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HEARING BEFORE THE COMMITTEE ON COMMERCE UNITED STATES SENATE NINETIETH CONGRESS

SECOND SESSION

ON

H.R. 13781

TO AMEND TITLE II OF THE MARINE RESOURCES AND
ENGINEERING DEVELOPMENT ACT OF 1966

JUNE 24, 1968

Serial No. 90-74

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HEARING

BEFORE THE

COMMITTEE ON COMMERCE

UNITED STATES SENATE

SEVENTH CONGRESS

COMMITTEE ON COMMERCE

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TO AMEND TITLE II OF THE MARINE RESOURCES AND ENGINEERING DEVELOPMENT ACT OF 1966

MONDAY, JUNE 24, 1968

U.S. SENATE,
COMMITTEE ON COMMERCE,
Washington, D.C.

The committee met at 10:25 in room 5110, New Senate Building, the Honorable Warren G. Magnuson, chairman of the committee, presiding.

Present: Senators Magnuson and Moss.

OPENING STATEMENT BY THE CHAIRMAN

The CHAIRMAN. The committee will come to order.

This morning the hearing involves the House bill, H.R. 13781, which amends title II of the Marine Resources and Engineering Act. The Chair has a very short statement. Title II is the National Sea Grant College and Program Act introduced in 1966 as separate legislation and passed by the Senate, and in the House attached to the Marine Science and Resource Act as title II, they embodied this legislation. The pending House bill proposes to amend the authorization of funds for the sea-grant college program. Senator Pell was going to be here as our first witness and speak on the proposed amendment, but he called me late last night and he has some matters that unavoidably detain him up in Rhode Island, but he will testify later on in the hearings.

Title II originally provided for an authorization not to exceed the sum of \$5 million for fiscal year June 30, 1967, and not to exceed \$15 million for the present fiscal year which ends on June 30 and for each subsequent fiscal year such sums as Congress might specifically authorize by law. The last clause means that if the sea-grant college program is to survive at all, it is imperative that there be an authorization for funding the program during the coming fiscal year, which is only a few days away. And the program would only barely survive under the authorization of H.R. 13781 now pending.

The record of funding for the Sea-Grant College Program Act is of course not very impressive. Instead of up to \$5 million authorized in fiscal 1967, there has been no appropriation at all. The National Science Foundation, which administers the program, did reprogram \$1 million of other funds in 1967 to start planning, but the money could not be used until fiscal 1968. Instead of the maximum \$15 million authorized in the Sea-Grant College Act for fiscal 1968, \$4 million was appropriated and \$1 million of funds reprogrammed the previous year was carried over to make it a total of \$5 million.

A rigid criteria has been set up and six institutions of higher education have received institutional sea-grant college grants. The University of Michigan along with these others and the University of Miami, have each received planning grants to assist in preparing for the sea-grant college program. Many other institutions of higher learning of course aspire to this status.

The Subcommittee on Oceanography of the House held hearings this year and proposed to authorize not to exceed \$18 million for fiscal 1969 and a like amount for fiscal 1970. Incidentally, during the hearings it was revealed the National Science Foundation has submitted to the Bureau of the Budget a request for the sum of \$15 million for the sea-grant program in fiscal 1969 and the Marine Resources Council had requested \$10 million. The Bureau of the Budget cut the request to \$6 million. The House subcommittee recommendation of \$18 million each for fiscal 1969 and 1970 went to the Standing Committee on Merchant Marine and Fisheries. Instead of the subcommittee's proposal the standing committee accepted the budget figure of \$6 million for fiscal 1969 which as I stated earlier would barely permit the sea-grant college program to survive. For fiscal 1970 they would authorize a little more, not to exceed \$8 million. It is a matter of some urgency that the hearing today is limited to the consideration of H.R. 13781.

We planned initially to take up S. 3144, which relates both to future funding of marine exploration, and new sources of funds to supplement the sea-grant college program. We will defer for the time being action on the Senate bill which in no event could provide further funding for the program in fiscal 1969. So the House bill is before the committee, unlike the Senate bill, and we don't think it can wait.

(A copy of the House bill and agency comments thereon follow:)

[H.R. 13781, 90th Cong., second sess.]

AN ACT To amend title II of the Marine Resources and Engineering Development Act of 1966

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That title II of the Marine Resources and Engineering Development Act of 1966 is amended as follows:

(1) Section 203(b) (1) of the Marine Resources and Engineering Development Act of 1966 is amended by inserting immediately after "for the fiscal year ending June 30, 1968, not to exceed the sum of \$15,000,000," the following: "for the fiscal year ending June 30, 1969, not to exceed the sum of \$6,000,000, for the fiscal year ending June 30, 1970, not to exceed the sum of \$8,000,000."

(2) Section 204(d) (1) of the Marine Resources and Engineering Development Act of 1966 is amended by deleting the phrase "in any fiscal year" each time it appears therein.

GENERAL COUNSEL OF THE DEPARTMENT OF COMMERCE,
Washington, D.C., April 15, 1968.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in further reply to your request for the views of this Department concerning H.R. 13781, an Act "To amend title II of the Marine Resources and Engineering Development Act of 1966."

H.R. 13781 would amend section 203 (b) (1) of title II of the Marine Resources and Engineering Development Act of 1966 to specifically authorize the appropriations of funds to the National Science Foundation for the Sea Grant Program for fiscal years 1969 and 1970. It would authorize \$6,000,000 for fiscal year 1969 and \$8,000,000 for fiscal year 1970. The Act presently authorizes, subsequent to fiscal year 1968, "only such sums as the Congress may hereafter specifically authorize by law." The amendment would retain this language subsequent to fiscal years

1969 and 1970. Additionally, the legislation would amend section 204(d) (1) to provide greater latitude in the percentage of total funds that can be granted to a particular institution in a given fiscal year.

The legislation would not have any immediate effect on the operations of the Department of Commerce. In the long run, however, all agencies concerned with oceanography and development of marine resources will benefit from the increased knowledge and increased number of technicians, scientists, and engineers that will result from the Sea Grant Program. Agencies within the Department that will benefit are the Environmental Science Services Administration and the Maritime Administration.

The Department favors the objectives of H.R. 13781. However, we would defer to the National Science Foundation as to the appropriate ceiling for the appropriations to be authorized.

We have been advised by the Bureau of the Budget that there would be no objection to the submission of our report to the Congress from the standpoint of the Administration's program.

Sincerely,

PEDRO R. VAZQUEZ,
(For General Counsel).

COMPTROLLER GENERAL OF THE UNITED STATES,
Washington, D.C., April 17, 1968.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: Your letter of April 3, 1968, requests our comments on H.R. 13781, 90th Congress, entitled: "An Act to amend title II of the Marine Resources and Engineering Development Act of 1966."

We have no special information as to the desirability of this measure and therefore make no comments regarding its merits.

Sincerely yours,

FRANK H. WEITZEL,
Assistant Comptroller General of the United States.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
April 26, 1968.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, U.S. Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: This letter is in response to your request of April 3, 1968, for a report on H.R. 13781, a bill "To amend title II of the Marine Resources and Engineering Development Act of 1966."

This bill would authorize appropriation of funds in fiscal years 1969 and 1970 to the National Science Foundation for the purpose of carrying out the provisions of title II of the Marine Resources and Engineering Development Act of 1966. It would also remove a limitation on funding by deleting "in any fiscal year" from Section 204(d) (1) of the Act.

This Department has no objection to the bill. However, we defer to the views of the National Science Foundation concerning the details of this proposed legislation.

We are advised by the Bureau of the Budget that there is no objection to the presentation of this report from the standpoint of the Administration's program.

Sincerely,

WILBUR J. COHEN,
Acting Secretary.

MAY 29, 1968.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, U.S. Senate,
Washington, D.C.

DEAR SENATOR: This is in response to your request for the views of the Department of Justice on H.R. 13781, an Act "To amend title II of the Marine Resources and Engineering Development Act of 1966."

Whether this legislation should be enacted involves questions as to which the Department of Justice makes no recommendation.

Sincerely,

WARREN CHRISTOPHER,
Deputy Attorney General.

The CHAIRMAN. The witnesses at today's hearing will be Dr. Leland J. Haworth, Director, National Science Foundation, accompanied by Robert Abel, head of the Office of Sea-Grant Program; Dr. Wenk, the executive secretary, National Council of Marine Resources and Engineering Development; and Dr. Joseph Henderson, director, Applied Research Laboratories, University of Washington, and a member of the Foundation's Sea-Grant Institutional Advisory Panel.

All right, Lee, we will be glad to hear from you.

STATEMENT OF DR. LELAND J. HAWORTH, DIRECTOR, NATIONAL SCIENCE FOUNDATION, ACCOMPANIED BY ROBERT B. ABEL, HEAD, OFFICE OF SEA-GRANT PROGRAM; AND WILLIAM JAY HOFF, GENERAL COUNSEL, NATIONAL SCIENCE FOUNDATION

Dr. HAWORTH. If I might, I would like to have Mr. Hoff with me as well as Mr. Abel.

The CHAIRMAN. All right.

Dr. HAWORTH. I have a statement that will take perhaps 15 minutes to read.

The CHAIRMAN. I am pleased, of course, to appear before you today to state the National Science Foundation's views on H.R. 13781. I might say that in the interest of brevity I have not included in my statement very much about the general aspects of the program. We are very strongly for it. We know that other witnesses will speak of its relationship to the total marine resources program of the country, particularly Dr. Wenk. So, I have confined my testimony more to the Foundation's program and what our views of that are.

As you have said, Mr. Chairman, this bill, as passed by the House, would amend title II of the Marine Resources and Engineering Act to provide a clarifying change in the wording of the cost-sharing requirements for the sea-grant program and would authorize for that program \$6 and \$8 million for fiscal years 1969 and 1970, respectively.

Let me say, first, that the second paragraph of the bill will remove a very awkward administrative disability in the program and we strongly favor it. Second, with respect to the financial provisions of the first paragraph, let me say immediately that we prefer open-ended authorizations for the sake of flexibility.

Now I would like to interject a brief paragraph or two about how we are handling the program in the sense of the types of grants. You have alluded to this, but I thought perhaps for the record it would be well to define them in a bit more detail. The act calls for the support of sea-grant colleges and of sea-grant programs. After a great deal of thought and after conferring with Members of the Congress who initiated the bill, we decided the best thing to do was to break the program into two parts, one of which would provide for what we call the institutional program and the other the project program. Each grant under the institutional program supports a broad range of activities covering at least two, and hopefully all three of the major activities defined in the act; namely, research, training, and information transfer.

We expect that the institutions given this sort of support will receive continuing support providing they do their job effectively. We also expect that after a period some of these that have been very effective may be designated as sea-grant colleges. None have been so designated as yet.

Project grants are more narrowly defined. Under these an institution works on some one type of activity; it may be a research project, it may be a training program; in principal there might be some that are solely information transfer projects, although we haven't had any proposals for such.

As you said, Mr. Chairman, the President's budget requests \$6 million for fiscal year 1969, \$1 million more than was available for the current year. I feel compelled to note, however, that, at the fiscal year 1969 appropriation level set by the House for the National Science Foundation, I shall probably be forced to reduce sea-grant funds to the fiscal year 1968 level.

A significant increase in funds will be necessary in fiscal year 1970 if the Foundation is to initiate programs and projects at additional institutions as well as support the essential continuity and some growth in ongoing activities.

One of the reasons for the concept of sea-grant colleges was that existing mechanisms for Federal support in marine resource development did not provide sufficient continuity. This was outlined during the hearings held in the Senate Special Subcommittee on Sea-Grant Colleges in May of 1966. The testimony of the witnesses and a report entered as part of the record by the National Committee for a Sea-Grant College, emphasized the need for continuing, broad-based support similar to the land-grant college concept. Consequently, the sea-grant institutional support program was developed for continuous support in education, research, and information transfer in marine science and research activities within the availability of appropriated funds.

In line with the clear intent of the program, the Foundation plans to provide institutional support on a continuing basis, and to allow reasonable growth, so long as the grantee is making substantial progress toward sea-grant goals.

We initiated six sea-grant institutional programs at six institutions in fiscal year 1968, and in addition, awarded small grants to two other major institutions for the support of planning activities prior to the submission of institutional proposals in fiscal year 1969. We may expect at least two and possibly as many as four meritorious institutional proposals from high quality institutions in the coming fiscal year, with about the same number of new institutional proposals in fiscal year 1970.

The question that immediately arises relates to the level of funding for these continuing institutional programs. In every case, initial funding was minimal. It enabled the institution to organize for sea-grant activities, and to get a limited number of projects underway. If the objectives of the National Sea-Grant College and Program Act as specified by the Congress are to be achieved, the institutional programs must be allowed to grow until maturity is reached and maintained. At a time of severe budget constraints, growth will necessarily be much slower than any of us would like, but some growth is neces-

sary if the enthusiasm, organization, and momentum of the institutional programs are to be maintained. The need for continuing support and at least some growth under the sea-grant institutional support program, therefore, forms the minimum base on which the sea-grant budget must be constructed.

For fiscal year 1969, we have budgeted \$3.3 million for continuation of institutional programs started in fiscal year 1968, and have tentatively allotted an additional million for new ones. Continued support of institutional programs in fiscal year 1970 is estimated at approximately \$5.5 million and we expect additional meritorious proposals, the acceptance of which would probably increase the total institutional program to more than \$7 million.

Institutional support is, of course, only a part of the sea-grant program. To some extent, institutional support has the possibility of obtaining early useful results, but this program essentially is directed at present primarily to building competence and excellence in terms of sea-grant objectives, and to creating regional capabilities that will be of great importance when the scope and direction of the total national program is better determined.

Sea-grant projects, on the other hand, are awarded for specific purposes, usually within a definite time frame. For example, we may support a marine technician training program for 2 years to help a school get started, or to expand its training capacity. At the end of 2 years, we expect that the program will be in full stride. Similarly, research projects may be funded for 1 or 2 years, and both we and the principal investigator hope that results can be achieved within the term of the grant.

Further, sea-grant project support is the principal means through which we can bring competence in the smaller institutions into the program. Projects enable inland schools to participate. They help us to carry out the intent of the Congress to make an appropriate geographic spread of sea-grant funds.

One class of sea-grant projects to which we give high priority, and which may call for continuing funding, is used for the support of institutions located in areas in which there are pressing problems or immediate opportunities. Such institutions develop multidisciplinary approaches to such opportunities as intensive aquaculture and management of salt water marshes, or the systems engineering of shellfish production. Through projects of this kind, the institutions make an immediate contribution while developing and improving their overall capacity for productive work in the marine environment.

During the next few years the opportunity for sea-grant project support is expected to be the relatively most rapidly growing aspect of the program as larger number of institutions become prepared to participate. Hence, the authorization for fiscal year 1970 should allow room for increasing the support for sea-grant projects significantly above the anticipated fiscal year 1969 level of a bit less than \$2 million.

In view of the requirements of a minimum of \$7 million for institutional support and several million dollars for sea-grant project support, there should be significant, though not entirely predictable, growth in fiscal year 1970. Failure to provide this would reduce the sea-grant project support program, and depending on the level, might require postponement of new institutional grants in fiscal year 1970.

For the sake of flexibility we would recommend an authorization without a specific dollar limitation.

We can, of course, tailor the program to any budget level. The principal question is one of the comparative advantages and disadvantages of postponing activities that are ready to begin. In a field where long leadtimes are necessary to produce results, particularly in the production of essential manpower and the development of criteria and methods for using and harvesting the oceans, undue postponement could put the Nation at a disadvantage. A decision in the next few years to launch a major national ocean effort could face the handicap of inadequate information on which to proceed, and insufficient manpower to carry out the national tasks.

Now, Mr. Chairman, with your permission, I should like to report to you on the status of the sea-grant program as fiscal year 1968 ends. As you know, late in fiscal year 1967 Congress authorized us to reprogram \$1 million of that year's funds into the sea-grant program, thus permitting us to announce the program. Our budget submission for fiscal year 1968 included \$4 million for the program. In spite of the effects of Public Law 90-218, which reduced the total funds available to us by a substantial amount, I was able to allocate the full \$5 million to the program this year. All but \$100 of this amount has been obligated on the projects and institutional grants described in an attachment to this statement, which I would like to submit for the record.

We have given institutional support for 1 year to Oregon State University, the University of Hawaii, the University of Rhode Island, Texas A. & M. University, the University of Wisconsin, and for 6 months to the University of Washington. We also have supported broad, multidisciplinary projects at Louisiana State University, and the University of Delaware.

Altogether, we have supported 27 sea-grant projects this year, ranging from artificial culture of shrimp and pompano to restoration of kelp beds, and including individual education and training projects. Although these 33 awards for project and institutional support combined were made out of a total of 160 proposals, this hardly tells the whole story of the interest engendered by the sea-grant program. We have had this year over 1,500 contacts with industry, universities, and State governments. Several hundred have expressed the desire to participate in the program in the future and are currently planning for this purpose; obviously we will be able to fund only a small fraction. In several institutions, coordinating divisions of marine resources have been established to make maximum effective use of talents and facilities scattered throughout universities, and departments not previously in communication have begun cooperative efforts. We have tried to bring individuals, Federal and State Government facilities, and private industrial interests into alliances which will exploit the resources of each, in the common cause. We remain responsive to industrial needs, and we encourage industrial affiliations with universities.

For purposes of administering the program, the Foundation has formed productive relationships with other Federal agencies, and with the academic and industrial communities on the outside. First of all, we have formed two advisory panels. About 50 persons participate in a proposal review panel for sea-grant projects. From this panel, the Foundation selects task teams of specialists to review individual proposals.

In addition, the Foundation has established a sea-grant institutional support panel consisting of nine eminent individuals from universities and industry across the country. Because of the wide competence of the members of this panel, the Foundation looks to them for general program guidance of a more specific nature than that provided by the National Council on Marine Resources and Engineering Development, as well as for evaluations of individual proposals for institutional support. I would like to submit listings of our panel participants for the record. This is attached to my written statement, Mr. Chairman.

We believe that we have approached successfully the critical interface problem between the sea-grant program and the mission-oriented Federal agencies. Many aspects of the sea-grant program are closely related to activities of other Federal agencies. We have established working contacts with representatives of those agencies to insure coordination, to avoid undesirable duplication of effort, and to give the sea-grant program the benefit of those departments' experience.

For example, within the Department of the Interior, a special sea-grant coordinating committee has been formed consisting of senior representatives of each of the agencies and bureaus in the Department. Each of the 10 members of that committee serves as the contact and coordinator for his agency on matters concerned with the sea-grant program. The committee chairman serves as our principal contact with the Department of the Interior. Our arrangements with other agencies and departments are somewhat similar, usually involving an individual acting as the point of contact for programs of mutual interest.

In conclusion, Mr. Chairman, I would like to emphasize five points:

First, from our experience during the past year, we have learned that the concept of the program alone has sparked cooperation among departments in schools and universities to a degree not accomplished in the past.

Second, the program is accelerating the progress of orientation for the study and development of the resources of the sea, not only among major institutions strong in marine science, but also among universities that have some capability and potential but do not yet have programs sufficiently broad or deep to qualify them for full institutional support.

Third, since the sea-grant program involves State governments and industries in cooperation with universities, it is producing alliances on a scale much broader than, although related to, the sea-grant program itself. Several of our large industries are exploring possibilities for alliances with academic institutions to pursue applied projects that will benefit both the academic and industrial communities and therefore, the national welfare.

Fourth, while the timing of sea-grant establishment was perhaps unfortunate in the sense of competition for funds with other high-priority national programs, in another sense, the timing has been excellent. Academic and industrial communities appear now to be in position to reap the benefits of the seeds of basic research which have been sown throughout the past decade. We believe ourselves to be almost at the point of demonstrating sea-grant ability to encourage large-scale, complex, and rewarding projects of real value to the Nation.

Fifth, as you can see from our grants lists, we have already given a practical demonstration of our program's conceptual promise of enriching the ranks of engineers and technicians to perform the useful work in the sea to which the national oceanographic program is dedicated.

Mr. Chairman, it is our view that this program is developing along very promising lines and can result in significant benefits to the Nation. I urge its continuation and enhancement.

(The attachments referred to follow:)

ADVISORY PANEL FOR SEA-GRANT INSTITUTIONAL SUPPORT

- Dr. Sanford S. Atwood, President, Emory University, Georgia
 Mr. Bernard Berman, President, The Bissett-Berman Corporation, California
 Dr. Douglas Brooks, President, Travelers Research Center, Connecticut
 Dr. John C. Calhoun, Jr., Vice Chancellor, Texas A&M, Texas
 Dr. Joseph Henderson, Director, Applied Physics Laboratory, Washington
 Dr. Chalmer G. Kirkbride, Vice President, Research and Engineering, Sun Oil Co., Pennsylvania
 Dr. David Potter, General Manager, Defense Research Laboratory, General Motors Corp., California
 Dr. Robert H. Roy, Dean, Engineering Science, Johns Hopkins University, Maryland
 Dr. Henry B. Steinbach, Director, Marine Biological Laboratory, Woods Hole, Massachusetts, and Professor, Department of Zoology, University of Chicago, Illinois

SEA-GRANT PROJECT CONSULTANTS

- Alexander, Ord—Consulting Engineer, Washington, D.C.
 Burkholder, Paul R.—Lamont Geophysical Observatory, Columbia Univ.
 Busser, John H.—American Institute of Biological Sciences.
 Cagle, Fred R.—Tulane University.
 Caldwell, Joseph M.—U.S. Corps of Engineers.
 Chapman, Wilbert M.—Ralston Purina Co.
 Christy, Francis T.—Resources for the Future.
 Collins, W. Leighton—American Society for Engineering Education.
 Crawford, T. Stephen—University of Rhode Island.
 Cronin, Lewis E.—University of Maryland.
 Crutchfield, James—University of Washington.
 Emerson, Haven—Oceans General, Inc.
 Fibel, Lewis R.—American Association of Junior Colleges.
 Fulling, Roger W.—E. I. duPont de Nemours & Co.
 Gilmore, G. Philip—General Dynamics Corp.
 Hood, Donald W.—University of Alaska.
 Isaacs, John D.—Scripps Institution of Oceanography.
 Jacobs, Paul M.—The Gorton Corporation.
 Johnson, Milton G.—U.S. Coast and Geodetic Survey.
 Kielhorn, William V.—Lockheed Aircraft Corp.
 Lyman, John—Consulting Oceanographer, Washington, D.C.
 Miller, H. Crane—Smithsonian Institution.
 Moore, Johnes K.—Salem State College (Massachusetts).
 Novak, Arthur—Louisiana State University.
 Padan, John W.—U.S. Bureau of Mines.
 Pomeroy, Lawrence—University of Georgia.
 Spangler, Miller B.—National Planning Association.
 Stephan, Edward C.—Ocean Systems, Inc.
 Timme, Richard C.—Interstate Electronics Corp.
 Torpey, William G.—Executive Office of the President.
 Vetter, Richard C.—National Academy of Sciences.
 Wallace, Elizabeth M.—Oyster Institute of North America.

Additional panelists have agreed to serve and are pending formal processing.

SEA-GRANT INSTITUTIONAL SUPPORT AWARDS FOR FISCAL YEAR 1968

Oregon State University—Dr. Herbert F. Frolander, \$553,000 for 1 year

Oregon State University will follow a plan that encompasses training, research, and advisory programs emphasizing marine food resources. A special feature of the plan is that OSU's Sea Grant activities will take place in several parts of the state, taking advantage of other institutions' capabilities.

Educational activities include both undergraduate and graduate education, as well as marine technician training program at Clatsop Community College in Astoria. Specific elements of the training program are planned in Marine Biology (Zoology), Marine Economics, Marine Fisheries, Marine Food Science, and Technology, Mineral Resources of the Oregon Continental Margin, Oceanography (Benthic and Pelagic Studies), Ocean Engineering, and Oceanographic Technician Training.

The research program includes several broad areas categorized as marine fisheries, aquaculture, seafood technology, mineral resources, marine economics, ocean engineering, and ocean law. The program in ocean law will be conducted by the University of Oregon School of Law at Eugene.

OSU is carrying out many activities such as development of Model Port Systems through which it is pioneering the programmatic approach to the systematic development and economic growth of seaport areas, that are in close accord with the aims of the Sea Grant College Program. The State has strongly supported these activities, and the legislature has already appropriated funds to match those supplied by the Sea Grant Program.

University of Rhode Island—Dr. John Knauss, \$477,200 for 1 year

The University of Rhode Island will conduct activities in education, research, and advisory services.

The planned Sea-Grant-related education program at present adequately funded from other sources will receive NSF support only for graduate research assistantships. It provides for marine-related education at the graduate level in ocean engineering, oceanography, and fisheries, as well as a two-year associate degree program in fisheries and marine technology to provide trained personnel for New England marine industries.

The research program covers five broad areas, Organic Extractables (food, drugs, etc.); Pollution; Ocean Engineering and System Analysis; Resource Development and Conservation; and Marine Economics.

An advisory services program (New England Marine Resources Information Program) has already been launched. Its basic functions are information storage and distribution, field work with the commercial sectors, and educational activities tailored to meet the needs of the marine industries.

University of Washington—Dr. Stanley Murphy, \$220,000 for 6 months

The University of Washington will conduct activities in education, research and advisory services.

The planned education program encompasses marine-related education in various aspects of fisheries management and technology at the graduate and undergraduate level.

The research has three principal parts: (1) A comprehensive marine acoustics program consisting of the application of acoustic techniques to marine resource location and classification; (2) Fisheries resource development and conservation; and (3) Projects within the newly created Division of Marine Resources directed toward development of equipment and methodologies required for the exploitation of the food, mineral, power, and living resources of the ocean.

An advisory services program features several workshops planned to identify regional and local problems and to determine approaches to their solutions.

University of Hawaii—Dr. Wytze Gorter, \$435,400 for 1 year

The University of Hawaii program encompasses ten separate disciplines divided into three groups; Biology and Related Fields, which includes fisheries, marine biology, agricultural (marine) economics, food science and technology, and botany; Oceanography and Related Fields, which includes oceanography, geo-sciences, and meteorology; and Engineering and Related Fields, which includes ocean engineering, physiology, and agronomy and soils.

The education part of the program calls for the development of graduate level refresher courses in oceanography, an ocean engineering curriculum to include a laboratory course, and an educational TV series in ocean engineering to serve

the student, the practical engineer and the public. It also plans to establish a distinguished lecturer series to be conducted by guest lecturers. A marine technician work-program is planned for the second year.

The advisory service activities in this program will be conducted through the Extension Service of Tropical Agriculture and the College of Central Studies, which conducts extension courses as well as special programs and conferences.

The research program includes fisheries, acquaintance, marine economics, food science and technology, marine minerals, precious coral growth, human physiology in the sea, and submarine soils.

University of Wisconsin—Dr. Robert Ragotzkie, \$376,000 for 1 year

The University of Wisconsin provides research, education, and advisory service in marine resource development. Although the education part of the program is broadly oriented, the research effort is directed toward regional problems associated with the Great Lakes. Educational improvements call for both graduate and undergraduate course development. New staff additions will be made to the College of Engineering to accommodate a planned M.S. program in ocean engineering. Special Ph.D. programs will be set up to combine social and marine sciences.

Included in the research program are several broad areas categorized as lake eutrophication, fisheries sciences, ocean engineering, lake shipping economics, mineral resources, utilization of trash fish (such as alewives) and the development of new interdisciplinary applications involving legal and socio-economic factors. Most of the field activities associated with these problem areas will be conducted in Lake Michigan in the vicinity of Green Bay, making optimum use of the planned concentration of facilities to be located there.

Under the advisory service activities, a section will be established in the Economic and Environmental Development Division of the University Extension to implement the Sea Grant Extension Program. Also, the staff of the University-Industry Research program at the University will be augmented to prepare appropriate publications and to provide liaison between the University research faculty and their industrial R&D counterparts engaged in marine resource related activities.

Texas A. & M. University—Dr. John C. Calhoun, \$475,000 for 1 year

Texas A&M will conduct activities to assist the University to coalesce its academic efforts into a more highly integrated program with respect to marine resources and Sea Grant objectives. Plans for the Sea Grant-related education program provide for graduate level curriculum development in ocean engineering at the College Station campus, and in marine biology at the Galveston Laboratory. In cooperation with staff members of the Marine Biology Laboratory, the Texas Maritime Academy, the James Connally Technical Institute, and the Galveston Junior College, Texas A&M will develop two curricula for a technician training program—Fisheries Technologist and Oceanographic Technologist. Effort will also be devoted toward bringing marine resources subject matter into graduate programs of many departments not now involved.

The research program covers Fishery Sciences, Marine Economics, Pollution, Coastal Economics, Pollution, Coastal Engineering, Aquaculture, and Seafood Technology. In addition to research in these categories, Texas A&M will initiate efforts in other academic disciplines to explore the application of their scientific and engineering principles to the resources of the sea.

The advisory services program will be directed toward projects to serve the marine community, which includes the fishing industry, port authorities, dredging companies, the shipping industry, the petroleum industry, and the chemical and refining industries. The first year activity will concentrate upon identification of the marine groups to be served and the methods that will be most appropriate.

SEA-GRANT PROJECT AWARDS FOR FISCAL YEAR 1968

MULTIDISCIPLINARY PROJECTS

Louisiana State University—Dr. Jack R. Van Lopik, \$198,000 for 1 year, "Utilization of Salt Water Marshes for Intensive Aquaculture"

Louisiana State University will conduct a coherent, multidisciplinary project for the utilization and management of salt water marshes, for intensive aquaculture, and for graduate student instruction in subjects related to the project.

Research will be centered in three water areas of differing salinities at Barataria Bay, where a concentrated effort will be made to determine all ecological factors of importance to marsh maintenance and productivity. All pertinent disciplines will be involved in the team approach. A related study will concern the ecology and taxonomy of higher marsh plants, and will provide a complete collection for research and instruction. Variations in ecological requirements of various plants will be used, through aerial photography, to determine the existence of differing kinds of substrates in the marshland. An initial approach to artificial cultivation of useful species will be taken through the culture of pompano and redfish in brackish water ponds, with determination of life cycles, food supply, predation and disease factors, growth rates, tolerances to various parameters. Anticipating ultimate use of the marshes for aquaculture, a legal study will begin examination of the Federal, State, and local legal structure as it relates to marsh utilization. Graduate students will be involved at both the masters and doctoral levels in all research activities. An initial effort in advisory and extension services will be a seminar on finfish culture during the summer of 1969. University personnel will be supplemented by specialists from the State Department of Wildlife and Fisheries, and will utilize State research facilities at Grand Isle and Rockefeller refuge. NSF funds will be used for support of faculty and researchers for equipment, materials, and travel to the research sites.

University of Delaware—Dr. Franklin C. Daiber, \$311,000 for 2 years, "Systems Engineering and Development of Commercially Valuable Marine Resources in the Delaware Area"

The University of Delaware will conduct a multi-disciplinary project to develop methods of systems engineering for growing and marketing shellfish. The Project will involve the culture and selective breeding of oysters under controlled conditions, including the biology of spawning, larval growth, setting of larvae, growth to harvestable size under economical and disease-free conditions, breeding for early maturity and good market qualities. Environmental control will be a key factor. In addition, the influence of climatic water balance on conditions in the estuary and their effects on shellfish will be investigated, and experiments will be conducted on potential means of opening live shellfish by mechanical, sonic, thermal or electrical methods. A program will be initiated for the training of extension agents to work with industry. Graduate students will participate in all aspects of the project, under the Departments of Biology, Agricultural Engineering, Civil Engineering and Geography, and under the Agriculture Extension Program.

EDUCATIONAL PROJECTS

American Society for Engineering Education—Stephen T. Crawford, \$11,700 for 6 months, "Conference on Ocean Engineering Education"

ASEE conducted a conference involving about 25 Deans of Engineering Colleges to examine the problems of curriculum and course development in ocean engineering. The Conference was held in San Diego June 20–22, 1968, following the ASEE annual meeting in Los Angeles. The Conference was conducted by the Ocean Engineering Committee of ASEE. Because the great majority of engineering deans, including those interested in ocean engineering programs, have never been exposed to the marine environment, ASEE included an indoctrination program of a visit to San Diego laboratories and a short voyage on a Scripps ship. Qualified specialists in marine engineering and related activities briefed the group, after which the participants discussed common problems and opportunities. A report will be issued free of charge to all interested colleges and universities by ASEE, with a summary in the ASEE Journal.

American Association of Junior Colleges—Dr. Lewis Fibel, \$13,400 for 4 months, "Planning for American Junior College Involvement in the Training of Marine Technicians"

The American Association of Junior Colleges convened a meeting March 17–20 at the Florida Institute of Oceanography, St. Petersburg, for interested community and junior college administrators to discuss marine technician training. The group will also begin general planning for marine technician curricula. Training might be offered, for example, in such fields as marine electronics, marine mechanical engineering, and diver training and its related fields.

University of California—Scripps Institution of Oceanography, Dr. William Nierenberg, \$89,000 for 1 year, "Applied Marine Engineering Program at Scripps Institution of Oceanography"

Scripps Institution of Oceanography will initiate a graduate research and education program in applied marine science and engineering. The new applied program will involve the Departments of Earth Sciences, Marine Biology and Oceanography, with engineering support from the Departments of Engineering, University of California at San Diego. The Program will initiate activities in such fields as support of ocean industry in the concept, research and design of transport, harbors, mining production, recreational facilities, beach control, fisheries, and disposal; and development of the technological base in delineation and appraisal of marine resources; analysis of limiting conditions, currents, effects of organisms on man-made structures, etc. Grant funds will be used for support of faculty and employment of research assistants, and for procurement of expendable supplies and equipment.

Cape Fear Technical Institute, Arthur W. Jordan, \$165,200 for 2 years, "Improvement and Expansion of Marine Technology Curricula"

Cape Fear Technical Institute, which has a successful on-going program in marine technician training, will expand the program from a student enrollment of about 20 to about 150. NSF grant funds will be used for the support of faculty, and for operating personnel aboard the Institute's training ship. The training program covers the basic academic education for marine technicians, plus actual shipboard experience in support of oceanographic operations, biological oceanography research, fisheries, and research ship operations.

Florida Atlantic University—Prof. Charles Stephan, \$193,600 for 2 years, "To Establish a Cooperative Ocean Engineering Education Program Between FAU and Ocean Engineering Organizations"

Florida Atlantic University, which is at present the only institution offering an undergraduate ocean engineering program will expand the program to include on-the-job training. The student will alternate six-month periods between academic training and employment in a cooperating industry. Federal program or laboratory. FAU has demonstrated substantial industry interest, sufficient to ensure employment opportunities for participating students. The institution will use the grant for employment of faculty and administrative personnel, and for purchase of instructional equipment. First year expansion would bring approximately 45 additional students into the program, with an additional 67 the second year.

Massachusetts Institute of Technology—Dr. Alfred H. Keil, \$62,000 for 1 year, "Development of new subjects for Ocean Engineering Graduate Program at M.I.T."

MIT has initiated a graduate program in ocean engineering leading to the Master Science and Doctorate in Ocean Engineering, and the professional degree of Ocean Engineer; the course started with the Fall term, 1967/68 academic year. New subjects are required to provide a comprehensive curriculum. Use of existing ocean-related subjects already has been planned in close cooperation with other MIT departments and Woods Hole Oceanographic Institution.

Results obtained from the MIT initiative, and copies of notes prepared on the new subjects, will be made available by MIT to other institutions with a present or potential interest in ocean engineering. Availability of the MIT materials will be announced through the American Society for Engineering Education and other channels, and copies of the report and notes issued on request in accordance with Sea Grant objectives.

Curriculum development will consist of initial review of subject material, preparation or rough notes, teaching of subject for the first time, and editing of lecture notes with preparation of copies for distribution. Recognized authorities are in charge of subject development in the respective fields.

New England Aquarium—Dr. Delbar P. Keily, \$4,800 for 4 months, "Guidance Counseling of Young People Toward Career Opportunities in Oceanography"

The New England Aquarium, which has an educational mission, conducted an experimental program to improve the quality of guidance counseling toward marine careers. Using techniques developed by MIT, selected guidance counselors from area secondary schools were brought to Boston for a day's indoctrination by experts in various marine fields. The guidance counselors selected students

with an expressed interest in marine careers and brought them to a simultaneous seminar in which the students were exposed to specialists in the various marine occupations. By cooperation with the Boston Sea Rovers, a diving club famous for its annual "Underwater Clinics," both students and counselors received additional information and indoctrination by participating in the Sea Rovers Clinic on the day and evening following the guidance program. Guidance counselors and the project personnel will follow up, making comparisons between actual career or undergraduate program selection between students exposed to the guidance program and those receiving only routine counseling. In addition to assessing the immediate impact of the project, the Program Director expects to use the follow-up data to suggest a methodology useful in improving guidance counseling in other marine areas.

University of New Hampshire—Dr. Donald Melvin, \$29,800 for 2 years, "Educational Project Experience in Ocean Technology"

The University of New Hampshire will conduct a Sea Grant Project involving six ocean-oriented undergraduate engineering projects per year for two years for the purpose of exposing students to realistic project engineering. The proposal is based on the University's experience in conducting an experimental "Design Projects Course" as a cooperative venture between the Electrical and Mechanical Engineering Departments. Students will be provided with a list of possible ocean engineering projects prepared by faculty and outside experts, and choose their project in consultation with engineers and scientists in the industrial and academic communities. After project selection has been made, students will be grouped into project teams with a faculty advisor, and will then be responsible for organization, creation and management of a budget, and technical direction of the project. Teams will be composed of students from several of the engineering disciplines. On completion, a performance evaluation to produce engineering data to support results will be required of the students, with results presented both orally and in a written report. Engineers and scientists will serve as a jury and grade individual and team student efforts. NSF funds will be used for salaries, project materials, and specialized equipment. Seventy-two students will participate during the two years of the project at the rate of six students per project per year.

New York University—Dr. John R. Ragazzini, \$143,300 for 2 years, "Course Content Improvement and Expansion in Ocean Engineering Graduate Training"

The School of Engineering and Science at New York University will expand its ocean engineering activities by filling gaps in course offerings, establishing an ocean engineering seminar for graduate students, and regularizing its ocean engineering coordinating committee. The project is based on activities started during the academic year 1967-68, in which an ocean engineering option was offered by four departments of the school. The NYU ocean engineering program is entirely at the graduate level, with advanced degrees (at the MS level at present) offered in the traditional engineering specialties, and not in ocean engineering *per se*. Five departments would offer ocean engineering options under the proposed project. Funds will be used for development of new courses in the participating departments, development of an interdepartmental seminar program in which all ocean engineering students will be required to participate, support of the interdepartmental coordinating committee, partial support for students who will work as teaching assistants, and the addition of a new faculty member (supported only in part under the proposed grant) to augment instruction on the ocean environment. The program expansion is planned to spread over the academic years 1968-1969 and 1969-1970.

Woods Hole Oceanographic Institution—Dr. Scott C. Daubin, \$18,900 for 1 year, "Ocean Engineering Education Program"

Woods Hole Oceanographic Institution, in cooperation with Massachusetts Institute of Technology is conducting a summer program for 10 graduate students in ocean engineering. The project is directed both to theoretical and practical engineering considerations in two fields: buoy systems engineering, and deep submergence systems engineering. Supporting subjects include an introduction to physical oceanography, experimental fluid mechanics, and biological oceanography. The Woods Hole Project supplements the graduate ocean engineering program at MIT, and is a pilot project from which experience in the conduct of such summer programs can be obtained. Participating faculty is primarily from Woods Hole, with additional supporting faculty from MIT. The

summer curriculum includes 4 hours of lectures a week plus homework and outside reading: design projects during each phase of the subject, and sea operations, including submersible operations centered on ALVIN. Sea Grant Support is used for faculty reimbursement and is matched by fellowships for the students.

Mississippi State University—J. E. Thomas, \$88,000 for 2 years

Gulf Coast Technical Institute, a branch of the Mississippi State University School of Engineering, will initiate in September, 1968, a curriculum in marine engineering technology leading to the Bachelor of Engineering Technology degree. The course is for the junior and senior years, with students selected by transfer from junior colleges and four-year institutions. Entry requirements are satisfactory credits in mathematics and the basic sciences. The course will develop baccalaureate engineers prepared to work in ship construction, ship repair, ship service, and ship operations. Local industries have agreed to provide summer employment experience. Initial enrollment in the fall of 1968 will be from 10 to 15 students, with from 20 to 25 entering in the fall of 1969, after which the new course is expected to be self-sustaining.

Santa Barbara City College—Dr. Robert J. Profant, \$149,200 for 2 years

Santa Barbara City College will establish a program in marine technician training with a core curriculum to prepare technicians to work in general oceanographic and other marine operations both ashore and afloat. The curriculum will have two general options: diving technician and general technician. In both cases, the student will receive the academic background of the core curriculum plus the specific skills available in several practical courses. In addition, the college will establish a safe diving program for all diving activities (including those of a scientific support nature) carried on at Santa Barbara. Provision is made for supporting activities and for evaluation of the curriculum. Entering class will be 54, with an estimated 40 continuing into the second year. Instructors will be drawn from industry and other academic institutions as well as the college faculty. Sea Grant funds will be used for support of faculty salaries and specialized instructional equipment.

RESEARCH PROJECTS

California Institute of Technology—Dr. Wheeler J. North, \$99,300 for 2 years, "Restoration, Propagation, and Management of Marine Algae"

The project will develop techniques for establishing commercially valuable kelp beds in barren areas, starting with introduction of kelp spores. Preliminary investigation indicates that such techniques can be developed. Once feasibility is demonstrated, the project will attempt to extend the techniques to other useful algal species, with emphasis on species flourishing in relatively warm water so that such species may be available for growth in areas affected by thermal pollution. To aid in the training of qualified persons for future work in this field, the project includes provision for a teaching program under Dr. North for students retained as research assistants for summer work.

Lamont Geological Observatory—Columbia University, Dr. Paul R. Burkholder, \$198,400 for 1 year, "Research and Graduate Training in Food and Drugs From the Sea, and Marine Pollution"

Applied biological research will be expanded in three main areas, Food from the Sea, Drugs from the Sea, and Detection of Marine Pollution. The research and the associated graduate student training will both be in fields of direct interest to the Sea Grant Program. This program will include a limited amount of related basic research. Under the Food from the Sea category, work will be expanded on the fermentation of trash fish for the development of foods suitable for human use, and the isolation of marine proteins to produce hydrolysates and protein isolates suitable for human consumption. In the Drugs from the Sea studies, new antibiotics and potential anticancer agents will be isolated, and their structure and synthesis defined. The Pollution Studies are intended to devise novel systems of detecting marine pollution and ways of monitoring and relieving its undesirable effects on the environment. The initial effort will be to determine the influence of effluents from the land upon the water masses between Montauk Point and the Chesapeake Bay with particular emphasis on the influence of Long Island Sound, the Hudson River, the Delaware and the Chesapeake.

Stevens Institute of Technology—Dr. John P. Breslin, \$97,000 for 1 year, "Forces and Motions Induced by Waves on Ocean Platforms"

Stevens Institute of Technology will use the facilities of the Davidson Laboratory for research into the forces and motions induced by waves on ocean platforms with the objective of developing design criteria that will improve design and construction of exploration, trial drilling, and production drilling platforms. Research will be directed to three principal elements: (a) a more precise specification of wave-induced loads on both submerged and projecting surfaces; (b) means of reducing motions induced by the seaway for both moored and dynamically positioned platforms; and (c) determination of wind-induced loads for prediction of overturning moments. The project personnel will adapt to the case of ocean platforms the well-proved Davidson Laboratory program for computing ship motions, supplementing existing information through the use of model elements in the laboratory research tank facilities. A wind tunnel will produce the necessary wind loadings on model elements. Configurations will then be studied to determine how motions can best be reduced at critical frequencies. Results will be presented in a form suitable for use by industry designers.

University of Miami—Dr. C. P. Idyll, \$225,000 for 2 years, "Development of Techniques for the Mass Culture of Economically Important Pink Shrimp and Pompano"

Several aspects of mass shrimp culture will be studied and new techniques developed intended to provide data needed to prove the technical and economic feasibility of commercial rearing of pink shrimp (*Penaeus duorarum*) and pompano (*Trachinotus carolinus*). Specifically studies to be conducted include: (1.) Hatching eggs from wild female shrimp in tanks and rearing the larvae to the demersal stage in ponds under both ideal and experimental and environmental conditions, (Salinity, temperature, light, water circulation, food kind and density). The larval stages will be fed diatoms and/or brine shrimp. Post-larval, juvenile and adult shrimp will be fed a variety of food types to identify the best, cheap source of nutrition. The early juvenile to adult stages will be reared in $\frac{1}{4}$ -acre ponds with aeration and oxygenation as needed, and variable shading of the surface with plastic cloth screens. (2.) Pompano will be reared in the same types of tanks and ponds, as the shrimp, under the same conditions and a variety of food sources to develop improved culture techniques for this fish.

Francis T. Nicholls State—Drs. Alva H. Harris and Curt Rose, \$60,000 for 2 years, "Shrimp production in Louisiana Salt-Marsh Impoundments Under Existing and Managed Conditions"

This project is to determine the feasibility of shrimp farming in the impounded marshes and lagoons of Louisiana. The existing productivity of impounded nursery areas already producing shrimp is to be determined and then compared with another operating under experimental conditions. Natural nursery areas will be encompassed with levees and water control structures will be used to provide control over movement of tides and shrimp into and out of the impoundments. Both impoundments will be stocked by natural recruitment of the brown (*Penaeus aztecus*) and white (*P. setiferus*) young shrimp from flood tides. The second phase of the program is to develop methods of management and harvesting that will determine the economic feasibility of shrimp farming in the Louisiana marsh. To do this, patterns of ingress and egression, population fluctuations, growth rates, natural mortality, and food habits of both species will be investigated. The effects of predators and parasites will be determined also. The Louisiana Land and Exploration Company, a private owner of extensive marshland acreage, is providing, free of charge, the use of some of their land for this research and some of the financial support for the project.

University of New Hampshire—Dr. Arthur C. Mathieson, \$35,300 for 2 years, "Ecological Studies of the Marine Red Alga *Chondrus crispus*"

The ecology of the red marine alga, *Chondrus crispus* (Irish Moss), will be investigated for the purpose of developing information which can be of use in expanding the amount of this valuable resource in American waters. This alga is one of the principal sources of the phycocolloid, carrageenan, which is widely used as an ingredient stabilizer in many food and pharmaceutical products. Regular observations and measurements will be made at each of four stations in the intertidal and subtidal zones, and the growth and reproduction of in situ

plants of *Chondrus crispus* will be correlated with several environmental factors (temperature, light, salinity, nutrients, tides, substrate currents, precipitation, biological interrelationships, etc.). Some of the measurements will involve the use of SCUBA techniques. Also, the growth of cultured germlings, and the photosynthesis and respiration of macroscopic plants will be determined in the laboratory. Other field studies will yield information on succession of the alga in denuded areas, potential usefulness of artificial substrates, effects of grazing by animals, regeneration and propagation capacity following harvesting, and transplantation potential of this species.

University of North Carolina—Howard T. Odum, \$100,000 for 2 years, "Optimum Ecological Designs for Estuarine Systems of North Carolina"

This project will provide information on the feasibility of establishing associations of organisms in estuaries which can process man's wastes, metabolize inflow, develop the missing loops of the mineral cycles, and channel the fertility into one or more populations with food potential. Nine marine ponds will be constructed in a high marsh area along the coast of North Carolina. Three of the ponds will be continually seeded with mixtures of marine organisms (larvae, adults, plankton, micro-organisms, etc.) and will receive a steady inflow of urban waste mixed with sea water. Three ponds will be seeded, but will be supplied with sea water only, i.e., no wastes. The remaining three ponds will receive the wastes mixed with sea water, but will not be seeded artificially. Principal populations, some principal nutrient cycles and the total photosynthetic production and system respiration will be measured. Those populations of larger organisms which develop in large mass will be studied for growth rate and net production per area of meat potential for harvest.

New England Institute for Medical Research—Dr. James H. Green, \$33,600 for 2 years, "Useful Biomedical Materials Derived from the Sea: An Interdisciplinary Approach"

Recent work identified the presence of a substance extracted from the liver of the lemon shark which acts as a stimulant to the body's host defense system and also suggested that other fractions of this same system. At the present time physical and chemical analyses are being made to determine the structure of the active agents. Work under this project will include the determination of the scope and level of effectiveness of the materials in various disease states and the tolerance level and toxicity, if any. Also, efforts to understand the bio-chemical mechanism by which these materials activate the host defense system will be made. The second phase of this project involves studies of bioluminescent marine planktonic organisms. While earlier work has identified the luciferin-luciferase system, the mechanism by which light is emitted is not completely understood. This program will attempt to further elucidate the system, especially to establish the nature of the light-emitting moiety. Second, the development of a method of growing bacteria will be completed; extraction and purification of the enzyme from *Photobacterium fisheri* on a preparative scale will be undertaken, and an effort will be made to find a linking system that will enable the bacterial luciferase to be used for detection of adenosine triphosphate and other co-factors which supplant firefly luciferase in these reactions.

STUDY AND PLANNING PROJECTS

University of Miami—Dr. John H. Clotworthy, \$10,200 for 4 months, "Sea Grant Institution Program Planning"

The proposal is to conduct studies necessary to development of an optimum institutional program in the Institute of Marine Sciences to serve the Southeast Florida region. Once developed, the full program would be proposed to the Foundation for institutional support under the Sea Grant Institutional Support Program. Reason for requesting the planning grant is to provide the manpower necessary for consultation with industry and other elements of the community and to "consolidate and interrelate the numerous factors of requirements and interests which are evolving."

University of Michigan—Dr. Hansford W. Farris, \$25,000 for 7 months, "Planning a Coherent Program for Development, Utilization, and Conservation of Marine Resources of the Great Lakes"

The University proposes to charge six members of the faculty with the primary responsibility to inventory the University's resources, evaluate the effectiveness

of current administrative relationships, and develop an overall long-range plan for the development, utilization and conservation of marine resources. Its present potential and strength will be considered in light of preliminary study of regional problems. The staff assigned will be in close contact with the faculty and administration of the University of Michigan and other institutions and with the appropriate state and federal agencies in the propagation of the plan. A program of institution-wide scope will be developed incorporating research, education, and advisory services. Once developed, the plan will be proposed under the Sea Grant Institutional Support Program.

University of Maine Law School—David J. Halperin, \$49,700 for 15 months, "Survey of Maine Law Affecting Marine Development"

The University of Maine Law School will make a complete survey of all statutes, court decisions, administrative regulations, and policies of the State of Maine, which affect marine resource development, and will examine their scientific validity and economic impact. The study will be directed from the Law School, but will involve experts in the sciences and economics from other institutions, including the State Department of Sea and Shore Fisheries. The inter-disciplinary team will relate the laws and regulations to conservation, health, and the economic well-being of the state, will determine the extent to which the laws and regulations are observed, and will determine what major gaps exist in the legal structure insofar as the state's ability to utilize its resources is concerned. The initial step will be to survey the legal structure in detail, utilizing work already accomplished by Garretton of the New York University Law School. The second step will be the interdisciplinary analysis.

University of Alaska—Dr. Donald W. Hood, \$34,200 for 1 year, "An Approach to Marine Resource Development in Alaska"

The marine resources of the State of Alaska are considered to be of great value. While some exploration and development of seafood, petroleum, and minerals has occurred, little in the way of planning for such activities has been done. This project consists of a study which will provide: a basis for curriculum planning for education, an appraisal of Alaskan marine resources, and establishment of priorities for research and identification of the most useful areas for early development. A committee of ten experts, five from Alaska and five from other states, will prepare a report which is to serve as a guideline for marine resource development in Alaska. The committee members will compile existing information on Alaskan marine resources, visit specific areas of such activity and prepare the report.

University of Rochester—Dr. Donald L. Woodrow, \$20,700 for 1 year, "Study of Potentially-economic Sand and Silt Deposits in Lake Ontario, New York"

The geometry, thickness and regional extent of widely spaced submerged beaches in Lake Ontario between Rochester and Henderson Harbor, New York will be mapped. The offshore gravel, sand, and silt deposits lying between 10 and 100 feet depths will be studied to determine their economic quality as well as that of the landward silt and sand deposits, and to demonstrate continuity of the beaches in space and time of formation. A fourteen day cruise over the area to be studied will be made, taking continuous recording fathometer traces and sub-bottom profiles. Cores, dredge samples and underwater television pictures will be taken at selected sites; cores will be split and photographed on board ship, and SCUBA divers will take photographs of the bottom and collect samples of organic materials. Lithographic logs of the cores, and grain-size and mineralogic analyses of the sands will be made. Summary maps will be compiled from bathymetric data, sub-bottom profiles and sediment data.

The CHAIRMAN. Thank you, Dr. Haworth. Of course, what the Commerce Committee will be concerned with is whether or not we should seek to up the authorization of the House. And I, like yourself, appreciate that that is a most difficult task in this climate.

But in order to do what you suggest, the continuation and enhancement and in view of what we have been doing and what the response has been in the past year or year and a half, it seems to me that we are going to have to attempt to either have what you suggest—the 1970 authorization—more flexible, or have a higher amount within which the Appropriation Committees can work.

Now, the House committee report, as you will recall, stated that the Foundation originally recommended \$15 million for 1969, fiscal 1969. And there must have been some real justification on the part of your panel and your group to recommend that amount; was there not?

Dr. HAWORTH. Well, this was our view at that time, in view of the great interest and potential capabilities of so many universities and colleges, that we could usefully have used that much money.

The CHAIRMAN. Your basic interests from these institutions who are quite enthusiastic about this would probably justify almost that amount, for 1970 at least?

Dr. HAWORTH. I would think so; yes.

The CHAIRMAN. In other words, you could justify the allocation of more funds in view of what your experience has been with it up to date, if Congress would give them to you?

Dr. HAWORTH. Yes. In normal times, yes. Even more.

The CHAIRMAN. But it would be pretty limited under the present funding.

Dr. HAWORTH. Are you speaking of fiscal year 1969 or 1970?

The CHAIRMAN. Let's take 1969 first.

Dr. HAWORTH. Yes; it is limited as everything else is, of course.

The CHAIRMAN. What did the House bill do, limit it to \$5 million?

Dr. HAWORTH. For 1969?

The CHAIRMAN. Yes.

Dr. HAWORTH. \$6 million for 1969; yes.

The CHAIRMAN. But you mention in your testimony a minimum ought to be \$7 million at least—what are you thinking of?

Dr. HAWORTH. I made no statement about 1969, Mr. Chairman—the budget calls for \$6 million. And that is the maximum that I would be able, as far as I can see, to allocate.

The CHAIRMAN. I see. On page 4 you state that the institutional programs for fiscal 1970 are estimated at \$5.5 million. And other meritorious proposals might increase the institutional program to more than \$7 million.

Dr. HAWORTH. That is correct.

The CHAIRMAN. Yes. That is 1970.

Dr. HAWORTH. That is 1970.

The CHAIRMAN. Now, supposing we had to stick with the House figure of \$6 million for fiscal 1969, and—time is running out on us—and the Appropriation Committee would allow the \$6 million, just generally how would that affect the present programs going now? Would it keep them going? Obviously, there would be no enlargements of them.

Dr. HAWORTH. Yes. We can keep the present institutional programs going and perhaps add a couple of new ones in fiscal 1969 at the \$6 million level, and have—we will have two and a half, something of that sort, left for project support out of the \$6 million—\$2.7 million, literally.

The CHAIRMAN. In other words, we are talking about a bare continuation of the program and no enhancement?

Dr. HAWORTH. Some enhancement, but not as much as we would like; yes.

The CHAIRMAN. What would be the case as to differentiating between institutional grants and special projects?

Dr. HAWORTH. You mean for the Congress to differentiate?

The CHAIRMAN. No; if this amount is required for the institutional grants, what would we have left for any special projects, if anything?

Dr. HAWORTH. In 1970. If we did what seems desirable for the institutional grants, they would add up to about \$7 million.

We predict that we would need at least \$7 million, or we could very usefully use at least \$7 million for institutional grants, and we could usefully use several million dollars for project grants.

It is a little hard this far ahead to predict that exactly—and clearly that adds up to more than \$8 million.

The CHAIRMAN. So we are talking about your original request of \$14 million.

Dr. HAWORTH. That was for 1969. I am now speaking to 1970.

The CHAIRMAN. But \$14 million would be your figure for 1970, too?

Dr. HAWORTH. Well, I would say that if the money were available one could very usefully use \$12 to \$15 million in 1970. I recognize, however, Mr. Chairman, that these are hard times.

The CHAIRMAN. Well, I recognize your problem, too, but it seems to me that we ought to make the attempt to have a sufficient amount authorized. Now, if the Congress wants to appropriate less, or tighten up, which they probably would this fiscal year, that is their business.

What the President may want to do with the expenditures, of course, is beyond our control now, because we did vote to cut \$6 billion last Friday.

But I understand that that \$6 billion is going to be pretty highly selective, and it is not going to be one of these things across the board which doesn't make too much sense and sometimes is pennywise and pound foolish. So there are some programs that you have got to keep a reasonable expansion in and more than a minimum.

We are faced with that, then. The House, as I understand it—that was the budget figure.

Dr. HAWORTH. It was the figure in the President's budget for fiscal year 1969. However, as you know, the House reduced the total without referring to the sea-grants program as such.

The CHAIRMAN. Yes. Do you want these other things put in the record?

Dr. HAWORTH. Yes, please.

The CHAIRMAN. We will put all of that in the record in full.

Off the record.

(Discussion off the record.)

The CHAIRMAN. I have no further questions. Thank you very much.

Dr. HAWORTH. Thank you, Mr. Chairman.

The CHAIRMAN. The next witness is Dr. Wenk. We will be glad to hear from you, Ed.

**STATEMENT OF DR. EDWARD WENK, JR., EXECUTIVE SECRETARY,
THE NATIONAL COUNCIL ON MARINE RESOURCES AND ENGI-
NEERING DEVELOPMENT; ACCOMPANIED BY ENOCH L. DILLON,
STAFF ASSISTANT FOR LEGISLATIVE AND GOVERNMENT AF-
FAIRS, NCMRED**

Dr. WENK. Mr. Chairman, I would like to ask Mr. Dillon to accompany me also, if I might.

The CHAIRMAN. All right, that will be fine.

Dr. WENK. Thank you, Mr. Chairman, members of committee, I am pleased to be here today to testify on H.R. 13781, a bill to extend authorization of the National Sea Grant College and Program Act (Public Law 89-688) for fiscal years 1969 and 1970.

The National Science Foundation is charged with initiating, developing, and supporting programs under this act, while the National Council on Marine Resources and Engineering Development is required to advise the Foundation with respect to policies, procedures and operations of the Foundation in carrying out its functions.

SUPPORT FOR THE SEA-GRANT PROGRAM

In representing the Council, I should like to note its wholehearted support of the sea-grant program and of its continued authorization. Moreover, the Council urged an increase in sea-grant investments as one of 12 areas for priority emphasis recommended to the President for fiscal year 1969.

President Johnson explicitly mentioned the importance of broadening education and research, particularly in sea grant and other university programs in his special environmental message and in his message forwarding the second annual report on Marine Science Affairs to the Congress.

In the brief remarks that follow, I should like to outline (1) the relationships of sea grant programs to the broad national policy enunciated by the Marine Resources and Engineering Development Act, Public Law 89-454; (2) the special provisions of the Sea Grant Act that render it far more valuable than simply another source of research and education funds; and (3) the reasons why extension of the instrument is so important for training specialized manpower needed for marine technology development in the 1970's; for meeting regional maritime research needs; and for disseminating results to industry and the public.

The CHAIRMAN. I am glad you are going to do this, because there has been a little confusion as between sea grant opportunities and activities and proposals as against our Marine Sciences Act and I am glad you are doing this.

A NEW NATIONAL POLICY FOR MARINE SCIENCES

Dr. WENK. Thank you, Mr. Chairman. It is in that perspective I would like to note the enactment of the Marine Sciences Act, almost exactly 2 years ago, was a turning point in Federal policy for the study and utilization of the sea.

This committee, Mr. Chairman, and especially your own personal leadership were key factors in developing this landmark legislation. For the first time in our Nation's history an explicit objective was enunciated:

"To develop, encourage, and maintain a coordinated, comprehensive, and long-range national program in marine science for the benefit of mankind to assist in:

- Protection of health and property;
- Enhancement of commerce, transportation, and national security;
- Rehabilitation of our commercial fisheries; and
- Increased utilization of these and other resources."

This mandate of the Congress and the President further identifies eight objectives related to these goals. These are in section 2(b) of the basic legislation.

Specifically the marine science activities of the United States should contribute to the following objectives:

The accelerated development of the resources of the marine environment.

The expansion of human knowledge of the marine environment.

The encouragement of private investment enterprise in exploration, technological development, marine commerce, and economic utilization of the resources of the marine environment.

The preservation of the role of the United States as a leader in marine science and resource development.

The development and improvement of the capabilities, performance, use, and efficiency of vehicles, equipment, and instruments for use in exploration, research, surveys, the recovery of resources, and the transmission of energy in the marine environment.

The effective utilization of the scientific and engineering resources of the Nation, with close cooperation among all interested agencies, public and private, in order to avoid unnecessary duplication of effort, facilities, and equipment, or waste.

The cooperation by the United States with other nations and groups of nations and international organizations in marine science activities when such cooperation is in the national interest.

The marine environment was defined to embrace the great oceans, their living contents and the seabed. Also included were the vital margins of Continental Shelf, bays, estuaries and the Great Lakes.

ROLE OF MARINE SCIENCES COUNCIL

Inasmuch as 11 major Federal departments and agencies have statutory authority for different marine science activities, the act conferred on the President the responsibility for providing momentum and coherence to these diversified activities. On an interim basis, it provided him with a Cabinet-level, policy planning and coordinating council chaired by the Vice President to advise and assist with implementation.

Mr. Chairman, you recall that when you initially proposed this legislation it was not accepted enthusiastically by the administration. But after its enactment, I think the record shows the administration has recognized the forethought and the logic of this legislation in order to meet the objectives. And the administration has endeavored to respond promptly and energetically to that congressional mandate.

Shortly after signing the act, the President requested Vice President Humphrey to convene the Council. It has met some 12 times since; identified and supported new initiatives required to implement objectives of the act; prepared for the President to transmit to Congress two annual reports on marine sciences that summarize goals, programs, budget proposals and accomplishments of the participating agencies in terms of more effective use of the marine environment; and undertaken long-range legal and economic studies of marine affairs. It is now coordinating national plans to carry out the President's proposal for an International Decade of Ocean Exploration.

BENEFITS FROM THE SEA

The President has noted that the demands on the marine environment will be intensified in the coming years. He has said:

In preparing for the coming decades, we must turn our attention seaward in the quest for fuels, minerals, and food—and for the natural beauty of the seashore to refresh the spirit.

Yet the sea will yield its bounty only in proportion to our vision, our boldness, our determination, and our knowledge.

We have taken new steps to strengthen the nation's scientific and technological base for understanding and using the oceans. We have made good progress but much remains to be done in the years ahead.

The Council has been especially concerned with highlighting opportunities deserving special emphasis, evaluating progress toward meeting public needs, and identifying impediments to further advancements in realizing our stake in the sea.

We have endeavored—

The Vice President wrote in the 1968 report—

to utilize the high quality base of science and engineering within an institutional framework which will insure that new concepts can be translated effectively and promptly into practice—a framework that includes participation by state and local governments, private industry, and the academic community.

The Vice President went on to note why the oceans are important to the country. He said:

There are one-and-one-half billion hungry people in the world. The full food potential of the seas, seriously neglected in the past, must be realized to combat famine and despair. Technologies now at hand can be directed toward increasing the world's fishing catch and enriching the diets of the underfed.

Seventy-five percent of our population lives along our coasts and Great Lakes. Nine of our 15 largest metropolitan areas are on the oceans and Great Lakes, and three are on ocean tributaries. Twenty million children live in these metropolitan areas within sight of potential water recreation areas but are often denied their use. Only three percent of our ocean and Great Lakes coastline has been set aside for public use or conservation.

More than 90 percent by value of our intercontinental commerce travels by ship. Although there have been rapid changes in the character of ocean cargoes and technologies of cargo handling, the average age of our port structures is 45 years and the average age of our merchant ships is 19 years.

The continuing threats to world peace require our Navy to maintain a high level of readiness and versatility through a sea-based deterrent and undersea warfare capability. Middle East conflicts following closure of the Gulf of Aqaba vividly emphasize the urgent need for a strengthened code of international law of the sea.

Thirty million Americans swim in the oceans, 11 million are saltwater sport fishermen, and 8 million engage in recreational boating in our coastal states. All these activities are threatened by the dumping of industrial wastes into ocean tributaries. This pollution will increase seven-fold by the year 2000 unless there are drastic changes in waste handling.

Ocean-generated storms cause millions of dollars of damage annually along our coasts, but marine weather warning services are available to less than one-third of our coastal areas.

These problems point up the dividends that should be anticipated from investments in marine sciences:

In economic development we should anticipate:

Fishery production that could double in 15 years;

The increased extraction of offshore oil and gas that could increase by a factor of 4 by the year 2000;

Revenues to States and Federal Government from offshore rents and royalties during that interval of over \$20 billion.

In contribution to humanitarian concerns:

Acquisition of inexpensive fish protein for undernourished people throughout the world; and

Reduced loss of life by better prediction of storm and flood;

And to enhance the quality of living:

Reduced pollution of bays and estuaries; and

Expanded seashore recreation.

IMPORTANCE OF ACTIVITIES IN THE COASTAL ZONE

I should like to emphasize that the bulk of our marine activity takes place and will continue to occur in the near term in the coastal zone, the waters and bed of the Continental Shelf. These marine resources are producing a rapidly growing part of this Nation's wealth but also are the source of problems because of conflicting use.

Seventy-five percent of our population live along the coasts and the shores of the Great Lakes. Our greatest population growth is expected there. All of the megalopolitan areas of the country in the year 2000 will be in those areas along the water.

As the people of our country enjoy increased prosperity and more leisure time, greater demands are generated also on coastal land and offshore waters for residence and recreation—which in turn contribute to further development by demands for products and services.

Many industries have found it necessary or advantageous to locate in the coastal zone because of proximity to marine resources, ocean transport, labor, and product markets.

All of these factors indicate that the growth of the coastal zone and shelf activity will continue and its pace will be accelerated. So will conflicts.

The use of the marine environment and the development of its resources for the benefit of all our people depends on three important factors:

Determination of the nature and richness of living and material resources which are present in the oceans, and development of the technology for using and extracting them, as a basis for sound decisions on private investment and by government;

Determination of the needs for coastal zone land and water and how to resolve the conflicting demands;

Development of wise management policies to insure that their use will benefit all of our people and that the resources will be protected for the future.

These problems vary from region to region—from Puget Sound to the Mississippi Delta; from the Bay of Maine to the Chesapeake, and from Lake Erie to Lake Superior.

Regional approaches thus require regionally oriented capabilities to deal with these questions; and they also require increased Federal-State cooperation.

NEED FOR INVESTMENTS IN RESEARCH AND EDUCATION

With this background, Mr. Chairman, I should like to note that if we are to realize future return on the marine environment and head

off its depreciation, we must be willing to make well-considered investments today—especially to continue development of the strong core of scientific research on which this entire enterprise rests.

We also must take steps:

To accelerate training and education of specialized manpower, especially ocean engineers and technicians, required by industry and Government which are not being developed through programs;

To initiate and support applied research, in predevelopment stages, particularly related to recovery and utilization of marine resources;

To disseminate knowledge and information about marine resource development to all interested and concerned sectors of the Nation.

VALUE OF THE SEA-GRANT PROGRAM

The sea-grant program, established as title II under the basic marine Sciences Act, does this. It is a major innovative step to meet these needs.

As you know the program has two parts.

The institutional-type sea-grant programs will strengthen marine science programs of colleges and universities engaging in multifaceted activities that embrace education, research, and advisory services. Institutions will be selected on such factors as ability to perform special studies of differing marine ecologies or resource problems, so as to concentrate research on problem areas of greatest regional interest and concern.

The sea-grant college provision, intended to enlarge the base of funding, should also be especially valuable in providing longer term, broader based support to academic institutions than is generally possible through the project grant system. It should also encourage interdisciplinary approaches to broad problems and enhance communication between classical disciplines so often isolated within a university.

Sea-grant projects are intended to advance scientific, engineering, and technological know-how, especially at the stage where scientific discovery first blends into a possible social application, but also where practical economic benefits are still uncertain. This mechanism also provides a means for responding to varied and changing research needs of the Federal Government and is of particular importance in complementing programs of those agencies not having broad extramural programs, or supporting research on topics that cross missions of various agencies and fail to gain the interest of anyone. In the future, the Government may express such interest through announcements by the National Science Foundation, to invite attention and participation of the non-Federal community for research and study, and particularly the industrial community, to meet these needs.

Support in this category encompasses more than research projects. The legislation intended support for symposia and conferences, for the development of innovative educational curricula and for new programs needed for training of critical or specialized technological skills.

The sea-grant program is being carried out at universities, but with the expectation that the Federal and State governments, the academic institutions, and industry will examine common problems and pool diversified resources, facilities, and specialized talents for their solu-

tion. The program thus augments rather than replaces existing programs of support and should provide a cohesiveness among these on-going efforts.

Only now are we receiving the dividends of the accelerated educational and training programs in marine science of the early 1960's. Today's program must respond to the challenge of the 1970's.

The entire marine science program is dependent on an expanding base of highly skilled and innovative specialists. Ocean scientists and engineers comprise this core, but there is also a growing need for specialists in many other disciplines to turn their energies and intellect to the sea—from economics, law, business, public administration, and foreign affairs.

The supply of teachers holding doctorates or masters degrees, and interested in teaching in the marine field, is not keeping pace with the demand. In fact, perhaps half of the new doctorates being turned out may be needed in educational institutions to keep pace with enrollments. At the same time, qualified students are applying faster than they can be accommodated.

While the burden of specialized marine science education has rested primarily with a very small number of educational and research institutions, as the field grows it will increasingly depend upon a broader base of universities and colleges for its scientists, engineers, and technicians.

The sea-grant program offers a new approach to meeting national needs for technical manpower. It should benefit the Nation as a whole, and it will be of particular benefit in responding to the needs of States and communities to use marine resources for strengthening local economies, conserving limited coastal resources, and improving the quality of the environment.

The Sea-Grant College and Program Act is a natural second step to complement and implement the explicit provisions of the Marine Sciences Act mentioned earlier that call for expansion of human knowledge and for education and manpower needed.

EXTENSION OF SEA-GRANT AUTHORIZATION

This sea-grant program has been in operation only a short time. The first grants were made in February 1968 and there is thus no operating experience on which to evaluate either the intrinsic merits of the program or the grantee performance. However, I note again that its need and its promise has earned the explicit support of the President and the Marine Sciences Council; and the oceanographic community.

No funds are currently authorized for fiscal year 1969.

In order for this important program to continue, funds amounting to \$6 million must be authorized for fiscal 1969, and additional amounts will be required in succeeding years.

In view of the novelty of the program, the fact that its implementation has just begun and its directions are still being determined, it seems to me unwise to place the dollar limit on authorization for fiscal 1970 as low as it is in H.R. 13781. If an authorization limit is deemed necessary, it should be large enough to permit further healthy development and evolution of the program.

The passage of an authorization for the sea-grant program at this time is essential. The program is underway and its continuation is

required to supply manpower and research for existing programs. I hope that the authorization bill now before you, but without a funding limitation for fiscal year 1970, will earn your support.

Thank you very much, Senator Magnuson.

The CHAIRMAN. Thank you, Doctor, that is a very fine statement and a very excellent review of our objectives and our goals.

You are familiar, of course, with the figures we have in front of us. And in the next to the last paragraph of your statement you suggest that either we—which we do sometimes in legislation—authorize such funds as may be necessary, leaving it up to the Appropriation Committees and the people involved, such as the Science Foundation, to justify the amount they ask for, or we up the figure of the House bill, particularly for the fiscal year 1970, as Dr. Haworth mentioned.

It seems to me that we wouldn't be—I wonder if you would agree with me—that we wouldn't be asking too much in doing that, because relatively, when we consider many, many programs needed by the Nation, this is a very small amount relatively, considering what is at stake, and the need for moving in this field. So I appreciate your general statement on that amount.

We will have to determine the dollar figures ourselves. I don't like to bring this up, but today I am in the process of recommending to the Senate the appropriation for the Space Agency. And that is a great effort in itself but I have often thought that relatively we ought to be doing the same thing in oceanography. It could be even more important to us than the space program, although I think both are important.

So I am going to try and suggest that we get at this a little differently than the House bill, particularly so that the program can keep moving even if it is at its present level for fiscal 1969, but not put a crimp on it for expanding.

I imagine that is what the Council will ultimately recommend in the long run, the Marine Council, more activity in this whole field.

Have you found the kind of cooperation with the agencies in this field that you expected?

Dr. WENK. Well, Mr. Chairman, the cooperation by the agencies in this field has been most gratifying.

As I mentioned earlier, the Council has met 12 times since it was formed and the attendance by the statutory members or alternatives who must be at a policy level has been almost 90 percent. I believe this is a very firm indication of their support.

I think it is also fair to say that each agency is obliged to represent the statutory mission that it serves and to call the shots as it sees them. This is the kind of problem that the Congress faces when it is confronted with a number of diverse and competing interests. The Council faces the same situation.

The CHAIRMAN. One of the purposes of this was to try and put these people together so they wouldn't become involved in departmental feuds or wanting to keep everything within their own departments, the minor power struggle that goes on which becomes a detriment to the whole program, and see if they can't all work together, because it is scattered among many agencies, this work. And I think you are going to serve even a better purpose under the present climate, because the struggle for the appropriations between the departments now is becoming pretty great and very important.

Well, we appreciate this fine statement. I think it points out what we should be doing, what we need to do and the importance of this whole matter.

We have been a little late as it is and I think we can catch up with our know-how.

Dr. WENK. Senator Magnuson, this whole field has really benefited by the interest and support of the Congress.

The CHAIRMAN. Well, the national interest has grown so much in the past 4 or 5 years, or in the last 2 years.

Dr. WENK. It has.

The CHAIRMAN. As you point out, the young people have become interested in this whole field and all of its facets. The response has been great in the schools. But we still aren't turning out enough. We still can't handle them, let's put it that way, that is the answer to it. That is why the institutional grants are so important, to get a school prepared in a cohesive way to handle this. That is why the Foundation was wise in separating these two things, to get the institutions ready. That is the basic thing to begin with. The other things can come along, the projects.

Senator Moss, do you have any questions?

Senator Moss. No. I want to compliment Dr. Wenk on this very fine summary. It was excellent and I appreciate it very much. I am glad to note that we are making some progress.

Dr. WENK. Thank you, Senator Moss.

The CHAIRMAN. And you refer to anticipated dividends. Down in the space appropriations we call them spin-offs. But whatever you call them, they amount to the same thing. And there is no question about the anticipated dividends for the small investment, relatively small, we should make in this field.

Dr. WENK. I think the returns on this investment are very clear.

The CHAIRMAN. I would think the military investment alone would be great, because that runs through the wool and weave of all of this.

Dr. WENK. It does indeed. Our present ability to deter a nuclear war depends very critically on such things as the Polaris program, which in turn depends for concealment on knowledge about the marine environment.

The CHAIRMAN. Yes, and the sonar problems in the oceans, with the great advancement of underwater craft, platforms, or even the submarines. Surely that would dictate that this is more than a national investment.

Dr. WENK. What has happened, Senator, as a result of this recent interest, is a very broad and deep question being asked as to what this Nation's stake is in the oceans. It is paradoxical that as a maritime nation we have forgotten that history, and now we are beginning to realize the importance of the oceans in terms of military security, and also in terms of economic development, in terms of the benefits of coastal living. Also, and by no means least of these four, the manner in which nations may work together in the study of the use of the sea that could be a major factor in developing better world understanding.

The CHAIRMAN. Isn't it true what little we have been doing in the international field with other countries in the whole business of oceanography, that we have met with great response from the other people to join in different efforts, have we not?

Dr. WENK. We have indeed. In this regard you recall the President proposed this International Decade of Ocean Exploration just recently. We were pleased to note your support for this proposal through Senate Concurrent Resolution 72. We hope it passes. Some 46 nations were requested to consider whether they would participate with the United States. We are now beginning to get their reaction both individually and collectively through international organizations. It is most encouraging.

The President and Vice President and Secretary of State asked me to spend a week discussing ocean interests in the Soviet Union and other European countries about 2 weeks ago, and—

The CHAIRMAN. Yes. I might recall for the record that one incident, the *Oceanographer* that went around the world, Coast Geodetic I think had that.

Dr. WENK. That is correct.

The CHAIRMAN. The last I heard some 17 nations participated in different projects on the way, including the Soviets.

Dr. WENK. Right. They made a stop at the port of Odessa, one of the few times an American oceanographic ship has entered the port. They were cordially received by the mayor. There were a number of oceanographers who visited the ship and who rode with the ship as it left Odessa.

The CHAIRMAN. Yes. And I am glad you mentioned double fish production, because we are dragging behind despite the fact that the consumption of fish, I think, has gone up four times and our contribution to that production is down from what it was. Of course a lot of those figures are due to the bulk, the fishmeal, because this was tonnage-wise. But in the field of commercial fisheries, we are not holding our own. Here you get back to marine technology. That is what it amounts to, modernizing the fleets compared to the other fishing countries. And I think you and I have often suggested that there is enough food in the oceans for everybody if you practice conservation, in a joint effort, do like we do in timber, a sustained yield is there all of the time for everybody.

Dr. WENK. It is indeed. The most conservative estimates from the marine biologists would indicate a self-sustaining yield five times what we are catching today and it may be many more times than that. So this offers a great potential, both in terms of consumption in the United States and also in meeting this very serious protein deficiency throughout the world with a low cost nonperishable product—the fish protein concentrate—which at a cost of only 1 cent a day could meet the protein requirements of a large number of people.

The CHAIRMAN. Thank you very much for coming.

All right. Dr. Henderson, we will be glad to hear from you.

**STATEMENT OF JOSEPH E. HENDERSON, PROFESSOR OF PHYSICS
AND DIRECTOR, APPLIED PHYSICS LABORATORY, UNIVERSITY
OF WASHINGTON**

The CHAIRMAN. Joe, we are glad to see you.

Dr. HENDERSON. I'm sorry I don't have any flankers on my side here—

The CHAIRMAN. I will be your flanker.

Dr. HENDERSON. OK, you do that, sort of act as anchor man on this relay team.

Unfortunately, I didn't get the word that we weren't going to discuss the Senate bill as well this morning, so you will find in my testimony here a number of references to that, and I may blunder into them. So if I do, I guess it won't hurt anything.

The CHAIRMAN. Well, I want to say to all of the witnesses here, I think the contribution you make to us and that we will make to the Senate is not so much you discussing the dollars and cents. That is going to be our problem. But to point out again and reiterate and create the awareness of the importance of this program to us, the investment we need to make and the dividends.

Dr. HENDERSON. It is a pleasure to have the opportunity to appear before the Senate Commerce Committee at the hearings on the House of Representatives bill 18781. This bill relates to methods of financing the sea-grant college program.

The CHAIRMAN. I want to say right there, because we have the distinguished Senator from Utah here, who has been listening very carefully, and there might be a tendency, I would think, although he is on a great inland sea, the Salt Lake out there, but the sea-grant program is not limited to just institutions on the water. It can be used in many, many places. And part of the bill itself directed this kind of spread, so that other places could get interested. They can do it just as well sometimes, some projects don't need to be right on the water.

Senator Moss. Thank you.

Dr. HENDERSON. As a member of the Sea-Grant Advisory Panel for Institutional Support of the National Science Foundation, relating to the sea-grant college program, which is now almost ready to proceed on the second year of funding, I find it most appropriate to discuss with you certain elements of this program, and particularly its orderly continuance. Being a part of the University of Washington I can perhaps give you a little flavor of the sea-grant program from the university viewpoint.

It has been my privilege to participate in the site visits to three of the institutions receiving sea-grant college funds, and I have had the opportunity of reading the other sea-grant proposals and of discussing these proposals with other members of the Panel that have visited these other institutions. I would like to relate to you some of the excitement and eagerness that was apparent at the institutions which I have visited—these were the University of Washington, Oregon State University, University of Hawaii—at the prospect of being able to have a program sufficiently large that in a new field it could approach the “critical mass necessary to achieve a chain reaction.” In other words, a program large enough that there would be a central theme and spontaneity within each prospective sea-grant college, so that it could achieve the local support necessary and be recognized as a going entity in that university's scheme of things. On the other hand, there were serious and somewhat unexpected problems encountered as a result of the creation of the sea-grant college programs.

I think you must realize that the existence of the sea-grant funds really caused consternation, welcome though it was, within most of the universities involved. Traditionally universities operate on a departmental basis with strong departmental structures, and of course

in their narrow, particularized fields. Since ocean science is a multifaceted field, with its chemical oceanography, physical oceanography, biological oceanography, marine geophysics, ocean engineering, maritime law, fisheries, and the like, the Sea Grant Act requires the crossing of departmental lines.

This was the major problem encountered, and produced the major organizational difficulty within the universities themselves. In addition, the Sea Grant College Act requires its programs to be really applied oceanography, where an attempt is also made to transmit useful scientific data and procedures as rapidly as possible to the ultimate users, be it mining, fishing, or any other form of exploitation of the sea. This has required the establishment of relationships not only to those individuals or corporations that harvest the sea, but to the training of technical people to help these individuals, nearly all of which are properly classed as "small business."

To most universities that is not a normal university program and has called for a significant reorganization of the universities to meet the challenges of this "applied" program with its concomitant delegation of authority and responsibility across the normal administrative lines, not only within the departments, but in the schools and colleges that make up a large university. This has been done only after considerable strain and trauma, but the universities have faced the problem squarely and have created organizations variously called schools, divisions, et cetera, reporting high in the administrative structure of the universities, to accomplish the objectives of the Sea Grant Act. It has not been easy for some of the universities to dig up the matching funds to meet the challenge of Federal funds, especially since ships and real estate are excepted from Federal funding. The point of all this is that difficult as it has been for the universities to prepare to become sea grant colleges, they have met the challenge laid down by the 88th Congress because of the long-range implications of the program to the universities themselves and the national importance of the almost unexploited oceans. This is particularly true of those universities bordering the sea or Great Lakes.

These exciting prospects must afford satisfaction to Congress for having created such a fine program and one which is likely to put the United States into world leadership in the exploitation of the sea.

There is another implication of the Sea Grant College Act that I do not know whether it was intended by Congress or not, but it is really significant and important in national concept. In the final analysis, the Sea Grant College Act represents the first serious attempt by the Federal Government to encourage the universities into reorganizing themselves internally so as to be able to mount an interdisciplinary attack on a national scientific problem. By common consent, nearly all serious human problems, be they nutrition, public health, pollution, conservation, defense or what have you, require a broad-based attack readily available only at a university. It is in the common interest of all concerned to insure that this first attempt serve as a successful precedent, for the sake of all future federally supported systematic university research.

The present financial straits in which this Nation finds itself, largely as a result of the Vietnam conflict, apparently threaten this significant program in its infancy. The reason the universities were excited about

this program and were more than willing to provide the one-third seed money required by the act was the fact that a long-range continuity was anticipated and was expected to be provided. This continuity is apparent through the documents, bills, and other accessory literature that enabled the colleges and universities to prepare their programs. The planning everywhere was done on the basis that a modestly expanding and long-time range program was contemplated. In fact, the National Science Foundation and the Sea Grant Institutional Support Panel accordingly pledged the main grants on this basis. The reduction in funds proposed in House bill 13781 for fiscal 1969 and 1970, if it prevails, is so far below the funding that had been anticipated for these years that it is going to create a tremendous hardship on the universities that have met the challenge, and could possibly blunt the development of this extraordinarily important national program.

The proposals of this bill "not to exceed \$6 million for 1969" will not enable the continuation at the current level of grants already made and resolutely closes the door to other schools just as deserving and just as important in the national picture as those to whom grants have already been made. These universities are still in the process of solving their organizational problems related above. We know which universities these are, and they are good ones and must be somehow in this program. They have earned their places in oceanography the hard way by past sterling performance.

To be specific—and here I won't be quite as inhibited as the Director of the National Science Foundation—I believe and recommend that the Senate must take the necessary steps to restore funding for the sea-grant program—funding to the maximum level possible but not less than the minimum level that will permit continuance of present grants and to make a minimum of new grants. This number, after all compromises between the House of Representatives and the Senate, by my estimate, is "\$8,500,000 for 1969" and "\$12 million for 1970." This is far below the expected and planned-for funding and recognizes the financial stringency of the Nation, but it will enable the continuance of one of the finest national programs in recent times, and will not blunt it in its infancy as the H.R. 13781 in its present form will do.

The CHAIRMAN. Now you arrive at those two round figures based upon your experience as a member of the Advisory Panel?

Dr. HENDERSON. This is correct.

The CHAIRMAN. In which you see these applications come in, you see the importance of them, and you see the competence of the people who want to get into them, based on the fact that they have rearranged, as you point out, their university activities to live up to this and to come up to it, and this would be a minimum, you feel, in round figures?

Dr. HENDERSON. That is in round figures, this is certainly true. As I looked over the proposals as they came in, in no case did we give any institution the amount they requested. In all cases they were pared down, more or less. And in no case did it really approach the amount which the school had originally requested. We had encouraged them, or they had been encouraged by the literature, to expect to come in with additional growth potential for future years.

The CHAIRMAN. Dr. Haworth mentioned a number of smaller schools that should be a part of this program.

Dr. HENDERSON. This is correct. We know who they are too, they have already come in with their proposals, or have come in with unofficial proposals. We can see them coming and know what the proposals are going to say pretty much. I believe somehow we should end up with additional moneys for 1969, if it is possible. That is the reason I say after all of the compromises are done, we should end up with my number—remember, I don't have to be inhibited on this—I think the minimum is \$8,500,000 for 1969 and with the growth potential for 1970, I don't believe it should be less than the \$12 million. This will enable us to go ahead, I believe, with an orderly program and not have misled the other schools in the Nation who do not yet have these grants.

The CHAIRMAN. All right. Now, do you have some comments on S. 3144?

Dr. HENDERSON. Yes, I do. Do you want me to give those?

The CHAIRMAN. Yes; why don't you go on?

Dr. HENDERSON. All right. This is on the Senate bill which was originally a part of the request for comments today. This amendment to the Marine Resources and Engineering Development Act of 1966—this is the one that deals with the diversion of offshore money, Louisiana money I believe, primarily—could go a long way to alleviate the problem discussed earlier in this testimony. Such stable funding from a known source of funds of “up to \$25 million annually” will permit the sea-grant program to develop along the lines and at the same rate as the well planned, progressive, intelligent, normal growth program originally contemplated. It will also enable the United States to proceed on schedule on this rather daring creation, the national sea-grant college program of 1966. The sea-grant program is so important to the Nation's future that if the vagaries of normal funding can be avoided by this bill, I can only strongly recommend its passage. There is a certain amount of poetic justice and normal economic pride involved in having the income of an exploited Continental Shelf asset provide the seed for the greater exploitation of the oceans for the national good. This is a fine example of the American system.

The CHAIRMAN. There is one other factor here that surely dictates too that we continue this program at the most reasonable level. The word “law” has been mentioned by different witnesses, including yourself.

It seems to me that we are going to have to have a whole new field of international law as it pertains to the resources of the ocean. And surely we want to be, we, the United States, to be in a position in participation in that, to say that we have a stake in this.

It is a little like prospecting and things of that kind. If we do nothing and lag behind, we are not going to have much muscle in these international conferences to establish these basic guidelines, are we?

Dr. HENDERSON. That is certainly correct. And this is certainly a part of the sea-grant college program.

The CHAIRMAN. Whether it be done through the United Nations group or whether it be done by a worldwide conference or whether it be done by oceans to oceans with the countries involved. But it seems to me that even this amount might be more than worthwhile just for the establishment of that principle alone.

Dr. HENDERSON. I can say that in the consideration of the programs of these sea-grant college programs for institutional grants, that we

considered as a very important part of these proposals their proposals on the law of the sea and the maritime laws that apply to this type of project. And if it wasn't there, we asked specifically why it wasn't there, because we recognize that this was an important part of this whole program and one that properly belonged in those schools which did have law schools and people interested in this type of thing.

We agree with you as to its importance.

The CHAIRMAN. And no one knows better, Senator Moss, than Dr. Henderson, the importance of oceanography to the national defense. I think probably he has had more experience with that than anyone else. We can tell us a lot of things here that are classified with the department he runs out there. Thank you very much, Dr. Henderson.

The CHAIRMAN. I see our colleague, Senator Pell, is here. We will be glad to hear from you.

STATEMENT OF HON. CLAIBORNE PELL, U.S. SENATOR FROM THE STATE OF RHODE ISLAND

Senator PELL. Thank you very much, Mr. Chairman. I apologize for not having been here promptly at 10. I had an important commitment, of which you are aware, in my own State. Thank you so much for letting me come at this time.

I particularly am glad to be here because I believe that the sea-grant program is at a most critical point in its short history. It really is at a crossroads, and the action of Congress at this point may well decide whether the program is to fulfill the bright promise that you, Mr. Chairman, and all of us who are so interested in it saw only 2 years ago.

Essentially, the question is whether we are going to give this program an adequate authorization of funds or whether we are going to apply fiscal shackles that will force the sea-grant college program to "dogpaddle" for the next 2 years.

As the author of the act that established this program, I earnestly hope we will choose the former course.

The importance of this decision, I think, can be realized only in the context of our overall national oceanologic program.

I know that I need not tell this committee or its distinguished chairman that legislation approved by the second session of the 89th Congress 2 years ago marked a historic turning point in our national oceanologic program. Under your leadership, Mr. Chairman, the Congress adopted the Marine Resources and Engineering Development Act of 1966. That act established a national policy to intensify our effort to study and exploit the resources of the sea. It strengthened immensely the direction and planning of our oceanologic programs by establishing the National Council on Marine Resources and Engineering Development.

Vice President Humphrey, as chairman of that Council, has demonstrated an intense personal interest in the advancement of our oceanological programs. The effectiveness of the Marine Sciences Council owes much to his active, strong, and personal leadership, as well as the abilities of the Council's executive secretary, Dr. Edward Wenk, Jr.

A further provision of the act was the establishment of the Marine Sciences Commission, which will be submitting recommendations later

this year on the scope and organization of a long-term national oceanologic program.

A second major oceanologic act of the 89th Congress was the Sea Grant College Act. As chairman of the Special Subcommittee on Sea Grant Colleges of the Labor and Public Welfare Committee, I conducted 4 days of hearings on the concept of the program and its organization. Those hearings demonstrated strong support for establishment of a sea-grant college program, and both Houses of the Congress subsequently approved the act without a dissenting vote.

The primary aim of the sea-grant program is to build up the national resources, in trained manpower and in technology, that this country will need to carry out an expanded oceanologic program.

We have an opportunity now, while Congress awaits the recommendations of the Marine Sciences Commission, to prepare the groundwork for whatever program is recommended, by authorizing adequate funds for the sea-grant program.

The skilled technicians and trained scientists needed for the national oceanological program cannot be produced overnight. A minimum of 2 years is required to train an oceanologic technician and even longer leadtimes are needed to produce fully qualified marine scientists and engineers and to develop the sophisticated undersea technology that will soon be needed. In short, forcing the sea-grant program to dogpaddle now may well force our national oceanological program to tread water 2 or 4 years from now.

By supporting an adequate sea-grant program, we do not commit ourselves to a specific oceanologic mission in the future. We merely prepare ourselves to undertake expeditiously whatever missions we want—be it improved fishing, fish farming, mineral exploitation, or aquaculture.

What, then, is an adequate authorization level for this program? During its first full year of operation, the sea-grant program has had available \$5 million in appropriations. This \$5 million, by the way, represents only one-third of the \$15 million Congress authorized for this program for this fiscal year; and I understand that almost every penny of the \$5 million has been committed by the Office of Sea Grant College Programs in the National Science Foundation.

The bill before this committee, H.R. 13781, would authorize \$6 million for the coming fiscal year 1969, and \$8 million for 1970. The \$6 million authorization for 1969 was set, I understand, because this is exactly the amount, I am very disappointed to say, that was requested in the administration budget. It is an appropriation limit, however, that is unrealistic and tragically short of meeting either the needs or the opportunities of the program. An authorization level of \$6 million allows no flexibility. It would not even permit the Congress to provide a later supplemental appropriation if the fiscal situation allowed it.

Since the budget request has played such an important part in determining the authorization approved by the House of Representatives, I think it is important to know the background of that budget request.

For the fiscal year that begins on July 1, the National Science Foundation recommended spending \$15 million. The Marine Science Council recommended \$10 million. Both of these recommendations were

made, of course, in full cognizance of the need for fiscal restraints during the coming year.

In the light of these recommendations, I think it would indeed be a mistake to adopt the minimal \$6 million budget request as the maximum authorization for appropriations.

I think it is also worthwhile noting that the House Subcommittee on Oceanology, a very knowledgeable group, has supported an authorization of \$18 million for each of the next 2 years.

The authorization of \$6 and \$8 million for the next 2 years would result in the stagnation of the sea-grant college program. Much of the money committed during the first year of the program is in institutional and project grants that clearly carry a moral obligation for continued support for at least a few years.

We are hopeful, too, that other institutions will receive grants from the program. And in order for any such programs to be developed and worked out, there will obviously have to be an expansion, not a mere continuation. What is proposed now in H.R. 13781 is a cut of 60 percent in the authorization for a program that would produce more return per dollar spent by the U.S. Government for the taxpayer than any other program with which I am familiar.

In addition, planning grants have been made that also raise an expectation of grants in succeeding years.

With the authorization limits provided by H.R. 13781, the sea-grant program would be faced with the prospect of breaking faith with institutions that have invested substantial time, energy, and resources to planning for participation in this program. I can think of no more effective way to dampen enthusiasm for a program.

Mr. Chairman, the administration has asked Congress to authorize open ended funding for this program. I do not think Congress should grant that request because it is important that we have a periodic review of progress of the program and its administration.

We are aware there have been some delays in getting the program underway. I think it has improved substantially, but I think it is important that we in Congress keep a close eye on it, act as a spur to the administration and keep it moving.

I introduced the administration bill, S. 2607, last fall so that it would receive proper consideration. But I introduced at the same time my own bill, S. 2612, authorizing an appropriation of \$20 million for 1969 and \$25 million for 1970. I continue to believe that these are solid, realistic estimates of the funds that could and should be used constructively by the sea-grant program to develop some of the basic materials we will need for our national oceanologic program.

I also give this committee my very hearty endorsement of S. 3144, introduced by you, Mr. Chairman, which would earmark a portion of our Continental Shelf mineral revenues for exploration of the marine environment and for the sea-grant colleges program.

I realize that bill is not before us today. But I think the idea is excellent. When I first introduced the sea-grant college bill in the Senate in 1965, I proposed that 10 percent of the Outer Continental Shelf revenues be used to finance the program. I withdrew that proposal because of very strong opposition from the executive branch. I very much hope that you, Mr. Chairman, as time goes by, will have better luck in this regard than did I, and I look forward to supporting you in this effort.

Now that the program is established and operating, I think this method of financing is not only warranted but singularly appropriate. It would be most fitting indeed to reinvest in ocean development a portion of wealth our subsea areas already are producing.

So I congratulate you, Mr. Chairman, for bringing forth this proposal.

I cannot conclude, Mr. Chairman, without acknowledging that I am aware of the very tight fiscal situation which confronts the Federal Government. I know there are many urgent needs that are not being met, and I agree that the sea-grant college program must bear some part of the fiscal austerity.

I cannot help but think, however, that a reordering of some of our national priorities is called for. We hear it discussed often, and we know it is needed. And our oceanologic programs, including the sea-grant college program, deserves a somewhat higher ranking than they are now accorded.

For example, we now spend nearly 10 times as much on outer space programs as we spend on our oceanologic programs. You, Mr. Chairman, as chairman of the Appropriations Subcommittee for the space program, commented earlier in today's hearings on this disparity. This is an imbalance that I find almost incomprehensible. It is a gap that I believe should be narrowed as rapidly as possible. In fact, I believe the Federal funds spent in ocean space and outer space should be equal. Why? Because I suspect we will find that we will be farming the oceans long before we are farming the moon, and it will produce a far greater return to us.

While it is an admirable technical achievement to take closeup pictures of the barren Martian landscape, I think we should first try to get a clear profile of the ocean bottoms that cover 70 percent of our own earth.

I think it should be noted also that, in the outer space program, the Federal Government pays nearly 100 percent of the costs, and this Federal investment has brought almost nothing in the way of investment by the private sector.

The oceans, on the other hand, hold a clear promise of material return to man. Private investment in ocean development already exceeds Government spending in marine sciences. I only wish we could say this about space. We can expect that each dollar of Federal money invested in the education and training of ocean engineers, technicians, and scientists, and in the development of ocean technology, will bring forth substantially larger investments by private industry.

In conclusion, Mr. Chairman, I respectfully urge this committee to recommend an adequate authorization for the sea-grant college program so that the building of the foundation for an expanded national oceanologic program will not be retarded.

The CHAIRMAN. Thank you, Senator, for that very fine statement. I think that you have probably hit the nail right on the head when you suggest that even though we are in a tight fiscal situation, we ought to give in one case, the President who now has the \$6 billion to handle, and in the other case the Appropriations Committees of the House and Senate the right to establish priorities.

There are some programs that should not take the cut that others could. Now that is our responsibility. But surely the authorization

ought to have the flexibility so we can do just that, rather than a limitation such as this that the House put on.

Senator PELL. Correct. I would also suggest another thought here. Some programs are ongoing, they have been going for 100 years. Other programs have been started recently, in a small way, with seed money, hoping they will develop. There are very few of them, and this sea-grant college program is one of them. To continue it at the proposed authorization level means a slowdown of the development of the program. The return per dollar spent, what this program can mean to the economic welfare of our people is such that, while perhaps the program cannot be expanded at the rate I would like, there is certainly no reason why the authorization should not be increased from what it was last year.

The CHAIRMAN. I think in terms of dividends, what ever you want to call it, the dollar invested in these programs will show up and you can pinpoint it. There is nothing intangible about it. It is there. In the field of fisheries alone, this amount is worth while. I am thinking in terms of American activity in the oceans of the world to establish some, not necessarily prior legal rights, but establish at least equal legal rights for these United States in the oceans of the world, and that alone needs this amount of money.

Senator PELL. From the viewpoint of the private sector of the economy, the fascinating thing today is apparently that it is the glamour industry of the future. People are trying to find programs or oceanologically oriented industries in which to invest. But at the same time, because the field is so new, private industry needs the fundamental research, technical research and applied research that this program and others would make available to it. You do not find this private investment in outer space programs. You find for every dollar spent in outer space, about 99 cents comes out of our pockets as taxpayers. In oceanology programs you would find the figure would be far less.

The CHAIRMAN. And marine engineering, marine technology is just beginning. And no one has ever suggested—take a comparable field, the land-grant colleges—the money we have invested in those to train people to take care of our land, conservation, and grow the food and all, has been one of the best investments we ever made in this country.

Senator PELL. This was the theory of Dr. Athelstan F. Spilhaus when he suggested the idea of sea-grant colleges. There is no reason why we can't take exactly the same concept and apply it to the sea and to agriculture in farming the ocean.

The CHAIRMAN. The land-grant college program has proven its worth way over in dollars and cents.

Senator PELL. Right, and that program was inaugurated with courage and vigor in the midst of the Civil War, when budget conditions were even more severe than they are today.

The CHAIRMAN. Senator Moss?

Senator Moss. I congratulate our colleague for the leadership he has shown in this area of study and exploitation of the sea. I am in accord with your views generally. I agree we are at the beginning and it would be tragic if it were slowed down so much that we couldn't continued to make progress.

The CHAIRMAN. I would think that in view of what the Congress did last week that a President of the United States or the President would like some flexibility such as we are suggesting here.

Senator PELL. Well, this House bill does—

The CHAIRMAN. I must say he is going to need it.

Senator PELL. Right. And this niggardly bill of the House would give him no flexibility. If there were worthy programs in other areas which are not now being funded, there would be very little room under this bill to do it. The program should be expanded.

The CHAIRMAN. All right.

We thank you very much. And you don't need to apologize for being late; we understand the problems that Senators have.

May I say we were a little late coming in here ourselves this morning.

Senator PELL. Thank you very much, Mr. Chairman. I have an attachment here that I wish to insert in the record.

(The attachment referred to follows:)

[From Science magazine, June 21, 1968]

SEA-GRANTS: DEMAND IS HIGH, BUT BUDGET IS LOW

In October 1966 the "sea-grant" college program was authorized by Congress, the program being so named by analogy to the land-grant college legislation of 1862. The program is now completing its first year since the appropriation of its initial funds, and its opening performance is getting mixed but generally favorable reviews.

By 1 July the Office of Sea Grant Programs of the National Science Foundation will have made grants totaling \$5 million to some 30 colleges and universities. That academicians have welcomed the program enthusiastically is evident from the fact that 170 grant applications and innumerable inquiries have been received. While the program is small, it clearly represents an important new attempt by the federal government to stimulate and support university education and research programs of a practical nature in the field of marine resources.

Some members of Congress have been impatient at the slow pace with which the sea-grant program began and the meagerness of the appropriations requested for it. The Special Senate Subcommittee on Science—whose two majority members are chairman Edward M. Kennedy of Massachusetts and Claiborne Pell of Rhode Island (who initiated the sea-grant legislation)—last month deplored the fact that the first grant was not made until February of this year, 17 months after the sea-grant legislation was enacted. The subcommittee charged, too, that the sea-grant budget for the next fiscal year is inadequate; the budget will, at most, be up only \$1 million over the present year and may be kept to its present level.

"If the administration and [NSF] do not ask for enough funds to support the applications from educational and training institutions throughout the country, then the sea-grant college program may be doomed to dilution and ineffectiveness," the subcommittee said.

No money was appropriated for the program until June a year ago, and this partly explains the delay in starting it. NSF scarcely can be blamed, moreover, for budgetary stringencies which make a major increase in next year's sea-grant budget impossible. The Foundation requested a sea-grant budget of \$15 million, but the Bureau of the Budget imposed a \$6-million ceiling. Leland J. Haworth, director of NSF, told a Senate appropriations subcommittee on 12 June that, unless \$30 million of a \$100-million House cut in NSF's appropriation is restored, the sea-grant budget will be reduced to \$5 million.

Despite his complaint that the sea-grant program was slow in starting, Senator Pell has said the program is now being well run. Representative Paul Rogers of Florida, who was the sea-grant bill's chief sponsor in the House, also has expressed approval of the small team which is administering the program with the help of project consultants and an advisory panel headed by Sanford S. Atwood, president of Emory University in Atlanta.

The University of Rhode Island, in Pell's home state, is among the first six universities to receive "institutional" grants, the other five being Oregon State, the University of Washington, the University of Hawaii, the University of Wisconsin (Great Lakes studies qualify for support), and Texas A&M University, Florida Atlantic University, a new state institution in Congressman Rogers' south Florida district, is one of more than a score of institutions to receive a "project" grant.

Applications for institutional grants are evaluated by Atwood and his panel as well as by the sea-grant office staff. Institutional programs must be broad in scope. The program at the University of Rhode Island, for which \$477,000 has been awarded, indicates the great variety of activities which may be included. Among other things it provides for graduate education in ocean engineering, oceanography, and fisheries; research concerned with organic extractables (food, drugs, and the like), ocean engineering and systems analysis, marine economics, pollution, and development and conservation problems; and a regional information program for the benefit of industry and the public.

Budgetary conditions permitting, the universities awarded institutional support this year will receive renewed support in succeeding years, with the grants becoming larger as the sea-grant programs expand. Moreover, such institutions will, within a few years, be formally proclaimed "sea-grant" colleges or universities if their programs develop satisfactorily.

Colleges and universities which do not yet qualify for institutional support, or which wish to mount marine-resources programs of lesser scope, may apply for project support. For example, Florida Atlantic University's \$193,000 project grant supports a cooperative education program in ocean engineering in which FAU students alternate between academic work and on-the-job training, with 6 months of study on campus, followed by 6 months with industry. Caltech has received a \$99,000 grant for a project in which commercially valuable kelp will be grown in the heated water discharged by industrial installations such as steam electric generating plants.

Robert Abel, director of the sea-grant program and formerly chairman of the Interagency Committee on Oceanography, says the program is beginning to encourage large-scale, complex projects of major economic value. Louisiana State University, for example, has been awarded a \$198,000 grant for a project to investigate the potential of Louisiana's vast marsh areas for aquaculture. The sea-grant office helped in the formulation of this project, and, as a mission-oriented agency, it will even be soliciting proposals for attacks on significant problems of resource development and conservation.

If the sea-grant program is allowed a \$6-million budget for the fiscal year starting 1 July, a few new project grants may be possible, Abel says. But, with less money than that, institutional programs and renewable projects may be supported at levels lower than the grantees had been led to expect. Thus, although the sea-grant program shows promise of eventually having a major impact, its immediate prospect is for little or no growth, and possibly for retrenchment.—LUTHER J. CARTER.

The CHAIRMAN. Thank you very much.

The committee will be in recess at the call of the Chair.

Thank you all. The record will be left open for 1 week for additional statements.

(Whereupon, at 12:05 p.m., the committee was adjourned, subject to the call of the Chair.)

(The following material was subsequently supplied for the record:)

ADDITIONAL LETTERS AND STATEMENTS

STATEMENT OF HON. HIRAM L. FONG, A U.S. SENATOR FROM THE STATE OF HAWAII

Mr. Chairman and members of the Commerce Committee, I appreciate this opportunity to express my views on H.R. 13781, a bill to provide authorization for funding the Sea Grant College and Program Act of 1966 for fiscal years 1969 and 1970. As approved by the House of Representatives, H.R. 13781 would authorize \$6 million and \$8 million for fiscal years 1969 and 1970, respectively.

The proposed ceilings, in my opinion, are definitely inadequate for carrying out the purposes of the Sea Grant Program effectively. As a cosponsor of the Sea Grant Act, I strongly supported its enactment mainly because the measure placed special emphasis on the practical aspects of developing our marine resources. The Office of Sea Grant Programs of the National Science Foundation, which administers the Act, has properly focused its efforts toward the main goal of the legislation—to exploit the ocean and its resources. This it is doing through grants for education, research, and advisory services. It has made a good start and should be encouraged to build a firm foundation for an expanded national oceanographic program.

Six Sea Grant institutional programs were initiated in the current fiscal year. NSF anticipates receiving proposals for institutional grants from as many as four high quality institutions in fiscal year 1969, plus a number of others in fiscal year 1970.

At a time when marine science and technology have attracted and promoted more national interest in its practical benefits and potentials than ever before, it would be shortsighted to restrain the Sea Grant program. Any dampening of support by the Federal Government at this crucial point could have serious, adverse effects on many fronts.

Institutions which have already begun Sea Grant activities with fiscal 1968 funds at a minimum level would be curtailed from moving forward as vigorously as they anticipated. Those institutions which have already received some planning money preparatory to submitting proposals next year or which expect to apply in 1970 will be similarly discouraged. The uncertainty of adequate funding will lessen the enthusiasm so necessary in assuring the success of Sea Grant programs on a national basis as contemplated in the Sea-Grant Act.

Besides the academic community, the private sector of our economy would react adversely to the slackening of Government plans to invest in oceanics. Unlike outer space projects, which are almost completely financed by the Government, ocean-oriented projects are being heavily financed by private industry. It is my feeling that the Government should do more to supplement industry's role in marine affairs than is now the case. The Sea Grant Program is the ideal vehicle for demonstrating Government's back-up role for more effective use of the seas through education, training, research and information transfer.

Beyond the institutional-type Sea Grant support, financing of Sea Grant projects for short-term, specific purposes should be adequately funded. A total of 27 Sea Grant projects—as distinguished from the six institutional-type grants—were funded this fiscal year. Because project-type grants are intended to bring relatively rapid, tangible returns, they should be continued and expanded through adequate appropriations.

The level of funding to assure continuity and enhancement of both institutional-type grants and projects will be inadequate under the authorization ceilings proposed in H.R. 13781 for fiscal years 1969 and 1970.

The handicaps under which the Sea Grant Program will be forced to operate in the next two fiscal years, if the ceilings proposed become law, can be seen in terms of the original requests made for the Program.

The National Science Foundation requested a \$15 million ceiling for fiscal year 1969. The National Council on Marine Resources and Engineering Development—the Cabinet-level council chaired by the Vice President and directed by the Sea Grant Act to advise the NSF in this area—recommended \$10 million.

Moreover, the House Subcommittee on Oceanography unanimously recommended \$18 million for each of the next two fiscal years when all Members of the Subcommittee cosponsored H.R. 13781.

Nevertheless, the House Committee on Merchant Marine and Fisheries drastically reduced the recommended authorizations to \$6 million and \$8 million for fiscal years 1969 and 1970, respectively. The House of Representatives then approved those figures.

The \$6 million proposed in H.R. 13781 for fiscal year 1969 is only \$1 million more than was available in the current year. However, as of this date, the overall NSF appropriation for fiscal 1969 has been cut by the House to a point where the Director of NSF has announced that he would be forced to reduce Sea Grant funds to the fiscal year 1968 level, or \$5 million.

According to the NSF, all but \$100 of the full \$5 million available this fiscal year has been obligated. To continue the newly funded institutional and project grants at a level above bare survival and to finance incoming requests for additional worthy grants from fully qualified institutions will far exceed the \$6 million proposed in H.R. 13781 for fiscal year 1969.

As I stated at the outset, the intent of the Sea Grant Act is to emphasize the practical aspects of ocean-related activities; in short, the harvesting of dividends from seed money invested in the development and exploitation of marine resources.

In a time of budget-tightening, this Congress should give high priority consideration to those Federal programs which can maximize revenues needed by the Government with modest expenditure of public funds.

The Sea Grant Program deserves such high priority consideration.

If the Committee is not agreeable to the NSF suggestion for an open-ended authorization bill, the passage of an authorization bill with substantially higher ceilings than those specified in H.R. 13781 for fiscal years 1969 and 1970 is essential for the continuation and strengthening of the Sea Grant Program.

Therefore, I strongly urge this Committee to give Congress the flexibility it should have in funding the Sea Grant Program by approving an authorization of \$10 million for fiscal year 1969, as recommended by the National Council on Marine Resources and Engineering Development, and \$15 million for fiscal year 1970.





