

A Special Report  
by the  
Committee on Oceanography

DATA LIBRARY  
WOODS HOLE OCEANOGRAPHIC INSTITUTION

A Review of  
"OCEANOGRAPHY 1960 to 1970"  
and Comments on the  
Interagency Committee on Oceanography  
Fiscal Year 1962 Program

August 1961

GC  
57  
.C6  
1961



A Special Report  
by the  
Committee on Oceanography

DATA LIBRARY  
WOODS HOLE OCEANOGRAPHIC INSTITUTION

A Review of  
"OCEANOGRAPHY 1960 to 1970"  
and Comments on the  
Interagency Committee on Oceanography  
Fiscal Year 1962 Program

August 1961

MBL/WHOI



0 0301 0034047 7

DATA LIBRARY  
WOODS HOLE OCEANOGRAPHIC INSTITUTION

TABLE OF CONTENTS

	<u>Page</u>
I Introduction	i
II Review of Committee Reports	
A. Education and Manpower	3
B. New Ships	5
C. Shore Facilities	9
D. Ocean-Wide Survey	16
E. Engineering Needs	20
F. Radioactivity	23
G. Ocean Resources	25
H. International Cooperation	30
I. Basic Research	31
III Legislative Activities	34
IV Other Items	
A. Medical Aspects	35
B. The National Oceanographic Data Center	35
V Interagency Committee on Oceanography Program	
A. Department of Defense	36
B. Department of Commerce	38
C. Department of Interior	40
D. National Science Foundation	43
E. Atomic Energy Commission	44
F. Health, Education and Welfare	44
G. Treasury Department	45



REVIEW OF "OCEANOGRAPHY 1960 TO 1970"  
AND COMMENTS ON THE  
INTERAGENCY COMMITTEE ON OCEANOGRAPHY  
FISCAL YEAR 1962 PROGRAM

I. INTRODUCTION

The first chapter of the Committee on Oceanography report Oceanography 1960 to 1970 - "Introduction and Summary of Recommendations" was presented to the government agency sponsors, the scientific community and the Congress in February 1959. During the past two and one-half years chapters on basic research, resources, defense applications, artificial radioactivity, new research ships, engineering needs, education and manpower, ocean-wide surveys, international cooperation and a summary of the status of U. S. oceanography in 1958 have been prepared and widely distributed.

The scientific community, the government agencies and the Congress have all reacted to these reports, and a great deal of public interest in oceanography has developed. Bills on oceanography have been introduced in the House and the Senate. Congressional hearings have been held, and several Senators and Congressmen have played an active role in investigating the country's needs in the marine sciences and in encouraging cooperative planning and budgeting by the Federal agencies.

At the same time, we have seen the development of a new way of coordinating and planning the support of an area cutting across many agency lines. The Interagency Committee on Oceanography of the Federal Council on Science and Technology, under the able chairmanship of Secretary Wakelin, has been instrumental in developing a strong core of responsible leadership and effective coordination of the various agency programs in oceanography.

At this time, it seems both appropriate and useful to review our two and one-half year old Report and to make specific comments on the recent report of the ICO, "United States National Oceanographic Program, FY 1962." Since these two reports are organized differently we have not tried to review them both at once. Because both reports are concerned with a national effort

in oceanography the sections in this review are closely inter-related. Section II is mainly concerned with our report. Comments on the ICO program are contained in Section V. In cases where comments apply almost equally to both sections appropriate cross references are made.

We have enjoyed a most cordial relationship with the members of the ICO, the staff of the Federal agencies, members of the Congress and the scientific community. We hope that this report will be useful as a gauge of the progress achieved thus far toward the development of a "National Oceanographic Program" and of the critical problems that lie ahead.

## II. REVIEW AND ANALYSIS OF "OCEANOGRAPHY 1960 TO 1970" AND SOME COMMENTS ON THE ICO PROGRAM

### A. Education and Manpower\*

We agree with and reemphasize the statement in the ICO Report, that the education of young scientists is the most important part of our long-range national program. The situation is improving. Oceanography departments in universities report a distinct increase in student interest in the last two years, amounting in some cases to a flood of applicants. This is almost certainly due to the increased public interest in oceanography and to better financial support for the field. It has been possible to increase the enrollment of well-qualified candidates some 50-100% in those institutions having the necessary space and funds. Other institutions have been unable to increase their graduate student bodies in spite of increases in the number of applicants because of lack of space or funds for support. Those institutions which have increased their student bodies can go no further because of lack of space.

There has been a tendency in the last two years to liberalize policies for granting federal aid to oceanographic education. Some agencies now make grants providing direct support for thesis research. To a limited degree, training grants have been made available through the National Science Foundation and the Department of Health, Education and Welfare. The Office of Naval Research contract research program continues to provide a most valuable source of support for graduate research assistantships. By general support of basic research institutions, ONR has developed a stable and beneficial atmosphere for long range research programs in which graduate students can be supported. Ford Foundation fellowships totalling about one million dollars also have become available to some oceanographic institutions.

---

\*Comments in this Section apply to our Chapters 1 and 8 and to NSF, HEW and ONR programs.

In short, there has been an improvement in the number of qualified candidates for graduate training, in the amount of money available for their support, and in the development of administrative policies which make it possible to utilize federal funds more effectively. However, this growth is less than optimal, and most of the problems that faced the Committee two years ago are still with us. The shortage of trained personnel, particularly in physical and chemical oceanography, is still acute. Expansion of training programs in most of the laboratories is now inhibited by one or more of the following major limiting factors:

(1) Lack of physical facilities. An adequate teaching program requires both ships and shore-based facilities, and both are in short supply. Few institutions can materially increase their present number of students without obtaining more laboratory space.

(2) Inadequate number of teachers. Oceanographic faculties are gradually increasing, but most of them still need diversification and strengthening, (particularly in physical oceanography) in order to develop a well rounded curriculum. Thus far there has been no federal support for teaching as recommended in our report. We still look for expenditures by the Office of Education, NSF and the Public Health Service to develop and strengthen those oceanography departments currently trying to expand their teaching efforts.

(3) Lack of financial support for graduate students. The support of graduate students in oceanography poses special problems to universities. Graduate students in the basic sciences, such as biology and physics, obtain a substantial proportion of their support through teaching assistantships and help in the instruction of the undergraduate body. Oceanographic teaching, on the other hand, is almost exclusively at the graduate level. With no undergraduates in their departments graduate students are cut off from this source of support. The critical period is normally the first two years, when graduate students are occupied with course work. This is the time when

training grants or fellowships would be particularly useful. Once thesis research has been started, the student can be supported through the remainder of his student career by a research grant or contract.

NSF support of research programs has increased and part of this support can be used for graduate students working on research programs. We continue to believe that direct NSF support of graduate students, either through training grants or through cooperative fellowship programs with oceanographic departments would be most valuable. The value of this type of support has been demonstrated by the Public Health Service and the Office of Education.

In summary, the stage is set for expansion of education and teaching in oceanography. There is increased student interest and the beginning of the development of effective mechanisms of financial aid for them. We recommend that the annual level of support for education and training originally suggested in Chapter I of our report be doubled. In-service training for technicians and scientific staff of Government agencies also should be increased. Actual accomplishments remain relatively slight. A broadly-based program of support is required including ships, laboratories and classrooms, teaching positions, and student stipends. The National Science Foundation should play a more vigorous and direct role in supporting graduate students.

#### B. New Ships for Research, Development and Surveying\*

During the last two years a promising beginning has been made in the design and construction of new ships. In the Department of the Navy a continuing program for construction has been formulated and set in motion (one small ship has been built and construction contracts for three large ships - one for basic research and two for applied work - have been let to date). The National

---

\*Comments in this Section apply to our Chapter 1 and 6 and to Navy, C&GS, NSF, BCF, Maritime Administration and U.S. Coast Guard programs.

Science Foundation has provided funds for the design and construction of a research ship. The Bureau of Commercial Fisheries is building three ships to replace existing hulls.

By far the largest part of the budget for new construction is for ships for applied research and development and for surveying. The Coast & Geodetic Survey, the Bureau of Commercial Fisheries, and the Navy all have budget items for such ships. These ships can be put to work on important development work and on the ocean-wide survey as soon as they become available. New ways of world-wide precise navigation will soon be available. This will be of great importance to the ocean-wide survey program.

In terms of total tonnage new ships are coming into being almost as rapidly as the Committee had hoped. They will be excellent ships and if present plans are followed, we will soon have more adequate ships at sea.

The design studies carried out to date strongly support our original recommendation that ships especially designed for marine science can be much more efficient than existing ships, which for the most part are conversions. To date, however, no newly designed ships have been delivered and subjected to the test of actual operations.

We continue to emphasize the need for adequate advance design work on each of the new ships. Each must be designed for, and in close coordination with, the future operator. Each, in a particular class, should be a step forward in the evolution of research ships and not a carbon copy of an existing "adequate" design. The "savings" which might be achieved by constructing a fleet of one-design hulls will be lost by the earlier obsolescence of these new ships.

#### Operating Costs of Research Ships

At present, two ships in the 1400 ton class are assured for basic research. Budgeting for operation of

the 1400 ton USF ship has not received much attention. The operating costs of this and other USF ships should be part of the long range programs of the USF and the Navy. As the Committee originally recommended, at least part of the operating costs of the larger ships should be provided by facilities contracts and institutional grants or they will tend to be diverted for use on applied problems.

### Ship Sizes

The size ranges outlined in our original report should not be interpreted too literally. In all cases we were referring to approximate displacement loaded tonnages.

There is little enthusiasm within either the Hydrographic Office or the Coast & Geodetic Survey for ships of the 500 ton class for ocean-wide surveys. Preliminary design studies for survey ships by these two organizations have been directed mainly toward larger and more expensive ships.

During the past two years both the Navy and the National Science Foundation have supported the design and construction of ships in the 1200-1500 ton class. One 600 ton 140 foot catamaran is being designed for the University of Miami Marine Laboratory under USF sponsorship, and another catamaran design is well along at Johns Hopkins. Recently FY 1962 support for a 3000 ton C&GS survey ship was included in the President's message on oceanography to the Congress. The Committee is on record as strongly endorsing the design and construction of this ship. We also recommended in our letter of endorsement that:

"Concurrently with the design of a 3000 ton open ocean survey ship, a systems study of the entire ocean survey problem should be carried out by contract with a competent industrial group. Survey ships of this size must utilize the best of modern instrumentation and technology to assure their favorable competition both operationally and economically with smaller ships."

No study of this sort is underway (or as far as we know, even planned). We must reemphasize the need for this study. The best available design and operational evaluation talent should be called upon to assure the development and construction of the best possible ships in each of the recommended classes. We need not hold back in the commitment of funds for construction while awaiting the results of these studies. Clearly large and small ships are needed both by government agencies and the private laboratories and they are needed soon. Operational experience with each class can guide the future emphasis as to numbers of ships in each size class.

### Legal Requirements

Research ships need to carry about twice as many people as commercial ships of comparable size and at the same time require ample space for laboratories and storage. Even so, existing legal requirements for living accommodations, safety and licensing of crews in research ships operated by non-government agencies have not become a limiting factor in the design of ships in the 1400 ton class. This may not be the case when the design of a ship in the 500 ton class is attempted. One problem centers on the present requirement for the use of lifeboats rather than rafts. It is perhaps significant that the smaller ships now being designed or constructed for the private laboratories are all less than 300 tons and therefore avoid most of the existing regulations.

### Continuity of Design Development

On the whole, the design of new ships for marine science has proceeded smoothly, if somewhat slowly. Since a number of agencies are involved and since the economics of the operations of these new ships have not yet been squarely faced, leadership is needed within the government to assure that we end up with a fleet that is efficient for the many different kinds of work to be done. It was originally recommended by the Committee that the Maritime Administration should be asked to give advice in these problems and this still seems a good recommendation.

## Nuclear-Powered Ships

Two years ago it seemed to the Committee that the use of nuclear power in the larger research ships was beyond the technological possibilities of the next ten years. This matter is at present being seriously explored in Norway. It should receive some attention in this country because the realization of relatively small and quiet nuclear power plants now seems less remote.

### C. Shore Facilities for Basic Research\*

In November of 1960 the Committee sent a letter to the directors of twelve oceanographic laboratories asking for specific information concerning their immediate (1 to 5 year) and long term (6 to 10 year) needs for shore facilities. The replies indicated that our original review grossly underestimated the need for such facilities. Most of the oceanographic laboratories are now seriously overcrowded and require much more space for machine shops, libraries, classrooms, laboratories, offices and special facilities simply to meet current requirements. Their shore facilities have not kept pace with their growing activity and increased demand for research in the marine sciences.

The original report in Chapter I, "Introduction and Summary of Recommendations," recommended only \$16.5 million over a ten-year period for basic research shore facilities. Our more recent review now shows that more than this total is actually needed to meet the immediate needs of the laboratories included in the survey.

We must revise our original estimate for the 10 year period and emphasize the urgency of taking immediate action to provide adequate shore facilities.

---

\*Comments in this Section apply to our Chapter 1 and to programs of NSF and the Navy.

### Summary of Immediate Needs

In the tables that follow, the responses from 12 oceanographic institutions and laboratories are summarized. We have identified immediate (1-5 year) needs as compared with requirements for a second 5-year interval. Only two laboratories (Texas A & M and Oregon State College) have comparatively modest requirements for the first 5-year interval as compared with the second 5-year interval. However, in both cases their short term requirements are critical. Only one laboratory (the Bingham Oceanographic Laboratory) did not make a specific, urgent appeal for funds for new construction or renovation and remodeling of existing buildings.

Only one laboratory (The University of Miami Marine Laboratory) felt that with the additional facilities requested during the first 5-year interval, they would be able to develop to a size and capability commensurate with their future interest and needs.

Within the next five years, approximately \$13.8 million is needed for new laboratory space, \$0.5 million to remodel and renovate existing buildings, \$6 million for new port facilities, \$1 million for special aquaria, radiological laboratories, seawater systems, etc. and \$1.5 million for library facilities for the 12 institutions queried.

The survey did not include the shore facilities needs of the Navy, the BCF, the C&GS, other Federal agencies, or state fishery laboratories. Less than half of the laboratories operated by universities and foundations are included. Although most of the non-Federal laboratories not included in the survey are small, some of them should expand several fold to meet national needs. Assuming an average of \$300,000 needed for shore facilities by each of 20 laboratories adds \$6 million to the amount needed for the next five years for a total of about \$29 million.

Although the information received is not complete, a total of about \$25 million is also needed for the second 5 year period.

There are many problems to be faced before adequate shore facilities can be provided. Although the Navy has a dominant role to play in the national program, this agency may not be able to foster the needed construction of shore facilities for non-Federal laboratories at a rate commensurate with existing and projected requirements unless its policies are liberalized by Congress. We recommend that the National Science Foundation, the Navy and private foundations play major roles in providing new shore facilities.

The information contained in this section is based solely on our survey of November 1960 and must not be interpreted as a commitment or a limitation of any of the laboratories.

TABLE I

## SUMMARY OF CONSTRUCTION FUNDS NEEDED FOR NEW SHORE FACILITIES

(IN THOUSANDS OF DOLLARS)

Lab	Facility	Thous. Sq. Ft.	First 5 Yrs.	Second 5 Yrs.	T o t a l s	
					First 5 Yrs.	Second 5 Yrs.
			\$	\$	\$	\$
SIO	New Labs & Classrooms	30	1,600			
	Marine Bio. Lab	12	700			
	Experimental Tanks, etc.	-	250			
	Docks & Marine Facilit.	-	600		3,150	
	New Labs, Shops, Office, etc.	90		5,690		5,690
WHOI	New Labs	55	2,900			
	Piers & Marine Facilit.	-	3,000			
	Aquaria, Special "	-	150		6,050	
	New Labs	84		5,000		5,000
TEXAS	Renovate Labs	13	165		165	
A & M	New Labs	60		3,600		
	Renovate Labs	-		150		3,750
LAMONT	New Labs	13	800			
	Docking, Shops, etc.		742			
	New Dorms & Cafeteria		500			
	Renovate for Library		150		2,192	
	New Labs			1,500		
	New Library			75		
	New Dock Facilities			1,500		3,075
BING- HAM	New Labs			1,000	None	1,000
COLL. OF THE PACIFIC	Renovate Library	-	20			
	Seawater System & Spec.	-	16			
	Dormitory & Cottages	5	90	no info	126	no info
U.S.C.	Renovate Lab	75	75			
HAI- COCK	Aquaria, Special Equip	80	80			
	New Library	20	600	no info	755	no info
U of ALASKA	Renovate Lab	10	200	no info	200	no info

TABLE I (continued)

<u>Lab</u>	<u>Facility</u>	Thous. <u>Sq. Ft.</u>	First <u>5 Yrs.</u>	Second <u>5 Yrs.</u>	T o t a l s	
					First <u>5 Yrs.</u>	Second <u>5 Yrs.</u>
			\$	\$	\$	\$
JOHNS	New Labs	18	1,080			
HOPKINS	Aquaria, Special Labs	1	600	no info	1,680	no info
MIAMI	New Labs	27	1,400	none req.	none req.	
	Environmental Lab & Special Facilities	16	600			
	New Library	2	500		1,480	
OREGON	New Lab & Shop	40	600		800	
STATE	Port Facilities & Shop	10	200			
	New Lab & Classrooms	40		660		
	Coastal Lab & Shop	30		500		1,160
	Equipment					
U of WASH	New Labs & Classrooms	140	4,700			
	Port Facilities & Land	-	1,500			
	Renovate Library	-	250	no info	6,450	no info

TABLE II

## "IMMEDIATE" AND "LONG RANGE" SUMMARY

(IN THOUSANDS OF DOLLARS)

	<u>Total First 5 Years</u>	<u>Total Second 5 years</u>
BINGHAM	none	1,000
SIO	3,150	5,690
WHOI	6,050	5,000
TEXAS A&M	165	3,750
LAMONT	1,742	3,075
COLLEGE OF PACIFIC	126	no info
U.S.C.	755	no info
U of ALASKA	200	no info
JOHNS HOPKINS	1,680	no info
MIAMI	2,500	none req.
OREGON	800	1,160
U of WASHINGTON	6,450	1,160
	<u>\$ 23,618</u>	<u>\$ 19,675</u>

TABLE III

DETAIL OF FIRST 5-YEAR REQUIREMENTS  
(IN THOUSANDS OF DOLLARS)

A. Classrooms, Shops, Offices, etc.

	<u>New Space</u> <u>Thous. Sq. Ft.</u>	<u>Cost</u>	<u>Renovate</u> <u>Space</u>	<u>Cost</u>
SIO	42	\$ 2,300	-	-
WHOI	55	2,900	-	-
TEXAS A&M	-	-	13	165
LAMONT	13	800	-	-
COLLEGE OF PAC.	-	-	5	90
HANCOCK	-	-	-	75
U of ALASKA	-	-	10	200
JOHNS HOPKINS	18	1,080		
MIAMI	27	1,400		
OREGON	40	600		
U of WASH	<u>140</u>	<u>4,700</u>		
	\$335	\$13,980	28	\$ 530

B. Port Facilities

C. Library Needs

	<u>Cost</u>		<u>Cost</u>
OREGON	200	U of WASH	250
U of WASH	1,500	COLLEGE OF PAC.	20
LAMONT	742	HANCOCK	600
WHOI	3,000	MIAMI	500
SIO	<u>600</u>	LAMONT	<u>150</u>
	\$ 6,042		\$ 1,520

D. Special Facilities - Aquaria, Seawater Systems, etc.

Summary

COLLEGE OF PAC.	16
HANCOCK	80
JOHNS HOPKINS	600
MIAMI	600
SIO	250
WHOI	<u>150</u>
	\$ 1 696

#### D. Ocean-Wide Surveys\*

The ocean-wide survey program has caught the interest of two agencies--the U. S. Hydrographic Office and the Coast and Geodetic Survey. The Coast & Geodetic Survey has initiated a special open ocean survey designed to test procedures for both the "continuous underway" and the "stop and go" type of survey. The Coast & Geodetic Survey ship, PIIONEER, started this "pilot" study between the Aleutians and Hawaii this spring. Similar work with the Hydrographic Office ship, REHOBOTH, in the equatorial Pacific from 120° to 180° west and 10° south to 20° north was also started during the spring of 1961.

##### Planning

A U.S. ocean-wide survey program is well along in the planning stage staffed and sparked by the Hydrographic Office. Although still under development, the program mainly reflects the operational requirements of the agencies. However, the U.S. program must recognize the need for close international cooperation and coordination. We must be able to justify priority assignments on scientific and international cooperative grounds when we go into the international arena to negotiate the necessary coordination of planning and exchange of data.

In planning the survey program the value of reconnaissance surveys should not be overlooked. The areas of high priority for reconnaissance surveys will be different than the priority areas for detailed surveys. Priorities for the latter may depend on navigational limitations and immediate military and fisheries requirements. But general knowledge of a relatively unknown area can become very important almost overnight and time and inaccessibility may not allow proper investigations after the information is needed.

Although the Navy, the Coast & Geodetic Survey, the Atomic Energy Commission, the Weather Bureau, the Coast Guard, the Bureau of Commercial Fisheries, and the scientific community are cooperating in planning this program, only the first two have any new money in their budgets for surveys.

---

\*Comments in this section apply to our Chapters 1 and 9 and mainly to programs of the Navy and the C&GS.

### Survey Instrumentation

During the past year the Office of Naval Research and the Hydrographic Office have taken steps to bring into being new, more and better instruments for survey data collection. Funds (totaling about 2½ million) are budgeted for survey instruments, instrument research and development, ocean buoys, etc. Among the factors to be considered in the development of survey instruments is adaptability to automatic data processing, for example by digital recording.

Complete systems studies of survey instrumentation and data collection should be carried out by a competent group. We place such a study as a high priority item. We must be able to bring the best of modern technology and systems analysis to bear on this problem. The instruments, the telemetering, the data processing systems and the ships we build over the next few years can be much more efficient than those we now use. If they are not they will be obsolete when the survey is well under way. We urge the ICO to take steps to see that such studies be carried out under the guidance of a special subcommittee.

### Operations

The Coast & Geodetic Survey, the Hydrographic Office, and the Bureau of Commercial Fisheries should play a major role in the ocean-wide survey program. Other agencies such as the Coast Guard, the Weather Bureau, the Atomic Energy Commission, and the Geological Survey, should also cooperate actively in planning, funding, and participation by personnel and ships where feasible. At the same time, the agencies should turn partly to oceanographic institutions and engineering exploration groups for cooperation and special assistance.

### Survey Ship Construction

The Navy has funded or is building several survey and military R&D ships. The first Navy survey ship (a 1300 ton AGS) is funded in FY 1962 and will go to the Hydrographic Office for special military surveys. A 2500 ton "world ocean survey" ship and a 4100 ton coastal surveyor are

scheduled for FY 1963. Thanks to the President's message (and hard work by ICC staff) a 3,000 ton ocean survey ship is in the FY 1962 budget for the Coast & Geodetic Survey as well as a 1,200 ton and a 750 ton ship. It is illuminating to compare the recommended and planned new construction in terms of survey ships to be in operation by 1964.

Recommended and Planned New Survey Ship Construction  
(in operation by 1964)

<u>Agency</u>	<u>Recommended</u>	<u>Planned</u>
Navy	2 500 ton* 3 1200 ton	1 2000 ton
C&GS	2 500 ton 4 1200 ton <u>1</u> 2000 ton 12	2 500 ton 2 1200 ton <u>2</u> 2000 ton 7

<u>Tonnages</u>	<u>Recommended</u>	<u>Planned</u>
500	4 ships	2 ships
1200	7	2
2000	<u>1</u>	<u>3</u>
	12	7

\*Approximate tonnages.

The question of ship sizes will remain, but differing opinions must not be allowed to cloud the need for a few new ships in each size class soon. (See Section II-B on Ships)

Getting Started

Above all these considerations we should keep in mind that a deep sea survey program can be and should be started now with existing methods. The development of instrumentation and speed up of obtaining data can be carried out simultaneously. Improved techniques could then be introduced in the survey program as soon as they are ready.

A modest beginning has already been made. The U. S. Coast & Geodetic Survey ship PIONEER, and the Hydrographic Office ship REHOBOTH are already at work. The Navy is planning significant support for survey instrument development but nothing has yet been done.

### International Cooperation

In order to reduce costs to the United States and to speed up the program international coordination is essential to the ocean-wide surveys. The new International Oceanographic Commission of UNESCO should be encouraged and used as a means of developing this coordination. Bilateral agreements should also be used. The establishment of regional commissions or councils should be seriously considered by the State Department.

### Shore Facilities

Except for modest funding of the National Oceanographic Data Center, there is no evidence that steps are being taken (or considered) to budget for the increased shore facilities needed to back up the increased ocean-wide survey program.

### Funding

About 1½ million dollars new money will be available for the Coast & Geodetic Survey in FY 1962 for ocean survey operations. This start has not been matched (to date) by the Navy.

Money should be budgeted soon for shore facilities. Money should be available in FY 1962 for a systems study.

It is becoming more and more difficult to determine how much new money is available for oceanography as this already generalized term becomes more general and more respectable. This is particularly true for the ocean-wide survey program. Will the 3,000 ton ships assigned to the Hydrographic Office be used for ocean-wide surveys or applied R&D? Should new instrumentation be charged off to the survey program or to classified projects? We know that the ICO is trying to keep these and other questions in mind as reviews and evaluations, plans and budgets for the national oceanographic program develop. This is not easy.

## E. Engineering Needs for Ocean Exploration\*

During the past two years many more people in government, industry, and oceanographic laboratories have become aware of the need for, and the feasibility of better oceanographic instruments. Some new instrument programs have been initiated, and better instruments are in the discussion stage.

In some small areas progress is as good as recommended but on the whole, progress has been only about half of our earlier recommendations. There has been a serious lack of funding for feasibility studies of advanced design instruments and vehicles and for building prototypes of production instruments. The fact remains that it is generally harder to obtain a small amount of money for preliminary design studies for new devices and ships than it is to find large sums for construction based on existing types or hurry-up designs with only marginal improvements. Funding procedures must include more money earmarked specifically for studies of advanced devices which show promise of greatly improving our ability to do research or conduct surveys.

### Survey Instruments

During the past year it has become apparent that survey instruments can be built which will permit much better surveys to be made than were practical even to consider a year ago. One example is that through the TRANSIT navigation satellite of the U. S. space program, accurate navigation over all oceans and in all weather may be available much sooner than we had dared hope. A second example is that it now appears feasible to build echo sounders that provide a three-dimensional picture of the bottom over a wide path on each side of the ship instead of producing only a single line of soundings underneath. Such an echo sounder should revolutionize the ability of a ship to explore, survey and chart bottom features.

Standardization and prompt production are required of many of the instruments commonly used for basic research and survey. Examples of such instruments are: winches

---

\*Comments in this Section apply to our Chapters 1 and 7 and to the programs of the Navy, NSF, AEC and the BCF.

with electric cables, towed temperature recorders, magnetometers, recording buoys, echo sounders, special navigation aids, etc. Having a small stockpile of such instruments that could be loaned during international cooperative programs would pay rewarding dividends. Recent meetings sponsored by OLR and the Hydrographic Office have emphasized such instruments and have tried to define acceptable specifications for many of them. However, funding for any reasonable number of prototypes or for production has not yet begun.

#### New Research Instruments

ONR, USF and AEC have increased their support to individuals and groups, building new instruments for individual research problems. This trend is to be commended as is their general policy of keeping instrument development closely tied to active research programs.

#### Deep Manned Vehicles

During the past two years the bathyscaph TRIESTE has made a record dive to the deepest part of the oceans, but it has not had mother ship support for oceanographic research. Similarly on the East Coast the deep submersible program involving ALUMINAUT is nearly underway, but the problems of an appropriate mother ship have yet to be solved.

Specific design studies on smaller submersibles that can be carried easily on the deck of a medium or large research ship have not been adequately carried out nor is such a craft budgeted.

#### Unmanned Buoys and Radio Frequency Requirements

Although several unmanned buoy programs have been funded, and progress in this program is better than in any of the other recommended areas for devices, it is only half the recommended rate. This seems particularly unfortunate in view of the needs for better synoptic ocean studies and global weather predictions. Radio frequency channels for such buoys must be identified and reserved soon.

### Other Specialized Research Vehicles

The submarines NAUTILUS, SKATE, and SEADRAGON have shown that even a minor "protective ice suit" permits a nuclear submarine to have great mobility and usefulness in the arctic. A nuclear submarine appropriately designed or adequately modified could roam the arctic almost at will for oceanographic research, logistic support, or rescue work. Preliminary design studies on such a craft are lagging.

The preliminary catamaran research ship study sponsored through the National Science Foundation is another small but bold attempt to improve our seagoing capabilities in research.

Design work on a large mid-ocean anchored buoy is proceeding and it is hoped that construction will soon be funded along with an appropriate research program.

Even with major help from industry on production and design research, oceanographic laboratories need much more space and equipment for instrument design, construction, and modification.

### Summary

Although a good start has been made, action of the scope and magnitude recommended has not yet been taken. To pave the way for such action in Fiscal Year 1963 (none too soon) about \$500,000 FY 1962 funds should be made available by the Navy for a group of advance design and systems studies by competent groups in industry. Such studies are particularly needed in the area of survey instrumentation, where reasonable objectives can be determined.

## F. Radioactivity in the Oceans\*

Our report on Artificial Radioactivity in the Marine Environment was concerned both with problems of regulation and monitoring of the introduction of radioactive materials in the sea and the research needed to understand the results of this introduction so that regulations might be meaningful and effective and scientists and laymen be informed of the expected effects. A research effort at an annual level of \$6 million was proposed.

We proposed that the monitoring of radioactivity should be carried out by agencies other than the Atomic Energy Commission. During the last year, the Department of Health, Education and Welfare and the Fish & Wildlife Service have taken on increasing responsibilities for monitoring studies of the estuarine environment. Much more remains to be done.

The International Atomic Energy Agency has taken into consideration the need for international standards, methods, background data, and regulations for the control and disposal of radioactive materials in the sea, and a handbook of methods, procedures, standards, and regulations is being compiled. The working group on radioactivity of the ocean of the Special Committee on Oceanic Research is working together with the International Atomic Energy Agency in establishing an international laboratory at Monaco for the study of radioactivity in the oceans. Some Euratom nations have active programs for studies of the effects of the release of radionuclides into the ocean. Research and surveys for these purposes should also be considered by the Intergovernmental Oceanographic Commission of UNESCO.

The AEC research support of oceanography has increased by a factor of five over the last three years. Plans are under consideration to reach the proposed level of \$6 million in Fiscal Year 1963. The following table reviews growth in support of the various objectives outlined in our report.

---

\*Comments in this Section apply to our Chapters 1 and 5 and to the programs of the AEC, BCF and HEW.

<u>Activities and Research Tasks</u>	<u>Recommended Annual Cost (Thousands)</u>	<u>AEC Support</u>		
		<u>1960</u>	<u>1961</u>	<u>1962</u>
<b>Control and Monitoring</b>				
Engineering studies.....	\$ 350	324	281	240
International coordination.	20			
<b>Estuarine and Coastal Studies</b>				
Estuarine physical studies.	1,400	175	165	180
Coastal physical studies...	1,400	99	189	440
Research in the Open Ocean..	1,400	309	997	1,380
<b>Sedimentation Processes</b>				
Residence times.....	134	81	98	187
Inorganic transfer.....	350(1)	107	85	120
<b>Effects of the Biosphere</b>				
General problems.....	600	313	378	644
Elemental analyses.....	100	14	32	145
Ecological studies of disposal areas.....	238	128	133	199
Effects of Radiation.....	100	48	30	95
Biological Field Experiments.	100			
Large Open-Sea Tests.....	400 - 2,000(2)			
<b>TOTAL</b>	<b>\$ 6,192(3)</b>	<b>1,598</b>	<b>2,388</b>	<b>3,630</b>

- (1) \$165,000 for succeeding years.
- (2) This item excluded from total because estimates are considered too uncertain.
- (3) \$6,007,000 for succeeding years excluding Open-Sea Tests.

It is evident that the AEC through its Division of Biology and Medicine is seriously attacking all aspects of the research needed to understand the effects of introduction of radioactive elements into the ocean. Research carried out with their support should ultimately give the necessary background for successful prediction of these effects. The support given to research institutions will also create a body of scientists able to guide the national and international efforts to eliminate hazards connected with introduction of radioactivity into the

ocean. Actual expenditures by the AEC for parts of our recommended research program differ somewhat from our recommendations. This is to be expected. In new research programs rates of development should depend upon the availability and interests of competent scientists.

#### G. Ocean Resources\*

There appears to be increasing awareness among agencies concerned with marine resources, of the need for long-term basic research to enlarge knowledge of the existing and potential resources of the sea. However, an inordinately large share of funds has been devoted to short-term studies for immediate application, to the neglect of longer-term, more fundamental studies upon which future applications must be based. Such studies, designed to give an adequate understanding of the occurrence, behavior and potential harvest of fish and other marine organisms are essential to extensive economic development and utilization of marine biological resources.

In reviewing and assessing recent progress toward greater understanding of the resources in the sea, we find that:

1. In a number of government laboratories there are programs of study on particular fish and shellfish species of commercial importance. These laboratories should give more attention to broadly-based, comprehensive studies of marine communities and their inter-relationships if the goal of enlarging our knowledge of potential resources is to be achieved. Although some government laboratories are now orienting some of their research in this direction, the effort should be expanded and correlated with investigations underway at university marine stations.

---

\*Comments in this section apply to our Chapters 1 and 3 and mainly to the programs of the BCF.

2. The very small number of small-scale laboratory studies of the survival of young of commercially important marine pelagic species has not significantly increased in the past two years. However, there is provision for a modest start on this important problem at several BCF laboratories in the 1962 budget. Information to be gained from such investigations is crucial to understanding fluctuations in populations and hence to intelligent management and use of fishery resources.
3. Interest in fish behavior studies has increased and some projects are underway. Lack of both adequate aquarium facilities and sufficient trained personnel impede development in this field.
4. Some progress has been made on the development and use of anchored unmanned recording buoys.\* Two or three prototype instruments are currently in operation off California, and Baja California, financed, in part, by the Bureau of Commercial Fisheries. They are still far from the stage of development where they can be reliably employed in a wide-spread network. This stage could be reached soon if additional vigorous effort were devoted to their development. Equipment costs appear to have been correctly estimated. It is still too early to verify estimates for servicing and data reduction. Another buoy, financed by a National Science Foundation grant to the University of Washington is being developed for use on Cobb Seamount. The Woods Hole Oceanographic Institution is developing buoys.
5. Only very preliminary consideration has been given to the development and employment of mesoscaphes.\* Design and planning of such devices should be accelerated. Although the Navy should have a major interest in such devices, their uses for research on the living resources of the sea are also important. Mesoscaphes should be designed, built and operated by both the Navy and BCF.

---

\*See also Section E.

6. A few studies on the genetics of marine organisms are being carried out in university and private research laboratories and some progress has been made in serological research in government labs; however, these areas still remain largely neglected.
7. Although many investigations of the effect of added nutrients have been carried out in lakes, the results are unclear and no large scale experiments have yet been undertaken in the sea.
8. Some marine species have been transplanted with varying degrees of success. A recent example is that of the sardine transplanted by the Hawaii laboratory of the BCF. However, no carefully planned studies have been undertaken, and none appear to be developing.
9. The nature of aggregations of organisms in the sea is still mostly unexplored.
10. Planning for biological surveys has begun both in government agencies and in university marine laboratories. The mapping of parameters important to fisheries development should be made an integral part of all survey operations when the taking of these observations is compatible with other objectives. It is also important, of course, that biological mapping be adequately considered in its own right in the development of national plans for ocean surveys.

As noted in Section V-C, the item for "surveys" in the BCF 1962 budget is not, in fact, for the sort of survey recommended by this Committee.

11. We note with satisfaction that a National Oceanographic Data Center has been established with joint support of Navy, Interior, Commerce, National Science Foundation and AEC and that it gives promise of serving effectively both governmental and non-governmental needs. Adequate funding for the NODC is contained in the 1962 budgets of the sponsoring agencies.

12. Scientific, sociological and engineering studies of utilization of marine products in protein-deficient areas of the world are beginning to receive more attention. Perhaps the International Indian Ocean Expedition, now getting underway, the forthcoming International Conference on Fish in Human Nutrition, and new proposed programs for Central and South American development will provide the needed stimulus for further attention to these studies.
13. Economic and legal aspects of commercial fisheries, except for market statistics, continue to be ignored. This subject (like that cited in item 12), though apparently outside the usual type of study sponsored by the Bureau of Commercial Fisheries, is necessary to the effective development, support and planning of fisheries research.
14. No fundamental scientific studies of salt water fish pond culture have been started and apparently none are contemplated.
15. Manganese nodules continue to be reported by various exploration and research vessels but no consistent surveys have been undertaken. The Bureau of Mines is currently undertaking some analytical and sampling studies, and this work is being increased somewhat in 1962, but the funds for such studies are inadequate.
16. Estuarine areas continue to be lost to fisheries as industrial and domestic pollution of shallow waters continues. These important areas often serve as breeding or nursery grounds for commercial fish and shellfish species. Research directed to their preservation and development should be given high priority.
17. Interest in taxonomic and related studies has without question increased over the past two years. In university classrooms and laboratories, young scientists are turning more and more to this branch of biology. There is heartening indication of increased support from basic research funds, but it must be recognized that many years are required to overcome the neglect of the past. Support for the rehabilitation and expansion of museums has been forthcoming from the National Science Foundation.

18. Studies of the diseases and toxic effects of fishes and other commercially utilized marine species, despite the importance of this topic, are still largely neglected by government research agencies.

#### Ships for Resources Studies

The Committee in 1959 recommended the construction of fourteen new ships over a ten-year period, seven to replace existing ships to conduct needed research on marine resources, two of the new ships to be put into service in each year 1961 through 1966, and, in addition, one each in 1962 and 1963.

The BCF received in July 1960 appropriations for one new ship to replace the Albatross III which had earlier that year been retired from service because of extreme obsolescence. This Bureau has also removed from its service, during the last five years, two other research ships, the Alaska, which is on loan to the State of California, and the H.M. Smith, which is on loan to the Scripps Institution of Oceanography. The Black Douglas, BCF vessel based at San Diego, California, is being operated with a short crew and with inadequate maintenance, due to lack of funds. Although the BCF will fund three new ships (2 as replacements, one as an additional ship) in fiscal 1962, and will probably be able to support the Black Douglas properly, it would appear that we are not gaining much ground with respect to fisheries research ships.

#### Facilities

It is encouraging to see that the shoreside facilities of the Bureau of Commercial Fisheries will be notably augmented by the construction of a new laboratory building on the grounds of the Scripps Institution of Oceanography, and that this laboratory will provide space not only for Bureau scientists but also for scientific staffs of other, cooperating, fishery research agencies (governmental, university, and international). Important additions to the facilities of laboratories at Juneau, Alaska, Boothbay Harbor, Maine, and Oxford, Maryland are also being funded in 1962.

## H. International Cooperation\*

During the past two years there has been an increase in international cooperation in oceanography. Two recent developments are noteworthy. An Intergovernmental Oceanographic Commission of member states of the UN family desiring to cooperate in oceanic research and surveys is being organized under the umbrella of UNESCO. This organization should be useful in fostering cooperative oceanographic programs between the member nations and we urge its wholehearted support by the United States Government. Secondly, the International Indian Ocean Expedition (sponsored by SCOR and UNESCO) is well under way in the planning and early reconnaissance stages.

About a year ago, in response to a request from the Government, we proposed a plan for strengthening relationships between oceanographic centers in the United States and corresponding centers in Latin America. This was done at a time when tensions were particularly high between Latin America and the United States. We understand that this plan is now receiving renewed consideration by the President's Science Advisory Committee and the ICA. We hope that now action can be taken to implement this plan.

The Academy's Committees on Oceanography and International Relations are currently sponsoring a study (being carried out by the Marine Laboratory of the University of Miami) of ways and means of developing stronger relationships between Latin American and United States marine scientists. Reactions from Latin American scientists are being sought concerning the best mechanisms for such cooperation. One plan frequently referred to in the responses to this inquiry proposes a non-governmental Inter-American Council (or councils) for the exploration of the sea. Such a council (patterned after the famous International Council for the Exploration of the Sea) could help develop strong and warm ties between the marine scientists of our country and our Latin colleagues.

Specifically on the recommendations contained in Chapter I:

---

\*Comments in this Section apply to our Chapters 1 and 10 and to the programs of the NSF, State Department and ICA.

1. The National Science Foundation has contributed to the support of SCOR. Such support has been most useful and should continue.

2. Funds have been budgeted in NSF FY 1962 to support the International Indian Ocean Expedition. Continuing and close liaison is necessary between the Government agencies and the Committee on Oceanography to adequately plan and budget the remainder of the costs of this Expedition during FYs 1963 and 1964.

3. The Intergovernmental Conference recommended by the Committee was called by UNESCO and resulted in the establishment of the UNESCO Intergovernmental Oceanographic Commission.

4. Regional international organizations should continue to be supported. Other such regional organizations may emerge as the scientific capabilities of the developing countries and their needs for cooperation increase. These should be encouraged and supported.

5. The State Department is becoming more aware of the needs of marine scientists and more responsive to helping facilitate their research ship operations in foreign areas.

6. Except for one small expedition in the Gulf of Thailand and the South China Sea, the ICA has not supported cooperative oceanographic programs with other countries. Even this small project seems to have ended without generating much interest or understanding.

#### I. Evaluation of Progress in Basic Research\*

In Chapter I, "Oceanography 1960 to 1970" the IAS-NRC Committee wrote, ". . . The cornerstone of our oceanographic endeavors is basic research." and, ". . . The key to the growth of oceanography in the United States lies in basic research." The enduring truth of these statements needs to be constantly reemphasized.

---

\*Comments in this Section apply to our Chapters 1 and 2 and to the programs of the NSF, Navy, AEC, BCF, PHS.

In oceanography, as in other branches of science , the incessant demands of important, practical problems often overwhelm the quiet voice of basic research. This is most likely to happen in the mission-oriented federal agencies. The importance of fostering, supporting, and encouraging basic research, and of providing the intellectual atmosphere where enterprises in basic research may flourish, needs to be restated again and again.

We recognize that there is a continuous feedback between discovery and application, that reciprocal fertilization of ideas is important and does occur between basic and applied scientists. But the mutualism that should exist in funding these activities is all too often so heavily skewed in favor of applied science that little is left for support of basic studies. The Committee therefore expresses some concern that the Navy, for example, in enthusiastically embracing our recommendations for greater efforts in the applied marine sciences, and in moving vigorously to expand programs that are important to military defense, might inadvertently smother the Office of Naval Research. This Office has been the most important source of federal funds for studies in basic oceanography in the Nation's universities and research institutions. The Committee commends its enlightened research support policy, and urges that ONR support of the marine sciences be strengthened and continued.

Other federal agencies with directed missions support basic research in oceanography only to a limited degree despite challenging opportunities. The Atomic Energy Commission through its Branch of Environmental Sciences is an encouraging exception. Though its funds have been limited, this agency is supporting an increasing amount of basic research.

Participation in marine studies by the Public Health Service remains minor in spite of the potential importance that biological studies of marine organisms may have to medical and health-related problems. In the Bureau of Commercial Fisheries, there is considerable evidence of interest and desire to undertake the basic research necessary to provide information essential to informed

management of fishery resources. To date little progress appears to have been made toward translating plans into action. Strengthening the quality and increasing the amount of basic research in government fishery laboratories remains a high priority item.

Although we have emphasized our concern with the plight of our country's museums and the small amount of support available for studies on the taxonomy of marine organisms (Committee resolution of February 27, 1960) there is little evidence of improvement in this situation. The federal agency most involved, the U. S. National Museum of the Smithsonian Institution, is not represented on the ICO, yet the success of many government programs and surveys will depend upon accurate and prompt identification of the specimens collected. In this work, the U. S. National Museum must play a responsible role.

At present, the National Science Foundation is funding an increasing amount of basic oceanographic and marine biological research in the universities and research institutions. Considering that this is the federal agency charged with responsibility to encourage and support basic research in all branches of science, the increased interest in oceanography during the past two years, and the considerable expansion of financial support to this field is most heartening.

In this review of our report and the activities of agencies we wish to emphasize that our estimates for shore facilities for basic research made in 1958, were unrealistically low. (See Section II-C.) The same applies for our estimates of the funding needs for basic research programs apart from ships and facilities. While we are correcting the record we also wish to state that by listing the Navy and the National Science Foundation as joint underwriters for the basic research program we were emphasizing the natural and dominant role of these two organizations in basic research. Of course, all federal agencies with marine interests or missions need to support basic studies and maintain close and effective working relationships with the scientific community.

Finally, we wish to reemphasize that our recommendation for a "doubling of basic research activity during the next ten years" was (and is) a minimum recommendation and "that doubling the basic research activity will require more than doubling the total expenditures."

### III. LEGISLATIVE ACTIVITIES

The past two years have witnessed an increasing Congressional interest in oceanographic matters. During the last session of Congress extensive hearings were held by the Senate Committee on Interstate and Foreign Commerce, the Subcommittee on Oceanography of the House Committee on Merchant Marine and Fisheries, and the House Science and Astronautics Committee. However, the only bill to receive enactment during the 86th Congress was S. 2482 extending the area of operation of the Coast and Geodetic Survey from the limits of the continental shelf to the deep and wide reaches of the oceans. A bill S. 2692 covering the general expansion of oceanography, sponsored by Senator Magnuson and several other Senators, passed the Senate unanimously but did not get to the House floor. Several bills introduced by Rep. Miller of California, and others, provided a base for hearings but likewise did not reach the floor.

During the current session of the 87th Congress, Senator Magnuson has introduced a bill, S.901, rather similar to his previous bill. Hearings on this bill were held March 16-18, 1961.\* Rep. Miller has introduced two bills, H.R. 4276 and H.R. 4340, covering more specific subjects. Hearings on H.R. 4276 were held June 19-22, 1961 and on H.R. 4340 April 27, 1961. The House Merchant Marine and Fisheries Committee has formally reported out H.R. 4340 and a revised version of H.R. 4276 will soon follow.

Oceanography, being split as it is among several departments and agencies of the government, each with its own legitimate and long standing interest in different phases of the subject, does not fit in with the pattern of Congressional Committees, especially on budgeting matters. As a result there is an apparent (and natural but regrettable) lack of coordination between the two Houses of the Congress and their Committees.

In the Executive Branch, the Interagency Committee on Oceanography of the Federal Council on Science and Technology is operating quite satisfactorily. H.R. 4276 would establish a National Oceanographic Council having similar coordinating responsibilities to the ICO but with broader authority. We have recommended that such a council be established with an Advisory Committee made up of leading non-governmental scientists selected from a slate of nominations prepared by the National Academy of Sciences.

\*S.901 was passed by the Senate July 28, 1961.

#### IV. OTHER ITEMS

##### A. Medical Aspects of Oceanography

The medical implications of oceanography are revealed in studies of antibiotics, vitamins, toxins, and pharmaceutically important substances that are extractable from sea water or from marine organisms; in investigations of parasitism and pollution, and in the physiological activities of diverse marine creatures. Unsolved problems far outnumber those that are being attacked. Medically-oriented work with marine forms is handicapped by the general unavailability to medical scientists of space in marine laboratories. Moreover, the equipment, research facilities, supplies and financial support are generally much less in marine laboratories than in medical schools and research institutes, most of which are located far from the sea.

##### B. The National Oceanographic Data Center

The new National Oceanographic Data Center, now being organized jointly by the Navy, the National Science Foundation, the Bureau of Commercial Fisheries, the Atomic Energy Commission and the Coast & Geodetic Survey, can become an important adjunct to the country's basic research effort. This will be possible only if the director is a scientist, capable of recognizing the unparalleled opportunity for utilizing the accumulated data in his own research. The NODC can then become a major center for basic research. Otherwise it will function merely as an archive. If it is guarded by a jealous custodian it will be virtually useless; if its records are available, it will have a value in direct proportion to the ease and speed with which the data are retrieved and disseminated to the scientific community. We suggest that the NODC develop a "summer fellowship" program to encourage direct work with their data by marine scientists with specific problems.

## V. INTERAGENCY COMMITTEE ON OCEANOGRAPHY PROGRAM

The report of the Interagency Committee on Oceanography of the Federal Council for Science and Technology "United States National Oceanographic Program Fiscal Year 1962" marks a new and significant advance in the planning of the several Government agencies concerned with the oceans. The ICO has done an excellent job of coordinating and developing these programs. It is clear that there is good cooperation, good direction and a sense of unified national purpose throughout the report. In the sections that follow we analyze the agency programs (as we understand them) in some detail.

### A. Department of Defense

#### Navy\*

The Navy reports a \$10 million increase from Fiscal 1961 to FY 1962 (45%) totalling \$32,270,000 for 1962. This increase is almost entirely accounted for by three ships (two for military research and one for military survey activities). We are happy to see more ships being funded and realize that ships come in larger budgetary packages than research projects. However, the increase for Fiscal 1962 has been accomplished without any significant increase for research.

Research -- Detailed examination of the research portion of the Navy program shows that the 8% increase reported is almost entirely due to such budgetary items as oceanographic-hydrographic charting, instrumentation, geophysics-geographic prediction, oceanographic-hydrographic predictions, etc. All of these are more properly considered as applied developmental activities rather than research. In spite of an impressive increase in the Navy budget there will actually be less money available to ONR for research in FY 1962 than in FY 1961! In Fiscal 1963 there should be continued total program increases and a balance between increased funding for research and for development and facilities activities.

We have examined the CNR research program in some detail and feel that it is well founded and without duplication or unnecessary overlapping.

The Navy is to be congratulated that a considerable fraction of the funds being supplied to laboratories to carry out oceanographic research are "untagged" and the laboratory directors are remarkably free to use these funds in programs of their own choosing. Especially in CNR, "projectitis" has been held to a minimum.

Ship Construction -- During the three years covered by the ICO report, only one of the six ships funded has been for research. In contrast three out of seven large ships built by the USSR since 1957 have been for basic research. In the U. S. Navy TENOC plan the majority of the ships scheduled to be used for

---

\* See also Sections II-B, C, D and E.

research are listed near the end of the ten year period. We recommend that schedules should be reversed to achieve a better balance during the next few years between ships for basic research and ships for applied research and surveys.

Surveys -- We understand that the small surveys item which appears in the Navy budget in FY 1961 and 1962 is in support of the Indian Ocean Expedition. Only a minor portion of this work can be considered as contributing to the ocean-wide survey program. The studies being carried out during the Expedition by ships of the oceanographic laboratories are more properly identified as research. We are discouraged to note that even if this item could be regarded as surveys it is very small in amount and actually decreases from FY 1961 to 1962.

Facilities -- Inadequate, overcrowded shore facilities are seriously hampering the effective development of the national oceanographic program. A fiscal program for the Navy's share of a laboratory building program is entirely absent in the three years under review in the ICC report, and throughout the entire ten year TENOC program. FY 1963 funding should include a substantial Navy facilities contribution to help correct the critical shortage of space at most marine laboratories.

Other Subjects -- In the area of basic research the Navy has primarily supported physical oceanography as the subordinate discipline most pertinent to Naval needs. One of the key problems in this field is the study of the circulation of the oceans, yet only a handful of marine scientists are now engaged in this study. This number needs to be increased.

If the expected gains of the TENOC plan are to be really useful to the fleet, more officers and Navy civilians will be needed with sound scientific backgrounds. The numbers of such individuals should be increased and the quality kept high.

We have not yet had adequate time to study in detail the latest version of the Navy's Ten Year Oceanographic Plan (TENOC-1961), but we are impressed with the evident care and detail that has gone into its preparation.

Summary -- Because the Navy is responsible for the major share of the national effort in oceanography, we believe that it should maintain a balance between fundamental research and applied research and surveys. This will require:

- a) increasing the proportion of new ships constructed for basic research
- b) providing shore facilities for basic research, and
- c) increasing funds for the support of basic research. More good research scientists are constantly becoming available and operating costs are increasing.

Air Force\* and Army

We will not undertake to comment here on the programs of the Departments of the Air Force or the Army. These are relatively small programs and have not changed significantly during the last three years.

B. Department of Commerce

Coast and Geodetic Survey\*\*

The Coast and Geodetic Survey oceanography budget shows a marked increase from FY 1961 to FY 1962. This reflects the Survey's developing in house capability in oceanography. This capability should be supplemented by research contracts with institutions and industry in the coming years. The level of research activity within the C&GS is well below that needed to meet the statutory responsibilities of the Survey. A few more capable research oceanographers and more well trained technicians are badly needed.

By far the largest C&GS budget increase is for ship construction. As indicated in Section II-D, the Survey's ship building plans emphasize larger ships than recommended in our report. Realistic design and system studies should be made to compare the overall survey efficiencies of large with smaller ships.

In fiscal 1963 C&GS plans call for one 3000 ton, one 1200 ton, and two 750 ton coastal charting ships in addition to one 3000 ton, one 1200 ton, and one 750 ton ocean survey ship. The 1200 ton and 3000 ton coastal ships should be designed with an adequate capability for deep sea oceanography. Then, if priorities change, they can be used for open ocean survey and research work. This should be relatively easy for the large ships. The 750 tonners present more of a problem, but they too could be given considerable deep sea capability.

In both C&GS and Navy survey ships the ratio of survey personnel (scientists and technicians) to ship operating personnel appears comparatively small. It may be possible to improve this ratio although we recognize that in the Coast Survey ships many personnel listed as operative are actually engaged in the technical details of survey work.

C&GS is commended for adding programs of investigations of the overlying waters to the coastal survey missions of some of its major ships. However,

---

\* See Section V-B, Weather Bureau

\*\* See Sections II-B and D.

when reporting the increased effort in oceanography, only the funds required for these additional investigations should be considered.

The C&GS presently has the Pioneer on ocean-wide surveys in cooperation with the Weather Bureau, Bureau of Commercial Fisheries, Geological Survey, and University of Hawaii. This effort is commended as is their policy of authorizing changes in survey schedules to permit investigation of interesting features.

As the ocean-wide survey program takes shape, more attention needs to be given to automatic collection, processing, and utilization of data. The C&GS should study its instrumentation and data collection and processing methods and attempt to develop greater effectiveness in handling large quantities of data. This holds for shipboard and laboratory processing of oceanographic data and also for the processing and analysis of tidal data and the prediction of tides.

The proposed geodetic satellite has important implications for oceanography. The C&GS should taken an active role in this program.

Open ocean tides need to be studied to improve tidal predictions along coasts.

#### Weather Bureau

The Weather Bureau's contribution to the oceanographic program (though still small) shows a marked and encouraging increase in FY 1962. The Bureau needs to continue to increase its research efforts both within its own organization and by contract with meteorological and oceanographic institutions. Both Air Force and Weather Bureau involvement in oceanography has been marginal up till now. These agencies should greatly strengthen their support of the marine aspects of their research and development program.

One of the most critical and important problems is that of the exchange of energy and materials between the ocean and the atmosphere. The coming International Indian Ocean Expedition offers a splendid opportunity for the Weather Bureau and the Air Force to participate actively in a major meteorological research effort over an important but poorly understood area of the earth. This undertaking will rely heavily on adequate study of the atmosphere-ocean interrelationships. Both agencies should furnish funds and assistance for instruments, ships and aircraft.

#### Maritime Administration \*

While the Maritime Administration has been very helpful in assisting individual groups on research ship problems and design, they have not shown the

\* See Section II-B.

interest and initiative required for leadership in studies on specialized craft for research, biological resource studies, deep sea dredging, offshore drilling, factory ships, and other new types of work craft which use the ocean for something more than a highway. Imaginative leadership in this area is needed but this does not imply control.

#### Bureau of Standards

The Bureau of Standards has done some excellent work in oceanography but the Bureau should assume more responsibility in the quality control of oceanographic instruments and measurements. This might include monitoring any national calibration facilities for oceanographic instruments and serving as an advisory center for other such calibration facilities -- whether private, government or commercial.

C. Department of Interior

Bureau of Commercial Fisheries\*

Although FY 1962 shows a substantial total increase, most of this is for facilities and replacement ships. The increase for research, while encouraging, is relatively modest.

Research -- Although the more liberal Bureau policies regarding research are encouraging, nevertheless, only a little more than \$600,000 of the funds budgeted in FY 1962 are for new programs in oceanography. This is considerably less than the amount recommended by this Committee.

We endorse steps being taken by the Bureau to develop a research grant and fellowship program.

Although some of the FY 1962 research budget is for basic marine and estuarine studies, there is still overemphasis on short term studies for immediate application.

The Bureau is supporting some estuarine research but more needs to be done. This work should be correlated with other research and with surveys of industrial pollution problems. We note with approval that at least \$200,000 of the BCF research budget is to be devoted to basic estuarine research.

The Stanford Laboratory is doing an excellent job of relating meteorological events to oceanographic conditions. Here fundamental studies are being undertaken which will benefit both fisheries research and other fields.

Surveys--- The item shown under "Surveys" of \$1,250,000 is not for surveys, in the sense of our recommendations, but for an emergency Alaska salmon program to provide specific information required for certain international salmon management problems.

Facilities-- We are encouraged to see significant funds budgeted for new and improved shore facilities for Bureau activities.

Ship Construction--- Funds for new fishery research ships are long overdue. While a start has been made in the FY 1961 and 1962 programs, the net gain in total fishery research ships will be only one small coastal vessel, since the other three new ships will be replacements. As noted in Section II-B, rate of funding for new construction is still considerably less than the minimum recommended by this Committee.

\* See also Section II-G, Item 15.

### Bureau of Sport Fisheries and Wildlife

While \$158,000 is being budgeted by the Bureau of Sport Fisheries and Wildlife for research on life histories and ecology of sport fishes, both inshore and offshore environments, this amount is very small in relation to the importance of recreational marine fishing and the burgeoning problems of maintaining sport fish stocks in the face of increasing sport and commercial fishing pressure.

We urge the Bureau to play a larger part in the national oceanographic program. The programs and objectives outlined in the ICO report are well founded and should make an important contribution. We are particularly interested in the Bureau's plan to sponsor and finance graduate fellowships in fields of taxonomic relationships, life histories, behavior, etc.

### Geological Survey

The Geological Survey is carrying out a number of small high quality investigations on marine geology. This organization has a potential for making substantial contributions in the future. Funding to date has been disappointingly small in relation to this potential.

Geographical limitations of the Survey's activities should be removed so that it can carry out activities beyond the territorial limits of the United States under its own initiative supported by its own funds.

### Bureau of Mines\*

The Bureau of Mines support of research and development on marine mineral resources is still well below that recommended by the Committee. Although immediate economic pressures for exploitation and development of the mineral resources of the ocean are now slight, in the future nations may have to turn to the oceans as a source of mineral resources. We must establish a firm base for our own future use of these resources by exploration, research, and engineering studies of methods of their recovery.

\* See Section II-G, Item 15

#### D. National Science Foundation\*

Research--The National Science Foundation has provided a steady and substantial increase in their total funds for basic research during FY 1960, 1961 and 1962. The FY 1962 total is approximately double the FY 1961 figure. The Divisions of Biological and Medical Sciences and Mathematical, Physical and Engineering Sciences have shared about equally in this increase. With increased funds the Foundation has been able to support some large and comprehensive proposals as well as an increased number of smaller proposals. Large proposals are particularly significant in the oceanographic field where ship operations are a necessary and expensive part of research programs. Even more institutional and general ship funding is desirable in the future.

Antarctic Program--The NSF Antarctic Program is also expanding. Their ship, to be operated in Antarctic waters, serves an interdisciplinary program and will only be available part time for oceanographic work. There is also a need for an ice-working floating laboratory for operation in Arctic waters.

Indian Ocean Expedition--NSF funding for FY 1962 for the International Indian Ocean Expedition may not be adequate in view of the unexpected needs of the meteorology program; an essential part of the Expedition. Substantial increases will be requested for FY 1963 and a similar amount will be needed in FY 1964.

Ship Construction--Funds available to NSF for grants for ship construction seem to have reached a plateau at about \$3,500,000 per year. The NSF policy of turning design control and title to ships over to the grantee institution accompanied by adequate safeguards for recovery of the ship should the grantee fail to use the ship for the purpose intended, is heartily endorsed. One of our original recommendations was that this should be done. We are confident that in this way better ships will be built and their operation will be more efficient.

---

\*See Sections II-A, B, C, E, and I.

Facilities--FY 1962 shows a large increase in the NSF budget for facilities. While we applaud this increase, the amount budgeted will be insufficient to meet even the pressing and immediate needs of the oceanographic institutions. This amount should be increased to \$15,000,000 in FY 1963 and maintained near that level for several years to come.

#### E. Atomic Energy Commission

Our discussion in Section II-F of this report reviews the Atomic Energy Commission ICO program. We concur with the AEC research objectives outlined in the ICO report and with the research tasks which will be supported with this additional funding. We are pleased to see a significant increase in funding for FY 1962 in the AEC Biology and Medicine Division.

Other AEC Divisions show negligible or no increase from FY 1961 to 1962. This is surprising in view of the continuing problems of these Divisions that require work in the marine sciences. As indicated in our other Section, we are particularly anxious to encourage additional attention to the complex and difficult problems of deep ocean circulation. In the past, AEC support has been rightly concentrated in estuarine and coastal areas. However, future activities and capabilities portend a shift in emphasis toward the deep sea.

#### F. Department of Health, Education and Welfare\*

##### U. S. Public Health Service

The U.S. Public Health Service has substantially increased its support of inshore oceanography as related to problems of pollution. The FY 1962 program is approximately double the FY 1961 effort. About half of their total program is conducted by grants with coastal laboratories, and the remainder in their own laboratories. This is a good ratio and should be maintained. The increased PHS Division of Radiological Health participation in the oceanographic program is encouraging. We look forward to future extensions of this work.

---

\*See Sections II-A and F

### National Institutes of Health

The PHS National Institutes of Health have to date played no part in the national oceanographic program. We believe that the marine sciences are vital to much of the mission of the NIH. We urge NIH participation and support.

### Office of Education

Education remains a major problem in the development of a national oceanographic program. The Office of Education has interpreted its statutes to restrict the Office to a passive role in extending education grants. The Office acts only upon receipt of applications from institutions. To date such applications remain at a low level. The budget of the Office for educational grants is very small and shows no sign of increase.

### Pure Food and Drug Act

We view with concern the continuance of the Pure Food and Drug Act in its present form. In light of modern scientific knowledge, many of the provisions of this statute are superfluous. Worse, by adhering to outmoded beliefs we tend to ignore, and thus waste, much of the potential food value of our ocean's living resources. We recommend that the Department of HEW reexamine the Pure Food and Drug Act with a view to modification or removal of those portions that prevent efficient utilization of fisheries resources.

### G. Department of Treasury

#### U. S. Coast Guard\*

The oceanographic work of the USCG International Ice Patrol is well established and extremely useful. The Coast Guard should extend its oceanographic work to other areas. There is some indication that this is beginning through cooperative work with other agencies. It seems unfortunate, however, in view of the present rapid growth of oceanography, that USCG facilities are not used in a more positive manner for scientific purposes.

---

\*See also Section II-B

Specifically, the Committee offers the following comments and recommendations:

International Ice Patrol--Waters highly sensitive to marine climatic change lie immediately to the west of the International Patrol area in Ungava Bay and Hudson Strait. We suggest that the Canadian authorities be invited to make routine sections in these regions at the same times of year as the IIP Surveys.

Ocean Station Program--Vessels employed on the Ocean Station Program should do far more than just make bathythermograph observations. A great opportunity to develop time-series observations of hydrographic phenomena is being lost by not obtaining full oceanographic measurements at regular and frequent intervals from these ships.

Plankton Surveys--In view of the intrinsic interest in plankton distributions and the value of plankton as hydrographic indicators, we recommend that USCG vessels be equipped with high speed plankton collectors or recorders to be used on cruise courses at regular intervals. This should be done in cooperation with other agencies equipped with the necessary laboratories and personnel, such as the Bureau of Commercial Fisheries.

Educational Opportunities--The operations of the USCG, present and planned, offer unparalleled opportunities for the training of students in physical and biological oceanography. We recommend that serious attention be given to this point.

Legislation--Legislation to provide for an expansion of the functions of the Coast Guard currently in Congress should enable greatly increased U. S. Coast Guard participation in the national oceanographic program. The potential of this organization is great. We recommend passage of this legislation.

Funding--In view of the USCG potential, the level funding for FYs 1960, 1961 and 1962 is astonishing, even appalling. We would look for a substantial increase in subsequent years.



