquisition, and operation of scientific equipment required for investigations authorized above, including but not limited to amphibious craft, floating craft, fixed platforms, buoys, current meters, wavemeters, tide gages, sound equipment, direct density measuring equipment, turbulence meters, underwater cameras, and underwater television equipment.

3. Expansion and equipment of shore facilities necessary to support the investigations authorized in section 15.

4. Entering into contracts with qualified scientists, research laboratories, research organizations and educational institutions to conduct physical investigations in the near-shore zone.

As an example of the need for research and investigations indicated above, a letter from Mr. Richard C. Timme, National Marine Consultants, Inc., Santa Barbara, Calif., to the committee may be cited. It states in part:

One immense problem which coastal States must face in the near future is an adequate supply of littoral material (sand) to maintain areas of coastline recreation and structures. The supply of littoral material is directly related to the supply of material transported coastward by rivers, tributaries, and streams. As these sources are curtailed by dams,

storm drain projects, and flood control work, the general supply of littoral material to our beaches is gradually but surely being denied. We must know where we are going in this respect. What will happen when the sources are seriously curtailed? * * *

We bring this to your attention merely to emphasize what far-reaching effects that stepped-up research programs will have on the daily existence of the people of the United States and of the world, now and in the future.

Amendments to section 16

Page 47, line 14, following the word "institutions" insert the words "or industrial organizations". The purpose of this amendment is to broaden the area in which the Secretary of the Army may contract for research and studies authorized in section 15 of this act.

DEPARTMENT OF THE TREASURY, U.S. COAST GUARD

Section 17 would amend title 14 of the United States Code to include among the functions and responsibilities of the U.S. Coast Guard that of conducting oceanographic research in and beneath any accessible portions of the oceans, seas, gulf, and bays, including international waters.

As stated earlier in this report, the Coast Guard is presently precluded by statute from undertaking such research except in connection with the International Ice Patrol.

Also stated earlier in this report are the desires of the President of the United States, departments of the Federal Government, the Committee on Oceanography, and the Coast Guard itself that the present statutory restriction be removed.

Benefits which are anticipated will accrue from removal of this restriction likewise are stated earlier in this report.

Section 17 would authorize the Secretary of the Treasury to undertake, through the U.S. Coast Guard, and without regard to previous statutory limitations, a 10-year program of oceanographic research which would include the following activities:

1. Conduct, in cooperation with Government agencies, including agencies of friendly governments requesting and reciprocating such cooperation, bathythermography observations, sonic soundings, samplings of strontium 90, carbon 14, air pollution, sea water, and plankton; studies of marine borers and fouling organisms, and such other oceanographic research as, in the opinion of the Secretary and the Division of Marine Sciences of the National Science Foundation, will advance the marine sciences in the United States.

2. Expand, in pursuance of functions of the Department under this act, or in cooperation with other Government agencies, institutions and scientific organizations, research conducted on or from weather ships and other station vessels operated by the Coast Guard, offshore towers, and from such large oceangoing Coast Guard vessels, as the Secretary, in consultation with other Government agencies, may find adaptable to the oceanographic program and does not diminish the ability of the Coast Guard, or its officers and crews, to perform that agency's other missions.

3. Obtain and install on such Coast Guard vessels as the Secretary may designate such equipment or instruments as may be required for oceanographic research authorized under this section.

4. Provide such facilities or personnel as may be required for analysis of oceanographic data collected and transmitted by the Coast Guard.

5. Encourage and assist selected officers and employees of the Coast Guard to enroll in and pursue formal courses in oceanography.

Committee amendment to section 17

Page 49, line 21, after the word "Act", insert a comma and the words "to carry out". This is a perfecting amendment to correct an omission in the original printed bill.

SECTION 18

Appropriations would be authorized in this section in such sums as are necessary for the Secretary of the Treasury to carry out the duties, functions, and responsibilities to be authorized by section 17 of this bill, with a proviso that expenditures for instruments and equipment on Coast Guard ships and towers installed for oceanographic research not exceed \$82,500 for each ship or tower during the 10-year program.

Committee amendment to section 18

None.

SMITHSONIAN INSTITUTION, MUSEUM OF NATURAL HISTORY

Section 19 would authorize the Secretary of the Smithsonian Institution, in order to preserve, classify, and study marine, coastal, and Great Lakes organisms collected during the 10-year program of hydrobiological research, to—

1. Construct additional facilities for the purposes authorized in this section.

2. Establish a program for the recruitment, training, and placement of taxonomists in such number as may be required to classify fishes, marine invertebrates, and other marine organisms collected during the 10-year program.

3. Request and obtain cooperation from and cooperate with other Government departments and agencies having a direct interest in the preservation, study, and classification of marine organisms, and cooperate with the several States, educational institutions, laboratories, museums, and other public and private organizations and persons who may be of assistance in this field of marine science.

4. Make grants of funds to qualified scientists, institutions, laboratories, or museums, such grants to be used for taxonomy relating to marine organisms.

Committee amendments to section 19.

None.

SECTION 20

Section 20 would authorize appropriations in such sums as may be necessary to carry out the activities authorized in section 19.

GENERAL

Section 21 would provide:

Nothing in this Act shall operate to limit, restrict, or otherwise interfere with carrying out any work programed prior to enactment of this Act.

All appropriations authorized in the act shall be in addition to other appropriations provided for the various departments, agencies, bureaus, and offices to carry out their duties under law.

Agreements or grants executed pursuant to the authority contained in this act shall contain a provision that the Comptroller General of the United States or his duly authorized representative shall have the right to examine any directly pertinent books, documents, papers, and records of the grantee for a period of 3 years after the last payment to the grantee.

Secretaries of departments, and administrators of bureaus and offices authorized and directed to carry out provisions of the act, shall, after approval of the act by the President, include in their annual reports a report on major activities or programs undertaken under provisions of the act.

All ships and surface or subsurface craft constructed pursuant to the authorizations for appropriations contained in the act shall be constructed in domestic commercial facilities.

Committee amendments to section 21

Page 55, line 21, strike all of this subsection designated (c) and providing that—

All agreements for grants executed pursuant to the authority contained in this Act in excess of \$50,000 shall contain a provision that the Comptroller General of the United States or his duly authorized representatives shall have the right to examine any directly pertinent books, documents, papers, and records of the grantee relating to the purpose of the grant for a period of three years after the last payment to the grantee under the grant—

and insert in lieu thereof the following:

(c) The Comptroller General of the United States or his duly authorized representatives shall, until the expiration of three years after the last payment to such grantee or contractor, have access to and the right to examine any books, documents, papers, and records of any grantee, contractor or subcontractor engaged in the performance of any grant, contract, or subcontract executed for the purpose of carrying out the provisions of this Act, and a provision to that effect shall be included in each such agreement, contract, and related subcontract.

The amendatory language here was suggested to your committee by the Comptroller General.

Page 56, line 22, following the word "constructed" ending line 21 and before the word "pursuant" in line 22 insert the words "or modernized". This amendment refers to ships and surface or subsurface craft provided pursuant to provisions of this act.

Page 56, line 23, following the word "constructed" insert the words "or modernized". The purpose of this amendment, like that of the amendment above, is to assure that domestic commercial facilities be used in carrying out provisions of this act relating to authorization of research or survey ships.

AGENCY REPORTS

The reports of the agencies follow:

THE WHITE HOUSE,
Washington, March 29, 1961.

MY DEAR MR. PRESIDENT: The seas around us, as I pointed out in my message to the Congress on February 23, represent one of our most important resources. If vigorously developed, this resource can be a source of great benefit to the Nation and to all mankind.

But it will require concerted action, purposefully directed, with vision and ingenuity. It will require the combined efforts of our scientists and institutions, both public and private, and the coordinated efforts of many Federal agencies. It will involve substantial investments in the early years for the construction and operation of ship and shore facilities for research and surveys, the development of new instruments for charting the seas and gathering data, and the training of new scientific manpower.

We are just at the threshold of our knowledge of the oceans. Already their military importance, their potential use for weather predictions, for food and for minerals are evident. Further research will undoubtedly disclose additional uses.

Knowledge of the oceans is more than a matter of curiosity. Our very survival may hinge upon it. Although understanding of our marine environment and maps of the ocean floor would afford to our military forces a demonstrable advantage, we have thus far neglected oceanography. We do not have adequate charts of more than 1 or 2 percent of the oceans.

The seas also offer a wealth of nutritional resources. They already are a principal source of protein. They can provide many times the current food supply if we but learn how to garner and husband this self-renewing larder. To meet the vast needs of an expanding population, the bounty of the sea must be made more available. Within two decades, our own Nation will require over a million more tons of seafood than we now harvest.

Mineral resources on land will ultimately reach their limits. But the oceans hold untapped sources of such basic minerals as salt, potassium, and magnesium in virtually limitless quantities. We will be able to extract additional elements from sea water, such as manganese, nickel, cobalt, and other elements known to abound on the ocean floor, as soon as the processes are developed to make it economically feasible.

To predict, and perhaps someday to control, changes in weather and climate is of the utmost importance to man everywhere. These changes are controlled to a large and yet unknown extent by what happens in the ocean. Ocean and atmosphere work together in a still mysterious way to determine our climate. Additional research is necessary to identify the factors in this interplay.

These are some of the reasons which compel us to embark upon a national effort in oceanography. I am therefore requesting funds for 1962 which will nearly double our Government's investment over 1961, and which will provide \$23 million more for oceanography than what was recommended in the 1962 budget submitted earlier. A summary and comparison of the 1960, 1961, and 1962 budgets is contained in two tables which are enclosed with this letter.

1. Ship construction

The proposed program for 1962 includes \$37 million for ship construction, an increase of \$23 million over 1961. This will provide for 10 oceanographic vessels. Only two will replace existing ships. The others will be used to meet needs that have long existed in Federal agencies and other oceanographic institutions conducting research for the Government.

The present U.S. oceanographic fleet is composed of 27 research ships and 17 survey vessels. All but two were constructed prior to the end of World War II; many are over 30 years old. Only two of the ships were designed specifically for research purposes; the remainder has been converted from a variety of ships designed for other uses. Thus, the success of the national oceanographic program will depend heavily on the construction of the new specially designed vessels proposed for 1962.

2. Shore facilities and data center

Shore facilities are urgently required to provide laboratory space for analysis and interpretation of data and to train new oceanographers.

In oceanographic research about five scientists and technicians are required ashore for each scientist aboard ship.

For 1962, \$10 million is being requested for laboratories and wharf-side facilities. This represents a fivefold increase over 1961. It includes, for example, funds for a new Bureau of Commercial Fisheries laboratory to replace a 40-year-old structure and additional laboratory space at universities and other oceanographic institutions.

An essential part of the Shore Establishment is the new National Oceanographic Data Center which will begin its first full year of operation in 1962. This center will make available to the scientific community oceanographic data collected throughout the world.

3. Basic and applied research

The conduct of research is the central purpose of our whole national effort in oceanography. New ships and shore facilities are essential tools of scientific research, but it is the research itself that will yield new knowledge of the earth's "inner space," and new uses of the sea. The proposed program includes \$41 million for basic and applied research in oceanography. This is an increase of \$9 million over the 1961 level.

Basic research is the cornerstone on which the successful use of the seas must rest. Progress here is largely dependent on the work of scientists at many universities and laboratories throughout the United States and on ships at sea. Their investigations cover all aspects of the marine environment, the motion and composition of ocean waters, the evolution and distribution of marine plants and animals, the shape and composition of the ocean bottom, and many other geophysical

and biological problems. Of timely significance is the attempt to penetrate to the earth's mantle to better our understanding of the origin and history of our planet. This undertaking, known as Project Mohole, involves the development of new drilling methods that can be used in the deep seas. This project has recently resulted in a spectacular achievement. Samples from nearby a thousand feet beneath the sea floor were obtained by drilling in 3,000 feet of water.

Considerable attention will also be given to applied problems in the marine sciences. Oceanographers will be studying such problems as sound propagation in water, the effects of changes in ocean conditions on the movement of ships, weather forecasting, and fisheries management. Methods of predicting changes in ocean conditions also are being developed. Eventually they may lead to maps of "weather within the sea" much like the atmospheric weather maps of today.

Many advances are being made in methods of exploring the seas. Oceanographers are now able to descend to the great depths in bathyscaphes. New electronic equipment will allow them to probe the ocean and to "see" with sound pulses what before has been opaque. Using these new techniques, our scientists already have discovered vast currents below the ocean surface a thousand times larger than the flow of the Mississippi.

4. Training of oceanographers

The most important part of our long-range program in oceanography is the training of young scientists. Scientific manpower of every sort will be needed—technicians, college graduates, and post-graduate researchers—and they must be trained in many scientific disciplines. This training should go hand in hand with the conduct of research at universities and other oceanographic institutions. By their support of these institutions, the programs of the national Science Foundation, the Office of Naval Research, and the Department of Health, Education, and Welfare will be of major importance to an expanding program in oceanography; for they can result in the education of new young scientists as well as in the production of new knowledge. In the coming year, these agencies are undertaking to increase the number of fellowship awards and graduate student research contracts, and they also will encourage the development of new university programs in oceanography.

5: Ocean surveys

Worldwide surveys of the oceans—their properties, their contents, and boundaries—are needed to make charts and maps for use of scientists in their research programs and for a variety of commercial and defense applications. The U.S. ocean survey program for fiscal year 1962 is being increased within the limits of ships available for this purpose. I am requesting additional funds to allow the Coast and Geodetic Survey to extend the operating season of its existing ships, thus making the maximum use of limited ship resources. As already mentioned, funds are included for a new survey ship which will increase our deep-sea survey capability.

6. *International cooperation*

Oceanography is a natural area of opportunity for extensive international cooperation. Indeed, systematic surveys and research in all the oceans of the world represent tasks of such formidable magnitude that international sharing of the work is a necessity.

Our present maps of the oceans are comparable in accuracy and detail to maps of the land areas of the earth in the early part of the 18th century. Precise methods of measuring ocean depths have become available during the last 10 years, and these, when combined with new developments in navigation, should make possible for the first time modern maps of the topography of the entire sea floor. An accurate mapping of the oceans will require international cooperation in ship operations and in establishing a worldwide system of navigation. In these endeavors the United States can play a leading part.

This year an Intergovernmental Oceanographic Commission is being established under UNESCO to provide a means whereby interested countries can cooperate in research and in making surveys and maps of the deep sea floor, the ocean waters, and their contained organisms. Membership on the Commission is open to all countries of the U.N. family that desire to cooperate in oceanography. The United States intends to participate fully in the activities of the Commission.

The United States also will participate in the International Indian Ocean Expedition. Many nations, including the Soviet Union, are cooperating in this expedition under the nongovernmental sponsorship of the International Council of Scientific Unions. Over a quarter of the world's people live in the countries surrounding the Indian Ocean. If more can be learned of the Indian Ocean's extensive food resources, these nations can be helped to develop and expand their fishing industries as part of their general economic development.

7. *The Coast Guard*

At present, the Coast Guard enabling legislation limits the extent to which the Coast Guard can engage in scientific research. Only the International Ice Patrol is authorized to make such studies. I recommend that the statutory limitations restricting the participation by the Coast Guard in oceanographic research be removed. With ocean weather stations, deep sea thermometers, and other data collection devices, our Coast Guard can make a valuable contribution to the oceanographic program.

CONCLUSION

Knowledge and understanding of the oceans promise to assume greater and greater importance in the future. This is not a 1-year program—or even a 10-year program. It is the first step in a continuing effort to acquire and apply the information about a part of our world that will ultimately determine conditions of life in the rest of the world. The opportunities are there. A vigorous program will capture those opportunities.

Sincerely,

JOHN F. KENNEDY.

HON. LYNDON B. JOHNSON,
*President of the U.S. Senate,
Washington, D.C.*

COMPTROLLER GENERAL OF THE UNITED STATES,
Washington, May 11, 1961.

B-140845

HON. WARREN G. MAGNUSON,
*Chairman, Committee on Commerce,
U.S. Senate.*

DEAR MR. CHAIRMAN: Further reference is made to your letter of February 13, 1961, acknowledged on February 14, requesting the comments of the General Accounting Office concerning S. 901, 87th Congress, 1st session, entitled "A bill to advance the marine sciences, to establish a comprehensive ten-year program of oceanographic research and surveys, to promote commerce and navigation, to secure the national defense, to expand ocean, coastal, and Great Lakes resources, to authorize the construction of research and survey ships and laboratory facilities, to expedite oceanographic instrumentation, to assure systematic studies of effects of radioactive materials in marine environments, to enhance the public health and general welfare, and for other purposes."

The general purpose of S. 901 is a matter of policy for the determination of the Congress. However, in the consideration of the bill, we recommend the following corrections and clarifications:

We believe that because of the number of agencies and the amount of funds involved in carrying out the purposes of the bill, it might be well to consider the vesting of specific authority for controlling and coordinating the oceanographic programs of the several agencies in one organization to prevent duplication of effort and to assure the most effective and economical operation of the program.

Section 8(a) of the proposed legislation authorizes appropriations to the Coast and Geodetic Survey as are necessary for the construction of eight survey ships. The Coast and Geodetic Survey has requested funds in the amount of \$9,425,000 to be appropriated in fiscal year 1962 for one oceanographic surveying vessel under its existing ship construction legislation (33 U.S.C. 883i). The Bureau has also proposed in its 1962 budget justifications a program for construction of seven additional oceanographic ships and it expects to request the necessary funds during fiscal years 1963 through 1965. It is not clear whether the eight ships required to be constructed by section 8(a) of the bill are the same as or in addition to the eight ships included in the Coast and Geodetic Survey's proposed oceanographic program.

Section 8(b) does not place any limitation on the cost of operating new Coast and Geodetic Survey ships, while a 10-year limitation is imposed on the National Science Foundation by section 4(b) and annual limitations are imposed on the Bureau of Commercial Fisheries by section 6(b) and on the Navy by section 14. We recommend clarification on this point.

Section 8(i) imposes a qualification that any person receiving training or education at the expense of the Department of Commerce must agree to continue employment in the Department for a period of not less than 3 years for each year of training received. However, the bill does not contain a similar qualification for training and educational programs of other agencies. In view thereof, and since we are unable to ascertain whether such a limitation was intended for other agencies, we recommend that this phase of the matter be clarified.

By making oceanographic research one of the primary duties of the Coast Guard, under this bill, it appears that under the authority of 14 U.S.C. 92(d) the Secretary of the Treasury could then construct vessels for the exclusive purpose of oceanographic research. It is not clear, however, whether the Coast Guard was intended to have this additional ship construction authority since the bill would place a monetary limitation on the amount of scientific equipment that may be installed on each Coast Guard vessel assigned oceanographic research duties. Accordingly, we recommend that the bill clearly indicate whether this additional ship construction authority is intended to be granted to the Coast Guard.

Since section 10(d) does not appear to be related to the appropriations referred to in the preceding paragraphs of this section, we suggest that section 10(d) be redesignated as section 9(e).

On page 34, line 4, the bill reads "(a) Provide funds, by contract or otherwise * * *." We believe the word "grant" should be substituted for "otherwise" because this would make the provision more specific and would conform with the wording on line 23 of page 34 and in the general provisions on line 9 of page 54.

We suggest that the term "operating costs" on page 39, line 17, be clarified to indicate the actual costs intended to be included. We have been advised informally by the Department of the Navy that they overlooked this provision in their review of the prior bill and that careful consideration would be given thereto in their study of the present bill. We observe that operating costs of ships are also referred to in various other sections of the bill without indication of the costs intended to be included; e.g., line 23, page 8; lines 15 and 17, page 15; and line 10, page 24.

The general provisions on page 54 provide in section 21(c) that all agreements for grants in excess of \$50,000 shall contain a provision that the General Accounting Office shall have the right to examine the pertinent records of the grantee relating to the grant. While this provision is in accord with our recommendation of November 17, 1959, to your committee concerning S. 2692, 86th Congress, we now believe that it would be more desirable not to place a monetary limit upon our authority with respect to the review of such grants. Furthermore, in addition to grants, it is observed that the bill also contains authority for entering into contracts with qualified scientists, research laboratories, research organizations, or educational institutions to undertake basic and applied research studies and experiments in furtherance of the purposes of the act. In view thereof, we recommend that section 21(c) of the bill be amended to read as follows:

"(c) The Comptroller General of the United States or his duly authorized representatives shall, until the expiration of three years after the last payment to such grantee or contractor, have access to and the right to examine any books, documents, papers, and records of any grantee, contractor, or subcontractor engaged in the performance of any grant, contract, or subcontract executed for the purpose of carrying out the provisions of this Act, and a provision to that effect shall be included in each such grant agreement, contract, and related subcontracts."

The reference in line 16, page 20 of the bill, to "The Act of June 12, 1895," should read "The Act of January 12, 1895," and the sentence beginning on line 6, page 48, is incomplete, and apparently the phrase "to carry out" should be inserted on line 8 of the same page.

The bill contemplates that a considerable amount of basic and applied research will be done. Therefore, since it appears that these costs will be financed in whole or in part by grants, contracts, or otherwise, and that patentable discoveries may be expected to result from such research, we suggest that the committee may wish to consider the advisability of providing a policy statement concerning such patentable discoveries, i.e., whether or not patent rights are to vest in the Government.

Since the phrase "oceanographic research" appearing in line 18 of page 46 of the bill appears not to be properly applicable in the first sentence of section 81, title 14 of the United States Code, following the word "aircraft," we recommend clarification with respect to the intended use of this phrase. We also suggest a clarification of the amending language indicated in line 1, page 47 of the bill, to be added to the foregoing section 81, so as to indicate whether the items mentioned therein are intended to constitute aids to navigation.

Sincerely yours,

JOSEPH CAMPBELL,
Comptroller General of the United States.

DEPARTMENT OF STATE,
Washington, D.C., April 4, 1961.

HON. WARREN G. MAGNUSON,
U.S. Senate.

DEAR SENATOR MAGNUSON: In your letter to the Secretary of February 13, 1961, you asked for comments concerning S. 901, 87th Congress, 1st session, introduced by you.

International cooperation has always been a factor in oceanography and marine biological studies. Throughout the history of the United States the Department of State has had and will continue to have an interest in securing the cooperation of other countries for expeditions and surveys in international and territorial waters. These expeditions may be of private origin, they may be undertaken by Federal agencies, by individual States or they may be a combination of both.

The United States provides substantial encouragement and support to international organizations having science programs. They can include nongovernmental agencies such as the International Council for the Exploration of the Sea, the International Association of Physical Oceanography, the International Council of Scientific Unions, as well as intergovernmental organizations of which the United States is a member, such as the International Atomic Energy Agency, the World Meteorological Organization, and the Food and Agricultural Organization. It is desirable both for foreign relations and for the advancement of knowledge which will be of benefit to mankind that the U.S. efforts in marine science be strengthened. Such strengthening will be achieved by adoption of the expanded national program in oceanography recommended by the President in his recent messages to the Senate and House.

The Bureau of the Budget advises that, from the standpoint of the administration's program, there is no objection to the presentation of this report for the consideration of the committee.

Sincerely yours,

BROOKS HAYS,
Assistant Secretary
(For the Secretary of State).

THE SECRETARY OF THE TREASURY,
Washington, April 14, 1961.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Interstate and Foreign Commerce,
U.S. Senate, Washington, D.C.

MY DEAR MR. CHAIRMAN: Reference is made to your^d request for the views of this Department on S. 901, to establish a program of oceanographic research.

The Coast Guard presently has limited authority in the field of oceanography, such as providing meteorological services from floating ocean stations and studying ice and current conditions in the North Atlantic Ocean (14 U.S.C. 90; 46 U.S.C. 738a(a)). Under its limited authority, the Coast Guard has been conducting oceanographic work on its eastern seaboard lightships and has been taking soundings and bathythermograph readings.

The President, in his letter to the President of the Senate dated March 29, 1961, relating to a national oceanographic program, recommended that statutory limitations restricting participation by the Coast Guard in oceanographic research be removed. The Coast Guard, with its fleet of vessels and other units, is particularly well adapted to assist in this scientific endeavor. General statutory sanction to conduct and engage in oceanographic programs would make possible a greater contribution by the Coast Guard in that activity.

There is also pending before your committee S. 1189, which is designed to give the Coast Guard such general authority to conduct oceanographic research. The Department has submitted a report on that bill which recommended its enactment with certain amendments. Favorable consideration of that proposal would provide the Coast Guard adequate authority in the oceanographic field, and the enactment of S. 901 is considered unnecessary.

The Bureau of the Budget has advised that there is no objection to the submission of this report from the standpoint of the administration's program.

Very truly yours,

A. GILMORE FLUES,
Acting Secretary of the Treasury.

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF CIVIL AND DEFENSE MOBILIZATION,
Washington, D.C., April 4, 1961.

HON. WARREN G. MAGNUSON,
*Chairman, Committee on Interstate and Foreign Commerce,
U.S. Senate, Washington, D.C.*

DEAR MR. CHAIRMAN: This is in reply to your request for a report on S. 901, 87th Congress, a bill which would be called the Marine Science and Research Act of 1961.

While we favor expanded efforts in the field of oceanography, the enactment of legislation to accomplish this purpose would appear to be unnecessary in view of the coordinated and intensified national program for oceanography recommended by the President in recent messages to the Senate and the House.

The Bureau of the Budget advises that it has no objection to the submission of this report from the standpoint of the administration's program.

Sincerely,

FRANK B. ELLIS, *Director.*

NATIONAL SCIENCE FOUNDATION,
OFFICE OF THE DIRECTOR,
Washington, D.C., April 27, 1961.

HON. WARREN G. MAGNUSON,
*Chairman, Committee on Interstate and Foreign Commerce,
U.S. Senate, Washington, D.C.*

MY DEAR SENATOR MAGNUSON: This is in further reply to your recent request for the comments of the National Science Foundation on S. 901, the Marine Sciences and Research Act of 1961.

We are in complete accord with the objective of S. 901 which is aimed at assuring that the United States has a strong national oceanographic program. In this connection, as you know, the President, on March 29, 1961, transmitted to the Congress his recommendations with respect to the appropriation of funds for fiscal year 1962 to carry on the Federal effort in oceanography. The total amount requested for all Federal agencies is approximately \$97.5 million. Of this amount, nearly \$20 million is for the programs of the National Science Foundation. We believe that if the amounts requested by the President for the foundation for fiscal year 1962 for support of oceanographic research activities are provided by the Congress, they will enable the Federal Government to continue to strengthen its oceanographic research activities in a sound manner.

With respect to the National Science Foundation, in addition to authorization of appropriations, S. 901 would direct the establishment of a Division of Marine Sciences in the foundation, with a divisional committee consisting of representatives of various of the Federal agencies engaged in oceanographic research activities, together with six non-Federal scientists designated by the National Academy of Sciences-National Research Council. When the National Science Foundation was established, the Congress wisely provided for divisions concerned with general branches of science as, for example, the mathematical, physical, and engineering sciences and the biological

and medical sciences. After careful consideration of the matter, we have concluded that establishment of divisions on the basis suggested in the bill would not be as sound an arrangement and could lead to distortion and overlap in administration. Then too, there would seem to be equally appropriate reasons for establishing other divisions in the foundation for particular scientific disciplines which could lead to further organizational difficulties. At present, the foundation is supporting oceanographic research activities through its existing divisions among which there is extremely close cooperation and coordination. To aid in carrying out these responsibilities, the foundation has a full-time oceanographer on its staff as well as a special consultant on a full-time basis in the field of biological oceanography. Our organizational arrangements for handling cross-disciplinary fields such as oceanography is a matter to which we are paying close attention, however, and we will not hesitate to change them as circumstances warrant.

One of the primary objectives of S. 901 is to assure that there is a continuing national policy and program for carrying out the Nation's oceanographic effort. Coordination of the activities of the Federal agencies in this area is presently the responsibility of the Federal Council for Science and Technology, whose Chairman is the Special Assistant to the President for Science and Technology. It is, of course, important, in the carrying out of the national program, that full information be available with respect to the status of the national effort, both public and private, and the needs in particular areas of this endeavor. The National Science Foundation, in carrying on its support of basic research in oceanography and related needs, keeps in close touch with oceanographic research activities throughout the world. In this connection, we are planning to issue, at appropriate intervals, reports on the status of oceanographic research together with assessments, as appropriate, of national needs in this area.

We are deeply mindful of the importance of oceanographic research to the national welfare and are prepared to cooperate in any way possible to assure that the oceanographic effort of the United States is second to none.

The Bureau of the Budget has advised us it has no objection to the submission of this report.

Sincerely yours,

ALAN T. WATERMAN, *Director.*

DEPARTMENT OF THE NAVY,
OFFICE OF THE SECRETARY,
OFFICE OF LEGISLATIVE AFFAIRS,
Washington, D.C., May 26, 1961.

HON. WARREN G. MAGNUSON,
*Chairman, Committee on Commerce,
U.S. Senate, Washington, D.C.*

MY DEAR MR. CHAIRMAN: Your request for comment on S. 901, a bill to advance the marine sciences, to establish a comprehensive 10-year program of oceanographic research and surveys, to promote commerce and navigation, to secure the national defense, to expand ocean, coastal, and Great Lakes resources, to authorize the construction of

research and survey ships and laboratory facilities, to expedite oceanographic instrumentation, to assure systematic studies of effects of radioactive materials in marine environments, to enhance the public health and general welfare, and for other purposes, has been assigned to this Department by the Secretary of Defense for the preparation of a report thereon expressing the views of the Department of Defense.

The purpose of the proposed bill is as stated in the title.

The Department of Defense subscribes to the objectives of this bill and indeed recognizes the salutary effect which congressional inquiry into the state of the marine sciences has in this area by its emphasis on oceanography as a program required in the national interest. The Department, however, is opposed to the enactment of S. 901 for reasons stated in the subsequent paragraphs.

The bill proposes to establish a Division of Marine Sciences in the National Science Foundation in which an interagency committee would be formed to develop and encourage a continuing national policy and program for the promotion of the marine sciences. There is already in existence an Interagency Committee on Oceanography, established in January 1960 by the Federal Council for Science and Technology in recognition of the fact that oceanography is, indeed, an area which requires emphasis and support at the highest level. The Interagency Committee on Oceanography has effectively provided the coordinating mechanism among Government agencies engaged in oceanographic activities for the development of a meaningful national program. Its mission is similar to that which the bill proposes for the National Science Foundation division and includes, additionally, the very vital function of coordinated budget planning so as to recommend to the Council the level of funding required each year to support the program. Basically, the Interagency Committee on Oceanography develops an annual program incorporating its best judgment as to balance and emphasis in terms of both long-range scientific needs, requirements of Government agencies, and fiscal resources.

The membership of the Committee comprises those Federal agencies which have the major interests in Federal oceanographic programs. Its working panels, organized to consider each of the areas highlighted in the bill, include members from all of the Federal agencies engaged in the marine sciences. In addition, the scientific community is represented both within the Committee and in its several panels by the National Academy of Sciences.

In his letter to the Presiding Officers of the Senate and House on March 29, the President of the United States recommended a \$97 million fiscal year 1962 national oceanographic program. The Interagency Committee on Oceanography served as the focus for the formulation of this program. This program provides a substantial growth over the \$55 million level of effort in fiscal year 1961.

Those aspects of S. 901 which relate to the specific delineation of development items, shipbuilding tonnages, and money authorizations emphasize areas which will see many modifications over the years. Such specific delineation may, in fact, be restrictive to a program which fundamentally should be sufficiently flexible to accommodate program reorientation resulting from changes in agency requirements and technological advances as they occur and appear unwarranted.

As indicated by the President in his March 29, 1961, letter to the presiding officers of the Senate and House of Representatives, the most important part of the Nation's long-range program in oceanography is the training of young scientists. It is becoming apparent that the fundamental problem here is not only the ability of the marine sciences to attract adherents among students, but the ability of the educational institutions to accept, within their present facilities, the necessary enrollment to sustain the growth of the national oceanographic program. The Department believes that it is necessary to explore the oceanographic facility needs of the educational institutions and determine possible methods to provide for necessary expansion.

This report has been coordinated within the Department of Defense in accordance with procedures prescribed by the Secretary of Defense.

The Bureau of the Budget advises that, from the standpoint of the administration's program, there is no objection to the presentation of this report for the consideration of the committee.

For the Secretary of the Navy.

Sincerely yours,

ROBERT E. M. WARD,
Rear Admiral, U.S. Navy,
Chief of Legislative Affairs.

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., April 24, 1961.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Interstate and Foreign Commerce,
U.S. Senate, Washington, D.C.

DEAR SENATOR MAGNUSON: Your committee has requested a report on S. 901, a bill to advance the marine sciences, to establish a comprehensive 10-year program of oceanographic research and surveys, to promote commerce and navigation, to secure the national defense, to expand ocean, coastal, and Great Lakes resources, to authorize the construction of research and survey ships and laboratory facilities, to expedite oceanographic instrumentation, to assure systematic studies of effects of radioactive materials in marine environments, to enhance the public health and general welfare, and for other purposes.

We concur in the general object of this bill; however, notwithstanding our considerable interest in oceanographic research, we recommend that no action be taken on this bill for two principal reasons hereafter stated.

First, as stated in our report of May 16, 1960, to your committee, concerning S. 2692 of the 86th Congress, this Department is already engaged in carrying out certain types of oceanographic research. Our report stated also that while this Department concurred in the objectives of such proposal, we have authority to carry out such research and did not believe enactment of the proposed legislation was necessary. We believe the enactment of S. 901 is unnecessary also for the same reasons and might inhibit the flexibility of oceanographic research programs.

Secondly, a coordinated and intensified national program for oceanography has been recommended by the President in his recent mes-

sages to the Senate and House. We believe that, if adopted, this program would provide a balanced and effective use of overall resources available for oceanography.

For the foregoing reasons, we believe that action on S. 901 would be unnecessary at present. We wish to emphasize, however, our great interest in the subject of oceanography and our desire that this form of research proceed efficiently and advantageously in the national interest. Four bureaus of this Department, our Bureau of Commercial Fisheries, our Bureau of Sport Fisheries and Wildlife, our Bureau of Mines, and the Geological Survey are directly concerned with the field of oceanography. We are prepared to contribute our share, to the extent that funds may be appropriated, toward accomplishment of the general objective of oceanographic research.

The Bureau of the Budget has advised that there is no objection to the presentation of this report from the standpoint of the administration's program.

Sincerely yours,

JOHN W. KELLY,
Assistant Secretary of the Interior.

THE SECRETARY OF COMMERCE,
Washington, D.C., May 5, 1961.

HON. WARREN G. MAGNUSON,
*Chairman, Committee on Commerce,
U.S. Senate, Washington, D.C.*

DEAR MR. CHAIRMAN: This is in response to your letter of February 13, 1961, requesting the views of this Department on S. 901, a bill to advance the marine sciences, to establish a comprehensive 10-year program of oceanographic research and surveys, to promote commerce and navigation, to secure the national defense, to expand ocean, coastal, and Great Lakes resources, to authorize the construction of research and survey ships and laboratory facilities, to expedite oceanographic instrumentation, to assure systematic studies of effects of radioactive materials in marine environments, to enhance the public health and general welfare, and for other purposes.

As indicated in its title, the purpose of the bill is to provide for a coordinated, long-range program of oceanographic research and marine surveys. The bill appears designed to implement the report of the Committee on Oceanography of the National Academy of Sciences, entitled "Oceanography 1960 to 1970."

In the 2 years that have elapsed since the release of that report in 1959, the executive branch has substantially expanded its efforts in the field of oceanography in a variety of ways, many of which took into account the recommendations made in the Academy's report. These efforts would be further intensified under the coordinated national program for oceanography recommended by the President in his recent message to the Congress providing for a balanced and flexible use of overall resources available for oceanography. For example, the President's recommendations for fiscal year 1962 contemplate a virtual doubling of the fiscal year 1961 program.

This Department has accomplished much in the field of oceanography in recent years. Highlights of accomplishments in the Coast and Geodetic Survey since issuance of the Academy report on oceanography would include a 3-months oceanographic expedition by the ship *Explorer*; assignment of the ship *Pioneer* to exclusive deep sea oceanographic investigations; expansion of oceanographic observations by other ships within the framework of their regular operations. Several ships have been outfitted with special oceanographic equipment.

The level of oceanographic operations in the Coast and Geodetic Survey has progressed from an expenditure of \$6 million in fiscal year 1960 to \$11 million in fiscal year 1961. Moreover, \$14 million was originally proposed for fiscal year 1962, to which President Kennedy's program added \$10 million for a total of \$24 million a fourfold increase over 1960. A considerable portion of these increases has been allocated to ship construction; \$2 million in 1960, \$5 million in 1961, and \$17 million in 1962. The additional funds requested for fiscal year 1962 include \$9 million for construction of a 3,000-ton ship designed specifically for oceanographic operations on the high seas. It will be the first ship of this size to be built by the United States for that specific purpose. Furthermore, under the President's proposed 1962 budget, the Coast and Geodetic Survey, in addition to the large oceanographic ship, will be authorized to replace two smaller obsolete vessels. The Survey will also greatly expand its work in research and development of oceanographic research instrumentation. Funds are also included for additional oceanographers and for extending the working season of the four major ships in the Survey fleet. Extension of the season will be equivalent to the addition of nearly one ship-year of oceanographic work using existing vessels.

The Weather Bureau's major effort in oceanographic research during the past few years has been directed to a better understanding and improved prediction of the coastal flooding produced by hurricanes and other severe storms over the oceans. Pilot studies needed for the sound development of several other air-sea interaction problems have been conducted. Under the President's program, the Weather Bureau would step up its oceanographic research studies on the interaction between the sea surface and atmosphere as it relates to the exchange of heat and momentum. This research would account for about 30 percent of funds allocated to the Bureau for research under the President's program. Additional studies planned to develop improved techniques for storm surge forecasting would account for some 30 percent of the increased funding under the President's program. Accelerated procurement of specialized instrumentation such as infrared radiation thermometers and automatic marine meteorological observing stations to support these studies would take another 30 percent of the increased funds of the Bureau.

This Department believes that it now has adequate statutory authority to support its present and proposed oceanographic activities. Furthermore, we believe that these activities are adequately coordinated with the oceanographic programs of other agencies by the Interagency Committee on Oceanography (ICO) under the Federal Council of Science and Technology.

For the foregoing reasons we believe that enactment of legislation in the nature of S. 901 is unnecessary at this time.

The Bureau of the Budget advises there is no objection to the submission of this report from the standpoint of the administration's program.

Sincerely yours,

EDWARD GUDEMAN,
Under Secretary of Commerce.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., May 11, 1961.

DEAR SENATOR MAGNUSON: The Atomic Energy Commission is pleased to have this opportunity to comment on S. 901, a bill to advance the marine sciences, to establish a comprehensive 10-year program of oceanographic research and surveys, and to achieve other worthwhile purposes relating to marine environments.

While the Commission is in accord with the purposes and intent of the proposed legislation, we believe enactment of the bill unnecessary. This opinion is based on our belief that the balanced and flexible overall national program of oceanography recommended by the President in his letter of March 29, 1961, to the President of the Senate will provide for the best use of resources available for oceanography in general and those available to the Commission in particular for discharging its responsibilities in the field of oceanography.

With respect to sections 9(c), 11, and 12 of the proposed legislation wherein certain studies and regulatory programs relating to radioactive waste disposal are authorized, the Atomic Energy Commission has, under the provisions of the Atomic Energy Act of 1954, as amended, authority and responsibility for both the research and regulating aspects of the spheres of activity covered by the aforementioned sections of this bill. Furthermore, in fulfilling these responsibilities, the Commission has put into effect an extensive regulatory and research and development program in this field which will extend beyond the 10-year limit contemplated by S. 901.

We have been advised by the Bureau of the Budget that there is no objection to the transmission of this report from the standpoint of the administration's program.

Sincerely yours,

JOHN S. GRAHAM,
Acting Chairman.

HON. WARREN G. MAGNUSON,
*Chairman, Committee on Interstate and Foreign Commerce,
U.S. Senate.*