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NACOA AND NOAA OVERSIGHT

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HEARINGS

BEFORE THE

COMMITTEE ON OCEANOGRAPHY

OF THE

COMMITTEE ON

MERCHANT MARINE AND FISHERIES

HOUSE OF REPRESENTATIVES

NINETY-SECOND CONGRESS

SECOND SESSION

ON

NACOA OVERSIGHT

NOVEMBER 28, 1972

NOAA OVERSIGHT

NOVEMBER 29, 1972

Serial No. 92-38

929821 0097TY

Printed for the use of the Committee on Merchant Marine and Fisheries



U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1973

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NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE OVERSIGHT

TUESDAY, NOVEMBER 28, 1972

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON OCEANOGRAPHY
OF THE COMMITTEE ON MERCHANT MARINE AND FISHERIES,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 1334, Longworth House Office Building, Hon. Alton Lennon, chairman of the subcommittee, presiding.

Present: Representatives Lennon, Rogers, Kyros, and Keith.

Also present: Robert J. McElroy, chief clerk; Francis D. Heyward, subcommittee counsel; and Richard N. Sharood, minority counsel.

Mr. LENNON. The Subcommittee on Oceanography is meeting today to receive information from the chairman of the National Advisory Committee on Oceans and Atmosphere, and such other members of the committee as may desire to testify, relative to the first annual report of the committee, dated June 30, 1972, and forwarded to the Congress by the Secretary of Commerce on September 27, 1972.

At this point in the record, I would like to insert a copy of Public Law 92-125, which established the National Advisory Committee on Oceans and Atmosphere, and which includes the requirement for the annual report of the committee with which we shall be concerning ourselves this morning. In addition, I would like to insert a copy of Public Law 92-567, which amended section 7 of the original act. Finally, I would like to include in the record following the language of those two statutes, a copy of the report itself, dated June 30, 1972, forwarded by the Secretary of Commerce, with his comments, on September 27, 1972. I, therefore, ask unanimous consent that those items be included in the record at this point.

(The information follows:)

PUBLIC LAW 92-125, 92D CONGRESS, H.R. 2587, AUGUST 16, 1971

AN ACT To establish the National Advisory Committee on the Oceans and Atmosphere

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, There is hereby established a committee of twenty-five members to be known as the National Advisory Committee on Oceans and Atmosphere (hereafter referred to in this Act as the "Advisory Committee").

SEC. 2. (a) The members of the Advisory Committee, who may not be full-time officers or employees of the United States, shall be appointed by the President and shall be drawn from State and local government, industry, science, and other appropriate areas.

(b) Except as provided in subsections (c) and (d), members shall be appointed for terms of three years.

(c) Of the members first appointed, as designated by the President at the time of appointment—

- (1) nine shall be appointed for a term of one year,
- (2) eight shall be appointed for a term of two years, and
- (3) eight shall be appointed for a term of three years.

(d) Any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed only for the remainder of such term. A member may serve after the expiration of his term until his successor has taken office.

(e) The President shall designate one of the members of the Advisory Committee as the Chairman and one of the members as the Vice Chairman. The Vice Chairman shall act as Chairman in the absence or incapacity of, or in the event of a vacancy in the office of, the Chairman.

SEC. 3. Each department and agency of the Federal Government concerned with marine and atmospheric matters shall designate a senior policy official to participate as observer in the work of the Advisory Committee and to offer necessary assistance.

SEC. 4. The Advisory Committee shall (1) undertake a continuing review of the progress of the marine and atmospheric science and service programs of the United States, and (2) advise the Secretary of Commerce with respect to the carrying out of the purposes of the National Oceanic and Atmospheric Administration. The Advisory Committee shall submit a comprehensive annual report to the President and to the Congress setting forth an overall assessment of the status of the Nation's marine and atmospheric activities and shall submit such other reports as may from time to time be requested by the President. Each such report shall be submitted to the Secretary of Commerce who shall, within 90 days after receipt thereof, transmit copies to the President and to the Congress, with his comments and recommendations. The comprehensive annual report required herein shall be submitted on or before June 30 of each year, beginning June 30, 1972.

SEC. 5. Members of the Advisory Committee shall, while serving on business of the Committee, be entitled to receive compensation at rates not to exceed \$100 per diem, including traveltime, and while so serving away from their homes or regular places of business they may be allowed travel expenses, including per diem in lieu of subsistence, in the same manner as the expenses authorized by section 5703 (b) of title 5, United States Code, for persons in Government service employed intermittently.

SEC. 6. The Secretary of Commerce shall make available to the Advisory Committee such staff, information, personnel and administrative services and assistance as it may reasonably require to carry out its activities. The Advisory Committee is authorized to request from any department, agency, or independent instrumentality of the Federal Government any information and assistance it deems necessary to carry out its functions under this Act; and each such department, agency, and instrumentality is authorized to cooperate with the Advisory Committee and, to the extent permitted by law, to furnish such information and assistance to the Advisory Committee upon request made by its Chairman, without reimbursement for such services and assistance.

SEC. 7. There is hereby authorized to be appropriated to the Secretary of Commerce \$200,000 for the fiscal year ending June 30, 1972, and each succeeding fiscal year to carry out the purposes of this Act.

Approved August 16, 1971.

LEGISLATIVE HISTORY

House Report No. 92-201 (Comm. on Merchant Marine and Fisheries).

Senate Report No. 92-333 (Comm. on Commerce).

Congressional Record, Vol. 117 (1971) :

May 17, considered and passed House.

Aug. 2, considered and passed Senate, amended.

Aug. 5, House concurred in Senate amendments.

PUBLIC LAW 92-567, 92D CONGRESS, H.R. 15280, OCTOBER 25, 1972 .

AN ACT To amend the Act of August 16, 1971, which established the National Advisory Committee on Oceans and Atmosphere, to increase the appropriation authorization thereunder

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section 7 of the Act of August 16, 1971 (Public Law 92-125; 85 Stat. 344), is amended to read as follows: "There are hereby authorized to be appropriated to the Secretary of Commerce, for the fiscal year ending June 30, 1973, and for each of the two fiscal years immediately thereafter, such sums, not to exceed \$400,000, as may be necessary for expenses incident to the administration of this Act, and for succeeding fiscal years only such sums as may be authorized by law."

Approved October 25, 1972.

LEGISLATIVE HISTORY

House Report No. 92-1467 (Comm. on Merchant Marine and Fisheries).

Congressional Record, Vol. 118 (1972) :

Oct. 11, considered and passed House.

Oct. 13, considered and passed Senate.

Weekly Compilation Presidential Documents, Vol. 8, No. 44 :

Oct. 28, Presidential statement.

A Report to:

The President
and
The Congress

by the
National
Advisory
Committee on
Oceans and
Atmosphere

First Annual Report June 30, 1972

NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE

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 Director
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**NATIONAL ADVISORY COMMITTEE
ON
OCEANS AND ATMOSPHERE**

Washington, D.C. 20230

To the President and the Congress:

Sirs:

I have the honor to submit to you the first Annual Report of the National Advisory Committee on Oceans and Atmosphere.

The Committee was established by P.L. 92-125, approved on August 16, 1971, and was directed to submit a comprehensive annual report to the President and to the Congress setting forth an overall assessment of the status of the Nation's marine and atmospheric activities.

This report is submitted to the Secretary of Commerce for transmittal as provided by the statute.

Respectfully,

William A. Nierenberg
Chairman

June 30, 1972

FOREWORD

The newly formed National Advisory Committee on Oceans and Atmosphere (NACOA) has been charged by P.L. 92-125 to have direct concern with both the oceans and the atmosphere. NACOA is advisory to both the President and the Congress on the Nation's marine and atmospheric affairs—and to the Secretary of Commerce with respect to the National Oceanic and Atmospheric Administration.

To review and evaluate every program and issue over the vast domain of NACOA responsibility is to treat none of them well and would mean attempting, in some instances, to do what others are capable of doing better.* But to be able to

* In this, NACOA's first year, we have naturally drawn heavily on a long series of reports by which the field, particularly of oceanography, has been enriched. Specifically we wish to acknowledge our indebtedness to: "Oceanography 1960-1970," National Academy of Sciences, Committee on Oceanography, 1959. "Oceanography, the Ten Years Ahead, a Long-Range Oceanographic Plan 1963-1972," Interagency Committee on Oceanography of the FCST, ICO Pamphlet No. 10, June 1963. "Effective Use of the Sea," Report of the Panel on Oceanography, President's Scientific Advisory Committee, June 1966. "Our Nation and the Sea, A Plan for National Action," Report of the Commission on Marine Science, Engineering and Resources (Stratton Commission), January 1969. The five Annual Reports on Marine Science Affairs by the National Council on Marine Sciences and Engineering Development, 1967 through 1971, inclusive.

select for priority attention those maritime and atmospheric issues that have become urgent, whether for economic, social, or technological reasons, is an opportunity afforded no existing committee in this area. This opportunity NACOA has been given by its charter and by its statutory permanence. We find it a sobering charge.

In NACOA's First Annual Report to the President and to the Congress, we have chosen four topics: Law of the Sea, Fisheries, Weather Modification, and Coastal Zone Management. These issues meet two criteria: each is of current importance and each, despite the short half-year of our existence, we feel we can treat with balance. This means that some issues we did not treat may be more important than some we did, but we did not feel we can be helpful in these particular areas with so short a time to prepare. However, what we lay aside this year we may be in position to consider next. It also means that we judge some areas neglected in this Report to be well in hand. This is particularly true of the national program in basic marine and atmospheric research despite certain weaknesses in ocean engineering.

Of all the fundamental and pressing issues which NACOA wanted to include in this Report, but did not, Marine Transportation stands out. We did agree that recent governmental actions have been important in slowing the decline in our merchant marine. However, we also found that

it was next to impossible to examine the issues and choices from an adequate perspective in the absence of a detailed analysis of the maritime transportation system as it inter-relates with problems of economic growth, social costs and benefits, and environmental goals. We *recommend that the Secretary of Commerce be asked to undertake such a study in consultation with NACOA*. Such a study would be a major undertaking that could reveal a much greater possible contribution to our Nation's overall well being than even the present ardent supporters of a merchant marine consider to be the case.

It is NACOA's intent to learn how best to be of service to those we advise. It is our hope to place major issues in the context of national interest to reflect our understanding of the interplay between science, technology, and social and economic factors in national policy decisions in the light of limitations of manpower, budgetary, and physical resources. It is NACOA's goal to help clarify what is good husbandry of the resources of the sea and air and what this can mean to the United States of America.

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Introduction

A similarity which runs through most of the issues in NACOA's First Annual Report is the underlying need for specific international understandings as a requisite for solution. This requirement stems less from the international nature of the oceans and the atmosphere than it does from the need for wise management of what have lately become recognized as limited resources.

Effective resource management requires agreement among the parties whose interests are involved; interdependence amongst nations therefore clearly complicates matters. While coincidence between national and international interests plainly exists, it has nevertheless grown more difficult in recent years to keep questions of international politics from taking over where technological interchange would better serve all concerned. The hope is that where there is growing international awareness of a common problem, there can be found the mechanisms for providing the technological inputs for working things out.

Common interest issues are prominent in three of the four sections of this Report. In "Some International Issues Related to Law of the Sea" they are central. Here NACOA reviews the developing controversies over freedom of passage, freedom for research, and the jurisdiction of fisheries, and proposes means for fostering their resolution while protecting U.S. interests. In a second section, NACOA notes the growing international awareness that fish can be harvested to extinction if not biologically managed and suggests how this awareness provides the opportunity to work at rehabilitating the U.S. fisheries.

Thirdly, recognizing advances in the ability of some developed nations, including our own, to modify the weather both intentionally and inadvertently, NACOA advocates intensified national and international discussion and development of appropriate regulation.

The fourth section of the Report, on coastal zone management, though specific to the United States, describes a situation demanding virtually

unprecedented management efforts to weave together and rationalize the conflicting and at times incompatible needs of the many different users of this resource. The coastal zone is not only complex naturally, it is also the focus for an unusual confluence of national, regional, state, and local interests. Which is David and which Goliath when it comes to the oil terminal or the bathing beach? the oyster or the dredge? Here again NACOA finds that the nation's science and technology can be more effectively used in support of management. It is on the means for promoting a more effective interaction between management and science that the discussion of the coastal zone centers.

Finally, in a brief section titled "Moving Ahead" NACOA emphasizes the urgent need for action and for facing up to the pervasive impact on our society that appropriate action will have. The alternative, doing nothing, is in our view unthinkable. The days of the open ocean and limitless air are gone. The oceans and the atmosphere belong to all rather than to none, and it is in our common interest to enhance the use and decrease the abuse to which they are made subject.

Some International Issues Related to Law of the Sea

The rules governing the use of the seas by the nations of the world are today in a transition comparable to that which took place in our own country when the frontier and the open range disappeared. While NACOA finds the emerging U.S. positions at the level of the Working Group on Law of the Sea soundly in the national interest and consistent with international needs, it also finds that the actual situation, and the U.S. current tactics in negotiation, give less cause for optimism. These matters are discussed with respect to freedom of passage, fisheries, and freedom of research. NACOA then suggests the kind of effort and program adjustment which should result in a more positive approach and improved prospects for international agreement.

It will be impossible to come anywhere near the oceanic goals set by the Congress or proposed by earlier commissions and councils until an updated and accepted set of international rules is developed for international oceanic operations. The international negotiations on the Law of the Sea have a status comparable to those on disarmament, and may very well take longer to resolve. We should take care not to view this matter with undue optimism in view of the complexity and wide range of issues to be resolved.

The basic issues before us are in several broad categories which have to do with:

- the extent of territorial waters and the resultant effect on freedom of navigation and overflight and freedom for research;
- fisheries; and
- the appropriate regime for the management of the ocean basins.

The complexity of the issues derives from the many different interests, national and international, and has diplomatic aspects that are normally not discussed in official reports. NACOA nevertheless feels that the importance of a full and frank discussion of this multifaceted problem is essential if procedures and programs are to be adopted that can move matters forward. We conclude that the present situation is unsatisfactory

internationally and that the current U.S. procedures will not suffice to achieve the U.S. policy goals. This is a pessimistic statement more with respect to the direction matters have taken internationally than to specific criticism of past approaches. Nevertheless, NACOA feels that these difficulties could have been sooner anticipated and a more imaginative and coordinated program could have been developed.

NACOA has been critical of the activities of the Working Group on the Law of the Sea because of an apparent diffusion of objectives and a lack of sharply developed policies or positions. The situation has recently improved considerably, undoubtedly through the effect of increasing the delegation by five nongovernmental experts, and the formation of a broadly based advisory committee. One of the results of this interaction is, as is noted later, an agreed industrywide position for the fisheries industries. There is, however, the ever-present danger of weakening of objectives under the grind and tedium of a one-hundred nation debate.

The entire position of the United States in international oceanic affairs should be thoroughly reviewed and clarified without neglecting the possible contribution of any department or agency. The position must include a strong policy for keeping the oceans and the classical straits open for free navigation and the oceans free for commerce and for responsible scientific research. The oceans are a common heritage. This heritage carries with it the necessity for freedom to explore, freedom for navigation, and freedom for simple human enjoyment.

ACHIEVEMENT AT GENEVA (1958)

With these goals in mind, and before setting down specific programmatic recommendations, we present our analysis of the current situation and the history of how we arrived at what appears to NACOA to be a difficult impasse. Perhaps the most useful and illuminating starting point is the Geneva Conventions of 1958. These Conventions were the result of intensive and arduous preparatory conferences. They were momentous achievements, made possible largely by intensive and lengthy preparations involving considerable technical consultation. The signatories assigned the bottom resources out to the 200-meter depth to the adjacent state and made easy allowance for general research outside of territorial waters in this zone by agreeing that permission to carry on research in this region would "not normally be withheld." Freedom for research in the ocean basins outside these limits was unrestricted. Considerable detail went along with these conventions—specifying, for example, that lobster and shrimp were not to be classified as belonging to the bottom but rather to the water mass, and so on.

One provision was accepted that may soon be a thorny issue; it provided that the bottom resources of the region beyond the 200-meter depth be assigned to the adjacent state to the extent that they are economically

exploitable. Until recently it was expected that this controversial clause would be a dominant issue in the current discussions. Then a host of other difficulties arose which seemed for a while to overshadow it: concern about the depletion and management of the living resources of the world ocean, proposals for ultimate arrangements for the exploitation of the ocean basins, a number of unilateral extensions of territorial limits, a deepening universal concern about the environmental degradation of the oceans, and concerns dealing with the destruction of species, such as the whale. However, growing oil consumption may again force to the fore problems having to do with resources beneath the ocean floor.*

APPROACH TO GENEVA (1973)

Against this background we wish to make four observations. The first is that treaties in matters of this kind where a common heritage is involved must allow for change. In the course of increasing knowledge of the oceans and their resources, and increasing threats to the oceans, it is clearly necessary to review the arrangements periodically and adjust them equitably to new needs based on new knowledge. This point applies principally to our present emergent fisheries position.

The second observation is that these conventions have the force of international law and should be observed as such. Unfortunately U.S. experience with the 1958 Geneva Conventions has been largely the opposite. This experience raises grave questions as to the usefulness of attempts to improve the situation by treaty revision alone, unless a better basis is laid. For example, in waters off Chile, Peru, Ecuador, and Brazil, the United States or its fishermen have had to pay fines or seek permits in areas in which there should be unrestricted fishing access under generally accepted provisions and conditions at the time of the 1958 Conventions. Another example is in the area of scientific research. Various countries have affected the freedom to conduct scientific research in that they have not routinely granted permission to perform research in waters over their shelves, or they have instituted permission-granting procedures sufficiently cumbersome in many instances as to effectively exclude certain areas from planning for scientific research cruises. Their reasons often seem obscure, but it appears that they may be interpreted as possible efforts to force the reopening of previously settled matters for the impending Law of the Sea negotiations. It is all the more discouraging to observe that, for other reasons, several of the developed nations have also denied permission for

* It is possible that there will be a considerable lapse of time before international agreement on Law of the Sea is attained. NACOA recognizes that economic and other pressures may develop to such an extent that individual nations including the United States will take unilateral actions, especially with respect to resource exploitation. NACOA therefore urges consideration by the U.S. Government of suitable interim arrangements that will allow development of these resources to proceed, but at the same time will offer reasonable probability of meshing with eventual international agreements.

research on their shelves. The reasons may well have involved serious national questions, but they have also had chauvinistic overtones.

This leads to a third observation, our pessimism as to the chaotic state and the ultimate benefit of the preparatory sessions leading to the 1973 Law of the Sea Conference. The difference between the 1958 Conference, with its mark of success, and the current negotiations is that the former was preceded by quiet and hard work on the part of technical experts. The 1958 results were based on the best oceanic expertise available at the time and were limited to a small number of priority issues. Despite the best efforts of the United States and other major powers to limit the forthcoming Conference to a few issues—particularly the question of territorial limits—the member nations, led by the lesser developed countries, overwhelmingly voted to include all issues on the agenda. Most of the countries will not have the time to become adequately informed technically on a broad array of complex issues. Thus the Conference may degenerate into a series of position-taking statements on very narrow local issues rather than a striving for an optimum regime for the benefit of all and for a situation that could enhance conflict-free prospects around the world.

Our fourth observation is that a legalistic approach will not serve and an alternative must be sought. A legalistic approach will only work to maintain the present fractionated situation. A strongly pragmatic approach based on the realities of what the oceans can offer mankind and what is needed to deliver on this offer allows more hope for success. It appears that the true requirement is a framework which permits all nations to jointly participate in a mutual educational effort centered on the world's oceans, the current and future resources, and the factors to be balanced if mankind's long-term needs are to be most appropriately met by oceanic means.

Today's strong movement in the direction of further nationalism carries with it serious threats to classical free movement on the oceans. This is contradictory to the lofty phrase, the "common heritage of mankind," which opened the present debates on the uses of the resources of the midocean.

The current position of the United States with respect to three important issues treated in this chapter (freedom of passage, fisheries, and freedom of research) as it has slowly evolved in the ferment of the last years, seems to us now eminently sound. It satisfies U.S. national interests, it is based on good conservation principles, and it seems the best arrangement leading to an amicable international situation and the common good.

The Issue of Free Passage

The U.S. policy for free passage in waters outside the 12-mile territorial limit and in classical straits must remain unmodified. It is required in the

interests of world trade and communication, and is necessary to prevent cumbersome restrictions or procedures being placed in the way of open research. It is also necessary with respect to national defense. In this regard, the Committee has in mind not only the classical requirement for defense systems but also the historical fact that restrictions imposed on classical straits passage have almost always converted them to foci of military confrontation and sources of conflict.

The Issues of Fisheries

The U.S. position with respect to the fisheries question has been slow in formulation because of the lack of an agreed industrywide position. Now, however, the industry as a whole has agreed to support the position prepared by the U.S. Working Group. The coalition of interest has been largely induced by the realization that the current worldwide fishing capability can grossly reduce the catch of currently marketable fish and alter the relative species balance in a major way if uncontrolled and unregulated. The position proposed is to assign each coastal fishery to the adjacent state for management and licensing; to assign responsibility for anadromous fish to the country in whose waters the fish spawn; and to rely on multilateral arrangements for the pelagic fisheries. The basic approach is to place priority on conservation of the resource. This approach, in the case of the coastal fishery, has the important corollary that the fixed territorial concept is removed from the important fisheries domain, and should help relieve the pressures which appear to be driving territorial limits outward.

The Issue of Open Research

Our position with regard to the use of the ocean basins is largely in agreement with the positions of most other states. The principle of community ownership and international management has been accepted, but the question of the relation between a producing corporation and the international management is yet to be settled—and there is great resistance to such management conducting its own research while restricting research of member nations.

Except possibly for manganese nodule and phosphate mining, the deep-sea resources will remain inaccessible for many years. Therefore these questions are less immediate than the fishing and territorial waters questions, and even in the case of the nodules and phosphate beds the pressure for development may be resolved by the hidden question of the effect on individual states' economies by the introduction of new sources of specific minerals. Nevertheless, discussions relating to the use of the seabed have raised the specter of restrictions on freedom of research on the open sea. It is and should remain firm U.S. policy that this freedom of research on the open sea continue.

In a purely practical way, we as a world can never hope to realize any of the postulated benefits from the oceans if research is hampered. Even now it is proceeding at altogether too slow a pace to match the oft-stated expectations. International interference with research is far more serious than that on the national level. It has happened that scientific inquiry has been blocked in various disciplines in one nation or another at one time or another usually for ideological reasons. Fortunately for mankind, if not for that nation in particular, scientific inquiry advanced elsewhere. At a later date, the laggard nation was able to catch up, if not to repair the damage completely. This corrective is not available if the inhibition to science is on a global scale. More fundamentally, any further limitations on freedom of inquiry that are not for basic safety or the general welfare (such as those to control pollution) are a dangerous addition to a list of limitations that is already too large.

It is possible to understand and sympathize with the position taken by the developing nations. Mostly former colonies, they are sensitive to any possibility, however remote, that their share of the oceanic resources may be usurped by the more advanced nations who have the technology to exploit these resources. They transfer this concern to research as well, believing that their poor or nonexistent research capabilities put them at a gross disadvantage in obtaining their share of the resources. This could bring major oceanic development to a halt if such fears are translated into conventions restricting research on the open seas, because research and education do go together, and are not developed serially. Thus, halting exploration or research until the developing nations reduce the research gap would lead to a total slowdown, further frustrating hopes for fulfillment of the postulated benefits available to mankind from development of oceanic resources. It would also greatly impede applied research in nonextractive uses of the oceans such as meteorological research, which, for the immediate future, may be the most beneficial of all efforts.

RECOMMENDED COURSES OF ACTION

NACOA recommends means by which the United States may exert leadership based on its acknowledged advanced capabilities in oceanic technology. The 1958 Conference was successful largely because of the United States and the technical support that could be brought to bear on the deliberations. The generally formal, legalistic approach that has been followed in the last several years seems to be moving too slowly. If progress is to be made, we must change our approach by recognizing the obstacles to progress in negotiations and by altering our procedures accordingly. *Our principal recommendation is to engage other countries, particularly the developing nations, in as many joint projects with the United States as possible and in as great a variety as reasonable.* This en-

agement should be primarily at the technical level with the full cooperation of the involved government. Some of the harsher realities of oceanic research and development will be more widely understood and there will be improved ability to interpret the findings of others. This should go far toward allaying suspicions of unilateral exploitation. Or, from a different point of view, this should give the developing nations a better technical base to protect themselves in economic negotiations.

It happens that numerous U.S. programs exist at various levels of activity which could be employed toward this end. Aside from the necessary strengthening of the individual programs, the programs should operate in a coordinated way with the ultimate purpose of developing a better worldwide understanding of ocean technology and the value of a management approach to oceanic resources.

1. A first and important step would be greatly strengthening the office, in the Department of State, of the Coordinator of Ocean Affairs and Special Assistant for Fisheries and Wildlife. This Office has been very effective with its limited means in handling many fisheries problems, and has been supportive of U.S. research programs around the world and in species protection, particularly mammals. The success of this Office is based on its expertise and the relationships it has established with its constituent community in the United States. The problems, however, are too varied and too numerous for the Office to handle within its present means. It is this Office that has demonstrated the usefulness of joint research in the international realm by arranging for cooperative fisheries research.

2. Other governmental agencies have not been as effectively or imaginatively used. For example, the Agency for International Development has almost entirely dropped its programs in the oceans due to budget pressures. This lack of coordination seems difficult to understand at a time when Law of the Sea problems involve so much intradepartmental effort up to the Under Secretary's level at the Department of State. We recommend a vigorous AID program in ocean science and technology. There are a number of such efforts by the Department of Agriculture, with one example being the USDA's Economic Research Service, set up to work with AID for the purpose of enhancing international development in areas related to agricultural matters. By analogy, a similar decision could be reached to focus certain developmental activities in areas related to marine matters by a cooperative Department of Commerce/AID program. NACOA suggests this might be most logically assigned to the Sea Grant Program within Commerce's NOAA.

Thus, a new candidate for international programs is the United States Sea Grant Program. By analogy with our Land Grant Program it offers great promise. One of the great contributions of the Land Grant Program to the common welfare has been that of American agricultural technology, and the key element has been the educational contribution of our great

agricultural colleges and universities. Their dedicated students are to be found in the most remote corners of the world. They have been instrumental in helping feed the world's billions by introducing new agricultural and land management practices. We cannot properly compare the fledgling Sea Grant Program of the Department of Commerce with the Land Grant Program activity developed over the past century, but the potential is there. One possibility has already been noted. The Sea Grant Program could be made even more valuable than at present by introducing an exchange program for foreign students, particularly from the developing countries.

3. It was hoped that the International Oceanographic Commission (IOC) could serve as an important exchange mechanism between governments and during the period between important diplomatic conferences. It has been a major disappointment. For many nations it has become rather a political forum. A re-examination of the role of the IOC would be very much in order, looking to the possibility of having experts named as representatives rather than political delegates. If a major reconstruction takes place as a result of this review, it would be desirable to consider consolidating the oceanic and atmospheric interests.

4. Among the various U.S. programs the most useful could be the International Decade for Ocean Exploration (IDOE) of the National Science Foundation. It was originally intended to be a major international effort but has fallen far short of the intent. Its various current activities, such as GEOSECS (Geochemical Ocean Sections), the ocean buoy efforts, the midocean ridge studies, and the upwelling studies are very suitable candidates for massive international cooperation. Greater international participation at a higher level in these programs should be developed by more vigorous diplomatic activity, accelerated support to allow for more and a greater variety of projects, with funds specifically allocated for the support of cooperating developing countries. We note the important contributions of the IDOE to the oceanic pollution problem.

5. The National Marine Fisheries Service (NMFS) can play a vital role in exchanges with foreign governments—indeed they already do to a considerable degree—but this activity could be greatly enhanced, again with the motive of a mutual learning effort among nations. The NMFS is the basic support instrument for all of our activities related to biological resources. The NMFS should be strengthened to enable it to meet the increased demand for its services to related Law of the Sea activities, sea mammal protection, and additional fisheries conservation activities. The best support for a rational international program is a well-promulgated and sound scientific position—which is not presently available for many important issues.

6. There are military-related aspects apart from those of straight national defense requirements, and those warrant the most careful considera-

tion. Within the United States, in addition to various academic institutions and civilian branches of the Federal Government, the military branches—most notably the U.S. Navy—conduct considerable amounts of scientific research. Such research is intended to contribute to better understanding of natural phenomena. This is largely open research, it is not classified in nature. Outside the United States, particularly in a number of Latin American nations, much if not all of the oceanographic research is conducted by the navies, even research that would in the United States be conducted by civilian organizations. This suggests an important role for the U.S. Navy in extending its current relationships with these navies to include the exchange of research programs and techniques.

7. The National Oceanic and Atmospheric Administration's National Data Buoy Program and all the programs in general involving air-sea interaction, such as NORPAX and GATE, are extremely appropriate for intense international cooperation. There are immediate possible benefits for the participating countries regardless of a country's current level of research effort or sophistication, since many measurements of widely varying complexity are required. There are also appreciable cost savings for the individual countries. These programs can all use more support, particularly for those aspects which are directly related to international cooperation. Particular support is required to enable close contact between technical people at the working level.

8. Beyond these there are individual programs of sufficient magnitude and worldwide scope that they could carry important international involvements. The Deep Sea Drilling Project is a good example. It is also the unique tool now available for divining the potential resources beneath the deep ocean floor. The results of the research are now widely and voluminously disseminated. Greater international participation would help dispel the sense of inadequate knowledge that motivates the developing countries and builds pressures for increasing restrictions or widened territorial waters.

In summation, we do not underestimate the difficulties facing the negotiators who have to operate in a forum of representatives with widely varying backgrounds in technical development and varying nationalistic attitudes. It is as a result of our experience with these difficulties that we make our recommendations to engage other countries in suitable mutual efforts in the hope that a different and more positive approach may result which is aimed specifically at the sources of the difficulties.

Rehabilitating United States Fisheries

Fishermen have long contended with one another. Competition for a common resource has set commercial fishermen against the sportsman, one segment of the industry against another, one locality in the Nation against another, one nation against another. But now, as a consequence of technological improvement and overcapitalization, there exists the capability to fish to extinction. Awareness of this dreadful possibility is becoming universal and, NACOA feels, has produced the opportunity to achieve agreements by which to manage the ocean's living resources and conserve the ability to harvest them. This in turn would make it possible to create in the United States an environment which attracts private enterprise and thus leads to rehabilitation of a declining fishing industry. This section discusses the new awareness and the means by which a coherent program may be developed.

A COMMON THREAT

A gap exists between the declared national policy to rehabilitate the fisheries of the United States and the specifics of how to do it. One reason is that agreement on which of many problems is most important is no easier to come by than agreement on what to do if certain ones were picked. We are thus twice removed from coming to grips with the issues.

NACOA believes this situation is changing in the face of a common threat. We believe there is a general awareness—quite recent in origin—of what had previously been shrugged off as local by all except those affected. This threat, which now touches all coasts and all segments of the fishing industry and of sports fishing, is the threat to fish as a resource itself.

While there are underutilized fisheries, the potential for over-fishing exists by the international and interstate nature of much of the industry and the technology which underlies it. This potential for overfishing is stimulated by improving technology and by an economics which offers incentive to overfish to the fishermen who have little responsibility for management. It is not the husbandman who would kill the goose that lays the golden egg, but the hunter.

There has been a tendency to regard the decline of the world position of commercial fishing in the United States as a problem of international competition in which an unsubsidized, artisan-like, entrepreneurial, labor-intensive American industry has suffered the effects of competition with technologically-advanced, government-supported foreign fishing fleets. And in fact, the proportion of fish products imported into this country hit a peak, in 1968, of over 70 percent of the fish products used, though the average, 55 to 60 percent, is somewhat less.*

But these facts, serious as they are, divert attention from the more basic condition, masked by the rise in the total world catch, that fish resources are limited, that the potential exists in the world to destroy these resources, and that if our fisheries are not in fatal trouble now, they are going to be unless something is done about conserving the resource. The shrinking share by U.S. commercial fishermen of the growing catch has elicited suggestions for Government support to meet foreign competition, but this is a digression from the more fundamental problem, the threat to the resource itself. What purpose would any plan for rehabilitating the U.S. fishing industry serve if the fish themselves were gone?

ENVIRONMENT FOR REDEVELOPMENT

Adjusting to an approach which is resource-oriented rather than economics-oriented was the nub of many of the Stratton Commission recommendations; and it is the basis for existing fisheries policies which center on:

- obtaining the information on which proper resource management depends,
- minimizing institutional constraints such as Federal/State coastal jurisdiction problems, and
- adjusting conflicts in interest between sports and commercial fishermen, etc.

The Stratton Commission recommendations also touched on legislative, economic, and international issues, such as:

- the desirability of rescinding the requirement that a fishing vessel be American-made,
- the desirability of removing those types of control which impose inefficiency as an inhibitor to over-fishing, and
- the desirability of limiting entry to counter the inherent tendency of producers to overcapitalize when the price of entry is low.

Some of these recommendations have been translated into policy, others into official recognition as worthy bases for action. All remain valid today

* The U.S. catch, about two and a half million tons per year, has been relatively constant for 25 years, while the world catch has more than doubled in each of the last three decades. About half the U.S. catch is edible fish.

and some, such as limited entry, coastal jurisdiction problems, and sufficiency of biological information for resource management, remain crucial. But they have been upstaged by this new need of the hour—assurance there will be fish to catch in the future.

It is NACOA's opinion that assuring the resource, and the program for proper fisheries management which that goal implies, will provide the basic inducements for investment and venture. Limiting entry, modifying antiquated State regulations, developing new Federal/State guidelines, and improving the resource will also be necessary, but there need be no requirement for the kind of direct financial subsidy that can be both expensive and self-defeating.

We know this means borrowing trouble. In addition to adjusting and negotiating the conflicting fisheries interests within our own Nation (problems of resource management in the midst of jurisdictional confusion exist in inshore fisheries), we will have to assure our fishermen their fair share on the international stage.* It is our opinion that biologically determined regulations to assure a maximum sustainable yield could make worth to all the nations involved the cost of current restraint for future benefit. We believe the argument for rationalization of international agreements on conservation and allocation of catch can be made persuasive and the value of a share of the proceeds can be weighed by each nation as inducement to an agreement.

None of this is new. Resource management and bilateral or multinational agreements have arisen in response to specific fishery problems over the years and Fishery Conferences have proved their value. But they have in general been defensive efforts, evolutionary in nature, and often too local and slow moving. Furthermore we have, as a nation, shied away from approaching the problem of total conservation of fisheries partly because a course of action which depends on international agreement is not lightly undertaken, and partly because other elements of national policy were believed to have been involved whose importance, fate, and treatment can be quite separate.**

What is paramount from our point of view is the need to establish proper resource management as a matter of first priority. We must, however, be convinced that the price we pay for the potential benefit is justified. The Committee is aware that one reason for the decline of the fishing industry in the United States is that for the last 20 or 30 years commercial fishing has become less and less a factor in the life of the Nation. Unfortunately, fisheries are not regarded as part of the national wealth

* The preceding section on Law of the Sea discusses this in greater detail.

** In arriving at some agreement on the rights and responsibilities of coastal nations to the fish off their shores, the lumping of fisheries problems with those of off-shore mineral resource exploitation occurs in the politics of international negotiations if not in the actual agendas. Fishing and mining are totally different activities, but political combinations for one regard can carry over to the other.

as are submerged attached resources; the national efforts and energies devoted to fishing have thus declined, or at least not expanded in the face of growing foreign effort.

Thus, to raise the level of national effort in the fishing area by heroic means such as by a series of financial shots-in-the-arm, tariffs, quotas, and exclusions cannot automatically be assumed to be in the public interest. Any increase in effort, even control of the resource on a sound financial basis, must first respond to the questions: to what purpose? how? and how much will it cost?

IS IT WORTH THE EFFORT?

To what *purpose* do we wish to rehabilitate the domestic fishing industries? NACOA believes a rehabilitation effort is justified because the program necessary to do so can be expected to:

- advance established national policy,
- invigorate maritime activity,
- help reduce the present adverse balance of payments,
- increase domestic employment,
- contribute to the conservation and wise use of living marine resources,
- provide for expanded recreational fishing,
- arrest the trend toward total dependence on foreign fisheries, and
- provide an additional source of high-quality protein to the national food supply.

How do we propose to do it? NACOA believes the decline in the fishing industry should and could be corrected by providing a more attractive economic environment for individual venture and that at the same time the United States can contribute to the rational control of a global food resource. The time is now ripe, because of the threat to the resource itself, to find common ground in an industry which historically is beset with conflicting and fragmented interests. Before going into more detail as to how we suggest fisheries rehabilitation be undertaken, can we gauge the required effort?

How much will it cost, and is it worth it? These are tangled questions. It is easier to ask for an assessment of costs and of benefits than it is to provide the answers and then be persuaded by them. One reason we think this has been especially difficult in the fishing area is because the traditional approach has taken the point of view of one segment of the industry at a time—the problem of the pelagic fishermen and the 200-mile limit, of the coastal fishermen and Russian and Japanese competition, of the sports fisherman and the disappearing sardine. Or the approach has been ambiguous because only a part of the problem has been attacked—such as limiting entry (but how do you get the States to agree and how long will it take?); reserve an increased share of the catch for

coastal nations (but what do we do while we wait for agreement?); provide loans (but do those who least need it benefit the most?); discourage the marginal operators who reduce the catch per unit effort for everybody without helping themselves very much (but what do you tell them to do instead?).

NACOA suggests that a way to override the difficulties of industry segmentation and of diverse local goals is to approach the question of a national fisheries goal directly and derive from it a comprehensive, consistent national planning basis for fisheries operations.

AN APPROACH TO NATIONAL FISHERY PLANNING

NACOA proposes a target for an increase in the share of fish supplied to the domestic market by domestic fishermen. U.S. food fish consumption is now 6 billion pounds a year of which the domestic catch supplies about 40 percent. Per capita consumption of this edible fish has remained constant for at least 30 years. (Consumption of fish for industrial use varies because it competes in the animal-feed market with other sources of protein.) Confining ourselves to edible fish and assuming per capita consumption will not change by 1980, we will then consume about 7 billion pounds of fish. A target of 3.5 billion pounds for domestic producers (increasing from 2.5 billion pounds in 1970) would increase our catch volume by 40 percent and reduce our dependence on imports for edible fish from 60 percent to 50 percent. This amplification would occur because the market is growing. What we propose is to supply the market increase and simultaneously move up to a larger share for domestic producers. A similar goal could be set for industrial fishery products.

We believe the implementing plan to achieve this goal can be developed in the following manner.

1. Determine present productivity of fishing areas of interest to the United States (including all inland fisheries). This assumes continued improvement in catch or production statistics.
2. Determine what the productivity of these areas, populations, or species could be in 10 years if a program of ideal conservation were adopted.
3. Determine which of the above programs should be adopted and implemented and to what degree.
4. Enumerate the steps that would be required and identify the agencies that would be concerned, e.g., Department of State on the matter of preferential access to coastal fish populations; Department of Commerce on internal maricultural efforts, etc.
5. Estimate how much additional fish and related products would be available to the consuming public as a result of this effort.
6. Relate this to domestic market requirements in 10 years and set feasible goals, programs, and time schedules to supply this need.

We have not carried out such a planning effort, nor do we underestimate its difficulty. We believe, however, that most of the capacity to do so resides collectively in the numerous agencies of government, and that the National Marine Fisheries Service (NMFS), Conferences and Commissions such as the international Convention for the Northwest Atlantic Fisheries (ICNAF), and the Food and Agriculture Organization (FAO) have much of the needed statistical information by which fish populations can be estimated by species and by area. We would be surprised, however, if even collectively they have it all in a form which would permit working backwards from a postulated national market to requirements of a resource without gaps in the analysis. It is not our intention to lay out a detailed plan to mobilize specific agency programs for this effort, but to offer a target by which such programs could be rationalized as a national planning effort under an appropriate lead agency—NOAA, for example—to strengthen the fishing industry. The experts can identify the programs, the budgetary requirements, and test our hypothesis that the benefit would be worth the cost.

Underlying these six steps to rehabilitate the fishing industry is the strategy that we must:

- assure the resource,
- assure the U.S. share of the resource by establishing the principle of preferential access, and
- accommodate the needs of both recreational and commercial fisheries.

Since no nation is in a position to take such action unilaterally, implicit in this proposition is the recognition that, at the Law of the Sea Conference to be held in 1973, stricter control of fisheries by the coastal nations and procedures for their enforcement must be established to make possible both allocation agreements and biological control of the resources. This will necessitate some readjustment in our understandings with some distant-water fishing nations. The issue is not a trivial one, and we address it also in our discussion on Law of the Sea.

RECAPITULATION

Let us review the reasoning of our proposed approach.

- The fishing resources of the sea are limited and subject to extinction unless managed so as to permit a sustainable yield.
- Present fishing technology, especially as developed by protein-deficient nations who themselves do not have sufficient fishing resources, threatens the existence of the species they catch. The economics of the situation drive each nation (indeed each fisherman) to catch specific fisheries even to depletion, because if they do not, they fear some other nation (or fisherman) might do so.
- International fishing arrangements which are species-specific have been

worked out between the interested parties so as to protect and preserve the resource. Because these agreements are usually in response to a downturn in catch, that segment of the industry is victimized before it can begin to recover.

- Many developing nations are anxious to reserve any resource to which they can now lay claim for development at their own pace. They should be willing to agree to aspects of control and management which respect their future.
- The time is ripe for reaching agreement among nations for control of fishing.
- In order to elicit agreements among many nations, the basis of resource management control would have to be biologically rather than politically determined.
- With the fishing resource assured over a period of time sufficient to attract investment, and our national share of the catch reasonably predictable, U.S. private enterprise should be depended upon to harvest it profitably.

The six steps by which a plan for an increased share of U.S. market may be developed are to determine (1) the present productivity of the fishing areas of interest to the United States, (2) their potential under ideal conservation conditions, (3) the necessary critical conservation methods, (4) the agencies which should bear the responsibility, (5) the increased supply of fish which would be available to the domestic market, and (6) a market penetration schedule.

We recommend that NOAA be assigned the lead agency role for developing such a plan, verifying its economic and operational feasibility, and—with Department of State collaboration—for proceeding with its implementation.

The time for us to act is now because foreign competition and the threat to fish resources are now recognized as a national problem rather than a local one. Like the land when the frontier began to disappear, the oceans too now need management in the common interest of those who would harvest its bounty today and be custodian for generations to come.

Weather Modification

Both deliberate and inadvertent weather modifications are possible today. Potential benefits and potential risks are great and raise grave social, legal, economic, and jurisdictional issues. In this section NACOA discusses the effort it believes desirable in: legislation to define rights, responsibilities, and a sense of purpose; research to hasten and extend our abilities to reduce risks; and international agreement to promote peaceful uses of weather modification and to eschew its hostile uses.

ON THE THRESHOLD OF ENVIRONMENTAL CONTROL

NACOA is persuaded that we stand on the threshold of a new era of environmental control. The scientific literature indicates today, that under certain limited conditions, man can increase or decrease rainfall, increase or decrease snowpack in the mountains, and clear fogs over runways and highways. Claims of suppressing hail in the Soviet Union are impressive. A large-scale effort is now being mounted to develop better methods of hail suppression in the United States. The capability to diminish the force of a hurricane (though not the ability to steer it) seems to be near at hand. Further research and development make it likely that some of today's limitations will soon be removed and man may before long deliberately exert an even greater influence on the weather. These developments require our serious attention now.

Our ability to treat these problems has been increased by advances in mathematical modeling of atmospheric processes, increases in the speed and capacity of computers on which these models are run, and new forms of instrumentation. Delivery systems for cloud seeding (rockets, land-based and airborne nuclei generators) and predictive methods for local meteorological conditions are being rapidly developed. These advances make possible methods of measurement and diminish the reliance on a long expensive series of statistical observations which seek to filter a faint signal from a large background "noise." The result is an acceleration of the entire field.

While our capabilities and understanding are growing, so are the dangers. In some parts of the United States operational weather modification has been carried out for nearly twenty years and operations are also being carried out in many foreign lands. The results are often unrecorded or unpublished. There is also increasing concern that man's activities inadvertently affect the weather and thereby modify the climate. The more we have learned about deliberate weather modification, the more reason we have to be concerned over the inadvertent effects of various substances now being released into the atmosphere. These effects can extend to the global scale as well as being local in nature.

The potential benefits from weather control and conscious climate modification are very large. So are the potential risks—particularly from inadvertent climate modification. Furthermore, any technique enabling man to control large-scale phenomena necessarily raises grave social, legal, and economic issues where effects extend across state and national boundaries. There is still time to address these issues rationally before operational weather modification grows at a pace which forces hasty moves. This opportunity should not be wasted, and NACOA believes that the time has come to take action along several broad fronts.

RECOMMENDATIONS FOR ACTION

NACOA sees five areas in which action is required.

- *Legislation:* Legislation to define rights and responsibilities of citizens, the States, and the Federal Government is needed promptly. So is legislation to define means for regulating and licensing private operators, organizational responsibility in the Federal Government, and above all, a sense of national purpose. More specifically, legislation is needed to designate responsibility in ameliorating those weather disturbances that produce public states of emergency, to establish the procedures under which the Federal Government and its employees may legitimately modify the weather, to define the rights and responsibilities of commercial weather modifiers, and to designate responsibility (probably Federal) for monitoring inadvertent weather modification. Regulation is also badly needed, but the issue of separating the responsibility for regulation from promotion of operations, always delicate, deserves more study.
- *Research and Technology:* Development of the technology by which precipitation can be increased, decreased, and redistributed should be hastened through increased funding for basic research in cloud physics and the optical properties of particulates, for computer modeling, experiment design and field work, and the development of remote-sensing devices (e.g., satellites and Doppler radar).
- *Hurricanes:* Research and development of the technology to mitigate the effects of hurricanes should be accelerated. This may involve mov-

ing Project Stormfury from the Atlantic to the Pacific, where the greater incidence of this type of storm makes the cost-effectiveness much higher.

- *Public Policy:* A detailed public examination of the policy issues inherent in weather modification should be undertaken. It seems clear that operational weather modification will open the way to substantial social benefits, but the matter of potential social losses cannot be dismissed out of hand. Increasingly the question will be asked "Who benefits from weather modification?" All major consequences of large-scale operational programs should be assessed in advance of their implementation. NACOA believes both national and international reporting systems should be developed. Rarely—if ever before—has there been a more attractive opportunity for creative thinking and planning regarding the impact of a potential technological development upon international relations. This opportunity should not be lost.
- *International:* International agreement should be arrived at and the necessary institutional arrangements developed to eschew the hostile uses of weather modification and to investigate inadvertent changes in the global climate. The Global Atmospheric Research experiment now planned for 1977 can, with some other activities during that period, provide a superb tool for analyzing the vital interaction between long-term oceanic changes and natural or man-made climatic changes. It may be desirable to have an international conference, say in 1974, to discuss issues such as promoting the peaceful use of weather modification and possible collaborative efforts in inadvertent weather modification. The national laboratory dedicated to weather modification, proposed by a National Academy of Sciences study, should be internationalized.
- NACOA wishes to associate itself with the position taken by the National Academy of Sciences that in order to safeguard the life-sustaining properties of the atmosphere for the common benefit of mankind, *the U.S. Government is urged to present for adoption by the United Nations General Assembly a resolution dedicating all weather-modification efforts to peaceful purposes and establishing, preferably within the framework of international nongovernmental scientific organization, an advisory mechanism for consideration of weather-modification problems of potential international concern before they reach critical levels.*

HISTORICAL BACKGROUND

Before discussing existing efforts and suggested changes in more detail, it is useful to review briefly the history of weather modification and how we got to the present state. The era of scientific weather modification began

in 1946 when Vincent Schaefer and Irving Langmuir demonstrated that it was possible to initiate precipitation by dropping pellets of carbon dioxide from an airplane into a cloud composed of water droplets at below-freezing temperatures. This dramatic development led to Project Cirrus, a broad theoretical and field program intended to establish a strong scientific basis for cloud modification. Perhaps the most important scientific finding was that silver iodide crystals were as effective as dry ice in transforming supercooled clouds into ice-crystal clouds, and thence to rain. More spectacular—and more controversial—were (1) an experiment with seeding a hurricane off the east coast, with inconclusive results and (2) experiments by Langmuir that convinced him (but very few others) that periodic seeding of the atmosphere with silver iodide in the southwestern United States produced corresponding periodicities in the rainfall 2,000 miles to the east.

Enough interest was stimulated by Project Cirrus to set in motion two other agency projects. The first was the Cloud Physics Project under the auspices of the U.S. Weather Bureau, the Air Force, and the National Advisory Committee for Aeronautics, conducted from 1948 to 1951. The second was a 5-year Department of Defense project which began in 1952. These serious efforts yielded inconclusive results because of their brevity, the primitive state of the art of instrumentation, and partly because the design of the experiments was not sufficiently sophisticated to filter out the natural variability of the atmosphere.

Meanwhile, a determined band of meteorological entrepreneurs moved in and succeeded in placing nearly ten percent of the land area of the country under commercial seeding, from strategically located silver iodide generators, at an annual cost of between 3 and 5 million dollars. The movement spread to 30 other countries.

Sufficient interest and controversy were generated by these results that Congress established in 1953 an Advisory Committee on Weather Control to study and evaluate the results of private and public experiments. Its report issued in 1958 was cautiously optimistic, concluding that increases of 10 to 15 percent in rainfall were induced by seeding spring and winter storms in the mountainous areas of the western United States. More long-term research was recommended with special responsibilities being assigned to the National Science Foundation. The Advisory Committee report was subjected to considerable attack, primarily on statistical grounds. However, the NSF did mount a modest but sound program of fundamental research and field experimentation, which laid an important basis for the next decade. As a result of extravagant claims and questionable practices by a few commercial cloud seeders, and controversy on statistical interpretation of experimental results, the field did not flourish during the early 1960's.

A two-pronged study was initiated in 1963 and 1964, by the National

Academy of Sciences and a Special Commission of the National Science Board. Their reports, issued early in 1966, were moderately optimistic. The conclusions of the 1953 Advisory Committee that the order of a 10-percent increase in precipitation can be expected from seeding orographic storms in western United States were substantiated. Subsequent studies by the Academy and the Interdepartmental Committee for Atmospheric Sciences have reinforced early findings.

PRESENT STATE OF THE ART

- For certain meteorological conditions the evidence is persuasive that it is possible to increase precipitation by substantial amounts and on other occasions to decrease precipitation by substantial amounts.
- There is ambiguous evidence that the effects of seeding may influence precipitation at points 100 to 200 kilometers from the site of the seeding. This matter must be clarified.
- It now appears possible to acquire the additional knowledge necessary to predict the effects of seeding on a wide variety of cloud types and systems (convective, orographic, stratiform, migratory storm systems, etc.) in different geographic areas from reasonably realistic computerized cloud models.
- Supercooled fog can be dissipated on an operational basis.
- There is encouraging evidence that hail can be suppressed.
- There is encouraging evidence that the intensity of winds in a hurricane can be reduced.
- There is evidence that further development will lead to operational techniques for decreasing the frequency and duration of cloud-to-ground lightning discharges, with a subsequent reduction in forest fires.
- Advances in remote-sensing techniques are the first steps toward methods to modify tornadoes.
- No completely accepted technique yet exists for dissipating warm fog, but the potential economic benefits and the encouraging prospects of such a capability warrant further research.
- The prospects of inadvertent modification of weather and climate by changing the chemical composition of the atmosphere, the particle concentration, or by the discharge of heat are so real, and so likely to be realized within a matter of decades, that a major program of research appears to be warranted.
- Weather modification issues now reach to the stratosphere. It has been suggested that exhaust emissions from SST's may decrease the ozone concentration at high altitude and lead to an increase in ultraviolet radiation at the Earth's surface. Fortunately, the way appears clear to resolve this question before SST's are operational.

Ongoing National Projects

The Federal programs in weather modification are coordinated under the Interdepartmental Committee for Atmospheric Science (ICAS) of the Federal Committee for Science and Technology. A number of the research projects representing voluntary combinations of resources of several of the interested Federal agencies are National Projects. They include snowpack augmentation, surface-wind reduction in hurricanes, increase of natural rainfall in areas where needed, reduction of damaging hailfall, spreading heavy Great Lakes snowfall over a wider area, and improving visibility in warm and cold fogs. Though agency funding for weather modification has lately been increased—in the last 2 years from \$16 million (FY '71) to \$20 million (FY '72 Estimate) to \$25 million (FY '73 Budget)—the projects have characteristically been inadequately coordinated, underfunded through fragmentation, often not backed up by basic research, and undertaken with obsolete equipment. This is not a criticism of any specific project, but of the lack of central planning and execution.

SOME POTENTIAL BENEFITS

Although too much reliance should not be placed on benefit-to-cost analysis, attractive ratios are already being achieved in some areas of weather modification. The Southern California Edison Project in the upper San Joaquin River Basin in the Sierra Nevada range has been operated continuously every winter since the 1950-51 season. Although the exact figures are proprietary, the meteorologist in charge reports that annual runoff has been increased 8 percent over the lifetime of the project.* Bureau of Reclamation studies indicate something like a 10 to 1 ratio of benefit-to-cost for orographic precipitation enhancement of this sort.** However, these operational programs are limited in number and have remained relatively constant through many years. Many programs having large potential benefits at attractive operational costs are not operational today due to limitations in the present technology. This translates to limitations on the resources (laboratory facilities, scientific manpower, instrumented aircraft, computer time, etc.) necessary to improve the technology.

Hail suppression has been operational in the USSR for many years with reported benefit-to-cost ratios of as high as 17 to 1. Lightning-caused forest fires produce losses in excess of \$100 million annually and destroy valuable forests. An operational technique for lightning suppression is expected to yield a benefit-to-cost ratio of at least 5 to 1. A semioperational program in Alaska now beginning its fourth season reflected this ratio in the 1971 summer season. Cold fog dispersal over airport runways is now op-

* Private communication from Robert D. Elliott, North American Weather Consultants, Santa Barbara, Calif.

** "Some Considerations of Benefit-to-Cost Relationships Regarding Use of Weather Modification," by Loren W. Crow, April 7, 1972, Contract to NOAA, LWC #99.

erational, where this type of fog is prevalent, with a return in benefits six times the cost of the program. Warm fog is even more prevalent, and it seems likely that a similar benefit-to-cost ratio will be attained when the operational techniques for its dispersal are perfected.

It is estimated that the hurricane modification program alone, when operational, would cost about \$5 million annually and could reduce property damage and related costs by \$100 million annually, a benefit-to-cost ratio of 20 to 1.

There is another vast area which suffers a shortage of annual precipitation, reaching drought proportions in far too many years. This is the northern Great Plains area of the country. In this region, where summer rainfall is both scanty and sporadic, crop-production technique is based on trapping a portion of 1 year's rainfall to help support grain production in the subsequent year, and one crop is produced each 2 years per unit of land area. On the basis of soil quality, the potential exists for annual crops given a modest increase in rainfall. This area, which has been largely ignored by the Federal Government in its weather modification program, should be explored.

TECHNICAL OBSTACLES TO PROGRESS

Progress in any technical endeavor depends upon our theoretical understanding, our ability to measure, our facilities for experimentation, and our ability to mount and manage large-scale field experiments. We have made significant progress in all four areas in the last decade.

Understanding

In order to make progress in the National Projects and other applications of weather modification, a great deal more must be learned about the natural weather processes and how these processes can be modified to bring about the desired effect. Some of these areas where measurements are essential include:

- origin, detection, and counting of natural ice nuclei;
- modes of nucleation, optimum particle size and numbers, and inadvertent sources of artificial ice nuclei;
- detection, counting, and variability of natural cloud condensation nuclei;
- inadvertent sources of artificial cloud condensation nuclei;
- water vapor, liquid water, rate of riming, cloud drop size, etc.;
- ice crystal type and size; and
- temperature in cloud, vertical and horizontal flow, electrical field, etc.

Instrumentation

The key to increasing our knowledge of the processes involved is accurate measurements of all of the needed information. This requires de-

Field Experimentation

As discussed previously, the Federal agencies are currently engaged in a variety of field programs. In almost every case the field programs are restricted by limited resources of one kind or another to the point where the programs are suboptimal and progress has been at a snail's pace. One would hope that the primary objectives of Federal programs to enhance rainfall, eliminate fog, and suppress hail and lightning would be the transfer of this technology to the private sector where it could produce an expansion of existing industries and create new ones.

What is badly needed is a field experiment which brings to bear all of the resources that can contribute to the success of the experiment. The experimental area might be somewhere in the Great Plains and should operate on a year-around basis. Experiments should be carried out with summer cumulus, winter upslope stratus, and winter migratory storms. The program should employ the latest in meteorological satellite and remote-sensing technologies, well-instrumented aircraft, and an increased density of surface, upper air, and radar observations of the National Weather Service. The emphasis should be on providing the tools necessary to fully measure and observe the physical and dynamic changes taking place both naturally and under the influence of seeding. Maximum effort should be made to determine results through direct observation of the changes in the cloud. In addition, the experiment should be designed in such a way as to provide optimum conditions for a statistical evaluation (e.g., random crossover design). The technologies developed by NOAA in Florida with dynamic seeding of tropical cumulus, by NOAA with seeding of low stratiform clouds over the Great Lakes, and by Bureau of Reclamation supported programs in the Dakotas and Texas provide the initial groundwork for this effort. The field experiment should be concentrated in an area less than the size of a State. From this experiment should come the basic knowledge which is needed for most phases of weather modification.

INSTITUTIONAL FACTORS AND REGULATION

Weather modification today within the Federal Government is carried out by seven agencies to meet their individual mission needs. The Department of Transportation is concerned with the effect of fog on airport operations, the Department of Agriculture is concerned with the reduction of lightning-caused forest fires, the Department of the Interior is interested in increasing the water supplies in the West, and the Department of Commerce is interested in abating hurricanes and other severe storms and in reducing or increasing precipitation for a wide variety of purposes. What is lacking is a central focus for the overall effort. Some progress has been made in this direction with NOAA having been assigned responsibility for monitoring the weather modification activities

velopment of improved instruments and the means to test and calibrate these instruments under actual or simulated conditions. The priority areas requiring attention are: (1) airborne instrumentation that can rapidly and accurately provide measurement of the type discussed in the preceding paragraph; and (2) more effective nucleating agents and more efficient methods of getting the nucleating agents into the target area.

Significant progress has been made in recent years in satellite technology and in remote sensing from aircraft and from the ground. NOAA's coming high resolution geostationary satellite and its developments in Doppler and optical radars and other remote-sensing techniques will make significant contributions to the advancement of the technology of weather modification. Satellites and remote sensing should be able to tell us something of the physical changes taking place within the seeded cloud and thus aid in the evaluation of field experiments.

In the final analysis, however, it is the precipitation on the ground and the runoff into the rivers and reservoirs that count where precipitation enhancement is the goal. Measuring the true difference in precipitation and runoff between seeded and unseeded areas continues to be the best hope for assessing results, but a vast improvement in this area is needed. Here radar, in combination with recording rain gages, represents the primary hope.

Facilities

A significant one-time investment in facilities will be required in order to support the developmental programs. The more important of these include:

- cloud chambers to stimulate the natural environment to enable the study of the natural processes involved and how they are affected by artificial stimulation.
- a test and calibration facility. NOAA has in operation the analog to what is needed here, i.e., National Oceanographic Instrumentation Center. Here new instrumentation developed by both public and private organizations are tested in modern facilities, and reports are issued as to their accuracy, reliability, maintainability, etc. The Center also provides a calibration service to both public and private organizations. Such a facility is urgently needed in the weather modification field.
- modern well-instrumented aircraft. A majority of the needed aircraft already exist in the private sector. The Federal Government need only be concerned with providing the minimum number of heavy aircraft equipped with sensing and recording systems, radars, and seeding capabilities required of the program. NACOA notes with concern the need to cancel NOAA's planned move of its hurricane modification project (Project Stormfury) to the Pacific for lack of such aircraft

within the country, both Federal and non-Federal. More importantly, though, is the need to have a single Federal agency responsible for taking the lead in development of the technology of the overall program. The present fragmented approach is moving the country ahead in weather modification in an erratic fashion.

Certain basic facilities and services which represent common needs of most Federal programs do not exist. Instrument development programs are critical to progress in weather modification, yet no focused program in this area is in evidence. There is a strong need for a central Federal facility to test, evaluate, and calibrate instrumentation and equipment used in field experiments. Again, no such facility exists. The lead agency should be responsible for doing the type of field experiment recommended for the Great Plains area. It should focus on drawing on the research results of the NSF and other Federal agencies and testing these in an operational environment. The end objective would be a feedback to the mission-oriented programs of the other Federal agencies, and a technology transfer to the private weather modification sector.

There is an immediate need for some form of regulation. As the Federal Government invests increasing resources in major field projects such as the National Hail Research Experiment and the Great Plains project, it becomes imperative that these experiments not be compromised by other seeding activities on their peripheries. To illustrate the problem, there recently was a test carried out to determine whether a seeding program upstream of a field project could be affecting the project. The results showed that 20 to 30 percent of the seeding agent introduced 100 miles upstream was actually contaminating the field project. In addition, the National Science Foundation has reported that two major weather modification projects supported by the NSF in the western United States were seriously compromised by unregulated cloud seeding in the vicinity of the projects. In one of the cases, the Foundation investment of over a quarter of a million dollars was negated by the lack of regulation.

Regulation at this time should be the minimum necessary to ensure that critical Federal experiments are not vitiated as a result of contamination by a nearby seeding activity and to ensure that all commercial operators are licensed and meet certain specified standards to protect the populace from unsafe seeding procedures.

EVALUATION

Experimental weather modification is an activity that does not lend itself to demonstrating a precise connection between actions and outcomes. The accuracy of assessment after the fact can be increased by better use of advanced instrumentation such as geostationary satellites, modern radars, computer models, aircraft probes, nuclei counters, etc. However, even with the best of instrumentation it is impossible to measure all variables over

a region of several hundreds of square miles. Even with unlimited funding, exact evaluation of an experiment is not possible. In the case of operational weather modifications, there are economic limits to the instrumentation that can be afforded. Therefore, decisions regarding operation must be made with only part of the data at hand. Whether the missing data are of serious consequences depend upon the specific circumstances. If operational weather modification is to be more generally applied, the decision making apparatus for determining when and how to permit operations needs to be improved.

Therefore, NACOA wishes to emphasize need to integrate statistical and other analytical approaches (mostly computer modeling) to reduce the uncertainty in evaluating the efficacy of weather modification. NACOA urges all agencies that sponsor research and development in weather modification, and all those who conduct operations, to explore and utilize both statistical and nonstatistical techniques and to conduct studies designed to bring these approaches together.

The Coastal Zone

An increasing population and increasing economic activities, poured into the attractive but confined space of the coastal zone, give rise to a host of conflicts and problems because of the incompatibilities of unrationalized multiple uses. The coastal zone is exceedingly complex naturally, socially, and economically, and every aspect of planning, negotiation, understanding, agreement, and implementation seems to involve many levels of government. As a result the management aspects of the coastal zone take on greater significance than is usual where an intimate mix of institutional and scientific activity is required. NACOA finds that prompt action on coastal zone management problems is urgently needed. These needs have already been pointed out in many reports including the milestone Stratton Commission Report issued three and a half years ago. NACOA is disturbed at the lack of definitive progress by the Federal Government on this matter, and the findings strongly underscore the need for action. State governments are already moving in this area, and the public is calling for action. NACOA recommends prompt enactment of coastal zone legislation.

THE NEED FOR LEGISLATION

Pressure is building in the coastal areas of the United States. Increasing population and increasing economic activity, crammed into a confined space, mean myriad conflicts which result from incompatibilities of unwise and unconstrained multiple uses.

The coastal zone is a pressure cooker precisely because its bounds are limited. Yet because it is the interface between land and sea it is a zone which is more complex naturally, socially, and economically than the continental interior. In addition, it is a zone in which every aspect of planning, negotiation, understanding, agreement, and implementation seems to involve more levels of government than any other zone.

There is ample evidence that the public is impatient with the lack of meaningful progress in this area and is demanding much more than a token commitment on the part of its government. The problems of the coastal zone now have too direct an impact on too many people for its

issues to be conveniently swept under the rug. An impressive manifestation of these concerns was evident at the recent Stockholm conference on the environment where important American citizens, acting as representatives of several hundred nongovernmental organizations, came to be heard on these and related matters. The fact that they felt impelled to act on their own, outside the normal channels of government, testifies not only to their great concern for the subject but also their lack of confidence that the established system would produce an adequate response.

The problems of the coastal zone have an extraordinary range: Usage problems include deep-draft oil terminals to alleviate the growing energy crisis vs. conservation of shore areas for recreation and protection of living marine resources; commercial vs. sports fishing; condominium development within jumping distance of the breakers vs. preservation of the dunes for their inherent physical and aesthetic value; marinas, housing developments, and industrial sites vs. wetlands; roads vs. hiking trails. Technical and scientific problems include the need for understanding the processes of circulation, stability, waste-receiving capacity, marine productivity, and habitat to mention only a few. Then there are the problems of man's impact on the ecosystem from dredging and filling, engineering and construction, contamination of water, water diversion, and many others. The list is almost endless.

Several features are worthy of special mention. Since it is the tidal tributaries and the nearshore waters of the coast that receive outfall effluents and surface and subsurface drainage and are immediate to atmospheric injection sources, pollution of the oceans is determined largely by what happens in the coastal zone. Most of the species on which commercial or recreational fishing industries depend are dependent on the waters, wetlands, and bottoms of the coastal margin. Finally, the coastal zones of the world are gateways to the oceans through which must pass most commerce serving man's marine-related needs. The regulation of man's activities in the coastal zone involves balancing social, economic, political, and national security trade-offs of great complexity with local, state, regional, national, and international consequences.

This situation has been recognized for some time and this recognition has during the last 5 or 6 years led through a lengthy series of studies, commissions, and policy resolutions to a gathering momentum for comprehensive legislative action, presently represented by two well-conceived coastal zone management bills under active consideration by the Congress. NACOA feels that the passage of suitable legislation has been delayed much too long and urges prompt enactment of one of these. At this time, we strongly favor legislation devoted exclusively to the management of the coastal zone unencumbered by the larger issue involved in land-use management legislation applicable to the entire nation. We feel it is vital that this legislation also provide for the establishment of research and

technical advisory sources closely coupled to each level in the management hierarchy including local, State, and Federal echelons. The basis for these recommendations follows.

THE PROBLEM

It is widely recognized that the coastal zone problem is first and foremost a management problem, and that the crux of the management problem is jurisdictional.

This is not to say that the other elements typifying a management problem are all in hand. The Stratton Commission, for example, mentioned several, including the neglect accorded marine affairs by State governments at that time and their failure to develop and implement long-range plans. Furthermore, there is a continuing and undesirable gap between those responsible for coastal zone decisions and the technical and scientific expertise needed to help them assess the consequences of their decisions before they are made.

But the last few years have seen a growing awareness of the importance of the problem and a broad consensus regarding the major goals. These were described by Lawrence, the Executive Director of the Stratton Commission, during the 1969 Hearings on the Coastal Zone, as including:

“. . . the urgent need to halt the deterioration of the Great Lakes and estuaries, provide more adequate seaside recreational opportunities, improve our ports, accommodate expanding industries seeking shoreline space, capitalize on opportunities to make more effective use of the waterfronts of coastal cities, and protect our coastlines from accidental oil spills and other forms of pollution.”*

It is our conviction that all these goals can be met. The plans to do so must be drawn up in such a way as to take advantage of the full range of possibilities represented by the coastal zone as a whole, adjusting local plans to keep within the guidelines derived from the larger context. For this, resolving the jurisdictional problem is mandatory.

To see why this is so, consider the ownership of the coastline for example. Excluding Alaska** about 70 percent (26,000 miles) of the 37,000 miles of U.S. shoreline is in private hands, 12 percent (5,000 miles) is

* “Coastal Zone Management Conference,” Hearings before the Subcommittee on Oceanography of the Committee on Merchant Marine and Fisheries, House of Representatives, 91st Congress, October 28-29, 1969.

** Prior to the recently approved Alaska Native Lands Claims Settlement Act, the extent of whose impact on land ownership in the coastal zone is not yet known, only 1 percent of Alaska’s 47,000 miles of shoreline was privately owned. Most of it (88 percent or 41,000 miles) is owned by the Federal Government, and the rest (11 percent or 10,000 miles) by State and local governments. Less than one-fifth is in any way developed, and more than half of that is used for recreation. In “the lower 48” plus Hawaii, more than 40 percent is developed, two-thirds of which is used for recreation. “Report on the National Shoreline Study,” Department of Army, Corps of Engineers, August 1971.

owned by State or local governments, and 11 percent (4,000 miles) by the Federal Government. The ownership of nearly 3,000 miles or 7 percent is uncertain. Seaward below mean high water, the State generally has jurisdiction, in most cases out 3 miles.

Although Alaska's coastal zone has important management problems, those with difficult jurisdictional properties lie elsewhere, and this discussion will focus on these. The greatly complicating factor in the non-Alaskan coastal zone is of course the problem of how to deal both equitably and wisely with the private interests involved when they begin to conflict with each other or the public interest. One illustrative statistic—two-thirds of the 2,700 miles of critically eroding shoreline is privately owned, virtually all of it under extensive development. And "significant" erosion affects over 40 percent of the shoreline, again much of it traceable to man-made developments.*

Accordingly, when NACOA undertook to review the present status of the coastal zone management problem, it arranged for briefings from representatives of local governments, State governments, intrastate and interstate regional commissions, as well as from the major Federal agencies involved, the Department of Interior, the Department of Commerce, EPA, the Department of Defense (including both the Corps of Engineers and the Navy) and the Department of Transportation (the USCG). In addition, points of view representative of other Federal agencies, industry, and of the conservation community were also sought. Using the judgment of knowledgeable Committee members to supplement these briefings, we feel the following factors are of special significance.

- Though what is done on land does affect the coastal zone, the major indicators of impact are marine. Hence, the coastal zone poses unique problems for management, many differing in kind as well as degree from those facing inland land-use management.
- The coastal zone—and its problems—differs from one place to another in fragility and the need for protection, as well as in biological productivity, and the presence of mineral resources. Management approaches and priorities for early attention should differ for estuaries, wetlands, exposed beaches, and unique areas such as the Everglades from those applied to more stable systems such as the coast of Maine, areas already heavily developed such as New York Harbor, or where extensive oil or mineral deposits underlie the region such as along the Gulf Coast of Louisiana.
- Priority attention and management decisions should also be determined by the relative severity of the environmental impact of the various types of activity proposed. Activities producing permanent or

* "Critical" erosion is that where action to stop it is felt justified in the light of economic, safety, demographic, or ecological factors. "Significant" erosion is undesirable but efforts to arrest it may not be justified in these terms. *Ibid.*

preemptive changes demand that a wider context and broader set of considerations be applied to regulatory decisions than do activities whose impact can be controlled or rectified.

- It should be recognized that the cumulative effects of multiple similar activities are far different from those of a single case. The effect of one offshore oil well or of one retirement village is not the same as that of 25,000.
- The scientific knowledge needed as a basis for sound management decisions is spotty and generally inadequate. Institutions for bridging the gap between existing knowledge and contemplated action are relatively few and weak.

COASTAL ZONE NEEDS FROM SEVERAL VANTAGE POINTS

Since local, regional, State, and Federal interests and jurisdictions may all impinge at once on various coastal zone issues, and the management problem has a large jurisdictional element, NACOA found it instructive to hear representative views from each level. We will typify them in what follows by quotation and by paraphrase. While they differ in a number of respects, there are two related jurisdictional principles which all these views tend to support:

- Regulatory authority must be associated with existing political entities or combinations of such entities even when the physiography or other features of the coastal zone region to be managed are not completely coincident.
- The State and its constitutional powers make it the key political entity in coastal zone management in that localities and intrastate and interstate regional authorities derive their powers from the State or States involved.

Local Government

We note that local government, be it in the city in highly populated areas, or the county in areas of low population density, is closest to the people, and its elected officials must raise much of the money to carry out decisions made regarding their communities. The system is likely to work best if they have some latitude in land-use decisions, subject to conformity with reasonable environmental standards and carefully conceived regional or state guidelines. The greatest current handicap is the unavailability of the right kinds of expertise. To use the words of a discussant,

"We are in an era when politicians, managers, and scientists of many disciplines must get together in a systematic approach using all our resources . . . There is a need for adoption of standards, criteria and priorities at the Federal and State level within which local agencies can operate . . . There is a need for the Federal Government to identify nationally significant areas and to identify uses in those areas, to include Federal procurement of land if necessary. The States should follow suit within their jurisdictions.

"In the remaining areas, local government should be permitted to act within criteria established. Should the criteria work hardship on local agencies, there must be subvention . . . Local government must have more ready access to either direct interdisciplinary advice or funds with which to obtain such advice . . . Private property owners must receive some protection against costs disproportionate to benefits they may receive." *

State

It is at the State and local levels that most of the pressures have been felt and most of the attempts at solution have been made. Though helpful legislation has been passed, the result is what one would expect from catch-as-catch-can solutions—the problems simply get bigger and move up in priority. Although several States have moved toward comprehensive coastal zone management arrangements, this has not been, in general, true in the past. State experience can be most instructive for action at the Federal level. As one State official put it, the problems characterizing State efforts at coastal zone management during the last 20 years have arisen from "expedience, inexperience, and lack of political interest." Programs have often grown without sufficient statutory authority, guidelines, or priorities, resulting in a tendency to make ad hoc decisions on each issue as it arose. Continuing demands for more and more mineral production, flood control, hurricane protection, navigation channels, and the reclamation of wetlands for human habitation and agriculture, he informed NACOA, have produced tremendous pressures on an ill-defined set of environmental priorities.

"Such an approach to environmental management, at best, is partially effective and only prolongs the agony of environmental degradation by partial control and regulation of specific destructive activities and projects but which fails to accomplish very much control over the accumulative and quantitative effects of multiple actions. At worst, (there) are cases of overzealous environmental agencies and individuals which take a completely negative position on all environmental manipulation and which would bring progress to a halt. Such an inflexible position is self-defeating since neither the executive and legislative branches of government nor are industry and the public prepared for such drastic change. The probable result will be rebellion against environmentalists and the environmental position unless all branches of government and a majority of the public is fully aware of the need for and the ramifications of such regulatory severity . . .

". . . many of the same errors are being repeated on a national level as the Federal Government wrestles with problems of coastal and environmental management. From the state's position, the Executive Branch of Government has not spelled out the national environmental policy in sufficient detail and clarity, particularly in the area of setting priorities, and there is much evidence that the Legislative Branch is still proposing vast public works projects and industrial development that are environmentally disruptive while expecting and promising environmental protection and management in the same locality. Legislative demands for incompatible activities create an almost impossible position for state

* "Statement for Presentation to NACOA," 27 April 1972, George Dawes, Harbor and Tidelands Administration, City of Newport Beach, Calif.

and Federal administration to resolve and guarantee environmental stability . . .
 "Much more research specifically aimed at gathering data to make environmental management determinations is needed:

- The research should be associated with and geared to furnish data to specific planning bodies or agencies.
- Research may be carried out by Federal agencies, state agencies, and universities but it should be specifically oriented to produce needed answers in the shortest possible time. Vague, undirected or uncontrolled research programs, particularly in universities, will be inefficient and costly. . . ."

In conclusion, NACOA was told,

"It should be obvious that the technical personnel of the states is more familiar with and in a better position (than the Federal Government) to make local judgments concerning environmental impacts. Local political pressure and public demand, however, may negate efficient local management unless specific national and state environmental priorities and policies are developed.

"Once a clear and well-defined national policy is established and accepted by the public and local governing bodies, then workable guidelines and planning can follow, and the states could be expected to do most of the planning and decision making." *

Regional

There are two sorts of regional organizations, one intrastate and the other interstate. Each has its problems and unique applications, the former being built usually about a unique feature or situation (for example, San Francisco Bay), the latter about regional needs that transcend State boundaries (for example, the New England River Basins Commission). In both cases, however, multiple jurisdictions must be welded into a single ad hoc jurisdiction or district for some specified purpose. And in both cases active citizen initiative and broad public interest are probably crucial, since State action is required if the regional body is to have regulatory authority.

Referring to the San Francisco Bay Project, "The experience," says a recent Conservation Foundation Publication **

"provided many lessons to those who seek to protect other estuaries and other national resources, even if there is no pattered, ideal way to achieve environmental protection that will work everywhere. 'Much more important are the personalities and the quality of local politics.' . . . In other areas, other political arrangements may be needed. Several states might be involved in a resource. A compact, or a full regional government might be desirable. But it is worth reviewing the major ingredients of the San Francisco Bay story—because each of them *may* have been indispensable there and could be crucial elsewhere: A resource that was highly valued . . . rising environmental concern . . . factual basis . . . nucleus of concerned, hard-working citizens . . . legislators to take up the cause . . . campaign for legislation . . . coverage, from the press . . . an agency

* "Coastal Zone Management Problems—The State's Position," prepared for presentation to NACOA by Lyle S. St Amant, Louisiana Wildlife and Fisheries Commission, New Orleans, La.

** "The Saving of San Francisco Bay," Conservation Foundation, Washington, D.C., 1972.

which provides a forum for all the interested governmental jurisdictions and other parties to work out their problems together . . . non-nonsense staff and a respected, diplomatic chairman . . . public hearings and public debate . . . power to control uses of the resource it seeks to protect . . . Finally, of course, a plan and a law . . . that is enforceable . . . respected, and that draws wide support from the community."

The bite in the San Francisco Bay Group could very well have been its regulatory power. This is somewhat unusual at either intrastate or interstate levels such as, for example, the New England River Basins Commission. Although the NERBC has been influential and effective in a number of specific instances, it has authority only for planning. Formal interstate compacts may be increasingly desirable as management needs, which cross State boundaries, multiply in number and severity.

IMPLICATIONS AT THE FEDERAL LEVEL

We wish to emphasize that the *management* aspects of the coastal zone take on greater significance than is usual where an intimate mix of technical and scientific work is required.

NACOA believes that only by proper management can one get a handhold for progress in the coastal zone, that the powers vested in the States make their role pivotal, that the lead-agency concept for Federal involvement must be used, and that scientific and technical support must be made available and responsive to all levels of authority.

- Proper management is the key to progress in meeting and overcoming difficult problems in the coastal zone and in learning to anticipate them.
- Technical and scientific knowledge, without which proper management would be impossible, can be encouraged to serve the needs of that management.
- Management is in turn subordinate and in service to the local region—the coastal State—and derives a large part of its technical problems, goals, and force of implementation from the locality.

NACOA therefore advocates a National Coastal Zone Program whose two principal elements are Management (planning, legislation, development of regulations and standards, monitoring, and enforcement) and Research and Development (basic and applied research, engineering development, technical assistance, and advisory service). In order to make certain that the necessary collaboration between these two major elements is ingrained in the structure of the national program on the coastal zone, NACOA further urges that the research and development, as well as the management elements, be tied closely to existing geographic and political jurisdictions.

The summary of views held by various levels in the jurisdictional hierarchy indicates that they are looking for Federal action to provide

a number of vital elements now missing in a satisfactory coastal zone management system. Among the more important of these are:

- the articulation of national policy regarding the management of the coastal zone, and an effective means of governmentwide coordination in its implementation;
- the identification of nationally significant coastal zone areas, the specification of uses suitable for these areas, and initiative, including purchase, to assure appropriate development;
- for the remaining areas, the establishment of standards, criteria, and priorities of use within which lower levels of government can act on their own initiative;
- protection or compensation for private property owners against costs disproportionate to benefits;
- regulatory procedures, including procedures for appeal, that are uniform, reasonable, direct, and centralized;
- the provision, through support of appropriate research and services programs and institutions, of accessible, responsible, and competent technical expertise available to all levels of decision makers.

Since 1965, the major studies on ocean affairs, particularly the Stratton Commission Report, emphasized the importance of a prompt attack on coastal zone problems. Many of these recommendations are apparent in the U.S. oceanographic program today. A particular example is the Sea Grant Program supporting several institutions which are developing a capability to assist State and local governments in technical aspects of coastal problems. Basic legislation in coastal zone management is overdue both at the State and national levels. Some forward-looking states have made considerable progress in the areas, but the Federal Government is lagging badly.

RECOMMENDATIONS

In this chapter NACOA has discussed the basic elements that national coastal zone legislation should encompass and encourage.

The Senate has unanimously passed the Magnuson Coastal Zone Management Act—S. 3507, introduced by Senator Hollings—which largely satisfied the requirements we have put forward. A similar bill—H.R. 14146—has been introduced by Representative Lennon in the House. NACOA strongly recommends the passage and enactment of one of these bills.

There are competing legislative proposals which would have the effect of absorbing coastal zone management into a much larger national land use program (H.R. 7211 and S. 992). We do not support this approach for a number of important reasons: (1) The problems of the coastal zone have been very well defined by the work of earlier national and

State commissions. In the much larger land-use bill, the urgency would be diffused in the enormous variety and complexity of both physical and social problems that the larger act involves. (2) The technical problems, including the biological aspects, are sufficiently distinct that there could be no net gain, and almost certainly a loss, by mingling marine-oriented technology with land-use technologies. (3) The logical place in the Federal Government for a land-use program is the Department of the Interior. By contrast the governmental reorganizations of the last 7 years have placed most of the expertise in coastal zone affairs in Department of Commerce, in the National Oceanic and Atmospheric Administration. Further, other agencies that have expertise in this area, such as the Corps of Engineers, have strong links to NOAA.

We consider S. 3507 and H.R. 14146 progressive in the sense that they match very closely the developments of many of the coastal states, who are moving toward separate coastal zone programs of their own. H.R. 7211 is regressive in this respect. The movement towards separate management of the coastal zone is clearly supported by the National Governors' Conference, which for 3 successive years has strongly endorsed national coastal zone legislation. The same movement has been supported on the parliamentary level: *viz*, in the National Legislative Conference.

The Committee feels very strongly that there should be strong coupling between the information-gathering and the management functions. The legislation that we support does not do so explicitly; however, the fact that the Department of Commerce, with NOAA, would have the primary Federal responsibility for implementation of this program (under S. 3507 and H.R. 14146) assures the opportunity of this coupling. H.R. 7211 creating a land-use program centered in the Department of the Interior would impede achievement of this desirable goal. The legislation we favor does provide that the Secretary of Commerce will prepare rules and regulations which State coastal zone management plans must meet. NACOA observes that the Secretary, with the expertise available to him through NOAA, is in a position to recognize the necessity for close coupling of the information-gathering and the management functions in formulating these rules and regulations and to monitor state activities to see that this coupling actually occurs. Indeed NACOA is specifically charged with oversight of these issues and intends to make further recommendations in the future.

Moving Ahead

This first NACOA report is a beginning. It begins to examine the spectrum of critical national needs and priorities in the light of our Nation's role in man's stewardship of the oceans and atmosphere.

These are not abstract, remote problems for a few experts to worry about. They are basic to this country's well-being and perhaps even to its survival. It is already very late. In some places the oceans, coastal waters, and atmosphere have been degraded and their resources despoiled. In a few areas, we are close to the peril point and little time is left to turn matters around.

The preceding chapters provide NACOA's assessment of how things now stand with respect to our interface with other members of the world family, our fisheries resources, weather modification, and the condition of our coastal zones. We are not in good shape in many of these areas, and we are not moving rapidly enough or confidently enough to put our affairs in order. Each of the preceding chapters sets out the condition in which NACOA finds us, and the priorities as NACOA perceives them.

How did we get in this shape? What failings allowed us to arrive at situations tending toward irreversibility? What should we do to correct the failings?

National policy is the sum of governmental and private decisions and actions. Neither government nor private parties have been sufficiently alert to the emerging problems, nor prepared to make the adjustments and sacrifices necessary to deal with them.

The machinery for national policy making for marine and atmospheric affairs has been, and remains, weak and disunited. Responsibility and accountability are divided. Coordination is inadequate. Priorities are slow to emerge, decisions even slower, and resources to implement these priorities are too little and too late.

The problems addressed in this first NACOA report all show a common pattern: they arise from the behavior of a system that takes action

only in a crisis. Man's increased power to exploit the environment, and to destroy it, has brought an end to the era in which societal decisions could be based on a frontier philosophy. We no longer deal with unlimited resources of energy and materials. The shoreline is not unlimited. Species can be made extinct by over-zealous exploitation. Once we could fire a pistol that sent the settlers rushing to fill the vacant lands. Today, the ocean frontage is overcrowded, the pioneers have no new lands to conquer, but we still make decisions as though they did.

The established procedures for determining social actions do not reflect the new realities; and the deficiencies can often be traced to a failure to use available knowledge. The system should therefore address the need to keep information about the *realities* of our environment ever before the decision makers, be they legislators, city managers, governmental executives and, ultimately, our citizens. The system should also guarantee that those who gather data about the environment do so to support the informational needs of decision makers. The results of decision making should square with the realities; data gathering should be responsive to needs.

Each system for decision making should incorporate a system of checks and balances, permitting decision makers the opportunity to influence those who develop the information, and to give those who develop the information an opportunity to review and influence the decision making. Any system which does not display the characteristics of candor and consistency necessary to popular support will not be effective.

The pattern that should be adopted is clear. Its absence can be discerned as a reason for failure of existing attempts to reconcile competitive uses of common resources. This pattern emerges from the common sense observation that you cannot manage something you do not comprehend and you do not appreciate what you need to know until you try to manage something.

Some of the decision problems are highly decentralized, such as shoreline protection and development or estuarine development and conservation. Others are highly centralized, as is the case with Law of the Sea negotiations or severe storm modifications. But each resource problem, at whatever level, requires the close integration of fact finding and evaluation of alternatives.

To guarantee that these processes are carried out with integrity, it is necessary to provide for the generation of national policies. These policies should define the national interests and should provide guidelines for the resolution of conflicts which arise in pursuit of these policies. To make these points explicit, NACOA strongly urges that:

- legislation establish, in every case, both a focus of policy responsibility and a center for assembling the information upon which decisions can be made—and explicit provisions to see to it that these interact with each other;

- a strong policy-level office be maintained, reporting to the President and with outreach to state governments and private interests to focus and coordinate national policies, priorities, and implementation;
- the Administration and the Congress reopen the unfinished business of the Stratton Commission with respect to the structure, organization, roles, and missions of NOAA and other primary agencies charged with responsibilities for the oceans and atmosphere. The present arrangements, while a distinct improvement over the conditions which preceded the Stratton Report, still fall short of providing the fully integrated and accountable management system that is required. Scattered and divided responsibility is unlikely to produce the perspectives and decisions needed for arriving at goals and priorities for the oceans, the atmosphere, and the coastal zone. NACOA itself intends to address these issues in the coming months.
- an integrated annual budget and legislative program related to priority objectives of national oceanographic and atmospheric policy should be formulated and adopted by the President and the Congress at levels of effort commensurate with the critical problems confronting the Nation.

Absent these measures, serious discontinuities in policy planning, resource allocation, and policy execution will continue to bog us down in half measures and compromises. We can do better than that.

Mr. LENNON. Before we hear our first witness, I would like to explain that I am not particularly happy with the timing of this hearing. However, in view of the date on which the report was finally forwarded to the Congress, which came during the last busy weeks before the Congress adjourned, it was considered desirable to schedule this hearing after adjournment, recognizing the fact that most members of the subcommittee might not be in Washington at the scheduled time and that of those present some would have other commitments which they could not cancel. Even with the recognition of those facts, it is my opinion that an exchange of viewpoints here this morning, which can be reflected in the hearing record, will hopefully provide some assistance to the Subcommittee on Oceanography and to the Committee on Merchant Marine and Fisheries during the next Congress.

Finally, let me say that it is with mixed feelings that I recognize that this will be one of the last subcommittee hearings which I will be privileged to attend as a Member of Congress. My interest in the problems of Oceanography has been deep and sincere, and while the programs in the area of Federal ocean affairs has been somewhat slower than many of us would have hoped, I have the feeling that we are moving forward and that in the not too distant future a Federal ocean program cohesive in nature and broad enough to serve the national interest will be an accomplished fact. I expect the National Advisory Committee on Oceans and Atmosphere to contribute not only to the realization but also the continuation of that effort.

I might say I read the report with interest and I also read the Secretary of Commerce's comments, which he made in forwarding this report.

Now here to discuss with us the first annual report of the National Advisory Committee on Oceans and Atmosphere, I welcome Dr. William A. Nierenberg, chairman of the committee. He is here this morning together with several other members of his committee.

Doctor, we welcome you and the other members of the National Advisory Committee and look forward with pleasure to your statement.

STATEMENT OF DR. WILLIAM A. NIERNBERG, CHAIRMAN, NATIONAL ADVISORY COMMITTEE ON OCEANS AND ATMOSPHERE, ACCOMPANIED BY ADVISORY COMMITTEE MEMBERS

Dr. NIERNBERG. Thank you, Mr. Chairman, Congressman Lennon, and members of the committee. Let me begin abruptly by saying that it is with no pleasure that I note that this is the last occasion at which formal discussion takes place between you, as chairman of the Subcommittee on Oceanography of the House Merchant Marine and Fisheries Committee, and the National Advisory Committee on Oceans and Atmosphere whose existence is testimony to your vision and hard work. Your contribution to ocean affairs has been so marked, there is no completely fitting way of saluting this moment, but we thought it would at least be appropriate to tell you what we have been doing; why, and what we plan to do, and then to solicit your comments, your suggestions, and your advice. I would also like to open for discussion with you, though it could hardly be more than a beginning because of its complexity, questions relating to the coordination of national

programs and effort in marine and atmosphere affairs. But first let me introduce to you personally the committee members who have come with me today to be present at this oversight hearing and to honor your years of effort in the Nation's marine and atmospheric interest.

They are William J. Hargis, Jr., Vice Chairman, Director, Virginia Institute of Marine Sciences; Wayne V. Burt, Associate Dean of Research (Oceanography), Oregon State University; John C. Calhoun, Jr., Vice President for Academic Affairs, Texas A. & M. University; John P. Craven, Dean of Marine Programs, University of Hawaii; Charles L. Drake, Professor, Department of Earth Sciences, Dartmouth College; Thomas A. Fulham, President, Suffolk University; Joseph J. George, Director of Meteorology, Eastern Airlines; Francis S. Johnson, Director, Center for Advanced Studies, University of Texas at Dallas; Thomas F. Malone, Dean, Graduate School, The University of Connecticut; Mark Morton, Vice President and Group Executive, Aerospace Group, General Electric Co.; John J. Royal, Secretary-Treasurer, Fishermen & Allied Workers' Union; Clement Tillion, Alaska House of Representatives.

I have also brought with me the staff of the committee whose executive director, Mr. Douglas Brooks, has appeared before you earlier in the year.

Now, as to what we've done in the brief year of our existence. What we did was less than what we wanted to do but more than we had at first hoped.

Our annual report, which had not yet been transmitted to the President and to the Congress when I last appeared before you, is now on the public record. I will not take the committee's time to review it in detail—except, of course, to respond to your questions. But I would like to tell you why and how we chose for treatment the four topics which appeared therein: Law of the sea, fisheries, weather modification, and coastal zone management. We chose them because we felt that they were issues requiring action, issues which, each in its own way, were at some critical juncture in development.

These topics had to survive a further test to appear in our first annual report. We had to be sure we had something to say which would make a substantial contribution—which would be worthy both of the subject and of our audience. Not every topic survived this last test. One in particular—marine transportation (as noted in our foreword)—passed the test of importance and readiness, but not the test of amenability to NACOA treatment in the time available. We simply did not have the time nor the resources to deal with this important subject with the depth and balance it deserved by the June 30 deadline.

I go into this detail because these same criteria hold during this second year of NACOA's existence. From a list of 20 possible areas to which we considered bending our effort, some 10 or 11 have been chosen for further exploration; and hopefully, some six or seven will survive and emerge next June 30.

I would like to tell you briefly of the topics we have been considering so as to elicit your comments, but before doing so, I would like first to inform you of a special report, just issued, which was a direct response to a request from the Administrator of NOAA to make an independent and public evaluation of the performance of NOAA's

weather and flood forecasting-warning dissemination system during the great Agnes tropical storm and floods in June 1972.

As you may know, NOAA conducts immediate in-house surveys in any disaster of magnitude to evaluate the nature of its own performance and to ascertain where improvement could be made. Agnes was so huge—damage came to \$3.5 billion, I understand, and there were 118 deaths directly related—that the Administrator requested NACOA to make an independent judgment of system behavior. This work has been completed by a panel chaired by Mr. William Carey and was transmitted to Dr. White early last week. The report is, of course, being made public.

Now let me offer brief mention of a scant dozen topics and subtopics which we believe are ripe for consideration by the Oceanic and Atmospheric Community and which NACOA is currently exploring to see whether the second criterion—can NACOA do the subject justice and in the time available—can be met.

The order, by the way, is of no significance. It is still too early in our thinking to consider the question of priorities.

In deciding what issues to take up this second year, we started with the results of our first year's work. Each of the subjects dealt with in our first report resolved a number of issues—at least to our satisfaction—but gave rise to others. For example, take coastal zone management. You know, of course, of our direct and deep concern and recommendation that the unique and complex problems of the coastal zone be worked at in such a way that scientific and technical support is directly available and responsive to management needs as they develop.

We would be bringing coal to Newcastle to detail the issues here. We intend, however, while keeping informed on the Department of Commerce's implementation of the responsibility assigned them by the recent coastal zone legislation, to help by identifying and making recommendations on some of the key considerations facing the Nation as this program moves ahead. In addition to problems of multijurisdictional and interagency coordination, serious questions remain regarding the relation to coastal zone management goals, procedures, and institutional arrangements to goals, procedures, and the like in the broader national need for land-use management on a continentwide basis.

Within the coastal zone program proper, the question of appropriate arrangements and funding and staffing policies to promote an adequate flow of information and technical advice to coastal zone managers is still quite open. We know some mechanisms have been successful; others have not. We feel we can be of service here.

Weather modification is another major issue developed in our first year but worth developing further in our next. You may recall that the committee felt the technical and scientific aspects of this activity have progressed to the point where the nonscientific questions of societal, economic, and political impact of weather modification operations are now in urgent need of answers. The possibility of the hostile use of weather and climate modification as a weapon brings an international dimension most strongly into the picture. We have established a special panel under the direction of Dr. Thomas F. Malone to move this subject forward.

An international dimension is also strongly marked in our other two first-year studies, law of the sea and fisheries. With regard to law of the sea, we feel an obligation to help advise appropriate agencies regarding the kind of international cooperative programs which we have recommended as one way of bringing developing countries to share the practical benefits of marine resource development and to reduce the present political split in the United Nations between developing and developed countries that threatens to inhibit even such activities as marine research which are clearly in everybody's self-interest.

In fisheries, we would like to encourage the experts in the field to move ahead in developing the biological management approach, recommended in our report, to this severely threatened resource.

In marine transportation, the major systems study which we recommended be undertaken by the Department of Commerce as a necessary prerequisite to the formulation of appropriate policy and a corresponding long-range plan has not yet been carried out although some relevant aspects such as deep-draft ports are under study in the Executive Office of the President, for example. We feel there are some things NACOA might do to help and are exploring them now.

There are additional recommendations in our report which we intend to follow up also. We are fully aware that NACOA recommendations do not necessarily mean action—in fact do not deserve it until the ideas are independently examined. But we do mean them to be taken seriously. We are in no position, nor is it our function, to see to it that our ideas and suggestions are implemented. But it is our responsibility to see that our ideas and suggestions are understood. Implementation then would depend on their merit and on their winning in healthy competition with other suggestions for action.

There are several other major issues which have emerged from our planning sessions, and on which work is now underway. You may be surprised at one of these, basic science. You may recall that we stated in our report that we felt basic oceanographic and atmospheric science was in a comparatively healthy state. We still do. But we are aware of growing anxiety that the momentum may be lost in several fields to almost transcendental importance to both the United States and international science if their value is not recognized by the funding agencies and the Congress.

One of these is marine geophysics. The emergence of the theory of plate tectonics and continental drift as a unified theory to explain the evolutionary development of the earth in the last 160 million years has been said to offer the same sunburst of excitement, the same impulse toward coherent explanation and understanding, in the field of geology, as did the atomic theory in the field of physics early in this century. What happens when a particularly exciting and unifying theory appears on the scene is not only that the available data and observations become more comprehensible, but a whole series of crucial observational designs are suggested whose potential usefulness is more assured than was previously the case. Where should the Nation invest its effort? This is what we are looking into.

Another is physical oceanography. There are two basic reasons why we are addressing ourselves to this topic. The first is technical and

scientific; the second has to do with the global nature of the problem. The two are, of course, interrelated.

Within the last 4 or 5 years people have begun to see what obstacles exist to a real understanding of certain major problems in physical oceanography and how, by combining forces, one can develop programs that should be undertaken—in air-sea interaction for example, or in the variability of ocean currents with depth in the oceans.

Now here is where the global nature of the problem comes in. The fact that other nations are beginning to match our capabilities and that the nature of the problem—and its size and expense—make it desirable to pool resources, makes it a major area for international cooperation. This in turn lends itself to U.S. interests in the 1970's. We hope to talk about this in our next report.

A special problem for marine and atmospheric science has been created by the recent trends in military support of oceanic and atmospheric science. From the end of World War II through the end of the 1960's, the DOD support of basic research helped fuel the intense and incredible technological progress that took place. Circumstances are changing and many aspects of that support are no longer needed or desirable in the same form and sponsorship. As the handover takes place from military to civilian sponsorship for the support of research in the oceans and atmosphere, one must be aware of two dangers: (1) That basic projects are not lost in the transfer process and (2) that the defense system has not given away so much that its own needs can no longer be satisfied. We feel this problem needs to be looked into. We have made a start on reviewing NOAA programs and progress, through the special study on NOAA's disaster warning service in Hurricane Agnes. This is the beginning of what is a statutory responsibility of NACOA—that we be in a position to advise the Secretary of Commerce on the carrying out of the purposes of NOAA. Here our job is to learn enough to be helpful.

Now that's quite a menu—and I am not quite finished. Let me repeat once again that we are not committing ourselves to report on each of these issues by next June. Nor will we necessarily confine ourselves to the topics I have treated because other items of current importance may arise between now and then. But the scatter and variety of topics we are considering does underline the requirement that we face up to one more important issue—coordination.

This year we feel some treatment of organizational matters could be particularly timely. Government is always reorganizing in its effort to bring more effective management to bear as problems and issues change, but in particular there arises the possibility of some sort of department of natural resources being established. If it takes the form developed in the document, "Papers Relating to the President's Departmental Reorganization Program," released in February of this year, care must be exercised so that the marine and atmospheric focus for resource development, transportation, international cooperation, and engineering development activities recommended by the Stratton commission, and in part accomplished during the past few years, will be maintained.

Although there is a general feeling that the President is re-examining his previous reorganization proposals, how and in what form new proposals will appear is not yet evident. From what we now see,

however, the need for interagency and Federal-private program coordination will be greater than before.

The Marine Resources and Engineering Development Act, Public Law 89-454, stood the national marine program firmly on three bases: A clear statement of national policy; a long-range planning activity (the Stratton commission); and a short-term planning and coordinating body (the Marine Council).

The act assigned to the President the responsibility for implementation. Although events have moved in the direction intended by the act, now may be time to freshen the national commitment embodied in it, taking into account recent developments and their anticipated projection. For example: There might be a statement of national policy regarding coordination and comprehensiveness which would recognize explicitly its application to all activities (not only science and engineering) with practical, social, and economic aspects essentially marine (or atmospheric) in nature. This would merely make explicit the situation that now exists, and which is recognized in the semantics of Public Law 92-125 establishing NACOA with cognizance over marine and atmospheric affairs. NACOA can serve, and in fact does, within its resources, as an inheritor to the policy analysis and long range planning function of the Commission.

In bringing to a close this sketch of the list of topics we are currently considering for further committee deliberation.

I would like to point out that one important source and stimulus has not been developed as fully as we would like. We have not had as much dialog with Members of Congress as we would wish on matters of mutual interest. We are very much aware of our unique statutory role as being advisory to both the President and the Congress and it is our hope that, as we go along, we can be as responsive to congressional concerns as is possible within the limits of our resources. It is for this reason that the committee is particularly grateful for the opportunity to appear before you today at this oversight hearing and look forward to the substantive discussion to follow this talk. I know of no better way of expressing our working appreciation of your efforts in oceanographic affairs.

Mr. Chairman, may I just interject one brief remark. Dr. Stratton asked me to express his sincere apologies at not being able to be here today. He really found it impossible to attend with his best efforts.

I also would like to introduce two other members of the committee, who have arrived: Dr. Mark Morton and Mr. John Royal. Thank you, Mr. Chairman.

Mr. LENNON. Thank you, Doctor.

Let me for the record sincerely share with my distinguished colleague from the great State of Massachusetts, Hon. Hastings Keith, the very gracious tribute that you paid me in the first part of your statement. I do not know of any man on this subcommittee, or the full committee, who has been more dedicated or spent more time, or had more concern and involvement in the matters relating to the total subject which we are discussing here today than my distinguished colleague and friend from Massachusetts, who also made the decision that he would return to a better environment than the Washington area and go back home. It is my pleasure to recognize you now, Mr. Keith.

Mr. KEITH. Thank you, Mr. Chairman. It was not that Cape Cod needed to have that plug from you. It is perhaps a better environment than Washington, but in order to uphold Cape Cod's environment, we have to be down here to see how NACOA is doing in its role as adviser to Congress. I am looking forward to further testimony from several representatives here.

I would say that my main reason for not seeking reelection was not, as I said, the environment, but my very great interest in the substance of many matters—most of which are before this subcommittee. If I were to tend to these substantive matters properly I could not campaign. So I chose this route.

I appreciate the opportunity to welcome this group here this morning. I look forward to further discussions, particularly on the law of the sea.

I have been an adviser to Congress in this respect and have written extensively on the subject. I hope that as these hearings progress we will have the benefit, which we so badly need, of your advice and counsel on this and, in particular, on the fisheries problem, which is such an important part of the law of the sea.

Mr. Chairman, I do not know whether you would like to have me ask a question at this time.

Mr. LENNON. If you might hold the question.

Doctor, are there other members of your committee here who desire to be heard before we start the questioning?

Dr. NIERENBERG. I had not polled them, Mr. Chairman, I do not know. They are certainly welcome. They are unusually reticent. They are not normally like this at committee meetings.

Mr. LENNON. I was going to suggest that if there are other members of the committee who want to make a statement or want to interject something at this point before we start asking questions, we would be glad to hold up the questioning.

Dr. NIERENBERG. Mr. Chairman, if you will give me the liberty as the questions are asked, I would like to ask members to respond to the questions.

Mr. LENNON. Very well, under those circumstances, will you go ahead with your questions, Mr. Keith?

Mr. KEITH. In the heavy print of your report to the President and the Congress you state in the second sentence:

While NACOA finds the emerging United States position at the level of the working group on the Law of the Sea in the national interest and consistent with national needs, it also finds that the National situation and the United States' current tactics in negotiations give less cause for optimism.

Would you explain, please

Dr. NIERENBERG. Yes. First, let me say something. We treated subjects which were critical at the time. Therefore, it is a developing subject. What is said at one time is not necessarily true at a later time. Partly, if I may say with some pride, those in charge of the negotiations are now more inclined to accept our advice and have, if I may say so, so we are less critical now by a lot than we were when we were first briefed.

The statement means just what it says, we were not happy with the briefings we received initially. We responded to these briefings in a

variety of ways. I think many of our suggestions were taken. I think the position was emerging at the time.

We felt at our hearings the kind of things that we were pleased with were the developing attitude toward the problem of worldwide fisheries, that we were basing our national position in international negotiations on our concern with protecting the biological stocks of the oceans which are being threatened. It seemed to us this was the best approach, because if there were no fish for anyone an international position would not do you any good, no matter what it was.

It is that emerging position at the time which is now fairly well fixed that we approved of. The tactics are another matter. Perhaps the most pleasant way to put it is the following: We felt overall that the working group and the various advisory groups involved at that time were taking far too legalistic an approach in this problem; that legalisms simply offered no solution. I say it in two senses at the moment. I mentioned one. In the case of fisheries the basic problem seemed to be biological. The growth of fishing fleets all over the world and the entrance of new fleets all the time were generally threatening biological stocks to no one's advantage, and a solution had to be based on sound, technical biological understandings of the situation with regard to what the oceans can actually produce in the way of fish.

In the other areas we felt that solutions needed to be firmly based on scientific and technical reality as well. For example, the motivation of many of the countries was based, it seemed to us, on the belief that very great wealth was available just within arm's reach at the bottom of the oceans, and it would simply take some kind of legal discussion to clear up the question of ownership and make available this wealth.

This, of course, is far from the truth. That led us to what seemed to be the next obvious points, that a good deal of the difficulty, other than purely political actions, was based on the fact that so many of the countries involved in the discussion of the law of the sea simply were not equipped technically to understand the vast array of problems that had to be understood in a discussion. This was the reason that we felt that the approach, if you like the profile we were presenting—the general tactical steps, I suppose one could say—did not seem to us to be appropriate and a more practical, pragmatic approach was necessary. Of course, this does present difficulties for our negotiators because they do have to deal with so many countries who simply have no marine capability at all, and, therefore, no backup for their negotiators. This is one of the reasons that we have a very specific proposal in our report that the United States embark on a program—financially, it would be very modest—of cooperation.

Mr. KEITH. You say they took your advice and changed their tactics, and that you are now on the same wavelength but to a greater degree. What particular tactics did you advise them on?

Dr. NIERENBERG. I suppose the particular tactics were mostly to adopt what I would call in today's parlance a low profile. That is to say, developing expertise takes a certain amount of education. People have to be involved with the problems for long enough to know what the scientific and technical problems are.

Mr. KEITH. In what way were they taking a high profile?

Dr. NIERENBERG. On the matter of tactics, I think simply they were probably being too eager in preparing positions and detailed proposals for agreement in what was a very complex series of meetings.

The great danger in preparing detailed proposals to be put forward is in losing sight of the many issues included and in fact losing points that should be nonnegotiable. Let me be very explicit to show you you one concern. The subject of freedom to do research on the high seas is, in the opinion of NACOA, a nonnegotiable issue. Our country is not unique in this regard, I might add. If you start to put forward too many issues or points that you would like to have resolved in a specific way, you open yourself up to bargaining—diplomatic bargaining—where no bargaining was either required a priori or desirable.

In the case of the freedom of research on the high seas you may find yourself, if you are not careful, being forced to consider it as a bargaining element for some other items that you consider desirable. We felt that it was not anything to be bargained or traded.

Mr. KEITH. Did we make a big issue of our nonnegotiable position, thus creating that high profile you are talking about?

Dr. NIERENBERG. No, we did not make a big issue of it.

Mr. KEITH. I thought Dr. Handler's paper was pretty good.

Dr. NIERENBERG. That is right. I would like to say Dr. Handler's paper was the direct result of the activity of our committee. I, myself, and our committee, would not have objected to the United States doing what it eventually did in August—much after our report—in specifically stating those issues that it felt were nonnegotiable and not particularly putting forward any other issues, because those are fairly complex and require a considerable amount of education on the part of the participating nations. The issues that we felt are nonnegotiable, for example, were the maintenance of freedom of navigation of the classical straits. They are using another phrase than classical straits now, but I use it for this discussion.

Mr. KEITH. You mean passage?

Dr. NIERENBERG. Not passage, but freedom of navigation. This is somewhat broader. Also, the freedom for research on the high seas we felt was a nonnegotiable issue and should have been so clearly stated and apparently has been since then by our representatives at the working session on the law of the sea at Geneva last August.

Mr. KEITH. I still do not know exactly what tactics of negotiation disturbed you. All four of us have attended these sessions, and have been concerned about certain phases of the deliberation process. I would be interested—and I believe Chairman Lennon would be interested, too—if you would delineate for us these tactics that gave you cause for concern.

Dr. NIERENBERG. Perhaps I can put it in another way. From the presentations and briefings we received—I suppose this was in January and February of this year—we concluded that the working group had dozens of points, all sort of tossed into one pot, and all sort of chips in a bargaining game, without any priority as to which ones were the ones that were essential to the country and which were genuinely negotiable in some sense. We felt in such an atmosphere or presentation, the ones that are really essential could be genuinely lost.

Mr. KEITH. You made a judgment with reference to the nonnegotiability of the scientific research element in this conference. I would

imagine that your contacts with the scientific fraternity would allow you to obtain considerable expertise in this area. As you know, the area involves several different articles. I wondered how you would get acquainted with the logic behind the various positions. Do you have staff that are assigned responsibility for the law of the sea, and within that staff structure do you have those that are particularly acquainted with the military aspects of it versus the fisheries aspect versus the scientific research aspects?

Dr. NIERENBERG. Yes, within our resources. We follow it closely. In other words, we had massive briefings the end of January on the law of the sea negotiations. We considered the subject so important that I suppose it has worked out to date that we have had additional briefings bearing on the law of the sea or its background every 2 months. We had one additional briefing on the negotiations by Ambassador McKernan in May and a recent and most excellent briefing by Mr. Stevenson, the chairman of the working group, the end of October, and other briefings on related matters in between. I anticipate that we will keep this up regularly for the entire committee.

Mr. KEITH. Was it on the basis of these briefings that you initially felt that they were taking the wrong tactics * * * and by reason of your advice, they modified their tactics which now meet with your approval?

Dr. NIERENBERG. The answer is, "Yes"; I do feel that. It is a strong statement to make. We found that the working group was unable in our briefings to make a clear-cut statement on each of the issues that we felt were important. In fact, we agreed which were the issues but we could not get a clear-cut statement from the working group at the time as to where they stood on each of the issues with regard to negotiability.

Mr. KEITH. At about what time did you reach the conclusion that the tactics were wrong? How many briefings did you have before you reached that conclusion?

Dr. NIERENBERG. To be numerical about it—I hope Mr. Brooks can refresh my memory—we had half a day's worth of briefings from the working group, I believe, in January. This was preceded by briefings on law of the sea by members of the National Academy of Sciences and on the forthcoming Stockholm Conference by the Department of State. We spent the entire next day in executive session going over every detail.

Mr. KEITH. Who would be "we"?

Dr. NIERENBERG. NACOA as a whole. The committee sitting as a whole.

Mr. KEITH. How many were there?

Dr. NIERENBERG. At that time virtually the entire committee, 21 out of the 25. Then we considered the situation important enough as apparently you do that we brought various aspects out in a number of other meetings later. Ambassador McKernan and Mr. Herman Pollock briefed us on Department of State activities in marine and atmospheric matters including the law of the sea. That was in March and we discussed it in executive session at our April meeting. It was at that point we felt that we understood the situation enough at that time to start to interact fairly strongly and directly with the working committee on these matters.

(The following was submitted for the record:)

DATES OF MEETINGS AT WHICH NACOA WAS BRIEFED ON MATTERS RELATING TO LAW OF THE SEA ISSUES, THE BRIEFING SUBJECTS, AND THE NAMES OF THE BRIEFERS FOLLOWS

January 31 to February 1972

Freedom of Scientific Research and Law of the Sea.—National Academy of Sciences speakers: John A. Knauss, Dean, Department of Oceanography, University of Rhode Island; William T. Burke, Professor of Law, University of Washington.

United States Preparatory Efforts for 1973 Geneva Conference on Law of the Sea.—John R. Stevenson, Legal Advisor, Department of State; Howard W. Pollock, Deputy Administrator, NOAA; Vincent E. McElvey, Director, U.S. Geological Survey, Department of the Interior; John Warner, Under Secretary of the Navy; Jared Carter, Deputy Director of Ocean Affairs, Office of the Secretary of Defense.

March 20, 1972

Department of State Activities in Oceans and Atmosphere.—Ambassador Donald L. McKernan, Coordinator, Ocean Affairs and Special Assistant for Fisheries and Wildlife, Department of State; and Herman Pollack, Director Bureau of International Scientific and Technological Affairs.

May 22, 1972

Status of Law of the Sea Developments.—Ambassador Donald L. McKernan, Coordinator, Ocean Affairs and Special Assistant for Fisheries and Wildlife, De-Relating to Law of the Sea."

June 19 to 20, 1972

Review of Draft of First Annual Report.—Committee discussion of each draft chapter in Executive Session including that on "Some International Issues Relating to Law of the Sea."

August 14, 1972

Briefing on the Stockholm Conference.—Dr. Thomas F. Malone, Dean, Graduate School, The University of Connecticut and Member of NACOA.

Briefing on Follow-on to Moscow Negotiations.—Dr. F. Gilman Blake, Office of Science and Technology, Executive Office of the President.

September 22, 1972

Cooperative Programs with Developing Countries.—Panel Discussion—Burdick Brittin, Deputy Coordinator of Ocean Affairs, Office of the Special Assistant for Fisheries and Wildlife, Department of State; William H. Littlewood, Associate Director, Office of Science and Technology, Agency for International Development; John Twiss, Chief of Operations, International Decade of Ocean Exploration Office, National Science Foundation; Jon Galehouse, Office of National Centers and Facilities Operations, National Science Foundation; RAdm Malcolm Garrison, USN (Ret.), International and Interagency Affairs, Office of the Oceanographer, U.S. Navy; Gilert Jaffe, Director, National Oceanographic Instruction Center, NOAA; Robert C. Junghans, Oceanographer, Oceanographic Services, NOAA; Philip Roedel, Director, National Marine Fisheries Service, NOAA.

October 30 to 31, 1972

Presentations on Ocean Dumping—A Legislative Overview and Alternatives to Ocean Dumping.—Robert Strelow, Senior Staff Member, Council on Environmental Quality; Implementation and Management of Ocean Dumping Legislation—T. A. Wastler, Chief, Water Quality Protection Branch, Water Quality Division, Environmental Protection Agency; *The Army Corps of Engineers and Ocean Dumping.*—Col. John H. Cousins, COE, USA; *The U.S. Coast Guard and Ocean Dumping.*—LCDr Joel Sipes, USCG. Marine Environmental Protection Division, USCG; *A Local Assessment.*—Martin Lang, Commissioner, Department of Water Resources, City of New York; *Trends in Ocean Dumping*—David Smith, David Smith and Associates, San Diego; *Ecological Aspects of Ocean Dumping.*—Allan Hirsch, Director, Marine Ecosystems Analyses Program, Office of Marine Resources, NOAA.

International Issues and Law of the Sea Development.—John Stevenson, Legal Advisor, Department of State.

Mr. KEITH. Did you put your observations in writing and more or less formulate and convey them to Ambassador Stevenson?

Dr. NIERENBERG. No. We did it orally. In fact, Dr. Hargis and I met with Mr. Stevenson and we had lunch with him and went over all these points and delivered to him the committee's concerns, and so on.

You see in matters of this type, I think a written report would be of no very great use, especially since we felt from what we heard that the emerging fisheries position, as an example, was quite satisfactory.

We did one other thing. I personally—Mr. Hargis could not attend—met with the Under Secretary of the Navy who was assigned the responsibility for the entire DOD. That was a very fruitful session. I met for an hour and a half with Mr. Warner and his entire staff on the military aspects. I might personally say I have adequate clearance to discuss all aspects of the problem.

Mr. KEITH. Who did you have advising you in this meeting with Ambassador Stevenson?

Dr. NIERENBERG. Myself.

Mr. KEITH. You had no backup staff?

Dr. NIERENBERG. I did not take my staff with me, no.

Excuse me, sir, Dr. Hargis and I were there.

Mr. KEITH. When you met with Secretary Warner, did you have staff with you then?

Dr. NIERENBERG. No. Part of the reason was a matter of clearance. Some of the discussion was top secret.

Mr. KEITH. How do you feel about our position with reference to the mining of the deep seabed?

Dr. NIERENBERG. I do not know that we have a position with regard to mining of the deep seabed.

Mr. LENNON. If the gentleman will yield. On page 5, at the bottom of the page: "It is possible"—this is a footnote and I want to let you know that I thoroughly agree with it—"It is possible that there will be a considerable lapse of time before international agreement on law of the sea is obtained. NACOA recognizes that economics and other pressures may develop to such an extent that individual nations, including the United States, will take unilateral action, especially with respect to resource exploitation. NACOA therefore urges consideration by the U.S. Government of suitable interim arrangements that will allow development of these resources to proceed, but at the same time will offer reasonable probability of an international agreement."

I would assume that is the position of NACOA at this time?

Dr. NIERENBERG. Yes, sir, Mr. Chairman. I apologize. I missed the reference in the question. That is NACOA's position. I thought the question was, What the U.S. position is at this time.

Mr. KEITH. No; I inquired what your position is.

Dr. NIERENBERG. This is our position.

Mr. KEITH. What is your position with reference to the patrimonial sea concept?

Dr. NIERENBERG. When you put the question that way, we have no specific position. I think we must fall back and say we do agree with our position on fisheries, that basically they be treated as resources, whatever their geographical extent. Those that are contiguous to a

nation—the responsibility for those contiguous to a nation—be assigned to that nation. That is the closest to a patrimonial sea concept that the committee has been willing to accept simply on the basis of the existing biological resources.

Mr. KEITH. In other words, you favor the coastal species concept versus an extension of the fisheries zone.

Dr. NIERENBERG. Yes; rather than the actual physical zone; yes, sir.

Mr. KEITH. Mr. Chairman, I am acquainted with the format, and I want to be sure that what I am doing here is conducive to your purposes. Do you have other witnesses you are going to hear from?

Mr. LENNON. Not on the question of this report. This is the NACOA report that we are considering.

Mr. KEITH. As to the format of this morning, are you going to hear from other members?

Mr. LENNON. No; we offered the opportunity to the chairman—and we are very grateful for the personal appearance of so many members of the Commission who came great distances—I want the members to feel free in looking over the membership of the Commission who are here and have been assigned chairmanship of the various panels which the chairman of the committee has referred to—to feel free to ask questions of anyone who is here as a member of the committee. The chairman has indicated they will respond to questions if you want to direct questions to any members of the committee. Am I correct in that?

Dr. NIERENBERG. Yes, sir. It so happens by the nature of the work I was the principal in charge of the international affairs. The procedure we used, Mr. Chairman, generally, was to assign specific areas to members of the Commission itself as group leaders with the staff to help them. I have been the principal speaker mostly because I was the group leader, if you like, on the work on international affairs. For example, on the coastal zone part of the report, Dr. Hargis, as you could guess, is the group leader.

Mr. KEITH. As I indicated in my remarks earlier, this is of great interest to this committee, because if your staff is so structured that you have individuals assigned to major areas of interest, then we, as Members of Congress seeking to live up to the spirit of the act and the purpose of your organization, would know with whom we should be in contact. I think it would be very good for us at this time to have it in the record. This law of the sea problem is a very difficult thing for the Congress to stay on top of, or even to get up speed on. So if you would tell me, sir, who it is that is responsible for the international regime structure and authority on your staff, and then tell me who it is for fisheries and who it is for science, I would appreciate it.

Dr. NIERENBERG. I think in this case perhaps the best way in specific areas is to go through our executive director, Dr. Brooks, who could supply precisely the contacts for you.

Mr. KEITH. For the purposes of discussion, who is here this morning that could discuss the international regime authority? Who within the Commission?

Dr. NIERENBERG. It is really several of us. In practice, I wrote the rough draft. I would say fully half of the committee participated in one way or another.

Mr. KEITH. I understand that, but I thought from an organizational point of view you had certain people with certain areas of expertise. We know Dr. Hargis and we have great respect for him. We are very familiar with the problems of coastal zone management because we have a great deal of legislation in that area ourselves. We would like to know where to turn to someone.

Dr. NIERNBERG. In the case of fisheries, we depend on Mr. Royal, Mr. Fulham, and Mr. Tillion.

Mr. KEITH. I know that with Mr. Fulham's presence you are very well supported in that field.

Dr. NIERNBERG. On military aspects, John Craven and myself. Dr. Craven has absolutely impeccable credentials in this area.

John, would you recite your background?

Mr. CRAVEN. I have been in the Department of Defense for many years. While I am primarily technologically oriented, I have paid particular interest to the international law of the sea, and the relationship of technology to the law of the sea as a subspecialty.

Mr. KEITH. Who within the Department of Defense do you deal with in getting the position of the administration and their logic so you would feel free to be critical of it insofar as their tactics are concerned?

Mr. CRAVEN. Mr. Warner and his staff.

Mr. KEITH. But who on Mr. Warner's staff?

Dr. NIERNBERG. There has been a change. Jared Carter had been for many years deputized by Mr. Warner to carry the entire load. It all went through him for the DOD. He is just transferred to be Deputy Under Secretary of Interior, and I am embarrassed that I do not know his replacement.

Mr. KEITH. That was before the most recent convocation in Geneva. They were represented at Geneva by others; and I wondered if they were the same ones you deal with. Jared Carter has not been with Defense for several months.

Dr. NIERNBERG. The change was after our report. Speaking to the report, it was afterward.

Mr. CRAVEN. Let me be responsive to this. I hesitate to bring a single person up because there are a whole host of personalities, but I and those associated with this thing are keeping in continuous contact with those who attended the Law of the Sea Conference at Rhode Island, members of the State Department who are concerned with the presentation of these, with the members of Mr. Warner's staff and Mr. Carter's staff, the Judge Advocate General of the U.S. Navy. So it is difficult to come out precisely with a specific set of individuals other than the fact that we have been on an interactive basis to keep in touch.

Mr. KEITH. Who were you in contact with who went to the conference in Geneva?

Dr. NIERNBERG. Which conference? There were three working conferences, I guess, to date. Do you mean the one in August?

Mr. KEITH. The most recent one.

Dr. NIERNBERG. That is not represented in any report the committee has prepared. We had a report—

Mr. KEITH. I was interested if you did have one. I will talk to Dr. Fulham. It seems to me if you are going to come out and be critical of the tactics, you should have some exchange on which you base these charges.

Dr. NIERNBERG. We did. We had five or six exchanges at as high a level as decisions are made. I am saying, in the process of preparing this report, in the area we are discussing, as I said, we had exchanges with Mr. Warner—

Mr. KEITH. Mr. Warner did not even get over to the conference at Geneva, and he doesn't have that responsibility any more.

Dr. NIERNBERG. That is right.

Mr. KEITH. The responsibility now rests with Admiral Doyle and the International Security Agency. I think these are the kinds of people that should be advising you if you are going to advise Congress.

Dr. NIERNBERG. Yes, sir; and we will be in touch with these people before we present our next report to the Congress.

Mr. KEITH. It ought to be a continuing relationship.

Dr. NIERNBERG. It is continuing in the sense of every 2 months or so. We meet once a month. I have been trying to get one other thing in. We have statutory agency observers—

Mr. LENNON. I will make it crystal clear that this report was filed on June 30, 1972, prior to the Seabed Committee meeting which took up most or part of August. For the record, on page 4, in relation to your discussion of the working group on the law of the sea, you say that the situation has improved considerably, undoubtedly to the effect of the increasing of the delegation by five nongovernmental experts.

At this point, would you furnish for the record the five, by name and occupation, nongovernmental experts that were added to the working group on the law of the sea prior to the time this report was made? It is possible that group has changed since this report was made on June 30 of this year.

(The information follows:)

FIVE NONGOVERNMENTAL U.S. DELEGATES

The five positions on the U.S. Delegation for nongovernmental experts, referred to in the report, were filled by the following designees:

William T. Burke, Professor of Law, University of Washington, Seattle, Washington.

Mr. Marne Dubs, Director, Ocean Resources Department, Kennecott Copper Corporation, New York, New York.

Mr. William Neblett, Executive Director, National Shrimp Congress, Inc., Key West, Florida.

Mr. Cecil Olmstead, Vice President and Assistant to the Chief Executive Officer, Texaco, Inc., New York, New York.

Mr. Walter V. Yonkers, Executive Vice President, Association of Pacific Fisheries, Seattle, Washington.

Mr. LENNON. Then you go on to say, "the formation of a broad-based Advisory Committee". Would you furnish for the record, to be inserted at this point, the names and identities of the members of this broad-based Advisory Committee that were in being at the time that this report was filed on June 30, 1972?

(The information follows:)

ADVISORY COMMITTEE ON THE LAW OF THE SEA

I. PETROLEUM SUBCOMMITTEE

- Mr. George A. Birrell, General Counsel, Mobil Oil Corporation, 150 E. 42nd Street, New York, N.Y. 10017
 Mr. Melvin Conant, Public Affairs Senior Adviser, Standard Oil of New Jersey, 30 Rockefeller Plaza, Public Affairs Department, New York, N.Y. 10020.
 Mr. G. Winthrop Haight, Forsyth, Decker & Murray, Suite 3333, 51 W. 51st Street, New York, N.Y. 10019.
 Mr. Minor S. Jameson, Jr., Independent Petroleum Association of America, 1101 Sixteenth St., N.W., Washington, D.C. 20036.
 Mr. William J. Martin, Jr., Standard Oil Building, 225 Bush Street, San Francisco, Calif. 94104.
 Mr. Byron E. Milner, Vice President, Products Division, Atlantic Richfield Co., Box 2679-T.A., Los Angeles, Calif. 90051.
 Mr. Cecil J. Olmstead, Vice President, Assistant to the Chairman of the Board, Texaco, 135 E. 42nd Street, New York, N.Y., 10017.
 Mr. Richard Young, Attorney and Counsellor at Law

II. HARD MINERALS SUBCOMMITTEE

- Mr. T. S. Ary, Vice President, Union Carbide Exploration Corporation, 270 Park Avenue, New York, N.Y. 10010.
 Mr. Willard Bascom, Chairman of the Board, Ocean Science and Engineering, Inc., 1601 Water Street, Long Beach, Calif. 90802.
 Mr. Seymour S. Bernfeld, American Metal Climax, Inc., 126 West Cedar Drive, Denver, Colorado 80223.
 Mr. Paul S. Bilgore, Assistant General Counsel, The Anaconda Copper, 25 Broadway, New York, N.Y. 10004.
 Mr. Marne A. Dubs, Director, Ocean Resources Department, Kennecott Copper Corporation, 161 E. 42nd Street, New York, N.Y. 10017.
 Mr. John E. Flipse, President, Deepsea Ventures, Inc., Gloucester Point, Virginia 23062.
 Mr. John L. Shaw, International Nickel Co., Inc., 300 120th Ave., N.W. Building 4, Bellevue, Washington 98005.

III. INTERNATIONAL FINANCE AND TAXATION SUB-COMMITTEE

- Mr. Kenneth E. Hill, Eastman Dillon, Union Securities & Co., One Chase Manhattan Plaza, New York, N.Y. 10005
 Mr. John A. Redding, Continental Bank, 231 South LaSalle Street, Chicago, Illinois 60604
 Mr. John G. Winger, Vice President, The Chase Manhattan Bank, One Chase Manhattan Plaza, New York, N.Y. 10005

IV. INTERNATIONAL LAW AND RELATIONS SUB-COMMITTEE

- Mr. R. R. Baxter, Harvard University Law School, Cambridge, Massachusetts 02138
 Mr. Thomas Clingan, Jr., Professor of Law, University of Miami School of Law, P.O. Box 8087, Coral Gables, Florida 33124
 Mr. Arthur H. Dean, 48 Wall Street, New York, N.Y. 10005
 Mr. Richard L. Gardner, Henry L. Moses Professor of Law and International Organization, Columbia University School of Law, 435 West 116th Street, New York, N.Y. 10027
 Mr. Louis Henkin, Columbia University School of Law, 435 116th Street, New York, N.Y. 10027
 Mr. H. Gary Knight, Louisiana State University Law School, Baton Rouge, Louisiana 70803
 Mr. Robert B. Krueger, Nossaman, Waters, Scott, Krueger and Riordan, 445 South Figueroa Street, Los Angeles, California 90017
 Mr. John G. Laylin, Covington and Burling, 888 16th Street, N.W., Washington, D.C. 20006

- Mr. Philip C. Jessup, Council on Foreign Relations, 58 East 68th Street, New York, N.Y. 10012
- Mr. Benjamin Read, Director, Woodrow Wilson International Center for Scholars, Smithsonian Institution Bldg., Washington, D.C. 20560.
- Mr. Charles S. Rhyne, World Peace Through Law Center, 400 Hill Building, Washington, D.C. 20006
- Mr. Dean Rusk, The University of Georgia School of Law, Athens, Georgia 30601
- Mr. Louis B. Sohn, Bemis Professor of International Law, Law School of Harvard University, Cambridge, Massachusetts 02138

V. MARINE ENVIRONMENT SUB-COMMITTEE

- Mr. Richard A. Frank, Center for Law & Social Policy, 1600 Twentieth Street, N.W., Washington, D.C. 20009
- Mr. Bostwick H. Ketchum, Associate Director, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543
- Mr. Anthony W. Smith, Attorney at Law, 1701 18th Street, N.W., Washington, D.C. 20009
- Mr. George M. Woodwell, Brookhaven National Laboratory, Biology Department, Associated Universities, Inc., Upton, Long Island, New York 11973

VI. FISHERIES SUB-COMMITTEE

- Mr. Charles R. Carry, Executive Director, 215 Cannery Street, Tuna Research Foundation, Inc., Terminal Island, California 90731
- Mr. J. Steele Culbertson, Director, National Fish Meal & Oil Association, 1225 Connecticut Avenue, N.W., Washington, D.C. 20036
- Mr. Philip A. Douglas, National Wildlife Federation, 1412 16th Street, N.W., Washington, D.C. 20036
- Mr. Jacob J. Dykstra, Pt. Judith Fishermen's Coop. Association, Point Judith, Rhode Island 02882
- Mr. August J. Felando, 1 Tuna Lane, San Diego, California 92101
- Mr. Harold E. Lokken, 1921 N. 48th Street, Seattle, Washington 98101
- *Mr. Robert G. Mauermann, Executive Secretary, Texas Shrimp Association, 910 East Levee Street, Brownsville, Texas 78520
- Mr. William R. Neblett, Executive Director, National Shrimp Congress, Inc., P.O. Box 431, Key West, Florida 33040
- Mr. John J. Royal, Secretary/Treasurer, Fishermen and Allied Workers' Union, Local 33, I.L.W., 806 Palos Verdes Street, San Pedro, California 90731
- Mr. Richard H. Stroud, Executive Vice President, Sport Fishing Institute, 719 Thirteenth Street, N.W., Suite 503, Washington, D.C. 20005
- Mr. Lowell Wakefield, Wakefield Seafoods, Inc., Port Wakefield, Alaska 99550
- Mr. Leon John Weddig, Executive Director, National Fisheries Institute, Inc., Suite 314, 1225 Connecticut Avenue, N.W., Washington, D.C. 20036
- Mr. W. V. Yonker, Executive Vice President, Association of Pacific Fisheries, 1600 South Jackson Street, Seattle, Washington 98144

VII. MARINE SCIENCE SUB-COMMITTEE

- Mr. William T. Burke, Professor of Law, University of Washington, School of Law (Condon Hall), Seattle, Washington 98105
- Mr. John C. Calhoun, Jr., Vice President for Academic Affairs, Texas A & M University, College Station, Texas 77843
- Mr. L. Eugene Cronin, Research Professor and Director, University of Maryland Natural Resources Institute, Chesapeake Biological Laboratory, Box 38, Solomons, Maryland 20688
- Mr. Paul M. Fye, President, Woods Hole Oceanographic Institute, Woods Hole, Massachusetts 02543
- Mr. Bruce C. Heezen, Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964
- Mr. John A. Knauss, Provost for Marine Affairs, University of Rhode Island, Kingston, Rhode Island 02881
- Mr. Roger Revelle, Richard Saltonstall, Professor of Population Policy, Director of the Center for Population Studies, 9 Bow Street, Cambridge, Massachusetts 02138
- Mr. Warren Wooster, Scripps Institution of Oceanography, P. O. Box 109 LaJolla, California 92037

VIII. MARITIME INDUSTRIES SUB-COMMITTEE

Mr. William J. Coffey, American Institute of Merchant Shipping, 1200 Connecticut Avenue, N.W., Washington, D.C. 20016

Mr. Herman E. Denzler, Jr., 101 Norland Avenue, New Orleans, Louisiana 70114

Mr. Emmett A. Humble, Humble Oil & Refining, Marine Department, P. O. Box 1512, Houston, Texas 77001

Mr. Warren G. Leback, Sea-Land Service, Inc., P. O. Box 1050, Elizabeth, New Jersey 07207

GOVERNORS

Governor William A. Egan,¹ Alaska

Governor Linwod Holton,¹ Virginia (Represented by : Alexander Gilliam)

Mr. LENNON. If there have been any changes either in the different individuals, the nongovernmental experts, since the report was filed, and if there have been any changes in the advisory committee that you referred to here since the report was filed, and you can learn the identity of those people, please insert those in the record at this time. I think that would clarify the discussion the gentleman has had.

Mr. KEITH. Thank you, Mr. Chairman.

I want to make one thing perfectly clear. I have a great deal of respect for the expertise and commonsense of the people that were serving on the delegation from the private sector and in particular from the fishery sector. I know Tom Fulham's qualifications and I know the people with whom he is dealing. If I have questions I can go directly to him, or to those representing the fisheries. Who would I go to if I wanted something on the mining of deep sea beds within your staff and on your committee?

Dr. NIERENBERG. I would say as far as the Commission is concerned several people. Mr. Morton, for example.

Mr. KEITH. On the table of organization, who is charged with responsibility for advising you and for making up that part of the report which expresses NACOA's point of view—you can't do it all alone? You have to have somebody that advises you. I would like to know who it is because you are charged by statute with advising the Congress, and we don't want generalities. You have your own representatives in specialized areas. I would like to know who the comparable number is to Tom and to whom that man looks in the Defense Department or in the mining of the deep sea beds. I know who it is in science; I am satisfied with science. But I am particularly interested in the defense aspect of the mining of the deep seabeds.

Dr. NIERENBERG. If you gave me the parallel to Mr. Fulham in fisheries, it would be Dr. Craven in the military area, as an example. I know of no better expert in the whole country on questions that affect military technological aspects with regard to the ocean.

Mr. KEITH. Military technological aspects?

Dr. NIERENBERG. Yes; the questions of the kind we are talking about. Underwater engineering, the question of the importance of passage. The question of submarine warfare, both anti and pro, and all related questions are very well represented in our committee. Dr. Craven, to name one member, since you want just one name. I recommend him to you very highly.

Mr. KEITH. And I would be appreciative if he would tell us what it was that he objected to on the territorial sea concept.

¹ Added since June 30, 1972.

Mr. CRAVEN. My own personal concern has to do with the delicate balance between the territorial sea concept and the concept of the patrimonial sea. As of the time we held our hearings and our discussions it seemed to me—and this again is a personal value judgment—that the military view at that time was maintaining a very rigid insistence with respect to relatively narrow territorial seas which was interfering with the rate at which progress could be made in substantive aspects of the patrimonial sea; namely, the ability of the United States to have control of its coastal fisheries and have control of its coastal mineral resources. So I was very much concerned personally, as to the seeming development of inflexibility of our position in this regard, and perhaps at this juncture that is the most substantive answer I can give.

Dr. NIERENBERG. With regard to the other half of the question—

Mr. KEITH. I would like to pursue this a little bit. What do you think our position as regards the rest of our territorial sea should be?

Mr. CRAVEN. I think that the developing concept of difference of jurisdiction, the concept of absolute sovereignty over a specific zone is already fading into the twilight. There are reasons for concern over portions of the sea that relate to national security. There are portions that relate to the requirement of free passage. There are portions that relate to the management of the fishery resources. There are portions that relate to the mineral resources. There are portions that relate to freedom of research. Certainly from a military standpoint, we should like the width of the territorial sea be as narrow as possible.

Mr. KEITH. For what purposes?

Mr. CRAVEN. For the purposes of military security. So that if one does take this particular aspect, and I believe it to be the case that for the purpose of military security, the ability for us to have free passage and for others to have free passage on as large a part of the ocean as is possible is a sound and firm principle. But if we too rigidly adhere to that point and don't open up the pathways and approaches to allow appropriate management, if you will, of the ocean's resources, if we make the width of the territorial sea for military purposes the all-encompassing doctrine, then I think we are finding ourselves in a position at the Law of the Sea Conference from which we couldn't really successfully move. It seems to me from a military standpoint we must maintain freedom of passage, we must maintain traditional international straits, and we must maintain the capability to deploy our military systems in this regard. But this requires, it seems to me, some sharpening up of definitions as to the width of the territorial sea for various purposes.

I think this concept is developing where we are seeing pollution zones, we are seeing fishery zones, we are seeing mining zones, we are seeing Continental Shelf zones, and I would expect that we will end up with some kind of an international relationship which focuses on each individual function in the ocean rather than to seek an all-encompassing doctrine.

Mr. KEITH. Could it be said that we really insist on freedom of passage in the territorial sea?

Mr. CRAVEN. If the concept of territorial seas included freedom of passage, then you can't include freedom of military passage in this

regard unless you change the whole concept of the territorial sea. You would now have a new definition if you allow military passage.

Mr. KEITH. On the full-time staff do you have anyone who is assigned responsibility for this particular area?

Dr. NIERENBERG. Right now, yes, sir, we do, Mr. Nelson, who is on detail from the U.S. Navy. He is one of the people who does staff work.

Mr. KEITH. Is he here today?

Dr. NIERENBERG. Yes, Mr. Chairman, we have a very rigid procedure in our committee that policy is made by the committee and the staff does the staff work.

Mr. KEITH. I beg your pardon and I should have known that. I am glad to see it work out that way.

Dr. NIERENBERG. I would like to be responsive to your interest in our expertise in the other areas, specifically about mining. In the mining area there are quite a number of the committee familiar with different aspects of it, but I think we rely most heavily in the overall area on the help of Mr. Baird, vice president of International Nickel of Canada and former Under Secretary of the Navy who is now on the committee, and Mr. Dayton Clewell. They are not here today. Mr. Clewell is senior vice president for research of the Mobil Oil Corp. And Dr. Morton with General Electric Co. who is here. Virtually everybody is familiar with the technology involved. Dr. Wenk of course, was very helpful in our deliberations as mentioned in the report. We are very well equipped in this area.

Mr. KEITH. Mr. Chairman and other members of the committee, I have taken enough time.

Mr. LENNON. I would say the advisory committee hasn't been in being very long. I commend them for their straightforward recommendations concerning the use of the sea.

The report was submitted to the Secretary of Commerce for his comments before it was transmitted either to the President or to the Congress, and I note he takes issue and I quote from his report on page 3 in the first paragraph.

I must note that the NACAO Report does not fully reflect either the carefully defined policy which the United States has followed in the current Law of the Sea negotiations, based on the President's statement on United States Ocean Policy of May 23, 1970, or the institutional arrangements created to implement that policy.

Nevertheless I commend NACAO for the flat statement regarding the problems relating to the Law of the Sea. I question in my own mind the input that NACAO will have into the decisions made relating to the Law of the Sea. I hope that you will continue your interest and your involvement even though I don't believe executivewise you are particularly involved in it excepting in your general concern.

I know I was quite "shook up," and I attended the Geneva meeting in August to learn that there was agreement generally among the nations of the world on the establishment of a 12-mile territorial sea, and the immediate recognition on the part of Department of Defense representatives of their concern for how it will affect free passage in the straits of the world. It is a very complex question that has developed.

I want nevertheless to commend NACAO for its flat statement that it made early in its report on page 4 and the recognition that things were beginning to change a little bit. I commend them too for what I see to be a true fact, that there will be a considerable lapse of time, years in my judgment, before there is any international agreement on this subject related to the continued exploration and exploitation of the deep seabeds beyond the Continental Shelf.

As members of the committee will recall, just before the Congress adjourned we met with the State Department through the chairman of the Task Force on the Law of the Sea, and he agreed to brief this committee generally in January because there was some possibility—and I think there is even some possibility that during this week, certainly next week, the U.N. Assembly may take some definitive action or some approach to this subject. I trust that as soon as the 93d Congress convenes and our subcommittee is again in session it will immediately have Mr. Stevenson here to brief the committee because we have a commitment, or at least I have a commitment, which I cannot fulfill, to the other members of the committee that it will resume the hearings, and there will have to be a new session regarding the hearings we had this past fall and late summer related to a proposal to try to find some way to increase our resource exploitation in deep seabed minerals.

I am happy to recognize the distinguished gentleman from Florida. I might say he, too, has, certainly since I have been privileged to know him, been very interested and involved and concerned and dedicated to the effectiveness of this committee and what it is trying to do in this area. I am happy to recognize the distinguished gentleman from Florida, my personal friend and colleague, Congressman Rogers.

Mr. ROGERS. I thank the chairman for yielding.

I would not want time to pass without recognizing what Chairman Lennon has done in this whole field. He has been the driving force. He has been tenacious, he has given great thought, effort, and energy to this. Without his leadership I don't know where we would be in development of the resources of the sea.

I also want to thank my colleague, Congressman Keith, who has done just a great job in this area and given the committee devoted service.

I was interested in your comment on page 9. "You may recall that we stated in our report that we felt basic oceanographic and atmospheric science was in a comparatively healthy state. We still do."

Do you still feel it is in a comparatively healthy state?

Dr. NIERENBERG. You make a good point. It is a very, very good question.

Mr. ROGERS. It is a startling statement for me to read.

Dr. NIERENBERG. It is a startling statement, sir, for the director of a laboratory that is always asking for money, too.

Mr. ROGERS. Because I share the opposite feeling very strongly and I want you to comment on it.

Dr. NIERENBERG. Yes. I hope I don't miss the substance of your question. In comparison with the particular issues we have been talking about, I do think that we are in better shape as far as oceanographic and atmospheric research is concerned. The international issues, if not properly resolved, for example, present great problems and we felt

it more important to focus our efforts on them than in questioning the health of the fields of basic science.

Mr. ROGERS. Maybe I haven't interpreted your statement correctly. As I understand it you seem to think we are getting along very well with our basic oceanographic and atmospheric science research. That is the way I took your statement, particularly on page 9. I think we have been terribly negligent. I don't think we have funded the program. You do say there is some anxiety that the momentum may be lost if we don't fund and really support proper research. I find that contrary to your statement that you think it is all healthy.

Dr. NIERENBERG. Perhaps I can go into some detail.

Mr. ROGERS. I think it is shocking in light of the emphasis that has been placed on basic oceanographic and atmospheric science research. I think we are behind the Russians considerably in weather modification, are we not, and interaction of air and sea? The last time I visited there I found that to be true.

Dr. NIERENBERG. No. I don't think it is quite that simple. I think if we want to discuss that point, our relations vis-a-vis other countries of the world, and particularly Russia—I have just come back from a 3-week trip to Russia as chairman of the U.S. delegation of oceanographers—let me give you a precise statement about what I think is the case.

The Russians are making a very large investment in the oceanic and related atmospheric sciences. I don't know how to measure it in dollars. You understand the difficulties. I would say that in terms of ships, people, men, labs, they are exceeding us in those specified areas. They certainly have a magnificent effort in the fishery sciences, and they probably have a fisheries effort that is second to none in the world. But in the area of physical oceanographic and air-sea interaction their effort measured by what they are putting into it is probably equal to ours or greater and is growing at a faster rate than ours. That is a precise statement, sir.

The second statement as to conditions is that we did not feel the equipment they are using on the high seas, their actual scientific and technical equipment for measurements, is as good as that in this country. In other words measured by the actual productivity of this investment I do think that American science is better.

However, I will go to the other side of it. We had an opportunity to visit their labs, not just the working labs but the labs where they are developing their instruments, the actual instrumentation to go onboard their vessels, and it is a pipeline question. The instruments that they are developing in labs and that are now functioning—in fact they have already used them on the Black Sea and the Caspian Sea, for example, in geophysical research—are excellent, and when they show up on their vessels, which I expect momentarily, I might add, I think it will put the Russians in a better position to do research in the oceans than we will be. I think that is a correct statement also.

Let me make another statement as far as measuring results. The Russians do have and always have had one genius, and that is mathematics, which is a subject intimately connected with hydrodynamics and the subject of oceanography. They have employed this in meteorology as well over the years. Their institute is turning these talents to the problems of the oceans. This is in the theoretical area. They are

now doing very well. Malchek, a great mathematician, head of the Computer Institute and now head of the entire Academy of Siberia, is involving himself and his entire staff in the problem of air-sea interaction and the problems of oceanography.

I am trying to give you a complete picture. I think it is fair to say at the present rate the Russians will surpass us in basic ocean science of the kind I am describing if not next year, then the year after, and they have gained a momentum that is hard for us to pick up until we decide to make a bigger effort.

Mr. ROGERS. So they are growing very rapidly in basic science and they are doing very well?

Dr. NIERENBERG. Yes.

Mr. ROGERS. And some of their equipment is—

Dr. NIERENBERG. We have observed the equipment and seen it on shipboard.

Mr. ROGERS. And they are improving it rapidly?

Dr. NIERENBERG. Yes. The equipment we have seen in the pipeline about to come aboard the ships convinces us this investment in ships, men, and material will pay off heavily.

Mr. ROGERS. So in basic science they are ready to overtake us and in other areas probably have?

Dr. NIERENBERG. Yes.

Mr. ROGERS. What about fisheries. You admit they are far beyond us; aren't they?

Dr. NIERENBERG. We have on our committee John Royal, secretary-treasurer of the Fishermen and Allied Workers Union. We rely a great deal on his advice. We visited their fishery establishment and were very impressed by it.

Mr. ROGERS. They are far ahead of us basically aren't they?

Dr. NIERENBERG. They are far ahead of us in what I would call the pragmatic aspects of the fisheries research. They are not in what we would call biological oceanography basic science.

Mr. ROGERS. What is the difference? Is it better to be ahead in getting the fish out?

Dr. NIERENBERG. Coming back to the discussion with Mr. Keith, none of us would be able to help, the Russians or ourselves, if all of the fish were fished out of the ocean. There are other problems. Biological oceanography is basic science. We are trying to determine what the capacity of the oceans is to supply.

Mr. ROGERS. What I am saying is their efforts in fisheries are far ahead of us right now. You are saying we want to preserve and keep the fish population better than they do. Isn't that right?

Dr. NIERENBERG. No. Let me say something serious about the Russians and ourselves. The Russians in their fishery work are vitally and deeply concerned, as we are, about the depletion of the world biological stock. They genuinely are.

If I may, I will tell you an anecdote. The Russian deputy who received our delegation made the comment that he hopes that we can get a rational fishing program for the entire world so that our grandchildren will not be able to see fish just in museums. They are as deeply concerned as we are about the basic biological problem.

Mr. ROGERS. So they are working in that area, too. You say we are far ahead of them in that area?

Dr. NIERENBERG. No.

Mr. ROGERS. So they are comparable to us there. They are ahead of us in actual fisheries effort. They are overtaking us in basic science. What about weather modification?

Dr. NIERENBERG. Dr. Malone who I see has now joined us is our weather modification expert. Would you like to answer that question?

Mr. ROGERS. How is Russia comparing in their efforts on weather modification?

Mr. MALONE. The chief of their hydrometeorological service has been well known for his enthusiastic approach and optimism about weather modification and also about his interest in international cooperation in the field. I think they have a very aggressive program. Budyko is world famous for his work on climatic change and the influence of polar ice on climatic change. I would say they are in a very strong position on weather modification. They have done probably the most outstanding work in the world in the suppression of hail, and those experiments are no longer experiments but operations which are continuing, and they cover hundreds of thousands of acres. They claim a return of something like 30 rubles per ruble investment. We are now setting up a similar experiment in the Colorado-Montana-Nebraska area, and I must say it was their success which led us to see what we could do.

Mr. ROGERS. Thank you. I think that gives us a proper perspective.

Dr. NIERENBERG. Could I go back to the first part of the question. I am delighted you raise these questions. Let me now be an advocate. Here we have to be statesmen, of course (indicating the report).

Mr. ROGERS. This is the point I am trying to make. Whether it is statesmen or commissioners, I think it ought to bring forth enough facts to let the American people know what our true situation here is, and I don't read there that Russia is getting ahead and we are falling behind. We are transferring some of the effort from the military to the civilian but the civilian is not supporting it and we are falling behind, are we not?

Dr. NIERENBERG. Yes, sir; I agree with you completely. I do want to point out this is the first report. I think the questions are very good and I am very pleased you raise them. We had really about 6 months on this. We deliberately put aside basic science not because we disagree with the points you make but because we felt in the priority of items we should do it this way. As I say in my statement, we expect to hit the points you have made in our next report. We have discussed exactly these points in our most recent meeting yesterday.

I want to make one remark, that because of neglect of the field I am talking about now—very specifically about physical oceanographic and biological oceanographic science and air-sea interaction—because of the neglect in the past decade or 15 years of the kind you describe, or the lack of emphasis, which is the proper emphasis, we do have some limitations in manpower. I have to be fair and admit it. This means that in the planning process you can't solve problems just by throwing money at them either.

Mr. ROGERS. We tried to get to the manpower problem in this committee in the sea-grant college program in trying to train people. It has been moving.

Dr. NIERENBERG. And the effects are beginning to show.

Mr. ROGERS. Let me ask two or three other questions.

I am delighted that you are going to address yourselves to it and I hope you will make as dramatic a report to this Nation as can be made to let them know what our status is. I think that is the responsibility of the commission. That is one of the reasons we wanted to establish it so we could let the American people know how feeble our efforts have been and what needs to be done and the plans for 10 years ahead. That is what we need you to do with the best minds we have been able to assemble on the committee. We need to have that done if we want to move.

Does Russia in their weather reports say there is a 10-percent chance of rain?

Dr. NIERENBERG. I have heard any number of Russian reports. I haven't heard that.

Mr. ROGERS. Everywhere I go people say, what does 10-percent chance of rain mean? If you are in the rain, yes, 10 percent of it hits you. If you are where it never rains at all that day, it doesn't rain. A 10-percent chance. How does that help you?

I have talked to some private weather people—I don't remember the name right now—who did some of the forecasting for Eisenhower when he made the invasion. Some of you I am sure know him and his outfit. He says they can give you precisely the prediction. Why can't our Weather Bureau do that? Is it going to rain or isn't it, instead of giving us that it is a 50-percent chance. You can't go wrong on that at the bureaucracy really. Fifty-percent chance. If it did rain, they were right and if it didn't they were right. What about that?

Mr. MALONE. Mr. Rogers, perhaps as one of those who is responsible for starting this system I should rise to its defense.

Mr. ROGERS. I am glad to know who started it.

Mr. MALONE. The intent was to share with the user a little bit of extra information that the forecaster had. On some days he is quite confident it is going to rain and he will say 90 percent. On some days he is quite confident it will not rain so he will say 10 percent. On some days he honestly doesn't know and will say 50 percent.

Mr. ROGERS. Wouldn't it be better to say we don't know or it may, or we really feel the indications are it will rain and prepare for it? Or all indications are that it will not rain. If it rains, then OK, he is wrong. But this percent, you don't know whether it is going to rain or not—ever.

Mr. KEITH. Occasionally they have zero percent.

Mr. ROGERS. Once in a while.

Mr. MALONE. Of 100 times when the expression 10 percent is used it will rain 10 times. In 100 times when 90 percent is used it will rain 90 times.

Mr. ROGERS. But that doesn't tell me anything for that day where I particularly am in Washington, D.C., because it may rain over here in Virginia and the 10 percent covers everybody there, but not here. I just don't see it is telling the public much and why we pay for a tremendous effort to give a weather forecast when we are simply going to say maybe it will and maybe it won't.

Mr. MALONE. Sir, sometime I would like to sit down and go through some examples.

Mr. ROGERS. I would like to, too. I hope we can get into the private forecasters. They have been predicting for the White House, White House parties and all. They don't use the Weather Bureau. They go out and get a private forecaster to come in and tell them. At least they have in the last administration. I think they do some here. Maybe on the inaugural parade they have done it for President. Nixon That would be interesting to find out. If they are using the Weather Bureau, it is 10 percent clear.

Dr. NIERENBERG. I clearly can be of very little help in this discussion. I am awfully happy Dr. Malone is here. Now I must apologize. I don't mean to stop the excellent discussion but I have to catch an airplane to attend the installation of a new chancellor of the University of California, which happens with more startling frequency than desirable.

In leaving I would like to say I have enjoyed this exchange and wish we could do it more often. I think it would be beneficial to the committee to exchange views with Members of Congress and it would certainly give us added confidence in our work.

Mr. LENNON. Before you go, Doctor, let me say that hopefully all of the members of the subcommittee will have an opportunity to read the report in detail, and if they do, many of the questions that have been asked here today are in my judgment answered to some reasonable degree. We will take up the report's comments on some of the questions that have been raised here today with Dr. Hargis. Keep up the motivation and determination because this committee, if it makes up its mind to do it, with its membership, can have a tremendous input in everything related to the oceans and the atmosphere if you keep at it as you have done so far.

Mr. ROGERS. One more question on fisheries. On your territorial waters and your fishing limits, we have a problem in South America's 200-mile limit for fishing. It is my understanding the fishing limit does not necessarily prohibit moving through the area, it is simply fishing. Is that right? Or have you studied that?

Mr. HARGIS. That is correct, that is our understanding too. The patrimonial sea concept is not new, but in terms of consideration by this committee it is a new thing. When we prepared our report we were dealing with the positions that were presented to us by Mr. Stevenson and the people that came up in answer to a summons from us. The patrimonial concept is a newer concept in the sense that it has come under serious consideration since we prepared our report.

Mr. ROGERS. Because in our own approach we have the 3-mile territorial limit, but we have extended our fishing limits beyond that. People can move back and forth without invading our territorial limit.

Mr. HARGIS. That is our understanding at the present time.

Mr. ROGERS. I don't know this to be a fact, but I presume there must be some similar concept say with Peru. Maybe they have a 12-mile limit and a 200-mile fishing limit.

Mr. HARGIS. I think it is correct that in the patrimonial seas or territorial seas foreign countries do not limit it to navigation.

Mr. ROGERS. It is simply fishing?

Mr. HARGIS. Yes.

Mr. ROGERS. It is my understanding, and I am not sure—perhaps you have checked into this Peruvian situation—we have been paying fines every time our ship has been caught fishing within 200 miles. Do you know what it costs to get a license to fish within those waters?

Mr. HARGIS. Mr. Royal will answer that.

Mr. ROYAL. Yes, is the answer to your question, Mr. Rogers. The going rate right now for Ecuador is \$20 per ton, and that license must be purchased by the vessel owner before entering the waters of that country if attempting to fish.

Mr. ROGERS. What would be a normal charge?

Mr. Royal. Our vessels range from 200 tons to one of 2,000 tons. The normal would probably be 1,000-ton vessel. We have vessels of 500 tons. It is \$20 a net ton carrying capacity. Sometimes even higher than that. That is for one country. That is for Ecuador. In Peruvian waters you must purchase a license.

Mr. ROGERS. How much is Peru?

Mr. ROYAL. The same thing. I think in Colombia it is \$120 a ton. We don't go into Colombian waters.

Mr. ROGERS. Here is what I am saying. Has anyone added up how many millions we have paid in fines?

Mr. ROYAL. Yes, sir. I think it is in the neighborhood of \$8.5 million in the last 2 years.

Mr. ROGERS. What I am saying is that this way the Government is paying when all we have to do is have the shipowner to pay a license fee. I presume it would go into the cost of the fish but it would prevent international incidents. Why isn't it a better approach to go in and get licenses and avoid the fine payments? In fact they might even negotiate the license fees down if they could do it.

Mr. ROYAL. You have about 20 small republics from the California border to the coast of Chile. If you had to pay a license anywhere from \$20 per ton carrying capacity up to \$100 at this time you could never get your vessel out of an American port. You couldn't afford it.

Mr. ROGERS. The Government is paying all of your fines when you get caught?

Mr. ROYAL. We are not happy with that. The State Department has always told the American overseas or long distance range fisheries not to purchase licenses outside of 12 miles because in doing so we would affect and weaken the U.S. juridical position.

Mr. ROGERS. I understand. What I am saying, I would hope the commission would look at this problem and see if it isn't more logical, if you are going to be captured if you are in their waters and the Government has to pay tremendous fines, much more than a license fee. Isn't that generally true?

Mr. ROYAL. That is correct.

Mr. ROGERS. Isn't the fine more than the license would be?

Mr. ROYAL. For a given country, yes.

Mr. ROGERS. Wherever he is caught. It seems to me we ought to at least explore that possibility and also do away with the fining and perhaps save money at the same time.

Mr. HARGIS. May I interject? Mr. Royal, of course, has considerable experience, being a representative of the Fishermen's Union on the west coast. As far as the committee as a whole is concerned, these questions have occurred to us but they have not been considered as

yet formally, and we do have them under advisement and will take cognizance of your special interest in the matter.

Mr. ROGERS. I would hope this could be done because I think we have not been realistic. Here we are now talking about a 12-mile territorial sea, which is an extension of our 3 mile. We don't let people fish within certain areas, and if we are going to have that same principle, it is a matter of degree, I presume.

Mr. HARGIS. Yes, sir. We will take your special interest in view, and we do have the question under review. We are not happy with the situation as far as the fisheries are concerned, and the international negotiations are a major factor in the welfare of our U.S. fisheries.

One of the problems, of course, in representing a commission or committee which has such competent individuals is that in working the way we have been in trying to develop a committee opinion after studied consideration, from time to time the committee position does not either represent the current situation or the thinking of all of the individuals. We do have a number of people in it who are directly interested in the fishing industry. Mr. Keith has already recognized Mr. Fulham, and Mr. Royal has made some comment. I believe that Mr. Royal would like to respond a little further to your questions, Mr. Rogers, and also Mr. Tillion who is a member of the Alaska House of Representatives as well as a fisherman himself.

Mr. ROYAL. If I may, Mr. Chairman, in answer to your last question, Mr. Rogers, as you probably are well aware the U.S. Government State Department just concluded an agreement with the country of Brazil on shrimp fishing. This was patterned along the line you were speaking of, and presently others in the State Department are carrying on and continuing negotiations with Ecuador and others to try to bring about a similar type of working arrangement and negotiate as they did in Brazil to act during the interim time until such problems are resolved hopefully for all sea commerce.

I share the view of the chairman, Mr. Lennon, and I think we are looking at quite a few years before there will be a definite solution to it.

In the meantime these negotiations are taking place and hopefully we can work out—when I say we, the State and Government—can work out an arrangement with the CEP countries, Chile, Peru, and Ecuador, negotiations similar to those concluded with Brazil on the shrimp fisheries.

Mr. ROGERS. Thank you; and thank you, Mr. Chairman.

Mr. TILLION. I am a member of the Alaska State Legislature, but that is not what I am here as. I am a State Department adviser with the international fisheries, both Russian and Japanese. I have been a fisherman all my life. I am also chairman of the Advisory Committee to the International North Pacific Fisheries Commission.

I sympathize with John Royal's position. You have to realize that the United States has only three major fleets—our shrimp fleet which catches a large portion of its catch in waters that would be claimed by other nations, our tuna fleet that ranges over the whole world and is probably one of our most valuable fleets, and our Alaska king crab fleet in the part of the Continental Shelf we claim under the Truman Doctrine, which Japan doesn't acknowledge and Russia does.

It is not quite as simple for my constituency, the fishermen of the North Pacific. We would like to extend jurisdiction, but even that has some problems. If we extend it, for instance, in the Pacific Northwest to 200-miles copying South Americans, we would without a doubt lose the International North Pacific Fisheries Commission. This keeps the Japanese fishery west of 175° west longitude, or roughly 1,400 miles off the Washington coast. One of the major schooling grounds for our North American salmon is from 250 to 500 miles off the coast. Therefore, even though I sympathize with extended jurisdiction and would love to have extended jurisdiction, if I didn't lose the other treaty, I have to realize that if we extend the jurisdiction and lose the treaty, we would lose approximately 20 million salmon more than we are now losing. The Japanese take about 5 percent of the North American salmon and take about 70 percent of Russia's salmon, which is one of the reasons we don't like to sit down at the same table with both Russians and Japanese. We don't wish to share that on which we have a fairly good deal.

We can't go into detail here, but there are just a lot of different things involved in this. Naturally, while I watch the Japanese and Russian fleets strip our Pacific Ocean perch in sight of where I fish. I get furious. When I realize some of their data was falsified and they took approximately a million more halibut than they claimed, I get kind of wild.

We just finished a negotiation on this, and we will get additional enforcement. But now as this commission comes to the recommendations that I consider very important and will try to push through to bring to you people, they are not necessarily recommendations that other segments of the fishing industry of the United States would care for.

There is always the Department of Defense that might not agree with the position of the fishermen of the United States, and we hope within the next year to give you at least, if nothing better, a majority opinion and a minority opinion and the facts as we have them. Then in the final analysis it is going to be up to you gentlemen to hammer out what becomes law.

Mr. ROGERS. I appreciate your statement and the problems involved, and I presume all of you will not agree on everything and the determination will have to be made. Because there may be a variety of opinion is no reason not to face the problem, and I am sure you agree. I presume if you have a treaty you need enforcement. Maybe Defense can be called in to help in the enforcement of your problem. I am not saying we have to necessarily extend our territorial fishing waters everywhere, but I am saying in those States that have done it, it is a fact, and we are having to pay taxpayers' dollars to ransom them out. If it can be done a better way, maybe it ought to be approached.

Mr. TILLION. As we approach the law of the sea, the State Department would be very leery of us now starting to buy licenses.

Mr. ROGERS. The State Department is leery of almost everything, you will find.

Mr. TILLION. As an Alaskan, I have considered the State Department my archenemy for 20-some years. That is a separate issue, but at this point, with the law of the sea so close, I agree that the

report on fisheries that you have before you is too mild, and I would like to see something with more backbone is it like support for the concept of limited entry.

I certainly hope that in the coming year we will put something together, but you must realize we barely have gotten acquainted with each other.

Mr. ROGERS. I understand that. As the committee chairman said, you have not had time to get together and these are things you are going to go into. I think it will be helpful to the committee and to the Nation.

Mr. HARGIS. I wonder if I might say right here we appreciate your views, we appreciate the opportunity to receive them, and hope we will more in the future.

We do have under study both the law of the sea, which we did comment, and I think fairly effectively, and the fisheries which I am not quite so proud of, and we will include more releases after more material deliberation next time.

I wonder if I could briefly point out how the committee operates. We don't have a large staff. We have not felt we could ask for the funds for a large staff. We did ask for funds for a somewhat larger staff for this year and received help. But we don't have enough funds to have experts in all areas within our staff.

The 25 members of the committee are rather broadly competent with individual interests in different areas, and we can supply the committee with a list of credentials of the current members.

In addition, we do have official observers from the agencies, regular contact points—whom we ask for advice and information and to detail temporary staff to us from their agencies and we expect to get it.

When we are dealing with the law of the sea, Mr. Keith, one of the problems was that we were forced into a position of taking the testimony presented to us and assuming that we had been given everything available as our base of information. We were not happy with it. Based upon the information we had at the time, we felt that the U.S. negotiating situation was a weak one. It has improved considerably. That is the basis on which our assessment was made. We still have that subject under review.

Mr. KEITH. If I may comment, I think the recent explanation you have given there is one the committee can understand. It was a question of tactics. That reflects the way conventions are finally arrived at. If there were some specific tactics you objected to, I would like to know what they are. The report makes a point of it, and I hope to find out so they can be exposed and eliminated.

Mr. HARGIS. We will be glad to attempt to explain that to you further, Mr. Keith.

Mr. LENNON. I want to particularly welcome as a member of the committee the gentleman from the State Legislature of Alaska House of Representatives. I commend the committee for its having at least one member who has legislative background and legislative experience. It is very helpful.

I might say on one page of the Congress report they make it crystal clear as to their position relative to the situation the gentleman from Florida addressed himself to, technically the waters off Chile, Peru, Ecuador, and Brazil. They make the observation on these conventions

and refer to the Geneva Convention in 1958 which seemed to have the force and effect of law. But since the 1958 Geneva Convention, these countries—Chile, Peru, Ecuador, Brazil, Colombia, and others—have turned away from what was the definitive understanding with respect to the agreement entered into in the convention of 1958. That is what has caused the problem.

I do hope and take the liberty to ask the counsel, if he can find the time, if he can obtain copies of this report sufficiently, to take the trouble to have someone on the staff mark them just as he has marked the one I am privileged to have before me which I reviewed last night for a couple of hours, and send them to the members of the Oceanography Subcommittee with a request from me, my parting request, that they will read this report, and then I am going to suggest to NACAO that early in January or soon after the formulation of the Oceanography Subcommittee it confer then with the counsel of that subcommittee, whoever he or she may be, and the chairman of the subcommittee and have a recapitulation, a recap of what you have done here today, because the chairman expressed his anxiety over the fact that there was a lack of communication and dialog with Members of Congress.

I am also going to suggest at this meeting of the Oceanography Subcommittee the members of the Fish and Wildlife Subcommittee of this full committee sit in joint session and hear a recap. It won't be necessary for all of the members of the committee to return to Washington for that but certainly we would like to have the chairman and vice chairman and the staff members to answer questions of the full membership of the Oceanography Subcommittee and the Fish and Wildlife Subcommittee certainly by the 20th of January at the latest.

Now it is my pleasure to recognize for questions another gentleman who during his entire career and especially since his membership on this full committee and subcommittee has demonstrated an equal interest, involvement, and concern with the matters we are addressing ourselves today. My good friend, Congressman Peter Kyros.

Mr. KYROS. Thank you, Mr. Chairman. I am glad to be here with you even though the House has adjourned. There is a lot of work to be done on the oceanography field and I am interested in making other Members of the House aware of it.

Mr. Chairman, do you have any recommendations to protect our coastal zones for the interim period while we are waiting for the Law of the Sea Convention in 1973, which your report states might not be very successful.

As I travel around the United States, and I am certain you and your members find this also, the fishermen along the coastline are demoralized. I don't know whether it is weather, high prices, or the fact the Soviet and other foreigners' fleets fish off our coast. They complain of the depletion of species, whether it be haddock or other fish, and they are looking to us to do something specific. What could your committee come up with before the 1973 convention?

Mr. HARGIS. As Chairman Lennon pointed out, we did comment about possible interim action by the Congress concerning exploitation of resources or use of resources. I think that the best way to answer that is that we do have the question of the law of the sea and the individual items or problems that are concerned in those nego-

tiations under study at the present time. We are concerned with the fisheries, we are concerned with the mining of the Continental Shelf, the mining of petroleum and other significant economic resources. We will attempt to make interim recommendations, that is recommendations that can be acted on or requested by the Congress in the spring, that is between now and the time that a successful convention on the law of the sea can be convened and can act.

The best information we have right now is that it will likely be 1974 before such a thing takes place, and we are concerned that we will not wait that long. So we will try to come up with some interim recommendations.

Mr. KYROS. It is my impression in talking with colleagues from coastal States that we will get some legislation in this House this year, or at the very least proposed this year, which will probably be more advanced than what you suggest. There will be proposals extending limits to 200 miles, I am sure.

Let me ask you one more thing. I have not had an opportunity to read the report carefully, but on ocean research is there a possibility of international cooperation; that is, do we have some deep sea vessels?

Mr. HARGIS. No. The Russians are fairly well equipped with major deep sea research vessels. I suspect that they are just on a par with us, maybe a little superior in terms of tonnage, not necessarily sophistication. There is considerable opportunity for international cooperation in oceanographic research and as you are probably aware, one of the initiatives that has already been taken is an interchange of scientists. Dr. Nierenberg, our chairman, was recently in Russia for 2 or 3 weeks in the oceanographic area. While I cannot personally detail to you the results of those negotiations or discussions, there were seven specific areas of possible cooperation brought up which will be considered, I think, in Washington next week.

Mr. KYROS. The area I am thinking of more particularly is South America and Central America, where we should be turning our attention. We have always neglected South and Central America. It seemed if we shared our deep sea research vessels with them and did research with them on their resources, it would improve our friendship with these countries. We could then turn to fisheries and other areas and deal with them on a much more reasonable and friendly basis.

Mr. HARGIS. Yes, sir; that is a very good point. The committee did comment very specifically on this and we will probably have more recommendations to make after further study. We did comment that there should be a deliberate initiative taken by the United States to cooperate with the lesser developed countries, with South America and African countries, and as a matter of fact, on a worldwide basis in gathering information that would be relevant to their concerns and their resources and assisting in that fashion. It is on pages 8, 9, and 10 of our report. We expect to give you further information on this at some future date.

Mr. KYROS. Mr. Hargis, one last question: Would you have any input in determining the agenda for the 1973 Law of the Sea Convention?

Mr. HARGIS. I do not know how much input we will have. We will try to have as much input as we can. We have received, as Dr. Nierenberg indicated earlier, served two reports since August, including one

last month from Mr. Stevenson and we have scheduled more reviews. We will endeavor to get our opinions heard on what should be included on the agenda for those discussions. We will attempt to lay them before them and persuade them to use them.

Mr. KYROS. Thank you very much.

Thank you, Mr. Chairman.

Mr. LENNON. Thank you, sir.

Mr. HARGIS. Excuse me, Mr. Chairman. Mr. Fulham has had considerable experience and he wanted to make a few remarks relative to Mr. Kyros' point.

Mr. FULHAM. I merely wanted to respond to your question, Mr. Kyros, on the interim activity that might be undertaken regarding fisheries while we are waiting for the Law of the Sea Convention to become law if and when it does. To the best of my knowledge there are only two remedies. One would be under present international commissions and the second would be bilateral negotiation between the United States and countries which happen to be operating on a particular fishery that was endangered. We have used them both. As you know, I watched the demise of New England fisheries along with yours. As far as the International Commission for the Northwest Atlantic is concerned, the history of it is that it has responded after the damage has been done. As far as bilateral negotiation is concerned, we have undertaken two, one with the Soviet Union, one with Poland in the Middle Atlantic. Those also were in response to damage. They have been reasonably successful, nothing outstanding. That appears to be the only remedy that can be undertaken in the interim period. Thank you, sir.

Mr. KYROS. Thank you.

Mr. LENNON. Just to correct the record, I am reminded that in the 1958 convention that the South American countries refused to sign that part of the treaty related to the territorial sea and the contiguous zone. But there was an understanding on the part of the other nations of the world, as I have been told—even our own—that while they declined to sign they expected to live up to it, which, of course, they have not done.

Doctor, there are a number of questions that I had in mind or intended to ask, but in the interest of time, I will be rather brief. Counsel has spent quite a bit of time studying this report. On page 6 of the chairman's statement, and I quote: "The possibility of hostile use of weather and climate modification as a weapon brings an international dimension most strongly into the picture." It seems to me in reading this report some reference is made to the U.S.S.R. and its adaptation of the weather modification related to defense, both aggressively or otherwise. Is there some reason to believe that the Soviet Republic has reached a point in time, and can we document that they have been able to proceed scientifically to the extent that they can use weather modifications or the hostile use of weather modification as an offensive or defensive weapon?

Mr. HARGIS. Mr. Chairman, we have, of course, raised the question.

Mr. LENNON. I raise the question because you have raised it in the report.

Mr. HARGIS. Yes, sir. We have considered the various aspects of weather modification and are still considering them. The possibility

of using an ability to manipulate weather, of using ability to affect geostrophic forces, either aggressively or defensively, of course, is a subject of much concern. There Tom Malone, who is in charge of the special panel that we have established, is more qualified than I to speak specifically to your question about what information we have about Russian capabilities.

Mr. LENNON. How did you obtain this information? Was it through DOD, or did you obtain it through your own conferences and the people involved in the weather modification and prediction?

Mr. HARGIS. I will ask Dr. Malone to comment, but first I should say that the panel or the committee brings to its deliberations people who have considerable experience in various aspects, and several of the members of the committee are themselves aware of these possibilities and problems. We have had them mentioned to us by some of the people who are giving testimony or would have given testimony on weather modification. It is difficult to say exactly how they came up, but we do have a concern and we know that there is a possibility of aggressive and defense use or at least attempts to use weather modification aggressively or defensively.

Mr. LENNON. It is not classified, is it?

Mr. HARGIS. Some of it is classified; yes, sir.

Mr. LENNON. If it is classified, we do not wish that part.

Mr. MALONE. Mr. Chairman, I would simply comment that we have no direct evidence about any other country having a weather modification capability as an aggressive weapon. Our thinking is that one cannot exclude this possibility developing in the future. It is desirable that we set up international conventions and cooperation while the question is still uncertain rather than waiting for this eventuality to catch up with us. It is in that sense that we urged a vigorous national program in weather modification and international cooperation.

Mr. LENNON. On page 24 of the report, I quote: "Hail suppression has been operational in the Soviet Republic for many years, with reported benefits-cost ratio of as high as 17 to 1." Then you go on to say that lightning-caused fire forests produced losses in excess of \$100 million annually and destroy valuable forests. Present operation technique for lightning suppression is expected to yield a benefit-to-cost ratio of at least 5 to 1. A semioperational program in Alaska now beginning its fourth season reflects this ratio in the 1971 summer season.

Mr. HARGIS. Yes, sir.

Mr. LENNON. I know in certain eastern parts of the United States, particularly in the area where you grow a lot of tobacco, hail is a destructive factor and it could wipe out a million dollar crop in a small geographic area. Have we advanced to the point where we have any type of hail suppression? I never heard of it.

Mr. MALONE. No, sir; we have not. We have a project in Colorado which is intended to develop such a capability.

Mr. LENNON. Yet you say that Russia has had it for many years. Are they that far ahead of us in the technique and science and prediction and capability in this respect? It is a little embarrassing for the public to read that and know we do not have it.

Mr. MALONE. There are among the scientists in our country reservations about the success of the Soviet experiments and operational pro-

gram, and it is to resolve this uncertainty that we have set up a research program which is intended to ascertain whether or not in fact a reliable technique can be developed.

Mr. HARGIS. I would point out, Mr. Chairman, that at the time the committee was reviewing this question, Dr. Malone did play a very strong role and is doing so still in this area of atmospheric science. We also had Dr. Johnson, Dr. Solumi, Dr. Baum, General George, and Dr. Tribus in those areas. At the time we reviewed this, we did feel that there was enough credence to this claim by the Russians to make those comments.

Mr. LENNON. Doctor, in the report you state that weather modification today within the Federal Government is carried out by seven agencies to meet their individual mission needs, and then you name those agencies. You conclude that statement by saying that the present fragmented approach is moving the country ahead in whether modification in an erratic fashion. Is there any recognition on the part of the seven agencies which predict modification to meet their own mission needs that this is a fragmented, erratic modification program and should be coordinated in one single agency? You know the inhibition on the part of any bureau or department of any government, whether it is municipal, county, State, or National, to give up anything. How will that condition ever be met head on?

Mr. HARGIS. That is a difficult question, Mr. Chairman.

Mr. LENNON. I know it is difficult, and that is the reason I thought you would help us on it.

Mr. HARGIS. It should be pointed out—I do not like to fall lamely behind on the defense we are studying, but that is the case—we had a presentation yesterday by the Interagency Coordinating Committee on the Atmospheric Sciences, and we began talking about the budget, and this is the first step in attempting to do something more than remark on it, which we do and intend to do. I am sorry that Mr. Rogers has gone because we began doing the same thing about the oceanographic budget, and we were not satisfied with the methods of compilation of figures, and we are setting about getting those. That information aside, we are considering now the problems of organization related to atmospheric science and oceanographic science.

Mr. LENNON. Doctor, on page 7 of the general statement in paragraph 2, I think he wraps up the prime responsibilities of the individual members of this important committee and its total objectivity. I call it to the attention of the members who are not here in the second paragraph on page 7. I won't spend any more time on it except to urge you to read it.

On the top of page 10, I read from the bottom of page 9: "As the handover takes place from military to civilian sponsorship in the support of research in the ocean atmosphere, one must be aware of two dangers: One, that basic projects are not lost in the transfer process; and two, that the defense system does not give away so much that its own needs can no longer be satisfied. We feel that this problem needs to be looked into." I think I know what is meant, but I would ask you, if you can find the time, to go into that in some detail and furnish us some information. The record will be kept open for several days, and if you will amplify the record by what is meant by that statement, I would appreciate it.

Mr. HARGIS. I will do that, sir.

(The information follows:)

SHIFT FROM MILITARY TO CIVILIAN PROGRAMS

In recent years several factors have led to a shift in Federal emphasis from military oceanographic science and technology activities to civil programs. For example, subsequent to the formation of NOAA, several important naval activities and programs were transferred to NOAA, including the National Oceanographic Data Center (NODC) and the National Oceanographic Instrumentation Center (NOIC) by Executive Order 11564 of 6 October 1970 and the Navy Spacecraft Oceanography Project in FY 1972. It is too early to determine whether military requirements are still being adequately met by these activities, but there is of course the possibility that an erosion in this regard could occur, and should be headed off by careful program monitoring at the interagency level.

A more pervasive influence of concern, however, is the general climate of opinion in both the executive and legislative branches that the military support for research should be more strictly limited to programs with a clear, direct, and hopefully immediate application to mission accomplishment. The Mansfield amendment of November, 1969, is of course, a clear articulation of this point of view, and the discussion in the Congressional Record for September 11, 1972, for example, concerning the FY 1973 authorization bill for the Department of Defense indicates that in the House particularly the sentiment is running strong for reductions in the military sciences budget of each of the three military departments.

It is true that the DOD oceanography research budget has held approximately level since 1969 at \$30-35M/yr—and is estimated at about \$33M for 1973, according to the annual report of the President to the Congress on the Federal Ocean Program, April 1972. However taking account of inflation and increased costs during this period, level funding is of course tantamount to reduction in purchasing power. Looking ahead and noting the general movement toward Federal budget austerity, it seems clear that the DOD may experience growing difficulty in maintaining its present level of support for marine and atmospheric R&D. The fact that NSF's oceanographic research budget has gone from essentially the same levels as DOD's in 1969 to approximately double DOD's in 1973, and that NOAA's oceanographic budget—though much smaller in amount—has gone from one-tenth of DOD's to approximately one-half, does not necessarily imply that these organizations are picking up the research that may be squeezed out of DOD. In fact, the growth of these programs results primarily from new large scale program initiatives such as IDOE, MESA, JOIDES, and Sea Grant.

It seems clear that the military science drop-out situation could become serious if it has not already done so, and in any case, would benefit from monitoring by an interagency, broadly based organization such as NACOA.

Mr. HARGIS. One point is that there is considerable change in the support of oceanography by the DOD, and in the period of transition we are concerned that some of the important programs might fall through the cracks in terms of support, and this is one aspect we have under study. We will respond.

Mr. LENNON. In paragraph 3 of page 10, there is the conclusion, "But the scatter and variety of topics we are considering does underline the requirement that we face up to one important issue—*coordination*." [Emphasis added.]

That is a big challenge to me. I would like your comments on what I am about to read from the beginning of the last line on page 10:

But in particular there arises the possibility of some Department of Natural Resources being established. If it takes the form developed in the document of papers related to the President's departmental reorganization, at least in February of this year, the marine and atmospheric focus for resource development, transportation, international cooperation, and engineering development activities recommended by the Stratton Commission and in part accomplished during the past few years, are in danger of being lost.

Was the thrust of that statement related to the coastal zone management program which is one of the four matters you addressed yourself to in the report? Was that the prime focus on the impact that you might have if the papers relating to the Presidential departmental reorganization plans released in February of this year were implemented? Are you indicating that the development activities recommended by the Stratton commission and in part accomplished by the past few years are in danger of being lost? Would you take the time to tell us a little bit more about what you are trying to get over to the committee and to the Congress in that statement?

Mr. HARGIS. Yes, sir. We are aware that there is under consideration reorganization of several of the executive agencies or departments at various levels in Government. The document that we refer to is perhaps the latest and the best that we can get regarding the Executive's point of view. We have not had any input at this point from the congressional committees involved, and we will hope to have that in our studies. We have set up a specific review group to examine the various proposals for reorganization that have tentatively been made and those that might appear in the future on an on-going basis. Now, when we say that there are areas of concern—and I should interject that there is a revision of the testimony from the draft which you quoted which states this concern in more positive terms—that is, instead of voicing alarm over the danger that recent gains might be lost, we feel the present situation makes a cautionary observation that care must be exercised to maintain the gains more appropriate—what we are concerned with is that judging from the Presidential planning document that we have referred to, there does seem to be an opportunity for losing the focus on oceanic matters—ocean engineering, ocean technology, ocean environments, ocean resource management, and the problems of the coastal zone—in the reorganization proposed therein. We want to assure ourselves that this does not occur, or at least not in such a way that it is detrimental to those advances towards a coherent and comprehensive program in marine affairs that we have made and that we hope will continue over the next couple of years.

Mr. LENNON. Doctor, there were several discussions on the fact that, if there was a Department of Natural Resources established either through an executive reorganizational plan or an act of Congress, unquestionably NOAA would very likely become a part of the Department of Natural Resources.

Mr. HARGIS. Yes, sir.

Mr. LENNON. There was thinking on the part of the administration and the Congress that even the Department of Agriculture would become a part of the Department of Natural Resources. I cannot at this point in time envision that. I think there would be serious objection to it across the country so it would not become a reality. In your judgment, and in the judgment that you can speak for the NACOA Committee, should NOAA become a part of the Department of Natural Resources assuming the establishment of such a department?

Mr. HARGIS. I cannot speak for the committee, sir, because we have not deliberated on the question in the fashion that we would prefer to arrive at a position.

Mr. LENNON. In your statement you indicated some apprehension about it.

Mr. HARGIS. Yes, sir; there is. At this point I guess the best way to say it, sir, is that we want to be sure that whatever realignment is made is not damaging to those things that we think are critical, that is, the national interest in the multiple uses of the ocean, in the development of ocean science and technology and of sea-going industry, and in the atmospheric aspects that we are just now bringing under our cognizance, as well. We do feel apprehensive but we do not have a position to state at this point beyond the point that we do not want to lose the positive gains that have been made. One question will be: If there is a Department of Natural Resources, should NOAA go into it, and if so, what configuration would it best fit into, and if so, what responsibilities should it have? One of the responsibilities that we have begun to look at is the possibility that oceanographic and atmospheric and terrestrial activities will all be folded together. This does give us some concern although it may turn out to be the logical way to go.

Mr. LENNON. Doctor, I think you know that the Stratton commission made it crystal clear in its recommendation for the agency.

Mr. HARGIS. Yes, sir.

Mr. LENNON. In Reorganization Plan No. 4, which brought together the various components of what is now NOAA to put them under one umbrella and put them in the Department of Commerce, I for one did not think that was the right way to go. But I recognized that if we tried to put up a fight, that we would not have it for another 4 to 5 years. I supported it strongly before the committee and on the floor of the House. There are people who object to NOAA being in the Department of Commerce. The Bureau of Commercial Fisheries, yes, but they say that NOAA has an outward view and should not be related to the hard, nitty-gritty grinding of how you generate commerce. We have members on this full committee—a very distinguished membership, who are always critical of the fact that NOAA is where it is. That is the prime objection to NOAA. I speak of my distinguished and beloved friend John Dingell and we support each other 99 percent of the time but on this we differ. I want this committee which was created to be an adviser and counsel to study in depth this question because some day the Congress may be faced with that. If we cannot come back to you people in the area of technology and skill in science and other areas that you represent for the advice and counsel that the Congress needs to make a decision, particularly this full committee, we are in serious trouble. I am not going to ask you to comment at this point. I do wish your committee would give serious thought and be prepared sometime in the future to give your sincere conscientious advice to this committee and the Congress as to which way they ought to go.

Mr. HARGIS. Yes, sir; I will do that.

Mr. LENNON. There are a number of questions but I will yield to the counsel and then I will pick up some more. I wanted to spend a lot of time on the coastal zone management. Since this report was issued on June 30, as you know, there was signed into law the Coastal Zone Management Act of 1972. We had quite a shakedown cruise trying to get it finally enacted by the Congress and we are very grateful for the fact that the President signed it, even though he had been persuaded that the administrative responsibilities ought to be in the

Department of Interior, and I can understand that because there is no more influential man in America in this administration than my dear friend, Rogers Morton. Mr. Counsel.

Mr. HEYWARD. I wanted to ask a few questions concerning procedures and the way the committee is operating, Dr. Hargis, rather than going into details on the report itself. Referring back to the public law which created the committee, the effective date was August 16—I recognize the time delay in appointing the members of the committee, but are the appointments of the original members of the committee effective from the date of the law or are they effective from some other date of appointment; do you know?

Mr. HARGIS. I think they are effective from the date of appointment.

Mr. HEYWARD. So that those appointed for 3 years will serve for 3 years from the date of appointment. Could you give us that date?

Mr. HARGIS. That is my understanding. October 19.

Mr. HEYWARD. In the appointment process for the first 2 years there will be members serving for less than a full 3-year term. Of those who were appointed for 1 year, the nine members of the original committee, have any of them been reappointed since October or have their replacements been designated?

Mr. HARGIS. It is my understanding that the President has under advisement a list of possible candidates for selection and that is the state in which the replacement is. In the meantime the members who were appointed for 1 year are serving until they are replaced. This is an option that is open.

Mr. HEYWARD. Does this law as you interpret it provide for members to continue to serve even though their terms have expired?

Mr. HARGIS. Yes, sir; that is the way we interpret it. "May serve until replaced" I believe is the wording.

Mr. LENNON. Subsection 3 of (d) of 2a. "A member may serve after the expiration of his term until his successor has taken office."

Mr. HEYWARD. If these appointments are made, will they be effective from October 19?

Mr. HARGIS. I can't answer the question except to fall back upon the initial statement which was that their terms run from the time of actual appointment until the expiration of 12 months of calendar time thereafter.

Mr. HEYWARD. I am bringing this up only so I can call to the attention of the committee and staff to the fact that this ought to be clarified as to the date of appointment. If some people are going to serve in an interim period, you are going to have 3-year terms beginning all over the lot. I would suggest that you consult with legal advisers on how this should be set so there is no question about it.

Mr. HARGIS. We will do that, sir.

Mr. HEYWARD. In connection with the report itself, I am certainly not critical of the report. I think within the time frame available to the committee they have performed a very valuable service by bringing forward the contents of this report. I must say, however, I was so much concerned that I felt that perhaps it might have been more valuable if the committee had addressed itself to specific programs and activities rather than policy matters.

The reason I say that is, as you are perfectly well aware, that the Stratton Commission made specific recommendations particularly

addressed to coordination in the Federal Executive Department of marine and atmospheric programs. For various reasons the recommendations of the Stratton Commission, perhaps very logically, were not carried out in toto. But there are areas of noncoordination which still exist, to which I think that this committee, as I view it, as a successor to the Stratton Commission on a permanent basis should address its attention and specifically recommend to the President and to the Congress as to whether certain programs which are now being carried on do not deserve the priorities which they have and other programs which have not been addressed should be pulled up and how interagency coordination should be strengthened and duplication terminated.

Mr. HARGIS. We agree.

Mr. HEYWARD. I am sure you agree but I hoped that this particular report was going to address that because I also agree with you that in any new reorganization, particularly a Department of Natural Resources, there is a very serious chance that some of the problems may be "falling through the cracks," so to speak. Some part of that reorganization plan, before it is "in concrete" as far as the administration is concerned, might be adjusted to plug some of those cracks.

For instance, in connection with the Department of Natural Resources, if NOAA is going into it and if it is to take over coordination envisioned by the Stratton Commission, perhaps there should be some high focus, as an Under Secretary, for instance, who is concerned with marine resources. This is just one idea that can be considered.

The point I am making is that I would hope that committee very early would try to do what it can to address itself to specific programs.

I think that the comment on the Law of the Sea can be valuable, but I don't think that the committee is in a position, with its resources and available time, to address itself to policy problems which are already being addressed in other arenas. It seems to me that more time could be spent in a valuable way by addressing yourselves to specific program areas. That is why I believe that section 4 of the bill was as specific as it was in trying to in effect continue the concept of the charge which the Stratton Commission had on a "one-shot" basis, that your committee has on a continuing basis, a continuing review of progress of marine and atmospheric programs of the United States. It is a pretty broad responsibility.

I think one valuable part of the Law of the Sea discussion, although I must say I don't agree with some of the supporting information you have in the statement, is your recommendation for international cooperation in particular areas. I think that type of suggestion is one that your committee has properly made. It should be as specific or even more specific than it has been.

I noticed in your discussion on international cooperation your comment about Sea Grant. I don't know exactly what you had in mind as to Sea Grant in the international arena. You did specifically refer to the exchange program.

Mr. HARGIS. Yes, specifically using funds from that source of support for bringing numbers of people from the lesser developed countries concerned in the areas of resource development and giving them appropriate training. That was just put out as one possibility.

Mr. HEYWARD. I think that is an excellent type of suggestion.

The other point: No mention was made, at least to my recollection of the functioning of the Office of International Affairs. NOAA has such an office in its setup. I am not sure what its total function is, but it seems to me that some of these things which are suggested here could very properly be implemented by that Office. The agreements with Canada and with France, on a bilateral basis, on oceanographic programs I assume come under the aegis of that Office. Some of your other suggestions might also. The question was raised by the chairman in connection with weather modification and why Russia is so far ahead in its hail-suppression program. All of the international programs, it seems to me, should be addressed and commended or criticized by your committee. I am not referring only to NOAA. I am also including others such as the National Science Foundation as long as the program relates to your province, that is, the oceans and atmosphere. You are certainly not limited to NOAA.

Mr. HARGIS. No, sir; we don't consider it limited that way. We consider that our area of responsibility is broad, ranging over all of the national oceanic and atmospheric programs including private as well as public.

I don't mean, Mr. Heyward, by saying I agree so curtly to appear to be putting you off. We do agree with your interpretation that we are charged with looking at the coordination aspect and with looking at programs. We did decide in the first report to concentrate on several areas we thought had high priority and that is the way we approached it. We do intend more detail in the next one, more detailed review of organizational matters and programs even. There is, of course, a limitation as to how much detail you can go into. We do regard our responsibility as covering important national programs.

Mr. HEYWARD. Will you receive detailed briefings from every agency and every department on what their program interest in the oceans and atmosphere is?

Mr. HARGIS. Yes, and we did insofar as it was possible at the time we were preparing the first report. We looked into the agency budgets and this was one of the inputs we had. It didn't get into the report except in a superficial way related to our concern over the overall balance of the proposed budget for the next cycle. We did look at that and we are looking at it in more detail now, including individual agency programs and the possibility of duplication.

Mr. HEYWARD. Until we get the detailed comments, suggestions, and recommendations on implementation and coordination of specific programs, maybe some of these broader subjects could be left alone. What was the comment, that this was a statesmanlike report? I think Congressman Rogers' reaction was that the report probably should be much more critical and much more descriptive of problem areas even if you don't have solutions to recommend. It seems to me that would be a lot more helpful; and later on after you have accomplished all of this coordination effort and are riding high, then you can sit back and dwell in the clouds on the philosophical problem of Government policy.

Let me ask one more question or make one more statement. I haven't asked many questions.

In connection with your next report—and I suppose the staff will have a lot to say about this—would it be possible to perhaps move the

timing up a little bit? The reason I am suggesting this is that the Congress in its wisdom—I don't know whether it was wisdom or not—gave the Secretary of Commerce 3 months to comment. It seems obvious from the first report that he may take every minute he can. The first report got over here at the end of September, about the time Congress was winding up its business. There is nothing to prevent you from submitting your report, say, at the end of May so that he can get his cut at it a little bit earlier. I would certainly encourage you not to use all the time available up to June 30 if you can possibly help us out by moving it up a little bit.

The other part, of course, is that I would like to say one thing about the "coastal zone" comments. I think it was an excellent section. I am not sure whether that is what delayed the Congress receiving the report by September 30 or not. Maybe that was, but you had nothing to do with that.

Mr. HARGIS. No, sir.

Mr. HEYWARD. Fortunately, we solved that problem in the meantime, at least to some extent.

I assume the committee will be keeping its eye closely on implementation and, if I may say so, coordination in the coastal zone area as well as other areas?

Mr. HARGIS. Yes, sir. I believe I am ad hoc, or however one acquires the responsibility, chairman of that subcommittee of the committee, and I can guarantee it is going to get attention.

Mr. LENNON. Mr. Keith.

Mr. KEITH. Paul Rogers and I visited the Soviet Union back in 1966. In the conclusions and recommendations of our report, we said, "Improve systems for dissemination of results of oceanographic research to relevant Government agencies and the general public. Our free and highly competitive enterprise system is one of the strengths of our society and we should make the best use of it to further our oceanographic program."

This came as a result of conversations we had with Mr. Federoff, the Soviet oceanographer working closely with the United Nations at that time. He said that practically every bit of oceanographic data is available in the United States, somewhere, but there is no way it can be found. Have we made any progress in the collection, storage, and dissemination of this data?

Mr. HARGIS. I think so; yes, sir. The NODC program is improving now with greater coordination among the Federal agencies. The NODC is now in NOAA, and there is considerable support for this program from various of the Federal agencies, and there have been improvements. I think that is a safe statement to make.

Mr. KEITH. Finally, it is very easy to be critical of tactics of negotiators on the Law of the Sea Conferences, but once you get really detailed information concerning the background factors and have the interface with the individual concerned you get sort of confused by the facts and you find that things are not as bad as you thought they were. I would be interested in knowing whether any of your members or staff attended or audited—to use an educational word—either the New York or the Geneva meetings.

Mr. HARGIS. There are a number of us in the committee who by virtue of other responsibilities, assignments, or appointments are involved in one aspect or another of the negotiations. I am myself an adviser.

Mr. KEITH. I understand.

Mr. HARGIS. And I have also been an adviser to Ambassador McKernan and people attempting to negotiate these things concerning the view held by the various States. So there are people on the committee who were at the meetings. Mr. Royal attended the meetings, for example. And there are people on the committee who by virtue of other assignments do receive input. I think it is safe to say, and I stand to be corrected by the staff, that we had no official observers.

Mr. KEITH. I have been sort of a bug on this since I have been on this committee. As I mentioned earlier, I visited the Soviet Union and other places, and have been to Geneva on several occasions. I think to some extent because of my prodding of the chairman of this committee, the staff has gone. Just in the conversations that take place during lunch and at social events, as well as in auditing the discussions, they have become familiar with the personalities and aware of the background factors that lead us to use the tactics that we do. If you also attended these sessions, you would be in a much stronger position to advise the Congress, because during the sessions of Congress the committee staff can't go. I commend very highly to you your staff's participation.

Thank you, Mr. Chairman.

Mr. SHAROOD. I want to echo what Captain Heyward commented on with regard to methodology of the committee's work and what you ought to be looking at. He and I worked on the drafting of this bill and the writing of the committee report together, and I am sure you all have read the report of the committee.

In the report we recommended the language of one of the panels of the Stratton Commission in terms of what the engineering panel thought the committee would be looking at. There is a whole list on page 6 of the committee's report of various topics. Most of them are rather long-range analysis problems. I think part of the discussion with Mr. Keith earlier today highlighted the problem of dealing with a current issue; namely, the law of the sea. What was in the report superseded by events rather quickly. You started out and quoted this language in boldface print on top of your statement on law of the sea where you expressed concern. This is apparently predicated on the meeting that occurred in January. I don't know when this was put into print, when it was locked in, but apparently from Dr. Nierenberg's testimony events then began to change prior to the actual dissemination of the report.

Mr. HARGIS. That is right.

Mr. SHAROOD. So this tends to create a certain degree of confusion when attempting to cope with a problem in a rather high state of fluctuation. I would hope I think, with Captain Heyward, you would attempt to look at more long-range problems, and problems that are in the immediate state of negotiations or preparation, which perhaps you ought to be addressing in terms of your interface with other agencies and your coordinative role, not clearly spelled out here, are perhaps not the proper subjects for your reports to Congress at all. Where there is a probability that whatever benefit to be derived from the report

will be perhaps negated by changing events. I think the same is true perhaps with the coastal zone section of the report.

Mr. HARGIS. We fully certainly appreciate the guidance of counsel concerning the interpretation that you derive from your awareness of the intent of the drafting of the legislation. That is valuable.

One thing I would like to respond to is this: I don't know that the committee would agree we should not deal—as a matter of fact I think we would not agree—that we should not deal with important activities that are current. Perhaps this is not the type of thing that should be cast in concrete in the report. There are other mechanisms for us to communicate with the Congress and with the Executive, either by memorandums or letters and other things. We have used these. I would point out that I personally do concur—at this point I don't have the benefit of consulting with the rest of the committee—I personally concur with the report's statement, inference, whatever you call it, that NACOA played a part in the development of the scenario of the Law of the Sea. One of the recommendations we made specifically was there should be more technical people on the delegation. I am not saying we were the only ones that made this, but one of the recommendations we made was that there should be more people from the fishing industry and not only should there be more people but they should not be put in the situation where they could only respond when they were queried. They should be given a more active role. We were assured this was going to be done and we believe it was done.

Another thing, of course, was in commenting on the tactics, we were acting on the basis of reports that we had from the delegation leaders themselves and our conclusion was that this wouldn't be the way we would play the cards. So we made the comment.

Mr. SHAROOD. All of that is appreciated but when you do put it in bold faced type at the head of a report to Congress when perhaps that problem has already been resolved tends to throw the report in some sort of a strange light.

Mr. HARGIS. We agree with that. Yes, sir.

Mr. SHAROOD. Again we must take a careful look at what the committee said in its report on the legislation. There is very heavy emphasis there on more long-range view of where we ought to be going and what our deficiencies are in terms of achieving goals rather than current day-to-day problems.

Mr. HARGIS. Yes.

Mr. LENNON. I have already commented on the fact that the coastal zone management legislation was signed into law as you gentlemen are aware of. I understand from you, Dr. Hargis, that you had been designated as the chairman within the committee of the group that would be principal advisors to NOAA in the implementation of the Coastal Zone Management Act.

Mr. HARGIS. No, sir. I am chairman of the committee of the NACOA to examine the progress of development of the implementation of the act. What sort of advisory role we will be called upon to serve in NOAA itself is not as yet clear. That is where they will say "We want you to advise us on this point." I think it would be safe to say we will give them such advice through whatever proper routes are available to us that we feel is necessary. I don't believe any one of us

on the committee has as yet been requested by NOAA to fit into an advisory capacity.

Mr. LENNON. I want to make it crystal clear that the greatest challenge to NACOA and to NOAA is its involvement and concern, its decision, and moving forward expeditiously as quickly as possible but with the right to deliberate decision in the field of implementation of the Coastal Zone Management Act. I say that because I have some reason to believe that there will be efforts by at least somebody in the next session of Congress to change the existing law.

In my judgment NOAA ought to be able to present to Congress certainly by April 1 some definitive action that it has taken since it was given this authority, demonstrating the progress it is making. Maybe the chairman of this subcommittee, whoever that may be, ought to have an oversight hearing sometime no later than April of next year, not to oversight—I think you know what I mean—but to give you an opportunity to get on the record the efficiency with which NOAA moved and the effective manner in which NOAA moved to implement the law that is now on the books. And to have that printed in the record for distribution to Members of Congress would be in my judgment the most effective way to solve at least the first step anyhow in convincing Congress that the Congress was right in its decision to keep NOAA or to keep the coastal zone management program within what it was originally designed to do, the National Oceanographic and Atmospheric Administration. That is going to be challenged.

Gentlemen, I know you members of the committee can be very influential and helpful, as you live in all parts of the gulf and Pacific and Atlantic and the interior, in letting the world know that you do believe, if you do believe, that NOAA has the expertise, knowledge, background, and capability to implement the Coastal Zone Management Act as it was passed by the Congress and signed into law by the President.

Are there any other questions, gentlemen?

If not, I want to express my personal appreciation and that of the members of the committee who appeared and those that will have an opportunity to read this report.

Again, I repeat that I hope no later than the 20th of January at least you and the chairman and some others can conveniently come at not too much taxpayers' expense and meet and talk with all of the members of the Oceanography Subcommittee and Fish and Wildlife Subcommittee to establish the rapport that the chairman of your committee indicated he wanted done.

Thank you very much. The subcommittee will stand in recess until tomorrow morning at 10 a.m.

Thank you.

(Whereupon the hearing was adjourned at 12:10 p.m. to reconvene at 10 the following morning.)

The first part of the report deals with the general situation in the country and the progress of the work done during the year. It also mentions the various committees and sub-committees set up to deal with the different aspects of the problem.

The second part of the report deals with the specific measures taken to improve the situation. These include the establishment of a central committee to coordinate the work of the various departments, the appointment of a special committee to investigate the causes of the problem, and the implementation of a series of reforms designed to improve the efficiency of the government.

The third part of the report deals with the results of the work done during the year. It shows that the various measures taken have had a beneficial effect on the situation, and that the government is now in a position to deal with the problem in a more effective manner.

The report concludes by stating that the government is committed to continuing its efforts to improve the situation, and that it will continue to work closely with the various departments and committees to achieve its objectives.

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION OVERSIGHT

WEDNESDAY, NOVEMBER 29, 1972

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON OCEANOGRAPHY OF THE
COMMITTEE ON MERCHANT MARINE
AND FISHERIES,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10 a.m., in room 1334, Longworth House Office Building, Hon. Alton Lennon (chairman of the subcommittee) presiding.

Mr. LENNON. The Subcommittee on Oceanography is meeting today for the purpose of reviewing the organization, current programs, and future plans of the National Oceanic and Atmospheric Administration in relation to its responsibilities.

As the subcommittee will recall, the National Oceanic and Atmospheric Administration was created by Reorganization Plan No. 4 of 1970, which became effective, on October 3 of that year. For the purpose of this record, I will ask that a copy of that plan be included at this time.

(The document referred to follows:)

REORGANIZATION PLAN NO. 4 OF 1970

(Prepared by the President and transmitted to the Senate and the House of Representatives in Congress assembled, July 9, 1970, pursuant to the provisions of chapter 9 of title 5 of the United States Code.¹)

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

SECTION 1. *Transfers to Secretary of Commerce.* The following are hereby transferred to the Secretary of Commerce:

(a) All functions vested by law in the Bureau of Commercial Fisheries of the Department of the Interior or in its head, together with all functions vested by law in the Secretary of the Interior or the Department of the Interior which are administered through that Bureau or are primarily related to the Bureau, exclusive of functions with respect to (1) Great Lakes fishery research and activities related to the Great Lakes Fisheries Commission, (2) Missouri River Reservoir research, (3) the Gulf Breeze Biological Laboratory of the said Bureau at Gulf Breeze, Florida, and (4) Trans-Alaska pipeline investigations.

(b) The functions vested in the Secretary of the Interior by the Act of September 22, 1959 (Public Law 86-359, 73 Stat. 642, 16 U.S.C. 760e-760g; relating to migratory marine species of game fish).

(c) The functions vested by law in the Secretary of the Interior or in the Department of the Interior or in any officer or instrumentality of that Department, which are administered through the Marine Minerals Technology Center of the Bureau of Mines.

¹ Effective October 3, 1970, under the provisions of 5 U.S.C. 906.

(d) All functions vested in the National Science Foundation by the National Sea Grant College and Program Act of 1966 (80 Stat. 998), as amended (33 U.S.C. 1121 et seq.).

(e) Those functions vested in the Secretary of Defense or in any officer, employee, or organizational entity of the Department of Defense by the provision of Public Law 91-144, 83 Stat. 326, under the heading "Operation and maintenance, general" with respect to "surveys and charting of northern and northwestern lakes and connecting waters," or by other law, which come under the mission assigned as of July 1, 1969, to the United States Army Engineer District, Lake Survey, Corps of Engineers, Department of the Army and relate to (1) the conduct of hydrographic surveys of the Great Lakes and their outflow rivers, Lake Champlain, New York State Barge Canals, and the Minnesota-Ontario border lakes, and the compilation and publication of navigation charts, including recreational aspects, and the Great Lakes Pilot for the benefit and use of the public, (2) the conception, planning, and conduct of basic research and development in the fields of water motion, water characteristics, water quantity, and ice and snow, and (3) the publication of data and the results of research projects in forms useful to the Corps of Engineers and the public, and the operation of a Regional Data Center for the collection, coordination, analysis, and the furnishing to interested agencies of data relating to water resources of the Great Lakes.

(f) So much of the functions of the transferor officers and agencies referred to in or affected by the foregoing provisions of this section as is incidental to or necessary for the performance by or under the Secretary of Commerce of the functions transferred by those provisions or relates primarily to those functions. The transfers to the Secretary of Commerce made by this section shall be deemed to include the transfer of authority, provided by law, to prescribe regulations relating primarily to the transferred functions.

SEC. 2. *Establishment of Administration.* (a) There is hereby established in the Department of Commerce an agency which shall be known as the National Oceanic and Atmospheric Administration, hereinafter referred to as the "Administration."

(b) There shall be at the head of the Administration the Administrator of the National Oceanic and Atmospheric Administration, hereinafter referred to as the "Administrator." The Administrator shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level III of the Executive Schedule Pay Rates (5 U.S.C. 5314).

(c) There shall be in the Administration a Deputy Administrator of the National Oceanic and Atmospheric Administration who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level IV of the Executive Schedule Pay Rates (5 U.S.C. 5315). The Deputy Administrator shall perform such functions as the Administrator shall from time to time assign or delegate, and shall act as Administrator during the absence or disability of the Administrator or in the event of a vacancy in the office of Administrator.

(d) There shall be in the Administration an Associate Administrator of the National Oceanic and Atmospheric Administration who shall be appointed by the President, by and with the advice and consent of the Senate, and shall be compensated at the rate now or hereafter provided for Level V of the Executive Schedule Pay Rates (5 U.S.C. 5316). The Associate Administrator shall perform such functions as the Administrator shall from time to time assign or delegate, and shall act as Administrator during the absence or disability of the Administrator and Deputy Administrator. The office of Associate Administrator may be filled at the discretion of the President by appointment (by and with the advice and consent of the Senate) from the active list of commissioned officers of the Administration in which case the appointment shall create a vacancy on the active list and while holding the office of Associate Administrator the officer shall have rank, pay, and allowances not exceeding those of a vice admiral.

(e) There shall be in the Administration three additional officers who shall perform such functions as the Administrator shall from time to time assign or delegate. Each such officer shall be appointed by the Secretary, subject to the approval of the President, under the classified civil service, shall have such title as the Secretary shall from time to time determine, and shall receive compensation at the rate now or hereafter provided for Level V of the Executive Schedule Pay Rates (5 U.S.C. 5316).

(f) The President may appoint in the Administration, by and with the advice and consent of the Senate, two commissioned officers to serve at any one time as the designed heads of two principal constituent organizational entities of the Administration, or the President may designate one such officer as the head of such an organizational entity and the other as the head of the commissioned corps of the Administration. Any such designation shall create a vacancy on the active list and the officer while serving under this subsection shall have the rank, pay, and allowances of a rear admiral (upper half).

(g) Any commissioned officer of the Administration who has served under (d) or (f) and is retired while so serving or is retired after the completion of such service while serving in a lower rank or grade, shall be retired with the rank, pay, and allowances authorized by law for the highest grade and rank held by him; but any such officer, upon termination of his appointment in a rank above that of captain, shall, unless appointed or assigned to some other position for which a higher rank or grade is provided, revert to the grade and number he would have occupied had he not served in a rank above that of captain and such officer shall be an extra number in that grade.

SEC. 3. *Performance of transferred functions.* The provisions of sections 2 and 4 of Reorganization Plan No. 5 of 1950 (64 Stat. 1263) shall be applicable to the functions transferred hereunder to the Secretary of Commerce.

SEC. 4. *Incidental transfers.* (a) So much of the personnel, property, records, and unexpended balances of appropriations, allocations, and other funds employed, used, held, available, or to be made available in connection with the functions transferred to the Secretary of Commerce by this reorganization plan as the Director of the Office of Management and Budget shall determine shall be transferred to the Department of Commerce at such time or times as the Director shall direct.

(b) Such further measures and dispositions as the Director of the Office of Management and Budget shall deem to be necessary in order to effectuate the transfers referred to in subsection (a) of this section shall be carried out in such manner as he shall direct and by such agencies as he shall designate.

(c) The personnel, property, records, and unexpended balances of appropriations, allocations, and other funds of the Environmental Science Services Administration shall become personnel, property, records, and unexpended balances of the National Oceanic and Atmospheric Administration or of such other organizational entity or entities of the Department of Commerce as the Secretary of Commerce shall determine.

(d) The Commissioned Officer Corps of the Environmental Science Services Administration shall become the Commissioned Officer Corps of the National Oceanic and Atmospheric Administration. Members of the Corps, including those appointed hereafter, shall be entitled to all rights, privileges, and benefits heretofore available under any law to commissioned officers of the Environmental Science Services Administration, including those rights, privileges, and benefits heretofore accorded by law to commissioned officers of the former Coast and Geodetic Survey.

(e) Any personnel, property, records, and unexpended balances of appropriations, allocations, and other funds of the Bureau of Commercial Fisheries not otherwise transferred shall become personnel, property, records, and unexpended balances of such organizational entity or entities of the Department of the Interior as the Secretary of the Interior shall determine.

SEC. 5. *Interim officers.* (a) The President may authorize any person who immediately prior to the effective date of this reorganization plan held a position in the executive branch of the Government to act as Administrator until the office of Administrator is for the first time filled pursuant to provisions of this reorganization plan or by recess appointment, as the case may be.

(b) The President may similarly authorize any such person to act as Deputy Administrator and authorize any such person to act as Associate Administrator.

(c) The President may similarly authorize a member of the former Commissioned Officer Corps of the Environmental Science Services Administration to act as the head of one principal constituent organizational entity of the Administration.

(d) The President may authorize any person who serves in an acting capacity under the foregoing provisions of this section to receive the compensation attached to the office in respect of which he so serves. Such compensation, if authorized, shall be in lieu of, but not in addition to, other compensation from the United States to which such person may be entitled.

SEC. 6. *Abolitions.* (a) Subject to the provisions of this reorganization plan, the following, exclusive of any functions, are hereby abolished:

(1) The Environmental Science Services Administration in the Department of Commerce (established by Reorganization Plan No. 2 of 1965, 79 Stat. 1318), including the offices of Administrator of the Environmental Science Services Administration and Deputy Administrator of the Environmental Science Services Administration.

(2) The Bureau of Commercial Fisheries in the Department of the Interior (16 U.S.C. 742b), including the office of Director of the Bureau of Commercial Fisheries.

(b) Such provisions as may be necessary with respect to terminating any outstanding affairs shall be made by the Secretary of Commerce in the case of the Environmental Science Services Administration and by the Secretary of the Interior in the case of the Bureau of Commercial Fisheries.

[F.R. Doc. 70-13375; Filed, Oct. 5, 1970; 8:45 a.m.]

Mr. LENNON. The subcommittee will further recall that we met on July 6, 7, 15, and 16 of last year to review the implementation of that plan and to discuss with the Administrator and his staff their plans for the future. We had what I consider a productive exchange of viewpoints, but we were unable to arrive at certain conclusions because of the fact that at that time NOAA was still in the process of organization and "shakedown." And for that reason, several tentative plans were laid aside until we could have a further exchange of views on them. I am referring specifically to the question of oversight effectiveness and the problem of whether specific funding authorization legislation would be helpful to the administration or to the Congress or to both.

Since our meetings in 1971, several legislative enactments have placed new responsibilities on NOAA. Among these are the recent Marine Protection Research and Sanctuaries Act of 1972, involving comprehensive research responsibilities relative to the ocean dumping and the Coastal Zone Management Act of 1972, involving the implementation of a national program to assist the coastal States in the beneficial use, the effective management, protection, and development of the Nation's coastal zone. In addition, legislation has been enacted creating the National Advisory Committee on Oceans and Atmosphere charged with the responsibility for a continuing review of Federal marine and atmospheric affairs and an annual report to the President and to the Congress setting forth an overall assessment of those activities.

We are, therefore, pleased this morning to again hear from Dr. Robert M. White, the Administrator of the National Oceanic and Atmospheric Administration, accompanied by members of his staff. I trust that he and the other witnesses will be prepared to give us clear insight into the progress made during the last year, as well as an understanding of the problem areas which exist and of the plans to solve them.

I must admit that the timing of this particular hearing is somewhat unfortunate. I had intended to schedule this review at an earlier date while the Congress was still in session and while more members would be available to participate. However, I felt that it might be of major benefit to the subcommittee to review the annual report of the National Advisory Committee prior to, or simultaneous with, our discussions with NOAA. Because of factors which it is unnecessary to discuss here, we could not review the Advisory Committee report until yesterday

and, therefore, this meeting was necessarily delayed. Unfortunately, from the subcommittee viewpoint, the Advisory Committee felt that detailed comments on marine and atmospheric activities of NOAA and other agencies could best be handled in its second annual report. Therefore, the report which we discussed with the Advisory Committee yesterday did not serve the purpose in regard to NOAA programs that I had hoped it would. In any case, we are pleased to have with us as our first witness, Dr. Robert M. White, who I understand will give an overall review of NOAA's program and will then turn to three of his associates for more detailed discussion of specific program areas.

Those witnesses in addition to the Honorable Robert M. White, Administrator of NOAA are David H. Wallace, Associate Administrator for Marine Resources; Richard E. Hallgren, Associate Administrator, Environmental Monitoring and Prediction; and Donald F. Moore, Assistant Administrator for Environmental Modification.

Dr. White, we will be delighted to hear from you now, please.

I assume you and your associates will appear in the order in which I called them. Thank you very much, gentlemen.

STATEMENT OF ROBERT M. WHITE, ADMINISTRATOR, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DEPARTMENT OF COMMERCE

Mr. WHITE. Mr. Chairman and members of the subcommittee.

It is a pleasure for my colleagues and me to appear before you today to review the activities of the National Oceanic and Atmospheric Administration. Before I proceed, I would like to introduce Dr. John W. Townsend, our Associate Administrator, and Mr. James Brennan, NOAA's Deputy General Counsel. Mr. Howard Pollock, our Deputy Administrator, asks me to express his regrets at not being able to be present today because of a long-standing speaking engagement.

We have just passed NOAA's second anniversary which occurred on the 3d of October. In the formation of the National Oceanic and Atmospheric Administration, it was the hope that it would become a civil center of strength in ocean and atmospheric affairs in the Federal Government. This was the essence of the many recommendations of the President's Commission on Marine Science, Engineering and Resources in its 1968 report. I believe that this basic objective has been achieved.

It is particularly appropriate, Mr. Chairman, that you are conducting this review. To a large degree it has been your vision and leadership that has led to the growing realization of the national need for a vigorous ocean program. It was largely through your efforts that the Marine Resources and Engineering Development Act of 1966, which began the chain of events leading to the establishment of NOAA, was set in motion.

Two years is a substantial period of time. It is time enough for a Congress to complete its work. It is also time enough to make an appraisal of whether the National Oceanic and Atmospheric Administration has set a course which in time will meet the objectives established for it at the time of its formation. Nevertheless, in the life of a complex Federal agency, 2 years is still a relatively short period of time and it would be premature to expect the full attainment of the goals

originally envisioned for it. The presentation by my associates and myself will be in the nature of a progress report on our accomplishments.

With your permission, Mr. Chairman, we will submit for the record a more detailed summary.

(See appendix A for a more detailed summary.)

When we commenced life as an agency, the sum of our parts was then funded at the level of \$281.3 million in fiscal year 1971. Since then our programs have been actively supported by the President, and the Congress. In fiscal year 1973 our appropriation was approved at the level of \$396.9 million. This is an increase of 41 percent over our fiscal year 1971 level and an increase of almost \$126 million. While this increase may not have satisfied many who felt that ocean and atmosphere programs deserve better, it is a very large increase, exceeding most other Federal scientific and technical programs. It represents excellent progress. Such an increase in the vital financial resources available to NOAA to carry out programs is one of the concrete indications that NOAA is achieving the wherewithal to meet many of the aspirations we all hold for it.

The realization of those aspirations requires more than a working organization, and more than the necessary financial aid. This realization requires the necessary statutory basis to carry out our national oceanic and atmospheric policies. It is gratifying, therefore, to be able to report that, through the support of the President and the 92d Congress, NOAA, over the past 2 years, has been given key statutory authorities and responsibilities which will enable it to play the role originally envisioned for it with greater effectiveness. These new statutory authorities present NOAA with significant new challenges for the years ahead. I refer, of course, to the Coastal Zone Management Act of 1972, the Marine Protection, Research, and Sanctuaries Act of 1972, the Marine Mammal Protection Act of 1972, and the act to require reporting of weather modification activities.

It is against these generally favorable organizational, financial, and legislative developments that I would like to report on NOAA's accomplishments.

Two years ago we were confronted with the question of how to "bring it all together"—how to bring together the efforts of nine different Federal entities into a working whole. We found that the President's Commission on Marine Science, Engineering, and Resources Report provided us with the framework for defining three key missions of the organization into which all of the elements could readily fit. First, to explore, develop, and conserve the ocean's living and nonliving resources. Second, to establish a national environmental monitoring and prediction system, which could treat the environment as a unity. Third, to explore the possibilities and consequences of the modification of environmental processes, especially those of the weather.

These three missions could be readily carried out in conjunction with other Federal agencies within the existing statutory authorities of the separate groups which came together to form NOAA as a result of President Nixon's Reorganization Plan No. 4 of 1970. It was not possible, however, to discharge a fourth mission which the President's Commission identified as being of the highest priority—that

of coastal zone management. However, as a result of the action of the 92d Congress, this vital fourth mission has now been added to the other three. This new legislation, together with the marine mammal protection legislation, now places the National Oceanic and Atmospheric Administration squarely in the environmental management business. We look forward to this new challenge.

The issues surrounding environmental management cast in sharp relief the dilemmas which the Nation confronts in attempting to secure for its citizens the necessary conservation and protection of the environment and its resources, as well as the economic development that is so important for their well-being. One of the central points of philosophy which I have sought to impress upon NOAA's activities is the need to take a balanced view of this problem. We believe that emotionalism on either extreme does not well serve the goals of rational management of the Nation's environment and its resources. We hope that the National Oceanic and Atmospheric Administration can evolve as an agency within the Federal structure which can provide authoritative scientific and technical information as well as assessments of possible environmental consequences, so that those in a position to make public policy decisions can make them in the full light of the knowledge of the consequences of various courses of action.

Building a unified working organization is more, however, than a matter of defining missions, establishing a philosophy, or even securing financial resources. It requires taking decisions on the operations of various elements of the organization, and the interactions between those that will bring the varied and specialized talents of all of NOAA to bear upon its broad missions. It is not my intention here to go into a detailed description of how our organization works. Some examples of our progress toward integration of our activities can however illustrate what we have achieved. The basic integration process stems from our establishment of policy officers at the associate and assistant administrator level for each of our three broad missions. It has been possible by such organizational mechanisms to bring together the full talents of NOAA's major bureaus on key national problems. You will be hearing from these gentlemen later this morning and I will have them talk for themselves.

We have, in addition, taken other measures toward integration. For example, when NOAA was formed, we found ourselves with approximately 50 vessels of varying sizes, operated in different ways by different elements of the organization. We have now taken steps to establish a single NOAA fleet under single management of the National Ocean Survey so that we can get the most effective use out of our vessels and so that their maintenance and operation can be handled more efficiently and expeditiously. The NOAA fleet concept is now well along toward implementation.

Another example, is the NOAA Marine Advisory Service. Many organizational elements of NOAA actively engage in providing various marine advisory services. We have taken steps to establish a single NOAA-wide marine advisory service under the leadership of our Sea Grant Program Office. This service incorporates the capabilities of the universities as well as our in-house laboratories and facilities.

As one of the Nation's principal environmental agencies, we have been particularly conscious of our responsibilities under the National

Environmental Policy Act. To insure that NOAA is fully responsive, we have established an Office of Ecology and Environmental Conservation. Thus, for example, we have been able to bring the total capabilities of NOAA involving our fisheries, weather, oceanographic, and seismological competence to bear on the environmental impact assessment of the Alaska pipeline, the Four Corners power development, the possible leasing of offshore oil lands in the Atlantic, and the siting of nuclear powerplants. These are but a few of approximately 1,000 such requests for environmental impact assessments NOAA is called upon to participate in each year.

I could go on with other examples, but there will be sufficient to indicate how we are moving forward to insure that the unique spectrum of capabilities which we have brought together are efficiently managed and put in the service of our most important national needs.

To direct our marine resources program, we were successful in attracting to our organization, Mr. David Wallace, of the State of New York. Mr. Wallace will discuss this program in detail later this morning. I would like to comment on some of the strategy in action. Our strategy has been based on the fact that NOAA only possesses special authorities in the ocean resource field. While they are substantial in the area of marine fisheries, they are quite limited when it comes to the ocean's nonliving resources. We have asked ourselves where we can contribute most to achieve our national resource goals within our authorities. We have also sought to identify the core problems that need resolution so that we can apply the necessary effort to them, while insuring that short-term needs are not neglected. We have arrived at a mix of activities; some aimed at short-term objectives, and others at longer-term needs. For example, in our fisheries program, we have identified and are now devoting substantial effort to two major obstacles (both of a long-term nature) to development of a rational fisheries management system. One is the confusing state of present fisheries jurisdiction and the consequent management arrangements that flow from them. We have, with the cooperation of the States, set about developing a cooperative program of management of our Nation's fisheries by the States and Federal Government. The second is the long-standing need for accurate fish stock assessment. To attack this problem we have initiated our marine resources monitoring and prediction program.

Attacking such core problems is not sufficient. We have had to respond quickly on many occasions to immediate problems facing our Nation's fisheries. The mercury contamination problem is a good example. We initiated a program to address this threat by a systematic survey which has been measuring the presence of mercury and other heavy metals such as lead, cadmium, arsenic, and chromium, as well as PCB's and pesticides in fish. We have already sampled 95 percent of the important commercial species to date. This effort continues.

As I have indicated, the authority of NOAA to engage in nonliving resources activities is restricted. What we have sought to do is to identify a small number of high priority nonliving resource problems and have focused attention on them. Thus, for example, the growing pressures to develop the oil and gas resources of our continental shelves have led us to join with the Geological Survey of the Department of the Interior, to mount a systematic geophysical reconnaissance map-

ping program. Similarly, we recognized the fact that development of the hard mineral resources of the sea, whether they are inshore, such as sand and gravel, or in the deep ocean, as with manganese nodules, may very well be retarded unless the environmental impact of marine mining is known. We have, therefore, initiated a program to assess the environmental impact of sand and gravel dredging in inshore areas and are looking at the possible environmental effects of deep ocean mining of manganese nodules.

Our commitment to protection of the oceans and the environment is deep. We feel that we can contribute in a comprehensive way if we can provide the necessary technical and scientific information on the consequences of various ocean uses. To that end we have instituted our marine ecosystem analysis program specifically designed to assess man's impact upon the marine environment. This program will provide for a sequence of required studies. Our first such study will be in the New York Bight area where dumping of waste products is cause for general concern. If we are successful in this effort those who manage our coastal zones will have available to them comprehensive information on the types, effects, and distribution of pollutants, and the effects upon the biological and chemical condition of the ocean which is required for making management decisions on the use of these vital areas.

The Commission on Marine Science, Engineering, and Resources recognized that the national effort for the exploration, development, and protection of the oceans' environment and its resources would increasingly require the development and application of ocean technology as a key. I believe that we have made a start in formulating a series of programs which, over the course of the next decade, will prove indispensable for our effective use of the oceans. We have initiated a civil manned undersea science and technology program (MUST). Our present purpose is to explore the possible uses of existing industrial and university developed submersibles and habitats. This modest program has already demonstrated substantial values to placing man in the oceans. We have successfully used undersea vehicles to explore lobster populations of Maine, study pollution conditions off New Jersey, and investigate reef ecology off Florida.

Our data buoy experiment has provided research data on ocean and atmospheric conditions. Test buoys are now operating in the Gulf of Mexico and the Gulf of Alaska.

We continue to place great emphasis on the use of earth orbiting satellite systems for monitoring the oceans. NOAA's own environmental satellites are already providing us with global maps of sea surface temperature and critical information on ocean weather conditions. Next year we will launch NOAA's first operational synchronous satellite system which will give us a capability for interrogating remote platforms over the oceans and the land for critical environmental data. We have begun to examine the applicability of the new space data emanating from NASA's Earth Resources Technology Satellite. We are examining the potential of this satellite system for detecting ocean pollution, for locating schools of fish, for determining shoaling conditions. We are convinced space satellites will become key elements of our ocean monitoring and assessment system.

Technology development is more than just hardware. The development of the science and technology of mariculture is one of the areas we have identified as having great potential for the creation of new industries, new sources of employment, and new sources of supply for seafoods of high economic value. Through our national sea grant program, and our National Marine Fisheries Service, our research efforts have assisted in developing this fascinating new capability.

These are but some of the highlights of what we are attempting to do in our marine resources program. We now have additional tasks to undertake, tasks as I have already indicated just assigned to us in the past 2 months by new legislation. I should like to comment briefly on how we are organizing to discharge them. Passage of the new coastal zone management, marine mammal protection, and ocean dumping legislation signal new directions which NOAA will take. The new legislation confronts us with responsibilities that involve, not only our extensive capabilities in the science and technology of the oceans, but also social, economic, and legal aspects of ocean problems.

Fortunately, we are in a good position to move ahead. Even prior to this passage we have been conscious of the national needs expressed in these pieces of legislation, and have been devoting effort to them. For this reason I believe that we can move rapidly to implementation. For example, through the sea grant program, NOAA can draw on the large pool of talent and knowledge that is essential for the successful implementation of that act. Some 95 percent of the sea grant effort has been devoted to the study of the problems of the coastal zone for the past 5 years. It is not only our sea grant program that places us in a good position to move ahead rapidly, but also the work of our Fisheries Service, our Environmental Data Service, and our National Ocean Survey.

I am pleased to be able to report to you that we have already moved rapidly to establish an interim Office of Coastal Zone Management. We have reprogramed funds and personnel in the initial staffing of this office. We have made contact with States and associations representing various governmental groups. We are now in the process of preparing the preliminary guidelines that will be necessary to implement the legislation. We are off to a fast start.

Similarly, we have already taken a number of key steps in anticipation of the passage of the Marine Mammal Protection Act. We have reprogramed, as announced by Secretary Peterson, a quarter of a million dollars to step up our research to find effective ways of reducing the mortality of porpoises in connection with tuna fishing. In addition, Secretary Peterson has announced our intention to seek international agreement to set aside one of the Pribilof Islands so that we can examine the causes of the fluctuations of the Alaska fur seal population. We have taken a strong position in international forums on the restoration of depleted stocks of whales. Lastly, we believe that our marine ecosystems analysis program will be a key element in the discharge of our responsibilities under the Ocean Dumping Act.

We have made similar progress in the carrying out of our second basic mission—that of developing and operating systems to monitor and predict environmental conditions such as weather, ocean, earth, and solar hazards, so that through environmental information services

and hazards warnings, life and property can be protected and the efficiency of commercial, industrial, and agricultural activities improved.

Hurricane Agnes demonstrated in the starkest possible terms the vital nature of responsive and accurate environmental monitoring and prediction systems to protect life and property against the hazards of nature. In that storm, over \$3.5 billion of economic loss was recorded, the largest of any natural disaster in our history. NOAA was responsible for the weather and flood warnings. The performance of our organization was good. However, the situation demonstrated as nothing else could the need for a national system of coordinated observations, communication, and community preparedness. While we have made solid progress in all of these activities during the past 2 years, there is much to be done.

During the past 2 years, we have substantially extended our public communications systems. We have stepped up our continuous broadcasting of weather information over the NOAA radio system of very high frequency stations. The number of stations has increased from 18 to 65. We have extended our NOAA weather wire to bring hard copy information on a 24-hour basis to additional radio and TV stations and newspapers. We have successfully launched our new generation polar orbiting weather satellite system. The NOAA-II satellite was launched on October 15 and became operational on November 8. This is a powerful new tool for environmental monitoring and for the first time provides us with the ability to make worldwide vertical temperature soundings through the atmosphere as well as global sea-surface temperature maps. We have moved to establish a more comprehensive environmental monitoring and prediction system by establishing a new Office of Oceanography in the National Weather Service to spearhead a growing program of real time ocean observation and prediction which can be carried out in conjunction with our weather and river observation and prediction system.

Because of the essential and inherent international character of an environmental monitoring and prediction system, we continue to work closely with other nations in the development of the international system. In particular, we have made substantial progress in working with other nations within the context of the world weather program. I regard this as one of the most outstanding examples of international collaboration in any field. Another example of such international collaboration is represented by our joint participation with Canada in the International Field Year of the Great Lakes. This field year is the most comprehensive study of the circulation and water balance and pollution conditions of the Great Lakes ever undertaken.

As in the field of ocean resources, we believe one of the keys to the future is in the development of suitable technology. We have made good strides in the development of automatic weather stations, in the use of satellites, and in developing remote sensing techniques for atmospheric conditions by microwaves, acoustical, and optical procedures.

The pressures on us to provide more environmental monitoring and prediction services emanate from all segments of the economy. The growth of aviation, marine, and other modes of transportation which are sensitive to environmental conditions are placing increasing pressures on us for more observations and additional services. The pro-

tection and development of our natural resources, as, for example, in offshore areas or in the preservation of our forests, call for more precise and more comprehensive environmental support. The increasing needs of water management call for more extensive river and flood forecasts. Our space program and communications industries generate pressures for additional services on the upper atmosphere and solar conditions. It is difficult to keep up and we look to new technology to meet growing national needs.

Dr. Richard Hallgren, NOAA's Associate Administrator for Environmental Monitoring and Prediction, will discuss these matters more fully in his testimony.

While our third mission at the present time is by far the smallest, it is also one with good potential for growth and broad impact on society. I am satisfied that our progress in carrying it out is encouraging. There is no more exciting activity in NOAA than our program to explore the feasibility and, where warranted, to develop a national capability for beneficial modification of environmental conditions and to assess the consequences of inadvertent environmental modification. We are presently focusing our efforts in the rapidly evolving field of weather modification.

During the past Congress, action was taken to give NOAA the authority for insuring that all actions of U.S. citizens in carrying out weather modification activities in this country are systematically reported. I am pleased to be able to report that the regulations implementing this weather modification reporting statute have now been published in the Federal Register and the act is now fully effective.

Weather modification is an activity of growing importance to this Nation. Today our Nation has only primitive capabilities for modifying weather conditions under very specialized conditions. However, the work to date, both within our own organization and other organizations, gives reason to be encouraged about the future.

During the past 2 years we have made much progress on the scientific and technical front. Project Stormfury, directed at the modification of hurricanes, has achieved encouraging results. In hurricane Debbie 3 years ago, a substantial reduction of the maximum winds occurred in connection with our seeding. This result cannot be considered conclusive. Additional experiments on hurricanes are needed to verify these initial results. Nature, however, has not cooperated with us during the past 2 years in providing suitable candidate storms for seeding.

During the past 2 years we have moved to demonstrate the significant possibilities of increasing rainfall from tropical cumulus clouds, attempted to modify the storms of the Great Lakes regions, and sought ways to reduce lightning and hail.

The recent report of the National Advisory Committee for Oceans and Atmosphere has urged a much more vigorous effort in this field and especially the undertaking of a systematic experiment in the High Plains area of the United States to fully demonstrate the potential in this field. I am pleased to report that we are carefully studying the recommendations of NACOA.

When Mr. Moore talks about weather modifications, his testimony will give you further details of what we propose to do there.

Our concern with the inadvertent aspects of weather modification is just as deep. We believe that it is necessary to understand whether significant changes in global climate can result from man's pollution of the atmosphere. To this end, during the past 2 years we have moved, in collaboration with other nations, to establish a network of climate monitoring stations, and we have moved to acquire the necessary computer facilities which will enable us to assess the consequences of inadvertent modification of atmospheric conditions. I will leave the details of the discussion of this field to Mr. Donald Moore, our Assistant Administrator for Environmental Modification.

None of the activities on which I have commented can take place in isolation from similar activities of the other nations of the world. Many of our responsibilities transcend national boundaries. We have continued our extensive work in the many international fishery commissions on which we represent the United States and in the United Nations specialized agencies such as the World Meteorological Organization, the Food and Agricultural Organization, and the U.N. Educational Scientific and Cultural Organization.

During the past 2 years, however, we have reached a watershed in international relationships dealing with the environment and its resources. The United Nations Conference on Man and the Environment held in Stockholm this past June, is a landmark event in which the nations of the world joined to consider how, by international action, we can protect the earth's environment. The UN Conference on Law of the Sea reached its final preparatory stages and will most likely culminate in a Law of the Sea Conference during the coming year or shortly thereafter. The results of these conferences will set forth the rights, obligations and jurisdictions of the nations of the world with respect to all aspects of the oceans and the environment. In addition to these multilateral United Nations conferences, our government has moved vigorously in many ocean and environmental areas to secure increased international collaboration on a bilateral basis with such nations as France, the Soviet Union, Japan, and others.

We in NOAA regard a successful outcome of these international activities as being absolutely crucial to the successful formulation and implementation of our national policies. We have therefore taken a conscious decision to devote much effort to these activities.

A report on NOAA would not be complete without some discussion of the interaction of our organization with nongovernmental groups of an advisory or constituent nature as well as our interaction with other agencies of the Federal Government. NOAA is not an island. It is essential that we interact on a continuing basis with a host of groups outside of the Government who are affected by our activities. This is the only way a Federal agency can know whether it is being responsive to national needs. We interact continuously with industrial associations, conservation groups, associations representing Government and quasi-governmental entities, and so forth.

Of vital assistance to us are our advisory bodies. These are more formally constituted groups whose advice and comments we actively seek. Primary among these groups is the National Advisory Committee on Oceans and Atmosphere. While its principal function is oversight, it also provides a valuable function as an advisory committee. We are indebted to you, Mr. Chairman, and members of your committee for

your leadership in fostering the legislation creating this Presidential Committee. You heard yesterday from the chairman of that committee and hence, there is no need for me to summarize the recommendations or the activities of this group. Their able chairman, Dr. William Nierenberg, has already done so. However, I want to take this opportunity, Mr. Chairman, to tell you that we are giving their recommendations deep consideration, and hope to be able to report to them each year on our proposals for action on their recommendations.

In addition to the National Advisory Committee for Oceans and Atmosphere, there exist several other formally constituted advisory bodies assisting NOAA in a number of specialized areas. For example, the National Academy of Sciences and the National Academy of Engineering jointly review our scientific and engineering efforts, and recommend how they can be made more effective. The Secretary of Commerce has organized a National Marine Fisheries Advisory Committee to assist him in structuring our fisheries programs. Our sea grant program maintains its own advisory committee to advise on that program. It is my belief that through such advisory bodies, and through less formal but frequent contact with a wide variety of user and interest groups, we can maintain a responsive organization.

This committee is well aware of the great importance of insuring adequate coordination of the activities of the agencies of the Federal Government. Because of the nature of NOAA's activities there is hardly a major Federal agency with whom we do not interact. We participate in a large number of multilateral and bilateral interagency coordinating mechanisms. Among the principal multilateral interagency coordination mechanisms in which NOAA participates actively are the Interagency Committee for Marine Science and Engineering, of which I am chairman, and the Interagency Committee for Atmospheric Sciences, both bodies of the Federal Council for Science and Technology.

The Interagency Committee for Marine Science and Engineering has taken over the functions and responsibilities of the Marine Sciences Council. This body meets regularly at a policy level to conduct a systematic program review of all oceanic activities of the Federal agencies. Over 12 meetings have taken place during the past year. I feel that the Interagency Committee for Marine Science and Engineering has been an effective body. It does not have directive authority over any agency but through this mechanism we insure that the necessary information exchange on various agency programs is brought about. Through this mechanism we have been able to develop collaborative programs. Much the same can be said of all the work of the Interagency Committee for Atmospheric Sciences and the Federal Committee for Meteorological Services and Supporting Research.

Such multilateral bodies do not replace the need for specific bilateral coordinating mechanisms between NOAA and other agencies. This is especially true with those agencies with whom we interact very closely. Thus, for example, we have established a special coordinating mechanism between ourselves and the Geological Survey and between ourselves and the Office of the Assistant Secretary for Fish and Wildlife on matters of common concern. In our satellite programs we have established a meteorological satellite program review board with NASA which has been an effective means for making sure that our two agen-

cies are working closely together on meteorological satellite problems. The task of interagency coordination is a never-ending but a vital one.

In summary, Mr. Chairman, I believe that the record will show that the National Oceanic and Atmospheric Administration has made good progress during its first 2 years. This progress would not have been possible without the support of the President and the Congress.

On a personal note, I would like to thank the subcommittee and you, Mr. Chairman, for your often demonstrated confidence in NOAA and for the encouragement and support you have provided us. There is no doubt in my mind that our Nation is well on the way toward the kind of national oceanic and atmospheric program which it must have to meet the needs of its citizens. I will be most happy at this point to answer any questions you may have.

Mr. LENNON. We thank you, Dr. White. The Chair recognizes the distinguished gentleman from Massachusetts.

Mr. KEITH. Thank you, Mr. Chairman. Although it may have appeared that I was disrespectful because I did not pay attention to the words you were reading, it is because I read your statement last night. I appreciate your presenting testimony—yours and your staff—so that we could be more helpful in these discussions today.

I, as a retiring Congressman, would like to commend you and your staff for your devotion to duty. It was a great lift to the Nation, in my view, when we created the organizations of NOAA and NACOA. It has been a long struggle. I remember in 1962 when we first had some legislation establishing an organization devoted to somewhat the same end as yours and President Kennedy pocket vetoed it. This committee has been concerned. I think the end result was worth waiting for.

We have a report to the President and the Congress by NACOA. I think it would be helpful if you would explain your role as it relates to NACOA and as it might be reflected in this report to the President and the Congress. There are some rather startling observations in that report and some which appear to be a bit naive.

I would be interested to know if this is the product of discussions that took place between your agency and the Advisory Committee. Is it wholly their product that was conceived and published by them, without an intimate relationship with you during the writing process?

Mr. White. I would be glad to comment on that.

Our organization provides only administrative support to NACOA. We have no hand whatever in the preparation of the material that goes into the NACOA report. We do not review it. It is a totally independent and separate assessment by the members of the Committee on Ocean and Atmospheric Activities which they choose to look at.

The law setting up that body also provided that the report would be transmitted to the President and the Congress through the Secretary of Commerce so that he would have the opportunity to comment independently on the recommendations of the National Advisory Committee for Oceans and Atmosphere. In the transmittal of this material to the President and the Congress, the comments of the Secretary of Commerce were included. These comments are based upon discussions that our Department has with all the other departments of the Federal Government who are affected by the recommendations of NACOA. The Secretary of Commerce's comments are then based upon an assessment of the views throughout the Federal Government.

I think you will find that there are many instances here where the Secretary of Commerce has disagreed with the recommendations and findings of the National Advisory Committee of Oceans and Atmosphere. That was the purpose of that provision in the legislation, to be able to make available to the Congress at the same time both the views of NACOA and the views of the Secretary of Commerce, and in a sense the views of the administration. In this way it is possible to point out whether the administration and the Secretary differ or concur with the views of NACOA. The analysis of the Secretary of Commerce has been made available and does point out a number of cases where there is disagreement and other cases where there is full agreement.

Mr. KEITH. I think that the processes are perfectly logical and healthy as you described them. I haven't had a chance to review the comments of the Department of Commerce on the NACOA report so I won't pursue that any further except to say that I am sure that they will be enlightening and helpful to the Congress and to this committee in furthering legislative programs.

In the committee hearings on oversight in July of 1971, questions about the Stratton Commission report were raised. If I recall correctly, you offered to delineate the extent to which the recommendations of the Stratton Commission report, in light of the present policies, were appropriate for further consideration and action.

You said:

We have done a number of reviews of the Stratton Commission Report. Indeed, the organization form which I am proposing as discussed this morning and the program we are proposing conforms with the general recommendations. There are obviously many other recommendations that do not apply to the organization, so could we be given some time to prepare for this committee a rundown on how we are coming with regard to the various Stratton Commission recommendations that do apply to us.

Have you had a chance to make that rundown? Would it be helpful at this time to the committee and other interested parties that are here today if you were to delineate further the significance of the Stratton Commission report in your planning for next year's legislative program?

Mr. WHITE. I do not recall whether we submitted a formal document to this committee which outlines our response to the Stratton Commission recommendations.

The Stratton Commission report has been used as a guide for almost all the activities which we have undertaken in the organization. Of course, it is not possible to find an exact 1-to-1 correspondence between many recommendations of the Stratton report and what we have done. The circumstances in which we find ourselves after a number of years have passed is also different.

In broad outline, we believe that we are moving in the direction of the basic Stratton Commission recommendations. For example, one of the things that the Stratton Commission report pointed up in the fisheries area was the lack of suitable management systems for our fisheries. One of the programs that we have instituted in response to that is looking at developing better management systems.

The Stratton Commission report urged that we look at the development of technology. We have not obtained as much money as we would like to put in a number of technology areas, but we have moved ahead. For example, we have attempted to get an undersea science and tech-

nology program established. We have further pushed our buoy and our satellite efforts.

Mr. KEITH. I am not going to pursue it further. I think what the committee was asking at that time, in view of the changed climate—I do not mean weather modification, I mean in the passage of time—was, to what extent are there some national goals that might require further legislative action.

I think that your observation about the written responses might be of some assistance to the committee as a supplement to these hearings. It should be noted that we have done this with reference to the recommendations. Some, obviously by reason of the changed circumstances, we have eliminated. We feel that others still are appropriate. I think that would sort of tidy up the ends.

As you recall, we had to compromise in order to get this bill through.

You mentioned the fisheries. I think that in that field NACOA's comments sort of remind me of some of the bills that have been filed by legislators in an effort to highlight the problems of an industry and come up with solutions that would sound good to their constituencies, particularly if they were fisheries oriented. I would say in summary that they are rather impossible of accomplishment under present circumstances and are not realistic. Therefore, in a way, like the foreign aid to Latin America, rising expectations give rise to further frustrations. I haven't read your comments on those in general, but, it did seem to me, as one who represents a fisheries-oriented district, and as one who has proposed from time to time the kinds of things that are mentioned there, that there are certain things that cannot be done. Nevertheless, it still makes good reading.

We are interested in the comments from NACOA and from NOAA. Their realistic appraisals give us justification in our stance firmly in favor of, or opposed to, constituent interests that may reflect a very provincial point of view. I think it would be helpful, particularly to those who are interested in fisheries problems, if there could be some supplemental observations made at a later date in reference to the practicalities and realities of these fisheries solutions.

I do not know that this is the time for it, but I personally have been very frustrated in not doing more about the lobster fisheries. All of us like lobsters. It is a fishery that does lend itself to much closer coordination between the Federal Government and the State governments. As you know, Rhode Island has one law relating to the taking of lobsters and Maine another and Massachusetts a third.

It would be very helpful, I think, if you could play a lead role in that respect. I note that in Mr. Wallace's statement he talks about this management plan. Perhaps he will get into some detail. I am glad to know that progress is being made on it. I know there has been a Sea Grant Act allocation of funds—I believe it was a quarter of a million dollars—to the lobster hatchery run by John Hughes down in Martha's Vineyard. We have done so little as a nation in the lobster fishery. The lobster is such a delicacy, and is so much in demand that I would hope that we could have perhaps, not just these more general overviews given today, but a more detailed report as to the progress being made.

You mentioned the offshore mining, and the increased role of NOAA in the environmental aspects of it. Just to bring it right down to the

nitty-gritty, we have the Stallwagon Banks proposal which has many people on the cape and in Massachusetts very much concerned.

But to get to the real nitty-gritty, down in Fairhaven, for example, which has a good port—and customarily they have dredged it and have been using it as a dumping area for years—they have been unable to get environmental approval for the continued use of that dumping area. Meanwhile, the economy of an entire area is being threatened because the harbor is filled in.

It seems to me, that when the environmental agencies go contrary to an established practice, the burden of proof rests more fully with them than it would in the case of a new kind of operation. I just want to mention this in passing to acquaint you and others here with the hangups that we have at the local level. All of the new interests and the new authority sometimes disrupt operations which have been eminently successful and which may very well have contributed significantly to the efficiency of the fishery. The actual dumping and dredging process may be beneficial, in some instances, in that it stirs up the organisms on the ocean bed and may, on balance improve rather than harm the environment in the ocean or in the coastal zone. Finally—and I have many more questions, and perhaps more observations to make, but just to let you get on with other witnesses—I would like to ask if NOAA has taken any position with reference to the deepwater port. We are tremendously handicapped on the east coast by the lack of a deepwater port. There has been some discussion as to alternative methods. I guess this is the only question I really have for you that I would like your comment on at this time. Have you made any recommendations with reference to this? Has your advice and counsel been asked?

Mr. WHITE. Yes, Mr. Congressman. Let me answer the last question first. We have not taken a position on the deepwater port. There is a large deepwater port study underway, and we are participating in that deepwater port study especially on the environmental aspects. That study is in process and we are participating. As an organization, we have no position.

I would like to take the opportunity to comment on a few of your comments, sir.

Mr. KEITH. I would be happy to have you do so.

Mr. WHITE. You raised the question as to what kind of a legislative program is now implied as we compare the original Stratton Commission recommendations with where we stand today. I would just like to note that the action of the 92d Congress was very forceful in implementing many of the recommendations of the Stratton Commission report. Certainly the coastal zone management legislation, the establishment of the National Advisory Committee for Oceans and Atmosphere, and the ocean dumping legislation, were key steps in implementing many of the recommendations of the Stratton Commission report.

Furthermore I think that the policy established by the President with respect to the seabed resources and the law of the sea, although not the same as that of the Stratton Commission proposal closely parallels many of the aspects of the Stratton Commission proposal. I feel that a lot has been done legislatively to carry out the Commission's recommendations. I think the point you make is a very sound one. Time has now passed, and perhaps one of the tasks that ought

to be undertaken, perhaps by the National Advisory Committee for Oceans and Atmosphere, is to take a new look at where we stand today as contrasted to where we were at the Stratton Commission report time. We can then see where those recommendations are valid or whether new ones need to be made now. I think great progress has been made.

Mr. KEITH. I would concur in all that you have said.

Mr. WHITE. On the fisheries problem, you asked what kinds of legislation will be required. I think you will see certain proposals for legislation coming from the administration which will be very important in developing a State-Federal cooperative management effort in the near future. We are looking at that carefully, and I hope there can be some proposals coming forward.

I would leave to Mr. Wallace a detailed discussion of the State-Federal plan on lobsters but merely at this point in time indicate we have now commenced to work directly with 11 east coast States who have a major lobster fishery, to see whether we can work out, in a coordinated way, the necessary rules and regulations and management procedures that would be necessary to preserve that resource. I agree with you fully that this is a thing much to be desired, because it would be a sad, sad world were the world without the Maine and New England lobster.

Mr. KEITH. Without the Massachusetts and New England lobster?

Mr. WHITE. Without the Massachusetts and New England lobster.

Mr. KEITH. Mr. Kyros hasn't arrived yet.

Mr. WHITE. You commended on offshore mining. One of our concerns has been the environmental impact of dredging sand and gravel, for example, from our offshore areas. We have a dual concern. On the one hand, it is clear that sand and gravel are becoming increasingly economical to mine from offshore areas, as contrasted with taking them from land. Hence, there is a question of economic value in acquiring those offshore resources.

On the other hand, there is a question of what you would do to the environment, were you to do this, and what would be the impact on fisheries, on the biological characteristics of the ocean, or on the recreational values of the area. It is for this purpose that we have now joined formally with the State of Massachusetts in a joint project close to your area, Mr. Congressman, to look at the environmental impacts of doing this kind of thing. This is a very important kind of activity we must all engage in, to make sure we have the necessary facts as to what the consequences of various courses of action would be. We consider that a quite important project to undertake.

Mr. KEITH. I think it has been very helpful that you have made those observations which prove, as usual, your competency before this committee. Just to sum it up, I hope you won't go overboard with reference to this environmental thing as it relates to the positive nature of some of these smaller projects, where they customarily have dredged these harbors and for years used the same dumping grounds, and where there is no proof of any adverse effect and plenty of proof as to a beneficial effect. I think the burden of proof in these situations rests squarely on the environmental agencies.

I said I wouldn't take any more time, but there is one thing very dear to the hearts of all Members of Congress in a way. That is the

SST. I read recently that a new scientific commission had concluded that there was more possibility of a threat through the atmosphere than had been thought to be the case during the debate. I would point out that in debate on that issue we were only arguing for an experimental model. We were not arguing for approval of the whole project. In my view it was unfortunate that we turned it off.

As an agency to what extent are you knowledgeable and responsible about this kind of development?

Mr. WHITE. Mr. Congressman, we have been involved. I believe the report you may be referring to is a report which was sponsored by our organization. We asked the National Academy of Sciences, which established a panel under Dr. Herbert Friedman, to assess whether some of the scientific findings on the effects of the oxides of nitrogen on the ozone content of the upper atmosphere were sufficient to be a cause for concern.

What that report found was that there is sufficient uncertainty to make it important for us to find out. There is now going on under the sponsorship of the Department of Transportation, a major research project. I think it is funded to the extent of about \$20 million over a 3-year period. The project's specific purpose is to obtain the observational information, and make an assessment of the possible consequences. My own personal belief, Mr. Congressman, is that a few test vehicles would not under any circumstances have an adverse consequence. It only becomes a matter of some uncertainty when you get a large fleet.

Mr. KEITH. In this particularly problem area it is necessary, it seems to me, to work with other nations. You know, sometimes our legislative efforts involved foreign policy implications. Sometimes there are provincial interests saying that we shouldn't fly the plane because we don't have to, and other nations feel otherwise. I trust you are working closely with the international organizations and the other countries.

Mr. WHITE. Yes. I am very pleased to report to this committee that at the technical level we have been working with the French and the United Kingdom.

Mr. KEITH. How about the Soviets?

Mr. WHITE. I was in Moscow with Russell Train, Chairman of the Council on Environmental quality, negotiating a program of environmental cooperation agreed to by President Nixon and President Podgorny just 2 months ago. One of the items we discussed was the effect of the SST. The Soviets have agreed to look at the problem with us. We will be having a group from the Soviet Union coming here, indeed Dr. Townsend will be the chief scientist on our side for this activity. We have taken steps to get together with the Soviets. We hope to have them here soon to begin discussions on this problem.

Mr. KEITH. Thank you very much, Mr. Chairman. I appreciate your allowing me all this time.

Mr. LENNON. The gentleman from California, Mr. Leggett.

Mr. LEGGETT. Thank you very much, Mr. Chairman.

Dr. White and members of your staff, I want to compliment you on completion of a successful 2-year embryo program of this important agency for which many of us have had very extensive and ambitious hopes, for a great number of years.

Unfortunately, it is also the appropriate time to commend the two retiring members of this committee, Mr. Keith and Chairman Lennon, who have done so much to develop legislation, work with the staff, to coordinate with your agency on an oversight basis in bringing the current status of this hybrid new development to us. I would only hope, not being too nostalgic, that whoever replaces these important congressional overseers have a similar devotion to the important altruistic objectives of the agency in the direction in which we are currently pointed.

I am not exactly positive that when voids are left in Congress, in different oversight functions, in legislative functions, that they are always filled. I hope they will be in this case, but, of course, that remains to be seen.

I am impressed with the fact that your agency has made a material jump or a quantum jump in its budget over the past year. Hopefully, I would anticipate that your full \$396.9 million program for the current year will be spent. I guess you probably are not really precisely knowledgeable in that respect at the present time, but I think it is important that this particular area be one of the areas that absorbs, if we ever do develop what we call a peace dividend. I would hope that the peace dividend is absorbed rather healthfully in this agency, because I see rather massive prospects for a proper utilization of manpower, of research, of engineering and of many, many talents in this very provocative developmental area.

Let me ask you this: You have submitted, I presume, your budget for the 1974 fiscal year. You probably have some feedback which you can't give us, as to what may have happened to that at the OMB. Let me ask you this: We will ask you in January what budget request you made, and you will tell us. Can you tell us today what budget requests you have made? I know you can't tell us what you think may be approved, but as compared to \$396.9 million, would you say that the request you have made may be a quantum jump from that?

Mr. WHITE. I am not in a position, of course, at the present time to discuss the nature of our request. I can say, of course, that we have requested an increase in funding. We think it is a good increase. It has been directed at key programs that we think need additional support. What has happened to those requests is just not known at the present time. I really don't think I am at liberty to go beyond that kind of statement.

Mr. LEGGETT. I am not going to press you beyond that. I am pleased to know you have indicated you are going to ask for an increase. I think that is very important. I think that unless we have your leadership in pioneering in new areas, asking for perhaps new money that you might not be able to get, what happens is that you get checkmated right at the outset in the further expansion of the agency.

As an example, continuously we have found in the old days that when the Defense agencies submitted their full request to OSD, those requests for many years totaled \$120 billion, and OSD would then reduce those to below the \$80 billion or \$75 billion level, but at least OSD then got the input as to what the agency wanted, in what directions the Army, Navy, Air Force, and Marine Corps thought they needed to go. Later they figured out that they were better off in submitting

budgets more in line with what they were going to get, lest all of the discretion for modification be in a super agency.

I think it is important that we get a considerable amount of aggressiveness from agencies. If you tend to look to much at the outset at what the overall national deficit is, and become scared by that, and other agencies don't, then the agencies that squeak the most get the most grease. I would think we should be just as zealous in our ambitious undertakings with respect to exploration of the sea as we can. It would be my personal view that I think the space program is a good program, and it was my idea when we developed NOAA that it should have separate program magnitude budget and participation.

I was discouraged to find that from the organizing agency we merely took the bits and pieces of the existing agencies and funneled them into a superagency. Now we have new targets. Of course my colleague from Massachusetts has pointed up the needs of the lobster industry. You know we have a program out in California—unfortunately Mr. Keith has left—where we have done extensive studies of the sea grant program, in which we figured out that we can grow Maine lobsters in 72 degree California warm salt water, and they have the same texture, aroma, quality and capabilities of a Maine lobster. I think if we could reciprocate, and figure out how to grow California abalones in Maine, or in some kind of an artificial environment, there would be many of us from California who have to spend so many years in Washington who would be much more at ease as we perform our Federal functions. We can't export California abalone beyond the limits of the confines of the State due to State law. I think there is a fantastic industry that could be developed here.

As you know, we have actually grown in tanks in California better than 4,000 Maine lobsters. We had to kill them because we didn't have the capacity to bring them up to requirements. We have asked your agency for assistance. We have been given general assistance in developing a program, but the main reason we can't fully get into that is that we lack money. We are working with P.G. & E. because we think the nuclear towers, with their excess heat capacity, can be used in an integrated program of the oceans to bring water up to proper temperatures and make use of it in this very important area. I don't think that your agency, in my view, idealistically should be just a passive bystander when things like this go on or only be putting out a miniscule amount of funds to the State and local development agencies as they move in this area. I think you should really be a critical pioneer when ideas such as this are brought forward, and when some of the preliminary research is done at the local level, then I think this should be where your agency should really take critical and important leadership, and should be pressing the local research facilities and perhaps drawing other universities into these studies. If the idea is good for California, it ought to be good for many other areas of the country.

It is a fantastic source for all States for this what I guess should be called a miracle. I should think it would not only be called a miracle. I should think it would not only be good domestically but internationally. So much for that.

I was a little bit concerned about your indications that you feel you do not have adequate mission in the nonliving oceanic areas. Of

course we are going to be vitally concerned, in the next Congress, with, as you indicated, manganese nodules and the idea of licensing in different areas, if that comes about. I would like to ask you this: Do you think you need a further precise mission in this area? Are you prepared to submit the functions of your agency might be in this important area?

Mr. WHITE. I would like to make a comment on your statement on mariculture, and then answer the last question which is a very important one. I agree with you fully that one of the most exciting things now developing is in the field of mariculture. I think your comment is correct that we as an organization need to take a leadership role in this, in fostering things at the local level, making sure that the necessary basic work in genetics, in disease, and things such as these are done, and we are moving in this direction.

We are now reviewing all of our mariculture work in the organization. We have had a study commissioned by a citizen of your State, Mr. Charles Black, to make a complete review of all the possibilities and activities in the mariculture area and we are looking at the recommendations coming out of the study he has been making for us. I am hoping we can give much more positive direction and much more extensive assistance in this field because we regard it as one of very substantial potential for the country.

On the question of our authorities in the nonliving resources area, I was merely stating the fact that the statutory authorities that came into NOAA with respect to nonliving resources were limited. However, we have an enormous supporting role to play in the nonliving resources area, and we have quite a bit of authority to provide those supporting activities. Let me give you just a few examples.

One of the prime requirements or needs, as stated, for example, by the offshore oil industry, has been for environmental information. This is an area where we can support offshore nonliving resource development quite within our authorities. As another example, one of the things we are concerned about is the transport of oil from Valdez, Alaska, down to the west coast of the United States, and the need for a system for monitoring any possible oil spills that might result. We are looking at the necessary environmental support system. So there is a large area of very important activity dealing with the support of the national nonliving resources goals that we have adequate authority for.

When I say our authorities are restricted, I mean that the principal authority for dealing with the management of the ocean's nonliving resources comes under the Outer Continental Shelf Lands Act and comes under the Department of Interior. I am not proposing any shifts in that act. I believe that there is a need for us to work very closely with those responsible for the management and leasing of those mineral resources.

We have appeared at hearings before the Senate Interior Committee to delineate for them the kinds of things that we can do to help the progress toward our national offshore resource goals. My comment is not in the way of a complaint, but in the nature of a statement of fact.

To answer your question specifically, we haven't looked deeply at the additional authorities that we would want in the nonliving resource area.

Mr. LEGGETT. In the area beyond the Continental Shelf is there any conflict with any other agency? Do you think you have enough authority in the nonliving area?

Mr. WHITE. As you know, our national policy is that once you get out beyond the continental shelves this would be a region whose resources would be subject to an international regime. Presumably such a regime would be established pursuant to a seabed treaty that would come out of the Law of the Sea conference and would be in conformity with our national position. Hence you would not have the same kind of problem we have in the management of the resources within areas under our national jurisdiction. I don't see a real problem there at present.

Mr. LEGGETT. Of course space comes under international agreements too, but still we are able to explore space and to exert considerable dominance in that area. I would hope that we would do the same thing beyond the Continental Shelf. It is certainly not going to stop research and it is not going to stop certain kinds of exploration and such things.

Mr. WHITE. I misread you. I thought you were referring to the management of those resources. Yes, I would concur with you fully on that, that there is a big role, and I think we have the necessary authorities to pursue the role of exploration and research in the deep oceans, and we do have substantial programs along those lines, so I agree with you fully in that sense.

Mr. LEGGETT. Do you think you have adequate personnel in your existing agency to perform the functions assigned to you by Congress?

Mr. WHITE. Let me try to answer the question this way.

Mr. LEGGETT. Let the record show you have hesitated.

Mr. WHITE. I do think more people are necessary. I would make that judgment on the basis of independent and objective analyses of many of the functions which we discharge. A good example is in the disaster warning area, where the analyses of some of the disaster survey teams have shown that our system is very thin, in terms of the personnel available.

I think it would be fair to say that our personnel are stretched thinly in a number of the functional areas in which we operate.

Mr. LEGGETT. The President has indicated that he intends to propose a number of reorganizations. I suspect, from the zeal with which he has made that statement, that he would in fact effect some of these reorganizations whether or not Congress passes legislation. Has there been any indication so far as you know that you are able to relate to us of any reorganization that would affect your agency, perhaps moving it into another hybrid agency?

Mr. WHITE. I have not been involved in any of the discussions and deliberations that are now going on with regard to reorganization plans of the Government. We were heavily involved in the proposal of the President for the formation of the Department of Natural Resources which was before the last Congress, which would move the National Oceanic and Atmospheric Administration from the Department of Commerce to the new Department of Natural Resources. Those are the plans that I am presently familiar with, and I have no reason to believe that those plans have changed any.

Mr. LEGGETT. If they are moved into a Department of Natural Resources would EPA then remain as a separate agency?

Mr. WHITE. According to the plans presented to the last Congress, EPA was to remain as a separate, independent agency.

Mr. LEGGETT. To what extent does your agency conflict with EPA at the present time and to what extent do you cooperate?

Mr. WHITE. Both EPA and NOAA were brought into being by the same message of the President. One was Reorganization Plan No. 3, the other was Reorganization Plan No. 4, as part of the President's environmental package of that year.

In his message he stated the two agencies were going to have to work very closely together. We have been attempting to do so.

One of our problems is that both of the agencies are quite new, and both of the agencies are receiving new statutory authorities, and I think it would be fair to say that the full implications of the degree of overlap is not fully appreciated. For example, in the Federal Water Pollution Control Act, there are many provisions which are very similar to provisions in some of our statutes. I think there is an absolute necessity for these two agencies to get together and work this out.

Aside from the new statutes of both of these agencies, there is and has been a long-standing set of associations between EPA and ourselves.

For example, in the monitoring of pollution conditions, in the assessment of contaminants in the ocean and so forth, there is no question that this is a problem area that requires substantial attention on the part of both agencies and we are trying to devote time to that.

Mr. LEGGETT. We ran into a real debacle in California in the past couple of months. EPA, perhaps consulting with your agency, adopted certain rather high standards with respect to pollution in inland waters, and the local State agency, the regional water control agency for San Francisco Bay, adopted EPA standards which became effective immediately for all dredging that takes place in the bay. The indications are that were those standards implemented—and of course the Corps of Engineers felt they had an obligation to help implement the State adoption of Federal standards—the increase in dredging costs would escalate by 1,000 percent in 1 year. There was no budget whatsoever to take care of it. Of course, there was no real inclination on the part of the State to devote a very large portion of their revenue-sharing funds to that objective, and for a while there we had a small crisis which of course stopped dredging, and the State adopted the high standards. I told the courts really you have only two choices. You have either got to ignore the State standards until they are properly funded or else you have to stop commerce in San Francisco along the east coast because the alternative would be for the ships to be fighting for the center of an undredged channel which presents more of a threat to the environment than the existing condition. I would hope particularly in this dredging area we would move along simultaneously with our capacity to fund programs, and not set standards which are so high which obfuscate and complicate an integrated program from achieving some success.

Mr. WHITE. I am not familiar with the particular case you are referring to, sir, but it does illustrate the kind of dilemma that we face with this problem across the board.

Mr. LEGGETT. Indications are that this would cost something like \$2 billion additional annually, were these high standards implemented immediately. Of course, that would take a very, very large portion of the pollution funds which I guess were cut in half, according to this morning's newspaper, leaving virtually nothing for other kinds of activities. I want to thank you for giving the committee this much time. I do enjoy the opportunity to help review with you your performance of the last 2 years. I want to congratulate you again, particularly Howard Pollock, who helped originate the legislation and is our great friend. Again, Mr. Chairman, I want to congratulate you very simply but forcefully on overseeing a very excellent and productive agency. I yield back the balance of my time.

Mr. LENNON. I will yield to you at any time for that. The gentleman from Florida, Mr. Rogers.

Mr. ROGERS. Thank you, Mr. Chairman. I am sorry I was late, but I have looked through your statement, and am interested in the discussion. What amount of your budget would you say is actually going into research? Perhaps you could give us a breakdown for the record, because I believe the Chairman has a number of questions. We can get this for the record, and any areas that have been previously financed by the military that you have now assumed the responsibility for, and how the funding compares in the various areas that are under the responsibility of NOAA. It would be helpful for us to see that.

(The information follows:)

TOTAL APPROPRIATIONS AND RESEARCH ITEMS TRANSFERRED TO NOAA FROM DEPARTMENT OF DEFENSE AND DEPARTMENT OF TRANSPORTATION

[In thousands of dollars]

Appropriation	Appropriation history		
	1971	1972	1973
Salaries and expenses.....	\$152,441	\$183,067	\$205,026
Research, development, and facilities.....	88,758	108,215	144,721
Research and development (SFC).....	15	500	
Satellite operations.....	24,997	33,120	36,320
Pribilof Islands.....	2,774	2,914	3,232
Fish protective fund.....	60	61	61
Total, NOAA.....	269,045	327,877	389,360
Research items transferred from Department of Defense:			
Corps of Engineers:			
Lake survey.....	659	752	152
Great Lakes (IFYGL).....	582	2,389	3,360
Subtotal.....	1,241	3,141	4,112
Navy: National Oceanographic Instrumentation Center.....	1,808	2,072	2,214
Total, Department of Defense.....	3,049	5,213	6,326
Research items transferred from Department of Transportation:			
Coast Guard: Data buoy project.....	13,000	13,092	13,893
Total transfers.....	16,049	18,305	20,219

Mr. ROGERS. Your budget is what, \$200 million as I recall?

Mr. WHITE. \$396.9 million.

Mr. ROGERS. You did get an increase. Have you also increased responsibilities?

Mr. WHITE. The increased statutory responsibilities have come during this past Congress, Mr. Rogers. We will have to now seek the funds,

hopefully starting with a supplemental, to get some of the new legislation under way, and then going into the 1974 budget.

Mr. ROGERS. I have been impressed with what you have done in NOAA. I think it is moving along. I think we are not doing a sufficient job, but I think that is mainly because of budgetary problems. I think if we can give you the support I am sure you will be able to respond. I commend you for what you are doing in moving ahead. I have particularly been impressed with what you have done in the hurricane research area. I think that has been most impressive. Thank you very much, Mr. Chairman.

Mr. LENNON. Thank you, Mr. Rogers.

Dr. White, on page 7, you address yourself to the dilemma which the Nation confronts, "in attempting to secure for its citizens the necessary conservation and protection of the environment", and at the same time to balance this with "economic development that is so important for" the well-being of the citizen.

I want to commend you for your next sentence: "One of the central points of philosophy which I have sought to impress upon NOAA's activities is the need to take a balanced view of this problem. We believe that emotionalism on either extreme does not well serve the goals of rational management of the Nation's environment and its resources." Hopefully that will be the position that NOAA will continue to take. In some instances, this subcommittee, as well as the Fish and Wildlife Conservation Subcommittee, of the Merchant Marine and Fisheries Committee has found itself impaled on the horns of a dilemma, in trying to hammer out the National Environmental Policy Act, which came before this committee, while recognizing the necessity for continued economic development and the well-being of our citizenship, as you have expressed it here.

We sat here, I remember so vividly a few months ago, the Fish and Wildlife Conservation Subcommittee, of which I happen to be a member, considering legislation that would amend the National Environmental Policy Act that would permit interim licensing for some 13 nuclear powerplants that were scheduled to come on the line within the next 19 months. Affluence, intelligence, and articulate expression were all represented in opposition to this bill. Yet when I took the time to interrogate, asking, "Are you a family man?" "Yes?" "How many children." "Six." "Do you live in a single family home?" "Why of course." "By chance is that home heated by electricity?" "Why yes." "Is it cooled by electricity?" "Yes."

Then I went on down to the hair dryers and the electric toothbrushes. Yet they were adamantly opposed to the entire licensing of these nuclear plants to meet what was obviously the probability of a brown-out or black-out, but they were not willing to give up their conveniences. They didn't want to share those with anybody else.

I suggested to them that it would cost \$4.4 billion to construct these plants, which, after public hearings, had been permitted for construction by the Atomic Energy Commission, and that nobody had gone into court to try to restrain the issuance of the construction licenses.

I asked, "Who is going to pick up that tab? People bought the bonds in good faith for the power companies to have funds to build these plants. They have to be amortized and the interest has to be paid."

I asked them if they would be willing to have their present electricity rates increased 20 percent in order to amortize this, just closing down these plants, and never let them open. "Oh, no." That just shows what we are coming to. I am very grateful to you and I hope it will be the landmark of NOAA to take a fair, rational power position with regard to the necessity for the continued economic growth and welfare of our people. I understand and recognize the necessity of conservation and protection of the environment and I am much impressed with that. I hope that will be the goal of you, your associates and everyone in your department.

My distinguished friend from California asked you a very blunt question. He took it away from me. I want to quote and tell you what I intended to ask. I quote from the first sentence of paragraph 2, page 2, "The authority of NOAA to engage in nonliving resources activities is restricted."

I had already written the question down and I wanted a yes or no answer with an explanation. The question is: "Should it be restricted?" Inasmuch as you have already discussed the matter with your usual understandable and efficient ability, we won't get further involved with this, but it does give me a great deal of concern. Here is an agency charged with a statutory responsibility which has been substantially increased by reason of the enactment into law of the Marine Protection, Research, and Sanctuaries Act of 1972. The act was signed into law October 27, and under its provisions your agency is intricately involved in research and monitoring the oceans. That is what you are charged with under title II of the act.

I have often wondered if we are not going to have to come to some point in history where NOAA has the authority which Interior now has to issue licensing for offshore drilling or exploration or exploitation of oil, minerals, and everything else.

I am being brutally frank about this. I remember the fight that took place on the floor, and how it developed in this fight to try to retain what the Stratton Commission had that the responsibility for the implementation and responsibility for coastal zone management be put under NOAA. I understand the oil and gas companies of America. They have to work closely with the Department of the Interior because that is where they get their licenses, their permits to drill. Yet Members of Congress came up to me, after they passed through the teller line, voting the other way and said, "Al, I hated to vote against you, but I had people from the petroleum industry in my office telling me if we don't support the Department of the Interior's efforts to take away the coastal zone responsibility from NOAA, we will never get a permit to drill off the gulf coast, off the Pacific coast or anywhere else."

That ought not to be when we talk about industry. You know what that means by way of technical definition, but at some time the Congress is going to have to face that hard decision as to whether or not the Department of the Interior will continue to make the decisions. Yet you are charged with the responsibility of monitoring and keeping it clean, under the law, but yet some other agency has the real power. I just pass that on to you for whatever it may be worth in time.

Coming back to the suggestion of the gentleman from California as to your probable request for funding, under the Marine Protection, Research, and Sanctuary Act, the bill provides under title II for the responsibility of the Secretary of Commerce, relating to the ocean, which means that your agency in the Department of Commerce, within 6 months after the enactment into law of this act, must institute a comprehensive and continuing program of monitoring and research regarding the effects of dumping material in the ocean waters or other coastal waters, including the Great Lakes, and so forth and so on.

There is authorized for that particular research study for the first fiscal year after this act is enacted, and the next 2 fiscal years thereafter, "Such sums as may be necessary, but not to exceed \$6 million per annum." I express the hope, Doctor, and to your associates, that when you take your request for the funding, that you ask for a figure that would approximate what this committee thought was the necessary amount. The suggestion was that we keep it an open amount. I resisted that because I didn't want to take to the floor of the House open end funding. I don't think that is the thing to do, but I do hope that you will be successful in your first year for the administration of title II, I hope that you will request the amount that this committee in its judgment authorized, because it authorized what we thought was the minimum necessary for you to do what your responsibilities under this act are.

In title III here again we talk about the Secretary of Commerce—that is under title II, and here again under title III—Marine Sanctuaries, again it is the Secretary of Commerce. There again we authorize funding not to exceed \$10 million a year, even including the fiscal year in which this act is signed into law, which means you would be entitled to go to the Office of Management and Budget and request \$10 million for the balance of fiscal 1973. That is what title III says. I want to tell you, the Office of Management and Budget and subsequently the Appropriations Committee, that this committee took the very minimal amount that it thought it would need to provide the funds for your department to carry out the mandate of this act. I would appreciate your keeping that in mind and you can quote me because I know that is true.

When we come to the Coastal Zone Management Act, signed into law on October 27, we had a few problems to which I have just referred. There are substantial funds authorized in that act. I want to say, Doctor, that in this particular act, and I think my memory serves me correctly, that the figures in here, which are found under authorization appropriations section 315 of the act approximate the figures recommended by the Office of Management and Budget. The conferees of the House and Senate reduced the figures set by the Senate. I insisted upon that because I wanted your agency in the Department of Commerce going to the Office of Management and Budget to say this was the minimal amount that was agreed to. This was not the biggest amount approved by one of the two bodies of Congress. This was a minimal amount.

I think with these two acts alone, that you can, even if you are unsuccessful in raising your budget estimates for fiscal 1974 in the other areas in which you are now involved administratively, that these two will give you substantial help.

I am delighted that you have established an Office of Coastal Zone Management and I assume hopefully you were able to transfer funds in the interim. We were hopeful that there would be a supplemental before the Congress adjourned to take care to some degree the funding of these two acts but I recognize that that could not be done, since the two acts were not signed into law until after the Congress adjourned, as you well know.

I am also delighted that you have already started a dialog and a contact with the various States, cities, and counties, in trying to implement this program as quickly as you can. I am inclined to believe—I have read it and reread it a number of times—that the Commission report was one of the strongest and the most objective, helpful things we could do for some 80 million of our people who live in the coastal zone. Doctor, can you and your associates state what you think you can accomplish by, say, April or May of next year?

Mr. WHITE. Mr. Chairman, we are naturally optimistic and zealous in pursuit of the things we are charged with. We have been most active in trying to launch the coastal zone program. We have been inquired under the act so that we can base our budget requests on hard active contact with the States to try to find out from each individual State the readiness of each State to put up the matching funds required under the act so that we can base our budget requests on hard information that the States are prepared in various ways to go ahead. We enthusiastically look forward to the implementation of this act and in moving as fast as we can, sir.

Mr. LENNON. I want to say to you, sir, that some things have changed somewhat since the Congress adjourned, such as in its membership. I have had some reason to believe, and I can be perfectly frank in saying to some of my colleagues, that an agreement was worked out. I had to be involved in it, although I could not be bound by it because I won't be here next year.

(Discussion off the record.)

Mr. LENNON. I want to say to you in all candor that it is what NOAA does, the image it is able to create in its expediting its work that will impress upon the people of America the expertise, the knowledge and the know-how within NOAA. I think this is one of the most important things for which NOAA ever has had the implementation responsibility.

I commend you on what I think you are doing in this direction, but urge you all to do more and let the world know about it. You have to spread and advertise what you do. I think it is disgraceful that you have to do it, but unfortunately that is the only way you can convince the average American citizen to keep up with what is going on.

I can give you my affectionate farewell after counsel has asked some questions.

Mr. HEYWARD. Dr. White, I am going to try to be brief. There are some questions I would like to ask you to clarify for the record.

I flipped through your statement and some of the comments or questions I have are questions which have not been directly asked by members. On page 4 you talk about the level of funding.

For fiscal 1973 you say the appropriation was approved to the level of \$396.9 million.

In the current report, which is the successor of the annual report required on marine science activities, the total for Commerce in 1973 is something less than \$200 million. Since there are about \$19 million in that \$194 million for Maritime Administration activities, the difference, I would gather, between the \$175 million and the \$396.9 million concerns the activities of NOAA which are not directly tagged as "marine science."

Mr. WHITE. That is correct.

Mr. HEYWARD. What generally would those categories be? Would that be in weather modification?

Mr. WHITE. Weather modification would not be included. Some of the satellite work is not, but there is some satellite work being done. The Weather Service generally is not included. That is a very large part of the organization. Earth sciences activities are not included, nor seismology, either. So quite a large amount of NOAA's activities are not directly marine-related.

Mr. HEYWARD. In connection with the comments that both Mr. Leggett and the chairman have made concerning nonliving resources, would you agree that the result of your agency's activities in this field comes from the form of language in Reorganization Plan No. 4, which identifies certain programs as transferring to you which Interior was administering through a particular outfit, the Marine Mining Technology Center of the Bureau of Mines? Is there any doubt in your mind as to what came or should have come?

Mr. WHITE. Of course, I leave the detailed interpretations to the legal people. The authorities we deal with in the mineral resources area came to us from the Bureau of Mines. There were authorities in ESSA which became part of NOAA, which pertain to nonliving resources in indirect ways. I guess my comment mostly is directed toward the question of management of the nonliving resources, which is clearly assigned to Department of the Interior.

Mr. HEYWARD. I am sure this has caused problems in the minds of the subcommittee.

During the past year when we held hearings on the Deep Sea Resources Act, for instance, we asked some of the companies who were testifying in support of that bill as to how much contact work or coordination there had been with any of the Federal agencies. As I recall the answer, it was rather scarce—maybe by their own choice, I don't know. It seems to me that area is one in which somebody should be really taking the lead if we are to assist the industry. Never mind whether the administration or the Congress will support that bill in its present form. The question is, "Shouldn't we be assisting industry in ocean research for the identification and potential exploitation of the resources of the sea?"

Mr. WHITE. Yes. We have been working very closely with the NSIA, the National Security Industrial Association, and their Ocean Science and Technology Advisory Committee. We have asked them to assist us in looking at, for example, the kinds of help and support industry would need, within the authorities, we have in the marine minding area. Indeed, the program that we now have and are building through our Marine Minerals Technology Center in particular is designed to address those problems that are not being addressed elsewhere, and which industry and we see as possible obstacles toward the develop-

ment of an ocean mining capability. We are working very closely with industry on this.

Mr. HEYWARD. I think this is a problem, if there is one, that may be resolved with a Department of Natural Resources. I hope that any legislation or reorganization plan creating a Department of Natural Resources would be pretty specific in language identifying the legislative charter, so to speak, as to what the Department would be doing.

In connection with your comment on page 12, concerning heavy metals, and so forth, in fish, is there any valid baseline in this area to work from, or is a part of this concern merely discovery of something which had been present for a long time?

Mr. WHITE. This program will do several things: It will, for example provide baseline data for the first time. We are taking samples of various species all around our coast. This kind of thing has never been done with such comprehensiveness before.

With regard to mercury, it seems evident now, after much research, that while there are clearly areas where industrial pollution has caused high mercury content in certain areas, by and large it appears that most of the mercury in the ocean is natural. We judge this by going back and examining samples of fish which have been in museums 50 years. Examining their mercury content we find roughly the same levels of mercury as occur in fish today. Expert judgments—and I am not an expert in this area—indicate that in the ocean there may be as much as 10 percent that is manmade mercury, but most of it is natural.

Mr. HEYWARD. I am not suggesting, of course, that we shouldn't cut out the conditions that we legitimately can. What I am suggesting is that much of the publicity has ignored the fact that many of these things exist in their natural state and we cannot cure them merely by addressing ourselves to man's activities. We have to cure it by addressing ourselves to nature's activities, too.

Mr. WHITE. I think that is right; yes, sir.

Mr. HEYWARD. In connection with ocean mining, I would also like to comment that we did have testimony from Dr. Roels, I believe of Columbia University, in connection with ocean mining environmental research. He found in his research that the activities, at least in removal of nodules, might well be beneficial rather than deleterious to the ocean caused by the up-welling movement of materials from the ocean depths.

In connection with your statement on page 17, you referred to Sea Grant. Has not Sea Grant also supported mariculture, in a substantial way?

Mr. WHITE. Yes; that is the point of my statement.

Mr. HEYWARD. I am referring to coastal zone activities here. This is a part of the coastal zone problem you are talking about, is it?

Mr. WHITE. In analyzing the Sea Grant program, one will find that about 90 or 95 percent of its activities have been directed to a spectrum of problems, all of which reside in the coastal zones.

Mr. HEYWARD. A large part of it has been in support of mariculture?

Mr. WHITE. Over \$4 million, I believe, of Sea Grant funds are directed toward mariculture activities which, of course, take place principally in the coastal zone areas.

Mr. HEYWARD. There is one statement on page 19 that I read which confused me. You said Secretary Peterson has announced our inten-

tion to seek an international agreement to set aside one of the Pribilof Islands for a certain purpose. That sort of startled me. I did not know we needed an international agreement. I gather what you mean is we want an agreement for the international management of the seals on the Pribilofs?

Mr. WHITE. The International Fur Seal Treaty was originally agreed to among the four nations in 1911.

Mr. HEYWARD. This is a change in the present international agreement, then.

Mr. WHITE. The treaty provides for the harvesting of the seal herds at a maximum sustainable yield. Anything you do which changes that provision of the treaty has to be by international agreement. Therefore, if we set aside one of the islands which contains 30 percent of the herd, for research purposes, it has to be done by international agreement. We will seek such an agreement at the next meeting.

Mr. HEYWARD. I am glad I asked the question. In other words, you are saying, in effect, that an amendment to the present international agreement is in order.

Mr. WHITE. Yes, not a formal amendment but an agreement within its provisions.

Mr. HEYWARD. In connection with your discussion on the advisory committee, I notice that you refer to an Advisory Committee on Fisheries and an Advisory Committee on the Sea Grant program. The Congress has now given you an Advisory Committee on Coastal Zones and National Advisory Committee on Oceans and Atmosphere.

Mr. WHITE. There is also one on marine mammals.

Mr. HEYWARD. Is there no way that you could combine some of these individual advisory committees instead of having so many different ones?

Would you consider that, so that we do not have to try to keep up with as many committees as you have?

Mr. WHITE. I must admit at times it is difficult to keep up. A good fraction of my time and my staff's time is spent on this.

Mr. HEYWARD. I would suggest that the National Advisory Committee on Oceans and Atmosphere and its relationship with you might in some way work this type of thing out.

Mr. WHITE. We have had discussions with them with regard to the total advisory apparatus. These specialized advisory committees are absolutely essential if you are going to penetrate any of the programs in depth. If you really want to get an evaluation of how the Sea Grant program is doing and how it is allocating its funds and as to whether or not it is meeting its responsibilities under the statute, and so forth, you have to be able to devote a considerable amount of time to it and penetrate it in depth. That is true in fisheries, too.

You need specialized bodies, if they are really to provide you with the advice you can use.

Mr. HEYWARD. In connection with international activities, last year when you were here with us you furnished us with a copy of the organization chart. I had drawn, maybe improperly, from some of the statements that there may have been some changes in the chart which you then were working with. Could you furnish us an up-to-date organization chart with the identification of the personnel?

In addition to that, would you explain the international affairs focus? Does your Office of International Affairs coordinate all these different activities in which you are involved, in fisheries, oceanographic research, and meteorology, and the rest of them?

Mr. WHITE. We have a central focus for our international affairs in an Office of International Affairs for all of our international activities. They have to be coordinated.

Mr. HEYWARD. Thank you very much.
(The organization chart faces this page.)

Mr. LENNON. Mr. Sharood.

Mr. SHAROOD. Thank you, Mr. Chairman.

Mr. White, I have noticed in a recent issue of your NOAA publication a breakdown of the fiscal year 1973 budget with a caveat to the effect that there may be impoundment of some of the appropriations. Has that come about?

Mr. WHITE. No decisions on that have yet been made.

Mr. SHAROOD. Would you furnish the committee, at such time as any impoundment may occur, a report detailing what funds, if any, are in fact impounded and in what areas.

Mr. WHITE. I would be glad to do that.

Mr. SHAROOD. With respect to the porpoise problem—I am not sure whether it was your statement or one of the other statements—which mentioned a \$250,000 figure for work on the problem of accidental porpoise taking during tuna fishing. The Marine Mammal Protection Act authorizes \$1 million a year for research on this problem and then an additional \$2.5 million a year generally for research grants dealing with marine mammals including porpoises. Is this \$250,000 all that you intend to spend in fiscal year 1973?

Mr. WHITE. No. That was money that has been reprogramed out of fiscal 1972 funds to get an early start on looking at various aspects of the problems, such as improved net design, getting going, improved fishing tactics and the training of the captains on special backing down procedures to reduce mortality. We wanted to move as fast as we could.

Mr. SHAROOD. You envision a larger effort than just this \$250,000 in fiscal year 1973, do you?

Mr. WHITE. Yes. We commissioned a study by a panel consisting of scientists from our own laboratories and outside scientists as to what kind of a research program would be required to deal with the porpoise mortality program. They are recommending substantial funding as being necessary. We will seek much increased funding for that.

Mr. SHAROOD. With respect to the mass of the new legislation that has been enacted during the 92d Congress straining your organization, such as the coastal zone and marine mammal programs, it occurs to me that there is always a possibility, as with the case of the Coast Guard, that this upsurge of new responsibilities, may tend to shove aside the more traditional and less glamorous functions in the effort to really get going on the new programs. In the Coast Guard's case, its basic search and rescue activities, and perhaps others, may be downgraded in this fashion.

There are a number of people outside of your agency who are rumoring that basic ocean related programs perhaps are not receiving the degree of emphasis that they should. Yesterday, the NACOA people were here and, in his statement, Dr. Nierenberg reiterated that he felt that basic ocean science was in good shape. But he mentioned two specific areas that he felt perhaps we should look at again and make sure we are keeping up. In a dialog with Congressman Rogers they discussed at length the relative state of Soviet oceanography. Dr. Nierenberg indicated that with the instrumentation equipment they have in their pipeline it looked as though they may be at the point of rapidly surpassing the United States technologically. Where do you stand in terms of basic ocean science? What part of your effort is still directed to this area? It is very hard, in reading a budget and reading an appro-

priation statute, to really get a clear picture of where the emphasis in the agency lies.

Mr. WHITE. First, I agree with you that there is always the danger that new responsibilities will take so much of the time of the organization that you might tend to neglect other aspects of the organization. We are aware of that danger and we intend to guard against it.

On the question of ocean science, I think the assessment—I was not here yesterday at your hearings—of Dr. Nierenberg on the growth of Soviet science is correct. Incidentally, we will have a delegation of Soviet oceanographers here starting Thursday of this week as part of the exchange Dr. Nierenberg was on to the Soviet Union. I think it is fair to say that the Soviets are progressing well.

As to ocean science in NCAA, we do it in many ways. If you want to talk about basic science in oceanography, there is always the difficulty of definition. We do not have a large program in basic science. We do have a substantial program in the applied area. For example, the whole sea grant effort is directed to applied science and technology in the oceans.

The question is, whether there is a need for more—It is a hard question to answer. Scientists always are telling me of new things that they would like to do and of the important problems that they would like to attack.

We know that there are fundamental problems. Fish genetics is one. If we are to make progress in aquaculture we are going to have to know more. We have to know much more about the fate of pollutants in the ocean. That requires a great deal more effort in oceanography.

My assessment is that, while ocean science is in reasonable shape today, looking at it from the national science support point of view and our point of view, I do not think there is cause for complacency. I think there are many problems that need additional work and could use additional funding. I do think that we must keep our eye on the progress being made by the Soviets, by the Japanese and the French too, as they move ahead. Understanding the ocean and its processes and resources is, after all, the ultimate key to being able to use the oceans profitably and is the ultimate key in being able to negotiate with other nations.

Mr. SHAROOD. Your answer is helpful, although I am not entirely certain that it is specific enough to really answer anybody's concern. However I realize it is difficult for you to be more specific now.

Passing from that, there is one other point I would like to cover. One of the provisions of the ocean dumping legislation, title III, authorized the creation of marine sanctuaries. This provision was not supported by the administration. The Interior Department viewed this as somewhat of a threat to their offshore drilling activities, particularly off the Atlantic coast. In the House, some effort was made on the floor to broaden this particular section of the bill to prohibit offshore drilling. The committee resisted that effort and the amendment was defeated. I think the committee's purpose was to create a vehicle which would permit the study and possible designation of areas that are to be set aside—at least to the extent that activities in those areas would be closely regulated, regulated more closely than is the case now where there is a general permit application for offshore exploration. We know that an outright ban would endanger passage of the bill.

There is a requirement in this section that in November of each year, the Secretary of Commerce report to Congress with regard to his efforts to establish marine sanctuaries. This perhaps puts a bit of a monkey on the Commerce Secretary's back because, on the one hand, he is heavily involved in our efforts to solve the so-called energy crisis and, on the other hand, he is being told that he should look at areas off our coast for potential protection.

Has your agency had an opportunity as yet to study this section of the act with a view toward implementation in any way? It is clearly permissive. There is no mandate here that the Secretary in fact designate any area as a marine sanctuary. Yet there is a clear burden that he look into it.

Mr. WHITE. Yes; we have studied that section of the act. We are giving it serious consideration. We haven't made any final decisions as to what we will do on this yet. It is a very difficult problem. It is a section of the act that is permissive. We are in the process of looking at it.

Mr. SHAROOD. Thank you very much, Mr. Chairman.

Mr. LENNON. Congressman KYROS.

Mr. KYROS. Thank you, Mr. Chairman.

I have only one question because so much has been covered.

On page 14 of your prepared statement, you indicate that, among other things, NOAA has used successfully undersea vehicles to explore lobster populations of Maine. It is my understanding that some kind of a study about the management of the lobster fish is being made by NOAA. What precisely are you doing?

Mr. WHITE. We have been using undersea vehicles off the coast of Maine to study techniques of estimating herring populations. In connection with some of the dives, we have found lobster populations where one would not expect them to be found; for example, in muddy benthic areas. This new, useful information might not have been discovered had we not used as submersible.

The question of lobster management is one of the problems we have identified in connection with our studies of fisheries management. For fisheries in general we have a rather confusing state of overlapping jurisdictions, and different regulations as between the States and between the States and the Federal Government. Fish, of course, are no respecter of political boundaries of any kind. If you are going to manage them intelligently you have to manage them by species. You have to get the political entities together who have the jurisdictional responsibilities.

One of the species we have identified that requires attention is the northern lobster. With the assistance of the States we have appointed a technical committee, which met at Milford, Conn. This committee came up with a series of recommendations on what the States can do to make their management systems consistent. We have also established a policy committee, consisting of the fisheries directors of the 11 Eastern States who are concerned with lobsters, to examine the proposals of the technical committee. These proposals have essentially been adopted by the policy committee. There are some questions that remain unanswered at the present time. For example, one of the recommendations has been that the Federal Government take steps to declare the lobster a creature of the Continental Shelf.

There are many difficult questions involved here. Does it biologically qualify to be a creature of the shelf under the terms of the 1958 Geneva Convention, for example?

We are now studying that kind of question. We will be getting back together with the States, and hopefully by joint action we can bring that species under some kind of management system, in which the rules and regulations up and down the east coast are consistent in such a way that we can preserve and maintain stocks. This is not an easy task, as you realize. There are all sorts of views on how to go. We are not expecting the process to be easy, but we do believe that unless we start this process sometime we are never going to get from here to there. We are in the middle of that process now.

Mr. KYROS. Before this, the Bureau of Commercial Fisheries had done some research on lobsters; I believe it was on the relationship between the deep-sea and inshore lobster.

Mr. WHITE. Yes, and we are continuing research on lobster populations now under its new title, National Marine and Fishery Service.

Mr. KYROS. So you are just going to be a research advisory group to the various States, that is all?

Mr. WHITE. I am sorry?

Mr. KYROS. You are going to be a research and advisory group on the American lobster to the several coastal States concerned?

Mr. WHITE. The management will be the responsibility of the States. There are certain things we ultimately hope we can do in generating a management plan for a particular species. I hope that eventually we can arrive at a point where the funding and implementation of a management plan, involving both State and Federal jurisdictions, can be brought together. Hopefully, funding for carrying out such a management plan could be a cooperative activity between the States and the Federal Government, so that we can begin finally to deal with these animals as species to be managed. In this way we can protect them and we can have a continuing industry, as well as a continuing recreational activity. We have seen too many stocks depleted because of inadequate management.

Mr. KYROS. Thank you, Mr. Chairman.

Mr. LENNON. Doctor, when I had the privilege of reading your statement this morning prior to the convening of the subcommittee, I was interested in the comment you made on page 27:

We have continued our extensive work in the many international fishery commissions on which we represent the United States and in the United Nations specialized agencies such as the World Meteorological Organization, the Food and Agricultural Organization and the UN Educational Scientific and Cultural Organization.

When I read that I was reminded of the fact that back in 1969, to be exact on March 20, 1969, when the now distinguished Vice President was the Chairman of the National Marine Council on Marine Resources and Engineering Development, I had the privilege of writing him a letter, telling him about the hearings of the Subcommittee on Fisheries and Wildlife Conservation, and how we had gotten involved and heard a great deal of testimony on the question of fish protein concentrate. One of the problems was, of course, that in spite of the fact that even at that time we were in the process of sending to Chile, under general foreign assistance aid \$900,000 worth of fish protein

concentrate, here in the United States we couldn't distribute it because the Food and Drug Administration wouldn't permit more than 1 pound to be packaged at a time. I told him that we had been able to convince the then Commissioner of the Food and Drug Administration that he ought to waive the 1-pound package limitation and restriction that the Food and Drug Administration had put on fish concentrate, and the Vice President responded in a very, very gracious letter dated April 10, 1969.

A few days later I read in the Washington paper that President Nixon seeks \$1 billion in hunger aid, with an assertion that "Hunger in America and abroad is embarrassing and intolerable."

I wrote the President a letter on May 8, 1969, about this problem and called his attention to the fact that we were then authorizing funds for construction of a pilot plant. Incidentally, we got into this thing on account of the Bureau of Commercial Fisheries. They are the ones that asked the subcommittee—of which I am the ranking majority member—Fish and Wildlife Conservation, to get into this thing.

I wrote the President and he very graciously responded, on May 15. I didn't get any more information about it, so on April 21, 1971, I wrote the distinguished Secretary of Commerce, inasmuch as by that time the Bureau of Commercial Fisheries had moved to his jurisdiction.

The Special Assistant to the Secretary, Hon. Sol. Mosher responded in the absence of Secretary Stans, and Secretary Stans responded on June 29, a very interesting letter.

As you may recall, again on April 13 this year I wrote you:

Dr. Ezra Levin sent me a copy of his April 7, 1972 letter to you about the FPC operations at the Aberdeen pilot plant.

I am interested in your response to the questions Dr. Levin has raised in addition to future plans for the Aberdeen Plant, the overall accomplishments of the pilot plant operation and any actions currently underway by your office to remove the one-pound packaging restrictions on FPC.

We had gotten a commitment from the Commissioner of the Food and Drug Administration that he would be willing to waive the packaging limitation requirements if the Government would get into this program. You then wrote me a very fine letter on May 1, 1972. I am going to put all of this, the whole thing into the record of this hearing. In your last paragraph on page 2 you state:

With regard to the 1-pound package restriction on FPC, members of my staff have been assisting the National Fish Meal and Oil Association in drafting a petition to FDA to remove the restrictions. This petition was filed by FDA in the Federal Register on March 18, 1972, and we will do all we can to assure its favorable consideration.

I haven't been able to follow up on it, Doctor. You wrote me on May 1 of this year with reference to this.

Mr. WHITE. Mr. Chairman, with your permission Mr. Wallace is here with me and has the details of what is now transpiring between ourselves and the FDA. I would like to have him answer the question.

Mr. LENNON. I was thinking about the amount of tax dollars that we have put into pilot plants. As to the plant that I referred to in my letter to the President, \$300,000 was expended for the design and construction of the plant. I believe that OMB withheld \$675,000 of public funds and that an additional \$900,000 is needed to complete

the plant. I want you to furnish for the record the amount of money the taxpayers have allocated for this plant since 1969.

(The information may be found on p. 236.)

Mr. WALLACE. Mr. Chairman, this matter of the removal of the 1-pound restriction imposed by the Food and Drug Administration has led to a series of continuing meetings and discussions between NOAA and the Food and Drug Administration.

Mr. LENNON. And they still deny it.

Mr. WALLACE. I don't know about that.

Mr. LENNON. I do. The Commissioner of the Food and Drug Administration sat right where you are sitting and said, "We will remove the 1-pound restriction if we can get the Federal Government to get involved in the packaging, processing, and making available of this fish protein concentrate," which everybody admits nutritionally is about the finest thing that could happen. Go ahead.

Mr. WALLACE. Within the past 6 months there has been a formal petition presented to the Food and Drug Administration by the Fish Meal & Oil Association, with whom our people worked intimately to organize the appropriate material to present the case. This has now been in the Food and Drug Administration's hands for a period of several months. I personally have met with the Deputy Administrator of FDA during that time, emphasizing the critical importance that we felt was involved in this particular issue.

At this moment, we still do not have the final answer; and I must say that I can't tell what their decision will be.

Mr. LENNON. Let me ask you this, sir. Since I wrote the Vice President, in his capacity as Chairman of the Marine Science Council and he wrote back in just 2 or 3 days saying, "We are getting ready to start to begin to commence," we have sort of drifted along. At that time I called to his attention the fact that we had just sent to Chile \$900,000 worth of fish protein concentrate through foreign aid under the Public Assistance Act. We export to the nations of the world where they have nutrition problems, and we don't put the restriction on it that it be packaged in packages of 1 pound. Is that so? Just yes or no and then you may explain it. You know more about this than I do.

Mr. WALLACE. I think you are correct, sir.

Mr. LENNON. Yet at the same time the manufacturers have just told us flatly they cannot produce it, manufacture it and sell it economically when they are restricted to a 1-pound package. We have put in all this money, and God knows it has been a good investment with the amount of nutrition for the hungry people of the world, but the President says in his statement—if you want to see the paper I will furnish it to you—"Hunger in America is embarrassing and intolerable," and we have to do something about it. We have to find the answer to the nutritional problems of our people. He said that back in 1969. I can't see why this can't be challenged in the Federal courts. If we can manufacture here at the expense of the taxpayers fish concentrate which is recognized by the great nutritionists of the world as being important to the people around the world, why can't our people get it? The average citizen today unless he can buy it economically in a package that is more than 1 pound, the companies can't do it. Do you know whether any group is opposed to changing the 1-pound pack-

age limitation? I am sure you have kept up with these things and you know all the answers.

Mr. WALLACE. Not to my knowledge.

Mr. LENNON. What is the objection to it by the Food and Drug Administration, when the Chairman assured us here that the Federal Government if it moved into this program that they would waive it. He made that statement in 1968, the then Chairman. Of course there is now another Chairman. I wish, gentlemen, inasmuch as the Bureau of Commercial Fisheries came to the Subcommittee on Fish and Wildlife Conservation and asked us to have these hearings and promote this product and we went ahead and pushed it, is the Congress at fault, or is it the Bureau of Commercial Fisheries? The Bureau of Commercial Fisheries is in your department today. I don't know how they feel about it today. I do understand that you have gone from the east coast to the west coast with menhaden for this pilot plant, transported inland in box cars. I have heard casually that it didn't turn out as well, that you didn't produce as much concentrate out of these pounds of menhaden as you did with the Pacific fish. What is the white fish out there?

Mr. WALLACE. It is the hake.

Mr. LENNON. Do you catch a lot of hake out there?

Mr. WALLACE. Yes, we do.

Mr. LENNON. Gentlemen, won't you look into this. People ask us why do we spend all this money and send it all over the world. We don't know how to answer it. We pull out our old files. This is what brought it to my attention. You said here, Doctor, you work so closely with Food and Agricultural Organization of the United Nations, and you are doing a fine job. I understand you are still shipping FPC all over the world. That is all right to feed the hungry of the world. I have no objections to that. I know of people in the South who would like this, but they won't package it.

Mr. WALLACE. Mr. Chairman, I think there are a couple of things that ought to be brought out for the record which are pertinent to this discussion. One of them is that the pilot plant operation at Aberdeen, Wash., did progress in a very substantial way to determine the process and the techniques that should be used to produce the kind of product that would be safe. There were some questions that the Food and Drug Administration had raised in the earlier processes regarding certain chemicals which might be left in the product as a result of the industrial treatment.

We feel that this has been overcome as far as the lean fish are concerned. The question of the fatty fish, such as the menhaden, are slightly different, and we feel that these require some additional study. One of the things that has happened is that the authorization for this particular activity expired as of June 30 this year. There were hearings held by Mr. Dingell prior to that time, and as a result of these hearings, the Congress did not act to extend the authorization.

The need for extended authorization was to complete the process on the fatty fish, such as the menhaden. So, in effect, this aspect of the pilot plant study has not been completed.

However, we do have the facts in terms of the lean fish, and these are available. I might say all of this information has been made available to the Food and Drug Administration.

Mr. LENNON. I can understand how the funding would expire. Looking at the file from 1969, I wrote the now Vice President who at the time was Chairman of the Marine Science Council, calling his attention to the fact that there was a plant in New Bedford, Mass., that qualified but they couldn't do it economically, being restricted to sales in the amount of 1 pound. I think this is germane inasmuch as the Bureau of Commercial Fisheries when in the Department of the Interior came to this committee or the full committee and made this request. We got into it. Right or wrong if the determination is made scientifically that this ought not to be, that our people in this country should not get the benefit and we are making it available to other nations at our expense, I think we ought to come out and say so. "You ought not to have it. If you can't make it in this way you are not entitled to it." With the welfare cases today, the food stamps that are involved, with our nutrition problems, I think it is a real challenge. If there is no objection I am going to ask unanimous consent to put this correspondence in the file in the sequence in which it was exchanged.

(The information follows:)

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., March 20, 1969.

HON. SPIRO T. AGNEW,
The Vice President,
The White House,
Washington, D.C.

DEAR MR. VICE PRESIDENT: The Subcommittee on Fisheries and Wildlife Conservation of the House Committee on Merchant Marine and Fisheries conducted hearings on Fish Protein Concentrate (FPC) last summer at the request of the Bureau of Commercial Fisheries for the need of additional funding to construct a research pilot plant to develop new and less expensive processes for producing FPC.

For years, we have been told how FPC can be used to fight hunger and malnutrition throughout the world. At this time, we are in the process of sending \$900,000 worth of FPC to fight malnutrition in Chile. However, here in the United States, FPC cannot effectively be used to combat malnutrition because Food and Drug Administration regulations require that FPC be marketed in one-pound packages or less.

Testimony developed before our Subcommittee revealed that Dr. James L. Goddard, the then Commissioner of the Food and Drug Administration, had indicated a willingness to waive the one-pound packaging restriction on FPC if the food additive were used in a Government sponsored program to combat malnutrition.

Like you, I am keenly interested in the fight against hunger and malnutrition in this country. We now have a plant in New Bedford, Massachusetts, that can produce FPC that will meet the quality standards of the Food and Drug Administration. This product could be used here to help alleviate the malnutrition we are told exists in our country.

Several federal agencies would be involved in any developed feeding program using FPC as a food additive. It seems to me that you, as Chairman of the National Marine Council on Marine Resources and Engineering Development, could best coordinate and further such a worthwhile program.

I will be glad to assist and cooperate with you in this proposed program.

With kind regards,

Most sincerely,

ALTON LENNON.

THE VICE PRESIDENT,
Washington D.C. April 10, 1969.

HON. ALTON LENNON,
House of Representatives,
Washington, D.C.

DEAR MR. LENNON: Your letter of March 20 expressing your interest in the fish protein concentrate program is greatly appreciated. The contribution of food from the sea—and particularly FPC—in combating malnutrition at home and abroad is high on the agenda of the National Council on Marine Resources and Engineering Development.

The Marine Sciences Council is reviewing the entire FPC program, including the one-pound packaging restriction on the sale of FPC in the United States. I therefore have asked Dr. Edward Wenk, Jr., the Council's Executive Secretary, to keep you informed of developments.

May I take this occasion to say how much I appreciate how your interest and support in marine science affairs has contributed to progress so far, and that I look forward to talking with you personally about future advances.

Sincerely,

SPIRO T. AGNEW.

MAY 8, 1969.

THE PRESIDENT,
The White House,
Washington, D.C.

DEAR MR. PRESIDENT: Like you, I am keenly interested in the fight against hunger and malnutrition in this country. As a member of the Merchant Marine and Fisheries Committee, I have been most interested in the development of fish protein concentrate (FPC) as a food additive in the fight against malnutrition.

As you know, FPC is still in its formative state and last year Congress authorized funds for the construction of a pilot plant on the West Coast. The sum of \$300,000 is being expended for the design and construction plans of this facility, and the Bureau of the Budget is holding \$675,000 of the project funds in reserve pending an additional \$900,000 to complete the plant. This last item is not in your Budget.

Our national needs are varied and great, I realize, but I simply wanted to call your attention to the possibilities of using FPC in the fight against malnutrition both here and throughout the world. Perhaps this resource could also become a part of your proposed fight to combat hunger and malnutrition.

With kind regards.

Most sincerely,

ALTON LENNON.

THE WHITE HOUSE,
Washington, May 15, 1969.

HON. ALTON LENNON,
House of Representatives,
Washington, D.C.

DEAR MR. LENNON: Thank you for your May 8 letter to the President concerning hunger and malnutrition. We appreciate having your suggestion to use fish protein concentrate as a food additive and your comments are now receiving careful consideration.

With cordial regard.

Sincerely,

WILLIAM E. TIMMONS,
Deputy Assistant to the President.

APRIL 21, 1971.

HON. MAURICE H. STANS,
The Secretary of Commerce,
Department of Commerce, Washington, D.C.

DEAR MR. SECRETARY: In a recent press release from the Department of Commerce, I noted that the Fish Protein Concentrate Pilot Plant has been dedicated in the state of Washington. I believe the establishment of this plant to be a significant step toward the development of an FPC program in this country to combat protein deficiency.

This program has been of interest to me and others of my Subcommittee for many years for its potential service to the malnourished of this and other countries. You know of this problem of which I speak, for in your travels, I know you have met this specter first hand.

The specific reason for writing you, Mr. Secretary, is that under present FDA regulations, FPC is not permitted to be used as a commercial food additive and is restricted for sale in one-pound packages. If a meaningful program using FPC is to be developed in this country, the one-pound packaging restrictions must be removed with accompanying publicity which demonstrates the absolute purity and protein nourishing qualities of this product.

You would agree, I know, of the importance to move such a program forward. For this reason, I am requesting that you personally inquire of Secretary Richardson if the one-pound packaging restrictions on FPC can be removed.

A cooperative effort between FDA, Commerce, and the Department of Agriculture to implement an FPC program to combat protein malnourishment in this country would be, in my opinion, a genuine service to our citizens.

Most sincerely,

ALTON LENNON.

U.S. DEPARTMENT OF COMMERCE,
OFFICE OF THE SECRETARY,
Washington, D.C., April 23, 1971.

Hon. ALTON LENNON,
House of Representatives,
Washington, D.C.

DEAR MR. LENNON: In the absence of Secretary Stans who is presently out of the country on official business, this is to acknowledge your letter of April 21, 1971, concerning the one-pound packaging restrictions on fish protein concentrate.

We will be glad to give you a further response on this matter as soon as possible.

Sincerely,

SOL MOSHER,
Special Assistant to the Secretary.

THE SECRETARY OF COMMERCE,
Washington, D.C.

Hon. ALTON LENNON,
House of Representatives,
Washington, D.C.

DEAR MR. LENNON: I greatly appreciate the interest shown by you and members of your committee concerning the present regulations on fish protein concentrate (FPC), and agree that the present situation seriously inhibits the practical application of FPC as a protein supplement. We are working with the Food and Drug Administration to determine if the present packaging restrictions can be revised.

In addition, we are presently exploring with the Department of Agriculture the possibility of a cooperative program to use FPC as a protein supplement. As a result of this program and the various industry research and development activities which are being generated as a result of the Experiment and Demonstration Plant, we are hopeful that we may develop a constructive course of action to overcome protein malnutrition in the United States and other countries.

We will keep you advised of our progress.

Sincerely,

MAURICE H. STANS,
Secretary of Commerce.

APRIL 13, 1972.

Dr. ROBERT M. WHITE,
Administrator, U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Washington, D.C.

DEAR DR. WHITE: Dr. Ezra Levin sent me a copy of his April 7, 1972 letter to you about the FPC operations at the Aberdeen pilot plant.

I am interested in your response to the questions Dr. Levin has raised in addition to future plans for the Aberdeen Plant, the overall accomplishments of the

pilot plant operation and any actions currently underway by your office to remove the one-pound packaging restrictions on FPC.

Your assistance in this matter will be appreciated.

Most sincerely,

ALTON LENNON.

U.S. DEPARTMENT OF COMMERCE,
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION,
Washington, D.C., May 1, 1972.

Hon. ALTON LENNON,
House of Representatives,
Washington, D.C.

DEAR MR. LENNON: This is in reply to your letter of April 13, 1972, pertaining to the fish protein concentrate program (FPC) and a related inquiry from Mr. Ezra Levin. I have enclosed a copy of my response to Mr. Levin's letter of April 7. Since this is the third such inquiry from Mr. Levin pertaining to highly technical and complex aspects of the FPC program, you will see I have repeated my earlier suggestion that a meeting be arranged to answer all his questions directly and clarify any misunderstandings that may exist. I am convinced that this is the only way to resolve this situation.

Regarding our future plans for the Aberdeen plant, as you are aware we have asked for an extension of the Act (PL 89-701, as amended) to enable us to complete the program and all the original objectives of the Act. Because we have experienced some key problems in the plant during operations with menhaden and anchovy, our present plans are to shut the plant down at the end of the current fiscal year, resolve these problems in the laboratory, and then make what modifications to the plant are necessary before recommencing plant operations. For this reason it will be necessary to delay any further plant operations until the summer of 1973, during the fishing season when adequate supplies of fish would be available.

We have, however, experienced considerable success and gained much insight into the FPC process as a result of plant operations to date. Over 2,000 tons of Pacific hake have been processed and 45 tons of product have been produced meeting FDA specifications for FPC. Also, we have held meetings with industry to discuss the results of our efforts to date, provided them with various reports, and plan to make FPC from the plant available to both the public and private sectors shortly.

With regard to the 1-pound package restriction on FPC, members of my staff have been assisting the National Fish Meal and Oil Association in drafting a petition to FDA to remove the restrictions. This petition was filed by FDA in the *Federal Register* on March 18, 1972, and we will do all we can to assure its favorable consideration.

Sincerely,

ROBERT M. WHITE,
Administrator.

MR. LENNON. Mr. Sharood.

MR. SHAROOD. Thank you, Mr. Chairman.

Congressman Mailliard has been interested in the problem of making fish protein concentrate available as a food supplement for a number of years. In 1969, he contacted the Secretary of Health, Education, and Welfare in an effort to have the Food and Drug Administration lift the 1-pound bag restriction on its own motion. Unfortunately, neither the Department nor the Food and Drug Administration responded favorably, taking the view that there must be a petition filed in order to initiate a reevaluation of this restriction. In fact, the FDA's own regulations permit review of its food additive regulations on its own motion. This illustrates the low level of concern that seems to prevail in the Food and Drug Administration regarding malnutrition and the need to adopt vigorous measures to upgrade child nutrition. Not only in foreign countries is this an acute problem, but we have it right here in the United States. With your permission, I would

like to insert in the record the exchange of correspondence which occurred between Congressman Mailliard and the Department of Health, Education, and Welfare.

Mr. LENNON. Without objection, so ordered.

(The information follows:)

DECEMBER 17, 1969.

HON. ROBERT H. FINCH,
Secretary, Department of Health, Education, and Welfare,
Washington, D.C.

DEAR BOB: The American people and their elected representatives in Congress long have been aware of the poverty and hunger which exists throughout the world. The fact that the peoples of almost all under-developed nations suffer severe nutritional deficiencies has been documented and reported upon to such an extent that it hardly bears repeating. There has been perhaps an excess of discussion and a shortage of imaginative action.

We have attempted to respond to this worldwide crisis in a number of ways involving both private assistance and federal programs. Vast quantities of surplus agricultural commodities have been shipped abroad since World War II to alleviate emergency as well as chronic shortages abroad. Notwithstanding these efforts, however, the worldwide hunger crisis appears to be deepening.

The simple fact of the matter is that from an economic standpoint the United States is not capable of augmenting the diet of the world population ad infinitum, even at the relatively low level of the past twenty-five years.

One factor which tends to nullify our efforts is the basic problem of transporting and distributing within the recipient countries large volumes of bulk commodities. Additionally, a substantial portion of each dollar appropriated by the federal government for the disposal of surplus food commodities abroad is absorbed by the costs of transportation, both within the United States and by ship to the recipient country. Our aid programs have recognized to a degree this problem, and we have attempted to introduce modern farm technology in many of the aid recipient countries. However, climatic conditions, low levels of education, and many cultural factors tend to inhibit the introduction of American farm technology abroad.

Although I do not profess to be expert on this subject, all that I read tends to indicate that a lack of protein is common, and in many instances critical to the diet of the typical citizen throughout Latin America and Asia with few exceptions.

Until very recently, most Americans, including myself, assumed that this was a problem to be coped with in conjunction with the developing nations, but one which had little relevance to the United States. The evidence amassed and documented by the Senate Select Committee on Nutrition and Human Needs has proven, however, that severe dietary deficiencies, if not outright hunger, is widespread in many sections of the United States. The impact of severe dietary deficiency upon the brain and subsequent intellectual development of small children has received considerable attention during the past several years.

The worldwide population explosion and the inability of our agricultural aid programs to significantly affect the degree of hunger in the developing nations, coupled with our awareness of hunger in the United States, makes it imperative that the United States seek new methods of attacking the problem of inadequate diet.

Since time immemorial, man has been aware of the incredible resources of the oceans, and certain nations have traditionally relied upon these resources as a substantial component of their diet. Articles are constantly being written and statements being made to the effect that the world's fish resources, if exploited sufficiently, could arrest this chronic state of hunger. Unfortunately, it is no easier to introduce fish into the diet of people who are not accustomed to it than it is to augment the rice diet with surplus grains. Almost ten years ago, however, attention was focused upon the possibility of reducing fish to a concentrated high-protein powder which could be added to traditional foods that are inherently low in protein and which are the basis of many national diets.

So-called fish meal or fish flour had already become a substantial industry as an adjunct to the poultry and livestock industries. Research in the United States led to the development of processes for the manufacture of what came to be known as fish protein concentrate fit for human consumption. The Bureau of Commercial Fisheries of the Department of the Interior filed a petition with

the Food and Drug Administration in 1966 for approval of fish protein concentrate as a food additive. In February 1967, the FDA issued a regulation approving the use of fish protein concentrate, which was hailed by many as the beginning of a new era in our quest for a solution to low protein diet.

Fish protein concentrate has the advantage of being colorless and, when added to other basic foods at the proper rate, completely tasteless. The natural resistance to adoption of unfamiliar foods is thus overcome. It was felt, for example, that FPC could be added to the tortilla on which most of the Latin American population subsists. Recent developments indicate that rice may be treated with FPC to increase the protein level throughout Southeast Asia. Since FPC is a concentrated food additive yielding over 80% protein, its introduction will not entail the transportation and distribution problems encountered in the surplus grain programs.

The volume production of FPC in the United States will undoubtedly stimulate the growth of a comparable industry in the developing nations, most of which have access to fish resources. The United States must, however, assume a leadership role.

The interest of Congress was aroused, and the House Merchant Marine Committee initiated hearings which led to the enactment in November 1966 of legislation authorizing the construction of an experimental demonstration plant for the production of FPC to refine the techniques involved and to propagate the technological know-how. Since the enactment of that legislation, the Department of Interior has continued its research and has refined the process to the point where commercial production of FPC is undoubtedly feasible.

The Food and Drug Administration, however, attached a number of restrictions to its 1966 food additive regulation, which effectively forestall any possibility of introducing FPC in the United States as well as abroad. The FDA stipulated that fish protein concentrate for human consumption could only be manufactured from hake or species of fish similar to hake.

Additionally, the FDA prescribed that fish protein concentrate could only be sold in 1-lb. packages for home consumption. It was immediately apparent that the 1-lb. bag restriction and the requirement that it could only be sold for home consumption effectively eliminated any possibility of commercial production of FPC for the American market. The rationale behind this restriction was apparently based upon the fact that FPC is manufactured from the whole fish, and the Food and Drug Administration was concerned that there would be public reaction to the inclusion of an additive which was derived from the viscera and other portions of fish.

In line with this concern, it was felt that FPC should only be marketed as a separate commodity which the housewife could add to her food if she chose to do so. The Food and Drug Administration apparently was influenced in this decision by the objections of certain agricultural interests which viewed FPC as a threat to their welfare and raised the specter of public reaction.

The restriction on the type of fish from which fish protein concentrate could be processed did not immediately appear to be a significant problem. The supply of hake, however, in recent years has been drastically depleted. Although this fish is not consumed in the United States, it is caught by the Russian fishing fleet, among the others, off the east coast of the United States. In this regard, the Bureau of Commercial Fisheries has petitioned the FDA to expand the list of fish species from which fish protein concentrate may be derived. It is my understanding that laboratory studies of the Bureau of Commercial Fisheries have progressed to the point where the technical objections of the FDA to use of other than hake have been satisfied. The 1-lb. bag restriction and the requirement of sale for home consumption only remains to be resolved.

In response to inquiries from my staff, the Food and Drug Administration has stated that there is no petition pending before the Administration to remove these restrictions. The Food and Drug Act and the regulations of the FDA, however, permit that agency to undertake on its own motion a review of its regulations.

The efforts of the Bureau of Commercial Fisheries and private firms engaged in this field have brought us to the point where we can look forward to substantially alleviating the protein deficiency that exists both in the United States and elsewhere in the world. The arbitrary restrictions on the commercial use of fish protein concentrate, however, must be resolved before the food industry of the United States can be expected to invest the capital necessary to produce FPC in quantity. Although these restrictions do not apply to the sale of FPC abroad, they have inhibited the efforts of industry to attract investment capital.

There is a disinclination on the part of the banking community to enter a field which cannot serve the domestic market.

I do not propose to suggest what safeguards the Food and Drug Administration should adopt to insure that food products containing FPC are adequately labeled. I believe, however, that the urgency of the situation warrants immediate action by the FDA to undertake the necessary hearings on its own motion in the public interest to amend its regulations. Only by such action will commercial production of FPC for the benefit of those who are caught in the vicious cycle of poverty and hunger both here and abroad become a reality.

With best wishes to you and your family for the coming holiday season.

Sincerely,

WILLIAM S. MAILLIARD,
Member of Congress.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
OFFICE OF THE SECRETARY,
Washington, D.C., December 22, 1969.

HON. WILLIAM S. MAILLIARD,
House of Representatives,
Washington, D.C.

DEAR MR. MAILLIARD: The Secretary has received your December 17 letter concerning the labeling of food products containing FPC.

A reply will be forwarded to you as soon as possible.

Sincerely,

JERRY W. POOLE,
Deputy Assistant Secretary
for Congressional Liaison.

FEBRUARY 19, 1970.

HON. ROBERT H. FINCH,
Secretary, Department of Health, Education and Welfare, 330 Independence
Avenue SW., Washington, D.C.

DEAR BOB: On December 17, 1969, I wrote to you to urge that the Food and Drug Administration undertake on its own motion to amend its regulations which currently provide that Fish Protein Concentrate may be sold in the United States only in one-pound bags. My request was prompted by information I received indicating that this restriction, as a practical matter, precludes the introduction of FPC as a food supplement in the United States.

From a standpoint of commercial processing, the one-pound bag limitation renders the use of Fish Protein Concentrate an economic impossibility.

The President's recent conference on the problem of hunger in the United States highlighted the fact that so many of our poorer citizens are not able to secure a balanced diet. Lack of protein is one of the principal dietary deficiencies. While this problem is serious in the United States, it is critical in many other parts of the world.

The inability to sell Fish Protein Concentrate in bulk within the United States for use as an additive not only renders the process uneconomical from a cost standpoint but also greatly hinders the FPC industry in its attempts to attract adequate capital to develop the industry.

I am enclosing for your information a copy of a recent article from the *New York Times* which describes the joint efforts of a Swedish concern and the National Biscuit Company in the field of FPC. As indicated in the article, the National Biscuit Company has no plans to produce FPC for use in the United States because of the Food and Drug Administration limitations.

Failure of the FDA to remedy this situation will further compound the problem of overcoming dietary deficiency in the United States. It is inconceivable to me that an American firm must go abroad in order to develop Fish Protein Concentrate for the benefit of the world, and cannot apply the fruits of this technology within its own country.

I realize that you have many pressing issues of national concern occupying your time. I do believe, however, that the benefits of FPC warrant the prompt attention of the Food and Drug Administration, and I again urge you to see that Fish Protein Concentrate industry in the United States.

Sincerely,

WILLIAM S. MAILLIARD,
Member of Congress.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
OFFICE OF THE SECRETARY,
Washington, D.C. March 4, 1970.

HON. WILLIAM S. MAILLIARD,
House of Representatives,
Washington, D.C.

DEAR MR. MAILLIARD: The Secretary has received your February 19 letter concerning Fish Protein Concentrate.

A reply will be forwarded to you as soon as possible.

Sincerely,

JERRY W. POOLE,
Deputy Assistant Secretary
for Congressional Liaison.

APRIL 3, 1970.

Mr. JERRY W. POOLE,
Deputy Assistant Secretary for Congressional Liaison, Department of Health,
Education, and Welfare, Office of the Secretary, Washington, D.C.

DEAR MR. POOLE: Since I have had no reply to my letter of December 17, 1969, to Secretary Finch except your acknowledgment of December 22, 1969, your identical response to my letter of February 19, 1970, does not fill me with enthusiasm.

I assume that the Food and Drug Administration has been made aware of my interest in this matter, and that someone is considering the issues raised in my letters. Perhaps someone in your department can furnish me a statement setting forth your present position on Fish Protein Concentrate restrictions.

It has now been four months, and I do believe that more than an acknowledgment is in order by this time.

Sincerely,

WILLIAM S. MAILLIARD,
Member of Congress.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
OFFICE OF THE SECRETARY,
Washington, D.C., April 10, 1970.

HON. WILLIAM S. MAILLIARD,
House of Representatives,
Washington, D.C.

DEAR MR. MAILLIARD: Jerry Poole has asked me to respond to your letter of April 3 in which you express a lack of enthusiasm at the response which you have been given to your letters of December 17 and February 19 concerning the Department's position on Fish Protein Concentrate restrictions. Let me say I share your lack of enthusiasm for this delay in a positive response.

I am personally following this matter and will attempt to get you a substantive answer at the earliest possible date.

Best regards.

Sincerely,

DONALD A. MELBYE,
Special Assistant, Congressional Liaison.

THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE,
Washington, D.C., April 10, 1970.

HON. WILLIAM S. MAILLIARD,
House of Representatives,
Washington, D.C.

DEAR BILL: This is in further reply to your letter of December 17, 1969, and to your followup of February 19, 1970, concerning whole fish protein concentrate.

The proposal to preclear this new food substance met with objections from individuals who questioned the suitability of a food derived from whole fish without the removal of heads, fins, tails, viscera, and intestinal contents. To assure that individual consumers have free choice in deciding whether to use this source of protein in their diet, the regulation as promulgated by the Food and

Drug Administration provides for domestic distribution only for household use in packages weighing one pound or less.

Additionally, since the additive contains a relatively high level of fluoride, its use was confined to controlled conditions within the household to insure that safe levels of fluoride would be ingested if the label directions are followed. This consideration is particularly important for children up to eight years of age in which it has been demonstrated that disfiguring tooth mottling may occur as a result of excessive dietary fluoride intake.

The FDA does not have data establishing that the food additive can be safely used commercially outside the controlled conditions in a household or data demonstrating that bulk sales of the fish concentrate for use as an additive by food processors will not be deceptive to the consumer. In the absence of such data, the law would not permit the amendment of the food additive regulations for these uses either on petition or upon the initiative of the FDA. Furthermore, Congress has not provided FDA with funds for the extensive investigation required to obtain the needed information.

The FDA will continue to give prompt and careful consideration to proposals by interested parties to expand the authorized uses for whole fish protein concentrate. We would interpose no objection to fabricated foods supplemented with whole fish protein concentrate under a Government-sponsored program of feeding the poor or underprivileged in this country provided adequate safeguards are included to protect against excessive fluorides.

Sincerely,

BOB FINCH,
Secretary.

U.S. HOUSE OF REPRESENTATIVES,
COMMITTEE ON MERCHANT MARINE AND FISHERIES,
Washington, D.C., August 21, 1970.

To: Committee on Merchant Marine and Fisheries.
From: Richard N. Sharood, Minority Counsel.
Subject: Fish Protein Concentrate.

Recent newspaper articles have described the efforts of the National Biscuit Company in conjunction with a Swedish firm, Astra Nutrition, to develop fish protein concentrate on a commercial basis for distribution within the United States and abroad. These firms have established a joint subsidiary known as Nabisco Astra Nutrition Development Corporation. Nabisco Astra will employ the eviscerated fish rather than whole fish for the manufacture of fish protein concentrate and will therefore not be subject to the food additive regulations of the Food and Drug Administration. On the other hand, the additional steps required to clean the fish will result in a product costing twice as much as FPC derived from whole fish.

Most recently, it was announced that Nabisco Astra has contracted to furnish ARA Services, Inc., fish protein concentrate made from eviscerated herring. ARA Services, Inc., is the world's largest caterer of school lunches and will employ fish protein concentrate in its pre-packaged meals. Because it is using eviscerated fish, Nabisco Astra will be able to sell fish protein concentrate to ARA Services, Inc., in large bulk lots whereas under existing FDA regulations fish protein concentration manufactured from whole fish may only be sold in one-pound retail bags. This FDA requirement has effectively killed any prospect for large-scale commercial investment in the FPC business.

The herring base FPC to be sold by Nabisco Astra will be caught by foreign fishing vessels and processed abroad for importation into the United States. Notwithstanding the low cost levels associated with foreign fishing operations, the end product will, as indicated above, be twice as expensive as the Bureau of Commercial Fisheries estimates FPC derived from whole fish should cost, even employing higher cost American labor. I am enclosing for your information a report of fish protein concentrate which has been prepared by Miss Barbara Elkus, an intern who has worked in my office this summer. I believe if you read this report you will have a basic understanding of FPC, its history and current status as a food supplement.

I am also attaching for your information an exchange of correspondence between Congressman Mailliard and the Department of Health, Education, and Welfare which, I believe, clearly illustrates the low importance HEW and FDA attach to Federal efforts to stimulate the fish protein concentrate industry in order to alleviate the tremendous protein deficiency which exists in many parts of the United States and the world.

Mr. LENNON. Gentlemen, we don't have the background, knowledge, and expertise that the National Marine Fisheries Service has. We got this thing rolling and money authorized to build the plant and ship it overseas. We would appreciate it if you would bring it up to date and furnish for the record the last word on it. I am a little bit shocked to hear the statement made by minority counsel that it is Congressman Mailliard's information that nobody asked him. We asked the Food and Drug Administration and the Commissioner said he would do this. This of course was in 1968. Of course he left.

The committee will recess until 2 o'clock.

AFTERNOON SESSION

Mr. LENNON. The committee will resume its hearings. I am advised that it is the desire of the Associate Administrator for Marine Resources, David H. Wallace, Richard E. Hallgren, Associate Administrator, Environmental Monitoring and Prediction, and Donald F. Moore, Assistant Administrator for Environmental Modification, to summarize their statements and then make themselves available for questions. Then, of course, the entire text of their statements will be inserted in the record immediately following the summaries. I would like to request, too, gentlemen, Mr. Wallace, Dr. Hallgren, and Mr. Moore, that you furnish for the record a résumé, which I ask unanimous consent be inserted in the record immediately preceding your summary of your respective statements. That request is made for the benefit of the Members who are not here and the new members of the Subcommittee on Oceanography. We will certainly insist that they read this testimony when they do become members in the 93d Congress.

I assume that the Honorable David H. Wallace, Associate Administrator for Marine Resources, is the next witness, according to the schedule furnished us.

I understand, Dr. White and others, that this is the way that it was agreed that it should be handled. I want you to know that I have no preference.

I would be glad to sit here until late in the evening to listen to you gentlemen because that is what I am here for.

Go right ahead, Mr. Wallace.

STATEMENT OF DAVID H. WALLACE, ASSOCIATE ADMINISTRATOR FOR MARINE RESOURCES

Mr. WALLACE. Mr. Chairman, I hope that you have had an opportunity to read the statement which I am submitting. I believe in the interest of time it will be appropriate not to read it, but to try to hit just a few of the key highlights we have laid out here.

Obviously, I will be available to answer any questions that you might have from the total statement, even though I do not touch upon it in my summary.

(The prepared statement of Mr. Wallace follows:)

STATEMENT BY DAVID H. WALLACE, ASSOCIATE ADMINISTRATOR FOR MARINE RESOURCES, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Mr. Chairman and Members of the Subcommittee, it is a pleasure to appear before you today and have the opportunity to review the marine resource programs we have been developing in order to achieve the goal outlined by Dr. White; namely, to assure that ocean resources are used and conserved for the national economic and social well-being, while enabling them to be efficiently and economically developed by the private sector.

These programs involve our ocean fishery and marine mineral efforts, our Sea Grant Program, our mapping and charting activities, and our scientific and technological endeavors. They encompass programs that were brought together by the formation of NOAA; new initiatives have been instituted; and plans being developed for future efforts. I would like to elaborate briefly on the highlights of these efforts and our projections of future direction.

Our primary focus for marine resource development has been in waters close to our shores. It is here that the greatest potential exists and where we as a nation are facing our greatest problems, for the development and utilization of specific resources and for the conservation and protection of the oceans and their living resources. This focus also has been sharpened by the recently assigned statutory responsibility to NOAA for the management of the coastal zone in cooperation with the States. We firmly believe that the rational development and utilization of the coastal zone must be built upon sound knowledge and understanding. Our programs are strongly being directed toward this end.

In our efforts to address the root problems of fisheries resources, that is, the common property nature of the resources and the split jurisdictions for their management, as pointed out by Dr. White, we have initiated two major programs—a State-Federal Management Program and a Marine Resources Monitoring and Prediction Program (MARMAP).

Last year we began a cooperative State-Federal effort with the objective of providing the basis for institutional arrangements for unified fisheries management across jurisdictional boundaries. [As an initial effort, we are exploring with 11 Atlantic Coast States from Maine to North Carolina the development of a management plan for the American Lobster. The American Lobster is currently the most valuable fishery of the United States Atlantic Coast. We are encouraging the development of uniform State regulations for the conservation of this resource. We also are considering the development of model legislation designed to limit fishing effort at the level which will produce the best economic returns consistent with good conservation practices.]

In addition to our efforts to conserve our valuable lobster fishery, we are reviewing the status of other species which could benefit from the development of similar plans.

Living resources are not inexhaustible as evidenced by the impact of foreign fleets upon our traditional fishing ground. We recognize there must be combined State, Federal, and international management arrangements for the major fish stocks off our coasts and on the high seas. It is our belief that it is essential for the maritime nations to cooperate in the conservation and utilization of fish stocks on the high seas. Already, the U.S. is party to eight treaties and nine bilateral executive agreements involving 25 nations. Since NOAA has come into being, eight of the bilaterals have been renegotiated, and the 9th—U.S./Mexico—is imminent.

To negotiate international fisheries management arrangements with those nations competing for ocean resources now requires much improved life cycle knowledge of stocks. It is toward this end that we are directing a major element of our research effort, the MARMAP program. The objective of MARMAP is to provide information on the abundance and distribution of fishery stocks of interest to our fishermen. It is to be carried out by a series of systematic surveys in all major areas of interest to U.S. fishing fleets along the U.S.

Continental Shelf. This program is in its initial stages, concentrating on the establishment of sampling and operational techniques, which, incidentally, are being adopted by 20 FAO nations. We think that basic knowledge concerning fish stocks which MARMAP will develop will enable us to negotiate effective conservation agreements with other nations and assist us in resolving domestic allocation problems.

It is noteworthy that we have actively supported and assisted in the development of a strategy for gaining international agreement of strong measures to protect whales. A U.S. initiative resulted in the U.N. Conference on the Human Environment at Stockholm requesting the members of the International Whaling Commission to consider halting commercial whaling, to increase research, and to strengthen the IWC Secretariat. The impact of the Stockholm resolution contributed to the many important achievements of the IWC when it met in June of this year—reduction of quotas on certain species and imposition of quotas where none had previously existed; elimination of the blue whale unit; and agreement on strengthening the IWC Secretariat. New responsibilities for the protection of marine mammals have been assigned to NOAA through the recently enacted Marine Mammal Protection Act of 1972 developed by this Subcommittee.

Our agency is also responsible for the management of the Pribilof Island fur seal herds by international agreement. We have recently proposed that an extensive research program be carried out on St. George's Island in the Pribilofs to study the factors governing that seal population level. As the international manager of this herd, we believe that we must assess both ecological and economic effects that can result from our management program so that our final decisions will be rational and balanced.

Our tuna fleet has been faced with the difficult task of reducing the mortality of porpoise resulting from fleet operations. Our research effort in compliance with the Marine Mammal Protection Act is expected to give us fresh insights into porpoise behavior and perhaps into new methods of tuna fishing that will save porpoises from accidental death in tuna nets.

With the responsibilities placed upon us by the recent legislation, the protection of marine mammals both within our waters and world-wide is a matter of major concern which we intend to pursue vigorously.

While we provide many services such as financial assistance, marketing assistance and technical development for our commercial fishermen, as you are aware, we also feel a strong need to meet the growing needs of the Nation's sport fishermen. The just released 1970 national survey of hunting and fishing reported over nine million saltwater fishermen in the United States, spending more than \$1.2 billion on equipment, transportation, food and lodging. There is a significant sector of our population to whom we are attempting to respond. The construction of two sport fish laboratories to meet growing needs in the Gulf of Mexico commenced at the time NOAA was formed. One of these laboratories, located at Panama City, Florida, has recently been dedicated and now supplements our expanding sport fish research efforts at other locations such as our Miami facility, where we are increasing studies of species of principal interest to anglers in that area.

We have strived to improve our communications with sport fishermen and the many constituent groups concerned with our Nation's fish stocks in order to improve our responsiveness to their needs. Notably, as indicated by Dr. White, a Marine Fisheries Advisory Committee (MAFAC) composed of representatives from such groups, has been established to advise the Secretary of Commerce. This Committee is providing a vital link to the many interested groups and valuable advice in the formulation and assessment of our programs.

We are also broadening our efforts to assist the public, industry, and government agencies through direct contacts with a comprehensive NOAA Marine Advisory Service. Various elements of our organization have, through the years, provided information to a broad range of user groups. More recently, the Sea Grant institutions have made significant contributions to the public in their respective areas by providing advisory services. These institutions are to be commended for their responsiveness in promptly developing such services in response to the requirements of the Sea Grant legislation. It is upon this Sea Grant framework that we are building the NOAA Marine Advisory Service involving all our elements to insure effective information transfer to all user groups.

The Sea Grant Program, to which this Committee contributed so greatly in its formulation and subsequent development, will be the foundation of knowledge

supporting our new responsibilities for coastal zone management under P.L. 92-583. Sea Grant has acted as the catalyst needed to initiate a cohesive effort in the States, the academic community and industry in a matching fund partnership with the Federal government. As the Committee is aware, six institutions engaged in broad programs of research, education and advisory services have now been designated Sea Grant Colleges. Over 700 Sea Grant projects encompass efforts in mariculture, marine mineral resource development, pharmaceuticals from the sea, coastal zone management and protection, economics of marine resource recovery, Law of the Sea, and educational curriculum development.

In the field of mariculture, Sea Grant has made it possible to approach a point where pilot-scale operations will be able to test commercial application for some species. Sea Grant, working jointly with the National Marine Fisheries Service and industry, has intensified the investigation of solutions to environmental pollution resulting from seafood processing and the dumping of wastes. Sea Grant funding has also led to the creation of college curricula emphasizing the practical aspects of marine affairs with training of technicians in various fields, including commercial fisheries. These efforts have been in addition to the advisory services established by Sea Grant. The program is now playing a most active role in providing support for the research that is needed to address issues.

Such Sea Grant efforts, of course, are complemented by a broad range of activities of other elements in NOAA. Our mapping and charting activities also are fundamental to the utilization and management of our Nation's waters. The use of our waterways by commerce and the growing number of recreational boaters requires more than 950 up-to-date nautical charts to be on issue.

We have made significant progress with a cooperative program in the State of Florida in establishing accurately the low and high water lines. Other States have expressed needs for similar services and we are now holding discussions with them. As boundaries between Federal, State and private ownership are based on these waterlines, we anticipate greater demands upon our expertise in this area. This boundary determination effort is not restricted to the States, as exemplified in a cooperative survey performed with the Mexican government to provide control for delineating the seaward extension of the U.S.-Mexico boundary to the 12 nautical mile limit.

The detailed geophysical mapping of our Continental Shelves and assessment of their economic potential has historically been the province of private industry. We have produced 35 bathymetric maps covering an area of 142,000 square miles for portions of the East and Gulf Coasts, the West Coast, and the Alaska coast. In addition, geophysical maps describe the characteristics of 50,000 square miles of the Alaskan continental shelves. It is our intent to map the continental shelves and slopes bordering the U.S. where there is a clear cut demand for Federal mapping. Much of the effort heretofore has been undertaken with our own fleet. However, private industry has the funds to satisfy its mapping requirements and expects to use them in exploiting marine resources.

Such geophysical information and other data being acquired on our coastal waters is growing at a fantastic rate. Our data services are being increasingly called upon to provide information on the properties and characteristics of the marine environment both natural and man introduced. We have been developing a number of cooperative programs with other agencies to provide for their information needs. With the major investments made to acquire such vital data, its acquisition to data banks should be accelerated and access to the data streamlined to insure maximum availability. Our data centers are being developed toward this end.

The quality of the data we acquire or provide is, of course, dependent upon the state of our instrumentation. In line with our national responsibilities in maintaining a National Oceanographic Instrumentation Center, we have recently established new regional facilities for the testing and calibration of oceanographic instruments where there are concentrations of instrument users. These centers are located in Seattle, San Diego, and Bay St. Louis, Mississippi. Our regional approach will improve instrument reliability through reduction of hazards associated with shipping the instruments out of local areas. Through such centers we hope to facilitate calibration and contribute to the improvement in the quality of oceanographic information being made available to the various groups.

We have also initiated a major new program to obtain comprehensive information on marine environmental conditions. The formation of NOAA brought together the talents and facilities required for detailed physical and biological

analyses of marine ecosystems. With the growing competition for the coastal zone especially in urban areas, greater knowledge of these systems and man's impact upon them is needed by local planners, government agencies and the public. A detailed study is being undertaken in the New York Bight where problems of urban impact on the marine environment are so immediate. In particular, dumping of wastes and the consequent effects upon the environment, marine life and public health is of serious concern. As our initial efforts show promise in the New York Bight, we will investigate the extension of similar studies into other areas. Studies much as these are related to the efforts we are developing to be responsive to the Marine Protection, Research and Sanctuary Act of 1972 that assigns NOAA responsibilities for conducting research and monitoring to assess long and short term effects of ocean dumping as well as other man-induced impacts. By building upon the capabilities developed for our marine ecosystems program, we will be able to respond effectively to the responsibilities placed upon us by the recently enacted legislation.

A similar area of concern is the study of the impact of offshore mining operations upon both the environment and living resources. We have initiated two actions in this area. The first is a field program to assess the impact of offshore sand and gravel operations upon the environment. This is an outgrowth of a project initiated by our Sea Grant Program. It involves industry, the State of Massachusetts, several elements of NOAA and the cooperation of other Federal agencies. This program recognizes the conflict between the growing need for construction materials in our coastal communities and the potential adverse effects of mining operations upon the environment. We are attempting to investigate such effects in order to facilitate the development of meaningful regulations.

In addition, we have determined that a high priority should be placed on a program to determine the potential environmental impact of deep ocean mining. Representatives of the U.S. mining industry concur in this view. We are formulating plans to initiate such an investigation.

Underlining the programs such as I have described are many supporting scientific and technological projects. I would like to briefly cite two that are illustrative of those that we hold in great promise. One is mariculture research, which I mentioned earlier; the other, our Manned Undersea Science and Technology Program.

Cultivation of marine organisms in the U.S. is at a parallel stage of development with agriculture 50 years ago. Scientific breakthroughs in mass artificial propagation of several species offers great potential for mariculture. Pacific salmon have already been produced and are being marketed on a pilot basis. Oysters are being bred in hatcheries. We view the government's role as carrying out basic research and development from which private industry can proceed with commercial production. It is toward this end that we are fostering mariculture research in our National Marine Fisheries Service and Sea Grant Institutions. I have recently returned from the Far East and can assure you that Japan and other countries consider mariculture to be a significant means of increasing domestic harvest of a variety of fish and shell fish.

With the modest beginning of a Manned Undersea Science and Technology Program, we have had a very successful initial year. Operations were conducted on all three of our coasts and ranged from the study of walrus in the Bering Sea to investigation of reefs off British Honduras. Eight different research submersibles and two ocean-floor habitats were used. Our Nation has made a significant investment in acquiring such facilities and we believe that their utility and contribution to marine programs has been aptly demonstrated in this first year.

Over 125 scientific investigators participated in these programs. They came from universities, industry, Federal and State agencies and even from foreign countries. We would like to emphasize, however, that the degree of success we have had to date can in large measure be attributed to the excellent cooperation from other Federal agencies, particularly the Navy, the Coast Guard and the National Science Foundation.

In closing I would like to note that while our efforts are focused upon the waters bordering our shores we have become increasingly active in cooperative bilateral arrangements with other nations. We are responsible for the U.S. participation in marine bilateral agreements with France, Japan, and Canada and more recently we have participated in the consultations for potential cooperative marine programs with the USSR. In these international programs as well as in our own domestic programs, our activities will continue to search for un-

derstanding of the oceans, encourage utilization of ocean resources, and aim to protect and preserve the marine environment.

I would be pleased to answer any questions you may wish to ask concerning the program I have just described.

Mr. WALLACE. I think it is apparent that our programs have evolved in the past 2 years and are directed to achieving the goal which Dr. White outlined; that is, to assure that ocean resources are used and conserved for the national economic and social well-being while enabling them to be efficiently and economically developed by the private sector.

One of the things I want to point out is that our primary focus for marine resources development has been in those waters which are relatively close to our shores. I would say the Continental Shelf, but in some cases that is not really quite adequate to describe the area of our major emphasis.

We believe that in these areas the greatest potential exists for resource use and development, and some of the major problems as well.

Our program can be divided into three major components: living resources, nonliving resources, and supportive services which, in one way or another, help us to come to grips with the utilization of these resources.

Our fisheries problems have been attacked in two areas. These are relatively new approaches. One is the effort to develop the cooperative State-Federal program whereby the Federal Government works intimately with the States in enabling them to strengthen their own fisheries activities and, at the same time, participating with the States in dealing with those problems and those fisheries which go beyond the territorial limits of the States.

Our second major fisheries effort has been in the area of what we call MARMAP, an effort to assess the stocks of fish that exist adjacent to our shores so that we can develop, both domestically and on an international basis, rational management programs.

In nonliving resources, we have two substantial efforts: One, which Dr. White touched upon briefly this morning, is the effort off the coast of Massachusetts. Here, we are trying to determine the environmental effects that will result from the mining of sand and gravel from the oceans.

This is particularly appropriate today because many of our States have declared almost a virtual moratorium on the mining of sand and gravel. With our population growth along our shores proceeding at such a rapid rate, the sand and gravel needs are expanding tremendously. It is estimated that by the year 2000 we will need twice as much sand and gravel to meet the basic construction needs for our coastal areas.

As a consequence, we have initiated this program which, in some ways, is unique because it involves various aspects of NOAA—our Sea Grant program, our National Marine Fisheries program, our Environmental Research Laboratories; the State of Massachusetts; academic institutions in New Hampshire and Massachusetts; and private industry. Here is one combined effort to really solve a problem which we feel could become critical in the years ahead.

The second non-living-resource thrust—and again Dr. White touched on this—is our effort to establish a much closer working re-

lationship with the deep sea mining industry. We have had a number of meetings with them. We are in the process of reorienting the activities at our Marine Minerals Technology Center so that we can carry on efforts that are relevant to meeting the needs of the mining industry, particularly in terms of research, and to further evaluate this matter of the environmental impact of deep sea mining.

In terms of supportive services, I want to mention a very major activity that has been traditional for the National Ocean Survey, our nautical charting. This has been one of our long-term efforts. We produce something like 950 nautical charts needed by many users, ranging from recreational fishermen, to marine development, to our commercial shipping.

Besides these activities, we are engaged in the determination of coastal boundaries, and activity which is critically important to the States and to the Federal Government because this determines the jurisdiction of the various political institutions.

We have a cooperative program underway with the State of Florida at the present time in this area. We expect to be having many more demands from other States to perform similar services.

Environmental data are also among the things which is of vital importance to us. We are trying to strengthen and expand our data storage and make these data available to various users looking to solving the many problems that exist in the marine environment today.

I want to mention only very briefly that our marine ecosystems analysis program can be tied in very closely with the ocean dumping problem. We have selected the New York Bight as the first area to carry out these intensive studies. If the results here prove promising, we would hope that we could expand these into other parts of the country at the appropriate time.

Lastly, I would like to mention our manned undersea science and technology program. Up to the present time, we had used something like eight submersibles and two habitats, and some 125 scientists from various academic institutions and from our own organization. Other governmental organizations have used these facilities as part of this program which was first funded in fiscal year 1972.

Mr. Chairman, this résumé is a very quick view of the kinds of things that are being carried on in the marine resources area. I would be happy to answer any questions you would like to ask.

Mr. LENNON. Thank you.

The gentleman from Maine, Mr. Kyros, was questioning about the problems relating to the lobster industry, which I believe has proceeded to be the most profitable of any of our commercial fishing industries, shellfish or otherwise. My recollection is he stated also that the State of Massachusetts, the State of Maine, and the State of Rhode Island had different basic State statutes relating to the taking of live lobsters.

Mr. WALLACE. That is correct, sir.

Mr. LENNON. Somewhere—either in your statement, and I did have an opportunity to read your statement—some suggestion was made, either in your statement or Dr. White's, that consideration was being given now by NOAA for legislation that would make uniform the taking of lobsters under certain conditions; is that correct?

MR. WALLACE. Mr. Chairman, we believe that at this moment our first effort should be to try to bring the States together and to provide the catalyst which will enable them to devise a uniform size limit that would be compatible with construction needs.

As a consequence, we have set up a technical committee which has met and has agreed upon what they believe is the appropriate size from a management standpoint.

We have met with the States themselves. I believe the States have agreed in principle that, first, it is desirable to have a single limit, and, secondly, that they will establish a size which they will all try to adopt. It seems to us that this is more appropriate than passing a Federal law which would establish the size limit.

MR. LENNON. Why would the States—Maine, Massachusetts, and Rhode Island—differ in this basic law relating to the taking of lobster?

MR. WALLACE. It is an economic matter primarily. Over the years many of the States have passed laws which have set size limits on various species, not only lobsters but others as well.

MR. LENNON. How about Connecticut? Are its laws of taking lobsters different from these other three States?

MR. WALLACE. Yes; Connecticut differs, and so does North Carolina and New York.

MR. LENNON. You state:

As an initial effort, we are exploring with 11 Atlantic coast States from Maine to North Carolina the development of a management plan for the American lobster. The American lobster is currently the most valuable fishery of the U.S. Atlantic coast. We are encouraging the development of uniform State regulations for the conservation of this resource. We also are considering the development of model legislation designed to limit fishing effort at the level which will produce the best economic returns consistent with good conservation practices.

Are you pursuing the development of model legislation to be submitted to the Congress, or are you sort of getting ready to suggest to the legislatures of the 11 States which have a potential for lobster taking that their legislatures pass approximately uniform laws in those 11 States, or States where lobster is taken?

MR. WALLACE. That is what we really had in mind, that we will try to encourage the States to take this action.

MR. LENNON. What you really had in mind is Federal legislation relating to this or encouraging the States to pass comparable uniform legislation?

MR. WALLACE. Our intention was to encourage the States to take this action rather than to have a Federal law which would establish these regulations for lobsters. That does not mean that we feel that we do not need Federal law. As a matter of fact, one of the difficult problems of any fishery management today is that the jurisdiction of the States goes only to 3 miles. Beyond that, we have a contiguous zone which has been set up prohibiting foreign fishing, but there are no Federal statutes which permit the Federal Government to take management action in that area.

We believe that if we are going to manage a fishery, such as the lobsters, there must be some mechanism giving the Federal Government authority to act in its jurisdiction in concert with the States.

MR. LENNON. Mr. Wallace, do you intend to pursue this through an educational process and the demonstration of the capability to give the

sort of economic advise to several States to convince them of the necessity of uniform legislation in the affected States in the lobster industry?

Mr. WALLACE. That is exactly what we are trying to do. We feel that this will eventually have to become a matter of intimate communication.

We are also talking with the Atlantic States Marine Fisheries Commission, a compact of Atlantic coast States set up for this very purpose. They are also working with the States looking toward the same ends. We feel that we must explore every possible way to do this with the States before considering the possibility that some Federal control might be necessary.

Mr. LENNON. To what extent is NOAA involved in salt-water sport fishing?

Mr. WALLACE. When NOAA was created, as you know, the sport fishing research was given to NOAA along with the Bureau of Commercial Fisheries. At that time, I think this was almost a marriage of convenience because there was too much real interplay between these two concepts. We have been attempting to bring together both of these, looking toward the total utilization of the resource and the encouragement of our recreational fishing.

We have started to develop an artificial reef fishing program. As a matter of fact, just a couple of weeks ago Dr. White and I had the privilege to be with the Navy down off Virginia Capes when a couple of these ships were put over, really launching this kind of program.

We have also greatly expanded our sport fishing surveys and research. We are carrying on part of this program at our laboratory in Miami for the South Atlantic. There are also activities at our center at Woods Hole, and at La Jolla in southern California.

We have asked, and have received, funding to greatly expand our sport fishing statistics. To date, we have had very meager information about the total scope and value of the marine recreational fisheries, the number of people involved, the kinds of fish they caught, the quantities they were catching, and the sizes they were catching. This is one of the new thrusts that we are planning to make at the present.

Mr. LENNON. You mentioned the statistics for the calendar year 1970 in which it was reported there are over 9 million salt water fishermen. Were you talking about sport fishermen?

Mr. WALLACE. Yes. I might point out, Mr. Chairman, that this information came from a small study which was conducted by the Bureau of the Census at the time when they were making our census studies in 1970. For a selected part of the census they also made this survey. They had made an original survey in 1965. These really are the only two surveys we have had on a national basis. They have been a great help in providing some indication of the magnitude of this sport fishery. But we need much more in-depth statistical information to properly manage these fisheries.

Mr. LENNON. To what extent have your plans progressed to conduct an investigation relating to the potential environmental impact of deep ocean mining?

Mr. WALLACE. We have had some progress. As I said earlier, a committee from OSTAC has met with our people at the Marine Minerals Technology Center. This summer, we sent some of our investigators

out to the South Pacific where there was one experimental operation going on in deep sea mining. We have had the opportunity to make some observations as a result of this. Unfortunately, from our standpoint, there is no U.S. deep sea mining activity being carried on at the present time. So, it is very difficult for us to do anything but theoretical calculations of the possible environmental consequences.

Mr. LENNON. Would you identify by organization the representatives of the U.S. mining industry and the recurring views that you express, that a high priority should be placed on a program to determine the potential environmental impact?

Mr. WALLACE. Yes; I can identify some of them. I would be happy to submit a rather complete list to you.

One of them is Deep Sea Ventures, which is a subsidiary of Tenneco. Another one is Kennecott Copper. The third one that comes to mind is International Nickel.

There are several others.

Mr. LENNON. How about the American Mining Congress?

Mr. WALLACE. I am really naming the key members of the committee with whom we have been working. That is the reason I say I cannot recall the complete committee at this moment.

(The information follows:)

MEETING WITH MINING COMPANIES

NOAA representatives met with representatives of various mining companies in their capacity as members of the Mining Panel of the Ocean Science and Technology Advisory Committee (OSTAC) of the National Security Industrial Association (NSIA). The Panel urged NOAA to place a high priority on programs to determine potential environmental impact of deep ocean mining. Members of the panel concurring with this priority are from the following companies:

Kennecott Copper Co.,¹ Lockheed (Subcontractor of Hughes Tool Co.,¹ Deepsea Ventures, Inc.,¹ International Nickel Co.,¹ St. Joe Minerals,¹ Consolidated Purchasing and Designing Corp., Construction Aggregates Corp., Allis Chalmers.

Mr. LENNON. In the advisory committee report on page 5 they state, and I certainly find myself totally in agreement with their projection, as to the considerable lapse of time that will take place before an international agreement on the law of the seas will be attained concerning the Continental Shelf. They stated:

It is possible there will be a considerable lapse of time before international agreement on the Law of the Sea is attained. NACOA recognizes that economic and other pressures may develop to such an extent that individual nations, including the United States, will take unilateral action especially with respect to resource exploitation. NACOA therefore urges consideration by the United States of suitable arrangements that will allow development of these resources to proceed but at the same time will offer reasonable probability of meshing with eventual international agreements.

You mentioned the companies that you identify with the American Mining Congress. I have some reason to believe that hearings will start early next year on the commitments that were made by the members of this subcommittee and on the commitment given us by the State Department. These companies which you identify were very anxious to proceed. I would assume that when those hearings resume that an invitation will be, and rightly so, extended to NOAA to come up and take a position.

¹ Most concerned with deep sea explorations.

I think it is so important, in light of that, that you move forward as rapidly as you can to perfect these plans, not just formulate them, but to perfect these plans to initiate such an investigation to determine the potential environmental impact of deep ocean mining. I think it is important that that be done.

Mr. WALLACE. I certainly concur with your feelings, Mr. Chairman.

Mr. LENNON. How will your administrative responsibilities relate to the marine resources as it is in turn related to coastal zone management?

How did NOAA have the responsibility in regard to this?

Mr. WALLACE. I visualize as an important role for the agencies in NOAA dealing primarily with marine resources to serve as the Federal focus for knowledge requirements that will be used in the development of the appropriate planning arrangements and in the management that would be carried out by the States, themselves.

NOAA is a vast reservoir of scientists, technical expertise, and capability which has to be the foundation for rational development and utilization of the coastal zones. This is the role that I visualize for the marine resources part of NOAA in relation to the coastal zone.

Mr. LENNON. Is it the feeling of those who handle the administrative responsibility in NOAA that it is likely that this question of the international agreement relating to the exploration and exploitation of the sea beyond the Continental Shelf will be resolved anytime in the next 2 years?

Mr. WALLACE. Mr. Chairman, I would rather not speculate.

Mr. LENNON. From the several sessions that I was privileged to attend in August in Geneva, I do not see this going on and on and on. I just wondered if the administration, with the President having made the statement where he defended this hopefully and unequivocally while we ought to be thinking in terms of mankind, at the same time we should not delay unnecessarily at least exploration and to some degree the exploitation of the sea.

Yours would be speculative as to when this will be resolved. Do you think we ought to wait until it is resolved 3 or 4 years from now, or even 3 years from now?

Mr. WALLACE. I do not think our research efforts should wait. It is for that reason and not solely for studying the environmental impact of deep ocean mining, that this summer, even though we did not have a budgeted program, we put together a small effort using our own funds, because of the opportunity that existed to get whatever information we could at this moment.

Mr. LENNON. That really comes back to my observation this morning. You are not funded for this purpose. You are going to be charged with the responsibility under the Marine Protection Research and Sanctuaries Act, the so-called ocean dumping bill, to determine the effect of pollutants on the ocean. You have that responsibility. The Department of the Interior handles leasing of some ocean areas, making contracts with companies for them under certain conditions.

I think that NOAA is going to be injected into this problem area. The public thinks you do have certain responsibility. When you come right down to it, the public is going to expect you to do things which the administration may not expect you to. Do you have any questions, Counsel?

Mr. HEYWARD. I have a few areas to clarify. In connection with your discussion of the State and Federal relationship, did I understand you to say that in your opinion there are gaps in Federal jurisdiction in the coastal waters, as to the authority of NOAA, for instance, in fish management?

Mr. WALLACE. Yes; I am quite certain that the Federal Government, at the moment, does not have management authority except for the so-called Bartlett Act, which was passed in 1965 or 1966, by which there shall be no foreign fishing in the zone from 3 to 12 miles. Obviously, we have the management responsibility to see that no such foreign fishing takes place in that zone. When you go beyond that, there is no Federal legislation which gives the Federal Government the authority to make appropriate management regulations.

Mr. HEYWARD. Several years ago, as I recall—this was when you were working with the State of New York—there were discussions of legislation to be proposed for this management purpose which would in effect, as I recall, delegate to the States some authority in the contiguous zone, beyond State jurisdiction. Is that completely forgotten these days, or is that still under consideration, or does it have any status at all?

Mr. WALLACE. At the present moment, we are hoping to have ready for the next Congress legislation which would establish appropriate authority for action beyond the 3-mile limit. This would be in combination with the Federal Government and the States, and along the same general concept that you mentioned earlier.

Mr. HEYWARD. Of course, we have, as I think you would agree, some regulatory authority outside the 3-mile limit. Maybe you won't call it management, but at least there is regulatory authority in connection with agreements that had been reached in the international commission areas, such as off New England, with ICNAF. To the extent that there are agreements which have been ratified, we do have regulatory authority in the area in which the Northwest Atlantic Fisheries Commission operates. What overlap is there between the Commission's activities and the State of Massachusetts, for example?

Mr. WALLACE. The United States has the right to enforce its authority on its citizens. If a U.S. citizen violated the ICNAF regulations at sea, it would still be possible to take action against that citizen when he came ashore.

The State of Massachusetts, for example, has the authority to enforce its own laws on its own citizens even though they might be committed on the high seas. When that citizen comes ashore he is still subject to the laws of the State of Massachusetts. So there is some possibility for enforcing these laws.

In ICNAF, we have an international treaty, as you know, and we have established certain quotas for our fishermen under the ICNAF agreement. We can enforce those regulations.

Regulations also resulted from the bilateral agreements between the Soviets and the United States. Here a sanctuary on the edge of the Continental Shelf was set aside where no vessels larger than 110 feet could take certain species of fish during January, February, March, and April.

The question has not been raised specifically as to whether or not, if an American fisherman with a vessel in excess of that size were to

go there and fish during the closed season, we could actually deal with him as a violator of the agreements.

Mr. HEYWARD. Even if you found he was violating the agreement, there is nothing in that agreement that has any sanction or penalty attached to it.

Mr. WALLACE. That is correct. Even though there have been violations of this agreement by the Soviets themselves, in each case, the names of the violators have been turned over to the Soviets who have taken whatever action they deemed was appropriate.

Mr. HEYWARD. In that connection, do we have any vessels of the prohibited size which would be inclined to fish in that area in violation of that agreement?

Mr. WALLACE. We have very few at the present time. Most of our coastal fishing vessels in the New England area are relatively small and are designed for rather short trips at sea. As a consequence, most of them are from 60 to 100 feet in length. However, there are a few vessels that operate out of New England that would be in excess of the size.

Mr. HEYWARD. In connection with another subject, on pollution and its impact on living resources, is there not a serious duplication of authority between NMFS and EPA, for instance, not only in the actual pollution activity itself, but also in the research as to the impact?

Mr. WALLACE. I think the authority for regulation and control is pretty clear. This is lodged in the Environmental Protection Agency.

The question of research is a very different matter. The National Marine Fisheries Service, formerly the Bureau of Commercial Fisheries, has been carrying on studies of deterioration of water quality in relation to living organisms for a good many years. This has been accelerated very much since NOAA has been created.

I do not believe there has been any question that NOAA has the authority and the responsibility to proceed in this area. We have received additional funding through our fisheries budget for ecological studies and we also propose further work through our new Marine Ecosystems Analysis program.

EPA, on the other hand, has also been carrying on some limited studies in the marine environment, although most of theirs has been more or less confined to the estuaries.

Mr. HEYWARD. I understand that that is true, but I am also aware that even before EPA was created that the FWQA, and probably the FWPCA before them, were doing research on the impact, for instance, of oil spills on fish. They were doing studies on how the oil affected the fish life and all of the food chain in the sea.

I wondered whether, in connection with the Coastal Zone Management Act and a proposal which is still in the background and has not come to fruition as to whether some sort of arrangement with the Coastal Zone Laboratories, might not be the place to delineate the relative responsibilities of the Federal agencies in this area so perhaps some of this duplication might be eliminated. I am sure you cannot handle all of this. Obviously each agency has to do some research affecting its missions. You cannot chop it up so that they do half of it and then knock next door and say, "What have you got?"

It seems to me, however, that there is an unnecessary amount of potential duplication in this field of impact on living resources.

Mr. WALLACE. I am glad you used the word "potential," because I believe that this is really a more factual description of the condition today.

I want to point out that we do not operate in a void. We are communicating with people at EPA. We are keeping them very intensely involved and aware of the efforts that we are carrying out. At least in this regard, they know what we are doing. We are trying to be responsive to some obvious needs for research and for the factual data base on some appropriate matters which have been discussed with them.

Mr. HEYWARD. Of course this was the concept that this committee and ultimately the Congress passed in connection with title II of the so-called ocean dumping bill—

Mr. WALLACE. Precisely.

Mr. HEYWARD (continuing). That your organization and EPA should work very closely and in coordination. I think that title II was maybe a flag to others that we did not expect NOAA to be pushed aside and ousted when it came to research in the ocean because at least this committee feels that your agency should be the lead agency in that.

In connection with research and stabilization in connection with the effects of sand and gravel mining and the total weather problem, the hurricanes and ocean effects and so forth on the beaches, I assume that you and the corps have very close coordination in that type of study also.

Mr. WALLACE. Yes; although, as you know, the corps has the basic responsibility for carrying out the erosion control projects.

Mr. HEYWARD. One other point that I would like to make in connection with coastal zone is the section on "estuarine sanctuaries" which we were told the administration was not in complete agreement with. Nevertheless, the Congress did authorize the Coastal Zone Management Act.

The authority is there for the States to get funds in connection with estuarine sanctuaries. I hope, at least to this extent, that you will give careful consideration as to the type of sanctuary we might have. It was not intended to be a grab bag for the States, but an opportunity to select types of sanctuaries which could be set aside where we could, at least in estuarine areas, maintain them in such a position that scientifically we could view the processes that were taking place there.

Perhaps this has not been decided, but is the Office of Coastal Zone Management now scheduled for a particular niche in NOAA or will that come later?

Mr. WALLACE. I think it would be more appropriate for Dr. White to comment in this particular arena.

Mr. WHITE. We are presently working in the Department on the specific definition of the Office of Coastal Zone Management. According to our plans it will report directly to the Administrator as an entity.

Mr. LENNON. Mr. Sharood.

Mr. SHAROOD. Thank you, Mr. Chairman.

Dr. Wallace, I was looking back over the testimony of Mr. Roedel a year and a half ago when he appeared here. He said almost the

same things that you are saying now regarding the institutional problems that affect our fisheries.

I don't detect a great deal of progress between what he said then and what you are saying now, other than perhaps with respect to the lobster, which you have specifically identified as a species with which you are actively engaged in working out a program with the States.

In his statement of July 1971, he said that the institutional problems, the allocation of labor, capital, and the common ownership of the resource, were the root problems facing the fishing industry. You say, "We are considering development of model legislation" in your prepared statement. Is it still at the "considering" stage or have you made a decision on a definitive approach to the problem?

Mr. WALLACE. Insofar as the Federal legislation is concerned, we hope to have legislation prepared for presentation to the next Congress.

Insofar as the States are concerned, I cannot overemphasize the complexity of this arrangement that gets involved between the States and the Federal Government.

Mr. SHAROOD. We are only talking about the 3 mile territorial sea.

Mr. WALLACE. The 3-mile limit is the jurisdiction of the States. When we get beyond that, the States have no jurisdiction.

Mr. SHAROOD. Where does the majority of fishing effort occur?

Mr. WALLACE. In all parts of this total ocean, out to the edge of the Continental Shelf. There are three zones: from zero to 3 miles, 3 to 12 miles, and then 12 miles to the edge of the Continental Shelf. This is where most of our coastal fishing takes place.

Mr. SHAROOD. Relatively speaking, how much of this occurs within 3 miles versus beyond 3 miles?

Mr. WALLACE. I would say at least one-fourth to one-third of it takes place within the 3-mile limit.

Mr. SHAROOD. You can tackle the problem beyond 3 miles, can you not, without regard to the States; or does it have to be handled as an entity?

Mr. WALLACE. Let's look at trying to manage a single species, let's say a species of New Jersey that migrates into the Delaware Bay during 3 months of the year. This species moves offshore for a short distance to feed during a certain period of time. Then, during the winter when the water is cold, it moves to the very deep water where the water is warmer and spends the winter time there. This same species is thus subject to three jurisdictions during the course of one cycle of its life. If you do not manage it in all three of those jurisdictions you cannot effectively manage the fishery at all. You can manage one piece of it, but it could conceivably be destroyed in the area where you have no jurisdiction.

So we have to look at this, it seems to me, from an inshore State-Federal relationship, a Federal relationship, and then some mechanism beyond 12 miles. We are hoping that from the law of the sea we will get some guidelines as to how this can be done to enable us to have a total management.

Mr. SHAROOD. I appreciate what you are saying. It is very enlightening but it doesn't answer my basic question which is at what pace are you moving in this direction? A year and a half ago we were told it was the most important problem facing our fisheries. Now a year and

a half later, we are told that you are still considering model legislation. When are you going to reach the point where something is actually going to be done?

Mr. WALLACE. I must say my use of the word "considering" was a bad choice. I accept that. But that doesn't mean that we haven't been doing something about it. We have been meeting with every one of the States, every coastal State in the United States. We have had teams sitting down with them and reviewing their laws. We are reviewing our relationships with them. We are trying to change the direction of our support under Public Law 88-309, the Commercial Fisheries and Research and Development Act, so that the activities of the States are relevant to a management problem that exists today.

We are talking with the three State fishery compact commissions. They are now meeting with us on a regular basis. We are reviewing the State laws and their relation to one another, and how we can make them a viable unit so that we can bring about this management technique.

Mr. SHAROOD. Has this bill you are referring to been cleared by the Office of Management and Budget yet, or is it still pending approval over there?

Mr. WALLACE. I am sorry, I want to be precise about this. This has not been finalized in the Department of Commerce. At this moment, this Federal jurisdiction legislation has not been brought to OMB. We would hope that this would be done very promptly.

Mr. SHAROOD. I certainly hope so. I know a great many people are looking forward to examining this at the earliest possible time.

Mr. WALLACE. I want to say further that we have been working with the individual States and with the compact commissions in developing this model State-Federal legislation. We would hope that we will have something from this very quickly.

I must emphasize that there are no instant answers to this problem. Every State has its own methods of doing business. It has its own techniques of management, its own laws already on the books. So it is a complex matter for which you don't have any ready answers.

Mr. SHAROOD. There is one last point I want to cover in the context of this overall fisheries management problem. That is the MARMAP project. A year and a half ago that was spelled out to us in some detail. It has not yet in fact begun, has it?

Mr. WALLACE. Oh, yes. It has.

Mr. SHAROOD. On an operational basis.

Mr. WALLACE. Yes, to the extent that equipment and technique development cruises are being made right at this moment.

Mr. SHAROOD. That is what I want to clarify. I have a copy of your NOAA quarterly publication. This is the October 1972 issue, which has a story on MARMAP in it. It says that six initial cruises are scheduled between July 1972, and February 1973. Further on down it says, "Progressively wider ocean areas will be examined and more complex research techniques explored during additional preparatory cruises planned for 1973, 1974, and 1975." Perhaps the word "preparatory" doesn't belong there. I want to get that straight. I have the impression, from reading that, that you are not talking in terms of operational cruises until 1976 perhaps.

Mr. WALLACE. That is true because MARMAP is not just one massive excursion going out and taking a lot of samples. It has three phases. The first phase is the sampling for eggs and larvae along all of our coasts to get some idea of the concentrations, the locations where the fish are spawning, and the success or failure of this spawning. This is phase 1 of the MARMAP program. This has been going on.

Mr. SHAROOD. But it is not preparatory.

Mr. WALLACE. It is preparatory in that we are in the development period in phase 1 of the 3-phase program. Although we are obtaining useful data, we are still involved in developing the overall monitoring, assessment and prediction capability. The first phase is the assessment of the eggs and larvae; the second phase is the assessment of the stocks of ground fish; and the third phase is a survey of pelagic, or surface fish stocks. All these together constitute the MARMAP project.

Mr. SHAROOD. Following on that, if the Law of the Sea Conference or a convention resulting from the Conference adheres to the U.S. proposal with regard to the species approach to management, will you have the data necessary to enable the United States to determine whether a given species, over which we have been vested management by international convention, is endangered by the current level of fishing pressure or if it is being under utilized, or is at the maximum sustainable yield? Will you be able to have sufficient scientific data to make decisions that will stand up before, let us say, international arbitration in as much as most decisions involving cutbacks by foreign fishing fleets probably will be subject to international arbitration.

Mr. WALLACE. On some species we would be able to do that today. On the other species we don't have enough data and we would hope that MARMAP will be getting this information for us. Hopefully, by the time the law of the sea becomes an effective mechanism—and we would think that this probably would be 5 or 6 years hence, at least, because even after the law of the sea convention is adopted it has to be approved by a certain number of countries before it becomes effective, but by that time, I feel quite confident we would have information that would be necessary to develop these management regimes so that we could make definitive decisions about how these species would be managed.

Mr. SHAROOD. Thank you very much.

Mr. LENNON. Thank you, Mr. Wallace.

Our next witness will be Dr. Richard E. Hallgren, Associate Administrator, Environmental Monitoring and Prediction.

STATEMENT OF DR. RICHARD E. HALLGREN, ASSOCIATE ADMINISTRATOR, ENVIRONMENTAL MONITORING AND PREDICTION

Dr. HALLGREN. I will submit my statement, as was done by Mr. Wallace, and will only provide a very brief overview of the general content of that statement.

(The statement follows:)

STATEMENT BY RICHARD E. HALLGREN, ASSOCIATE ADMINISTRATION FOR ENVIRONMENTAL MONITORING AND PREDICTION, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, DEPARTMENT OF COMMERCE

Mr. Chairman and Members of the Subcommittee: I am pleased to have this opportunity to report to you on the status of NOAA's environmental monitoring and prediction program. Our activities involve all parts of the environment—the upper atmosphere and space, the lower atmosphere, the ocean, and the earth. These environmental services focus on the protection of life and property and the improved efficiency of commerce, industry, and agricultural activities. In general, they include:

Warnings of pending natural disasters; forecasts of general environmental conditions; assessments of the short- and long-term effects on the environment of natural and/or man-made activities.

In developing our program we take into account that the prediction of the influence of the environment upon man is closely intertwined, scientifically and technologically, with the assessment of the impact of man's activities on the environment. Much of the scientific understanding required to predict the future state of the atmosphere or the ocean is needed to understand the dispersion of contaminants and the effects of man's activities on our climate. The same satellites, ships, buoys and aircraft can be used to meet the needs for acquiring data for atmospheric, oceanic, and upper atmosphere and space prediction services. We are taking into account these interactions in developing an overall environmental monitoring system and the associated research.

NOAA is only one of the agencies involved in environmental monitoring and prediction. A number of other Federal agencies, such as the Department of Defense and EPA, are also involved in monitoring and predicting environmental conditions to meet their mission needs. NOAA is responsible for the interagency coordination of the Federal atmospheric and oceanic environmental monitoring and prediction activities. The coordination arrangements are best developed in the area of meteorology where we have prepared national plans for a number of activities both broad in scope and specialized. We believe that these plans have brought about a more effective and efficient national monitoring and prediction system within the funds provided.

Many of the problems associated with assessing and predicting the environment are global in nature and must be handled on that basis. This was recognized and emphasized at the UN Conference on the Human Environment this past summer. The conference endorsed a concept of an Earthwatch. In NOAA we have been working internationally to develop the World Weather Watch, the Integrated Global Ocean Station System and the Worldwide Standardized Seismograph Network to keep watch over the earth's weather, oceans and earthquakes as essential parts of Earthwatch.

Today I want to focus primarily on NOAA's activities to provide warnings of hazardous weather and to monitor, assess, and predict oceanic conditions. First I would like to describe briefly a few highlights on our other monitoring and prediction programs.

This nation's effort to reduce the loss of life and property damage from earthquakes received major support from both the President and Congress during FY-73. We have been working closely with the U.S. Geological Survey and the National Science Foundation in developing a balanced and comprehensive program. The NOAA program is heavily service-oriented. We operate a system of seismological observatories, provide assessments on a national and regional basis of the risks of earthquakes and operate a network of specialized seismological instruments to provide quantitative information on strong motion effects on structures. In addition, we have an earthquake research program which is closely coordinated with efforts of the U.S. Geological Survey.

Since the formation of NOAA we have instituted a joint program with the U.S. Air Force's Air Weather Service to operate a Space Environment Service Center at Boulder on a 24-hour basis. This center provides forecasts and warnings of upper atmospheric and solar conditions, not only in support of our military and space operations, but also for communications and electric power interests where

serious disruption of public service may result from unanticipated magnetic storms. We also are expanding, or plan to expand, space monitoring activities through the use of our polar orbiting and geostationary satellites and have undertaken a comprehensive research program to develop better prediction models of solar and upper atmosphere phenomena and their interrelationships.

In addition to warnings of hazardous weather, NOAA provides specialized weather services to support agricultural and aviation interests and pollution control authorities. We have expanded our services in each of these areas during the last two years.

Probably the biggest single improvement in our basic observational system stems from the new polar orbiting satellite, NOAA II, which was placed in orbit in October 1972. This satellite is capable of measuring the vertical temperature distribution on a global basis twice each day. These global temperature data are essential to the preparation of meteorological predictions in support of our weather services. We have also undertaken a comprehensive effort to develop the new analysis techniques required to make maximum use of this rich new source of data and are taking steps to upgrade our operational and research computers at the National Meteorological Center in Suitland and the Geophysical Fluid Dynamics Laboratory at Princeton.

The NOAA II satellite, which developed to meet national needs, is also part of the international World Weather Watch. The satellite portions of the Watch have taken shape in the last couple of years. At a meeting in September 1972, in Geneva, the nations discussed the plans for obtaining global observations from satellites for research purposes and for the operational service programs. The plan calls for five geostationary satellites and two polar orbiting satellites. At the meeting, the United States indicated its plans to operate two geostationary satellites, and the European Space Research Organization, Japan and the USSR described their plans to each operate a geostationary satellite. The U.S. and USSR described their plans to each operate a polar orbiting satellite. As a result, we are hoping that by 1977 a complete worldwide environmental satellite system will be in operation.

Another important international activity which I reported to this Committee last year is the GARP Atlantic Tropical Experiment (GATE). This experiment is scheduled to take place in the summer of 1974 in the tropical Atlantic which is the birthplace of the hurricanes which strike the coast of the eastern United States. I am pleased to report that 13 nations have indicated their intention to participate in GATE. Approximately 25 to 30 major research ships, and 8 long-range aircraft have been committed to date. The U.S. has presently committed 5 ships and 4 long-range aircraft, as well as the use of our polar orbiting satellite and geostationary satellites. During the last year we have been focusing our effort on the development of the data acquisition system for use on our ships and aircraft. The prototype data acquisition system will be tested on our NOAA vessel DISCOVERER during January and February 1973 and will be left on the DISCOVERER as permanent equipment for future experiments.

As part of the International Hydrological Decade, the U.S. and Canada are taking part in the International Year of the Great Lakes. This is a joint program to conduct a comprehensive study of Lake Ontario to establish a scientific basis for improved management of the water quality and quantity of the Great Lakes. The field phase of the experiment began on April 1, 1972, involving U.S. and Canadian data acquisition networks. These networks include more than 10 major vessels, 40 buoys, several automatic meteorological stations and aircraft measuring physical, chemical, biological and meteorological properties. The data collection phase is nearing completion and analysis of the data is now underway.

The President has declared 45 major disasters during the first 11 months of 1972. Five of them resulted from Hurricane Agnes which caused the greatest natural disaster ever to befall this nation. Catastrophic flooding all along the eastern seaboard resulted in 118 lives lost and damages approximating \$3.5 billion. Also, earlier in the year, record rain fell on the Black Hills of South Dakota and caused a severe flash flood in which 236 lives were lost.

Our warning services, in general, functioned reasonably well throughout this period of concentrated disaster occurrences. It became clear, however, that the capability of our system was stretched to the breaking point, that substantial short- and long-term improvements can be made, and finally that these improvements must be made to reduce the loss of life and property.

Detection of hazardous phenomena, the preparation of warnings and the dissemination of information comprise the warning system which together with

community preparedness are of paramount importance in our efforts to minimize losses due to natural disasters. Let me briefly discuss these facets in terms of some of our recent achievements, our problems and our future plans.

To improve our basic detection capability we have installed three long-range network radars in Tennessee, Texas and South Dakota, and five radar remote transmitters and 10 remote receivers in Wisconsin, South Dakota, Texas, Louisiana, Missouri and Kansas. Three flash flood alarm systems were installed in West Virginia, Ohio and Tennessee, and 20 river and rainfall reporting stations in Massachusetts, Washington, Utah, Idaho, Ohio, New York, South Carolina, and California were automated to expedite the receipt of data at river forecast centers. To improve our dissemination capability we have installed 28 VHF-FM continuous broadcast equipments. There are now a total of 63 VHF-FM systems serving a potential audience of 24 million people. The NOAA Weather Wire Service, which is vital to keeping the mass media informed of changing situations, is now fully implemented in 20 states and partially in seven other states. Automatic telephone answering systems are operating in 85 major cities serving over 100 million potential listeners.

To operate the basic detection and dissemination systems NOAA has been organizing its field forecast services to meet the challenge of providing improved warning service. Forty-six Weather Service Forecast Offices have been established to which our best professional talent has been assigned. These forecast offices have the major responsibility in the preparation and distribution of statewide warnings and also for providing guidance to 237 Weather Service Offices throughout the country. We are making progress in improving our detection and dissemination systems. There are, of course, continuing actions necessary to maintain and enhance the capability and responsiveness of the system. Radars are routinely required to be replaced due to obsolescence. Additional radars and remote transmitters and receivers are needed to fill gaps that exist in the network and to provide radar warnings displays for those weather service offices without radar. We also need to improve our ability to determine more precisely the rate and amount of rainfall with radars.

About 90 percent of the 5,500 river and precipitation gage reports are manual observations from cooperative observers. Automation of many of these stations is being studied to enhance the prompt collection and delivery of rainfall and rain gage data to our forecast offices. Similarly, we will continue to strive to improve NOAA weather wire services, VHF-FM systems, and make better use of cable TV for disseminating warnings.

A major potential for the future is the Geostationary Operational Environmental Satellite (GOES) system. This system will provide a near continuous capability on a broad scale to detect, locate and track hurricanes and severe local storms. Another very significant aspect of the GOES system will be its capability to locate, collect and relay data from ships, buoys and other platforms such as river gaging and precipitation stations. Effective use of information from GOES will greatly assist key forecast offices in Washington, San Francisco, Kansas City and Miami.

We are also studying ways of applying modern technology and automation to increase the responsiveness of the system and the productivity and effectiveness of our manpower in the field. In this regard we are examining the feasibility of interconnecting forecast offices with the National Meteorological Center, the National Severe Storm Forecast Center, the National Hurricane Center, the National Climatic Center and others. As data flow through the system, the forecast office mini-computers could select information relevant to the forecast area of responsibility, store it and make it available for prompt retrieval on demand by the forecaster. The mini-computer could also perform the product and information distribution and documentation functions.

A warning system, no matter how good, without public preparedness and response is of little or no value. Likewise, a public prepared and responsive but having no warning system makes little sense. It must be recognized that these two activities go hand in hand. They must be jointly developed to reduce the loss of life and property from natural disasters.

NOAA is leading an effort with the cooperation of all Federal agencies involved to develop a Federal plan for a natural disaster warning system. Part of the plan relates to developing fully coordinated arrangements for preparing the public to respond to a warning. This activity requires concerted action by the Office of Emergency Preparedness, the Defense Civil Preparedness Agency and NOAA, on the Federal level, together with the state and local community groups.

During the last two years we have been intensifying our efforts to assist the communities in preparing disaster plans. In coastal areas that are affected by hurricanes, we have prepared maps showing which areas that would be vulnerable for inundation. We have also been working directly with communities in developing evacuation procedures. In the area of tornadoes we have been participating with cities and communities to educate the public on safety rules and procedures. We have worked with 140 communities in developing self help warning systems to cope with the flash flood problem. In addition, we have assigned flash flood specialists to forecast offices to aid local communities in developing flash flood warning systems.

The alerting of the general public to the imminent occurrence of hazardous phenomena posing an immediate threat to life and property has been traditionally and will continue to be one of NOAA's most important functions.

The rapidly developing energy crisis has focused attention on the quest for new sources of petroleum from the sea floor and on the use of the sea surface as a highway for the transport of fuels. The ocean now sustains a coastal shipping activity worth \$6 billion, an important U.S. fisheries industry having a \$5 billion capital value that includes 81,000 boats and an increasing use of the coastal margins by our people for residential and recreational purposes.

The ocean also serves our industrial society by receiving waste heat from shore-side power plants, waste chemicals from factories and sewage from coastal cities. Future plans call for the development of deep-draft port facilities, off-shore siting of large power-generating facilities and the construction of large complexes on the continental shelf.

Our challenge is to insure that the ocean as a resource is wisely used. We must identify its limitations, monitor its behavior and understand its processes in order to assure its full utilization and at the same time protect it from the harmful and perhaps irreversible consequences of man's activities.

Two complementary efforts are being studied. The first is to use existing technology and facilities to provide ocean monitoring and prediction services. The second is to conduct a program of research and development to insure that future demands for services can be accommodated.

The off-shore waters are where the nation's needs are most demanding and increasing. For example, the Gulf of Alaska and northeastern Pacific Ocean areas are where tankers will be on-loading, transporting and off-loading petroleum from the Alaskan oil field to the west coast of the United States along the marine leg of the Trans-Alaskan Pipeline System. We must strive to insure that adequate weather services are provided in warnings and forecasts to enhance the operational safety and efficiency of ship operations. To insure protection from tsunamis, we are upgrading our Pacific and Alaska warning services. Other high priority areas for new and improved services are the middle Atlantic coast region and the Gulf coast where increasing population densities have generated environmental problems requiring immediate attention.

NOAA has programs to meet national needs for physical, chemical and certain biological data. Improvements in monitoring systems could be through instrumentation of selected ships of opportunity, through use of environmental buoys still in the test and evaluation phase, through instrumentation of key coastal and off-shore sites, and through application of satellite data from our NOAA II and GOES systems. Water quality information can be acquired by collecting, in a systematic way, water samples from areas of high interest in order to analyze and assess pollution states and trends.

NOAA's capabilities were significantly increased when the major national program in ocean monitoring from space was transferred from the Navy to NOAA. The Spacecraft Oceanography Program, now a part of NOAA, will continue to develop techniques for observing ocean color, current velocities, surface waves and sea ice.

The National Data Buoy Center is now testing a large data acquisition buoy in the Gulf of Alaska. Others are being tested in the Gulf of Mexico and one off the east coast of the U.S. is being used to monitor coastal winter storms.

To further enhance monitoring, we are proceeding to develop automated observing systems for use aboard ships of opportunity and emplacement on coastal and off-shore facilities. A need exists for developing new and reliable techniques for monitoring petroleum, pesticides, polychlorinated biphenyls and heavy metals such as lead and mercury, in the ocean and marine atmosphere. As new collection capabilities are integrated into the NOAA system, we will eliminate the obsolete and redundant platforms and sensors to achieve an effective system

at a reasonable cost to the public. These research and development activities will complement our existing ocean science and technology efforts. From the MESA program described to you by Mr. Wallace will come techniques for improving our assessment and prediction services.

To achieve a program for oceanic monitoring, assessment and prediction, NOAA is working with other agencies such as EPA and the Coast Guard to arrange for the cooperative use of national resources in the acquisition and analysis of data required for assessment and prediction. Such coordination is carried out through an Interagency Committee on Marine Environmental Prediction for which NOAA has been assigned lead agency role. This Committee also provides an appropriate mechanism for coordinating national activities that are involved in international oceanographic programs.

In summary we are making progress in developing a national environmental monitoring and prediction system as was recommended in the Marine Commission Report. Although much work remains, I am confident that we can move forward with vigor with the full cooperation of all the Federal agencies.

Thank you.

BIOGRAPHICAL SKETCH OF DR. RICHARD E. HALLGREN, ASSOCIATE ADMINISTRATOR FOR ENVIRONMENTAL MONITORING AND PREDICTION NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Dr. Richard E. Hallgren became Associate Administrator for Environmental Monitoring and Prediction in the National Oceanic and Atmospheric Administration in September, 1971.

Dr. Hallgren was formerly NOAA's Assistant Administrator for Environmental Systems and held the same position in the Environmental Science Services Administration for a year before the formation of NOAA in 1970.

In his current post as Associate Administrator for Environmental Monitoring and Prediction, he provides policy leadership for NOAA's environmental satellite, meteorological, hydrologic, and marine services and coordinates NOAA's responsibilities in the World Weather Watch and the Integrated Global Ocean Station System. In carrying out additional responsibilities as Federal Coordinator for Marine Environmental Prediction and for Meteorological Services and Supporting Research, Dr. Hallgren coordinates and integrates the programs of NOAA in these areas with the programs of other Federal Agencies.

Born in Pennsylvania, Dr. Hallgren graduated from Pennsylvania State University in 1953 with a B.S. degree in meteorology and a minor in mathematics. He then served two years as a U.S. Air Force Weather Officer. Continuing his studies at Pennsylvania State University, in January 1960 he earned his Ph.D. in meteorology with a minor in physics.

In 1960 Dr. Hallgren joined the IBM Corporation as an operations research analyst and later became manager of the IBM Meteorological Systems Department. In November 1964 he became Scientific Advisor to the Assistant Secretary for Science and Technology of the Department of Commerce. He helped establish and became the first director of the Office of World Weather Systems within ESSA in February 1966. From July 1969 to October 1970 he was Assistant Administrator for Environmental Systems of the Environmental Science Services Administration, the predecessor of NOAA.

Dr. Hallgren was one of the 1968 winners of the annual Arthur S. Flemming Awards for outstanding young men in the Federal government. He was a Department of Commerce Gold Medal Award winner in 1969. He has been active internationally working with the World Meteorological Organization (a specialized agency of the United Nations), the Intergovernmental Oceanographic Commission, and various bodies of the International Council of Scientific Unions.

He has authored a number of papers on meteorology systems, cloud physics, and atmospheric electricity. He is a member of Sigma Xi, the American Meteorological Society and the American Oceanic Organization.

Dr. HALLGREN. NOAA's environmental monitoring and prediction program covers a very broad range of activities, and literally all parts of the environment. In other words, we not only have activities in weather monitoring and prediction, but our interests include the sun, the upper atmosphere, the oceans, and certain aspects of the earth as reflected by our earthquake activities.

This is an area which is heavily service oriented, and which has three major facets. We provide warnings of pending natural disasters. We provide forecasts of the general environmental conditions, each and every day. We provide assessments of the short-term and long-term effects on the environment of natural and/or manmade activities.

One of the opportunities afforded us by this broad range of involvement is that we can take into account how these activities are intertwined within an overall national environmental monitoring and prediction system. We can also take into account that in many cases the same science and the same technology is required to deal with problems of predicting what the environment might do to man as well as what man might be doing to the environment. We have been striving to develop NOAA's program to be responsive to both dimensions.

I would also like to stress, as Dr. White indicated, that even with this very broad involvement, NOAA's programs are only one part of the total program in each of these areas supported by other Federal agencies. Therefore, we have to have extensive interagency cooperation. In fact, we are the lead agency in both meteorological and marine environmental prediction activities. We have developed arrangements for coordinating with the other agencies involved.

Likewise, internationally, we work very closely, as was mentioned by Dr. White, through a number of international bodies of the United Nations to foster and coordinate our programs with those of other nations. We need their data, their information, and their knowledge of the environmental processes just as much as they need our data and knowledge.

A year and a half ago I mentioned, with regard to international activities, two major field experiments in my testimony; namely, the International Field Year for the Great Lakes and the GARP Atlantic tropical experiment (GATE). I am pleased to report, Mr. Chairman, that the field activity or the field portion of the International Field Year for the Great Lakes is now in progress, and in fact some portions of this are coming to a conclusion as winter sets in, and the entire field portion will be completed by March 31 of next year.

In the case of the GATE the plans are proceeding quite rapidly, for it is scheduled to take place in June through September of 1974. Thirteen nations, I believe that was the latest count, have committed approximately 25 ships. In addition, approximately 10 or 12 aircraft have been committed to the experiment. In addition, we have the necessary satellites committed by the United States and the Soviet Union. Therefore, it appears we have adequate facilities through international cooperation to carry out this very important experiment that takes place in the area where our hurricanes develop, and in the tropical regions where much of the energy reflected in midlatitude weather is put into the atmosphere.

I would like to cover very briefly two areas that are of great importance in the area of environmental monitoring and prediction. One area involves our activities concerned with natural disasters, and the other with the monitoring assessment and prediction of oceanic conditions. Through the end of November we had 45 declarations of natural disasters by the President. Of these, five were associated with Agnes, which, of course, has been classified as the most extensive disaster ever to strike the United States. In that, as Dr. White men-

tioned, there were 118 lives lost and \$3.5 billion of damage, which indicate the scope and magnitude of this disaster.

Smaller in scope, size, and dimension, but with even a greater loss of life was the Black Hills flood which took place earlier this summer, in which 236 lives were lost. These disasters brought home to us the problems of trying to cope with and have a full and adequate warning system. In these disasters our warning system performed quite well, in general, although we fully recognize it was stretched to its limit. Many people worked far beyond what is possible for a human to do; for example, in terms of the number of consecutive duty hours to provide these vital services that saved lives and protected property. As a result, of course, we have been working very hard to see where our system performed well and where it needs improvement.

There are two basic aspects to this particular problem. There is the overall warning system, which has essentially three parts, (1) detection of the natural phenomena, (2) preparation of the warning, and (3) dissemination of that information to the media and to the public.

The second aspect is the community preparedness. The community must be prepared to respond.

These two activities, the warning system and community preparedness, must go hand in hand. We have been constantly striving to make improvements in these, and I have tried to outline in my statement some of the improvements that have to be made. The job that has to be done is to bring about a more responsive system, through additional people and additional use of some of the new technology for detecting storms such as radars, and the synchronous satellite which provide detailed information on the smaller scale features of weather that are associated with these disasters. We must also use a whole range of automation for disseminating the information to the public and for bringing data up from the small communities.

We are presently working very intensively with the Defense Civil Preparedness Agency and the Office of Emergency Preparedness to develop better community preparedness plans throughout the Nation, so that our public can respond to the warnings. We have taken the lead in preparing a national program or plan for natural disasters.

In the area of the oceans, there is a growing need for more extensive monitoring, assessment and prediction in our coastal and offshore waters. As you mentioned this morning, Mr. Chairman, 80 million of our people live near the coast and use it as an extensive source of recreation.

In addition, we are turning to that region more and more for our resources, both living and nonliving, and of course it has always been an important transportation area. We are also turning to it as a possible situs for superports or nuclear plants.

These activities need to have environmental services, to make them more efficient and safe, and to be able to assess what might happen to the environment both in the short and long term.

Therefore, we are working with the other agencies to develop an improved service and an integrated arrangement and system to meet this broad range of needs for data and for predictions and assessments of what will happen environmentally in these areas.

This program, of course, will be built upon the existing activities that we have underway for weather prediction systems. We will also use the types of facilities that Mr. Wallace described in MARMAP

and will rely upon the research program on marine ecosystems analysis and our studies of ocean properties and processes that we have been pursuing for a number of years. In other words, we will be putting much of our ocean science and technology to work to try to meet this growing need for environmental services.

We in NOAA are taking the view that was suggested in the Stratton Commission report to bring about a national environmental monitoring and prediction system. There is much work remaining to be done, but I believe we are on our way. We are working very closely with the other Federal agencies in trying to achieve this system. Thank you.

Mr. LENNON. Thank you, Doctor.

Mr. HEYWARD. Dr. Hallgren, everybody thinks he is a fish expert, but I don't know if there are many experts in the field of environmental monitoring. There are a couple of questions I would like to ask. In connection with your comments about Agnes you say that your system—I have forgotten how you worded it—the capability of the system was stretched to the breaking point. Was that in communications basically, or to what were you referring there?

Dr. HALLGREN. One must recognize that Agnes was a very extensive and large disaster. It lasted for a long period of time. While we performed well in each and every part we saw that we were working without much latitude or any really spare residual capability. Some people worked 5 and 6 days consecutively, with only a couple hours sleep each day. In fact, one man slept in the room where the radar was, and he would try and watch the radar while still trying to catch a few winks of sleep.

We also saw where our communication system obviously was not as good as it could be in getting the warnings to the public as quickly as possible. For example, some of our dissemination systems were only partially implemented in the areas covered by Agnes. Therefore, throughout the system very substantial improvements are needed.

Mr. HEYWARD. Is there a possibility of a program that would have standby personnel of some type to come in to assist in this type of activity, either through OEP or some other agency that you could call on?

Dr. HALLGREN. Of course, there are many ideas such as the one you have mentioned in trying to solve this problem. We must use a number of techniques. In fact, we did in this particular storm. By knowing that the storm was going to be quite severe in one area, we moved people over temporarily to assist in that area.

In addition, it is my personal feeling that technology can go a long way in helping us in this regard. If we have arrangements whereby you have telephone communications that interconnect offices very well, then offices located in another place, maybe 50 or 100 miles away, can be helping out. Today's modern technology can make that possible, so I think it is a combination of the type of idea you mentioned and really putting some of this modern technology to work that is available to us is the way to build a more responsive warning system.

Mr. HEYWARD. How much of a problem is involved here in either the State or Federal capability to in fact force the public to take certain action, even after you have advised them when they are reluctant

to take action to protect themselves? Is this an area that is being pursued?

I don't suggest that we declare martial law, but perhaps something along that line that would in fact require the movement of people out of the area that is threatened, when many of them ignore the warning because "it hasn't happened in their lifetime."

Dr. HALLGREN. When I referred to community preparedness as being one of the two major activities, the other being the warning system, I was referring to the need to have sound plans of action within the communities to respond to the warnings that we issue. Of course, the people must react to the warnings and how well they react depends upon how well the plan has been thought through, and also how good our warnings are. We fully recognize that.

For example, in the case of Wilkes-Barre, the evacuation of about 100,000 people took place, based on the warning, and it was because someone came in and said, "You have to move out," and people did.

In other areas, of course, without good plans and without the strength of that forceful action, the warning service cannot succeed. We will want to work very hard and are working very hard to try and get more of our people out there working with OEP and DCPA in getting these community preparedness plans in being.

Mr. HEYWARD. Is the very critical decision point on when you invoke the plans? Unfortunately periodic casualties make it much more apparent to the people as to what they are doing, and yet as I recall some years ago when I was in Hawaii, when the Tsunami warnings came a couple of times that turned out to be duds, everybody immediately reacted, "Well, this is a bunch of hog wash." I guess periodic repetition is really the thing that keeps the public aware of what it ought to be doing, but obviously the capability in a situation such as Agnes, requiring action instead of leaving it to the public, is an answer.

I assume, from the experience of the flooding recently in Virginia, that as to the lack of damage as compared with the damage that occurred a couple of years ago, the very fact that that damage occurred a couple of years ago meant less damage this time.

Mr. LENNON. Mr. Sharood.

Mr. SHAROOD. Doctor, what is the present evaluation of the data buoy program? You have several in being. Is it being pushed? Is it considered a highly useful tool? Is it of questionable merit? Where does it stand in your overall environmental data accession system?

Dr. HALLGREN. I spent a good amount of my time thinking about and working with the people who are assigned to this very difficult and challenging development task. It is a key platform, whenever one is trying to design an environmental monitoring system that deals with both the ocean and atmosphere. It is an important and essential platform. We have been trying to move that technology forward, so that the buoys achieve sufficient reliability and can observe the range of parameters that are needed by those trying to make the predictions.

In this regard I think we are making a considerable amount of progress. Let me just say again that it is a very difficult technological problem. The ocean is a very harsh environment in which to place an automatic device and expect it to last for an extended period of time.

Since the buoy program has come into NOAA, we have adjusted its direction somewhat. Initially, it was concentrating on principally one class of buoy. They are now developing several classes of buoys. By class I mean different sizes and numbers of parameters or observations that are to be made by the buoy. In addition, we are trying to make sure that in each of these classes the buoys can be made ready for use both in an operational service and in scientific research projects like those that I have mentioned, for example the GARP tropical experiment or the marine ecosystem analysis program mentioned by Mr. Wallace.

We have several buoys in the water. These are the first larger class experimental buoys. We have had failures. What is encouraging is that the first buoy that we put into the water had more failures than the second one. I am hoping to see progress along this line with each succeeding buoy. At the same time we have the smaller ones coming in and we will be starting our test program there. It is not an easy problem. The men have a very difficult technological problem on their hands but I think we are making substantial progress.

Mr. SHAROOD. Thank you, Mr. Chairman.

Mr. LENNON. Doctor, I suppose in your capacity as Associate Administrator for Environmental Monitoring and Prediction that you necessarily work with Mr. Moore who is designated as the Assistant Administrator for Environmental Modification. I would assume that that is interrelated. Have you had an opportunity to read the report of the National Advisory Committee on Oceans and Atmosphere, particularly as it relates to monitoring and modifications, environmental monitoring, prediction and modification?

Dr. HALLGREN. I have read that report. I studied the section dealing with climate modification, because in this area Mr. Moore and I work very closely together. For example, the modeling effort that is required to understand climate variations is, to a very large degree, being done at the Geophysical Fluid Dynamics Laboratory of NOAA using the same computer and the same research scientists that are working on the problem of extended range weather predictions. These are closely intertwined problems.

Don Moore has been implementing the baseline monitoring stations that are essential to provide the information as to what is happening in terms of certain gases that may affect the way the energy is distributed in the atmosphere, and therefore the climate. We work very closely in this regard.

Likewise, in the area of weather modification, which by coincidence is the area in which my Ph. D. was awarded, we have to work very closely because the understanding of the physical processes in thunderstorms and in hurricanes needed to determine how we may go about controlling their intensities, is also needed to try and understand and predict where they might move.

Mr. LENNON. Are we involved to any degree in environmental modification on a hail suppression project to determine the capability of our being able to suppress hail?

Dr. HALLGREN. Mr. Chairman, please permit me to defer this question to Mr. Moore.

Mr. LENNON. In their report they state that weather modification is being studied by the Federal Government. It is carried out by

seven agencies in the Federal Government. The committee names the agencies. They concluded by saying, "The present fragmented approach is moving the country ahead in weather modification in an erratic fashion." I don't know whether we should take that seriously or not but I don't think they would put it in there if that hadn't been their analysis, judgment, and evaluation of the way we are moving.

Dr. HALLGREN. That is another question, Mr. Chairman, that I would like to refer to Don Moore.

Mr. LENNON. They state:

The Federal Government need only be concerned with providing the minimum number of heavy aircraft equipped with sensing and recording systems, radars, and seeding capabilities required of the program. NACOA notes with concern the need to cancel NOAA's planned move of its hurricane modification project, Project Stormfury, to the Pacific for lack of such aircraft.

I don't care what anybody does, if they are sitting at the top of the ladder monitoring. They make a lot of suggestions that I am sure are challenging to NOAA. Whether or not they can ever be implemented I don't know.

By the way, in connection with the operation in the Great Lakes, I see you refer to having 10 vessels involved there since early this spring. I believe you say that on page 6. You have 10 major vessels, 40 buoys, and several automatic stations and aircraft. The institute in my hometown has also participated in that program since early this spring. They are now on the way back to Wilmington, N.C., at this time. It was a great experience I know for the technical institute students, and I certainly express the hope that they have performed well. I will let you reply to that later, Dr. White.

Dr. HALLGREN. Mr. Chairman, I can tell you they did admirably throughout the entire period. The *Advance II* was one of the two largest research vessels that had the most comprehensive scientific missions on the lakes. Our *NOAA Researcher* and the *Advance II*, they had to cover some 100 stations across Lake Ontario on the average of two or three times a week, taking both samples of water quality as well as the more standard information concerning the temperature. They did just an excellent job, with the fullest cooperation in every way. We had many, many fine reports not only from the field team, but from the scientists who used these platforms during the course of the year.

Mr. LENNON. I am sure there were many other students involved as they were a couple of years ago. It has been a tremendous experience. Thank you very much, Doctor. We certainly appreciate your giving us this very informative and helpful and interesting statement.

(See Appendix B for detailed program summary.)

Mr. LENNON. Our next witness will be Donald F. Moore, Assistant Administrator for Environmental Modification, NOAA. First, I would like to have Mr. Moore's biographical sketch appear at this point. Go ahead Mr. Moore.

(A biographical sketch follows:)

BIOGRAPHICAL SKETCH: DONALD F. MOORE

Mr. Moore has been Assistant Administrator for Environmental Modification of the National Oceanic and Atmospheric Administration (NOAA), Department of Commerce since May 1972. Previously he was Assistant Administrator for

Policy and Plans of NOAA and Assistant Administrator for Plans and Programs of ESSA. Early in 1964 he was named Deputy Federal Coordinator for Meteorological Services and Supporting Research.

Mr. Moore was born in Clinton, Wisconsin, and attended Delavan High School, Delavan, Wisconsin. He enlisted in the Air Force in 1940 and was trained as a weather observer and forecaster. He was commissioned a second lieutenant in 1942, after attending Officer Candidate School.

His Air Force assignments included duty as inspector of weather facilities throughout the United States, as operations officer for weather squadrons in Brazil, Japan and Germany.

From 1950 to 1952, he worked in the Plans Office at Air Weather Service headquarters. He then was transferred to the Joint Chiefs of Staff in the Pentagon, where he was assigned as Secretary of the Joint Meteorological Committee. He was also designated Secretary for the Standing Group Meteorological Committee of the North Atlantic Treaty Organization, and the Subcommittee on Aviation Meteorology of the Air Coordinating Committee. From 1959 until 1961, he served with the Air Force Systems Command as deputy director of a research and development program to improve weather services—System 433L.

He joined the Weather Bureau in 1963 as military advisor to the Chief of Bureau and also held the post of acting chief of the Bureau's Office of Planning. He retired from the Air Force in 1964, with the rank of Colonel.

Mr. Moore has studied at the University of Maryland, George Washington University, American International College, the Institute of Tropical Meteorology at San Juan, Puerto Rico, and various military institutes including the Air Command and Staff College and the Air War College at Maxwell Air Force Base. He is a professional member of the American Meteorological Society.

Mr. Moore received the Department of Commerce Gold Medal in 1971.

STATEMENT OF DONALD F. MOORE, ASSISTANT ADMINISTRATOR FOR ENVIRONMENTAL MODIFICATION

Mr. MOORE. Mr. Chairman and members of the subcommittee, thank you for the opportunity to present to you information on NOAA's environmental modification activities. The importance of an environmental modification program in the National Oceanic and Atmospheric Administration was formally recognized in April of this year when the Department of Commerce established within NOAA my position as Assistant Administrator for Environmental Modification.

Of the three main goals of NOAA, my responsibility is: to explore the feasibility of and, where warranted, to develop a national capability for beneficial modification of environmental conditions, and to understand the consequences of inadvertent environmental modification.

To meet this goal, it is my responsibility to:

- Undertake long-range policy planning and analysis and recommend NOAA policy to the Administrator.

- Insure that NOAA develops and maintains effective programs in inadvertent and intentional weather modification.

- Monitor the management and allocation of NOAA aircraft facilities.

- Monitor and evaluate assigned programs and recommend program redirections, curtailments, expansions and new program initiatives.

- Conduct or monitor studies of the economic and social ramifications and possible unwanted side effects of environmental modifications.

- Carry out Department of Commerce responsibilities under the Weather Modification Reporting Act, Public Law 92-205.

Develop, in conjunction with NOAA's General Counsel, the legislative program necessary to the furtherance of the Nation's environmental modification programs.

The responsibilities mentioned above come about because of NOAA's recognition of the reality of weather modification and the realization that a new technology is surfacing that could lead to a significant effort in private industry and to considerable benefits for the public. At the same time NOAA recognizes that disbenefits will occur and must be minimized.

Several surveys of the status of weather modification have been completed in the past few years. In summary it can be said that the present state of the art in weather modification varies with the phenomena involved. Cold fog dispersion is now a routine operation. Precipitation increases from winter orographic clouds under specified conditions can be considered operational. Precipitation has been increased in tropical and semi-tropical maritime cumulus clouds and in winter clouds over the Great Lakes. Mixed results are being obtained with other forms of precipitation enhancement, and with warm fog dispersion and hail and lightning suppression. Hurricane modification looks promising but progress has been delayed for lack of suitable storms to experiment on.

Further research is needed in many areas of weather modification and is being pursued by many agencies of the Federal Government. A recent report by the Interdepartmental Committee for Atmospheric Sciences (ICAS), a committee of the Federal Council for Science and Technology (FCST), shows that Federal funding for weather modification was \$16 million in fiscal year 1971, an estimated \$20 million in fiscal year 1972 and a projected \$25 million in fiscal year 1973. The Departments of Commerce and Interior and the National Science Foundation account for about 90 percent of the expenditures, Commerce (NOAA) being funded at a level of \$9.2 million for fiscal 1973. The Federal effort in weather modification doubled from fiscal year 1969 to fiscal year 1972 and could be \$50 million per year by the late 1970's.

Private, State and Federal activities are increasing. Weather modification activities cover more than 60,000 square miles of the United States, most of it in the Midwest and Rocky Mountain States. A partial survey conducted by NOAA and the Council for Environmental Quality shows that more than 60 projects (27 Federal and 34 private) existed in 20 States in calendar year 1971. The State of South Dakota has embarked on an operational program in weather modification designed to increase rain and decrease hail. Florida, Texas, Arizona, Oklahoma, and Kansas have utilized weather modification in attempts at mitigating droughts.

Reports by several scientific panels have stressed the national importance of weather modification activities, both intentional and inadvertent. The Committee on Atmospheric Sciences/National Research Council's Report on Weather and Climate Modification, the Stratton Commission report, the Office of Emergency Preparedness (OEP) Disaster Preparedness Report, and the First Annual Report of the National Advisory Committee on Oceans and Atmosphere (NACOA) have concluded that a Federal role in the development and control of the technology is necessary. A call is made for an expanded research

effort to identify those weather situations and modification techniques which will result in an increase, a decrease, or a redistribution of precipitation in a predictable manner. NOAA is identified by most of these groups as the local Federal agency to assume a key role in developing a vigorous and effective research program and to coordinate a national program in weather modification.

To meet its weather modification responsibilities, NOAA has established a policy of conducting research in hurricane abatement and precipitation enhancement. Operational work on hurricanes and other severe storms is to be conducted when suitable techniques have been developed. Limited emphasis is placed on research in hail and lightning reduction, leaving this work primarily to other agencies of the Government.

Weather modification presents many opportunities for cooperation among Federal agencies. NOAA provides advice and technical assistance to OEP, as well as State and local governments. NOAA is expanding its participation with the Bureau of Reclamation, particularly in relation to a precipitation enhancement program. NOAA is supporting studies in cooperation with NSF to determine how best to deal with liability questions. NOAA provides advice and technical assistance to the State Department concerning requests for international aid in weather modification.

In addition to this cooperation with other Federal agencies, NOAA seeks to stimulate the private and university sectors of weather modification by increasing participation in NOAA's weather modification research program through grants and contracts to encourage the long-term development of resources and capabilities.

NOAA seeks to increase the involvement of the World Meteorological Organization (WMO) in weather modification by helping to enlarge the WMO role in rendering advice and assistance to foreign countries; by encouraging the establishment of international reporting programs, similar to the U.S. one under Public Law 92-205; and by recommending use of United Nations or WMO funds to meet the needs of foreign countries in lieu of AID funds.

The implementation of weather modification efforts within NOAA is accomplished by the Environmental Research Laboratories (ERL). The primary projects designed to intentionally modify the weather are Stormfury (hurricanes), the Great Lakes snowstorm modification project, and the Florida cumulus project. Other activities involve lightning and hail suppression. NOAA's efforts in inadvertent weather modification are directed at monitoring the atmospheric environment to determine the effects of man's activity on his climate and weather.

Our hurricane research is stimulated by the fact that in the past few years Hurricanes Camille, Cecilia, and Agnes produced \$1.5, \$0.45, and over \$3.5 billions worth of damage respectively. Since the last oversight hearings, we have conducted seeding experiments on Hurricane Ginger in October 1971, carried out several experiments on tropical cumulus clouds, conducted sea-slick experiments, and continued development of numerical and theoretical studies of hurricanes. No suitable hurricanes were present for experimentation in 1972 and none were seeded. The seeding effects on Ginger were inconclusive due, we think, to the large, diffuse nature of the storm.

Results from the Great Lakes snowstorm modification project have shown that the original seeding concept of redistributing the snowfall from lake storms has been found valid except in cases where the artificially produced snow crystals form snowflakes of high density; then the redistribution is not as effective. It may be possible to hasten the formation of precipitation and discharge more of the precipitation into the lake resulting in a more favorable hydrological balance for the Great Lakes region.

As a result of the work by the Experimental Meteorology Laboratory in Florida, the promotion of cloud mergers by silver iodide seeding has been shown to have great potential for producing significant amounts of rain. Application of this technique by NOAA helped in mitigating the 1971 south Florida drought. Important work is being conducted on the use of radar and raingage networks to accurately measure the rain in a large target area and on determining the effects, if any, of cloud seeding on the weather outside of the seeded area.

The success of NOAA's efforts in weather modification in Florida and the Great Lakes Basin, and the call by the various scientific panels mentioned above for a clearer definition of cloud seeding effects, has led NOAA to study the feasibility of initiating a program for a well-controlled year-around precipitation enhancement project. A site selection board is acting on proposals to study the climatology, the existing facilities and the active projects in the region. A request for proposals for a comprehensive design study is in preparation.

NOAA's inadvertent weather modification research is primarily concerned with making accurate measurements of the present amounts of manmade contaminants in the atmosphere, the determination of their rates of increase, and the properties of the atmosphere that are affected by these contaminants. Stations in Mauna Loa, Hawaii, and Antarctica are participating with a total of six stations planned for eventual installation. Barrow, Alaska, the next station to be implemented, will begin operation in January.

NOAA has recently been assigned a new responsibility in the field of weather modification. Public Law 92-205 requires all private weather modification activities within the 50 States, District of Columbia, Puerto Rico, and any U.S. territory or possession to be reported to the Secretary of Commerce. Federal rules and regulations were published in the Federal Register, volume 37, No. 208, dated October 27, 1972.

Adequate recordkeeping is required on all weather modification projects which includes any activity performed with the intention of producing artificial changes in the composition, behavior, or dynamics of the atmosphere. Reports are required before and after completion of each new project or activity, and on each October 1 for continuing activities. These records will be on file in NOAA and are open to the public as provided in the act.

A few problems exist to impede progress in weather modification. There is a real and growing concern over interference between private operational weather modification programs and expensive research programs supported by Federal funds. Contamination from private operational programs have already negated the results of some Federal research programs. This situation can only worsen as the activities increase.

The question of environmental hazards resulting from weather modification activities is under continuing study. Environmental impact statements are filed on all programs which could conceivably have any impact. Studies to date have not shown present activities to be harmful, either in terms of the seeding materials being used or in terms of lasting effects on the environment. It is recognized, however, that safeguards are necessary to insure that seeding activities do not produce hazardous weather conditions. NOAA provides for such safeguards in its own experimental programs.

Our field research on hurricanes is encountering some difficulties, primarily due to the low incidence of suitable hurricanes in the Atlantic test area. Also, the Department of Defense has informed NOAA that they will only be able to participate in Stormfury in fiscal year 1974 and beyond on a fully reimbursable basis, and then only if the necessary aircraft are available for nonmilitary use. Finally, some of the aircraft of the Research Flight Facility are aging and becoming of marginal use for hurricane reconnaissance. A move to the Pacific is planned when resources permit, so that additional test cases can be obtained.

While there are admittedly some problems associated with weather modification, the potential benefits of successful weather modification are extremely attractive. In addition to the human benefits that can accrue, there are economic benefits as well since application of weather modification techniques has the potential of producing benefits far in excess of the costs of the program. Benefit-to-cost ratios range from 5 to 1 for cold fog suppression to as high as 100 to 1 for some precipitation enhancement projects. The 100-to-1 ratio must be viewed as an outside estimate because the estimate was made without calculating possible offsetting effects or disbenefits. Savings of lives and property by mitigating severe storms and moderating hurricanes appear possible and become more urgent as our society becomes more urbanized, increasing the potential for disasters. Internationally, interest is high; areas of cooperation are developing and scientific exchanges are occurring both in inadvertent and intentional weather modification subjects.

The chance to alleviate human suffering caused by weather events and to exercise some measure of control over our environment is a challenge. NOAA has accepted this challenge and seeks to improve the technology of weather modification, to make it responsive to the needs of the citizens, and to cooperate with other nations in applying its benefits to all.

Thank you, Mr. Chairman. I will be happy to answer any questions you may have.

(See appendix C for detailed summary.)

Mr. LENNON. Thank you, Mr. Moore.

Mr. Moore, the chapter entitled "Weather Modification" in the NOAA report I am sure you have read with interest.

Mr. MOORE. Yes, sir.

Mr. LENNON. Its specific recommendations order definitive actions, legislation, technology, and so forth. There are some interesting points in this particular chapter. I note under No. 3 it is your responsibility to monitor and allocate NOAA aircraft facilities. Do you want to comment on the expression of concern, because NOAA has had to cancel

its planned move to the Pacific due to the lack of modern, well instrumented aircraft? They precede that question of concern by calling attention to the fact that at one time the best facilities will be required to support the development program. One of the requirements is modern aircraft. Just by way of curiosity, in the fiscal 1973 budget were there line items for any particular type of aircraft to meet the need that NACOA has mentioned here?

Mr. MOORE. No, sir; there were not. There was money to improve the instrumentation on one of our aircraft.

Mr. LENNON. I don't know how significant it is, this planned move of the hurricane modification project to the Pacific having to be canceled due to lack of suitable aircraft facilities to move it. Would you comment on the statement made by NACOA: "The present fragmented approach is moving the country ahead in weather modification in an erratic fashion". Is that a fair statement or does it go too far?

Mr. MOORE. I believe that there is a need for a central focus within the U.S. Government for carrying out research and development in all phases of weather modification. However, I believe that weather modification technology should remain available for use by all agencies of the Federal Government in the discharge of their mission responsibilities.

Sir, let me go back for a moment to answer your added comment with respect to the aircraft. The problem with respect to the move to the Pacific, which was in fact planned for this past summer, rested primarily with the military aircraft, not with NOAA aircraft, although our aircraft are getting old and the instrumentation is not as reliable as we would like. The overriding problem this summer was the fact that we depend very heavily on military aircraft. It takes about 17 airplanes to carry out this project. NOAA only has three of the type that can be used for this purpose, so you can appreciate we depend very heavily on the military.

The military were unable to provide us with enough aircraft with the type of recording systems and radar that were required to make it worthwhile to make the move. That was the primary reason we did not move this summer, not because of deficiencies in our own force.

Mr. LENNON. Did you have an opportunity to read on pages 27 and 28, under the same chapter referring to weather modification some of the findings, conclusions and recommendations of NACOA, related to the need for legislation that would require licensing of anyone privately engaged in any type of weather modification? You may be able to answer that now, Mr. Moore. Does the law now require that a person get a specific definitive type of license, and demonstrate capability and put up a bond sufficient to insure the recovery for any damage that might be done?

Mr. MOORE. No, sir; there is no Federal law that requires that. The only Federal law is the one which Dr. White mentioned, which merely requires that private seeders who are not supported by Federal funds report to us in advance their activities before carrying them out. Some States have licensing laws but there is no Federal law.

Mr. LENNON. Certainly the Federal Government through both the Federal Communications Commission and the Federal Aviation Agency has jurisdiction in the air.

Mr. MOORE. Yes, sir.

Mr. LENNON. Should we have legislation that would require the Federal licensing of anyone who was engaged in experimentation with clouds, hail, or with anything else? I am inclined to think we should. I am a States-righter, but in this you just move from one State to another when you get into clouds. You can't control this from the ground.

Mr. MOORE. You are absolutely right, Mr. Chairman. I think in my own judgment it is only a question of time before there is a need for some form of Federal regulation. NOAA is studying this problem. As I mentioned earlier where you have Federal projects being carried out in the country, we are concerned that our projects not be contaminated by private operators moving into the area. Some form of regulation will be required to prevent that.

Mr. LENNON. If a person seeded clouds or tried to modify the weather to any degree related to the upper atmosphere, it could move into another State in a matter of hours.

Mr. MOORE. Yes, sir.

Mr. LENNON. Certainly you have interstate and foreign commerce there. The Federal Government under article I, section 8, I believe of the Constitution, has definitive authority in any matter engaging in interstate and foreign commerce. I think legislation like that would stand.

On page 28, "To illustrate the problem, there recently was a test carried out to determine whether a seeding program upstream of a field project could be affecting the project. The results showed that 20 to 30 percent of the seeding agent introduced 100 miles upstream was actually contaminating the field project. In addition, the National Science Foundation has reported that two major weather modification projects supported by the NSF in the Western United States were seriously compromised by unregulated cloud seeding in the vicinity of the projects."

When you say unregulated, I assume it is a private individual. Is that a correct assumption?

Mr. MOORE. Yes, sir.

Mr. LENNON. "In one of the cases, the Foundation investment of over \$1/4 million was negated by the lack of regulation." That is \$1/4 million that comes from your Federal income tax and mine, too.

"Regulation at this time should be the minimum necessary to insure that critical Federal experiments are not vitiated as a result of contamination by a nearby seeding activity and to insure that all commercial operators are licensed and meet certain specified standards to protect the populace from unsafe seeding procedures."

If the general American public is going to become convinced that the responsibility to make these experiments is NOAA, and yet they read in the paper that somebody else is doing it, when something happens that causes them to lose money due to damage to their crops, the public is going to say that is the Federal Government. That is NOAA. I wish you would ask your counsel to look into this matter, Dr. White, rather seriously to determine if we haven't come to the point in time that the Congress shouldn't possibly consider legislation or at least have some hearings whether to require the strict licensing of those private individuals getting involved in any type of weather modification. I just don't believe private individuals ought to do it,

because we don't know that they have sufficient economic resources with which they can respond to a lawsuit by a community that was damaged substantially by inadvertent weather modifications. How would you respond to that, Doctor? I think this is a legal question, and certainly I am satisfied that if there is any possibility of that seeding getting across State lines the Federal Government ought to have jurisdiction over it.

Mr. WHITE. You have your finger on a very important and a very difficult problem, Mr. Chairman. We are discussing within the executive branch possible forms of legislation in the weather modification area. The executive branch has previously submitted weather modification legislation which provided for limited regulation and a study of the liability problem. I think 5 years ago, which did not pass because I believe the committee reviewing that didn't feel that the liability question, the one that you are addressing, was adequately handled in the proposed legislation.

The liability question itself has all sorts of ramifications, and that is why the drafting of such legislation is so difficult, but I can tell you it is under serious review within the executive branch at this time.

Mr. LENNON. What you are saying is that legislation was considered by the Interstate and Foreign Commerce Committee?

Mr. WHITE. Five years ago.

Mr. LENNON. That would require the licensing of those people who engage in any type of weather modification, talking about private individuals?

Mr. WHITE. No, that legislation did not address the question of licensing. That legislation addressed agency authorities, limited regulation, reporting and coordination and provided for a number of studies including one on liability.

Mr. LENNON. Do you have questions, counsel?

Mr. HEYWARD. I would like to ask one further question on this. What is the present legislative authority as far as NOAA is concerned for entering into the weather modification field? Is it the general research authority in this area?

Mr. MOORE. It is in our basic act.

Mr. HEYWARD. To do research in weather, is that the idea?

Mr. MOORE. That is correct.

Mr. HEYWARD. But there is no specific authority which covers the inadvertent results as I understand it. This was attempted 3 years ago, in order to clarify the issue of what liability would ensue.

Mr. WHITE. To my knowledge all of the agencies now engaged in weather modification draw their authority from their basic statutes, which require them to carry out certain missions, and weather modification therefore becomes a tool in carrying out the mission.

Mr. HEYWARD. I would think it would be very important that there be some basic statutory authority to do this within NOAA in its responsibilities in the weather area as the agency which might perform the work for the other agencies, whether fog dispersion or anything else. It is not only that the private citizen may be getting up and deciding he wants a little rainfall on his corn, but if all the Federal agencies are going to start monkeying around with the weather, there is no telling what we are going to get out of it.

I would like to ask you one other question, Dr. White, in connection with the various environmental projects that have been underway in NATO, under the Committee on the Concerns of Modern Society, in the earthquake area, in air pollution and in other pollution areas. Is NOAA involved in any of those projects?

Mr. WHITE. Yes, we have had some of our specialists involved in specific projects, as for example, the project to set up a flood warning system. That came up because of the devastating floods in Italy which ruined many of the statues and historical monuments. So we have been involved in a number of the projects, but strictly in a technical sense, as with earthquakes.

Mr. HEYWARD. Are you the lead agency, for instance, in flood warning projects in NATO for the United States of America?

Mr. WHITE. I don't know that you can designate us as the lead agency, but insofar as flood warnings are concerned, it is our specialists who are working with them.

Mr. HEYWARD. Following some of those projects, in the field of highway safety, for instance, there have been bilateral agreements of various types signed with other countries flowing from that CCMS initiative with countries outside of NATO. Have we done anything like that in the earthquake, flood warning, or other studies?

Mr. WHITE. In the earthquake area there are a number of activities going on. For example, we work with many countries in the world in establishing a worldwide seismic net, which gives us seismic information from all over the world. In our recent environmental negotiations with the Soviets one of the interesting results was to agree on a cooperative program in earthquake prediction. We will send our scientists and instrumentation to the Soviet Union to monitor quakes over there, and they will send their scientists and instrumentation here to our San Andreas fault region in California to monitor quakes here. The purpose is to join together to look at techniques for earthquake predictions. The Soviets have made some significant progress in the technique of earthquake prediction. These are some of the ways we work with other nations.

When it comes to floods and weather conditions, the principal mechanism for dealing with other nations has been the World Meteorological Organization. We deal with those mostly on a multilateral basis through that organization, although we also maintain bilateral arrangements.

Mr. LENNON. Returning to the question of developing weather modification, I remember now, having read in Mr. Moore's statement that Public Law 92-205 requires that all private weather modification activities within the 50 States, District of Columbia, and Puerto Rico be reported to the Secretary of Commerce. These Federal rules and regulations were published in the Federal Register on October 27, 1972.

Reading further from your statement, Mr. Moore, you raise some questions as to the environmental hazards resulting from weather modifications, and the studies that are being required now. You also state, "A few problems exist to impeding progress in weather modification. There is a real and growing concern over interference between private operation of weather modification programs and expensive research programs supported by Federal funds. Contamination from

private operations of the program have already negated the results of some Federal research programs.”

That is a recapitulation of what NACOA said in its report. This situation can only worsen as the activities increase. If the existing law ought to provide for a private person who is going to develop his own philosophy as to weather modification, that is not going to help the situation, is it, in reporting to the Secretary, except to put you on notice, “Don’t you go out there with a Federal project, because it might interfere with this project that John Doe is going to start,” or perhaps you have already started your Federal project and he wants to put one on in the adjoining State or community. You can’t stop him, unless you go into court and get an injunction. As I see it, this question ought to be seriously considered as to private environmental or weather modification. I think it has got to be done at a national level.

Mr. LENNON. Reading on further, I see that a number of States are opposed to weather modification. I think there ought to be certain standards set by the Federal Government that even a State could not get involved in weather modifications because in many instances it’s going to affect the adjoining States to some degree and it is involved in interstate commerce.

I would like counsel to go very seriously through this. My thinking would be that no private individuals can do this and no less than a political subdivision of a State, nothing less than that, but the State would have to follow Federal criteria. Then they could be licensed to do it. I don’t think people ought to be licensed to do this if it resulted in one single catastrophic incident. It would just destroy the public faith in the Congress and in the Federal Government if we sat here and did nothing about it, having anticipated that these things could happen.

Mr. MOORE. Mr. Chairman, may I take the other side of the question just for a moment?

Mr. LENNON. Yes; the other side, your side and my side.

Mr. MOORE. There are quite a number of reputable private concerns in the country doing weather modification today. Some of them are under contract to individual farm groups, some are under contract to the States. The State of South Dakota has its own program going. They believe very strongly in the weather modification they are receiving. They think it is beneficial to them. So I think from that standpoint there might be some opposition to Federal regulation in some quarters.

Then there is another point that should be made. There are certain functions in weather modification that are not really interstate in nature. I don’t believe they require the authority of a political subdivision. For example, cold and warm fog dispersal are very localized activities which go on today in the country, by and large, by private concerns working with airport authorities. I don’t think we really need to disturb that type of arrangement.

I do agree that there is a problem. I can illustrate for you, Mr. Chairman, in my testimony where I refer to the fact that we are looking at the possibility of locating a major experiment in precipitation enhancement in some place in the Midwestern United States. One of the criteria for selecting our site is we want to locate in an area

where the local authorities are not completely sold on weather modification already as a way of augmenting precipitation because they are apt to bring in some private seeders in the middle of our major experiments should a period of below normal precipitation develop.

That is not as difficult as it may seem. Some States are not enthusiastic about weather modification. The State of New Mexico, for example, has stated publicly they would welcome an experiment, but are not in favor of commercial operations. Other States take a different view.

Mr. LENNON. These figures you quote on page 3, "A partial survey conducted by NOAA and the Council of Environmental Quality showed that more than 60 projects, 27 Federal and 34 private, existed just in 20 States, not in 50, in calendar year 1971." Then you say that South Dakota is involved in it, Florida, Texas, and Oklahoma, Kansas and others. This is something that somebody has to give some thought to as they move down the line.

Gentlemen, we thank you for your patience and willingness to be with us today until the end of the hearing. Thank you very much.

Mr. WHITE. Thank you very much.

Mr. LENNON. We hope that you, as I suggested yesterday to NACOA after the Congress is organized next year and the subcommittee is created, you and your associates would at least notify the new chairman and the counsel of the subcommittee that you would be glad to come back and go over some of these things as you did today. I think it would help the dialog and the understanding and the rapport between the members of this committee, a number of whom will be new members for the first time on the Subcommittee on Oceanography. I want them to know you, all of you. And I want you to know them, because you have to work together.

Mr. WHITE. Mr. Chairman, before you adjourn the meeting, I would like to take this opportunity, which may be the last one that I and my colleagues have to address you in your present capacity, to tell you how much we have valued the support which you have given to the fields of oceanography and atmospheric activities.

And just to go on record, sir, with the deep appreciation of all of us for all of your fine hard work over the years, thank you, sir. [Applause.]

Mr. LENNON. I for one want to say it has been my greatest pleasure to work with you and your associates. I am very happy and proud of having made some little contribution in the several years I have been a member of this committee, in working to bring about the establishment of the National Oceanic and Atmospheric Administration. I wish you the best in the world. I don't want you to grow like the Health, Education, and Welfare Department, but I do want you to meet the challenge that is not only nationwide but worldwide. And I think you will.

Thank you very much, gentlemen.

The committee will stand adjourned.

(Whereupon, at 4:10 p.m., the subcommittee adjourned.)

APPENDIX A

PROGRESS REPORT ON ACCOMPLISHMENTS

CONTENTS

- I. Introduction.
- II. Major Program Areas.
 - To develop programs to assure that the ocean environment and its resources are wisely used in a balanced way to enable their development as well as conservation for the national economic and environmental well-being. To execute such programs so that the oceans' resources can be efficiently and economically developed by the private sector and provide an arena for the creation of new industry and revitalizing old ones.
 - A. Rational Fishery Management.
 - B. Depressed Condition of Segments of the Fishing Industry.
 - C. Declining Fishery Resources.
 - D. Aeronautical and Nautical Charting.
 - E. Boundary Determination and Related Legal Actions.
 - F. Marine Resource Exploration, Development and Conservation.
 - G. Marine Environmental Assessment.
 - H. Expanding Requirements for Data and Technological Understanding of the Earth and its Oceans.
 - I. Sea Grant.
 - J. Manned Undersea Science and Technology.

The problems confronting the U.S. fisheries in 1970 can be grouped into three major areas: (1) Need for effective fishery management to resolve growing conflict in resource allocation and to conserve the resource, (2) depressed economic condition of certain segments of the fishing industry, and (3) declining fishery resources resulting from excessive fishing and the deterioration of marine environments.

1. Effective Fishery Management

A. SITUATION IN OCTOBER 1970

Virtually every stock of fish of interest to U.S. fishermen which occurs in waters of the high seas has been subjected to exploitation by foreign fishermen. This has resulted in reduced catches and economic hardship on the domestic industry and is a definite threat to the existence of certain of our fishery resources. This problem has two inter-related aspects which arise because fish resources are common property vulnerable to exploitation by anyone. First, there has been an increase in foreign fishing off Alaska by Japanese, Russians, and South Koreans; off the Washington and Oregon coasts by Japanese and Russians; off the California coast by Russians and Japanese; off the South Atlantic (U.S.) coast and the Texas coast by Cuba; and off the Northwest Atlantic (U.S.) coast by Canadians, Russians, Poles, East Germans, West Germans, Bulgarians, Rumanians, Japanese, and Spanish. There are yet no fully satisfactory international management programs for highseas fisheries although there are many agreements on catch limits and allocations.

Second, the development of effective fishery management is complicated by domestic, as well as international, problems. The domestic problem is one of excessive fishing effort either among competing commercial fishermen or, in many cases, between commercial and sport fishermen. The domestic allocation problem is further complicated by a jurisdictional division between the states and the Federal Government. Also, the laws governing fishing often differ substantially from state to state even though the same species of fish or harvesting methods may be involved. The existence of this split jurisdiction, international, Federal, and state, prevents a rapid solution of the excessive exploitation of fishery resources.

B. RELATED MAJOR ACCOMPLISHMENTS, OCTOBER 1970 TO PRESENT

NOAA began in 1971 a cooperative State-Federal Initiative to improve the management of fish resources by achieving the rational allocation of these resources by achieving the rational allocation of these resources among competing users. This program aims at the root problems of the fishing industry and sets the stage for reestablishing an economically viable industry. Studies were initiated to identify socio-economic characteristics of fishermen and the industry and to evaluate the effect of alternative management techniques on resource protection and utilization. They included surveys and evaluations of regulations affecting the salmon, halibut, king crab, anchovy, groundfish, oyster, menhaden, and a selected Gulf coast fishery. The studies identified the extent of inefficient use of capital and labor, in exploiting these fishery resources, resulting from existing regulations, as well as the benefits to the fishermen which may result from alternative regulatory schemes. These studies will provide important information to both Federal and state fishery management agencies. The program works jointly with the states and industry to implement fishery-by-fishery management. Preliminary agreements have been reached by 11 states and the Federal Government to establish a lobster management plan in the North Atlantic. Other plans were underway for species in the Gulf of Mexico and in Pacific coastal states waters.

One of the most significant accomplishments was the initiation of a Marine Resources Monitoring, Assessment, and Prediction (MARMAP) Program in 1971 to provide an adequate data base to:

- (1) Manage resources and improve regulation of exploitation to insure maximum sustainable yields and economic return to U.S. fisheries;
- (2) Make informed decisions on multiple uses of the marine environment;
- (3) Provide commercial and sport fishermen with location of fish concentrations to improve fishing efficiency; and
- (4) Enable commercial and sport fishing industries to make informed capital investment decisions.

Besides completing several multi-vessel tests in the MARMAP mode, various standard methods for sampling, shipboard data recording, and other key survey activities are being used by 20 member nations of FAO as a first step toward global standardization of fish survey sampling techniques.

New protocols to the International Convention for the Northwest Atlantic Fisheries were developed in 1971 by NOAA in cooperation with other nations. One empowers the Commission to make new proposals on international enforcement. Heretofore, each participating government has enforced conservation regulations only with regard to its own nationals and vessels. Under the protocol, authorized inspectors from any signatory nation can inspect all vessels of signatory nations for the purpose of ensuring that the conservation regulations are observed. This enhances significantly our enforcement and surveillance program to regulate encroachment and over-fishing by foreign fishermen in areas traditionally fished by U.S. fishermen.

As a direct consequence of improved enforcement capability resulting from establishing an enforcement and surveillance program in NOAA in cooperation with the Coast Guard, Navy, and Air Force, 17 foreign fishing vessels were seized during the period January 1, 1969, to September 30, 1971, for violations of United States fishery law, resulting in penalties totalling \$224,183. From October 1, 1971, to the present, there were four violations prosecuted which yielded \$545,000 in fines.

Investigations completed in 1972 on the offshore population of northern lobsters have shown: (1) an inshore migration in the spring and a return to the edge of the continental shelf in the fall. (2) a growth rate nearly twice that of inshore lobsters, and (3) an estimate of harvestable surplus and optimum yield for the offshore stocks. These results provide a basis for establishing management regulations and international agreements to protect this resource.

In June 1971, NOAA added ten more species to the list of creatures of the continental shelf. Included were six species of crabs, two species of clams, and two precious corals. The effect is to permit the United States to control the taking of these species on the continental shelf of the United States and, thus, to manage the resources. Twenty-six species of aquatic invertebrates are now protected and managed in this manner.

NOAA was actively supported and assisted in the development of a strategy for gaining international agreement for greater protection of whales. This resulted in passage of a resolution at the UN Conference on the Human Environment at Stockholm calling for a consideration of a ten-year moratorium on commercial whaling by all members of the International Whaling Commission (IWC), increased research, and a strengthened IWC Secretariat. The impact of the Stockholm resolution contributed to the many important achievements of the IWC when it met in June of this year; such as, reduced quotas on certain species and imposition of quotas where none had previously existed, elimination of the blue whale unit, and agreement on strengthening the IWC Secretariat.

NOAA's other contributions to the conservation of marine mammals include: (1) implementation of a research project to reduce the incidental catch of porpoise by tuna fishermen and (2) the detailing of observers to Japanese whaling stations under the International Observer Scheme established by the International Whaling Commission (IWC).

NOAA and its components have been working with the Department of State for about three years in preparation for a third Law of the Sea Conference. These efforts have culminated in a U.S. draft article which would establish clear coastal state control of the fishery resources related to the continental margin and of the anadromous fish which originate in the coastal country.

An important bilateral shrimp fishing agreement with Brazil was signed May 9, 1972, and its ratification has been recommended by the Senate. The agreement responded to the situation created in 1970 when Brazil unilaterally claimed a 200-nautical mile territorial sea which encompasses an offshore area fished by 200-350 U.S. vessels over the past decade. This agreement does not recognize Brazil's jurisdictional claims. It is a conservation regime under which we continue to harvest shrimp.

In Fiscal Year 1972, NOAA initiated development of a Marine Sport Fish Statistics Program and assumed responsibility for compiling and publishing data collected in the Salt Water Angler Survey, 1970, conducted by the Bureau of Census. Previous surveys, in our opinion, have overestimated the number of fish captured by recreational fishermen. A two-part contract study will:

(1) Develop survey methods to minimize response bias and recommend methods to correct for the remaining bias.

(2) Carry out a pilot household survey to test these methods.

Based on the results of this study, NMFS will analyze the financial and statistical feasibility of obtaining sport fish catch and effort data using household survey techniques. If the results are negative, a collection program based on field sampling techniques in cooperation with the states may have to be developed.

A program on the population assessment and ecology of billfishes was initiated. Arrangements have been made with sportfishing clubs and organizations in New Orleans, Mobile, Pensacola, Destin, and Panama City to obtain data from big game fishing activities in the northeastern Gulf of Mexico. Specific information is collected on catches and ecological factors, including morphological and biological measurements and samples, amount of time spent fishing, time and location of catches and fish sightings, and water and wind conditions associated with catches and sightings. This program provides up-to-date sportfish statistical information to aid in assuring resource availability for recreational activities.

Through a cooperative effort involving the Navy, the Corps of Engineers, the State of Virginia, and the Tidewater Artificial Reef Association, two large artificial reefs were constructed off Norfolk using Navy surplus landing craft. The Virginia project is the latest in a continuing series of artificial reef emplacements in almost all coastal states and is part of a broader NMFS program to develop and conserve marine sport fishery resources of the United States.

Significant advances were made in 1972 for forecasting the abundance and availability of albacore tuna. The 11th annual forecast accurately predicted a major southward shift of the fishery. This resulted in a savings to industry by reducing the time and effort expended to locate fish.

A one-year resource assessment project in the Trust Territory of the Pacific Islands was completed in 1972. Good quantities of baitfish were located in the Marshall Islands. The seasonal distribution and abundance of skipjack tuna was determined. Development of a baitfish and skipjack fishery and its related support operations would provide the basis for the economic development of these island areas. In addition, this development could revive the Hawaiian skipjack tuna fishery and inject new and diversified employment and income into the Hawaiian economy.

C. FUTURE PROGRAM DIRECTION

NOAA's future direction to address fishery management problems will be toward fulfilling three primary needs:

To improve the basis for allocating renewable fishery resources among the increasing numbers of commercial and recreational fishermen.

To improve the decision-making mechanism by which the marine environment is allocated among competing uses. The objective is to insure that, under conditions of efficient management, fisheries find their rightful place in the pattern of use based on their short- and long-term contributions to society.

As a prerequisite to the foregoing, to understand far better than we do now the resource, the environment, and the interrelationships between the two.

With passage of the Marine Mammal Protection Act of 1972, NOAA has been given comprehensive authority and responsibility for the protection of such marine mammals as whales, porpoises, seals, and sea lions. Regulations for the implementation of this Act are being prepared. Research to develop fishing methods and gear with improved ability to reduce or prevent incidental porpoise catches by tuna fishermen will be accelerated. Studies to test our present strategy for maintaining Pribilof Islands fur seal populations at maximum sustainable levels will begin early next year. Expanded research on coastal whale populations, including aboriginal whale fisheries, will be undertaken. Support of, and participation in, international whale research programs will be undertaken within the program developed by the International Whaling Commission.

2. *Depressed Economic Condition of Certain Segments of the Fishing Industry*

A. SITUATION IN OCTOBER 1970

In addition to the problem of lack of effective resource management or allocation plans, most segments of the commercial fishing industry are plagued by a series of problems that seriously affect their ability to survive as viable components of our economy. These problems include (1) high interest rates and limited private sector money available for loan; (2) the common property nature of the resource, which causes unpredictable economic returns, thereby discouraging individual fishermen and processors from increasing efficiency and improving utilization of fishery products; and (3) increasingly high costs of Hull and Protection and Indemnity Insurances, a growing problem due in large part to the high risks and low safety standards associated with a largely obsolete fishing fleet and crews that are, in many cases, poorly trained.

The NOAA financial assistance program directly benefits the U.S. fishing industry by making loans available that could not otherwise be obtained because of the high risks involved. There are five separate financial operations: (1) The Fisheries Loan Program provides direct loans for purchasing, repairing, etc., fishing vessels and gear when reasonable financing cannot be obtained from other sources. (2) The Fishing Vessel and Mortgage Insurance Program guarantees loans for fishing vessel construction or reconstruction. (3) The Fishing Vessel Construction Differential Subsidy Program, now substantially phased out, was used to offset the higher costs as compared with foreign vessel costs. (4) The Fishermen's Protective Fund pays a portion of the losses sustained by participating fishermen whose vessels are seized by other nations in waters that the United States considers international waters. (5) The Merchant Marine Act of 1970 (P.L. 91-469) provides for a Capital Construction Fund in which a participating fisherman may obtain tax benefits by replacing vessels.

B. RELATED MAJOR ACCOMPLISHMENTS, OCTOBER 1970 TO PRESENT

The program to obtain data on the economic condition of the fishing industry was expanded to provide a basis for studies in the areas of pollution, financial assistance, and state/Federal partnership in fishery management. In this field, the following projects were initiated:

(1) Basic economic indicators—providing information on prices, earnings, demand for fishery product, and international trade regulations affecting fisheries.

(2) The acquisition, tabulation, and development of vessel data on cost and earnings.

(3) The financial positions of American fisheries (including cost and earnings analysis requested by industry).

The fish protein concentrate (FPC) Experiment and Demonstration Plant was completed as one of the final stages in this program. Constructed by contract

under P.L. 89-701 at Grey's Harbor, Aberdeen, Washington, the plant operated successfully on the non-fatty fish, hake.

Work has been successfully completed on new and more efficient methods of preserving fish, the mechanical opening of oysters and scallops, and the recovery of additional meat from crab shells waste. All these methods have now passed into industry application.

NOAA's voluntary, reimbursable fishery products inspection program was reviewed and is being changed from a continuous inspection system, requiring an inspector in the plant whenever operating, to an operation in which the inspection need is objectively determined and many of the inspection activities are shared by plant quality control staff under the official inspector's guidance. These changes will result in a substantial increase in efficiency.

During the period October 1970 to present, NMFS published approximately 800 different statistical publications and mailed out over three and three-quarter million daily Market News reports. Considerable effort was made to reduce the time between the end of the reporting period and the release of the statistical series to improve the usefulness of the data to the industry. The average time to release data has now been reduced from an average of 96 days in 1969 to less than 60 days. The goal is to reduce the lag time to 45 days or less.

C. FUTURE PROGRAM DIRECTION

NOAA will continue in its efforts to work toward solving problems that have significant impact on the utilization of the resources, such as labor, capital, and recreational activities. We continue to provide the U.S. fishing industry with direct loans, guarantees, and other forms of financial and technical assistance to enable the industry to become more productive and competitive. Emphasis will be placed on:

(1) Providing statistical and economic data and analyses which will be needed for solutions to growing allocation problems associated with increased demand for fishery products, recreational fishing opportunities, and increased use of the marine environment.

(2) Technological research, and marketing and economic studies to assist the industry in competing with foreign fishermen off our coasts with a view to shifting fishing pressure from overexploited fisheries to those that are exploited to a lesser degree or predominantly by foreign nations.

(3) Determining assistance required to the commercial fishing industry in meeting expected stringent pollution control and product quality and safety requirements and in upgrading the U.S. fleet to improve its ability to compete with the foreign nations fishing off our coasts.

It is our intent, therefore, to reduce substantially the level of programs which provide assistance or service to industry on a more or less permanent basis and to create an environment in which industry can undertake these itself.

3. Declining Fishery Resources

A. SITUATION IN OCTOBER 1970

Environmental factors that reduced the availability of fishery resources, either through contamination or loss of supply, had a direct economic effect on the fishing industry. The unfavorable publicity from the discovery of marine contaminants in fish and fishery products resulted in at least temporary losses of consumer confidence and reluctance by the American public to buy certain fishery products regionally and nationally. Those firms which specialized in the handling of products, such as swordfish or Great Lakes chub, were particularly hard hit.

Estuarine areas are responsible for up to 70 percent of our domestic production—in value or poundage—of commercial fish and shellfish, and up to 95 percent of the marine sport fish catch. Yet, industrial and human wastes, dredge and fill operations, channelization, and other actions of man continue to cause deterioration of many coastal and estuarine areas. Understanding the extent of such destruction is critical to resolving competing and conflicting uses of the coastal zone and assuring adequate consideration of fishing interests.

Coastal fishery resources generally have been overly exploited by domestic and international interests, causing a drastic decline of resource availability for certain stocks which, in some instances, have approached emergency levels.

B. RELATED MAJOR ACCOMPLISHMENTS, OCTOBER 1970 TO PRESENT

Research was initiated to determine the impact of various changes in environmental quality on living marine resources. The objective of this work is to assure that such resources are not diminished or destroyed by increasing pollution and other environmental changes.

In 1972, the International Commission for the Northwest Atlantic Fisheries (ICNAF), a 16-nation fisheries regulatory body, reached agreement on national catch quotas for a number of fish stocks of major interest to U.S. fishermen off New England. This marked the first time agreement has been reached on the allocation of national catch quotas within a major international fisheries management organization.

An intensive campaign to restore consumer confidence in fishery products was initiated in March 1971 following many misleading reports concerning mercury in fishery products. This work has continued. Marketing personnel contact food trades and institutional users, TV and radio stations, national magazines, consumer groups, and home economics classes to point out that fishery products continue to be good, wholesome, and nutritious foods. Over a million NOAA publications have been distributed.

NOAA also established a program to examine heavy metals in a wide range of fish species. As a result, it has been possible to establish that the heavy metal contamination that occurs in most species of fish is generally below levels of public concern and that most fish are safe for consumption by the American people. In borderline or questionable situations, NMFS is conducting in-depth investigations to determine the distribution, area, and size factors involved and the feasibility of reducing the level of contaminants. NMFS also determined the relation of levels of microconstituents in fish to consumption pattern of major fishery products. A system was developed for the acquisition, storage, retrieval, analysis, and dissemination of NMFS-generated microconstituent information on fishery resources and products.

Closely related to this activity, existing data were compiled in 1972 on the composition, quality, and nutrition of fishery products. These data will be analyzed, edited, and stored in a data bank. Further, extensive data are being obtained on the occurrence of trace elements in fishery products.

Factors that govern the toxigenicity of *C. botulinum* types C and D in fishery products have been defined. Also, a survey of the occurrence of the carcinogen (DMMA) dimethylnitrosamine has been made in selected processed fishery products; and an assessment of the potential hazard in selected U.S. fishery products from *Vibrio parahaemolyticus* has been completed to guide fish processors in providing safe products to the consumer.

Preliminary analysis of the economics of commercial salmon aquaculture was performed in 1972 for an experimental demonstration project. It was determined that salmon aquaculture is, in general, commercially feasible. A number of preconditions for profitability were identified. Based on the NMFS demonstration that chinook and coho salmon could be reared in floating net pens with a good feed conversion efficiency, a private company, with Sea Grant support, initiated in 1972 a commercial-scale demonstration in Puget Sound. The results of the project are being disseminated through a Sea Grant technical report.

A fishway was constructed on the Willamette River in Oregon. This facility provides spawning adult anadromous fish access to a 10,000-square-mile basin formerly blocked by a 41-foot falls, impassable during all but the most extreme high water conditions. Record runs of steelhead, coho salmon, and fall chinook have resulted and it has been estimated that 180,000 additional salmon and steelhead will be produced above the falls to provide about 250,000 angler days per year with an annual value of \$2 million to the local economy.

In 1972, the hatchery program contributed approximately 20 million pounds of coho, fall chinook, and steelhead to the commercial and sport catch to augment the 10 million pounds attributed to natural salmon spawning runs. The hatchery yield has risen to the present level with an overall benefit cost ratio of about 4 to 1; a \$16 million annual value.

FUTURE PROGRAM DIRECTION

NOAA is one of the Nation's key environmental agencies—concerned with proper and effective use of the environment for all national purposes: for the protection of life and property against the hazards of nature and for the con-

servation and development of our marine resources. Of special concern, of course, is the protection and proper utilization of our fishery resources. Along with the continuation of existing programs, we plan emphasis in the following areas:

The fishery advisory program of information dissemination to consumers and industry will become part of the comprehensive NOAA Marine Advisory Service.

Comprehensive review of proposed alterations to the marine environment and increased efforts to redirect or change proposed alterations that may threaten the environment or associated living resources.

A coordinated program with MARAD and other Federal agencies to determine the effect of oil spills from tankers.

A coordinated NOAA aquaculture program that will more properly utilize and direct the expertise in NOAA, academia, and industry.

A contaminants program to include more species and cover more coastal areas.

NOAA is moving toward a coordinated fisheries policy that has as its goal the conservation of our natural resources, the reversal of the long-term adverse trends in our fishing industry, and greater utilization and benefits from the resource that created America's first industry. The various issues facing the U.S. fishing industry; i.e., foreign competition, declining stocks, environmental deterioration, and excess fishing efforts dictate an aggressive and broad based approach. Solution or alleviation of many of these problems is beyond the forces of the private economy or individual state governments. As the Federal agency responsible for the conservation and management of living marine resources, it is NOAA's role to bring together the capabilities and resources within NOAA, within other Federal agencies and local governments, industry, and academia to assure that all appropriate and necessary actions will be taken to meet the national need to conserve and utilize all living marine resources effectively.

Problems in 1969 in the mapping, charting and geodesy areas were manifold, and can be broken down into the 5 following broad areas for discussions: Aeronautical and nautical charting; boundary determinations and related legal actions; marine resource exploration, development and conservation; marine environmental deterioration; and the expanding requirements for data and technological understanding of the earth and its oceans.

4. Aeronautical and Nautical Charting

A. SITUATION

In 1970, the demand for accurate and up-to-date nautical and aeronautical charts was still rising at an accelerated rate. Shipping was increasing each year and new super-tankers with up to 100-foot drafts were coming out of the shipyards. Boating, as a recreational industry, had grown from about 4 million in 1960 to almost 9 million boats in 1971 with a projection of over 12 million by 1980. Harbors and boating facilities were being constructed and existing harbors and facilities were being expanded and deepened to accommodate the increasing demand. In addition, development of near-shore areas was increasing and making changes in charted areas. Dredging, development of near-shore areas, oil extraction in off-shore areas, natural changes and new areas opened up to boating were producing a large amount of data that had to be shown on nautical charts in order that the shipping industry and boating public could continue to use the Nation's waterways in a safe and efficient manner.

At the same time, additional information and products were becoming critical to commercial and general aviation. The nation's airways were becoming crowded, with air carrier operations projected to grow during the 1970's both for domestic and international air carriers. By FY 1976, United States flag carriers were expected to fly a total of 237 billion revenue-passenger-miles and transport a total of 252 million passengers. This compares with 133.7 billion revenue-passenger-miles and 170 million passengers in FY 1971. The estimates for FY 1982 are 404.0 billion revenue-passenger-miles and 435.0 million passengers. Air cargo is also expected to have an averaged annual increase of about 15 percent. This would increase the FY 1971 level of over 5 billion revenue ton-miles of freight, express and mail to nearly 25 billion by FY 1982.

The Department of Defense, after the creation of the Interagency Air Cartographic Committee (IACC), dismantled its in-house capability for domestic charting and the IACC assigned NOAA the responsibility for all domestic, civil and military aeronautical charts.

These requirements for nautical and aeronautical charts were becoming increasingly difficult and expensive to meet with the manual production system employed.

B. RELATED MAJOR ACCOMPLISHMENTS THROUGH OCTOBER 1972

A project has been initiated to develop and implement computer-assisted automated cartographic techniques for the nautical charting program. To date this project has implemented automated data processing techniques to facilitate the flow of hydrographic survey data; implemented contracts to convert graphic source data to digital format to facilitate automated processing; develop the in-house capability to draft/scribe nautical charts via automated plotters; and develop the conceptual design for the storage and retrieval system necessary to support automated nautical chart compilation. To date all new hydrographic survey data is being processed using computer-assisted techniques at both Marine Centers and ten charts in the Gulf of Mexico area are being maintained using automated techniques. Additional charts are being converted to operational automated maintenance at the rate of three per month. A new laser optical plotter system is now under procurement which will improve the productivity rate of the graphic plotting system and will be capable of directly producing a film negative, thus eliminating the scribing process entirely.

Extensive systems studies have been conducted concerning the use of automated Data Acquisition Systems aboard high speed launches for hydrographic field party operations. The prototype field party system is scheduled to become operational during the 1974 field season.

Field data acquisition capabilities were improved when the NOAA ship *Researcher* was commissioned on October 8, 1970, at Miami, Florida. The ship is fully instrumented and equipped with the latest automated data acquisition systems to monitor all parameters of the ocean environment. The *Researcher* is one of the world's most advanced oceanographic floating laboratories and is capable of handling helicopters and small research submersibles.

An automated data acquisition and plotting system was developed and tested aboard the ship *Whiting*; four Class II ships have now installed this automated hydroplot system. A 59-foot high-speed launch was developed, tested and put into operation in FY 1970.

Improved coordination of Federal mapping, charting and geodetic programs is being accomplished through various Federal Coordinators and interagency committees. NOAA has been designated as the "Federal Coordinator for Geodetic Control and Related Surveys" and has recently requested all government agencies to provide a statement of requirements for geodetic control for FY 1973-74 so that these requirements can be better coordinated. In addition, NOAA and the United States Geological Survey have formed a NOAA/USGS Interagency Committee for Program Coordination.

A second generation automated data processing system is being developed for the Pacific Marine Center with installation and implementation scheduled for 1973. This system will greatly increase the processing capability at the Pacific Marine Center and will be compatible with the existing data processing system at the Atlantic Marine Center.

Interest in the Cooperative Charting Programs with the U.S. Power Squadrons and U.S. Coast Guard Auxiliary has increased significantly since 1969. Approximately 15,000 items for correcting NOAA nautical charts are expected to be reported in 1972. In cooperation with the U.S. Coast Guard Auxiliary, an observer's manual was prepared and distributed. The manual is intended to stimulate and improve Coast Guard Auxiliary reporting of nautical chart deficiencies, as a similar manual has done in the past for the U.S. Power Squadrons. The active participation by the many voluntary observers in this program is proving increasingly valuable as a ready avenue for specific inquiries in addition to providing continuing overall surveillance of NOAA's nautical charts.

The production of Coast Pilots by automated type-composition methods was initiated in 1970. These methods, in addition to reducing production costs, also reduce the lead time required for the publication of revised data. Thus, revised editions of the Coast Pilots can be issued annually, eliminating the need for cumulative annual supplements to Coast Pilot editions that were normally issued for a period of 5 years. To date, three of the eight Coast Pilots have been issued using the new type-composition methods; the remaining five are scheduled to be issued by 1975.

The conversion of NOAA's Aeronautical charts to the specifications of the Inter-agency Air Cartographic Committee (IACC) for joint civil/military use has been completed.

C. FUTURE PROGRAM DIRECTION

NOAA can no longer produce charts of the quality and in the quantity required effectively and efficiently by using outmoded manual systems. The use of automated methods to process collected data, compile, and publish charts is essential. It is NOAA's objective to fully automate chart compilation procedures by July 1, 1977. Studies are being conducted to determine the economics, feasibility, and the availability of production capability to produce and distribute selected aeronautical charts and chart supplements under commercial contract.

NOAA is considering plans to direct the resources of various components of NOAA and academic, regional and state agencies to a geographic area of high priority. The resulting descriptions and analyses of interrelated regional characteristics will aid in the solutions of problems related to the utilization and management of the coastal zone. This concentrated effort in a given area will allow a complete regional description faster and more effectively than heretofore and will speed up the benefits to all users.

5. *Boundary Determination and Related Legal Actions*

A. SITUATION

In 1970 the legal problems regarding boundary disputes are continuing to increase. Development of petroleum and mineral resources on the Continental Shelf was increasing. Oil leases and the high revenues obtained from industrial development of these resources were causing disputes between the states and the Federal Government as to the location of offshore boundary lines. For example, over 2 billion dollars was tied up in escrow in Louisiana, due to uncertainty in assigning seaward boundaries. The major source of these disputes was the lack of a defined baseline (mean low water line) along parts of the coastline. An accelerated program was needed to establish these baselines by tide-controlled photogrammetric surveys since the low water line was the court-accepted baseline from which boundary determinations are made. In addition, legal problems regarding inland boundaries were increasing, especially with regard to the control and management of the exploitation of the coastal zone wetlands. Urban areas were feeling the requirement for geodetic control to reference all boundaries; and the states and Federal government were involved in disagreements, disputes and court cases involving boundary locations.

B. RELATED MAJOR ACCOMPLISHMENTS THROUGH OCTOBER 1972

Efforts in developing the coastal boundary program continued. Significant progress was made in this area on the cooperative program with the State of Florida in establishing the low- and the high-water baselines from which boundaries can be determined. Other States (New Jersey, Georgia, South Carolina and Texas) have expressed the urgent need for high- and low-water baselines determined precisely along their shores to aid in settling jurisdictional disputes.

In addition to the seaward boundaries, numerous areas of the country have requested NOAA's assistance in the establishment of more precise and closer-spaced geodetic controls. These controls will assist in boundary disputes by providing a National Geodetic Control Net within reach of local surveyors to assure that boundary lines can be referenced to the National Net and thus easily re-established at a later date.

C. FUTURE PROGRAM DIRECTION

Future program efforts will provide graphic and descriptive coastal zone boundary determinations, tidal datums, hydrodynamic descriptions, prediction and monitoring services, and needed scientific knowledge for the planning and management of the coastal zone and Great Lakes regions.

NOAA's long-range objective is to develop and maintain national networks of horizontal and vertical control as the basic geographic control points for property and boundary surveys, urban planning and development, highway planning and construction, mapping and charting, space operations, and scientific investigations of geophysical phenomena.

6. Marine Resource Exploration, Development and Conservation

A. SITUATION IN 1969

The vast resources contained in the waters of the world, the earth mantle beneath, and the surrounding coastal margins were well known and attracting increasing exploration for basic energy sources, food, recreation, and similar necessities. The depletion of known supplies of ores, minerals, and fossil fuels ashore had intensified this offshore search. Data needed to explore and develop these resources were urgently needed both by industry and Federal management agencies.

With respect to certain strategic minerals such as manganese, nickel, cobalt and copper which are to be found in ferromanganese nodules on the deep ocean floor there was at this time no Government program to encourage the development of this resource.

B. RELATED MAJOR ACCOMPLISHMENTS, JANUARY 1969 THROUGH OCTOBER 1972

A major accomplishment toward meeting the requirement for adequate data has been the production of 34 bathymetric maps, depicting sea floor topography, of portions of the East and Gulf coasts, the West Coast and Alaska. In addition, geophysical maps portraying bathymetry, gravity, magnetics and seismic properties have been completed for approximately 50,000 sq. miles of the Alaska CONSHELP. Finally, six complete map units at a scale of 1:1,000,000 of bathymetry, magnetics and gravity, of the North Pacific SEAMAP area, have been compiled and are now being reproduced.

In 1972 a New England Offshore Mining and Environmental Study (NOMES) was initiated for the purpose of monitoring all aspects of the ocean environment—before, during, and after dredging—to evaluate the direct and indirect ecological effects of offshore sand and gravel mining. The major scientific objective of the experiment is to understand the responses of the marine ecosystem to dredging, enabling prediction of the potential impact of long-term sand and gravel mining operations.

In June 1972, planning was initiated to supplement the efforts of industry to determine the environmental impact of deep ocean mining for manganese nodules and to render assistance in the development of technology for the exploration of deep ocean areas suitable for commercial exploitation.

C. FUTURE PROGRAM DIRECTION

The future program objective of the marine geographical program is to adequately describe the ocean environment by maps and other information to provide effective support to ocean resource exploration and recovery, management of the marine environment, national security and scientific understanding of the oceans. The long-term goals include completing the bathymetric and geophysical mapping of the continental shelves and slopes bordering the United States.

The New England Offshore Mining and Environmental Study is taking place in Massachusetts Bay and will require 4½ years to complete. The experiment will not answer all questions concerning the effect of sand and gravel mining on the environment; however, it will provide a general understanding of cause-and-effect relationships. Followup studies based on information gathered can be used to refine our understanding of these relationships, acquire further knowledge of the underlying mechanisms governing the impact, and evaluate various dredging methods and equipment designed to minimize the environmental impact.

A program to support industry efforts leading to the recovery of ferromanganese nodules from the deep ocean and the environmental impact of recovery systems will commence in 1973. Initially, the program will focus on pre-mining environmental baseline studies and the establishment of an interface mechanism whereby the deep ocean mining industry may explore technical matters with all pertinent sectors of the Federal government.

7. Marine Environmental Assessment

A. SITUATION IN JANUARY 1969

The estuaries and waters adjacent to the Nation's shores are critical to the national economy and well-being. Over 70 percent of the population of the United States lives within the counties bordering the coast; and the major por-

tion of the industrial capacity of the Nation is located along these same coastlines. A major portion of U.S. fishery catches begin life in the marshes and wetlands at the edge of the sea, and millions of the American people use these areas for recreation. The coastal zone and adjacent estuarine waters have deteriorated. A lack of baseline data and technology to support rational management guidelines and regulations was intensifying multiple-use conflicts and allowing further deterioration.

B. RELATED MAJOR ACCOMPLISHMENTS THROUGH OCTOBER 1972

To assist in the management and protection of the areas, NOAA expanded its programs to provide charts, maps, tidal and circulatory data and baseline information required to develop comprehensive land-use plans, as well as zoning, conservation, and antipollution measures.

An estuarine circulation survey was conducted in Penobscot Bay, Maine to determine flushing rates and the time required to remove pollutants by river runoff and tidal action. Similar circulatory surveys were made along the Southeast Sound and along the New England coastline from Boston to Cape Ann, Massachusetts. These surveys are part of a long-range effort to provide comprehensive services for the major estuaries and coastal areas of the nation during the next decade. A special survey was conducted in New York Harbor to provide data needed for the construction of an East River tunnel.

A cooperative project with Florida was started during this period to survey, map and inventory the wetlands along with mean low water baselines for boundary determinations. Assistance has also been given to New Jersey in mapping its wetlands.

At the request of the Corps of Engineers, an extensive tidal and geodetic survey has been initiated for the purpose of developing a mathematical model needed in a study of the Chesapeake Bay.

NOAA has initiated a major new program effort to obtain comprehensive information on marine environmental conditions to guide management decisions. As a first step, the program development plan for a Marine Ecosystem Analysis (MESA) project in the New York Bight has been completed. The study, which will become field operational in early 1973, will provide baseline information on the area by comprehensive sampling of circulation patterns, tides, water mass exchanges, chemical properties, sediments and their distribution and the biological communities. The information obtained from the study will provide an objective base for setting public policy and for effective management of the marine resources of the area.

C. FUTURE PROGRAM DIRECTION

Added attention will be given to marine environmental quality problems in the future. Stress will be placed on integrated attacks on these problems through interdisciplinary programs which focus NOAA's total expertise and capability on selected areas.

MESA projects are in the planning stages for Puget Sound and Prince William Sound, Alaska. The objectives of these projects are essentially the same as those for the study already underway in New York Bight; however, the effects of oil on the marine environment will be particularly emphasized because of the future expansion of oil transportation in the two areas.

Under the Marine Protection, Research and Sanctuaries Act of 1972, NOAA will conduct research and monitoring to assess the long- and short-term effects of ocean dumping on marine waters and will assist research and demonstration directed towards minimizing or ending all ocean dumping within the next five years. Included in the Act is the requirement to acquire and manage marine sanctuaries for the purpose of preserving or restoring such areas.

Circulatory surveys along the Southwest Atlantic and New England estuaries will continue. A major circulatory survey is planned for Cook Inlet, Alaska beginning in CY 1973.

8. *Expanding Requirements for Data and Technological Understanding of the Earth and its Oceans*

A. SITUATION

In 1970, the Nation was faced with growing requirements for more precise technical data and standards of accuracy for measurements of the geophysical features of the earth and its oceans.

The North American Datum established in 1827-29, had distortions of such magnitude in the National Horizontal Geodetic Network that new surveys could not be accommodated into the network without placing unduly large corrections on the observations. Increasing land values, new resource discoveries and technological advances in communications, transportation, and construction place very stringent requirements for maximum precision of geodetic control networks. A committee established by the National Academy of Sciences and the National Academy of Engineering had recommended a new adjustment of the North American Datum and stated that it would be well worth the costs if it were accomplished within a reasonably short time frame of 10 years or less.

A significant step was taken toward organizing the expanding volume of marine data when the National Oceanographic Data Center was integrated into NOAA in 1970. The NODC, funded by 10 agencies, and operated by the Navy was moved into NOAA's Environmental Data Service and charged with coordinating the various components of the overall marine data system, along with other national environmental, geophysical, and climatological data.

B. RELATED MAJOR ACCOMPLISHMENTS THROUGH OCTOBER 1972

In support of accomplishing a new adjustment of the North American Datum:

(1) Data acquisition for the 45-station Worldwide Geometric Network of satellite triangulation was completed in November 1970; on the North American Densification Program in March 1972.

(2) Work on the High-Precision, Transcontinental Traverse Network, crisscrossing the conterminous states, continued through this reporting period. Approximately 5590 kilometers were measured by National Geodetic Survey parties, and about 555 kilometers by the Topographic Center of the Defense Mapping Agency.

Profiles of the geoid, made possible by recent gravimetric and astronomic surveys, were completed in various regions of the United States. These geoid profiles are important for figure-of-the-earth studies and are essential to relate scale and orientation of the satellite triangulation system to a new North American Datum. During the reporting period, a readjustment was made of the entire U.S. network of geoidal sections. Adjustment of geoid heights was completed for a continuous area in New Mexico, Arizona, Nevada, and California.

The basic continental releveled program designed both to revise published elevations of marks disturbed by changes in ground elevations, and to obtain data on broad regional vertical displacement associated with tectonic processes, was continued. During this period, more than 2,000 miles of the primary net of the conterminous states were releveled. A precise leveling net of 1,270 miles was developed around the Chesapeake Bay and major estuaries to furnish the Baltimore Office of the U.S. Engineers precise elevations of gauges. The information is to be used in developing a large scale model for studying the estuarine environment.

Nearly 560 miles of first- and second-order leveling in Florida were run as more Office of the U.S. Engineers precise elevations of gauges. The information is to be used in developing a large scale model for studying the estuarine environment.

Computation and adjustments were made for 2,590 miles of second-order leveling by the states of Louisiana, Maryland, Minnesota, Mississippi and North Carolina.

An adjustment has been made of the now completed portion of the network in the eastern half of the Eastern United States. The resulting evaluations have been compared to the adjusted evaluations of 1929 in order to compile a map of vertical crustal movements for this region. The map has provided valuable information to geologists, geophysicists, and marine scientists.

In order that the effect of geothermal development on land subsidence in the Imperial Valley of California can be monitored, NOAA cooperated in a leveling program with other Federal, State, and County organizations.

An extensive program of monitoring crustal movements is continuing in California, Alaska, and Colorado. NOAA, acting for the Office of Emergency Planning, is coordinating the approval of federal fund expenditures by nonfederal agencies which are attempting to reconstruct the control survey networks damaged by the California earthquake of 1971.

Approximately 4,600 new horizontal control points and 5,000 new bench marks were established. To provide ties to existing networks, upgrade older surveys, and determine the effects of crustal movements, approximately 50 percent of the

points occupied had been previously established. Another 1,000 points established by other agencies, under the auspices of the Federal Geodetic Control Committee, were adjusted and added to the national networks.

As a result of a cooperative agreement with the Air Force's Aeronautical Chart and Information Center, a system was developed to disseminate to the public the large quantity of unclassified and non-proprietary land gravity data held by the Air Force. Data are being made available in the form of magnetic tape or printed copy.

Cooperative area geodetic control densification projects were established on a cost-sharing basis. Projects underway or recently completed include portions of the State of Louisiana; Broward and Dade Counties in Florida, the Mid-Willamette Valley area of Oregon; Erie County, New York; and King County, Washington.

During the period between January 1970 and September 1972, the National Oceanographic Instrumentation Center (NOIC) evaluated 30 oceanic research instruments and described the laboratory and field test results in the form of Instrument Fact Sheets (IFSSs) which receive international distribution. In addition, NOIC calibrated 4138 items, including 2028 reversing thermometers, 1524 electronic test equipments, 484 electronic and/or mechanical ocean instruments, and 102 sea-surface thermometers.

In the area of methodology, NOIC developed 16 calibration procedural documents that were tailored to serve the national oceanographic community with some designed specifically for the National Data Buoy Program. All of these procedures are related to nationally defined standards. NOIC also established an optical calibration laboratory for underwater instruments, the only such facility known to exist in the eastern United States. The methodology effort also involved the development of the newly installed multi-million dollar regional marine calibration laboratory at the Mississippi Test Facility, including design review of all equipment, providing periodic technical consultations, and the design of the laboratory's total operations for data acquisition and computer processing. In conjunction with industry and universities, an active inter-laboratory calibration program was carried out on several ocean instruments and standards.

In the area of reliability, the FAILog program was moved forward with the promulgation of forms and instructions for the successful maintenance records. The FAILog Data Collection Instruction Manual has been completed and will be published soon. An implementation plan for collecting data from the fleet by the end of calendar year 1973 has been prepared.

The information collection and dissemination program of NOIC has inaugurated a Facilities and Instrumentation Referral Information System and has enlisted 135 members of the National oceanic community (government, industry and academic) on a cooperative participation basis to provide facility and instrumentation information of value to the community at large.

To fulfill its mission with regard to calibration of oceanographic instruments NOIC has established regional centers in Seattle, San Diego and Bay St. Louis, Miss. These centers will provide local capabilities where it is most needed and reduce shipping hazards to the delicate equipment.

In July 1971, at the request of Agency for International Development (AID), the director of NOIC made recommendations for oceanographic instrumentation to four member countries of Organization of American States (OAS)—Argentina, Colombia, Mexico, and Venezuela. Subsequently, funded by AID, the OAS and NOIC coordinated procurement of oceanographic instrumentation for these countries. NOIC has also conducted intensive instrumentation and facilities training seminars for representatives of the oceanographic institutes in two of the countries.

Significant accomplishments of EDS in the marine programs area since 1970 include:

1. *Development of total Environmental Data Services.*—Development and implementation of a strengthened interdisciplinary approach to servicing complex requests for marine environmental data and information. This new, single-contact data and documentation service is available to both NOAA and non-NOAA users, and concerns global environmental science data information and literature for all NOAA disciplines. EDS also provides referral information concerning data and literature collections and information services of other agencies and activities.

2. *International Decade of Ocean Exploration Data Management and Support.*—The National Science Foundation has designated the Environmental Data

Service (EDS) lead agency for data management and information services for United States programs in IDOE. Three EDS data centers—the National Oceanographic Data Center, National Geophysical and Solar-Terrestrial Data Center, and National Climatic Center—are involved in the acquisition, formatting, storage, and dissemination of IDOE oceanographic, geophysical, and meteorological data.

3. *EDS/EPA Pilot Data Project.*—In a related development, NOAA and the Environmental Protection Agency (EPA) began a cooperative pilot project in 1972 to combine EPA research information and monitoring data with EDS data inventories and bibliographic references in a single "browse-oriented" information and monitoring retrieval system.

4. *Environmental Impact Studies.*—"Environmental Guide for Seven U.S. Ports and Harbor Approaches," a 166-page special report compiled for the President's Council on Environmental Quality, was published in February 1972. The publication is an integral part of a National tanker Study to select suitable United States harbor sites for over 100,000-ton cargo capacity.

5. *International Exchange.*—The National Oceanographic Data Center (NODC) broadened its international data acquisition efforts by establishing bilateral exchange agreements with Brazil, Ecuador, Finland, Indonesia, Panama Canal Zone, Thailand, and Venezuela.

6. *Great Lakes Data Services Established.*—The National Oceanographic Data Center (NODC) established a special project unit to meet the needs of multi-discipline data users in the Great Lakes drainage area. The unit already has a project inventory for the International Field Year for the Great Lakes (IFYGL) consisting of about 3,000 computerized records of the data collected this year in Lake Ontario.

7. *Data Base for National Buoy Project.*—NODC coordinated the preparation of a report "Analysis of Environmental Conditions Within Specified Geographic Regions," compiled for planning use by NOAA's National Data Buoy Center. The report provides information needed in the deployment, design, engineering, and testing of developmental and operational buoys and buoy networks. It consists of an information and data base pertaining to atmospheric pressure, currents, temperatures, waves, and winds, as well as fronts, high-wave persistence, storm activity, and upwelling, as well as comprehensive studies of Atlantic Ocean and Gulf of Mexico hurricanes, extreme environmental conditions, and wave spectra.

8. *International Training Program.*—The first of three sessions of an Agency for International Development-sponsored training program in data management practices began in June 1971. Established under the auspices of the Intergovernmental Oceanographic Commission (IOC), of UNESCO, and conducted by NODC, the program provides training and experience in the acquisition, processing, and effective use of nearshore ocean data to individuals responsible for oceanographic efforts in the developing countries of Latin America, Africa, and Asia.

9. *NAVOCEANO Data to be Available Through EDS.*—Late in FY 1972, the Naval Oceanographic Office (NAVOCEANO) and the Environmental Data Service made arrangements for the transfer of the first large block of NAVOCEANO data to EDS, which, in turn, will make it almost immediately available to requesters. This is the initial transfer in an interagency arrangement that will eventually make most of NAVOCEANO's unclassified geophysical data holdings available to EDS users.

C. FUTURE PROGRAM DIRECTION

As previously discussed, the National Geodetic Networks adjusted in 1927 and 1929, are not meeting user needs. NOAA's goal is to complete the new adjustments by 1982.

New technologies have brought forth many new types of oceanographic instrumentation but standards for calibration performance, data output, and reliability have not been established. NOAA plans to emphasize engineering design and development of oceanographic instrumentation to provide high reliability, low maintenance costs, extended operability, improved data handling ability and calibration standards in ocean surveying instrumentation. Major future thrusts for EDS are to:

Implement specialized data files to service users of buoy data, marine chemistry (pollutant-oriented) data.

Strengthen the U.S. capability to contribute to international data exchange/referral as suggested by the OIC and the UN Conference on the Human Environment.

Expand the automated, subject-author-abstract environmental bibliographic service from its FY 1972 development stage. Managed by ESIC, the system is known as the Oceanic and Atmospheric Science Information Service (OASIS).

9. Sea Grant

A. SITUATION IN JANUARY 1969

Although the talents and skills of scientists and engineers had been directed towards various marine and coastal problems prior to 1969, there was no mechanism to bring together the required talents for solving practical ocean-related problems. The Sea Grant Program was the catalyst needed to initiate a cohesive effort in universities and industry in a matching fund partnership with the Federal government.

By early 1969 it had become apparent that the most pressing civil oceanographic problems were related to the coastal zone. States and local communities recognized the need for research into such specific problems as the accommodation of multiple users who were often incompatible with one another. Fields where multiple-use conflicts arose included marine transportation, fisheries, siting of power plants and oil refineries, recreation, and conservation.

Also, the problems and opportunities of mariculture research were becoming more apparent in early 1969, and efforts in the field were in need of support. Mariculture research had not yet reached a point where pilot-scale operations could proof-test commercial application. Similarly, waste disposal from seafood processing was a continuing source of environmental pollution and new water quality regulations preventing the dumping of wastes have the potential of forcing some small businesses to become unprofitable or cease operations.

A large body of students had been attracted to classical oceanography; however, the great need was for the creation of college curricular emphasizing the more practical aspects of oceanography and marine economics, law and social sciences. There was also a need for marine technician education and an increasing need for training in commercial fisheries. The high average age of commercial fishermen made it particularly important to meet this demand. Finally, the results of research efforts in ocean engineering and marine science were not being adequately communicated to users in business, industry, and Government. Advisory services, including publications tailored to the audience, and personalized extension services which would provide direct technical assistance were not available or were not meeting the need.

B. RELATED MAJOR ACCOMPLISHMENTS THROUGH OCTOBER 1972

Highlights of the Period

Establishment of support to 15 institutions engaged in broad programs of research, education and advisory services.

Establishment of 10 Coherent Area Programs representing preinstitutional status.

Establishment of Sea Grant Projects at 55 institutions.

Naming of six Sea Grant Colleges (University of Washington, University of Rhode Island, Texas A&M University, Oregon State University, University of Wisconsin and University of Hawaii.)

Extension of sponsorship to encompass 720 projects in aquaculture, marine mineral resource development, pharmaceuticals from the sea, coastal zone management and protection, economics of marine resource recovery, law of the sea, and educational curriculum development.

Improved coordination of the programs sponsored by Sea Grant with related programs in other parts of NOAA.

During this period, Sea Grant has in fact become the catalyst for cohesive efforts in the State, academic community and industry in a matching fund partnership with the Federal Government. It is now playing an active role in providing support for the research needed where multiple-use conflicts arise in the marine area. In the field of mariculture, Sea Grant had made it possible to approach a point where pilot-scale operations will be able to proof-test commercial application. Sea Grant, working jointly with the National Marine Fisheries Service and industry, has intensified the investigation of solutions

to environmental pollution resulting from seafood processing and the dumping of wastes. A fair degree of success has been achieved in meeting the need for the creation of college curricula emphasizing the more practical aspects of marine affairs including the training of technicians in various fields, such as commercial fisheries. Finally, advisory services, through Sea Grant support, were established to communicate the results of research efforts to users in business and Government.

Specific areas of major accomplishments:

Research

Sea Grant research has been aimed at the solution of practical problems, many of which are local or regional in nature. They encompass applied science, engineering, law, and socio-economics and are particularly aimed at direct users of the sea. Some samples of the results of key research activities are as follows:

Identification of manganese deposits in commercial quantities on ocean and lake bottoms.

Development of an acoustic method of determining fish population.

Design of a system using deep, cold, ocean water to produce nutrients for aquaculture and for power production, air conditioning, fresh water supply, and power plant cooling. The first stage, use of deep ocean water as a nutrient for aquaculture, has been tested successfully.

Development of a system to identify valuable elements in surface bottom deposits in the ocean *in situ* using activation analysis by a radio-isotope source.

Establishment or expansion of valuable kelp (seaweed) beds off California is being successfully accomplished. This effort is now reaching the point whereby the bottom areas can be seeded with high rates of survival and growth.

Development of techniques for commercial shrimp aquaculture.

Analyses of coastal zone laws, including clarification of wetlands laws, as they apply in specific states.

Development of the recommendations for the environmental quality section of Louisiana superport legislation.

Development of a successful commercial precious coral fishery off Hawaii.

Production and marketing of pan-sized salmon grown under culture techniques.

Location of economically significant sand deposits in Lake Ontario.

Publication of a directory of emergency services for fishermen.

Development of a method for the bulk pasteurizing of crab meat resulting in considerable savings to the industry.

Education

The Sea Grant Program has made rapid progress in fields concerned directly with education. This aspect of the program includes marine environment courses at all levels of education from kindergarten to 12th grade. At the technical and community college level, the program trains marine technicians for employment in marine-oriented industries. At the university level, broad multi-discipline programs in economics, law, socio-economics, applied sciences and ocean engineering have been introduced. For example, programs in business and economics are being developed to aid business organizations in better realizing the economic implications of marine industrial and commercial opportunities.

Advisory Services

In order to more effectively transfer the results of scientific and technological research to the user, the Sea Grant advisory services programs have received greater attention. Marine advisory programs have been set up at all universities receiving institutional support. In addition to publishing pamphlets, brochures, etc., which are made available to the general public, the field advisory service maintains contact with private industry, small businesses and governmental agencies. These services are especially useful to commercial fishermen, who have fallen behind technology in their businesses with resulting deterioration of their economic position. The following are examples of the reference documents that have been released under this part of the Sea Grant program:

Fishery report atlases for mid-to-south Atlantic Ocean and the Gulf of Mexico.

Atlas of oceanographic data of Puget Sound.

Annotated bibliography of infectious diseases and host response of marine fish.

Directory of marine related information sources.

Detailed listing and analysis of Maine laws and regulatory procedures related to marine resources.

Study showing distribution of landslide areas along the Oregon coast.

C. FUTURE PROGRAM DIRECTION

Future trends in the National Sea Grant Program are tied to changes dictated by the maturing of university programs started during the first three years of Sea Grant, and—to the extent these can be perceived—changes in national requirements.

Future program development is likely to include the following:

1. The slow development of ocean business dictates conservatism in the number of marine specialists to be produced. Although Sea Grant institutions have an extremely good record in placing technician graduates, it seems unlikely that additional technician training activities are desirable. Those under Sea Grant funding will be phased into normal state or institutional budgets and no new ones will be added. Course improvement projects will be funded when justified, but new courses will be kept to a minimum.

2. In the Office of Sea Grant, initiate a comprehensive NOAA National Marine Advisory Service coordinating not only advisory services performed in part by Sea Grant but also those of major NOAA components such as the National Marine Fisheries Service to provide a full scope of advisory services to those regions where service is not adequate. The extremely fast return of solid research results from Sea Grant, when combined with advances in the state of knowledge from other sources, indicate a high priority for advisory services transmitting the products of research to all users.

3. Increasingly, Sea Grant will seek to unify the research activities of scientists and engineers in many parts of the country so that solid programs directed to definite needs and opportunities may be developed.

4. Although the National Sea Grant network still is incomplete, at present there are 15 states with good and growing Sea Grant programs, and another five have beginning programs; ten coastal states have no institutional or coherent project programs. Sea Grant will continue to assess the needs and balance them with resources in order to bring all states into the program at the earliest time.

5. In view of the recent enactment of the Coastal Zone Management Act of 1972 and the Department of Commerce's responsibility for Coastal Zone Management, additional emphasis on coastal zone research in support of state management will be necessary. Although 96% of all Sea Grant activity relates to the coastal zone, some re-focus on short-term management problems will be examined.

Planning Goals for the Near Term Include the following:

Initiate several major mariculture pilot scale projects in selected bio-geographical zones, using the most promising high value marine species.

Initiate a combined effort among institutions and industries on the three coasts to recycle seafood processing wastes on a cost-effective basis.

Support research and studies in support of coastal zone management.

Initiate several new fisheries technician and seafood technician projects in appropriate regions where need can be demonstrated.

10. *Manned Undersea Science and Technology*

A. SITUATION IN OCTOBER 1969

In January 1969, the national level of support of undersea science and technology was in a state of decline. The Navy had severely cut back on its non-military undersea activities and the civil national oceanic organization had not as yet been formed. If our nation is to achieve better understanding and use of its marine resources, a focal point is required to develop, promote, and support a national, civilian, operational capability for man to work under the sea to achieve a better understanding, assessment, and use of the marine environment and its resources.

The first year's efforts to this end were divided basically into three major categories: staffing and developing a program plan; developing and implementing operational research projects; and initiating a modest technology effort.

B. RELATED MAJOR ACCOMPLISHMENTS THROUGH OCTOBER 1972

The major civil manned undersea activity at the beginning of these years was the deployment and operation of the undersea habitat Tektite in the Virgin Islands on the Tektite I and II projects. These projects, under the sponsorship of the U.S. Navy and the Department of Interior, featured cooperation between industry, NASA, the Navy, elements of the Department of Interior now within NOAA, Universities, and other Federal agencies.

The Manned Undersea Science and Technology (MUS&T) Program was initiated by NOAA in mid-1971 as the civil national manned undersea program. This MUS&T program has used many of the submersible vehicles and undersea habitat systems now in the national inventory for support to marine science and technology programs.

Operational programs were conducted from September 1971 through October 1972 on all three U.S. coasts, in British Honduras, the Bahamas, and in the Bering Sea. These projects entailed the use of eight different research submersibles and two ocean-floor habitats. Over 125 scientific investigators from universities, industry, the federal government, Canada, and various State agencies participated in these programs. Some of the programs were sponsored solely by NOAA while others were supported jointly with other agencies, including the Navy, Coast Guard, and the National Science Foundation. Examples of specific projects are:

- A program in New England utilizing both one-atmosphere and diver lock-out submersibles to enable scientists to observe first-hand herring spawning and population dynamics of lobsters;

- The use of submersible vehicles to determine the manner in which submarine canyons may serve as "pipelines" for the movement of sediment from the continental shelf to abyssal depths;

- The use of ocean floor habitats in the Florida Aquanaut Research Expedition (FLARE) and in a continuing Grand Bahamas Hydrolab Program to provide facilities for marine scientists to experiment with new underwater techniques and to use living reef population as indicators of environmental health.

A modest technology program included: the development of new diving tables, the development of a NOAA diving manual, and the evaluation of diving support equipment.

Preliminary requirements for undersea platforms and facilities have been established as a result of: a special workshop on manned underwater activities conducted for NOAA by the National Academies of Science and Engineering; an assessment for the Interagency Committee on Marine Science and Engineering, under the Federal Council for Science and Technology, programs which could effectively utilize these national assets; and a study of the scientific needs for ocean floor laboratories by the University of New Hampshire.

C. FUTURE PROGRAM DIRECTION

Future activities of the MUS&T program will focus on:

- The use and modification of existing undersea facilities for improved operational and cost effectiveness of undersea operations;

- The use of existing submersibles to survey and assess living and non-living resources to continental margin depths;

- The further development and implementation of international undersea programs including the joint use of facilities for coastal zone and deep ocean projects;

- The continued development of diver and scientific support technology; and

- The increased use of ocean floor laboratories in coastal waters extending ultimately to depths of 600 feet.

Some specific program areas to be addressed by manned undersea operations include:

- Determining the use of submarine canyons as natural flushing systems;
- Increasing the harvest of near-shore fish and shellfish such as herring and lobster; and

- Establishing a seafloor program to acquire longitudinal detailed data on the environmental impact of man's coastal activities and effluents on the marine environment and ecology.

APPENDIX B

SYSTEMS DEVELOPMENT AND OPERATIONS FOR MONITORING AND PREDICTING ENVIRONMENTAL CONDITIONS

CONTENTS

- I. Introduction.
- II. Major Program Areas.
 - To develop and operate systems to monitor and predict environmental conditions such as weather, ocean, earth and solar hazards so that, through environmental information, services and hazards warnings, life and property can be protected and the efficiency of commercial, industrial and agricultural activities improved.
 - A. Natural Disaster Warning Services.
 - 1. Floods.
 - 2. Hurricanes.
 - 3. Tornadoes.
 - 4. Earthquakes.
 - 5. Tsunami.
 - 6. Frosts and Freezes.
 - 7. Forest Fires.
 - B. Environmental Forecast Services.
 - 1. Atmospheric Forecast Services.
 - a. Basic Atmospheric Services.
 - b. Specialized Forecast Services.
 - C. International Atmospheric Programs.
 - 1. International Field Year of the Great Lakes.
 - 2. GARP Atlantic Tropical Experiment.
 - 3. First GARP Global Experiment (FGGE).
- IV. Oceanic Forecast Services.
- V. Space and Upper Atmospheric Services.
- VI. Geomagnetic Surveys and Services.
- VII. Environmental Data and Information Services.

The air, sea, land and space are dynamic, interacting parts of our total geophysical environment. These interactions are continuously being manifested by various phenomena some of which have immense destructive potential of life and property.

To assist man in living in harmony with his environment, NOAA was created to provide comprehensive ocean, atmosphere, earth, and space services that include:

- warnings of impending natural disasters,
- forecasts of general environmental conditions, and
- assessments of the short-term and long-term effects of natural and man-made activities on the environment,

for the protection of life and property and the improved efficiency of commercial, industrial and agricultural activities. This comprehensive environmental monitoring and prediction system will not only serve national needs but also constitute an essential element of U.S. participation in international activities such as the World Weather Program, the Integrated Global Ocean Station System, and Earthwatch, a concept that was recently adopted by the UN Conference on the Human Environment.

The purpose of this statement is to describe some of the accomplishments since the establishment of NOAA on October 3, 1970, with emphasis on the past year. In addition, problems confronting us will be identified and future courses of action presented. The two major sections of this statement concern natural disaster warning services and environmental forecast services.

Natural disaster warning services

During the first eleven months of 1972 alone, the President has declared 45 major disasters. Contributing to these declarations in five States was Hurricane Agnes which caused the greatest natural disaster ever to befall this nation. Hurricane Agnes caused catastrophic flooding all along the eastern seaboard with 118 lives lost and damages approximating \$3.5 billion.

NOAA's warning services, in general, functioned reasonably well throughout this period of concentrated disaster occurrences. It became clear, however, that these disasters stretched the capability of the system to the breaking point. Substantial short- and long-term improvements, such as in the technology to detect, process and disseminate warnings, must be made to reduce the risk of loss of life and property.

The Executive Office of the President called attention to natural disaster warning problems and the need for additional Federal actions to cope with them in early 1972 by:

The President's message to Congress on applications of science and technology identified a number of areas where new efforts are most likely to produce significant progress in reducing loss of life and property from natural disasters.

The New Technology Opportunities initiative on "Protection from Natural Disasters" where a number of urgent unmet needs was identified.

The Office of Emergency Preparedness (OEP) Report to the Congress on Disaster Preparedness which reflects a comprehensive study of natural disasters in the United States and offers findings and potential solutions to prevent or minimize the loss of life and damage to property.

The alerting of the general public to the imminent occurrence of hazardous phenomena posing an immediate threat to life and property has been traditionally and continues to be one of NOAA's most important functions. NOAA is leading an effort with the assistance of other Federal agencies to develop a Federal Plan for a Natural Disaster, Forecast, Warning and Assessment System which will be responsive to the findings contained in the OEP Report to Congress. The purpose of this Plan is to present a comprehensive, fully coordinated Federal program for improving the effectiveness of natural disaster warnings by providing more timely dissemination to the general public, and ensuring an enhanced preparedness by State and local communities to take effective action to minimize disaster losses.

The basic structure underpinning the warning services program is a monitoring subsystem that is able to detect, locate, and track environmental phenomena ranging from an event of limited scale and of small duration to immense destructive events affecting extremely large geographical areas over an extended period of time. Some of the elements comprising the monitoring subsystem for warnings have a multi-purpose capacity for providing information on more than one hazardous phenomenon. For example, radar provides continuous coverage of hazardous phenomena such as hurricanes, tornadoes, severe local storm and flash flood potential on a local and regional scale. The planned Geostationary Operational Environmental Satellite (GOES) system will provide near continuous capability on a large scale to detect, locate, and track hurricanes, and severe local storms occurring in the middle and low latitudes in the western hemisphere.

The following indicates accomplishments to date and NOAA's plans to improve each of the warning services related to floods, hurricanes, tornadoes, tsunamis, frost and freezes, and forest fires.

FLOODS

Flash floods present unique problems in the delivery of the warning to local officials and the public. The flooding is usually confined to a relatively small area and the time interval between the excessive rainfall and flooding is measured in minutes or a few hours at most. Community self-help systems comprising a local network of rainfall and stream gage reporting stations have proved to be an effective means for alerting communities. Commencing from a small program that was initiated in FY 1967 as a result of disastrous Virginia Floods in 1969, community self-help systems have been expanded so that 140 communities in the national now have an operational flash flood warning system. Plans are underway to establish additional self-help systems.

The disasters in West Virginia, in Rapid City, South Dakota, and the floods associated with Hurricane Agnes point up the urgency of expanding the program to provide adequate warning services to threatened communities at an accelerated

pace. In this connection, a new program of installing automatic flash flood alarm systems on critical streams is progressing rapidly. The first system was installed at Wheeling, W. Va., on May 9, 1972; and operated successfully during Hurricane Agnes. Two more systems were also installed in Wooster, Ohio, and Spring City, Tenn. It is planned to expand this system to all states having a stated need for this service.

Ten flash flood specialists are being assigned to forecast offices to expand flash flood warning services to the public and to aid local communities prepare flash flood warning plans. With the expansion of the flash flood warning program, hydrologic specialists will work with communities in setting up warning systems and establishing community preparedness plans.

Twenty river and rainfall reporting stations were automated in 1972 to expedite the receipt of data at processing centers. Rapid data collection is essential to timely flood warnings to save life and protection property. The automation of 35 additional stations is being considered in 1972. In order to make sure of the unique communications capability of the future Geostationary Operational Environmental Satellite (GOES), a selected number of river and rainfall stations will be automated to acquire hydrologic data from remote areas. Long-range plans call for the automation of additional sites utilizing the latest telephone and satellite communications technology.

Significant advancements have been made in the application of the national weather radar network to the detection and measurement of heavy rainfall and potential flood conditions by rapid computer processing of radar echo data. During FY 1972 three radars having a multi-purpose capacity to detect severe storms having flash flood potential were installed at Bristol, Tennessee; Midland, Texas; and Huron, South Dakota.

Twelve River Forecast Centers prepare warnings for more than 2,200 communities along the Nations rivers. The number of communities served has increased by about 57% in the past ten years due largely to user requests as they become aware that this service is available. The Centers provide advance warnings that vary from a few hours for small headwater areas to two or three weeks in advance for downstream points on large river systems. At many locations forecasts are prepared only when floods threaten, but continuous flow forecasts are issued daily for a growing number of sites.

The River Forecast Center in Salt Lake City, serving the intermountain states, is being expanded to provide basic river and flood forecast and warning services to Utah, Nevada, Arizona, and in parts of the Colorado River drainage areas. In addition, center staffs are being augmented to fill the needs of the public for services to be available routinely during more hours of the day and on weekends.

HURRICANES

As one of nature's most violent phenomena extending over large geographical areas, the hurricane has high damage potential. NOAA has been actively seeking to provide the public with accurate and timely hurricane warnings and to assist storm-prone communities in preparing plans to respond to such warnings. Contributing to the achievement of these objectives are the following completed and planned actions:

A concept for estimating the disaster potential for Atlantic hurricanes was introduced on a trial basis to assist communities in initiating appropriate evacuation and emergency measures. The disaster potential is issued when a tropical cyclone is estimated to be within 72 hours of the coast.

To assist in emergency evacuation during hurricanes six maps showing areas and roads that will be inundated by predicted storm surges were produced for the Galveston area. Four similar maps were also produced for the Corpus Christi area. In addition, the pre-publication compilation and field editing were completed on: six maps for the Charleston, S.C. to Savannah, Ga. area; four maps for the Norfolk area and six maps for the New York area. It is planned to construct hurricane evacuation charts for all flood prone areas of the Gulf and East coasts.

VHF-FM radio transmitters were installed in 28 cities to provide continuous warnings of hurricanes and other hazardous phenomena. There are now a total of 63 VHF-FM systems reaching a potential audience of 24 million people. It is planned to extend this broadcast service throughout the United States.

A computer program for forecasting the expected highest tides produced by tropical storms moving parallel to the coast was expanded to include two addi-

tional points at Stanford, Connecticut and Willetts Point, New York. This service is now available at 10 coastal points.

Installation of a satellite field service station at Miami was commenced in 1972. This station, when completed, will be capable of receiving satellite data observed by the GOES system and provide for the first time a near continuous observation of the entire life cycle of tropical cyclones. Pending the launch of the GOES system the station will utilize data now available from the Applications Technology Satellite of NASA.

Continued investigation into the physical processes within a hurricane in order to improve basic understanding of the energy conversion mechanism within the storm and the development of heavy precipitation and strong wind regions. In turn this knowledge will be useful in mitigating the destructive characteristics of a hurricane.

Future plans include the installation of an automated data handling and display system for real-time processing voluminous data gathered by hurricane reconnaissance aircraft and satellites. The advent of larger computers will permit the construction of a numerical-dynamic model capable of predicting hurricane movement. In addition, development will continue on additional techniques aimed at reducing hurricane prediction errors.

TORNADOS

The tornado is classed as nature's most violent phenomena and, although it is small in size compared to other atmospheric phenomena, it is a major natural disaster killer in the United States. However, the annual death rate from tornadoes has decreased by 42% since the National Weather Service Tornado Warning System was instituted in 1953 while during this same period the population in tornado-prone areas increased by 27%. The following actions were taken or are planned to further reduce the loss of life and property from tornadoes:

Three radars have been installed, mentioned previously in connection with flash floods, to fill gaps in the national radar network and thereby strengthen the capability also for the detection, evaluation, and tracking of tornadoes. Future plans call for the installation of additional weather radars in Southern Virginia, Eastern Texas, New York, North Dakota, Nebraska, and other critical areas.

Where local weather radars are not at stations located in proximity to network radars, five radar remote transmitters and ten receivers were installed to permit NOAA warning offices to have direct access to these radar displays. It is planned to expand this capability to additional offices. There are other stations, having warning responsibility, that cannot use radar remotes because of their distant location from network radars. Local use radars are planned for these locations.

The Radar Warning and Coordination (RAWARC) network was extended to South Dakota. This system connects the radar network to warning centers and provides for the collection of radar data as they relate to tornadoes and other hazardous environmental phenomena. Extension of the RAWARC network to additional locations is being planned.

Installation of a satellite field service station at Kansas City was begun. These stations will obtain data directly from the GOES system and relay them to those National Weather Service offices having warning responsibility. Pending the launch of the GOES system the field stations will utilize data from NASA's Applications Technology Satellite.

Tornado preparedness meetings in 15 cities were held with the mass media to solicit their cooperation in educating the listening public on safety rules and procedures. Five million brochures containing safety rules and precautionary advice on natural hazards including hurricanes, tornadoes, and floods have been distributed through the cooperation of the Defense Civil Preparedness Agency and the National Red Cross. In addition 3,500 public service announcements and 500 thirty-second films on natural hazards were given mass media distribution on public radar and TV. To achieve increased public and community preparedness to react effectively to severe storms, it is planned to assign community preparedness specialists to Weather Service offices.

Tornado research will be focused on the development of a three dimensional model aimed at understanding the primary processes responsible for their initiation and on the development of computer-assisted methods for predicting the location and intensity of tornadoes and severe local thunderstorms. The first automated probability forecasts of thunderstorms are now produced operationally. These improvements as well as automating improved methods for identifying and tracking significant radar echoes will increase the warning lead-time and decrease the size of tornado watch areas.

EARTHQUAKES

The January 1972 OEP Report to the Congress on Disaster Preparedness discusses four aspects of the national program to reduce earthquake losses of life and property. These aspects are:

- location of hazardous areas and detailed categorization of the risk potential;
- development of design and construction technology to improve earthquake resistance of man-made structures;
- development of earthquake prediction technology;
- demonstration of the feasibility of controlling the maximum size of future earthquakes.

NOAA's programs are directed towards hazards assessment and development of earthquake prediction technology and also support development of damage resistant design and construction technology. The most urgent need in State and local communities in high risk areas is for detailed regional and local risk maps describing the potential for earthquake damage. These maps, which must deal with earthquake recurrence rates, the types and location of surface geology and the expected response of different geological features to earthquake energy, history of earthquakes damage, and other factors, are essential to land use planning and building code establishment to prevent future damage, and for emergency planning to assist disaster victims. Where earthquakes have been considered in the siting and construction of facilities, such as public schools in California due to enactment of the Field Act of 1933, experience has shown that damage is greatly reduced.

The state-of-the-art in hazards assessment is such that many of the factors needed for risk mapping can be described within our present level of knowledge. Continued research is needed to identify all needed factors and to integrate these factors into more useful maps and other products. Effort is also needed to develop more economical methods of obtaining and processing the required data.

In the past few years, NOAA has published a series of maps showing current earthquake activity on global, national and regional scales. NOAA's 1969 seismic risk map of the conterminous United States has been incorporated by the International Conference of Building Officials into the Uniform Building Code, a code widely used in the more seismic areas of the United States. This seismic risk map is based on the effects of damaging earthquakes, both recorded events, and on damage reports and other sources for earlier periods before instruments were available. The first of an experimental series of regional risk maps has been published for Utah and Arizona (1972) showing the earthquake induced acceleration in hard rock with a 50-year return period, and the 50-year maximum acceleration (with ten percent probability of being exceeded). Data on hard rock acceleration, and the transmission of this acceleration through the different types and depths of surficial materials are essential to structural design efforts. Other maps, which may be included in a series for each high-risk area, will portray the expected velocity of the ground motion during strong earthquakes, the displacement of the ground, and the duration of strong shaking. Once the technique for acquiring and analyzing the required data are further developed, priority for mapping will be assigned to coastal areas where the potential for damage is greatest, such as the Valdez, Alaska, Puget Sound, and Los Angeles basins.

A goal is to predict the time, location, and magnitude of individual damaging earthquakes with sufficient accuracy and timeliness that public officials can take action to reduce loss of life and property damage. We can now predict, in general, where large earthquakes are likely to occur. On the basis of recurrence rates, we can predict in a time frame of years when damaging earthquakes can be expected in different geographic areas. On the basis of the historical record, we can estimate the intensities of expected earthquakes in each area. Although there has been encouraging research progress in Japan and in the Soviet Union, the capability to predict individual damaging seismic events does not now exist. Without a major breakthrough, it is unlikely that we can, in the near future, develop sufficiently complete knowledge and techniques to provide foolproof operational short-term or real-time predictions of individual damaging earthquakes. It will take basic understanding of earth strain-release phenomena and of the relationship of measurable phenomena (precursors) to these strain phenomena.

Analysis by investigators in NOAA and other institutions of global earthquake occurrence and of the physical processes occurring at the source of these earthquakes, using data from the NOAA operated World-Wide Standardized Seismograph Network, have provided strong supporting evidence for the theory of global plate tectonics. This theory describes the processes of earth strain energy accumulation and release on a global scale whereby narrow zones of very high seismicity occur at the boundaries where rigid plates shift with respect to each other. NOAA's creep meter network in California has recorded for the first time quantitative information on the propagation of aseismic fault creep events. This information is essential to understanding the processes by which strain is released in some areas without earthquakes while the strain is accumulated in adjacent, locked portions of the fault. Since these creep events were recorded in California, NOAA and Turkish investigators have identified and instrumented active faults in Turkey to determine if aseismic fault creep is occurring there. NOAA has achieved considerable success at measuring changes in earth strains by direct and indirect methods. Quartz-bar strain-meters, tilt meters and other techniques are used for direct measurements, and recent nuclear tests on Amchitka Island clearly demonstrated that man-made changes in earth strain cause detectable changes in the earth's magnetic field similar to those believed to occur prior to natural earthquakes. NOAA has monitored these changes in Alaska and proposes to further develop the techniques for application in other active seismic regions.

The National Science Foundation, working through academic institutions and through professional societies and local officials, is developing technology for design and construction to improve earthquake resistance of buildings, bridges, dams and other structures, and incorporation of this technology into building codes.

NOAA's contribution in support of this program is to provide quantitative information on the seismic risk to structures. It provides this through establishment and operation of the national strong-motion instrument network. NOAA's objective in designing its portion of the network is to determine the "free field" responses to earthquakes energy (responses of various types of ground surface regardless of the types of man-made structures thereon) and of representative types of structures. As a secondary objective, NOAA provides the central Federal source of information and records from strong-motion instruments installed and maintained by other organizations such as other Federal agencies, research institutions, and private building owners. NOAA has recently entered into an agreement with the Veterans' Administration to install strong-motion instruments in all VA hospitals in high risk areas.

Although there is always room for improved instrumentation and data processing and analysis techniques, presently available instruments are considered adequate for hazardous area assessment, and some network design studies have been completed. The collection of some 250 strong-motion records from the San Fernando Earthquake of 1971 and their subsequent utilization by engineers and scientists throughout the Nation attest to the value of this NOAA program. These records show ground and structural accelerations in some areas to be two to three times greater than had been expected. In an effort to obtain instrumental records of strong ground motion in active seismic regions of the world, NOAA has installed instruments in Central and South America, and NOAA and the National Science Foundation have established an instrument network in Yugoslavia in cooperation with the University of Skopje.

The national program to reduce loss of life and property damage from earthquakes involves the expertise and programs of a number of Federal agencies, the principal technical ones being NOAA, the United States Geological Survey, and the National Science Foundation. Through NOAA-USGS and NOAA-NSF agreements, the following types of program integration or coordination have been achieved:

- Studies to develop joint NOAA-USGS risk maps reflecting an integration of NOAA's seismic history, earthquake damage and solid amplification programs with USGS' fault zone mapping, studies of local geology and similar programs. The purpose is to provide local officials a product or series of products specifically designed to meet the needs of land-use planners, and the insurance industry.

- USGS participation in NOAA's world-wide, national, and regional earthquake monitoring networks and related information and data services;

- Improved coordination of earthquake prediction research, particularly along the San Andreas Fault in California;

Joint NOAA-USGS-NSF participation in prediction, risk mapping, tsunami warning services and other aspects of earthquake hazards reduction under the US-USSR Environmental Cooperation program;

NSF recognition of and support for NOAA's national strong-motion instrument network and related data services, and USGS involvement with describing the geological conditions at the site of selected strong-motion instruments;

Cooperative or co-funded research and service contracts and grants funded by NOAA, the USGS, and NSF to the maximum extent feasible.

TSUNAMI

To alert the public of approaching tsunamis (seismic sea waves) generated by earthquakes around the rim of the Pacific Ocean, NOAA operates the Pacific Tsunami Warning System. A regional warning system is also operated in Alaska to give rapid warnings to that state of tsunamis generated by earthquakes in the Aleutian Islands. Efforts to upgrade both the Pacific and Alaska warning services include:

The procurement and installation of additional seismometers and tide gauges to fill data gaps in the tsunami observational network.

Long-range plans to convert the Tsunami Warning System to a real-time operation by linking GOES data collection and relay capability with a selected number of tide gauges and seismic stations.

The development of pressure sensors capable of detecting tsunamis in the open oceans and relaying the information by means of GOES.

The development of realistic models for predicting the occurrence of a tsunami and the runup effects.

The provision of a local tsunami warning system for the West Coast of the U.S.

FROSTS AND FREEZES

As an element of its Agriculture Weather Service NOAA operates a fruit frost warning service to alert the agricultural community of the occurrence of low temperatures injurious to crops. Action taken to improve this service included the installation of two automatic telephones at Grand Rapids, Michigan, to provide agricultural weather information and the assignment of an agricultural meteorologist to Salt Lake City for preparing fruit-frost warning service to all areas subject to frost damages.

FOREST FIRES

NOAA also provides specialized warning service to fire control, forestry and rural air quality agencies to assist them in their respective programs of fire and smoke control.

Actions taken with respect to this service include:

The assignment of an environmental quality meteorologist to Alaska to meet the needs for fire weather and air pollution services and to provide meteorological support to the fire suppression activities of the Bureau of Land Management.

The establishment of a fire-weather program covering the states of Maryland, Delaware, and Virginia.

The development of long-range plans to assign specially trained meteorologists to those locations having smoke management and fire control programs.

SUMMARY

NOAA has been organizing its field forecast services to meet the challenge of providing improved warning services. Weather Service Forecast Officers (WSFOs) have been established and our best professional talent has been concentrated at this level. A close working relationship has been established between the WSFO and lower echelon Weather Service Offices (WSOs) in the preparation of forecasts and warnings. The WSFO is the hub of activity receiving information from data acquisition networks, satellites and radar and guidance from specialized forecast centers; assimilating this information into forecasts and warnings; and disseminating these products directly to the public and specialized users or to lower echelon WSOs for further distribution to our users.

To be truly effective, however, warnings and forecasts must be applied in time for a user to take appropriate action. This time requirement ranges from a very few minutes in the case of a tornado warning out to several days for a major flood warning. At present, much of our warning and forecast system is

geared to a manual operation. If NOAA is to meet its goal of providing warning services, ways must be found to improve our responsiveness to critical warning situations. A comprehensive program, Automation of Field Operations and Services (AFOS), has been developed to provide a focus and method for introducing automation on a large scale into the field operations of NOAA. The basic objective of the AFOS program is to improve warning and forecast services by applying modern technology and automation to increase the productivity and effectiveness of our field manpower.

This will be accomplished through a series of technological objectives.

Automate the sensing, acquisition, preprocessing and delivery of the data that is basic to the development of products and services.

Automate the monitoring of existing and developing weather conditions.

Automate the data handling (storage, retrieval and display of raw data and intermediate products).

Streamline and enhance, through automation, the actual production of forecasts and other instruments of service.

Automate, to the maximum extent feasible, the dissemination of weather and hydrologic services to external users, employing the optimum mix of dissemination techniques.

The key elements of the AFOS system are the WSFOs, all of which will have on-site mini-computers. The WSFOs will be interconnected with the National Meteorological Center, National Severe Storms Forecast Center, the National Hurricane Center, the National Climatic Center, and each other via a full duplex, voice grade, digital circuit. This circuit will carry the inter-WSFO communications traffic, field data destined for the National Centers, and National Center products destined for field offices, both alphanumeric and graphic.

As the National Digital Circuit data passes each of the WSFO nodes, the on-site mini-computer will pick off the data required for application within that particular forecast area and add it to its electronically stored data base. The contents of this data base are then available on a high-speed request/reply basis to any operating position within the WSFO. The data will be displayed on TV-type monitors with hard copy available upon request. The WSFO minicomputer will also perform the product and information distribution and dissemination functions. All automated NWS facilities within a forecast area, e.g., major WSOs, RFCs, and WSFOs with radar and/or upper air data acquisition functions, will have direct access to the WSFO minicomputer, including the data base.

Of major significance are efforts to improve support to environmental warning services through the planning for an initial steps toward implementation of a Geostationary Operational Satellite System (GOES). The GOES system is a joint NASA-NOAA program using the NASA Synchronous Meteorological Satellites (SMS) and the NOAA Geostationary Operational Environmental Satellites (GOES). Improvements to be achieved by a two GOES system include:

Near continuous cloud imaging day and night for all of the continental U.S., Central America and most of South America, and the adjacent ocean areas for detection and tracking of hurricanes and severe storms.

More rapid collection of meteorological and oceanographic data from remote automatic observing platforms such as buoys, ships, automatic stations and aircraft.

Real time support to the hurricane and tornado centers at Miami, San Francisco, Honolulu, San Juan, and Kansas City, through co-located Satellite Field Service Stations of NESS.

Detection of tropical disturbances that form in sparse data areas.

Other plans including the following:

Expansion of community self-help systems;

Installation of flash flood alarm systems;

Automation of hydrologic stations and data collection via satellites and ground based lines;

Construction of hurricane evacuation charts;

Expansion of VHF-FM, NOAA Weather Wire and radar warning dissemination systems;

Preparation of seismic risk maps;

Deployment of a strong-motion network.

This total effort is designed to minimize loss of life and property through improved warning services.

Environmental Forecast Services

Protection against natural disasters is but one of several major objectives of a comprehensive national environmental monitoring and prediction system. Equally important is the provision of forecasts of environmental conditions to ensure that the entire spectrum of man's daily activities is productive, efficient and safe.

Agricultural weather services contribute to increased productivity of the Nation's agriculture; the hydrologic service program directly impacts countless water-dependent industries such as those related to navigation, irrigation, power generation, recreation and pollution control; aviation weather services are critical to the safe, efficient operation of the National Airspace System; ocean data and prediction services are essential to the successful development of our offshore oil and gas resources; and upper atmosphere and space forecast services are vital to the operation of a wide variety of telecommunications systems, both Federal and commercial, and to the safe conduct of our space and high altitude activities.

No segment of our economic, commercial, industrial and agricultural activity is without requirements for environmental forecast information. Communications, transportation, resource development and recreation are but some of the beneficiaries. Our national environmental monitoring and prediction system contributes to the normal pursuits of every citizen in the United States in ways which are substantial, but difficult to quantify. The information and forecasts contribute to the enjoyment of life and the daily planning of every family's activities in the Nation. Collectively, the general public, national defense, and specialized interests such as marine, agriculture, and aviation, require environmental information to support their daily activities and to plan for their future actions.

For many of the basic functions of NOAA and other agencies, the data information needs are identical and therefore can be met by a common system. This makes possible the multiple use of the same data in the preparation of the various forecast products. The environmental forecast services of NOAA are supported by subsystems that monitor the current state of the environment, deliver the observations to processing centers and ultimately disseminate the information to the users.

The following sections describe the actions to improve the effectiveness of NOAA's atmospheric, oceanic and space forecast services so that they are fully responsive to the needs of this Nation.

ATMOSPHERIC FORECAST SERVICES

Atmospheric forecast services rely upon the operation of extensive basic activities that provide observations, communications, processing and dissemination of weather data, information and forecasts. These fundamental activities support the full range of NOAA's public and specialized forecast services.

NOAA is automating upper air observing activities where this is deemed feasible and practical. During the current fiscal year, for example, NOAA has been authorized to procure 89 mini-computers to automate the on-site computation of upper air soundings. The next generation upper air sounding system is planned to be automatic and designed so that only one observer is required to operate it while the present equipment requires two men in most cases. This planned system will make use of existing navigation aids for determining wind speed and direction. The resulting wind information will be more accurate than present equipment can provide.

Basic atmospheric services

The most significant achievement in atmospheric sounding techniques occurred with the successful launch of NOAA 2 (ITOS-D) on October 15, 1972. This satellite carries a vertical temperature profile radiometer that will make available temperature soundings and moisture data of the atmosphere on a global basis for use in numerical weather predictions. NOAA-2 also has on board a very high resolution radiometer which will provide data having a spatial resolution of one half mile. These data will be processed to produce highly detailed global sea surface temperature maps as well as definitive charts indicating the areal extent of sea ice.

The planned geostationary satellites will provide a measure of winds in the tropics and will collect data from a variety of platforms in remote locations

from which needed data are not now available. These new data sources from both polar orbiting and geostationary satellites coupled with more advanced computers now planned can support impressively more complex mathematical forecast models for the ocean-atmosphere system.

Where other agencies cease observing activities at locations that have been vital to the national surface observing network, plans are being developed with emphasis on procuring additional automated stations as replacement. These stations will be utilized to aid an observer in taking observations at airport locations and to obtain limited weather observations from locations that are unattended. Where gaps exist in the surface network, a newly developed remote automatic meteorological observing system will be procured to operate in and report environmental information from remote areas such as mountains and islands.

Applying advanced techniques in acoustics, microwave, infrared, and optical sensing may make possible significant improvements in our observational programs. These techniques hold considerable promise of obtaining data on a scale heretofore impossible and in turn improving our understanding of small scale atmospheric phenomena.

Basic communications functions are being automated to increase productivity. Basic communications networks such as National Facsimile Networks are being modernized and transmission speed increased.

The dissemination of information to the public is continually being improved through extension of the NOAA Weather Wire Service (to 35 stations by the end of this fiscal year) and expanded use of automatic telephones, VHF-FM continuous weather broadcasts and cable television circuits. It should be noted that these same dissemination media are also utilized for delivery of warnings. These programs are being given added emphasis.

Over the past several years there have been marked improvements in skill in predictions issued by NOAA's National Meteorological Center which provides central guidance to the field forecasters for the subsequent preparation of local forecast products for use by the public and other interests. As a result, these local forecasts have improved also. For example, at Salt Lake City NOAA forecasters have reduced their errors in temperature forecasts by more than 50 percent over the past few years. During the same period at Chicago the combined temperature and precipitation forecasts have improved from approximately 80 percent accurate to roughly 90 percent accurate.

Future plans call for improving precipitation modelling. A major shortcoming of present meteorological models is in the prediction of cloud cover and precipitation, for the scale of these weather elements are smaller than the present synoptic models. Advanced computers now under procurement and the developing potential of remote sensing offer considerable promise that improvements will result in the forecasting of these small scale phenomena.

To extend the range and scope of forecasts and to improve forecast accuracy, major emphasis is being directed toward an improved resolution in the basic hemispheric atmospheric computer model, the integration of satellite data into the computation process, and improved methods of implementing numerical prediction methods. Research is being performed toward achieving a fundamental understanding of large-scale circulation systems of the atmosphere and oceans and their interaction. Climate model experiments, using a coupled ocean/atmosphere numerical model, are being conducted to provide insight into potential large-scale changes in climate which may be induced by substances introduced into the ocean/atmosphere systems by man's activities. The recent acquisition of a 16-fold increased computer capacity at NOAA's Geophysical Fluid Dynamics Laboratory on the Princeton University Campus will insure the carrying out of experiments such as those just described and also prediction experiments from two weeks to several months in which the global atmosphere is defined with twice the resolution than previously possible.

In the future more detailed models of the global atmosphere will be developed in which the photochemical processes in the atmosphere will be simulated and the exchange processes between the upper and lower portion of the atmosphere will be studied. With these models new experiments on the response of the atmosphere to seasonal changes in solar radiation will also be undertaken. Also, the modeling of the circulation of the world ocean will be continued and emphasis will be placed on developing more detailed models for individual ocean basins which may be applied for ocean prediction and assessment purposes.

The deployment of buoys and other automated platforms, the successful launch and operation of the satellite NOAA 2 with its new vertical sounding capability and the planned implementation of a geostationary satellite observing system will make available rich new sources of environmental data on an operational basis. Much of these data will be distributed randomly in time and space in a manner which is radically different from existing conventional observing systems. To exploit fully these new data sources work has begun on the development of new techniques for reduction of the data to permit their assimilation into mathematical models of the ocean/atmosphere system.

Specialized forecast services

NOAA provides specialized weather forecast services to meet the environmental needs of aviation, agricultural, and air pollution control activities. These specialized services rely upon the basic observing, processing and communicating functions described previously.

Our Aviation Weather Service program is designed to provide weather information and warnings for safe, efficient aircraft operation and management. Our efforts to improve our service to aviation parallels our forecast reorganization program. An aviation forecast function is being assigned to every Weather Service Forecast Office (WSFO). To improve the public and aviation forecasts, the number of WSFOs was increased to 42 in FY 1972. Ultimately there will be a total of 52 WSFOs in the program.

The Agricultural Weather Service provides specialized meteorological information to support farming operations, including processing and marketing decisions. At the end of this fiscal year there will be 23 states in which no agricultural weather services are available. It is planned to extend these services to these states and to implement fully services in other states having only partial services now.

The Air Pollution Control Meteorological Services program has been proceeding on schedule in its efforts to provide support to Federal, state, and local air pollution control authorities. By the end of this fiscal year, we expect to have our planned complement of 20 environmental meteorological service units installed in those metropolitan areas indicated by EPA as critical for pollution episodes.

In addition to providing warnings of flash flooding discussed earlier, NOAA also operates a river and flood forecast program in support of Federal, regional and state water management authorities.

The need for additional flood forecasts grows as people make ever greater use of the flood plains. In addition, the growing demands on the nation's limited water resources create a rapidly growing requirement for forecasts of river stage, velocity, flow and water temperature for use in connection with river transportation, river and riverside construction, water supply, water quality management, and recreation.

Forecasts of river stage and flow are the basis for decisions relating to pollution control, scheduling of river shipping, conservation of municipal water supplies and management/allocation of water for irrigation, power, and recreation. Thirty-day outlooks of anticipated river flow volume are also made for a few locations. Ice formation and breakup is predicted for some rivers. Seasonal snowmelt runoff is forecast for 600 river sites where melting of the winter's accumulation of snow is the principal source of flow.

The new hydrologic models simulate and predict stream flow with accuracies related directly to the accuracy and density of data on rainfall, river stages, and rate of flow. To meet the needs for more reliable river forecasts and other hydrologic predictions, research is required for purposes of developing remote sensing techniques, predicting thermal pollution loads in streams, forecasting formation and break-up of ice jams, applying satellite technology to hydrology, and determining the areal extent and water equivalent of snowpack.

International Atmospheric Programs

The broad nature and extent of atmospheric processes demand international cooperation and coordination. Solutions of these problems will enhance the health and welfare of all participating nations.

The World Weather Program (WWP) coordinated by the World Meteorological Organization (WMO) provides the means whereby nations can combine their efforts to attack common environmental problems. The goals of the WWP are to increase the accuracy and extend the time range and scope of weather predictions, to develop means for assessing the consequences to global environmental quality

of mass pollution to the atmosphere, to determine the feasibility of large-scale weather modification and the consequences of human interference with weather processes, and to establish new bonds of international cooperation through joint activity to meet the needs of nations for atmospheric services.

Senate Concurrent Resolution 67 calls upon the U.S. to participate actively in this vital international program. NOAA has been designated the lead agency to bring together the programs of Federal agencies, including NSF, NASA, DOD, AEC, DOI, DOT, DOS and EPA, so that the U.S. participation will be coherent and responsive.

Major international field projects to carry out atmospheric scientific investigations are underway or planned; two under the World Weather Program and one under the International Hydrologic Decade, coordinated by UNESCO. With regard to the latter, NOAA leads this nation in the ongoing International Field Year for the Great Lakes (IFYGL). Relevant to the other investigations, NOAA leads this nation in the planning for the Atlantic Tropical Experiment of the Global Atmospheric Research Program (GARP), the research arm of the World Weather Program, and in the planning for the First GARP Global Experiment (FGGE).

INTERNATIONAL FIELD YEAR OF THE GREAT LAKES

The International Field Year of the Great Lakes (IFYGL), a joint Canadian and United States program, is of vital importance to the 35 million Americans and Canadians who live in the Great Lakes Region.

While this project is focused on Lake Ontario, the primary purpose of IFYGL is to improve knowledge of the Great Lakes and the Great Lakes Basin to provide a scientific basis for improved management of Great Lakes resources and environmentally sensitive operations.

On April 1, 1972, IFYGL commenced operations of the international (Canada and United States) data collection systems on Lake Ontario and the Ontario Basin. We are nearing the completion of the most comprehensive data collection program yet undertaken for one of the Great Lakes with regard to the network density in space and time spanning the lake and basin, the numbers and types of data acquisition systems and the use of advanced data-acquisition systems. The Canadian and United States data collection networks include more than ten major vessels with ship systems which measure physical, chemical, biological and meteorological properties at predetermined stations and along tracks utilizing an accurate navigation system and various measurement devices.

A network of some 40 buoys, towers, and automatic meteorological stations measure physical parameters in the lake and lower atmosphere. Weather radars measure rain and snow intensity over the lake and basin. An intensive network of advanced rawinsonde systems around the Lake make more precise meteorological measurements in the troposphere. Air craft data acquisition systems make in-situ measurements of vertical fluxes and meteorological parameters in the atmospheric boundary layer and by remote sensing systems measure surface properties and parameters of the lake and basin. Many other data collection systems are being utilized by participating scientists, e.g. water sampling analysis systems, stream gauges.

The analysis of these data by major experimental research projects is in an early stage. These analyses will continue for several years to ascertain important large scale spatial and temporal processes in the lake and basin and include the terrestrial water balance, materials balance and heat balance. Analysis products will also address small scale concentrations, distributions and variability of water circulation and diffusion, chemical and biological properties, fisheries, and the atmospheric boundary layer. Modeling and simulation projects address improved prediction for resource management on user scales.

NOAA continues to make a concerted effort to insure that the objectives of the participating U.S. agencies (Environmental Protection Agency, Department of Interior, Corps of Engineers and National Science Foundation) are met: and that the agreements between Canada and the United States are supported.

GARP ATLANTIC TROPICAL EXPERIMENT (GATE)

As part of the Global Atmospheric Research Program (GARP), the GARP Atlantic Tropical Experiment (GATE) has been initiated because it has been recognized by the world's leading scientists, that the meteorology of the tropical oceans constitutes one of the weakest links in our understanding of the general atmospheric circulation, and hence in our ability to predict weather and climate.

The tropic atmosphere and ocean represent the birthplace of the severe yearly tropical storms which ravage the east coast of the U.S. With data from the observational phase of GATE, we should be able to develop methods that will permit longer term weather forecasting with greater accuracy, as well as improve our forecasting procedures in the tropics.

Thirteen nations have expressed interest in participating in GATE and plan to deploy 25 to 30 ships and about 12 aircraft. The U.S. has pledged the services of five ships, seven aircraft, and polar orbiting and geostationary satellites. During August 1973, an international field trial will occur in preparation for the actual experiment. This field trial will bring together ships and aircraft from the U.S. and U.S.S.R.

For approximately two years NOAA, with the cooperation of NASA's Mississippi Test Facility (MTF), has been developing a shipboard data acquisition system whose purpose is to acquire, store, process and display meteorological and oceanographic data. This system was designed to take into account the long-term needs of NOAA as well as those of GATE. It will be used to acquire atmospheric boundary layer and upper air data as well as surface meteorological/oceanographic and subsurface oceanographic data. This sophisticated system is currently in process of landbased testing at MTF and will undergo approximately 2 weeks of sea trials on the NOAA vessel *Discoverer* during January/February 1973. Upon conclusion of the sea trial, the data acquisition system will be left aboard the *Discoverer* to be a permanent part of her equipment complement.

Two additional data acquisition systems will be procured. One system will be for the NOAA vessel *Oceanographer* and the other, funded by NSF, will be for the University of Miami's *Gilliss*. These two systems will be installed aboard these vessels during the early part of calendar year 1974, well in advance of the start of the GATE primary observation phase. These systems and others being considered will provide a continuing capability for NOAA and NSF to conduct future scientific projects.

Although GATE had its beginning as a meteorological project, it has been expanded to include oceanography. Within the U.S. a task group of the Ocean Affairs Boards Ocean Science Committee of the National Academy of Sciences has been established to develop the U.S. GATE oceanography program. Efforts are underway to prepare oceanographic research projects, develop appropriate ocean research instrumentation and to commence preliminary analytic work in preparation for the field program.

FIRST GARP GLOBAL EXPERIMENT (FGGE)

The First GARP Global Experiment (FGGE) is planned to commence in 1977 and last for a period of approximately one year, with two periods—each of one month's duration—of intensified observations.

The four major objectives of FGGE are to :

Obtain a better understanding of atmospheric motion for the development of more realistic models for extended range forecasting, general circulation studies and climatic prediction ;

Assess the ultimate limit of predictability of weather systems ;

Develop more powerful methods for assimilation of meteorological observations and, in particular, for using non-synchronous data in order to determine the initial condition for predicting the large-scale motion ; and

Design an optimum composite meteorological observing system for routine numerical weather prediction of the larger features of the general circulation.

During September 1972 the first FGGE planning conference was held in Geneva, Switzerland under the auspices of the World Meteorological Organization and the International Council of Scientific Unions. At this session it was recommended that the FGGE observing system should include the following observing systems, depending heavily on the World Weather Program :

Polar orbiting satellites ;

Geostationary satellites—present plans call for a total of 5 satellites including 2 U.S. satellites, and one satellite each from Japan, the USSR and the European Space Research Organization (ESRO) ;

Constant level balloons ;

Buoys ; and

Automatic land and ice stations.

The conference also reviewed the basic minimum requirements for the experiment, the possible contributions of various countries, and institutional and organizational arrangements. Further, the planning conference also urged that an ocean subprogram be a part of FGGE.

OCEANIC FORECAST SERVICES

The energy crisis and an increasing awareness of environmental quality problems have over the past several years focused attention on the ocean and Great Lakes. With the nation's increased dependence on imported fuels, the ocean has assumed increased importance as a primary transportation route as well as a vital source of petroleum from the sea floor. However, risks to the quality of the ocean environment must also be given adequate attention.

The increasing tempo of coastal shipping worth over \$6 billion now, the growing offshore oil industry presently valued at about \$1 billion, the important U.S. fisheries industry with a \$5 billion capital value including 81,000 boats and 128,000 fishermen, and an increasingly affluent population whereby 121 million marine recreationists with 9 million recreational boats bring into perspective the need to ensure adequate oceanic environmental services.

The quality of our productive coastal and offshore waters, which have a great capacity to provide essential resources to the nation, needs surveillance through monitoring and assessment. With proper planning, the advancement of industry, commerce, recreation and coastal zone development can be carried forward and the pollution problems can be suppressed and resolved to the future benefit of our nation.

The ocean also provides other vital functions for an industrial society. It receives waste heat from short-side power plants, waste chemicals from factories, and sewage from coastal cities. These wastes are diluted and carried away from the coast to mix with the waters of the world oceans. Mineral production from the sea bottom, new space for large power-generating facilities, deep-draft port facilities, and regional airport centers have been planned for construction on the continental shelf. Obviously, we are already using the coastal ocean and plan to use it even more in the future. The resulting increased possibilities for conflicts and our lack of knowledge about the character of the marine environment, point to a need for acquiring a better understanding of the ocean in order to use it more fully while still protecting it from devastating pollution levels which cannot be reversed.

NOAA has a large role to play in meeting these needs.

The Oceanic Monitoring, Assessment, and Prediction program has been designed to use NOAA's resources to meet the nation's needs for warning, forecast and assessment services and basic environmental data for the ocean and marine atmosphere. The program includes two complementary lines of effort. The first is to expand ocean-related monitoring and prediction services using existing technology and federal facilities. The second is a program of research and development to insure that needed services can be provided in the future and improved according to the changing needs.

The service-oriented program will initially focus on coastal waters where the nation's recognized needs are greatest. For example, one of the primary areas of activity during the initial phases is the Gulf of Alaska region and adjacent areas which will be crossed by tankers bringing petroleum from the Alaskan oil fields to the west coast of the United States as part of the overall Trans-Alaska Pipeline System (TAPS). Among the services which may be provided to assure that the TAPS operations do not harm the environment, we could supply:

- Detailed forecasts of conditions in harbors, ship anchorages, and restricted waterways to increase the safety to ship operations and improve efficiency;
- Improved marine weather forecasts in ocean areas traversed by tankers;
- Improved forecasts of surface and near-surface oceanic conditions such as sea, swell, temperature and current regimes;
- Assessment of water quality status and trends; and
- Special forecast services for oil spill and other contingency operations.

Such services should materially contribute to the safety of ship operations and thereby reduce the risk of ship collisions or groundings. But in the event accidents occur and oil spills result, assessment and prediction services will also assist those involved in clean-up operations.

The oceanic services program is not restricted solely to the Pacific coast. Other high priority programs are planned for the middle Atlantic coast region between

Cape Cod and the Carolinas and for the Gulf Coast. These areas are inhabited by a substantial number of the nation's population.

Improvements in monitoring can be brought about through instrumentation of selected ships of opportunity, through use of environmental buoys still in the test and evaluation phase, through instrumentation of key coastal and offshore sites, and through application of satellite systems and other remote sensing capabilities. Water quality information can be acquired by collecting, in a systematic way, water and air samples in marine areas of high interest in order to analyze and assess the information to determine pollution status and trends. Ultimately, operational buoy systems and additional satellite capabilities may contribute to the oceanic monitoring, assessment and prediction program and aid in the production of improved and more adequate environmental services.

The recently launched NOAA-2 satellite will fill some gaps with measurements in cloud-free areas of atmospheric temperature and water content together with sea surface temperatures. With the data from such satellites coupled with that produced by other platforms such as buoys and ships, we look forward to improved weather forecasts for many coastal regions.

Many important ocean areas are overcast for long periods of time with the result that satellites can supply only limited information. In cloud-covered areas, such as the Gulf of Alaska, environmental data platforms such as buoys are needed to provide atmospheric and oceanic observations.

The National Data Buoy Center (NDBC) of NOAA has been tasked to meet these environmental monitoring requirements which can be uniquely met with unmanned data buoys.

The NDBC is undertaking a comprehensive development program to assure that sensor, platform, mooring, communication and logistic technology is available to meet the wide range of scientific and operational needs. As an integral part of this program, one large data buoy is being field tested in the Gulf of Alaska, others are being tested in the Gulf of Mexico, and one, off the East Coast of the U.S., is used operationally for severe winter storm monitoring. In the scientific area, both drifting and moored data buoys will become an essential and significant part of the GATE and FGGE programs previously mentioned. While the progress to date on buoy technology has been encouraging, there is still much to do to achieve this important but difficult capability.

In other areas, NOAA lacks technological capabilities and sufficient understanding of environmental processes to provide services. Here the OMAP program calls for additional research and development activities. For many areas, we do not understand oceanic and atmospheric processes sufficiently to make useful warnings or predictions. For such areas, research will clearly be required—some of it, long range research—before adequate services can be provided routinely. In some areas, we understand the processes but require development of reliable observing techniques before the assessment and prediction services can be generated. We must advance in technological applications to monitor and understand significant oceanographic processes.

We must gain further understanding of the energy exchange processes which interact between the ocean and the atmosphere, and we must develop mathematical models leading to analysis and prediction techniques for the provision of the necessary environmental services.

Needs for considerable technological development effort have been identified.

For example, we need to develop better means for monitoring chemical contaminants in the ocean and in the marine atmosphere. A group of nationally recognized marine scientists have drawn up recommendations to guide NOAA in future research and development in this area. They emphasized the need for monitoring pesticides (DDT), certain industrial chemicals (Polychlorinated Biphenyls) and the metals lead and mercury. New sampling and analytical techniques are required for the OMAP program.

Further, aircraft-mounted radar applications are under development to measure sea state; assessment of salinity and current information are being derived by interpretation of multi-spectral sensor data on NASA's Earth Resources Technology Satellite (ERTS-1); and monitoring of sea ice conditions will be accomplished on a routine basis with NOAA satellites and experimentally with ERTS-1.

NOAA's capabilities in remote sensing were substantially increased during the past year when a major program in ocean monitoring from spacecraft was transferred to NOAA from the Navy. The Spacecraft Oceanography Program, now a part of NOAA's National Environmental Satellite Service, will continue to develop techniques for observing ocean color, current velocities, surface waves, and sea

ice. Some of the new NOAA responsibilities stemming from recently enacted legislation such as coastal zone management and ocean dumping can also be supported by newly developing satellite technology.

The Oceanic Monitoring, Assessment and Prediction (OMAP) Service is truly an integrated NOAA program, since most of NOAA's major line components have a significant role in it. The atmospheric and oceanographic services developed will be produced and disseminated by the National Weather Service to the users. The National Data Buoy Center of the National Ocean Survey supports the needed buoy operations while the National Environmental Satellite Service will supply satellite observations needed by the National Weather Service as well as certain other data needed by other groups for assessment and forecast products. NOAA's Environmental Research Laboratories will be of value to the TAPS operations through their tsunami research programs as well as by preparing large-scale maps showing earthquake risks in Port Valdez and Prudhoe Bay and the areas crossed by the TAPS Pipeline.

Through interagency coordination, NOAA is working with other agencies, such as the Coast Guard and EPA, to arrange for cooperative use of resources in the acquisition of data required for assessment and prediction of oceanic conditions. Such coordination is carried out through the Interagency Committee on Marine Environmental Prediction (ICMAREP) for which NOAA has been assigned as lead agency. The ICMAREP also provides the mechanism for working out national activities that are involved in international oceanographic programs.

Oceanic problems, as in the case of the atmosphere, are essentially global in nature and require international cooperation for solution. Under the leadership of the Intergovernmental Oceanographic Commission (IOC) and with the collaboration of the World Meteorological Organization (WMO), the Integrated Global Ocean Station System (IGOSS) is concerned with bringing nations of the world together to meet common needs in the oceans. Joint efforts are devoted toward obtaining observations of temperature and salinity at selected depths, surface and sub-surface currents, water transparency and wind waves and swell. Chemicals, including pollutants, and certain biological parameters to be monitored in the future, are still being identified and will be included in future phases.

SPACE AND UPPER ATMOSPHERIC SERVICES

NOAA monitors the state of the sun and the ionosphere as a system, and predicts solar events and consequent ionospheric behavior both for long-range planning purposes for telecommunication systems, and to permit warnings of power blackout, loss of long-range radio communications, or dangerously high radiation, or unsafe conditions for re-entering spacecraft. NOAA also monitors, predicts and assesses the state of the upper atmosphere.

The upper atmosphere extends from about 35 km to about 80,000 km, and thus is the flight medium for both high-flying aircraft and most manned and unmanned spacecraft. As the nation moves into the Space Shuttle Program and vehicles fly for longer periods of time in the lower portion of the upper atmosphere, the need for information in this region will become even more critical.

In order to provide services with regard to the sun and ionosphere, NOAA's Space Environmental Laboratory operates a Space Environment Service Center in collaboration with the USAF Air Weather Service at Boulder, Colorado. This Center provides data, forecasts and warnings for both civilian and military users at all relevant time scales. A recent accomplishment as a result of this joint NOAA/AWS has been to provide 24 hour a day coverage. The data are obtained from optical and microwave solar observatories around the world, a NOAA-operated riometer network, ionosondes, and solar environmental sensors on both polar orbiting and geostationary satellites. Data are also available from DOD and NASA sources. All data are placed in a time-shared computer, along with updated predictions and warnings of significant events. These products are available on an essentially real-time basis to all users through standard computer terminals over long distance telephone line. In addition, warnings are disseminated by telephone, teletype and by radio world-wide over the National Bureau of Standards WWV radio stations.

Predictions up to one week in advance are disseminated to subscribers by mail, telephone, and teletype as well as being available through the real-time data base. Predictions of monthly averages of ionospheric activity are prepared well in advance, based on historical data associated with sun spot cycles, and are published and disseminated world-wide for use by telecommunications activities.

These products serve the electric power industry, especially in high latitude, other government agencies such as DOD, NASA, and FAA, the aviation and marine transportation industries, and the world-wide research community, in addition to telecommunications interests. There are over 600 subscribers to such services at this time. As one example of the value of these services, most city to city communications in the State of Alaska depend on high frequency radio communications, which are especially vulnerable to ionospheric disturbance. Based on NOAA predictions and warnings, frequencies may be changed in sufficient time to avoid a major loss of communications when a geomagnetic storm threatens.

Data for monitoring and predicting the state of the neutral upper atmosphere are now obtained by NOAA, together with DOD and other agencies, on an infrequent and irregular basis and disseminated through our Environmental Data Service. Up to now, while the service may not have been adequate to meet all needs, particularly in the research area, there has been no demonstrated demand for routine, continuing data in this area, or for real-time prediction and warnings. However, with the advent of sustained power flight, flat re-entry trajectories and lengthy manned missions in space which will result from the Space Shuttle Program, the demand for such products will very likely be established, and a service activity in this area may well be required. A recent accomplishment in successfully heating the ionosphere by means of a higher power radar beam has resulted in modifying portions of the ionosphere. This is of particular importance in considering prolonged high frequency communication systems operation by circumventing natural ionospheric disturbances that impede communication performance.

While investigators have long suspected that some correlation exists between events on the sun and meteorological events in the lower atmosphere and oceans, no causal relationship has yet been defined, and it may well be that one of the greatest potential benefits from our programs in the upper atmosphere and space will be improved understanding of the relationship between the sun, the upper atmosphere, the lower atmosphere, and subsequently the oceans; thus, perhaps leading to greatly improved long-range forecasts for the entire earth environment.

GEOMAGNETIC SURVEYS AND SERVICES

Regularly scheduled magnetic charts of the United States were published, and charts of the world were compiled for publication by the U.S. Navy. NOAA continued to supply specialized geomagnetic services, such as real-time data for a cooperative USAF Air Weather Service—NOAA Space Environmental Laboratory program, and research programs involving a number of universities. NOAA's geomagnetic products and services are essential to in-house marine and aeronautical charting programs and marine geophysical investigations; to a number of uses in the Nation's defense and space programs, and to telecommunications, as well as other industrial activities.

Deteriorating observatory facilities and ever-increasing personnel requirements to obtain, process and disseminate geomagnetic data are jeopardizing these services. In recognition of these facts, NOAA is undertaking development of a new suite of instruments to automate these processes. NOAA has held a users conference attended by representatives of the academic, industrial and governmental communities, and has developed new methods for quality control both in the observatories and in the central processing facility in Boulder, Colorado. These steps are consistent with recent recommendations by the General Accounting Office.

ENVIRONMENTAL DATA AND INFORMATION SERVICES

In recent years, the growth and diversity of environmental sciences activities, both national and international, and the increasing, massive, uncoordinated body of data that these activities have generated have threatened to overwhelm both the data archival and retrieval facilities, and the capabilities of individual scientists, institutions, and Government agencies to comprehend and assimilate the data.

There is an urgent need for a cross-disciplinary, comprehensive reference service—a rapid response guide to all available environmental data and data sources. NOAA is developing an environmental data index (ENDEX) system to accomplish this. There is a corresponding need for a comprehensive service system for assisting in the full utilization of available published information on man's environment.

The massive volume of data and their varied formats call for modernization of procedures and expansion of automation, including the use of newly developed data and information handling facilities.

The combination in NOAA of new elements presents a requirement for coordination of data and information storage and retrieval system activities in all NOAA components.

Environmental data and information storage and retrieval services undergird a broad range of environmental monitoring, prediction, and warning activities including research. Automation for storage retrieval and processing of environmental data within NOAA areas of responsibility is rapidly taking shape; the concept involves merging existing systems (e.g., NSF, AEC, EPA) into a national network. Interagency agreements for the dissemination and exchange of environmental data have been or are being negotiated. These agreements, plus ENDEX, will form the nucleus of the U.S. participation in the International Data and Information Referral System recommended by the Stockholm Conference.

International data and information exchange activities, including augmented referral capabilities have been enhanced by nation to nation bilateral agreements, national activities in the World-Wide Seismological networks, World Data Center system and bilateral and multilateral activities within the UN.

Future programs are designed to provide environmental data and information (atmospheric, solid earth, ionosphere and solar terrestrial) as required for the development and conservation of earth resources, the health, safety and welfare of our people and the understanding and efficient use of the environment.

In addition to accelerating the development of ENDEX action, it is proposed to :

Accelerate the preparation and publication of coastal zone information and other products describing selected environmental regions and phenomena including the coastal zone, solid earth, (seismological and geomagnetic), ionosphere and solar terrestrial.

Modernize data acquisition, storage, and retrieval and product preparation (including NOAA library services) through automation, including hardware and software.

Develop new, and augment existing data files to meet user requirements including those for the atmosphere, and solid earth (seismological).

CLOSING REMARKS

NOAA was a participant in the first meeting of the U.S.-Soviet Joint Commission on Cooperation in the Field of Environmental Protection. Pursuant to a memorandum of implementation, a major area given to NOAA for arranging future cooperative efforts with the Soviets concerns the influence of environmental changes on climate. The effect of changing levels of atmosphere constituents on climate, the development and application of mathematical modeling to assess the consequence of atmospheric contamination on climate, and cooperation in polar research are a few of the topics contained within the area for which NOAA is lead agency for the U.S.

The deterioration in the quality of the global environment has awakened the nations of the world to a new sense of urgency. The UN Conference on the Human Environment which brought together representatives from 114 nations provided, for the first time in history, a focus for world attention on environmental problems. One of the most significant actions taken at this Conference was the adoption of an action plan to implement more than 100 recommendations addressing the widest spectrum of problems of the human environment.

One of the major components of the action plan is global environmental assessment or Earthwatch. Earthwatch is defined as the continuing assessment of the status and conditions of the global environment as a prerequisite for the identification and solution of environmental problems as well as for wise environmental management. Such an assessment requires major activities in global monitoring, processing, communications, research and information exchange.

A survey of NOAA's accomplishments and planning indicates that progress is being made toward achieving a national environmental monitoring and prediction system that is able to cope with natural disasters, provide environmental forecasts, and assess the effects of man's pollution on the environment and the effect of the environment on man.

It is readily apparent that the concept underlying the NOAA mission coincides with that of Earthwatch. As a result NOAA programs can be readily assimilated into Earthwatch. Only through the active participation of the United States and other nations can this truly global endeavor of Earthwatch be successful. NOAA endorses the Earthwatch concept and the more that NOAA can meet its national goals the greater will be the U.S. participation in Earthwatch.

APPENDIX C

FEASIBILITY OF BENEFICIAL MODIFICATIONS OF ENVIRONMENTAL CONDITIONS AND RELATED CONSEQUENCES

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 - D. Prospects.

1. *Introduction—Organization and Policy Concerning Environmental Modification*

A main thrust in the National Oceanic and Atmospheric Administration was formally recognized in April of this year when the Department of Commerce established within NOAA the position of Assistant Administrator for Environmental Modification. Of the three main goals of NOAA, his responsibility is: To explore the feasibility and, where warranted, to develop a national capability for beneficial modification of environmental conditions, and to understand the consequences of inadvertent environmental modification.

1.1 *Office of Environmental Modification (OEM) Responsibilities*

To meet this goal, the Assistant Administrator for Environmental Modification:

Undertakes long-range policy planning and analysis; recommends NOAA policy to the Administrator.

Insures that NOAA develops and maintains effective programs in inadvertent and intentional weather modification.

Monitors the management and allocation of NOAA aircraft facilities.

Monitors and evaluates assigned programs and recommends program curtailments, redirections, reductions, expansions and new program initiatives.

Conducts or monitors studies of:

The economic, social, and legal ramifications of environmental modification; and

Unwanted side effects.

Carries out Department of Commerce responsibilities under the Weather Modification Reporting Act, P.L. 92-205.

Develops, in conjunction with NOAA's General Counsel, the legislative program necessary to the furtherance of the nation's environmental modification programs.

The Office of Environmental Modification is *not* assigned responsibility for modification activities in the ocean environment or in the upper atmosphere. Activities concerning the artificial heating of the ionosphere, creation of artificial aurorae, creation of artificial reefs and the artificial upwelling of deep ocean waters are the staff responsibility of the Associate Administrator for Environmental Monitoring and Prediction and the Associate Administrator for Marine Resources.

1.2 *Status of Weather Modification*

The responsibilities mentioned above come about because of NOAA's recognition of the reality of weather modification and the realization that a new technology is surfacing that could lead to a significant effort in private industry and to considerable benefits for the populace. At the same time disbenefits must be recognized and minimized. Several surveys of the status of weather modification have been completed in the past few years. One, the first annual report of the President of the National Advisory Committee on Oceans and Atmosphere (NACOA), summarized the present state of the art in weather modification as follows:

"For certain meteorological conditions the evidence is persuasive that it is possible to increase precipitation by substantial amounts and on other occasions to decrease precipitation by substantial amounts.

"There is ambiguous evidence that the effects of seeding may influence precipitation at points 100 to 200 kilometers from the site of the seeding. This matter must be clarified.

"It now appears possible to acquire the additional knowledge necessary to predict the effects of seeding on a wide variety of cloud types and systems (convective, orographic, stratiform, migratory storm systems, etc.) in different geographic areas from reasonably realistic computerized cloud models.

"Supercooled fog can be dissipated on an operational basis.

"There is encouraging evidence that hail can be suppressed.

"There is encouraging evidence that the intensity of winds in a hurricane can be reduced.

"There is evidence that further development will lead to operational techniques for decreasing the frequency and duration of cloud-to-ground lightning discharges, with a subsequent reduction in forest fires.

"Advances in remote-sensing techniques are the first step toward methods to modify tornadoes.

"No completely accepted technique yet exists for dissipating warm fog, but the potential economic benefits and the encouraging prospects of such a capability warrant further research.

"The prospects of inadvertent modification of weather and climate by changing the chemical composition of the atmosphere, the particle concentration, or by the discharge of heat are so real, and so likely to be realized within a matter of decades, that a major program of research appears to be warranted.

"Whether modification issues now reach to the stratosphere. It has been suggested that exhaust emissions from SST's may decrease the ozone concentration at high altitude and lead to an increase in ultraviolet radiation at the Earth's surface. Fortunately, the way appears clear to resolve this question before SST's are operational."

As is evident in the above list, our confidence in weather modification techniques varies as to the type of atmospheric phenomenon being modified. Further research and funding is needed in many of the categories and is being pursued by many agencies of the Federal Government. A recent report by the Interdepartmental Committee for Atmospheric Sciences (ICAS), a committee of the Federal Council for Science and Technology (FCST), shows that Federal funding for weather modification was \$16 million in FY 71, an estimated \$20 million in FY 72 and a projected \$25 million in FY 73. The Departments of Commerce and Interior and the National Science Foundation account for about 90 percent of the expenditures, Commerce (NOAA) being funded at a level of \$9.2 million in FY 73. The funds are used primarily for research on the modification of precipitation (rain and snow), fog, hail, hurricanes and severe storms, and lightning, on studies of inadvertent modification and on research concerning the social, economic, legal and ecological aspects of weather modification. The Federal effort in weather modification doubled from FY 69 to FY 72 and could be \$50 million per year by the late 1970's.

1.3 *Public climate*

The public and scientific attitudes towards the assumption by NOAA of the responsibilities enumerated above seem receptive. Weather modification activities cover more than 60,000 square miles of the U.S., most of it in the Midwest and Rocky Mountain States. A partial survey conducted by NOAA and the Council for Environmental Quality shows that more than 60 projects (27 Federal and 34 private) existed in 20 states in CY 71.

The State of South Dakota has embarked on an operational program in weather modification designed to increase rain and decrease hail. Florida, Texas, Arizona, Oklahoma, and Kansas have utilized weather modification programs for drought relief. Such actions are taken even though conclusive scientific evidence of the beneficial effects of convective cloud seeding over statewide regions is not available. These actions are serving to direct attention to the desirability of conducting research programs over larger areas so that quantitative answers can be obtained as quickly as possible for utilization in the operational programs. NOAA, with its nationwide observing capabilities and expertise in weather modification research, is assisting in this task.

1.4. *Scientific Surveys*

The public and state activities mentioned above coincide with recent studies by several scientific panels. Their reports have stressed the national importance of weather modification activities, both intentional and inadvertent. These reports include the Committee on Atmospheric Sciences/National Research Council's Report on Weather and Climate Modification, the Stratton Commission Report, the Office of Emergency Preparedness Disaster Preparedness Report, and the NACOA Report. In short, the reports conclude that weather modification is a reality and that a Federal role in the development and control of the technology is necessary. In the majority of these reports, NOAA is identified as the logical Federal agency to assume a key role in developing a vigorous and effective research program and to coordinate a national program in weather modification.

The NACOA Report recommended action in legislation, research and technology, hurricane modification, public policy review, and international relationships. The report recommended legislation to provide guidelines for the conduct of weather modification projects by private, State and Federal agencies, to designate responsibility in ameliorating those weather disturbances that produce public states of emergency, and to designate a responsibility (probably Federal) for monitoring inadvertent weather modification.

The NACOA Report stressed that the development of the technology by which precipitation can be increased, decreased and redistributed should be hastened by increased funding for basic research in cloud physics, in the properties of particulates, for computer modeling, experimental design and field experimentation, and for the development of remote sensing devices.

The Office of Emergency Preparedness Report to Congress on "Disaster Preparedness." January 1972 concluded that:

Experiments in weather modification indicate many potential uses, including the mitigation of disasters caused by weather phenomena.

Moreover, the interstate and international aspects of most such activities suggest a strong Federal role.

The Federal management of weather modification operations should be exercised by a single existing agency in order to ensure effectiveness and economy.

The Department of Commerce has extensive technical knowledge and experience in the management and operation of weather modification programs and therefore could be assigned this function.

1.5 *Policy*

To meet its weather modification responsibilities, NOAA has established a policy of conducting *research* in hurricane abatement and precipitation enhancement. *Operational* work on hurricanes and other severe storms is to be conducted when suitable techniques have been developed. A limited emphasis is placed on hail, lightning and fog reduction, leaving this work primarily to other agencies of the government.

Weather modification presents many opportunities for cooperation among Federal agencies. NOAA provides advice and technical assistance to OEP, as well as state and local governments. NOAA is expanding its participation with the Bureau of Reclamation, particularly in relation to a precipitation enhancement program. NOAA is supporting studies in cooperation with NSF to determine how best to deal with liability questions. NOAA gives advice and assistance to the State Department concerning requests for international aid in weather modification.

In addition to this cooperation with other Federal agencies, NOAA seeks to stimulate the private and university sectors of weather modification by increasing participation in NOAA's weather modification program through grants

and contracts. Stabilized funding will encourage the long-term development of resources and capabilities.

NOAA seeks to increase the involvement of the World Meteorological Organization (WMO) in weather modification by helping to enlarge the WMO role in rendering advice and assistance to foreign countries, by encouraging the establishment of international reporting programs, similar to the U.S. one under P.L. 92-205 and by recommending use of United Nations or WMO funds to meet the needs of foreign countries in lieu of AID funds.

1.6 *Weather Modification Organizations in NOAA*

The implementation of weather modification efforts within NOAA is accomplished by the Environmental Research Laboratories (ERL). Mr. Eugene Bollay is the Program Manager for Weather Modification in the Office of the Director. He has line responsibility for the Experimental Meteorological Laboratory (EML), directed by Dr. Joanne Simpson and the Research Flight Facility (RFF) directed by Mr. Howard Mason. Other groups either partly or wholly concerned with weather modification within ERL are the Air Resources Laboratory directed by Dr. Lester Machta; the Atmospheric Physics and Chemistry Laboratory (APCL), directed by Dr. Helmut Weickmann, and the National Hurricane Research Laboratory (NHRL) directed by Dr. Cecil Gentry.

2. *Weather Modification Programs*

NOAA's research in weather modification is based on sound scientific principles developed by talented scientific personnel and is characterized (1) by carefully designed field, laboratory and numerical experiments, (2) by the energetic conduct of projects, and (3) by rapid dissemination of the project results via reports and scientific journal articles. The primary research programs supported by NOAA are Project STORMFURY conducted by the NHRL, the Great Lakes Snow Modification Project and a lightning abatement project, conducted by the APCL, and the Florida Cumulus Project conducted by the EML. The APCL also assists in the NSF sponsored National Hail Research Experiment (NHRE). In addition global monitoring for environmental quality control is conducted by the Air Resources Group and provides a valuable check on man's inadvertent weather modification potential.

2.1 *Intentional Weather Modification Activities*

2.1.1 *Project Stormfury—National Hurricane Research Laboratory*

Project Stormfury seeks to modify hurricanes by seeding with silver iodide just outside of the wind maximum the numerous large cumulonimbus clouds in the eyewall of the storm or, alternatively, to seed the many large cumulus in the spiral rainbands and rain sectors. Extra heating is released by the transformation of the cloud liquid to cloud ice, which has been shown to expand the eye, leading to decreased winds and less damage, which can be prodigious. In the past few years Hurricanes Camille, Cecilia and Agnes produced \$1.5, \$0.45 and over \$3.5 billions worth of damage respectively.

Project Stormfury conducted a Rainsector Modification Experiment on Hurricane Ginger 26 September and 28 September 1971. The Rainsector Experiment was used rather than an Eyewall seeding Experiment (called Eyemod) because Ginger had a poorly formed eyewall of large diameter on both days with the maximum winds located between 50 and 80 nautical miles from the center. Because of these characteristics, it was judged to be a very poor subject for the Eyemod experiment. Since the maximum winds were already so far from the center of the storm and the peaks so poorly shaped, Ginger offered little possibility for any dramatic reduction in the peak winds such as were noted in Hurricane Debbie (August 1969) after the seedings.

From the operational viewpoint the experiment on Hurricane Ginger was very successful. Eighteen flights were scheduled on 26 September and all were made. This is an outstanding performance and was due to the magnificent cooperative spirit of the Navy, Air Force and Research Flight Facility Squadrons.

First impressions are that there were some changes in the cloud structure (as revealed by radar and satellite photographs) which occurred at a time when they could have been caused by the seeding. The most prominent of the latter was the gradual increase in the radius of maximum winds.

In 1972 many successful goals were achieved by Project Stormfury in spite of the meager Atlantic hurricane season.

Project forces, consisting of a total of 16 aircraft from NOAA, the Navy, and the Air Force, were on alert throughout the Stormfury season (July 15 to

October 31, 1972) to deploy for an actual seeding experiment. The hurricane season was so devoid of activity that no alerts were issued and no eligible hurricanes were seeded.

Forces did deploy for dry-run exercises on July 12-14 and for cloudline seeding experiments on August 22-31.

The dry-run exercises were conducted over the ocean area east of the NAS Jacksonville, Florida and provided the coordination and data collections practice needed to make a live experiment successful.

The cloudline experiments were conducted from Barbados and were very successful. These tests are conducted on individual and groups of tropical cumulus clouds, ones similar to those occurring in parts of a hurricane. Experiments were conducted on six days with forces divided into two groups each day to provide for more efficient utilization of the forces. This also served to accelerate the training program. Vital data were collected to provide for improving hurricane and cloud modeling research. Various types of seeding materials and compositions were tested for their effectiveness and current methods of seeding and monitoring were improved.

Sea-slick experiments were conducted on the ocean east of Miami in June, 1972 to examine the feasibility of spreading and maintaining a continuous partially-polymerized thin film on the ocean's surface under various wind conditions. The tests utilized a polymer material developed under contract to NOAA by the IIT Research Institute and oleyl alcohol provided by the Naval Research Laboratory. Photographs and other documentation of the history and structure of the artificially induced sea-slick indicated that a clearly visible slick forms almost immediately upon deployment of the material from a ship; remains continuous and homogeneous for several hours; and damps waves and reforms after penetration by a ship. Relatively quiescent atmospheric and sea conditions prevailed during the tests. Additional slightly larger-scale tests are required to determine the evaporation suppression or energy reduction possible through the use of these artificial slicks.

Hurricane modeling research made substantial progress during 1972 in both the development of the asymmetric hurricane model and in the physical interpretation of its results. Hurricane "seeding" simulated experiments were conducted with the models and results published. Input data vital to modeling refinements of cloud physics parameters were also collected by research aircraft flights.

Many other significant research studies relating to hurricane modification were also conducted. These included several on hurricane and ocean interactions, and cloud physics effects of artificial nucleation of tropical clouds.

2.1.2 Atmospheric Physics and Chemistry Laboratory Projects

The program areas associated with weather modification are the Great Lakes Snowstorm Modification Project, Mitigation of Severe Storm Effects, Atmospheric Electric Interaction, and Inadvertent Modification of Weather and Climate, (mentioned in subsequent section).

Great Lakes Project.—The original purpose of the Great Lakes Snowstorm Modification Project was to redistribute snowfall downwind from the heavily populated shoreline regions. Seeding with silver iodide crystals is used to create many small crystals which then drift further inland than the unmodified larger snow particles would. A comprehensive report on the results of the two Great Lakes snowstorm modification projects has been compiled with two main results.

1. The original seeding concept of redistributing the snowfall from Lake storms has been found valid except in cases where the artificially produced snow crystals from snowflakes of high density; then the redistribution is not as effective. The numerical model of Lake storms has been extended to include the development of precipitation, and computer experiments with this model have indicated the feasibility of advancing the formation of precipitation and discharging most of it into the Lake before reaching the industrialized coastal areas.

2. Special shallow cloud systems have been studied, and it has been observed that they present a hitherto unexploited potential for precipitation augmentation. The climatological frequency for such cloud systems in the Great Lakes Basin is high during winter, and it appears that they constitute an atmospheric water resource which permits the recycling of water that has evaporated from one side of the Lake back into the Lake (through seeding techniques). It is

believed that an opportunity exists to alleviate with this method water requirements of Great Lakes' communities and, therefore, it is planned to conduct seeding activities for research purposes in the Great Lakes Basin. In this effort the assistance of universities and private research institutions will be enlisted.

Hail Suppression.—The National Hail Research Experiment (NHRE) is supported primarily by the NSF. APCL again supported the NHRE Project by operating a large network of hail impact and rain recording stations, by furnishing two aircraft during June 1972, and through Mr. Byron Phillip's co-directorship of the field effort. The aircraft were used to measure the airflow into and around the storms and to record cloud characteristics such as updraft speeds and temperatures.

Lightning Suppression.—From June to September an intensive flight program was conducted using a B26 aircraft on contract with Sierra Research Corporation to explore the modification of thunderstorm electrical fields by means of chaff seeding. The result of four seeding experiments and four control flights indicate that the atmospheric electric field underneath the thunderstorm decayed 6 times more rapidly when seeded with chaff than it decayed from natural causes in the control clouds. The results of the experiment are not only being analyzed with respect to the effect of chaff on the electrical field and eventually on lightning discharges, but also with respect to the effect that the chaff needles will have on the collision efficiency between cloud droplets and the formation of precipitation.

2.1.3 Florida Cumulus Project—EML

The narrow mission of the Experimental Meteorology Laboratory is to conduct modification experiments on cumulus clouds, directed toward precipitation enhancement and the forecasting and eventual mitigation of severe storms. The broader mission of the Laboratory is to understand and predict the relationships between cumulus-type and the larger-scale atmospheric circulations. In order to improve the daily and longer-range forecasts, the effects of cumulus clouds must be more accurately incorporated in the prediction models, to which EML work continues to contribute substantially.

"Dynamic seeding" techniques have been developed at EML and have proven highly successful in modifying tropical cumulus. The technique is to provide over a short time interval massive doses of silver iodide (100 to 1000 times more than in earlier projects) to a cloud volume which is slightly supercooled, say in the region 0 to minus 10 degrees Celsius (Centigrade). The rapid freezing of the supercooled cloud droplets and rain drops releases heat to the cloudy atmosphere and gives an extra boost to the growing cloud tower. Average height increases of 1km to 3km and broadening of the seeded clouds have been observed. The extra growth most often leads to additional rain on the ground.

From July 1971 EML has advanced on all fronts. Highlights are:

1. Practical applications of dynamic seeding were made to mitigate the 1971 south Florida drought. Results were analyzed, written up and published. It was estimated that about 100,000 acre-ft of water had been contributed by the 14 days of seeding.

2. A research seeding program was conducted in the EML target area in July 1971. Six operational days were obtained, 3 seed and 3 controls.

3. A research simulated seeding program was conducted in the EML target area in July 1972 to obtain a better unseeded sample. Four operational days were obtained and completely analyzed. Results of the multiple seeding experiment in the area to date are summarized below.

EML AREA SEEDING RESULTS 1970-72

	Floating target 10,000's of acre-feet	Total target 10,000's of acre-feet
Seed.....	2.6	4.8
No seed.....	1.0	4.0

The "floating target" is defined as all clouds seeded or merging with seeded clouds as long as the complex remains in total target.

4. Statistical tests have been used to obtain current best estimates of seeding effect on rainfall and to demonstrate how many more cases are needed to

establish the magnitude. With the floating target the expected value of the seeding effect is about three, with no probability that rainfall is decreased by the seeding. Double the present data sample can resolve the result conclusively. With the total target, the expected value of the seeding effect is about 1.5 but there is a finite chance it could be negative and at least 25 more *pairs* of cases will be required to resolve it.

5. Satellite pictures are being used to evaluate large-scale and downwind effects of seeding. Data are being collected to correlate cloud brightness with cloud height and rain volume. The performance and limitations of the new color densitometer now at NOAA Miami are being established.

6. An extensive calibrated radar raingage comparison was completed in the summer of 1972. Results have been analyzed and presented to the scientific community with startling and important implications for the measurement of convective rainfall. Huge differences in daily and even in monthly rainfall were found for gages only 1 mile apart. Calculations from the dense gage network showed: To determine monthly rain volume over a 200 sq. mi. area to better than a factor of 2—99% of the time, we need 1 gage every 7 sq. mi; 90% of the time, we need 1 gage every 22 sq. mi; and 50% of the time, we need 1 gage every 100 sq. mi.

Both the University of Miami and the Weather Service radars were found to give rain volumes to better than a factor of 2. Hence it is concluded that calibrated radar, together with gage clusters, is the optimal method of determining convective rainfall.

7. Progress was made on all aspects of numerical simulation of clouds and cloud groups.

a. The model of the whole south Florida peninsula completed its first phase and successfully predicts cloud locations and patterns under the several predominant wind and weather conditions. A radar-satellite comparison with its predictions has been written up for publication and agreement is remarkable.

b. The model of the build-up of a large cloud from the combination of several small ones has been carried to the publication stage. It predicts the size distribution of clouds over Florida very beautifully under fair conditions.

c. One and 2-dimensional single cloud models, with precipitation and ice crystal growth have made vast progress. These model simulations of cumuli led to the development of the EML dynamic seeding program and are used to screen out favorable and unfavorable situations for seeding. Models have thus enabled EML seeding programs to be more scientifically sound and successful than many predecessors. The 2-dimensional model is having the ice phase and a variable grid introduced and is also tackling the vital problem of cloud-environment mixing with a new approach. Mixing is the main brake against cloud growth and is little understood today.

8. A detailed plan for the summer 1973 research seeding program has been written up and distributed and is now being coordinated with state environmental groups.

2.1.4 *Precipitation Enhancement Project*

The success of NOAA's efforts in weather modification in Florida and the Great Lakes Basin and the call by the various scientific panels mentioned above for a clearer definition of cloud seeding effects has led NOAA to initiate plans for a well controlled precipitation enhancement project. A site selection board is acting on proposals to study the climatology, the existing facilities and the active projects in the region. A request for proposals for a comprehensive design study is in preparation.

The broad goals of the project are:

To develop a way to evaluate the effectiveness of precipitation enhancement technologies.

To develop the full potential for the enhancement, redistribution, and suppression of precipitation.

The more specific objectives are:

To execute carefully designed and controlled precipitation enhancement experiments making maximum use of the experimental site.

To increase our knowledge of the microphysical and dynamical characteristics of clouds.

To determine any extra-area effects of cloud seeding.

To develop a major new industry within the U.S. and for export.

Rather than fragment the efforts needed to solve the research problems in weather modification, a focused effort will be established at an experimental site

or sites where year-round precipitation enhancement studies can be carried out over a well instrumented area.

In such an area we can determine the (1) precipitation efficiency of cumulus modification and precipitation enhancement, (2) development of large-scale precipitation enhancement from shallow winter-type cloud systems during upslope flow conditions, and (3) enhancement of precipitation from the cyclonic storm systems moving through this area.

Of great importance to weather modification as a whole, the Program will measure, using remote sensors and instrumented aircraft, cloud physics parameters generally describing the microphysical and dynamical characteristics of clouds. These critical parameters are needed in sophisticated cloud models for predicting cloud behavior and precipitation growth and fallout. To a large degree they have at best only been approximated in past experiments. The real promise of success lies in the use of real-time physical measurements, multi-dimensional mathematical simulation models, computer support, and advanced evaluation designs.

Peripheral, but of equal importance to enhancing precipitation, is a study of extra-area effects, that is, unintended effects of seeding that occur outside the target area. The extra-area effects have come to light only recently, and some recent results suggest that these effects may be of major importance.

The sociological, legal, ecological, and economic problems associated with changing the precipitation regime are recognized as important problems, and studies in these areas will be pursued concurrently with the cloud physics research.

2.2 *Inadvertent Weather Modification*

The U.N. Conference on Human Environment, held in Stockholm in June 1972, recommended that governments: "be mindful of activities in which there is an appreciable risk of effect on climate; carefully evaluate the likelihood and magnitude of climatic effects to the maximum extent feasible before embarking on such activities; consult fully other interested States when activities carrying a risk of such effects are being contemplated or implemented."

NOAA is conducting research and making measurements relating to those admonishments.

2.2.1 *Atmospheric Physics and Chemistry Laboratory*

APCL's work over the past year in atmospheric pollution and inadvertent weather modification is impressive. Highlights are the following:

A network of about 20 ice nuclei measuring stations in the western U.S. is being presently installed. The network is designed to furnish background data on the ice nuclei population.

The Climatic Impact Assessment Program of the Department of Transportation calls for monitoring of stratospheric water vapor, ozone, and aerosol measured in a high flying B57 aircraft. NOAA is participating in this effort. At the end of FY 1972, all hardware was procured and ready to install. Since that time, two missions around thunderstorms reaching into the stratosphere have been completed and 4-5 missions studying the water transport through tropical upwelling in the inter-tropical conversion zone have been flown. The thunderstorm flights indicate that an active injection mechanism of water vapor into the stratosphere is at work.

The use of infrared remote probing for the measurement of stratospheric water vapor content from the NASA Convair 990 platform has been further developed, and the measurement of in-cloud temperatures during aircraft penetration and over ground and cloud surface temperatures using the methods of infrared scanning radiometers have been perfected.

2.2.2.2 *Air Resources Group*

Part of the total effort of the Air Resources Group of ERL is to monitor the atmospheric environment to help determine man's influence on climatic change.

Geophysical Monitoring for Climatic Change traces the global spread of atmospheric contaminants, such as, CO₂ and particulate matter resulting from industrialization, growing population, and urbanization. Absence of quantitative data has led to a variety of opinions by the public and the scientific community, ranging from dismissing the problem as something that nature will take care of, as in the past, to predicting imminent melting of the polar ice caps due to atmospheric warming from a "CO₂ greenhouse effect," or creation of a new ice age due to shadowing of solar radiation. The geophysical monitoring program is to pro-

vide data that make predictions of climatic change possible, consisting of (1) dependable measurements of present amounts of man-made contaminants in the atmosphere, (2) determination of their rates of increase, and (3) measurements of properties of the atmosphere that are affected by these contaminants.

This global monitoring requires extremely precise measurements. It also requires adequate sampling of "clean air" in remote polar and tropical environments of both hemispheres, to determine the trends in contaminants. NOAA, other U.S. agencies, and universities, in close cooperation with the World Meteorological Organization's plans for global monitoring, are developing a program to meet these needs. NOAA plans to establish six global background monitoring stations. Supplementary to the observatory in Mauna Loa, the observatory in Barrow, Alaska, is being activated. A preliminary program, including a close cooperative program with the National Center for Atmospheric Research, is beginning on the Island of Tutuila in American Samoa. Concurrent with the network completion will be the inauguration of measurements of additional trace constituents including carbon monoxide, methane, and a global tracer, Freon-11. A beginning program for fixed point time trends in oceanic constituents, including partial pressure of carbon dioxide, carbon monoxide, etc., will be begun.

The program to date has been successful in identifying long-term periodicities in total atmospheric ozone over large sections of the globe and in developing a model for prediction of carbon dioxide values. A successful method for preparing precision reference gases has been invented which will be applied by the National Bureau of Standards to the preparation of reference gases for the baseline monitoring including carbon dioxide, carbon monoxide and others. Continued analysis of the carbon dioxide record at Mauna Loa has shown a reduction in the rate of increase of carbon dioxide but also identified a presently unexplained year-to-year variation in the increase. Also, analysis of the Honolulu data on solar radiation has indicated that the increased attenuation caused by the injection of aerosols in the stratosphere in 1963 by the eruption of the Mt. Agung volcano has since subsided and solar radiation has now returned to previous levels. This indicates that there is currently no detectable man-made influence on attenuation appearing at this one low latitude station. A comprehensive investigation of the aerosol content of sodium and chloride at sea level and at 11,200 feet on Mauna Loa, confirms the protective barrier created by the subtropical inversion. Less than 1 percent of sea level sodium-chloride material observed at sea level is detected at Mauna Loa Observatory.

New advanced detection equipment has been developed and procured. This includes the installation and operation of a laser probe at the Mauna Loa Observatory to measure aerosol profiles up to the middle stratosphere, a multi-channel solar radiation detection system to determine the attenuation due to pollution in 13 different band widths, a multi-wave length sensitive nephelometer to determine the characteristics of surface aerosols, and a continuous recording system for small particle (Aitken nuclei) detection. All of the U.S. Dobson spectrophotometers for the measurement of total ozone are being modernized and re-calibrated. A comprehensive, accurate system for the measurement of surface ozone at very low concentrations in clean air has been designed and the initial system is being procured.

New techniques for automated data collection of the many parameters at the baseline observatories are under test. The heart of the system, a small computer, permits "real time" checking of accuracy and stability of all data and significantly reduces manpower required to process the observations.

This care and precision is required both for the detection of the small concentrations of trace materials and to insure that the small year-to-year trends can be accurately determined.

Contact has been made with a number of other countries planning monitoring programs. These include Japan, Australia, South Africa, Argentina, Canada, the United Kingdom, and the USSR. The agreement for scientific exchange between the U.S. and USSR executed by President Nixon in 1972 included as one of its major elements cooperative activities on establishing standard methods for background geophysical monitoring. An exchange of ideas and scientists will continue to take place. The U.S. has also been active with the World Meteorological Organization in the development of techniques and manuals for the regional and baseline stations and has continued its work in archiving and publishing turbidity and precipitation chemistry data.

3. Other Aspects of NOAA's Weather Modification Program

2.1 Reporting Regulations

Public Law 92-205, 85 Stat. 735, makes reporting of weather modification activities within the 50 states, District of Columbia, Puerto Rico and any U.S. territory or possession mandatory for all non-Federally supported activities. Federal rules and regulations have been published in the *Federal Register*, Vol. 37, No. 208, dated October 27, 1972.

Adequate record keeping is required on all weather modification projects which includes any activity performed with the intention of producing artificial changes in the composition, behavior, or dynamics of the atmosphere. Reports are required before and after completion of each new project or activity and on each October 1 for continuing activities. These records are on file in NOAA and are open to the public as provided in the statute.

3.2 Research Flight Facility

The OEM has staff responsibility for NOAA's Research Flight Facility. This Facility is a crucial element for much of the weather modification research conducted by NOAA, particularly the STORMFURY and Florida Cumulus Projects, the Great Lakes Snow Modification Project and the High Plains Project. The present fleet of RFF aircraft is composed of two DC-6's, one C130B and one B-57A. A total of 1,461 flight hours were recorded in FY 72 in support of NOAA's missions.

3.3 International concerns

Weather modification activities are pursued in many other countries, among them, the USSR, France, Italy, Japan, the Philippines, Kenya, South Africa, and Mexico. The United States is being asked more frequently to assist drought stricken or hurricane plagued countries in applying weather modification techniques to ameliorate their problems. NOAA is establishing a position of weather modification consultant to advise the State Department on requests for international assistance.

Also, the Office of Environmental Modification is maintaining a list of qualified experts and private firms in weather modification willing to operate overseas in a consulting or operating mode, in line with NOAA's policy to do research only and to encourage the development of the private sector's capability.

4.1 Problems

4.1.1 Potential for interference of projects

Current efforts in weather modification fall into two major categories—operations and research. The collective Federal program, currently in excess of \$25 million per year and growing, is, with the exception of isolated instances of drought emergencies and other disasters, research in support of various agency missions. On the other hand, the work being done by the private sector and some states is primarily operational and involves such activity as fog dissipation, hail suppression, and precipitation augmentation.

As noted in the section on the state of the art, weather modification techniques are becoming more and more effective, and the future application of these techniques on a wider and wider scale is a near certainty. With the expected proliferation of weather modification activities, both for research and for operational benefit, the chances of interference between projects will also increase.

In response to a survey by ICAS, NSF reported that in past years Federal research projects costing more than \$1.5 million are known to have been negated or degraded by activities of private weather modifiers. The three major agencies conducting weather modification research within the Federal Government, the Departments of Commerce and Interior and NSF, estimated in the same survey that planned research totalling approximately \$38 million could be seriously degraded or totally invalidated through interference from non-participating groups. Beyond the loss in dollars, the retardation of the research, which cannot readily be valued, would constitute a major additional loss to both the government and the nation.

The greatest threat to human safety considered possible for weather modifiers is to cause the triggering of a severe storm. This has not occurred yet and is considered highly unlikely by many cloud physicists. However, the seeding of clouds with silver iodide to cause their merger into a large rainstorm has been hypothesized and is being tested in Florida. The resulting 10,000 to 50,000 acre feet of rain claimed for this method could create flash flooding if the experiment

were conducted in mountainous regions. To safeguard against this, research and operational weather modification projects need to insure that sufficient observations are taken and that scientific control of the project is maintained through cloud modeling efforts or some other technique. This makes more urgent the development of the science so that more quantitative estimates of the weather modification effects can be predicted and evaluated.

Other less hazardous activities to man and his environment are (1) hazards associated with delivery systems, (2) the possible adverse effects produced by the seeding agents employed, and (3) the possible adverse effects produced by temporary or lasting changes to the weather or climate.

We know of no hazards under the first item since only recently have private industry groups been required to file their intentions with any Federal agency. In the case of Federally sponsored research, we are reasonably certain that none of these hazards have yet been created. The potential for these hazards may increase as new technologies are brought to bear in attempts to beneficially modify the weather.

Concerning the second item, the seeding agents now known to be employed have been adjudged safe in the quantities now used. All Federal agencies have, of course, submitted environmental impact statements regarding operations which could conceivably have a significant environmental impact.

With respect to the third item, there have been only a few studies of this potential problem, none of which can be considered conclusive. The most recent and perhaps the most thorough of these studies was carried out by the Stanford Research Institute on the Bureau of Reclamation's Winter Orographic Snowpack Augmentation project (WOSA) under contract to the National Science Foundation. In that study, SRI is careful to point out that while there are ecological effects, they are not large. Specifically, SRI states, "The environmental . . . impacts of (the Colorado snowpack program) on the high mountain areas where (the Bureau of Reclamation) operations would take place are almost uniformly negative, but are of only moderate intensity." The report also states: "The available knowledge concerning environmental requirements of biological communities cannot be used to predict with any precision the ecological effects of a WOSA program. Therefore, an environmentally responsible WOSA program must be accompanied by a comprehensive environmental monitoring program that can provide early warning of detrimental environmental effects. The monitoring program should be designed around and contribute to an understanding of the relationships between environmental effects and their causes."

At such time as the nation develops a significant capability in precipitation augmentation the operational application of this capability will have to be carried out with due regard for possible adverse environmental effects.

4.1.3 *Hurricanes*

The human misery and vast destruction of property caused by hurricanes places a high priority on hurricane abatement research. However the conduct of the field operations for this research is becoming increasingly difficult, due primarily to the lack of seeding opportunities in the Atlantic. Also, the Department of Defense is discontinuing joint participation with NOAA except in a supporting role and then only on a fully reimbursable basis and when DOD operational missions permit. Finally some of the aircraft of the Research Flight Facility are over 15 years old and have been flown extensively in hurricanes and other severe storms. Their future use is limited.

Nevertheless it is essential that more operational cases of hurricane seeding be attained. A move to the Pacific for STORMFURY operations is planned as soon as resources permit, where an average of three seedable hurricanes per operational year is expected as compared to one in the Atlantic.

4.1.4 *Instrumentation Improvements and Evaluation Procedures*

Major improvements in instrumentation and evaluation procedures are needed to advance our capabilities in weather modification. It is crucial that conditions in the natural environment be monitored accurately before, during and after modification experiments. Present capabilities from both instrumented aircraft and radar fall short of the needs. Development of remote sensing devices, satellite data and improvements in cloud physics instrumentation is necessary. Test and calibration facilities should be developed to aid in this development.

Complete measurements of all of the environmental and cloud variables will not be obtained and some uncertainty will be associated with all experiments. Statistical tests need to be sharpened to aid in the evaluation and combined with the physical measurements in meaningful ways.

4.2 Prospects

Whether Modification is an emerging technology that will benefit man and his environment by increasing the yield from his labors and by protecting him from the death and destruction of some severe weather events. The economic factors can be assessed only crudely at this time. The benefit/cost ratios of certain weather modification projects tend to be highly favorable, even with presently limited knowledge and the risks of failure associated with unreliable techniques. An important factor contributing to this result is the very low cost of engaging in most weather modification operational activities—with the notable exception of hurricane modification, which is carried out by the Federal government. The benefit/cost ratios, together with the advancing state of the art, make substantial increases in weather modification activities very likely. Examples of benefit/cost ratios for major categories of weather modification activities are as follows:

Precipitation augmentation.—NOAA estimates that the 100 thousand acre-feet of water produced over Florida in April and May of 1971 had a benefit/cost ratio as high as 68-1 with water costs determined by using the cost of water obtained from commercial irrigation sources. (Another estimate showed a 30-1 ratio.) General experience reported by the Department of the Interior (primarily the Bureau of Reclamation) shows ratios generally in excess of 10-1 and in some cases higher than 100-1.

Precipitation redistribution.—Estimates for certain areas within the Great Lakes Snow Redistribution Project being conducted by NOAA indicate a possible benefit/cost ratio of 5 or 10 to 1.

Hail Suppression.—Programs in the Soviet Union are reported to have ratios of between 5 and 17 to 1.

Cold Fog Dissipation.—Operational programs for airports are reported to have ratios of about 6 to 1.

Lightning Suppression.—Interior reports a ratio of about 5-1 for the 1971 season in Alaska (protection of forest land from lightning-started fires).

It should be noted that weather modification can produce disbenefits as well and these are not always included when stating cost to benefit ratios.

In addition to these economic benefits, scientific knowledge gained from the effects of intentional weather modification efforts will enable scientists to assess the effects of inadvertent weather modification on the environment and will suggest actions to take to mitigate the effects. These effects may be global. The international aspects of weather are present in both international and inadvertent weather modification and will involve nations more and more in the future. U.S.-USSR exchanges are planned in the near future concerning precipitation modification and inadvertent weather modification.

The chance to alleviate human suffering caused by weather events and to exercise some measure of control over our environment is a challenge which NOAA has accepted. NOAA seeks to make weather modification a more quantitative science, to help make it responsive to the needs of the citizens, and to cooperate with other nations in applying its benefits to all.

(COMMITTEE NOTE.—The following information was supplied in response to the request on page 139, and was supplied by NOAA.)

ONE-POUND PACKAGE LIMITATION FOR FISH PROTEIN CONCENTRATE

On February 2, 1967, the Food and Drug Administration (FDA) published the regulation (21 C.F.R. 121.1202) approving fish protein concentrate (FPC) manufactured from whole fish as a food additive. However, the FDA restricted its use to the home and prohibited its addition to manufactured foods. This was because of their stated concern that the consumer should be aware of the fact that FPC is made from whole fish.

These limitations have been one of the major barriers to the commercial development of FPC and, in fact, continue to limit both interest and involvement within the private sector. The inclusion of FPC in manufactured foods appears to offer the most commercial potential but the regulation prevents the purchase of foods supplemented with FPC and blocks industry from utilizing this food additive.

The activities described in the chronological list below detail some of the significant events which occurred during the attempts to remove the restric-

tions from the regulation. In carrying out the Fish Protein Concentrate Research and Experiment Program we have cooperated with private organizations as well as public institutions as required by section 4 of the FPC Act. During this period covered in the list NOAA staff had numerous meetings and contacts with officials of the FDA pertaining to the regulations and their modification, and made available on request appropriate scientific and technical information to interested private organizations.

February 2, 1967.—FDA published a regulation (21 C.F.R. 121.1202) approving FPC as a food additive but restricting it to household use and specifying that it be "packaged in consumer-sized units not exceeding 1 lb. net weight."

July 9, 1968.—NOAA personnel met with FDA personnel to discuss what would be required to amend the FDA regulations to allow FPC to be used in manufactured foods.

July 29, 1968.—Alpine Marine Protein Industries petitioned FDA to amend the FDA regulations to permit FPC to be shipped in bulk and used in manufactured foods.

August 16, 1968.—FDA replied to Alpine saying that their petition was inadequate and could not be accepted for filing.

October 4, 1968.—Alpine submitted a supplementary letter to FDA clarifying certain points in relation to their petition and the use of FPC in standardized foods.

November 22, 1968.—FDA replied formally that, in spite of the supplementary information, the petition was still incomplete and would not be accepted for filing.

April 18, 1969.—Alpine advised NOAA personnel that they intended to approach FDA on a product-by-product basis to remove the "one-pound package limitation."

May 12, 1969.—At the request of NOAA, the Committee for Marine Protein Resource Development of the National Academy of Sciences (NAS) reviewed the FPC regulation. It prepared a resolution requesting that the restrictions on the sale of FPC in packages exceeding 1 lb. and its use in manufactured foods be removed since they possess no scientific basis. This resolution was approved by the Academy's Food and Nutrition Board and transmitted to the Commissioner of FDA by President Seitz of the National Academy of Sciences with his personal endorsement.

December, 1969.—The White House Conference on Food Nutrition and Health recommended that the FDA regulations "be amended to permit the use of fish protein concentrate in manufactured food products."

October, 1970.—NOAA provided technical information to the Canadian Food and Drug Directorate. The Directorate published regulations pertaining to the use of "fish protein" (equivalent to FPC) prepared from whole fish. These regulations permit its use in manufactured foods.

December 3, 1970.—The NAS reaffirmed its position, in a letter to Commissioner Edwards, that the restriction on the use of FPC in manufactured foods be removed.

December 17, 1970.—NOAA personnel met with Deputy Commissioner Grant of FDA to determine the status of FDA's response to the White House Conference's recommendation. The Commissioner recommended that a petition be presented to FDA from industry (rather than another Government Department) recommending removal of the restrictions.

December 1970.—In a follow-up report of the White House Conference, the recommendation pertaining to FPC was rejected by FDA with the comment that "more study is needed on the processing and end product of fish protein concentrate."

February 18, 1970.—FDA published a notice in the Federal Register of the formal filing of the Alpine petition.

September 21, 1971.—Alpine withdrew their petition to the FDA due to the fact that they were no longer commercially interested in FPC.

January 4, 1972.—A petition, to amend the regulations to provide for the use of FPC in manufactured foods was forwarded to FDA by the National Fish Meal and Oil Association (NFMOA), in accordance with the FDA recommendation of December 17, 1970.

January 28, 1972.—FDA requested clarification of certain aspects of the petition.

February 10, 1972.—A response to the January 28 request was forwarded by NFMOA to FDA.

February 29, 1972.—FDA requested further information on trace elements.

March 17, 1972.—FDA published notice of filing of the NFMOA petition in the *Federal Register*.

March 23, 1972.—NFMOA responded to the February 29 request of FDA.

June 16, 1972.—FDA requested additional information on (1) trace elements, (2) kinds of foods to which FPC would be added and (3) levels of use.

August 4, 1972.—NFMOA provided the additional information.

August 15, 1972.—During a hearing before the Fish and Wildlife Conservation Subcommittee of the House Merchant Marine and Fisheries Committee, the Director of the Bureau of Foods of FDA indicated that they accepted the petition for removal of the restrictions in principle and expected to take action on the petition within 30 days.

September–October 1972.—NOAA staff had a series of meetings and telephone conversations with the staff of the FDA and NFMOA to supply additional data and to resolve points raised by FDA in connection with the petition on levels of use of FPC in foods and control requirements.

November 30, 1972.—FDA extended for an additional 90 days the time period for consideration of the petition.

STATUS OF THE FPC PROGRAM

Plant construction was commenced in January 1970, with the design based on the solvent extraction of ground whole fish under sanitary conditions. The plant had a designed nominal input capacity of 50 tons of fish per 24 hour day. In the process, fresh fish were ground, deboned, and extracted with isopropyl alcohol to remove water and liquids. Extraction was performed in a four-stage counter-current process. The extracted solids were desolventized, dried, milled, bagged and stored. The solvent was recovered by distillation and reused.

In March 1971, the experiment and demonstration plant construction was completed and plant operation commenced. During 1971, approximately 2,000 tons of hake were processed into 160 tons of product, 45 tons of which met all FDA requirements for FPC. Experimental variations in the process and mechanical problems caused the rest of the product to be deficient in meeting the requirements.

After the hake run in 1971, some experimental runs were made in the plant using fatty fish. Preliminary tests indicated that several substantial modifications and improvements in the plant were needed to operate successfully with fatty species, and to obtain all the engineering and economic data required by the Act. Work with fatty fish was discontinued in March 1972 so that the plant could resume production of FPC from hake to obtain additional product for large-scale testing. The plant operation ended on April 25, 1972, at the end of the Puget Sound hake season. Since the authority for operation of the plant (P.L. 89-701 as amended) was to expire on June 30, 1972, the plant was placed on a non-operating, care and maintenance basis.

Hearings were held by the Fish and Wildlife Conservation Subcommittee of the House Merchant Marine and Fisheries Committee on August 11 and 16, 1972, to consider extension of the Act. However, the Subcommittee did not report the bill out. Therefore, no funds have been obligated under the Authority of the Act since the end of FY 1972.

We are currently compiling information so as to provide as complete an information package as can be developed for persons considering commercial utilization of FPC. This effort will make available all the information on hand as well as key additional data that can be obtained without further plant operation, including perhaps the solution of several unresolved problems growing out of past plant operation with fatty fish. This type of work is generally authorized under the Fish and Wildlife Act of 1956.

TOTAL EXPENDITURES—FPC PROGRAM

The following summarizes the expenditures for FPC research and experiment and demonstration plant construction and operations:

Cost of plant construction and operations (fiscal years 1968 through 1972)-----	\$3, 929, 275
Research and development (fiscal years 1962 through 1972)-----	9, 516, 725
Total expenditures through fiscal year 1972 (fiscal years 1962 through 1972)-----	13, 446, 000



