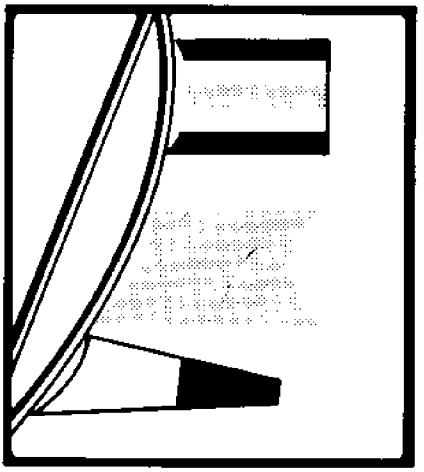
OUR NATION AND THE SEA: WHAT'S AHEAD?

PROCEEDINGS

OF THE

SEA GRANT ASSOCIATION MEETING



October 10-11, 1978
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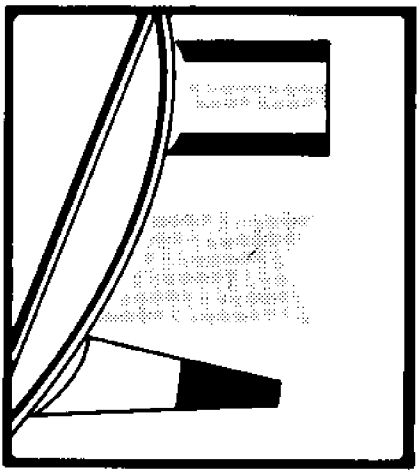

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THE OCEAN AND OUR ECONOMY

GIULIO PONTECORVO

INTRODUCTION

The question addressed in this paper is, is it possible to measure the contribution of the oceans to the economy of the United States?

To make a measurement of this kind we must first revise our way of thinking about ocean problems. We must move the focus of our attention from the value of the contribution made by particular or partial activities in the oceans, e.g., the role of a port authority, the development of a new coastal resort, the investment in offshore oil recovery, the expansion of a fishery, etc., to look at the value of ocean activity in the aggregate, as a totality of all the things that take place in, on and at the edge of the sea.

To make these measurements of the value of ocean activity meaningful (consistent) in a scientific sense, they must be linked directly to the other existing measures of aggregate economic activity, specifically the national income accounting system.[1] The national income accounting system measures

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[1] R. N. Cooper (1976), "The Oceans as a Source of Revenue," prepared for M.I. T. Workshop on the New International Economic Order.

_____, (1974), "An Economist's View of the Oceans," in R. E. Osgood (Ed.) Perspectives on Ocean Policy, prepared for National Science Foundation, Johns Hopkins University, Washington, D.C.

C. F. Bergsten (1974), "Commodity Shortages and the Ocean," in Perspectives on Ocean Policy, R. E. Osgood (Ed.), prepared for National Science Foundation, Johns Hopkins University, Washington, D.C.

"The Economic Value of Ocean Resources to the United States," Committee on Commerce, 94th Congress, U.S. Government Printing Office, December 1974.

R. W. Wright (1976), "Ocean Mining: An Economic Evaluation," Professional Staff Study, Ocean Mining Administration of the Department of the Interior, U.S.

A. T. Peacock, J. Wiseman and M. Roberts (1975), "The Fisheries Sector in the Social Accounts," Report prepared for the Department of Fisheries, Food and Agricultural Organization of the United Nations, Rome, unpublished.

the gross value of all current output (G.N.P.) in the United States. It is necessary to link the value of ocean output to the national income accounts for otherwise the measurements made of ocean output will be inconsistent. The nature of the inconsistencies that arise in looking only at partial analyses of ocean activity will be spelled out later but for the moment let us just emphasize the need to be consistent; to see that the value of the contribution of all the elements in the ocean sector plus the value of the elements in all other sectors of the economy correctly add up to the total value of our aggregate value of output and income not some sum which is either more or less than Gross National Product.

The purpose of addressing this measurement question is to improve the management of ocean space and resources. Extended national jurisdiction and the creation of economic zones forces the United States and many other countries into difficult choices involving the allocation of ocean resources at both the national and international levels. In general, as technological change, increasing world income and population put more pressure on the output from, and the space of, the seas, it becomes vital to upgrade the quality of both public and private decisions concerning activities in, on and under the oceans.

> "To manage the world's oceans efficiently we need much more information than we now have ... The need for accurate scientific and economic information is hard to overemphasize."[2]

Without systematic information on the income that flows from the wealth in the world's oceans, individual nations, especially those with complex economies like the United States, cannot develop coherent ocean policies.

> " ... it is not the lack of policies that is the issue; rather, the problem is the lack of a comprehensive approach to setting ocean policies."[3]

Furthermore, without coherent ocean policies, and without knowledge of the size and character of the income that flows from marine resources, the nations of the world will continue to

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[2]Richard N. Cooper, "An Economist's View of the Oceans," a paper prepared for the Conference on Conflict and Order in Ocean Relations, Airlie House, October 22-24, 1974.

[3]Comments by the Secretary of Commerce on the "Fifth Annual Report" of the National Advisory Committee on Oceans and Atmosphere, September 22, 1976, p. 4.

compound their difficulties in reaching agreement. The various issues before the United Nations Conference on the Law of the Sea, particularly the problems surrounding deep sea mining, illustrate this need.

In this paper we will first briefly examine the historical developments that have led to the increased value of ocean resources. We will then review the basic elements in the national accounting system. From that point we will articulate the methodology we will follow in creating an ocean sector out of the national accounting system. We will then proceed to define what we mean by an "ocean sector." Finally, we review our research findings, summarize the implications of this approach and, to the extent possible, remark on the progress made in determining the value of the ocean sector since this paper was written in June.

HISTORY AND BACKGROUND

The basic determinants of the technology utilized in exploiting ocean resources are not materially different from what they are on land. There are, however, substantive reasons for a separate analysis of what may be broadly described as the "economics of the oceans."

Historically, only a small proportion of man's economic and political world has been concerned with the management of ocean spaces and resources. Until recently, under an open ocean system with military control of the sea lanes in the hands of the Europeans and North Americans, the seas were not an area in which public policy had to make hard choices. When utilization and allocation were discussed at all, it was in terms of dividing up abundant resources into spheres of influence. However, abundance of ocean resources has given way to scarcity, and scarcity and the threat of it have been responsible for the growth of our attention to the seas. The need for a systematic approach to ocean policy has become compelling.

The first resource in which scarcity became apparent was fish. At one time the supply of fish was considered infinitely elastic relative to the demands placed on stocks. Today, increases in demand have made the supply functions for almost all species of fish inelastic. There is strong evidence of over-fishing throughout the world and only a small likelihood of a significant expansion in the catch from ocean fisheries in the future.[4]

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[4]The two possibilities for increases in catch involve a) moving to lower trophic levels and b) aquaculture. Both of these activities are capital intensive and require substantive management capability.

While the quantity of available living resources has become a problem, so has the amount of surface space in certain parts of the ocean. Today, the number of vessels using the English Channel has given that waterway the look of a major truck route, and for the first time, important harbors are being forced to install traffic control systems analogous to those found at major airports. Moreover, congestion is also a danger for recreational boaters in many areas.

Even if resources for each marine activity were more plentiful or carefully regulated, problems from overlapping demand would remain. For example, in Kuwait ballast discharge from tankers loading at oil terminals is polluting the Persian Gulf's once flawless waters, threatening the shrimp industry, beaches and water supply.

When we consider the trade-offs between fishing, recreational activity, petroleum recovery, waste disposal and transportation, it is clear that knowledge of the economic value of the alternative usages is central to coastal zone management. Under 200-mile jurisdiction, we must decide between increasing our capital investment in fisheries (to catch fish now taken by foreign fleets) or sharing our catch with other nations and perhaps selecting an appropriate charge for the use of our resources. To do so, we need more information on the value of alternatives than we currently possess.

> " ... We are ill prepared to meet this challenge ... because the marine programs and objectives of the numerous Federal agencies involved are sometimes in conflict and sometimes vague, and because effective mechanisms do not exist either to develop an overall national marine strategy or to assure satisfactory agency performance and coordination in its execution."[5]

THE NATIONAL ACCOUNTING SYSTEM

The initial goal in the development of national income accounting was to measure whether or not a nation (in the first instance 17th century England) was growing richer or poorer. That initial goal still underlies our interest in the measurement of our material well-being. Over the intervening two and a half centuries pursuit of that goal has led

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[5]Sixth Annual Report of the National Advisory Committee on Oceans and the Atmosphere, June 30, 1977, p. vii.

us to the development of our complex system of national income accounts.

This system of accounts was refined into essentially the present form in the 1930s. At that time, the need for these accounts was to provide a precise definition of the economic variables and sectors of the economy (consumption, investment, savings income, households, business, etc.) Defined in this way, these accounts provided the empirical content for the analytical systems which were devised to stabilize the economy in the period of the Great Depression. The proximate purpose of the national accounting system was therefore to assist in the analysis and solution of the national problems of unemployment, business cycles and low levels of economic growth. It is useful to note that originally the focus of the accounting system was on national problems and that local or regional problems were subsumed as part of a national average.

Today we still have to consider the problems of the 1930s. We are still concerned about unemployment, inflation and business cycles. However, the impact of those issues has been somewhat reduced and we have expanded our economic concerns to include a new set of difficulties. These new difficulties center around the questions of differential rates of regional growth (the Northeast compared to the so-called Sunbelt), the relative impact of federal tax and income transfer policies on cities, states, and regions and a number of particular economic problem areas where there is a specific need for a coherent national policy. Two obvious illustrations of the need for specific national economic policies are in food and agriculture and, of course, oceans.

We can now refine our original question; can we measure the value of the oceans in the United States economy to ask more precisely if it is possible to create an ocean sector within the framework of the national accounting system?

OUTLINE OF METHODOLOGY

Our basic hypothesis is that the present system of national income accounting as presented by the Department of Commerce clearly contains within it a place for an ocean sector. On one level the development of the ocean sector should be seen as an important and necessary step towards filling out the matrix of economic accounts which constitute the economy. While the ocean sector concept represents an advanced notion of an holistic system, it also entirely accords with the tradition of national accounting. Moreover, the new sector account is to be formulated and detailed in a manner completely consistent with the existing system of accounts.

Formally, we may define our process of ocean sector creation as a two-dimensional spatial and product reorganization of the macroeconomic system as defined by current national income accounting methodology. The accounts for the ocean sector must be created within certain consistency conditions.

Table 1 shows this n x 2 dimensional breakdown of the national income accounts. Consistency within the accounting system is maintained from a production standpoint with the system subdivided into two spatial sectors (ocean and other than ocean). The traditional approach utilized in structuring the national income accounts has been to have spatial unity (the United States) and, for purposes of analysis, division into production sectors (business, households, government), usually defined by function and/or the Standard Industrial Classification system, which identifies industries.

Our concern in this project is with the value of a_{01} (the value of output in the ocean sector). The conditions imposed by the national income accounting system are as follows:

i) Each element must divide the accounting system into mutually exclusive components.

ii) For each product sector (industry, etc.), the sum total for each product must equal the values in the spatial subsector, i.e., $a_{i0} = a_{i1} + a_{i2}$, $i=1, \ldots, n$.

iii) For each spatial sector the sum total in the ocean and other than ocean sectors must equal the corresponding values in each product sector, i.e., $a_{01} = \sum_i a_{i1}$ and $a_{02} = \sum_i a_{i2}$.

iv) The sum total for the value of production in each spatial sector must be equal the sum total of production measured across the product sectors, i.e., Gross National Product (GNP). The latter must be invariant to any division or creation or sectors within the accounting system.

i.e., $GNP = a = a_{10} + a_{20} + \ldots + a_{n0}$ (product sectors)

$GNP = a = a_{01} + a_{02}$ (spatial sectors)

v) Finally, there are two (column, row) consistency conditions involved in establishing an ocean sector.

Theoretically, these conditions require that the spatial definition on which division of the accounting system rests must be consistent across all productive sectors; i.e., whatever geographic or accounting rules and conventions we use to divide activities into an ocean and an other than ocean spatial sector

Table 1

Definition of an Ocean Sector Value Added in the U.S. Economy in an n x 2 Dimensional (Product x Spatial) Sector System

Spatial Sectors / Product Sectors	Ocean Sector 1	Other than Ocean Sector 2	Sum
1	a_{11}	a_{12}	a_{10}
2	a_{21}	a_{22}	a_{20}
⋮	⋮	⋮	⋮
n	a_{n1}	a_{n2}	a_{n0}
Sum	a_{01}	a_{02}	a = GNP

where a_{ij}, $i=1,2,\ldots,n$; $j=1,2$ is the value added originating in the ith product sector and the jth spatial sector.

This yields the following consistency conditions:

1. $a_{01} = \sum_{i=1}^{n} a_{i1}$

2. $a_{02} = \sum_{i=1}^{n} a_{i2}$

3. $a_{10} = \sum_{j=1}^{v} a_{ij}$, $i=1,\ldots,n$

4. $a = \sum_{j=1}^{2} a_{0j} = \sum_{i=1}^{n} a_{i0} = GNP$

for one productive sector (say government) should be the same for all productive sectors (fisheries, commerce and transport, etc.) A violation of these consistency rules will reduce or void the analytical basis of the spatial breakdown.

Table II is based on the 65 product sectors used by the Bureau of Economic Analysis (BEA) in determining the GNP (Table II). For our purposes it can be reduced to a simpler (2 x 2) table as indicated in Table III.

As noted in Table II, it is conceptually useful to think about the elements of a_{11} as consisting of two general kinds of activity. Those resources, (living, energy and other mineral) which are extracted from the ocean, and those activities which require the use of ocean space, (commerce and transportation, scientific research, military uses, commercial construction and government).

To be consistent with current national income methodology, the calculation of the value of element a_{11} in Table III requires analysis of the following issues:

1) Determination of which of the 65 sectors (as listed in Table II) utilized by the BEA in measuring GNP correspond to the product sectors of Tables I and III whose output originates from both ocean and non-ocean sources. This requires identification of and definition of an ocean sector which obeys the consistency rules.

2) Investigate the data sources and techniques employed by the BEA in constructing the existing eight different GNP series which they currently calculate for each of the 65 product sectors.[6] That is: we wish to discover how the BEA determines the values of elements a_{10} and a_{20} by each GNP method (particularly GNP determination by annual constant and current dollar factor payment flows) for each product sector. Special attention needs to be paid to the determination of output values for those sectors summing to the value of element a_{10}, the product sectors whose activities span both the ocean and non-ocean spatial sectors. Once this is done, we can then determine the value of element a_{11} by modifying those techniques used by the BEA in calculating the value of element a_{10}. However, this modification introduces and third and perhaps more arduous task.

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[6] These eight different series are calculated to arrive at one total G.N.P. Each of these eight represents a different methodology. However, the principal difference is in the utilization of either expenditure total or factor payment flow. (See pp. 17-18 of this paper.)

Table II

BEA Major Divisions	Sub Divisions	SIC Number
I. Resource Extraction		
Agriculture, Forestry, Fisheries (Division A)	Agricultural Services, Forestry, Fisheries	07-09
Mining (Division B)	Metal Mining	10
	Coal Mining	11-12
	Crude Petroleum and Natural Gas	13
	Nonmetallic Mineral Mining	14
II. Spatial Activities		
Construction (Division C)	Construction	17
All Manufacturing (Division D)		
Non-Durable Manufacturing (part of Division D)	Food and Kindred Products	20
Durable Manufacturing (part of Division D)	Transportation Equipment except Motor Vehicles	372-379
Transportation (part of Division E)	Water Transport	44
	Pipelines (except natural gas)	46
Communications (part of Division E)	Telephone & Telegraph	481, 482
Electric, Gas and Sanitary Services (part of Division E)	Electric, Gas and Sanitary Services	49

Table II (con't.)

Wholesale and Retail Trade (Divisions F & G)	Wholesale Trade	50
	Retail Trade	51
Finance, Insurance and Real Estate (Division H)	Real Estate and Combinations	65-66
Services (Division I)	Hotels and Lodging Places	70
	Amusement and Recreation Services	79
	Educational Services	82
	Miscellaneous Professional Services	84, 89
Government and Government Enterprises	Federal General Government	
	Federal Government Enterprises	
	State and Local General Governments	
	State and Local Government Enterprises	

Table III

Definition of an Ocean Sector Value Added
in a 2 x 2 (Product and Spatial) Sector System*

Spatial Sectors / Product Sectors	Ocean Sector (1)	Other Than Ocean Sector (2)	Sum
Product Originating in Both Spatial Sectors	a_{11}	a_{12}	a_{10}
Product Originating in Spatial Sector 2 Only	$a_{21} = 0$	a_{22}	a_{20}
Sum	a_{01}	a_{02}	a=GNP

*There are 65 sectors realized by the BEA in measuring GNP. Of these 65, only 23 contain product accounted for in a_{10}. In generic terms under resources subject to extraction, we find living resources, energy resources and mineral resources. Under the spatial definition: commerce and transport, commercial activity, construction and all government.

3) The Standard Industrial Classification system partitions the accounting system by class of output; it does not distinguish the spatial origins of output. Consequently, all of the product constituting element a_{10} contain economic activities originating in both the ocean and non-ocean sectors. At the present time the most detailed breakdown of GNP currently available is for each of the 65 spatially-undifferentiated product sectors of Table II. From this breakdown we have identified the output total for 23 subdivisions which constitute the value of element a_{10}, i.e., the sum of product originating in both spatial sectors. Therefore, the next task is to divide a_{10} into the value for elements a_{11} and a_{12} for each of the 23 product sectors comprising element a_{10}. This requires us to ascertain for each of the 65 BEA product sectors which of the underlying four-digit industries occurs in the ocean sector and which do not. We note that even under this fine a gradation, many four-digit industries will produce output in both spatial sectors. Once this is done, we must determine what percentage of element a_{10} each industry accounts for in each product sector. Then it is possible to aggregate these estimates across the 23 product sectors in order to determine the value of element a_{10}. To summarize, in order to generate a consistent estimate of income emanating from an ocean sector, we must:

a) Identify an ocean sector. This has two uses. First, we can determine which of the 65 BEA product sectors have activities originating in both the ocean and non-ocean spatial sectors. Second, we then determine what portion of each product sector's output is due to the ocean sector.

b) Determine the techniques used by the BEA in constructing the various GNP measures, for each unified product sector (elements a_{10} and a_{20}).

c) Adapt such techniques to apply to the portions of the product sectors whose output originate in the ocean sector. Once we aggregate the ocean sector portion of each product sector, we have determined element a_{10} consistent with both national income methodology and a rigorous definition of the ocean sector.

These consistency conditions (rules) represent a theoretical goal that can only be approximated by the empirical work. The consistency problem is, of course, one that affects the existing national income accounts. Since it is essentially an empirical problem where the constraints at any point in time are cost and data availability, it is reasonable to assume that the level of inconsistency can be progressively reduced in an operational system.

DEFINITION OF AN OCEAN SECTOR

The definition we choose for our ocean sector depends in part upon the applications we intend to make from the measurement. Given our desire to use the value of output in the ocean sector as a measure in the analysis of the economic effects of various policy options, we prefer a reasonably narrow conceptual view of the ocean sector. Consequently, as a first approximation, we can define an ocean sector as the element, a_{11} of the production vector containing those goods and services whose value can be directly identified with either an extractive or spatial use of the ocean within a 200-mile zone surrounding the United States.

1) This definition will allow us to measure the value of output from the ocean zone. However, it is not as spatially compact as, for example, the measurement of gross product originating in a state or in an area north of the 42nd parallel. Indeed, much value added from production for the U. S. economy which is identified with the oceans takes place on land. Therefore, the guideline we employ in considering what products fall within the purview of the ocean sector as we have defined it is does the value added from the activity in question occur because the U. S. has access to the 200-mile zone? If the answer is yes, then we include the value added from such activity in the ocean sector, regardless of whether the activity takes place in the economic zone or not. This guideline includes value added emanating from commercial fisheries, offshore energy extraction, and coastal passenger and cargo transport. The guideline also includes such land-based activities as ocean recreational services, marine scientific research, and beachfront construction since these activities utilize the 200-mile economic zone in some form.

2) We wish to limit the measurement to the value added of primary output of the ocean sector. This limitation runs counter to one possible line of argument that all economic activities owe their existence to the ocean sector through the interdependence of the economic system, i.e., if we compared the accounting measurement of the U. S. economy with and without the ocean zone the totals for value added in such product sectors as steel production, banking, and dairy farming would be altered. In a general equilibrium context one might conclude therefore that all 65 product sectors should be included in our ocean sector. However, in making this initial measurement of an ocean sector, it is desirable for both theoretical and empirical reason to keep the measurement relatively narrow. As a second guideline, therefore, we define the ocean sector to consist of those goods and services which directly utilize some characteristic of the 200-mile zone as an input in their production functions. Commercial fishing, beachfront recreation,

ocean-waste disposal, and the U. S. Navy use some aspect of the ocean system in their production processes and are included, while life insurance, dairy farms, and steel manufacturers clearly do not (although they may be dependent upon those who do to purchase their output) and are, therefore, excluded.

A more complex case involves those manufacturing industries which locate themselves near the coastline for transportation efficiency or to utilize the 200-mile zone for internally disposing of thermal, solid and other effluents as by-products of the manufacturing process.

One possible interpretation of the two guidelines would suggest the inclusion of the value added of these sectors in our ocean sector since they also utilize a spatial characteristic of the 200-mile zone as an input in their production process. However, we do not include such industries in our ocean sector since the use of the zone is not necessary for the survival of the industries in question. Even if there was no access to the ocean zone, these industries would remain in production by using alternative non-ocean disposal technologies. On the other hand, it is necessary to include the value added of those industries (such as refuse barge operators) whose primary activity involves the disposal of such waste within the zone, since these concerns would cease operation were a policy change to forbid such activities.

3) The definition of the inner boundaries of the 200-mile economic zone requires an arbitrary distinction. We propose in this initial approach to the ocean sector to exclude all economic activities utilizing inland rivers, lakes and seaways. For example, commercial and recreational fishing, scientific research, and water transport occuring in the Great Lakes or Mississippi-Missouri river system are not a part of our ocean sector.[7]

Food processing at sea and shipbuilding are two industries which fit the above distinction for goods and services which directly utilize ocean resources in production. We include both industries in the ocean sector even though food processing at sea does not directly utilize the ocean zone per se. The processing which occurs at sea, and not on land, reflects an important spatial characteristic of the ocean zone as an input in production of processed fish, that is, the economics of utilizing the capital embodied in the fishing vessel for

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[7] A broader spatial definition could certainly include activities within such systems to form a "water sector" rather than our ocean sector with little or no additional informational costs.

processing as well as catching fish. We also include recreational and commercial ocean-going shipbuilding within the ocean sector even though the 200-mile zone does not serve as a direct input into this industry (with the exception of those plants engaged in such construction located on the waterfront). However, the existence of the zone is the sole raison d'etre for this industry.

As noted, we wish to measure the value added generated from the production of goods and services in the ocean sector. This definition should also indicate the choice of methodology to be used in determining income generated from the ocean sector. Specifically, it is best to utilize the factor payment flow rather than the expenditure on final output approach for constructing GNP totals from the ocean sector.

The expenditure method calculates GNP by measuring the market value of the final output of goods and services while the factor payment flow method calculates the value added of all goods and services produced by the economy. Those two approaches, of course, produce equivalent estimates of GNP for the aggregated spatial and product sectors of the accounting system. However, they are not equivalent when determining income for an individual product or spatial sector. For example, there is substantial value added in steel production (factor payment flow method), but with the exception of inventory accumulation (a form of investment) very little steel output is considered as final production (expenditure method). On the other hand, the retail trade sector has a large figure for final output (almost all consumption goods) with a relatively small portion consisting of value added (mark-up). Thus, we can see that for each methodology, the weights accorded each product sector vary greatly.

This non-equivalence of method holds for our new spatial as well as the more familiar product sector partitions. The value accorded commercial fisheries' output by the expenditure method would be much larger than that by the factor payment flow method since the former evaluates output at market prices. These market prices include the value of intermediate inputs (gasoline, netting, ice, etc.) which are produced outside of the 200-mile economic zone. The cargo transport activities of the ocean sector would receive little weight according to the expenditure method since this activity is generally regarded as an intermediate input; yet the factor payment flow method would capture the substantial value added produced by this activity. The two approaches are consistent only in those spatial or product sectors where all the goods and services involved do not use any intermediate inputs from outside the sector in their production, and where they in turn do not serve as intermediate inputs in any other production process outside

of the sector. Unfortunately, there are few product or spatial sectors which contain economic activities whose production uses input from within the sector and whose output remains within the sector.[8]

The non-equivalence of these two approaches at the sector level requires us to decide which technique to use in measuring income generated by the ocean sector. We choose the factor payment flow method. The expenditure method would tend to overstate the value of certain ocean sector products (such as commercial fishing) and undervalue it for others (water transport). Valuation at market prices of ocean sector output may not reflect the true measure of the activities' dependence on the ocean sector. The techniques utilized and data available for measuring output by the factor payment flow method are more amenable to modification for use in measuring product sector output in a spatially defined context.

SUMMARY

1) It is possible to see the ocean sector as breaking new ground in the accounts system. The desirability of aggregation for reasons of industry type, geographic region and so forth, have long been apparent. Now, the growing interdependence of many aspects of the physical world calls for the increased examination in terms of so-called "natural" systems, as well as, for example, in terms of purpose or geopolitical organization. The work done on an ocean sector will be an enabling factor in creating sets of accounts for other sectors which are not yet reported. The utility of the national income accounting system may thereby be increased, as the new measurements will be of value in resource management. Furthermore, the creation of an ocean sector will make possible theoretical model building which can examine the relationships between the ocean sector and the rest of the economy, and the relationships between subsectors within the ocean sector.

2) Creation of this sector account may also lead to improvements in accounting for the public sector. For a variety of technical and theoretical reasons, the public sector presents a number of problems in national income accounting. It may be possible to extend the techniques used in the current research to public sector accounts in general and, thereby, provide a more accurate representation of the value of the public sector in the American economy. This is important when one notes the enormous growth

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[8] This in no way conflicts with the equivalency of the two methods at the GNP level since by definition there is only one sector -- the entire production vector.

of the public sector since the system of national accounting was first devised.

3) The research has shown clearly that possible changes in income accounting techniques are theoretically desirable. While this is true from the broad point of view of public policy and systems design, it is also true in more technical respects. For example, definitional work on both market and non-market measurements of output and the meaning of primary production indicates directions of potential improvement.

4) In terms of theoretical economics, the study has brought to attention particularly important questions about the adequacy of market price as a measure of economic performance. The project has shown clearly the need for additional work in determining the appropriate prices to be used in the allocation of resources in both the public and private sectors. Key issues of economic externalities, public commodities, and the valuation and allocation of commodities with incorrect or nonexistent prices have already received substantial attention, particularly in the analysis of fisheries. It is now apparent that this applies to a substantial part of the ocean sector.

PANELISTS' PRESENTATIONS

JAMES L. JOHNSTON

Professor Pontecorvo, as most of you know, is a distinguished economist who has made many contributions to financial history and the common pool problem in fisheries. We see in the present paper a broad expansion of his previous interests into an ambitious project to incorporate an oceans sector into a Leontief-style input-output structure of the national income accounts. Clearly, this effort is in its preliminary stages judging from the host of problems that Professor Pontecorvo himself identifies in his paper. Altering the standard Commerce Department's industry structure to isolate the unique contributions that oceans make to the economy of the United States is an extremely difficult problem. Professor Pontecorvo has done us a great service by thinking through in this initial stage some of the problems and reporting them with candor.

My role today is to add to that list of problems and to urge caution in proceeding toward an "efficiently managed" ocean sector. What concerns me is the possibility that an elaborate model designed by the most highly motivated and competent economist may, nonetheless, be tragically flawed and cause serious injury to consumers and others who were to be the principal beneficiaries.

IDENTIFICATION OF THE OCEAN SECTOR

The bulk of the paper we have heard today concentrates on separating the ocean related activities from others. But it is not clear how the attempt to discriminate between "wet" and "dry" industries helps policy formation or promotes efficiency. Consider two policies which could be evaluated by such a model. One is a new tax just on petroleum recovered from the outer continental shelf. Such a levy would clearly violate the principle of tax neutrality, and no model is necessary to establish this result as being inefficient. Similarly, a stringent regulatory regime for ocean fisheries would create an artificial stimulus for farm substitutes, and lake and river fishing as well. It seems to this observer that policy issues do not come neatly divided between ocean and land mass. Thus, mounting a large effort to separate them in the national income accounts may not have value in discriminating among policy alternatives. The fact that there has been little previously expressed demand from outside the government-academic establishment for such an exercise suggests that a more complete rationale should be offered. Particularly, those ocean policy

questions on the horizon should be examined to see whether a separation of ocean from non-ocean industries has value in excess of the costs. Indeed, it seems only fair that a model that facilitates economic trade-offs should itself be subjected to a cost-benefit evaluation.

THE NATURE OF THE MODEL

Since the model is in input-output form, it is useful to identify those questions for which it is well and ill-suited to address. Basically, the input-output model determines the levels of production in each sector which are required to satisfy a given level of final demand. All components of final demand are considered to be data.[1] Thus, for a given change in final demand for an industry's output, the model describes the direct and indirect changes in the supplier industries. It is a demand oriented model in the Keynesian tradition. As such it neglects changes in aggregate supply where so many governmental actions impinge. Remember, regulation, government research and taxes on ocean related activities impact first on costs and from there are transmitted on to prices and output.

There are several strong assumptions implied in the input-output formulation which deserve explicit comment.

Unchanged Relative Prices

One of the most serious problems with the input-output model is that changes in relative prices play no role. Consider a contraction in quantity demanded in the ocean sector. In the input-output model there would be corresponding contraction in the other sectors because the only role played by the other industries is one of supply. By contrast, a similar ocean sector output reduction would in the standard general equilibrium model, yield an increase in the output of the rest of the economy. This more sensible result is exactly the opposite from the outcome produced by the input-output model.

Factors in Constant Proportion

Closely related to the rigidity in relative prices is the problem that factors of production are fixed in constant proportions in the input-output model. A change in one industry's output always produces the corresponding contraction in the use of the factors of production in the same proportion as their use in the original equilibrium. Further, not all factors have identically the same proportional alternative uses. Thus, it is highly artificial to presume that the factors of production

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[1] William H. Miernyk, The Elements of Input-Output Analysis (New York: Random House, 1965), page 147.

would change in exactly the same percentage terms.

Zero Cross Elasticity

With respect to consumption of final products, the input-output formulation presumes complete independence. Reduced output in one industry has no effect on the demand for substitute goods. That is, the cross elasticities are zero. It should go without saying that such an assumption seriously strains credulity. All goods are at least partial substitutes in consumption, and to presume that demand for them does not increase when the output of one industry declines is tantamount to presuming that somehow resources disappear into a deep hole.

Old Technology

To compound the inflexibility described above is the fact that the basic structural relationships are old. The most recent input-output tableaus which, of course, lack identification of ocean resources, are more than ten years old. There are data available from the 1972 Census of Manufactures which might be the basis for the exercise envisioned by Professor Pontecorvo. But these data omit some important sectors which are required for completeness and even this more recent information predates the 1973 to 1974 oil boycott. Clearly, the structure of the U. S. economy has changed remarkably due to the four-fold increase in petroleum prices, and there is every reason to expect those changes to be especially felt in the ocean sector.

Leontief himself warns about extrapolating too far in time.

> "Comparing the structure of an economic system in two stages of its historical development, sufficiently removed from each other, one might easily find them as unlike as a butterfly and a caterpillar."[2]

No Externalities

A particularly difficult problem for any economic model is the appropriate handling of externalities. Effects which spill over from other economic activities and goods which are jointly produced or consumed collectively are quite common. In the ocean sector they appear in the common pool problem of fisheries and petroleum recovery, scientific research, technological development and, of course,

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[2]Wassily W. Leontief and Others, Studies in the Structure of the American Economy (New York: Oxford University, 1953), page 20.

environmental protection. One might even argue that most of the difficult problems in the oceans to which economics might contribute solutions are in this category. But, how could they possibly be solved by a macroeconomic model that ignores externalities.

Absence of Transactions Costs

An allied problem has to do with transactions costs. The typical macro model, and the input-output formulation is no exception, ignores costs of information, contracting, enforcement and protection of property rights. Incorporating these elements into economic analysis makes the results more robust in the sense that the analysis better predicts real world events.

But this is seldom done. Instead, the so-called "pure and perfect competition" model with zero transactions costs is invoked to show that the world is inefficient. As a part of such an exercise, a host of policy prescriptions are offered as a way to improve the state of the world, defined as those changes which will make the world more like the model. But "pure and perfect competition" is a simplification, for many purposes an oversimplification, to avoid the complications of transactions costs. In many instances the "pure and perfect competition" model is quite satisfactory, like zero friction models in engineering. However, a campaign to make an economic system conform to an economic model is topsy-turvy. It would be like setting out to lubricate the world so that it would more closely resemble the frictionless models of engineers. Clearly, economists have a lot to learn from the good sense displayed by engineers in absenting themselves from such campaigns.

SUMMARY

The input-output type model proposed by Professor Pontecorvo may be useful when fully developed for discriminating among some important policy alternatives. The model's designer has pointed to some difficult problems in its construction, mainly in consistently identifying an oceans sector. His candor is in the highest tradition of good scholarship.

This commentator has raised some additional problems. The first is about the applicability of the model to what would seem to be the bulk important policy questions which now appear to be on the horizon. Hopefully, a more careful inventory of potential policy questions will be conducted and compared with the features of the input-output model, to see if it can identify productive ocean policies.

The second problem has to do with the very subtle but nonetheless important assumptions embedded in the input-output technique. This kind of model is often used in tracing the interrelated changes in supplier industries given an exogenous change in the demand for the output of one industry. However, among other assumptions, the input-output formulation assumes:

1) no changes in relative prices,

2) factors of production are used in constant proportions,

3) all other goods demonstrate zero cross elasticity,

4) the technology underlying the model structure is of necessity from the previous decade,

5) no allowance for externalities is included, and

6) all transactions costs are presumed to be zero.

What concerns me is that with the press of too many problems facing policy-makers, they will grasp for an incomplete model and use its results to justify greater intervention into the ocean sector. The increased presence of decision-makers who do not stand the financial consequences of their actions will serve to distort the allocation of resources. This will do more than just increase costs. It will erode the property rights of the responsible economic agents and that in turn will destabilize the investment climate, curtail innovation, and reduce the resources recovered from the oceans. Essentially, externalities will be created and intensified rather than moderated, causing the model to be at even wider variance from the real economic system. Regrettably, what will follow is more justification for intervention, aided I must say by increasing ranks of economic model builders until, in the last stage, there will be virtual monopoly control of economic activity in the coastal zone by the regulators. The inescapable result will be higher prices for consumers and a lower level of welfare for society.

This is not a view unique to this commentator. Nor does it reflect any animosity toward mathematical modelling. No less a mathematicial theoretician and economic model builder than Francis Y. Edgeworth said that:

> "Among those who would suffer by the new regime (of universal monopoly) there would be one class which particularly interests the readers of this (Economic) Journal, namely the abstract economists who would be deprived of their occupation, the investigation of the conditions which determine value. There would

survive only the empirical school, flourishing in a chaos congenial to their mentality.[3]

It cannot be too often repeated that the rules derived from mathematical reasoning are essentially abstract and require, in practice, to be largely diluted with common sense."[4]

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[3]Francis Ysidro Edgeworth, Papers Relating to a Political Economy (London: Macmillan, 1925), pages 138, 139.

[4]Ibid., page 142.

GEORGE H. PAGE

I want to thank you for this opportunity to be here this morning and to discuss with all of you present the sense of urgency which the recreational boating industry feels regarding the future of our oceans.

Further, as I listened to Dr. Pontecorvo's remarks, I dreamed of the day when we could so objectively state the true value of recreational boating to our nation.

This is to say: First, that the relationship of recreational boating to our seas, and I include our inland seas, the Great Lakes in that relationship, is one of virtually total dependence. Second, in spite of the contention that boating possibly may be the second oldest participative recreation, we have a long way to go before we can reliably identify the specific dollar value, or dollar impact, that the sport and its companion industries have and will have on any particular segment of the country. Perhaps this is because boating is a leisure activity, which by nature is casual, part time, and often without specific plan, and therefore unsuited to precise census; but, I believe also that our lack of precise economic data on the industry results from the literally thousands of manufacturers involved and the wide diversity of product. We cannot be compared to the automobile or the private aircraft industries in any way, other than perhaps that our products are used for leisure activities, at least part of the time, and they can be bought on extended time payment plans. After that, the similarity disappears.

Without truly hard numbers, we can only estimate and project our economic profile. These estimates and projections will show that boating on a national level during 1977 accounted for:

$5.9 billion spent at retail
$1.9 billion spent on new boats alone
10.5 million recreation boats in use
52.6 million persons participating in boating

We also estimate that boating provides jobs for 350,000 full time employees and 100,000 seasonal employees, with an annual payroll projected at $1.3 billion.

Relating the sport briefly to energy consumption, because I am often asked this question, boats use approximately one half of one percent of the nation's petroleum yearly, or the equivalent of a half a tank of gas per year for each automobile in the United States.

The dollar figures I mentioned above are just those for our industry specifically. They do not include the "ripple" or spin-off business that boating also generates, such things as food and beverage purchases, bait, fishing tackle, hotel and motel accommodations used by cruising boaters as well as vacationing trailer boaters.

Nor does it account for the dollars spent annual in the maintenance and construction of boating facilities, which are appropriately catalogued as construction dollars rather than boating dollars.

There is no question in my mind as to the importance of boating to the nation's economy. Admittedly, our impact pales when compared to the automotive industry, or to the steel industry, or agriculture, but it still is an important part of the economy. This fact becomes even more apparent when you narrow the field down to those states lying in the coastal zone; when you place it in that strip of America that borders on the sea.

The 30 states that comprise the coastal zone of the United States account for 80 percent of the boating activity in the country. I base that figure on the distribution of boats registered by the various states. As you know, under the Federal Boat Safety Act of 1971, virtually all powerboats, that is, boats with mechanical means of propulsion, must be numbered, either by the states or by the U. S. Coast Guard. In 1977, the Coast Guard reported a total of just over eight million registered boats nationwide. Of this total, those 30 states contiguous to the oceans, the gulf of Mexico and the Great Lakes claim 80 percent. Now, here again, a portion of those 6.4 million boats are used for fresh water activities on lakes, rivers, and ponds that may be some distance from the shorefront, but because a boat is a mobile source of recreation, we have to consider that it is possible they will be used in the coastal zone at some time.

If you take the total 1977 expenditures on recreational boating of $5.9 billion and apply the same percentage to it for the coastal zone states, you would generate an estimated $4.7 billion in retail sales for those regions.

The importance of boating to these coastal states' economies is further underscored when you realize that the five top states in sales of inboard boats, outboard boats, sailboats, inboard/outdrive boats, while they may differ slightly in order of importance, are consistently within the coastal zone states. I am speaking of the following states as leading boating markets: New York, Florida, Maryland, Michigan, New Jersey,

Texas, California, Washington, and Massachusetts. A predictable list of top market states.

There is one other side to the relationship of boating to the sea, and more particularly to the coastal zone, and that is the fact that unlike other economies that are dependent on the seas, boating's dependency falls primarily within a narrow band of water and shoreline appropriately identified as the coastal zone. With the exception of those boaters who prefer inland lakes and rivers to the bays, gulfs, and estuaries along the shore, nearly all the recreational boating occurs within sight of land, if not within one mile of shore. And nearly all the support activities, docking, launching, sales, repairs, storage, etc., also occur within one mile of the shoreline, and more often than not, within a few hundred yards of the water's edge.

This is to say that boatmen must have access to the shore and use of inshore waters if they are to be able to participate in their chosen recreation. Where access to the shore and the water is encumbered or denied, the boaters, and with them the boating industry that supports the sport, face extinction.

I would like to make one additional comment on the economic importance of the seas, particularly the coastal zone region, regarding recreation. Although I cannot speak directly for the many other forms of recreation mankind derives from the seas, I feel it is important to keep them in mind as you consider the formulation of ocean policies. The concerns of those who take part in such recreational activities as fishing, swimming, surfing, diving, beachcombing, picnicking, and other associated activities were voiced at a national conference on marine recreation in Newport Beach, California, in 1975 and have remained virtually unchanged. That conference, entitled "Recreation -- Marine Promise" also identified the intricate web of conflicts that these uses present, conflicts that <u>can</u> be resolved by coordinated and cooperative planning.

Quite obviously, when each of the varied recreational uses of the shoreline is examined, each depends on one issue that is common to all: access. Without access to the resource, none of the recreational activities mentioned can be fulfilled. As Dr. Robert White, Administrator of the National Oceanic and Atmospheric Administration, so aptly stated at the 1975 conference, the issue of access "invokes social, economic and legal questions" which are difficult to resolve. Add to that the economic importance of the oil and gas industries and the aquaculture industry and their needs for at least limited basic access to the coastal resources and the problem is even further compounded.

Boating's immediate problem in the coastal zone is one of access, or facilities. We find ourselves approaching what might be

called "The Crisis at the Waterfront." That crisis for us is a mounting shortage of facilities to accommodate the recreational boating public. It is particularly severe where the population is concentrated in major megalopolis regions. The Northeast, the Southeast (particularly Florida), Southern California, the Pacific Northwest, and certain areas of the Great Lakes. The combination of rising development costs on the waterfront, the shortage of developable property, the "environmental conscience" of the Nation have virtually brought facilities expansion to a standstill. A recent survey conducted by NAEBM revealed that, given available capital funding and the necessary freedom to do so, present marine facilities could expand right now to meet the present demand for slips and moorings plus another 43 percent of the present demand. We could, right now, expand our present facilities by 143 percent of the present shortage. But we can't, in part, because the powers that give their blessings to such projects are ignorant of the facts. Our New York offices get countless cries for help from marina operators and potential facilities developers who have run up against the wall of ignorance regarding the impact of boating facilities on the environment. I am not advocating the destruction of vital marine environments for new facilities, but I am suggesting that there is a vast vacuum of knowledge relative to the relationship of boating facilities to the environment. We are working to seek to fill some of that vacuum, but too often industry's data is viewed with skepticism as being "controlled for industry's own gain." I am reminded of the logic that called for strict control of on-board sewage treatment facilities for boats when practical observation, in most instances, would demonstrate that total prohibition of discharge of treated effluent was not only unnecessary but in many cases impractical. A major effort was made by the federal government to put an end to what at its most extreme could be considered a very minor environmental problem when compared to other sources of marine pollution.

The point I am trying to make is that it is all too easy when developing major policies affecting our resources to recognize the major factors and interests while ignoring other aspects whether they be boating, beachcombing, bathing, or other human activities that on the surface, may not seem contributory to the economic well-being of the country. It is too easy to put restraints on the lesser industries or activities to foster others that might be deemed essential to the Nation's future. We should not lose sight, however, of the contribution to the economy that the smaller industries make in terms of jobs and dollar impacts. They have a place in the broader picture and it is up to people like you and me to assure them that place. It is up to all of us to work to achieve an atmosphere of mutual understanding by seeking to learn more of the concerns and facts that others have to offer and of cooperative efforts to provide a rational and equitable allocation of the available resources

that will, to the best of our abilities, provide continued opportunities for Americans to live and grow in a free and healthy environment.

Mr. Dearborn: Mr. Johnston, recently the United States participated with a number of other nations in a huge land grab, and we now have common property which extends 200 miles to sea. Was it your statement that you felt Mr. Pontecorvo's bookkeeping analysis would not provide more information, or that the information provided by this change in bookkeeping would not be useful in developing policy to control this common property?

Mr. Johnston: Thank you very much, Mr. Dearborn, for asking that question. It gives me a chance to answer a couple of others. I don't think I would characterize the 200 mile extended fisheries jurisdiction as being a land grab. First of all, I think you've got the wet and the dry mixed up. As far as the model being useful in tracing the implications, I guess what I'm saying is that the model is an interesting exercise in taxonomy. However, it's not clear that it's going to address the important policy issues. As Professor Pontecorvo has pointed out in such beautiful expositions in the past in his primary work on the common pool problem of fisheries, there is a difficult problem with externalities of common pool resources and the policy perspective will not have very much light shed on it by a macroeconomic model. On the other hand, a micro model might, indeed, shed some light.

The other part of your question is, is the model likely to give you misinformation? I think that's very possible because of the very strong assumptions. But there's a better point to be made. That is that information is costly. Unfortunately, in many cases, economic models presume the information cost to be zero, and that's implicit in both of these statements. Essentially, it says that the cost of either providing more information or the cost of misinformation is zero. What you want is to have that investment in more information where the value of the information is just equal at the margin to its incremental cost. What I'm saying is that we have a long way to go in the present formulation before we are sure that, number one, the policy issues that it will shed light on are, indeed, important ones and we're not leaving out important policy issues that a restructuring of the model might help. Number two, I think we want to make sure that we're not investing so much in the model that its costs exceed its values.

Now, as far as the comment made earlier that essentially this is not an input-output analysis that could be rejected for some of the reasons I mentioned, I would only like to offer that the input-output technique is perhaps the highest art form we have in dealing with industries and their interactions, and it came about after considerable time and investment. I don't see in the present description enough -- other than how you discriminate between a wet and a dry industry -- which would indicate how the model is going to be exercised. My presuming that the model is essentially like the input-output model is really a compliment. I presume that Dr. Pontecorvo was aspiring to what is essentially the latest thoughts in this area as it now stands, notwithstanding the best we now have has serious flaws in it. What I would suggest is that all of the flaws I've identified for the input-output model be reviewed with respect to this model, especially when the rest of the details are filled in to see whether or not it passes all the tests that I said were problems with the input-output construction. Then I would hope, since he says that this is an animal instinct, that you would look for other problems that might be in the model that might distort it. Clearly, that essentially involves a cost-benefit analysis of the model. Thank you for asking the question.

Dr. Pontecorvo: The issue has been raised and a compliment has been passed with respect to art form. I think there is a basic problem that we really shouldn't trouble you about, and that is whether or not this is an input-output study. It's not an input-output study. It's a reconstitution of the national income accounting system, a system which is already in place and already provides certain utilities. Now, what is being proposed is, rather, a reorganization of those accounts, and this is a modest cost operation. I hate to say publicly how modest. Too damned modest, I might add. Also, this is another key point, the accounting system reorganization does not presuppose any policy. I made it very clear at the beginning of my remarks that there was a distinction to be made between any analytical work that might be done subsequently and the creation of accounting data. We're talking about the creation of accounting data. We are not at this point talking about any policy conclusions. When they worry about policy conclusions that might happen if the accounting data is, in fact,

corrected, one can certainly worry quite legitimately about the accuracy and what precisely the interpretation of the accounting data is. That, I think, is a very, very important point, and, as I indicated in my conclusion, a point which we can address at some great length, because there are some problems with the national income accounting system, which I am very happy to be candid about, but which, in fact, require a major amount of thought before they can be accurately or in some sense scientifically articulated. So, clearly, that point is very, very substantive. Let's not dwell further on the nature of what we're doing because I think that just confuses the non-economists in the gathering.

Mr. Bish: Giulio, I see a problem between you and Mr. Johnston where I think you really have two different objectives in mind. You say that you're interested in a consistency-type model, and, heaven knows, there are these abuses where the Port District says how many dollars it adds to the value of the economy, and the fishermen say that, etc., and if we add them all up, they exceed the total sum of the economy because of the techniques that are used. So there's really a need for consistency and to know the relative size of the different industries, but you imply, Giulio, in your presentation, that the data somehow can be an aid to decision-making, perhaps on particular conflicts. In our particular conflicts, we're really interested in the relative value added by different uses. For instance, we could class Wentworth-by-the-Sea as a recreation facility and just as soon conclude that maybe it should be in the mountains rather than at the sea. On the other hand, we would want to ask how much greater is the value added to have it at the sea rather than in the mountains relative to other use? I would just suggest that the macro-income framework will not aid in answers to those questions, and that, in fact, for policy issues on resource trade-offs, you're always going to find it expedient to come back to a micro framework where your theory on relative contributions and value added is the driving force in the model, rather than the demand for the consistency in the accounting framework. Even the macro model that Curtis Harris has developed on industries, which may be the most sophisticated, has been shown, I think quite conclusively, to not be useful on predicting impacts of individual energy facilities, let alone dealing with the value added. So I think they are really two separate questions. One is a static consistency picture, but a wholly different

body of theory is needed if you want to know the relative contributions of different decisions at the margin.

Mr. Johnston: Well, I agree with a good part of it. It's quite clear that the macro system has certain limited utility, as all systems do. Similar content applies to the need for desegregation. I quite agree with you that desegregation is always an appropriate technique and it's always an appropriate question. I think Virgil summed it up very neatly when he observed that you can deal with desegregation and you can deal with partials and, ultimately, you may find yourself not having a national policy at all, if, in fact, a national policy is, indeed, desireable. So both are clearly necessary.

One utility of the macro approach is it does give an overall policy control kind of mechanism in hand. Secondly, in a broad kind of way, it gives you some idea of what your allocation decisions really imply. And it's quite clear that in addition to this, you need some particular studies or particular activities. I don't think you would disagree that, for example, monetary policy in the United States, which is a policy laid down by the Federal Reserve Board, for better or for worse, is, in fact, an aggregated policy that has all kinds of differential and discriminatory effects locally. It's obvious that any decision to raise interest rates has a disproportional impact on the construction industry, but this may be consistent with the national objective to fight inflation. So I don't think there's any quarrel with that kind of a proposition. I think it's extremely difficult to argue that one is more useful than the other. Both have their utility. I guess that's the answer I would give you.

Mr. Marshall: I'd like to throw a few challenges at the engine and boat manufacturer's group. First of all, a lot of the boat service activities are now on the waterfront when they don't need to be. There are some notable exceptions. For example, the Westerbeke Engine Company is in Avon, Massachusetts, a long way from the water and a very suitable location. But Ted Hood Sailmaker is right out on the point at Marblehead. Other sailmakers are well inland and there's no reason why they should not be. I happen to know of one boat hauling yard, which I understand is a very good one, which is about three miles inland and works very effectively. So this group is not without some guilt in using up the cherished waterfront property.

The second point I would like to make is that you mentioned a number of unknowns, a lack of information, but you weren't very specific. You didn't have time to be. I think it would be helpful to those of us who would like to know more about this and perhaps offer some research and advisory input to have some details as to the unknowns. We have some hunches, but I think we'd like to hear from you, and perhaps some of my colleagues have already heard from you.

The third point is relative to marine heads. My impression, and I think it's fairly well founded, is that the engine and boat group (NAEBM) has spent much of its energy in the last half-decade or so when this problem has been before us fighting it. I feel that there hasn't been enough energy spent toward trying to study methodologies to meet this challenge of environmental improvement. I'm a boat owner myself, and I feel let down by the engine and boat manufacturers in that I haven't seen them spending much industrial R and D development energy toward meeting this problem, at least, nothing compared to what I hear about in terms of fighting the problem? Please ignore the last point because that's really the environmental section in this afternoon.

Mr. Page: Thank you very much, sir, for these very searching questions. I think we're talking about a couple of different things. When I was talking about the necessity of having facilities on the waterfront, I was talking about the boat owner vis-a-vis the marina and his mooring and his service organization. My company is located in the Philadelphia, Pennsylvania, area. Most accessory manufacturers can be located anywhere. There's no reason for the sailmaker to be on the waterfront. On the other hand, I think that the proximity of the dealer-marina network, from a service point of view, should offer convenience. This is a very searching question and I don't have all the answers.

Second, as to specific data, I have a little fact card that the NAEBM puts out. I'd be glad to give you this. Some of the figures I gave you may be relatively precise, but when we say all the ancillary services that contribute to retail sales in boating, we're talking about consumption of gasoline and liquor and soft drinks and food as well as immediate boating-related accessories and equipment. I was merely trying to protect myself when I gave this presentation this morning by saying that some of

our figures were imprecise. Thank you.

Mr. Doelling: I wanted to encourage a little competition from the outer members of the board. I was trying to understand Virgil Norton's numbers in the first place. You talked roughly about a one billion dollars' worth of landings and about a quarter of a million fishermen and that set of numbers bothered me because that sort of said if all the money in the landings went to wages, that's $4,000 a year per fisherman or maybe $6,000, if your number was 1.5 billion. Somehow, I feel you ought to divide those by two to take care of insurance, the ship, profit and things like that. So, sir, question one: Is, indeed, the fishermen's income $2,000 to $3,000 per year on the average through the country? The second thought that came up is you said you had a one billion dollar industry and I guess the other end of the table said they had a six billion dollar industry. It sort of rubbed against my intuitive grain that they said the fishing industry was bigger and the boating industry was smaller, and I wonder if those are consistent numbers. Thank you.

Mr. Norton: I'll make a few comments on that. The numbers that I mentioned are pretty much available in published literature. The 340,000 number represents the total number of fisherman and processing workers. There are probably something over 150,000 fishermen, but then when you start talking about full-time fishermen, you start dropping down to probably around 60,000 to 70,000 and so it depends on how you classify them. As I indicated, these numbers are pretty much available. I think it's very important that these differences be brought out because it's just what you indicated, the relevancy to earnings. I think there are some fishermen who earn a great deal, a lot more than college professors, for example, but there are a lot of fishermen who don't earn very much, either because they're fishing part-time or because of certain constraints that I mentioned.

The second thing is, I think landings now are more in the range of over a billion-and-a-half and, as I indicated, if you took that number and tried to expand it to some kind of a multiplier related only to the primary fishing sector, you would come up with, say, three to four billion. Now, there's a study which was financed by the National Marine Fisheries Service and in it they did come up with a six billion dollar number associated with the U. S. commercial fishing sector.

I guess one of the reasons why I didn't linger on any of those numbers was because I feel that I'm just not sure which of them really means very much. I think that there are certain problems we can see that are affecting the efficiency of the industry. I'm not sure it's very easy to pinpoint exactly by how much. I think that's the basic situation.

SESSION II

THE OCEAN AND THE ENVIRONMENT

Guest Speaker: Dr. John H. Steele
Director
Woods Hole Oceanographic Institution

Panel: Evelyn F. Murphy
Secretary for Environmental Affairs
Commonwealth of Massachusetts

Keith Hay
Conservation Director
American Petroleum Institute

David Sensibar
President
Construction Aggregates Corporation

John M. Teal
Senior Scientist
Woods Hole Oceanographic Institution

Moderator: David A. Ross
Woods Hole Oceanographic Institution

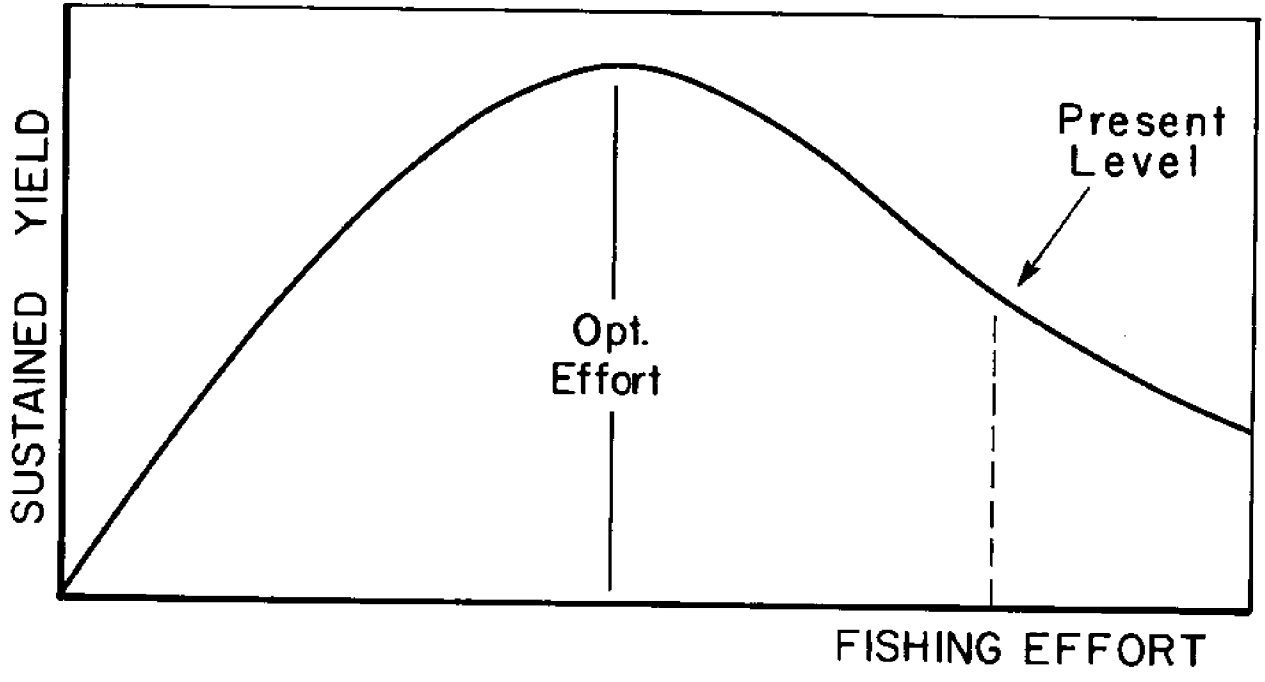
THE OCEAN AND THE ENVIRONMENT

J. H. STEELE

The title which I was given is very general, and I wish to concentrate on one particular problem which I feel is relevant to the work of Sea Grant. In assuring that our research at sea has the maximum benefit both to the science of oceanography and to the societies concerned with the ocean, we need to have a method of management which corresponds to the nature of the problems with which we are concerned. A very loosely structured management of our scientific resources in oceanography may result in a very large number of diverse and interesting scientific conclusions but may lack an overall pattern which has relevance to our practical problems. On the other hand, a very tightly organized and rigid management method would imply a degree of technological exactness which does not exist in oceanography or in any other of the environmental sciences. Thus, we are looking for a match between the structure of the science as it exists now and may exist in the future and the structure of the future management we need to obtain the best use of the scientific results.

I find it useful to begin with two rather simple examples of environmental problems. They are of a quite different character, but each is relevant to aspects of coastal zone management and therefore to the work of Sea Grant.

Fisheries management has long been based on relatively simple but easily applicable concepts of maximum sustainable yield (Figure 1). At this level of theory it is assumed there is an optimum biological yield which occurs at some intermediate fishing effort which is usually below that actually existing in any heavily exploited fishery. The management problem has been to devise methods which are socially, economically and biologically acceptable to reduce the effort to the optimum level. This theory, however, is now being questioned from many different points of view. I can illustrate two of these, again at a very simple level. The basic economic consideration is often not the optimum biological yield but the profitability obtained by the fishing fleet and this depends more on catch per unit effort (Figure 2). If I understand simple economic theory correctly, we are usually faced with the situation that, in an open access fishery, overall profitability can approach zero by excessive boats entering the fishery. Thus, in certain cases, such as Iceland, a restricted access fishery, imposed by political means, can permit a particular population of fishermen to exploit a resource at a high level of economic yield which



SIMPLE THEORY

Figure 1. A very simplified and schematic diagram illustrating the essential feature of the classical theory of fishery management.

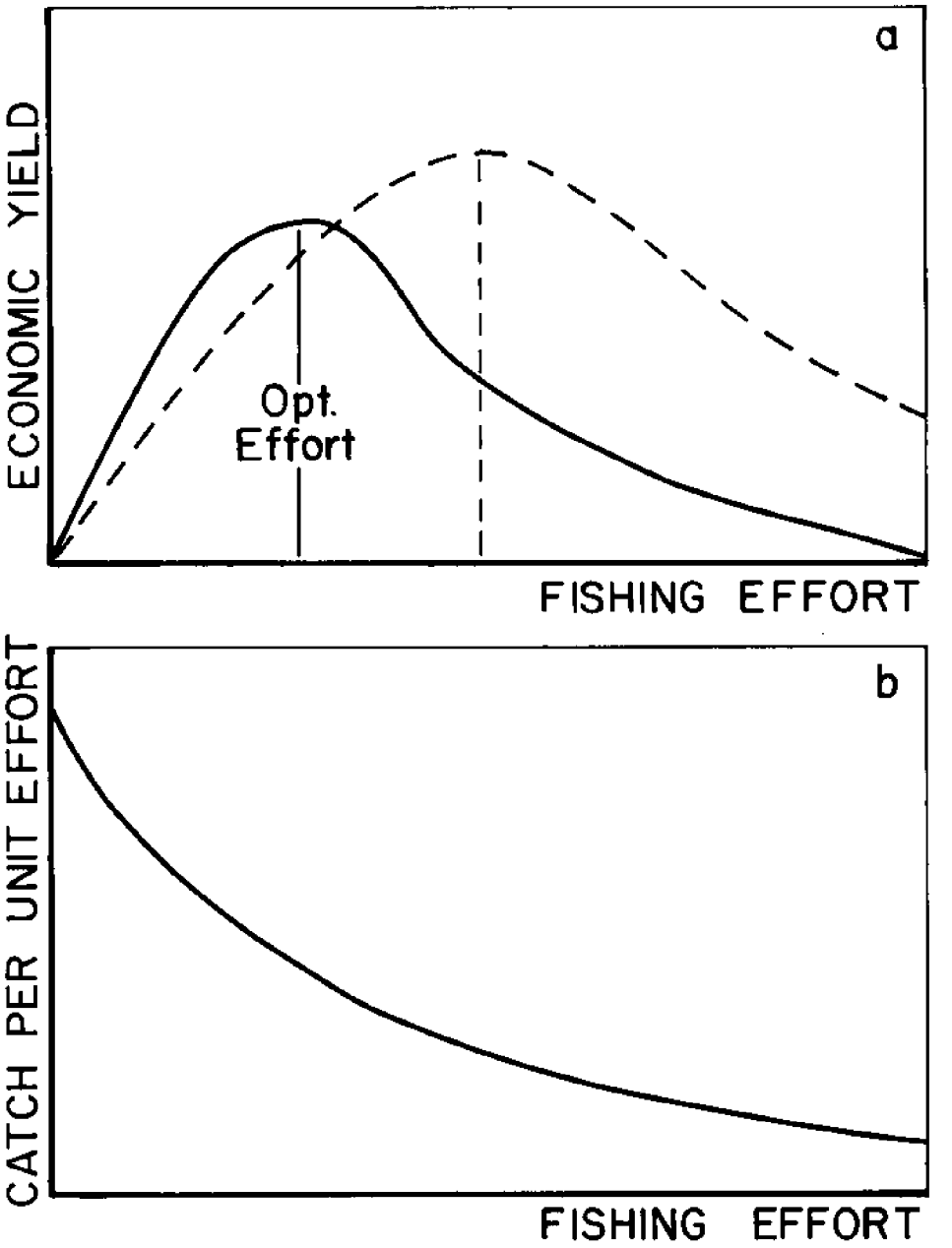


Figure 2. (a) The shift in optima resulting from a change from biological to economic criteria.

(b) Profit is related to rate of catching by individual fishing units.

may, in fact, be below the optimum biological yield.

There can, however, be ecological limitations to this simple economic concept because the high rate of catches implies a very high stock density of fish which, in turn, will require a much higher level of food intake than is necessary for the more heavily exploited stocks. It is now suggested that in many areas this amount of food is not available, and so the shape of the curve at the lower level of effort may not follow that of the simple theory (Figure 3). Thus, according to these ecological considerations, the optimum biological yield, and even the best economic practice, might require a fishing effort higher than that indicated by the simple theory.

There are further complexities that can occur when we consider the interactions of different species of fish; or what are known as the multispecies aspects of fisheries management. Yet, given all these complications, there is still one common feature to all the possible strategies for the exploitation of our fisheries. We assume that somewhere between excessive fishing effort and zero effort there is some optimum level which satisfies both the requirements of society for food from the sea and the other necessary requirement of maintenance of these stocks of fish.

There is a second very important feature in this management process. We do not consider it necesssary to stop all fishing until we have worked out scientifically, or legally, what that optimum shall be. We use a process of adjustment of the fishery to both the changing environment and the changing fishing practices. Thus, we are continually adding to the information available for management from the actual operations by the fishermen.

My second, and again simple, example concerns a somewhat hypothetical problem in waste disposal. It is, in fact, based on events that occurred in relation to my native city of Edinburgh. You may have heard that the phrase "gardy-loo" arose from the habits of the burghers of the City of Edinburgh for throwing their waste out of the upper windows and yelling warnings to any passers-by unfortunate enough to be in the street below. Things have advanced somewhat since those days but until a few years ago, sewage was disposed from several short pipelines (as indicated by O on the figure) into the estuary of the river Forth (Figure 4). As the population of Edinburgh grew and prospered, it became conscious that even this method of disposal had its local inconveniences and it was decided that a system of offshore disposal of sludge should be adopted. The initial scheme (I) which was suggested proposed that the sludge be dumped in a nearshore and deep, calm water area of the estuary where there would be little dispersal. However, this lay within the hatched area which contains prolific

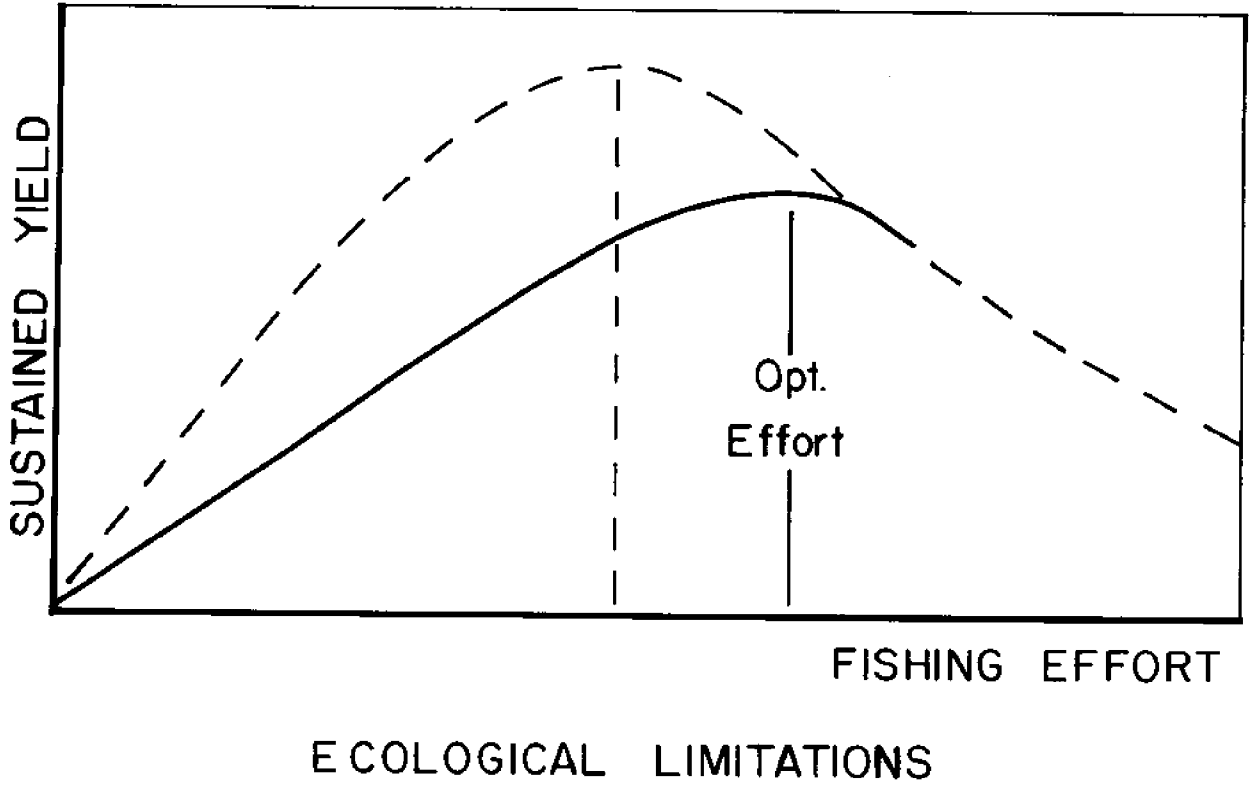


Figure 3. A hypothetical change in optimum effort which could result from the effects of food limitation on stock size.

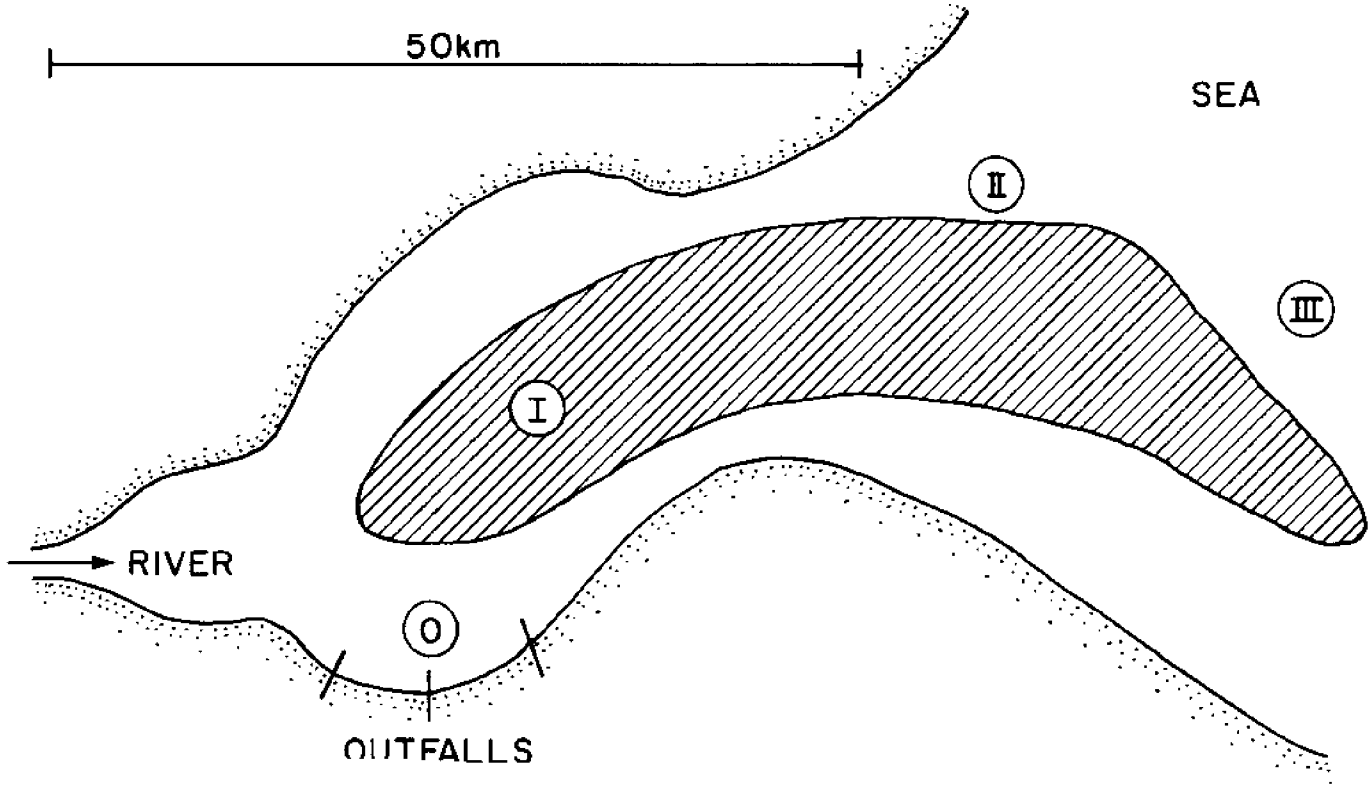


Figure 4. Four choices for sewage disposal: (0) the original shore disposal; (I) disposal in deep inshore water; (II) intermediate; (III) offshore.
Shaded area indicates shellfish grounds.

shellfish grounds and so there was an immediate protest from the local fishermen. Thus, a second choice (II) was made outside the estuary and the fishing grounds. This, in turn, created a protest from the population on the north shore who complained of the possibility that some material might come onto their beaches and that, anyway, it was not their problem. From studies of water flow at the second site the possibility of such a shoreward movement seemed very slight indeed but could not be completely discarded, and for this reason the third choice (III) became the only politically acceptable possibility. Thus, the present situation is to dump the material so far offshore that it will not affect fishermen and, in fact, any effect would be on the population to the south. And that is towards England.

I have tried to illustrate schematically the progressive combinations of value judgments involved in this process (Figure 5). Obviously, from a strictly commercial point of view, disposal of the sewage on the beach is cheapest. Anything beyond that is a decreased value on this basis. For the amenity groups, however, there are two low-valued situations. The original one (0) and the nearshore dumping (II) on the north coast. When these are combined and when the increasing pressure for greater amenity is added to the former set of values, one can see how the shift from the inshore began but also how it might have ended at the first location. Thus, it is necessary to add to these two considerations the pressure from the fishermen (Figure 6) and, as a result of that, to see how the only choices available are the present situation and the offshore extreme.

Once the present situation is considered inappropriate, there is an evitable trend towards the furthest offshore disposal that is practicable. This example is relatively parochial, but it demonstrates the same interplay of scientific, economic and political factors as occurred for the fisheries problem. I have tried to stress and perhaps over-emphasize the main differences. First, there is the lack of any middle ground literally and metaphorically. There appears to be no possibility of a compromise until the other extreme is reached. Secondly, the only evidence available for the decision is from a small number of experimental studies. A decision had to be reached *a priori* for the particular scheme eventually used.

In this particular case, it certainly was not true that "out of sight is out of mind." In fact, the opposite appeared to be true. Greater concern is now being expressed about the ultimate effect of the same amount of material dumped and dispersed offshore than was formerly voiced when it was a nuisance on people's doorsteps.

These two examples from fisheries and environmental quality have certain features in common. In particular, for both of

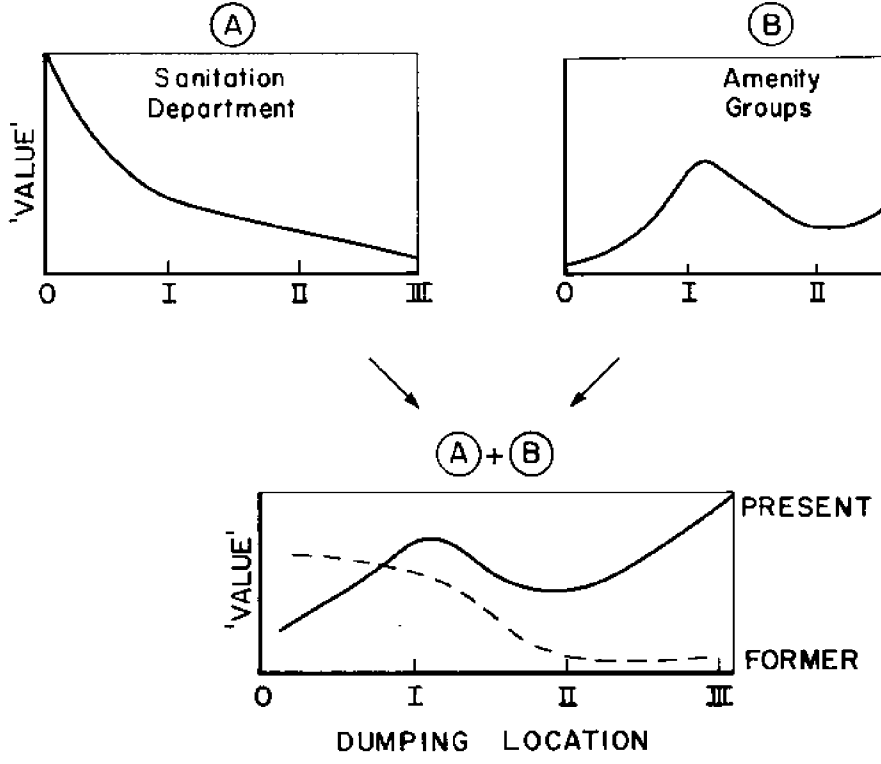


Figure 5. Possible utility (value) functions for sewage disposal options and for amenity groups, and their combination with different weightings.

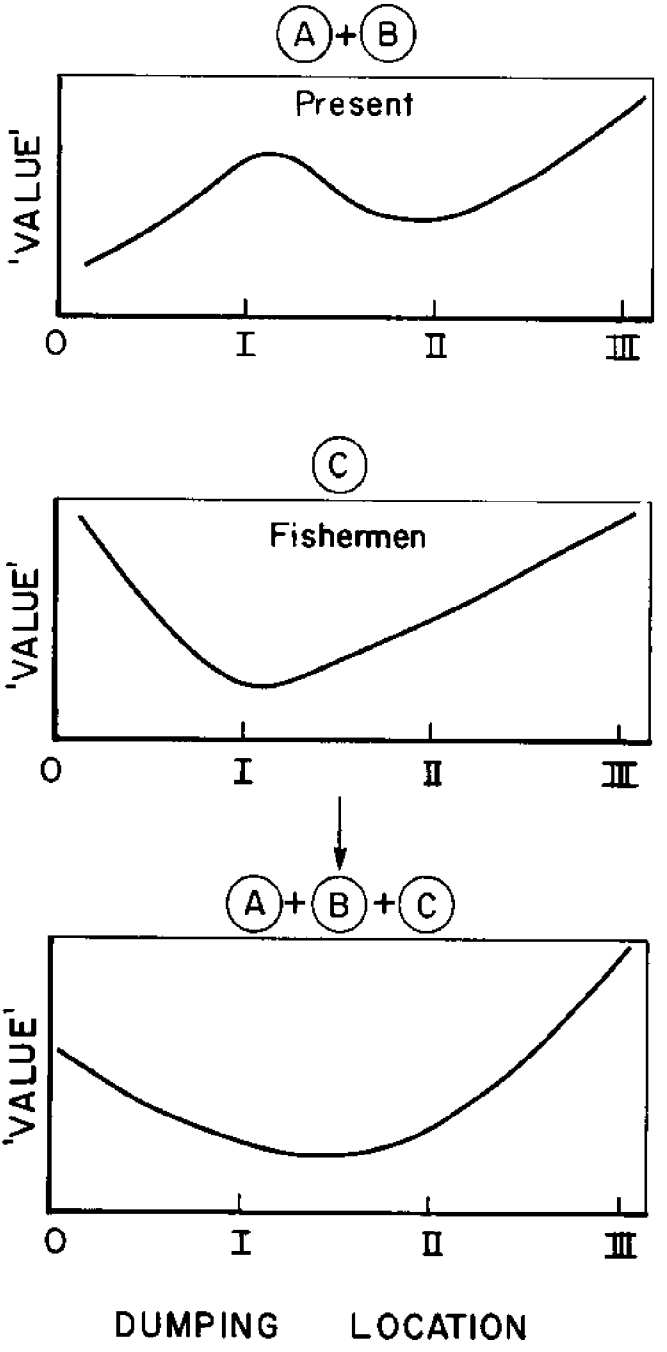


Figure 6. Combination from Figure 5 of (A+B) with added effect of fishing "value."

them, there is the significant degree of uncertainty that is always, and will always be, associated with environmental problems. There are, however, significant differences between the two examples. In the fisheries case, there is a consensus that, at least, a middle ground does exist somewhere. Also, for the fisheries problem we accept that the process of successfully reaching this middle ground must be undertaken in the context of a continuing fishing effort. For many environmental quality problems there is no agreement about the existence of any middle ground. In fact, the opposite is usually true and we are concerned with a choice between extremes. Further, the available evidence is necessarily circumstantial, deduced from studies of current flow and sediment characteristics, rather than from direct experience of dumping at the possible sites.

In these two examples we are concerned with the use of science or scientific method for practical problems. The present day approved scientific method is known as the hypothetical deductive approach. Those scientists present will know that nowadays it is essential in any proposal to have a hypothesis and to make testable deductions from this. However, this recent mandatory requirement in proposal writing has been around for quite a long time under another name. It is the old human practice of trial and error. It may be that this terminology is unacceptable because of its Anglo-Saxon rather than its Latin origin and also because the word "error" may now be considered an unacceptable consequence of human activity. It is, however, the implicit basis for our fisheries management. It has the advantage that, like so many other human activities, it can be continually cycled with an evolution to better practices and an adaptation to changing environments.

The alternative which has perhaps become more common could be categorized as trial and verdict. It does not admit the possibility of error as an integral part of the system. Further, for any particular problem, the decision is made a priori and adaptation or development occurs as an accumulation of individual cases. This inductive approach is distinctly out of fashion within the scientific community.

However, a major difference between the two examples, and also between the two approaches, concerns the idea of a middle ground, an area of compromise in social terms or an optimal solution in scientific terms. In both cases, we would expect that this middle ground could be reached in some finite and acceptable length of time. To me, the idea of a middle ground in the technical aspects of these scientific problems such as fisheries or environmental quality corresponds to the need for a middle ground in the way in which we manage our science. At the present, however, we tend to have a dominance of two ends. At one end of the spectrum we have the mission-oriented research which at its most extreme definition could be considered short term, requiring

Immediate and often ad hoc decisions. At the other end of this spectrum would be basic research, again in its extreme form, which is often seen as an infinitely extended process of testing new hypotheses without ever reaching firm conclusions. We accept the need, on occasion, for reaching rapid decisions and we look to mission agencies for the evidence on which to base such decisions. Yet we feel that they should be made in the context of a larger view of the underlying problems. It is for this reason, and perhaps against the views of some of my colleagues, I see a value in some longer term studies being conducted within government agencies. This can be true particularly in the areas I have used as examples, fisheries and environmental protection. Further, I feel that such longer terms studies should be conducted, not by different groups in the same department, but whenever possible by the same individuals.

For exactly the same reasons, I believe in the necessity for a strong and dependent basic science and I hope this belief is not entirely consequent on my present job. But I also believe it is desirable and possible for the institutions concerned with such basic research to be also involved in those problems of significance to society. It is desirable because so many of our environmental problems in the oceans are scientific in character. We are concerned with testing ideas as much as applying rules. It is this scientific character which makes the problems less amenable to a legal type of solution. It is also this which makes them interesting and exciting in their own right. The inherent interest of these problems makes it possible to expect a significant involvement by the so-called academic society.

I am always impressed by the strong desire for involvement by our best scientists and especially by younger and more active members of the oceanographic community. Yet they are often discouraged. It is necessary to remember that scientists, particularly the best ones, are human with individual social and economic drives as well as loyalties as citizens. The academic research community lives on soft money acquired on a year-to-year basis. It is a highly competitive world. Within this competition, however, there can be potential continuity in funding to an individual with a resource of good ideas. This can be provided in the basic sciences by the National Science Foundation and has an obvious appeal to good scientists, partly for personal reasons but especially for continuity of their research. I would consider that a major reason for the present dichotomy between basic and mission research, or between pure and applied, is determined by the methods of funding in management rather than by the interests or desired avocation of the scientists themselves. At some time in the past, this might have been acceptable since we could allow scientific concepts to develop gradually and at their own pace towards technological realizations. Now, especially in environmental studies, the critical problems

require information from that intermediate area between the scientific hypothesis and technological rule. We must never neglect the requirements for mission-oriented studies nor for basic research, but we must try to reverse the polarization and aim for a continuum between these two extremes.

Obviously, I am referring to funding by federal agencies to the academic sector. Again, obviously, the quantity of such funds is important but even more significant is the quality, the conditions and the criteria for such inputs to the academic sector. If we accept, as all the evidence indicates, that our environmental problems are not amenable to simple solutions on a short term basis, then we must allow for innovative and longer term study of their possible solution. I have in mind not only such global questions as the increase in carbon dioxide in the atmosphere but also the apparent local examples I gave at the beginning where the underlying problems for our fisheries or for waste disposal are of more general significance.

As an example, I would refer to the long-term support which ONR has given to institutions such as Woods Hole. This support covers the study of a wide range of problems from very practical to relatively basic. It has involved many of the best scientists in the Institution and has helped fund some of our most important discoveries. The basis for this involvement and for the value of the resulting research has been the underlying assumption of a long-term and broadly based relationship.

Very recently I have been impressed by the way the developing relation between Sea Grant and the Woods Hole Oceanographic Institution has involved some of our best younger scientists. I am sure this will be to the scientists' benefit and I hope it will also fulfill the aims of Sea Grant.

These are examples where funding patterns can build bridges to insure the flow necessary to establish the continuity between the artificially isolated extremes of basic and applied studies.

My original examples from fisheries and waste disposal were excessively simplified. I have further simplified the problems by considering only the search for a middle ground in the area of oceanographic science. There are other important and possibly more important areas where common ground is needed; in the social and class divisions involved; in the political associations; and in the accumulating legal framework. Yet all these other aspects or groups, at one time or another, look to the scientific community. It would be unrealistic on their part, or on ours, to expect always a single or an unambiguous answer, but the system should be structured to decrease rather than enhance such differences.

Also, I realize that even within this one scientific aspect, any proposed restructuring is not a simple matter but has its own political and legislative components. The solution is, however, urgent and essential for the proper use of our scientific abilities in ocean management.

It would be interesting to me to see how the Panel and members of the audience view these points.

PANELISTS' PRESENTATIONS

EVELYN F. MURPHY

A PUBLIC ADMINISTRATOR'S PERSPECTIVES ON "MIDDLE GROUND"

Dr. Steele has presented a provocative discourse on the use of scientific resources in ocean management. He has formulated a scientist's version of a "middle ground" described as "that intermediate area between scientific hypothesis and technological rule," and, elsewhere, as "a method of management which corresponds to the nature of the problems with which we are concerned."

He argues that such middle ground is needed and to date, given little attention. I agree.

But, as a public administrator, I would like to add to some of his concepts and introduce some different versions of middle ground. First, I would like to elaborate upon his version of "the present dichotomy between basic and mission research." Then, I want to discuss the political middle ground, that is, where various interest groups competing for the use of the same ocean space or resources meet to resolve differences. Finally, I want to present a concept of middle ground not defined by any particular dimensions of scientific inquiry, but rather, defined as professionals with a particular mixture of experience.

THE DICHOTOMY BETWEEN BASIC AND MISSION RESEARCH

In scientific and academic circles, much as been made of this dichotomy, what is really "basic research?" and what is "applied or mission" research? These question have been debated intensely for several decades.

Let me explain this specifically with regard to ocean management.

Every day, staff in state agencies in Massachusetts make decisions regulating or influencing the use of coastal waters, and as a consequence, off-shore waters, also. These actions are taken with no capability to conduct research within state government. None. Every day the vast scientific resources of Massachusetts conduct oceanographic research along lines that university scientists and federal agencies define as "basic" or "mission" research.

It is not as though one group exists unknown to the other. It is not as though one group does not want to work with the other.

Informal exchanges among colleagues occur and more formal occasions such as today provide some connections. But, a daily connection that really bears on the needs of the state public decision-maker, that is, a relationship in which the public administrator has control over the pursestrings that dictate what scientific questions are asked, within what period of time, with what base of data and what reliability, this kind of daily connection does not exist.

This is not to overlook the genuine offers for help that Sea Grant, Woods Hole and other academic and scientific groups have offered the state. However, you know as well as I that he or she who controls the funding, controls the research, particularly applied research.

Furthermore, I do not mean to suggest that the state government should actually conduct research. That would be a needless duplication of existing efforts. All I want to suggest is that state and local governments serve as a pass-through of some federal monies so that these public entities have some means to shape research to their needs, timetables and capabilities.

Let me also emphasize that the federal "mission" agencies' public interests and agenda are not synonymous with the interests and priorities of a state. In fact, the peculiar circumstances in which Massachusetts now finds itself is that we want stricter standards, better data, and better responses from federal agencies than those agencies are prepared to give.

Let us not delude ourselves that the federal government's guidance on scientific inquiry is necessarily more sophisticated or more appropriate than the scientific formulation state government may offer. And, let us not delude ourselves that state government is more political, ergo, more tainted and less honorable, in the use of science than federal agencies. Politics is ubiquitous.

I would like to urge you then, not to think that the spectrum of scientific applications runs from basic to applied research with the desired middle ground being between these two; this is a spectrum defined by traditional federal funding practices and misses the entire range of scientific and technological needs of particular states and local governments. Think, rather, of "basic," "applied" and what I will call "practical" and let us embrace all three. (I have chosen the word "practical" to connote state and local scientific interests because I believe you'll find these governmental bodies will tie scientific questions more directly to steps that can be taken immediately. For example, a state regulator may ask: What levels and forms of contamination in certain shellfish flats should dictate closure? Or, what are the possible consequences of disposal

of toxic substances in material in a channel that needs dredging?

THE MIDDLE GROUND OF INTEREST GROUPS

Next, I would like to consider the schism among interest groups. This is most vividly seen in the controversies now between scientists and fishermen, as Dr. Steele mentioned, in determining allowable catches on the Georges Bank. Scientists belittle fishermen for not understanding and respecting scientific measures for estimating the fish stock and its replenishing capabilities. Fishermen accuse scientists of defying what meets the eye, namely, more fish than the scientists' estimates would have one think.

Oil companies argue that their operations will not harm fishing and, therefore, fishermen and public officials should not make such a brouhaha about drilling on the Georges Bank. Fishermen say the oil industry does not understand that trawling for bottom feeders is different from shrimping in the Gulf.

So, the lines of hostility are drawn. It is easy to stand off and to criticize the other interest groups. It is easy to hold one's own position as superior in knowledge about the special profession that one has pursued for years.

In short, it is easy <u>not</u> to create a "middle ground" for interest groups. But the phenomenon we witness on the Georges Bank calls basically for a middle ground. We need food, i.e., fish; and we need fuel; we need the cargo brought by tankers across our oceans; we may need the mineral resources on the shelf's floor. In essence then, the challenge is to accommodate the multiple, ever-increasing, often competing economic interests for the same ocean space. That calls for cooperation. Scientists must sit with fishermen to understand and reconcile the disparities between the human eye's observations and the mathematical calculations of existing stocks. Oil companies must come to New England and sit with us to discuss their needs and concerns instead of taking them to the courtroom. Public interest groups must also stick to the facts rather than inciting emotional pleas for inaction.

I am increasingly struck by the consistency of the outcome when such disparate interest groups work together on an almost daily basis for an extended period of time. Each time, participants discover that their values are not as different as would seem. All recognize the need to maintain the long-term ecological productivity of the ocean or other natural resource; and all recognize that competing interests must be accommodated because the public's stake in those various interests is not one dimensional, not single purposed.

The responsibility for creating that middle ground rests on all of us, public and private interests alike. We must make time for such an effort. In return, the creation of such a forum promises new insights and foci for the scientific inquiry of the oceans and its many uses.

MIDDLE GROUND AS PEOPLE

Finally, I want to mention a notion of middle ground which relies on multi-faceted professionals rather than specific scientific products.

One persistent feature of ocean management and the problems of ocean use is that, as ocean uses involve increasingly sophisticated technologies, sea farming, harvesting massive technologically-hyped kelp beds to produce methane gas, etc., ocean contamination and disruption to marine systems become more complex and puzzling.

Staff in regulating agencies with academic training as recent as five years ago can find their knowledge outdated. There is a real need for staff in regulatory agencies to get back into the laboratory frequently and, at times, totally.

At the same time, scientists need to get a better sense of the conditions under which decisions about ocean regulation and protection are made, the legal constraints that force decisions into specific periods of time; the practical considerations; and the gaps and weaknesses in data which, nonetheless, are the best available information at the time of the decision making. The only way to get the full feeling for regulatory decisions is to make them yourself and have to live with the environmental, legal, political and economic consequences.

Ultimately, it is the calibre of professional people involved with ocean science and management that will be the measure of how enlightened and progressive our society treats the ocean. And so, the real middle ground is the professional, with broad, solid experience in ocean sciences and their applications through public regulation.

KEITH HAY

Our keynote speaker, Dr. Steele, has challenged this distinguished panel with a call for a "middle ground" between adversary groups. Today I should like to offer some reflections on the benefits and challenges of another kind of middle ground. I speak of government and industry cooperation in ocean resource development.

The very phrase "government-industry cooperation" sounds strange these days. Lately, we have seen a lot more of government-industry confrontation.

For many people on either side of ocean regulation, the battle lines seem clearly drawn. Some in government see industry as a greedy beast tearing through the seas on a rapacious search for profits. Some in industry see the government as an octopus, entangling all who come within its reach. The idea of unrestrained cooperation between the two monsters is almost unthinkable. Many people have grown to assume that the monsters are and will remain natural enemies.

The irony is that today the power of both creatures must be combined to some extent if our country is to conquer the real problems, the social, economic and environmental difficulties that threaten us all, regardless of where we stand. Each member of this panel has been chosen to represent a well-defined point of view. I promise not to disappoint you by embracing the octopus; I hope I'll convince you that I'm not the Loch Ness monster either.

The issue of ocean development calls out for industry-government cooperation because so many interests are competing in such different ways for ocean resources today.

In this country, the demands of inland states that need energy compete with those of coastal states that fear impacts on their shorelines. In addition, there are disputes over who should handle the job of developing federally owned resources, private enterprise or the government. Internationally, competition between inland and coastal nations and between public and private enterprise is intensified by conflicts between nations in different stages of economic development.

The value of the benefits derived from the development of the ocean's resources, as well as the distribution of those benefits, will depend on how these disputes are settled.

Currently, two major pieces of legislation typify the ways government and industry are struggling to develop a productive relationship in ocean regulation. One is the Outer Continental Shelf Lands Act Amendments, a law that was passed by the Congress and signed by the President in mid-September. The other is the Coastal Zone Management Act, a 1972 law that is now being administered by Mr. Frank's agency. Let's look at what each of these measures says about the state of cooperation between government and resource industries.

The oil industry did not believe that the new OCS law was necessary. However, the industry did not stridently oppose it because the measure does not include too many new opportunities for delaying OCS development. It may seem strange that not adding additional delay can be seen as a positive step. The major threat in the bill, as it was being considered, was that it might provide avenues for indefinite delay to those seeking legal bottlenecks to prohibit OCS development.

The new law will enable government authorities to regulate every stage of petroleum industry ocean activity. At least 47 sets of regulations, some of which duplicate existing rules, are required by this law.

The measure mandates the filing and approval of pre-leasing, pre-exploration and pre-development plans with both federal and state governments. In addition, development plans must be accompanied by studies describing the onshore impacts of offshore activities. The Interior Secretary may require that such information be included in exploration plans, too. Leasing plans must be reviewed by the governors of affected states, and the U. S. Attorney General will review the results of lease sales for possible anticompetitive effects.

Moreover, although the law does not specifically direct the Interior Secretary to undertake exploration, it does require companies to provide him with access to all the data they obtain from exploration, development and production activities. In addition, companies must furnish the Secretary with any specific data he requests, including processed, analyzed and interpreted information. A variety of unfamiliar new bidding systems will be required, too, although not so frequently as the Executive Branch had originally sought.

Oil companies frankly do not see the need for all this regulation. But the industry also recognizes that many people in government wanted an even more stringent measure, one that would have made the job of finding and producing energy much more uncertain, time-consuming and frustrating.

It is a sign of some accommodation, therefore, that the new

law reflects the interests of both those who want to develop energy resources, and those who want the government to retain absolute financial, social and environmental control over its holdings.

One welcome requirement in the new OCS law is that it requires the Secretary of Interior to consider how certain OCS leasing and production decisions will affect the nation's interest in obtaining oil and gas supplies. For example, before rejecting a development and production plan, the Secretary must determine that the advantages of disapproving the plan outweigh the advantages of additional supply it would provide. Requiring this kind of cost-benefit judgment sounds like a good idea. But some people are skeptical of how it will work because, to a large extent, the government has ignored a similar provision in the second law I'd like to consider.

The Coastal Zone Management Act was passed in 1972 and amended in 1976. Its purposes are to ensure the orderly development of coastal areas and offshore resources, and to give coastal states a voice in deciding how offshore resource development will proceed.

The CZM Act establishes a voluntary program that provides incentives to states that formulate and operate state CZM programs. There are two primary kinds of incentives: first, money, in the form of grants and loans, and, second, the "federal consistency" provision of the Act, which guarantees that the federal government will not undertake or license any activity that would conflict with a state program once it has been approved by NOAA.

The Act allows state programs a great deal of flexibility, but it does establish certain minimum standards for approval. Like the new OCS law, the CZM Act requires that the national interest be taken into account in making decisions regarding energy facilities.

In 1976, the Act was amended to include special provisions for development of coastal energy resources. The amendments gave express recognition to the need for what was called a "greater degree of energy self-sufficiency" in the U. S. in the wake of the oil embargo.

At the same time, the original language of the Act was amended to require that state programs specifically consider energy facilities. The state must now give "adequate consideration of the national interest involved in planning for, and in the siting of, facilities (including energy facilities in or which significantly affect, such state's coastal zone) which are necessary to meet requirements which are other than local in nature."

Those are the words of the CZM law. In practice, however, the U. S. Department of Commerce has sanctioned the office of Coastal Zone Management's approval of several state programs that do not provide for adequate consideration of national interests in siting energy facilities.

The oil industry believes that by approving plans that fail to accommodate the nation's interest in developing energy resources, the Office of Coastal Zone Management is administering the CZM Act in a way that does not reflect Congress's intentions in passing this legislation.

The real potential for short-circuiting energy development is that once a state program is approved, the state acquires virtual veto power over energy operations on the adjacent OCS. The federal consistency provisions of the CZM Act provide that all federal activities, and private activities conducted under federal licenses and permits, must be consistent with the provisions of approved state programs. An approved state program taking only local considerations into account, could be used to jeopardize or exclude the OCS production needed to increase our energy supplies.

The purpose of the Coastal Zone Management Act, as I understand it, is to promote cooperation between states and the federal government in balancing national needs, and state and local concerns. In conferring autonomy on state governments, in some cases on state bureaucracies because the legislatures never approved the plans, the federal government is not filling its responsibility to mediate between local and national interests. There cannot be effective cooperation between the federal government and industry here because this part of the government is not effectively performing the role that Congress assigned to it in the CZM approval process.

Unless state Coastal Zone Management programs specify which national interests should be considered in their planning decisions, and exactly how these interests will be included, energy companies will not know what they face from state regulators. Without this knowledge, planning for industrial operations will be uncoordinated and inadequate, and will lead only to confusion, inefficiency and delay in obtaining and distributing energy supplies. Delay can be the deadliest form of denial.

I don't think any industry expects to have carte blanche in any area. But in order for cooperation to exist, there must be some kind of reasonable working relationship between the parties that are trying to reach a common goal. If one of the parties opts out of the relationship, he takes the opportunity for cooperation out with him. I don't think that the Office of

Coastal Zone Management is being reasonably cooperative in this instance.

Some of these problems will be addressed at the CZM Oversight Hearings which the Senate has scheduled for 1979. The hearings will investigate whether the Coastal Zone Management law as it stands is clear enough and whether it is being administered correctly, in harmony with the intent of the Congress when it passed the legislation.

In the drawing up of the OCS legislation, and in the implementation of the CZM law, we have seen two different approaches to industry-government relations. What does this contrast tell us about the prospects for cooperation?

One thing seems pretty obvious: the government's interest in maintaining tight control over all aspects of ocean development must give way to some extent to industry's need for flexibility and vice versa.

Now let me turn specifically to New England where another kind of "middle ground" has been reached by cooperation between industries. I'd like to share with you some highlights of a successful joint effort, that between the oldest industry in the nation, the New England commercial fishing industry, and the newest one in this area, the offshore petroleum industry.

As you know, fishing in these prolific waters goes back to the early 1600s when colonists first discovered these famous fishing grounds. By the early 1970s, when the oil companies first expressed interest in drilling offshore in the Georges Bank, the fishing industry, understandably, was less than delighted with the news. The foreign fishing fleets with their tremendous factory-ships were taking the bulk of the catch. The fishermen felt that the last thing they needed out there was another uninvited guest in the form of the oil industry.

Initial efforts were made to strengthen communications between the fishing and the oil industries through the executive directors of the Atlantic and Gulf States Coastal Marine Fishing Commissions. In June of 1972 a meeting took place between these directors, a member of the Offshore Oil Operators Committee and me.

At first we thought that representatives of commercial and sport fishing industries, state and federal fisheries agencies, the Coast Guard, the Geological Survey, selected environmental organizations and the oil industry should all be brought together. After further deliberation, it was deemed inappropriate for these fisheries commissions to act as the vehicle for bringing the fisheries and oil interests together. Instead, direct contact

was made with the principal commercial fishing organization in New England, the New England Fisheries Steering Committee. It was soon apparent that the two industries could and should work together directly, with a minimum of federal or state assistance, to solve their mutual problems.

To examine the interface between the two industries in more detail, a seminar was held in Boston in October of 1973 to consider the subject "Fish and Oil at Sea." The nature and operations of both sport and commercial fishing were examined in detail as well as petroleum industry operations and their possible conflict.

The New England Marine Industries Council, which goes by the acronym of NEMIC, was organized. It consists of approximately 10 to 15 representatives from the fishing and oil industries and meets periodically throughout the year. NEMIC works to accomplish a number of goals, the first of which is achieving a better understanding of respect among the multiple users of the sea; to identify and examine potential problem areas; and to find solutions to these problems satisfactory to all. It coordinates commercial fishing and petroleum operations to ensure that the work of each is protected and unhampered by the other.

NEMIC recommends the collection of pertinent information and data relating to inter-industry problems and makes it available to its members and appropriate agencies. It also makes recommendations for regulations governing the multiple use of coastal and marine resources.

Let me illustrate some very practical ways in which we have achieved these goals. We were instrumental in obtaining funds for an in-depth study with Woods Hole Oceanographic Institution to examine fisheries and oil problems. This resulted in the publication of the study, "Effects on Commercial Fishing of Petroleum Development off the Northeastern United States." The study reached the conclusion that the two industries could live safely and profitably together if communications and mutual understanding prevailed.

NEMIC initiated meetings of captains of fish and oil vessels. This proved to be a most fruitful exchange of information and increased efforts to improve communications and exchange information of an operational nature.

In radio communications, oil company vessels are now advised to use channel 16, the emergency frequency, for initial contact between industry and fishery vessels. Virtually all fisheries vessels today have Very High Frequency (VHF) equipment, but each type of fisherman, e.g., lobstermen or purse seiners, may

use a different frequency. A placard was developed for the wheelhouse of seismic ships that lists the frequencies and procedures for contact between fish and oil industry vessels. A Submerged Tow Cable Warning placard was distributed to fishermen picturing the kind of warning signal to look for on geophysical vessels when they have their 5,000 foot underwater cables deployed. And finally, to help oil industry personnel who are operating among the crab and lobster pots, placards identifying fixed-fishing-gear markers were sent to all oil industry vessels.

The U. S. Coast Guard requires that fishermen report the location of their fixed fishing gear such as lobster and crab pots every two weeks. A listing of all such fixed gear bearings in the North Atlantic is published monthly by the Coast Guard in its "Atlantic Notice to Fishermen." This information is also broadcast by the Coast Guard routinely in its "Broadcast to Fishermen." This information is thus available to the oil industry.

Geophyical operators are requested to report the location of their general area of operations to the Coast Guard at least every two weeks. The geophysical reports are also reported in the "Atlantic Notice to Fishermen." And in this way the locations of oil industry vessels are passed on to the fishermen.

NEMIC has also been instrumental in placing fishermen on board seismic ships, and oil industry personnel have been invited as guests on fishing vessels. All these small, well planned actions have helped to create a growing spirit of inter-industry cooperation.

NEMIC's meetings are continuing. They have concerned a number of subjects, all the way from setting up a compensatory fund for lost fishing gear and the role of the Coast Guard and National Marine Fisheries in assisting both industries, to the establishment of offices for reporting incidents at sea.

NEMIC has worked out so well in the North Atlantic that similar meetings are planned in the Middle Atlantic and the South Atlantic areas.

NEMIC's work in New England has been a long, circuitous and sometimes bumpy road, but a very worthwhile venture. We have worked at developing cooperation, and we have succeeded for the good of all.

In conclusion, I would opt for the same kind of successful "middle ground" cooperation for government and industry. I suggest five ways to move toward that balance:

First, government must make sure that the rules it imposes are necessary, intelligible and cost-effective.

Second, industry must continue to develop technology that will enable it to achieve the purposes of regulation efficiently.

Third, government must issue regulations that are aimed at solving problems, not at protecting its preponderant influence over others.

Fourth, industry must be patient with some degree of regulatory uncertainty and delay.

Fifth, in dealing with each other, both sides should, as much as possible, act on the assumption of good faith.

The truth is that resource industries and government have a vested interest in each other's success. If the government does not provide the kind of economic and regulatory climate that makes resource development worthwhile, our coastlines will be used more for receiving petroleum imports than for producing oil and gas.

On the other hand, if industry gives a sluggish or hostile response to reasonable conditions for resource development, then in some areas, the government will try to find ways of moving ahead without industry's participation.

No one wants continuous hostility or a stand-off of any kind. Both industry and government want to use the ocean's resources to reduce oil and gas imports now and to keep the U. S. supplied with vital minerals in the future. Both want future generations to receive as much pleasure and benefit from using the oceans as we receive today.

I hope that this conference will provide the opportunity for industry and government to speak reasonably with each other. We all need this kind of dialogue.

DAVID SENSIBAR

John Steele's presentation here today raises the crucial issue that needs resolution if the work of Sea Grant is ever to reach utilitarian fruition. In his introduction, he said, "In assuring that our research at sea has the maximum benefit both to the science of oceanography and to the societies concerned with the ocean, we need to have a method of management which corresponds to the nature of the problems with which we are concerned." In his conclusion he said, "There are other important and possibly more important areas where common ground is needed; in the social and class divisions involved; in the political associations; and in the accumulating legal framework." It is to the management of the "accumulating legal framework" that I will address myself, and in particular, in the structural members in the legal framework, the permits. I believe that if we fail to find what John Steel has called a common ground in this area, Sea Grant becomes an academic exercise.

Believe me, you would never buy another car if your investment was half as precarious as the investments of those of us who now work in the ocean environment. As hostile as nature has made the ocean environment to man, nothing about it is as hostile as the climate of investment that we ourselves have created there. I do not speak for those investors with deep pockets. Perhaps if one has the financial capacity of a major oil company or a public utility, these man-created difficulties can be a boon. It certainly serves to keep the small investor out, except as he may invest in the large company, because most rationally run small and medium sized companies will study the prospects for investment in the ocean and demur. Those of us who invest do so largely because we started doing it long ago, before the legal framework accumulated, and are trapped.

The reason for this reticence to invest is the insecurity of future operations in the ocean. Would you buy the car if you could be prevented from using it every again at any time? Would you buy the car if you had to make annual applications for its use and had to garage it if your application was not acted on by some arbitrary date? Would you buy the car if the government agency acting on your application had to get prior approval from six other government agencies before it could act?

Yet this is what we must go through to conduct our operations in the ocean. We must get permits annually, from federal and state agencies. These agencies must get affirmative approval from many other agencies before they issue their permit. Affirmative approval means that all the second tier agency

need do to block the permit is fail to act. You would be surprised how many letters and complete files get lost when it comes to granting permits. Since we need more than one permit, sometimes six or even more for a single operation, the limitations of each permit are cumulative. For example, one permit will say you can only operate on the rising tide, another will say you can only operate between 6 AM and 8 PM, another will say you must shut down from December 1 to March 31. Thus, you are left with an operation on the rising tide cycle during daylight hours for eight months a year. Sometimes the restrictions are to prevent known environmental damage. Sometimes they are strictly cosmetic or worse to prevent highly speculative environmental damage. Whether they are for valid reasons or not, they are all equally binding. And all of the restrictions are subject to change at any time. Indeed, the permit itself is subject to instantaneous withdrawal. Is it any wonder that with this type of management of the legal framework, nobody wants to join us out in the ocean? Would you?

I do not consider myself a troglodyte. My liberal credentials are as good as most. I recognize that government has a valid role in the process of ocean exploitation. I know that we are paying now for past excesses. I am even satisfied that investment in the ocean be prohibited forever, for five years, for ten. But I do believe it is unfair to ask someone to invest in equipment that may be rendered obsolete by government fiat by the time it is built. Permit applications should be rejected, modified, or approved promptly. The requirement of affirmative response and other delaying abuses should be eliminated. Permits should be granted with fixed provisions and for multiple years, not less than five. To the extent possible, permit granting agencies should be merged so that the number of permits required is minimized. The burden of proof of environmental damage should be shared more equally. Just as it is not fair to require the agency to prove a damage to justify rejecting a permit application, so it should need to do a lot more than simply speculate that environmental damage may occur. Further, environmental effects must be netted out. The ocean must not be looked at in total isolation. The question should be asked and answered: What is the total environmental result of not granting this permit?

The purpose of this conference is to disseminate and advance knowledge of the ocean. But for the small extractive industry of which I am a representative, that knowledge is nearly worthless within the framework of the current management of permit application and granting procedures.

JOHN M. TEAL

I'm going to talk about John Steele's use of the word, the "middle way," and a number of different aspects from the view of a scientist who's trying to provide some of the information on which decisions regulating the environment, decisions preserving the environment, decisions about how industry shall use the coastlines, should be made.

My basic premise is that very few of us know what we're doing out there. And we are called upon to give advice to the decision-makers. We are called upon to give advice to people who want to protect the environment. We are called upon to give advice, sometimes, to industry. And we'd like to be able to tell industry on the one hand and the environmentalists on the other whether there is a middle ground somewhere in there where the industry can do certain things in certain fashions and the change in the environment will be minimal, maybe even beneficial.

We can very rarely do that because we, the academic scientists, have poor understanding of many details of how nature works. The same is true for industrial and governmental scientists.

One of the difficulties, and the reasons we don't know in any great detail what the consequences of our actions in the environment are, is that we don't have the proper basis for finding out. We haven't had the experience in the real world. We haven't had the experience or the opportunity to do manipulative research with ecosystems in nature.

If you try to answer a scientific question, the standard thing to do is to take a system, an animal, say, into the laboratory. You plan to subject the animal or its immediate environment to some change. If you add a chemical, you know what it is you're adding, but most important you have a control experiment, a control animal, so that you can compare what's happening to the control and what's happening to the experimental animal. That's true of any experiment, and only after doing that can you really make a good connection between cause and effect, which is what I'm saying we can very rarely do out in nature. What I'm pushing, and I'm sure that many of you have heard me talk on this sort of hobbyhorse before, is the necessity of doing experiments with ecosystems in nature. As John Steele just said, there are portions of nature that are too big to experiment on, and I can't argue with that. Going fishing in the North Sea is, in a way, a kind of experiment, but we haven't got another North Sea that we can use as a control. We have very little control on what the fishermen do, in spite of all the rules and

regulations various agencies are trying to pass and enforce. But there is a middle ground in that sense, too. There's a scale on which we can do experiments in nature and I think there have been damned few of them done. Far too few, considering that they can provide us with a great deal of information about what goes on, particularly at the edge of the sea. I think that in working with natural systems, the experimental approach is even more important than it is in the laboratory because we're working with such complex systems in the real world. Often, we don't even know what to include in a laboratory experiment if we try to bring the natural system into the laboratory and do a controlled experiment. I'll give an example here, because we've been doing experiments with salt marsh ecosystems in Massachusetts. The basic experiment has been to fertilize salt marshes in an effort to see what the consequences of increased productivity are.

One of the things that we would have expected would be that the animals which depend first on the primary productivity would increase but in our field studies, some of those animals decreased in abundance as a result of the increase in primary production. That isn't something we would expect and isn't something we would allow for in a laboratory experiment because it wouldn't have included the whole system. What happened was that the animals which were feeding on the plants tasted better; more fish came in and kept those populations lower than they would otherwise have been.

That's something that appears as a sort of emergent property when you're working with the entire system, and you can't do that in the laboratory. You can only work with the entire system when you're out there in nature. A controlled experiment in nature is not the same thing as taking advantage of an accident in nature, i.e., going out and taking a measurement after something happens, an oil spill or a hard winter. It's also very much not the same thing as going out and studying correlations between an environment and things that have happened to it. For example, going out into the New York Bight and looking at the distribution of sewage sludge and the distribution or health or abundance of commercial species of fish, you can find correlations. You can only be sure about cause and effect if you can do an experiment. You can't do an experiment with the whole New York Bight, I admit, but you can do experiments with marshes or with estuaries, and you can experiment with a natural portion of the bight such as the benthic-water interface.

One way I think that very useful sorts of experiments can be done and can be organized is cooperation between science and industry. Suppose you want to dump an effluent with minimal treatment into the edge of the sea. Look at it as an experiment; see what it does. Add on various stages and treatment as needed

in order to find out what the consequences are going to be that you know what stage of treatment you have to go to in order to provide the acceptable impact on the environment. Or, of course, you could do it the other way around. You could start out with the whole treatment system and cut it back. That would be more expensive. Either way, you could combine an industry trying to start something in the coastal zone with the scientific effort to find out what the consequences are going to be if you plan from the start.

The other ingredient that you must have is the possibility of being permitted by lawmakers and regulators to do that kind of an experiment. I think that is something we haven't been thinking very much about, or, at least, it's my impression that the people who are making the regulations about how we should be using the coastal zone haven't been thinking very much about.

I'm all behind the efforts to protect the coastal zone. However, I'm not very happy about proposed regulations coming into existence in coastal states and at the federal level which, unless they're modified, will prohibit the very kind of experiment that I'm talking about. Such experiments are necessary to gather the information on which to support the efforts to protect the coastal zone, on which to gather evidence to present in court cases when those laws and regulations are challenged, or to provide information which might mean changing the regulations to make them more restrictive and protective. I think the cooperation I'm suggesting which might be possible as a middle way between scientists and industry, on the one hand, has to involve also the cooperation of lawmakers and the people who propose and enforce the regulations for the conduct of activities in the coastal zone. Thank you.

Mr. Ross: I'd like now to throw the discussion open to the people in the audience and to the panel. Would anyone like to start with a question or further comment? If you do, please use the microphone and identify yourself. Perhaps while you're thinking of some questions, let me suggest a provocative one to Mr. Hay.

There's been a lot of study and concern about the offshore geological resources, oil and gas, on Georges Bank and I suspect many people are inclined to feel that drilling on Georges Bank, if done properly, can conceivably even be better for the environment than not drilling. What I mean is, if it is drilled and a pipeline installed, the net input of petroleum to the environment would probably be less than it is right now by transporting oil in small tankers in this region. These tankers constantly seem to go aground in coastal regions.

To the best of my knowledge, the oil industry is very enthusiastic and anxious to drill on Georges Bank. However, it hasn't been willing to commit itself or, actually, even comment on the idea of drilling and putting in pipelines, assuming, of course, there is enough oil to make it worthwhile. What you have now is a debate whether to drill or not to drill. Perhaps the debate should be, if, indeed, we assume that there will be drilling, how to drill and produce more safely rather than whether or not to drill. Do you want to comment on that?

Mr. Hay: Well, how do you drill more safely? With the preponderance of regulations and oversight capacity of the Geological Survey, and the geological studies that are done prior to drilling, I think drilling in that environment probably could be done as safely as anywhere in the world. There has been drilling in the North Sea where conditions are somewhat analogous to Georges Bank without any problems, without any blowouts, without any oil spills. Phillips, of course, was reworking one well and had a problem with one field, but as far as exploratory drilling, there have been no problems.

Let me say this -- if the industry does find deposits of economic value on Georges Bank, just as they did in

the North Sea, the companies will want to bring in a pipeline as fast as they can. They don't want to take it out of there by tanker. They did that in the North Sea only until they could get a pipeline in because it's much more economical and certainly more environmentally sane to put in a buried pipeline than to try to tanker it.

Mr. Jensen: Mr. Hay, I understand that the American Petroleum Institute lawsuits against the three coastal management programs have been turned down on the first round. Has a decision been made by API to appeal?

Mr. Hay: No.

Dr. Wenk: I'm not sure whether this is a question or a comment and I hope I'll be forgiven if I lay out a little preface before coming to the point. It's in support of three different thoughts that your speakers have advanced here that I'd like to synthesize. One thought is about the social cost of excessive permits. The second is this point about the fact that we live in one country with the number of common values that we somehow have rediscovered periodically after beating each other on the head. The third is Mr. Hay's observation about the partnership between industry and government, industry and society, and the notion of sitting down together, getting better acquainted. In his vein of humor, I couldn't help but think that people in business who approach negotiation from opposite points of view, often play golf as a way of easing their tension. I wasn't sure whether he was going to propose javelins instead. The key point, it seems to me, is this: People who are studying what's going on in our society today report frequently on the litigious atmosphere, and on the adversarial culture. The fact is, that a lot of people who are involved in some of our public interest groups, and I'm associated with many of them, feel they are attacking issues, but, in fact, what they're doing is expressing their frustration with the total system and just simply finding a convenient target. The challenge is how people approaching these issues from their different and legitimate separate interests may come together. What seems to be often lacking are three things: Number one is a common base of information. It's amazing how fragmentary the factual data are and how many misunderstandings arise simply because one or another party at the table simply doesn't know what the facts are that perhaps a second person may have. So, number one is the question of sharing information.

Number two is trying to understand how the system works. This is a matter where some of us take the point of view that separation of government and industry is not the same thing as separation of government and church. In point of fact, ever since the origin of the country, one can find some form of partnership has been involved. I can't find a single technology today in which the government doesn't have a key role to play, notwithstanding the strenuous efforts by those in industry to assert that all they need is more freedom for that entrepreneurship, and then in the next week, they ask for some form of incentives and tax relief and so on to help that particular sector. But the government bureaucrat takes a similar point of view by not admitting all the activities that involve regulation and trying to keep a low profile so as not to be accused of being a kibitzer. What's lacking is a sense on a part of these contenders that there is something larger at stake which leads me to the third point and the major question.

To come to that sort of negotiating position means trying to reduce conflict early in the process and not after everybody is in eyeball-to-eyeball confrontation, where the facts don't matter anymore, and the temperature has gone up, and everybody is digging in for position. To keep that from happening means coming prepared with a point of view of accepting a group concensus. My question about the oil industry here is the following: It distresses me that all too often there is a siege mentality in industry, and that they do not approach this question with adequate preparation as to the broader issue. The main criterion that they have to apply in the business is, of course, the profit and loss statement. No one can deny that's the place to start, but there is an element of social responsibility here that I often find missing in the whole notion of negotiations. The act of the corporation, which is an act of government to give an industry some role in our society, is a privileged role, as a matter of fact, under the law, and carries with it a social responsibility in return. What I do not find is the interest and dedication by industry before coming to meetings of this kind in trying to find out what the broader point of view is; in a sense, to conduct an impact assessment in advance that they make available to themselves, but from the point of view of just self-education, as to what the external costs are, what the social costs are, what the

environmental costs are, and what are the problems that will come in the future by taking the short-term point of view. So my question is, how do you feel about this question of industry approaching the bargaining table, as it were, not with the notion of steamrollering the dissent, not with the notion of defending past positions -- but considering the broader view that I mentioned above.

Mr. Hay: That was a mouthful. I'll only briefly try to respond to that. Number one, if there was an Earth Day for the oil industry, it probably was Santa Barbara and the spill there. If there was a second Earth Day, it probably was the Alaska pipeline. The pipeline took the industry through a tremendous learning experience, and there's no way to teach industry a lesson any better than economically. Every month that that pipe lay up there for four years and rusted, they lost almost $11 million. It's much better engineered because more time was taken to do it, and I think that industry is getting smarter all the time in looking at these things from an impact-assessment standpoint before they go into them.

However, an awful lot of people in industry are just as paranoid and just as polarized as some of the environmentalists, and they don't take the time to understand what the other side is really trying to do. They know their position, but there are not too many negotiators and diplomats out there trying to seek a Camp David agreement.

So I think that you will see people like me and other people in the future try to reach out and understand these problems and, hopefully, try to seek a middle ground long before we get to the courts.

Mr. Ross: David Sensibar, would you like to offer some comment on that?

Mr. Sensibar: I believe that one of the problems we face so often in this interface between public interests and industry is that we find ourselves on the cutting edge of the law. That is, there isn't a clear-cut experience record to dictate where public interests recede to private interests and where private interests recede to public interests. And so there is a tendency, I believe, on both sides to overstate the position so that in this ebb and flow you can recede as little as you have to to get the most that you can. I think you'll find that as the case law

evolves in this area and where there are things that can be cited as support for one position or the other, the contentiousness of these meetings will dissolve because people will know exactly how far they're permitted to go before the meeting begins. So I think in some of the contentiousness is that you're describing would disappear.

In the past, the very people that knew most about what we were going to experience or anticipated we were going to experience were not listened to because they were paid by industry. Therefore, they were industry spokesmen. They were not considered as objective scientists. This was a mistake on our part. Time has shown us that and I think it continues to be the case in many instances where industry, in good will and to their own self interests, admittedly, are attempting to do what they can to explain to the state decision-makers what they may anticipate, and very often are not listened to nearly as closely as they should be.

On the other far side of the coin, I think it's also important to comment on the fact that I, for one, don't ever expect there to be a significant moral aspect to industry, whether it be petroleum or otherwise. I expect them to stay within the law and I expect them to stay just within the law. Their primary obligation by their charters and by their legality is to provide profits to stockholders. That, I think, must be the primary recognition, so if we never expect the industry to do anything but try to make a profit and stay within the law, we probably shan't be disappointed.

SESSION III

THE OCEAN AND OUR TECHNOLOGY

Guest Speaker: Dr. A. H. Keil
Professor of Ocean Engineering and
Ford Professor of Engineering
Massachusetts Institute of Technology

Panel: David S. Potter
Vice President for Environmental Activities
General Motors Corporation

Elmer P. Wheaton
Vice President (Ret.), Missiles and Space Division
Lockheed Corporation

T. L. Brewer
Project Manager, Advanced Projects
Re-Entry and Environmental Systems Division
General Electric Company

Moderator: Godfrey H. Savage
University of New Hampshire

THE OCEAN AND OUR TECHNOLOGY

ALFRED A. H. KEIL

One of the logical consequences of the Marine Resources and Engineering Development Act of 1966 is the National Sea Grant Program. It has as its goal the expansion of ocean use and the participation of universities in this expansion. Since there can be virtually no ocean use without ocean industries, it follows logically that the National Sea Grant Program should emphasize links to, and cooperation with industry. The Sea Grant enabling act therefore requires matching funds from non-federal sources. Congress expects a substantial part of the matching funds to come from ocean-related industries through cooperation with the universities in the framework of the individual Sea Grant programs.

It is obvious to me why the Sea Grant Association considered this topic, "Ocean Engineering," an important and timely one. Ocean engineering and ocean technology activities within the National Sea Grant Program were always modest and have been declining in recent years. The Ocean Engineering element under NSGP's Marine Technology R & D is 10 percent of the total National Sea Grant R & D budget. Ocean engineering activities of all kinds are estimated to be about 20 percent of the total. It is important to look at the reasons for this pattern, particularly since overall federal support for ocean engineering and ocean technology development has also been declining. We must, therefore, squarely face two key questions: Is Sea Grant ocean engineering sterile and unproductive by nature, or is it unattractive to industry and, if so, why? Then, one must ask: Is it important to create an energetic Sea Grant-supported ocean engineering program, and if so, what provisions have to be made to make such a program a vigorous and effective one?

These questions concerning the Sea Grant Program relate to the much broader question: What should be the relationship between university, government (federal government in particular, but also state governments), and private industry for achieving the national objective of advancing all marine-related technologies and putting these advances to use, through our free enterprise system, for both the economic gain and overall benefit to society? The importance of effective cooperation among these three elements to our national strength in all cases of industrial developments has been symbolized by a well-known and highly successful industrialist, member of the National Academy of Engineering and strong supporter of

academia.[1] He compares the three participants (university, government and industry) to the legs of a three-legged stool. The relative contribution and the strength and length of each leg have to be commensurate. Their mutual interaction and connection to the common purpose, effort or objective, (the seat which they support) must be strong. But before recommending changes for the three legs of our stool and their interaction in the case of ocean developments, let me first trace the pertinent developments of the past 30 years because we must understand how we got to where we are, before looking ahead. I will look individually at the three "legs," government, university and industry, and touch briefly on the historic development of the interface of each with the other two during the post-World War II period.

GOVERNMENT--UNIVERSITIES--INDUSTRY

FEDERAL GOVERNMENT

Since a progressive, healthy industry is vital for the economic strength and national security of the U. S., there must be a concern in the federal government to create an environment in which the U. S. industry can develop vigorously. Federal support for the development of technology and of engineering practice during the past 30 years has been mainly in the form of research and development sponsored by the Department of Defense and NASA, i.e., by government agencies or departments which were the direct beneficiaries and users of the results of the research and development they sponsored. Therefore, the transfer of research results and new technologies toward military and space applications has been direct, and inherent to the programs of these government organizations. Obviously, there have been many spin-offs to the civilian sector from technology-oriented R & D sponsored by NASA and DOD, primarily as a result of technology transfers within those companies which were heavily involved in this government-sponsored work as well as in products and services for the private market.

Federal support for research and development aimed directly at the commercial sector has a very different relationship between sponsored research and users of any results of such research. The major and basic difference is that the sponsoring government organizations such as the Department of Energy (formerly ERDA) or the Department of Transportation are not the users of the results of the research and developments they sponsor. The users are the transportation and the energy industries, i.e., privately owned, commercial enterprises. It is, therefore,

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[1] Ralph Landau, The Chemical Engineering Trilemna, Chemical Engineering Progress, Vol. 72, No. 8, Aug. 76, pp. 13-16.

much more complex and difficult to design federally-funded research and development efforts for eventual commercial use, i.e., R & D programs which are so managed as to assure or at least facilitate the transfer of the research results and advanced technologies into successful applications by the private sector. The government's massive experience with space and defense developments does not apply. It is appropriate to note here that our major technological competitors on the world market, Japan and West Germany, have extensive experience with federal encouragement and support for non-military, non-space R & D, because they have been able to concentrate on the commercial sector almost exclusively for the last 30 years. In the U. S. that element has been running a very poor third to the military and space-oriented R & D. Furthermore, both countries (especially Japan) have established symbiotic relationships between government agencies and industries, relationships that at present would seem too close in the American context, but which have been most effective in supporting commercial development.

Consider the federal R & D support to universities. After the end of World War II, there were 20 years of rapid growth in support of science at U. S. universities. Major support came from the National Science Foundation, but it is important to remember that the advancement of engineering was always a small part of the total NSF expenditures, although Congress specified both science and engineering in the NSF charter. There was, however, a substantial growth in DOD and NASA support for basic and engineering sciences and for development of advanced technologies. During the past 10 years, even this support has leveled off and, in many cases, there has been an actual decline in support for engineering research and development at universities. At the same time, new research areas have come into the picture with the creation of new federal departments such as Transportation; new thrusts in existing departments such as the Department of the Interior, and the creation of new agencies such as NOAA, ERDA (now Department of Energy) and EPA.

In the case of the Department of Energy we see an explicit determination to foster the advancement of new energy technologies and to transfer the results into the commercial sector. Most recently the National Science Foundation in its Notice No. 72 of March 29, 1978 announced "the intention of NSF to provide funding for the encouragement of cooperative research between industry and university in order to strengthen the ties between these two segments of the nation's scientific and technological resources." NSF specifies, however, that proposed research should focus on fundamental scientific questions rather than on technological development. However, I see nowhere in the charter of any of these federal programs, as explicit and strong a commitment to transfer research results

developed by university-based efforts which are supported by industry and the federal government toward development of engineering solutions to national needs, as in the National Sea Grant Program.

The Sea Grant Program in recognizing, emphasizing and actually mandating this transfer of research and technical developments to the commercial sector in the marine field by means of its advisory services, is therefore a hallmark of recent federal legislation in any field of commercial endeavor. It establishes corollary responsibility and objectives for identifying development options and for opportunities for the conduct and further application of university research.

UNIVERSITIES

The substantial infusion of principally scientific research funding into the U. S. universities after World War II led to the development of large-scale research efforts at universities with systematic emphasis on the advancement of the scientific frontiers. This academic research revolution had great benefits, but also had its drawbacks, particularly for schools of engineering. By the middle sixties, there was a general attitude that the schools of engineering should be primarily science-oriented. Parallel to this development went a reduced emphasis on the engineering dimension (integration across scientific disciplines, synthesis, design, etc., i.e., all areas related to the doing of engineering) in the curriculum as well as in university research. A climate or attitude evolved where engineering efforts to put science to practical use were considered "unworthy of the sacred halls of academia." Sea Grant came into being in the late 1960s, at a time when the engineering schools in the U. S. had begun to realize they had become, or were becoming, schools of engineering science, and that many engineering-related courses had fallen by the wayside to make room for more and more emphasis on "fundamentals." Fortunately, during the 1970s a resurgence of "engineering" began in the engineering schools in an effort to provide a reasonable balance between science and fundamentals on one hand, and engineering endeavors on the other.

INDUSTRY

Industry exists to meet market needs economically by supplying technical services and products. It operates in a highly competitive environment, nationally and internationally, and must make profit in this process in order to pay dividends to its shareholders and to be able to invest in new, innovative ventures. The competitive environment forces industry to protect "special know-how" such as new process techniques and production capabilities. Such protection is often accomplished

through patents, but often "keeping trade secrets" is more desirable since applications for a patent could make competitors aware of new directions.

Following World War II many U. S. industries experienced a period of rapid growth. Such growth in the military/space industrial complex was the result of enormous military and space programs with their related purchases and the extensive R & D efforts supporting these programs. The free market sectors of the U. S. economy, on the other hand, generated many large and vigorous industries with little or no federal support in the areas of chemicals, pharmaceuticals, oil and gas, automobiles, paper/wood products, communications, electronics and computers, with the last three benefiting substantially from the DOD and NASA programs. Most of these industries established large internally-funded research laboratories which often became centers of excellence with international reputations. In addition, there are U. S. industries which became regressive such as railroads and shoe manufacturing, or developed slowly as for instance the marine industry with the exception of the offshore industry. A large number of intermediate-size and small companies have also made, and are making, valuable contributions to the economy, often because their smaller size provides a better environment for innovations, risk-taking and pioneering.

GOVERNMENT--UNIVERSITIES--INDUSTRY

Before reviewing the area of ocean engineering and ocean technology in the context of the "three-legged stool," we must appreciate the major constraints under which each of the three legs (i.e., industry, university and government) now operates. Industry, in a free enterprise system, must be oriented toward serving markets and generating profit. Industrial companies face a strongly competitive environment, nationally as well as internationally, and must for economic advantage, protect their proprietary information and patents. Universities with their primary thrust in education and extension of knowledge must protect their freedom of inquiry and teaching while depending primarily on externally furnished support for their operations and the research done by faculty and students. In addition to this responsibility of all universities to the academic environment, schools of engineering have the additional responsibility to develop sound engineering attitudes among their students, and to take steps to facilitate the transfer of their individual research to the practice of engineering, a step which transcends publishing research results, and which can easily be neglected. Government, acting as a surrogate for the people of the U. S., has a responsibility to prevent favoritism, to exert certain controls and to assure free competition, but it also has an obligation to create a climate in which U. S. industrial enterprises can prosper and thus

strengthen the U. S. economy.

The government, industry and the universities have responsibilities to themselves, but each of them has responsibilities to the other two legs of the three-legged stool. I have already stressed particularly the university's and the government's responsibility toward industry. I want to address now the responsibility of industry toward the universities. Universities, or academic institutions in general, are the source of talent upon which industry depends for its professional manpower. Industry discharges some of its responsibility to maintain these sources of trained professionals and fundamental knowledge through federal and state taxes (part of which is used to support education) as well as through direct contributions to academic institutions for "brick and mortar," equipment, student fellowships, endowed professorships, and occasionally unrestricted contributions for operating expenses. These actions are commendable and gratefully acknowledged, but now we have reached a point in U. S. history where, due to the academic and federal funding trends of the past three decades and the national need for technical leadership, industry's responsibility should go beyond these traditional bounds and include at least encouragement and hopefully support for engineering research and development in academic institutions in close connection with their educational programs. An illustrative and successful example was the establishment of the Electric Power Research Institute (EPRI) some six or seven years ago. It is sponsored by the electric utilities of the United States. EPRI supports research at the universities relevant to the improvement and future development of the electric power industry for the common benefits of all their members, and through them, the U. S. economy and citizens.

Why have I gone into such detail about engineering education and engineering research and development at the universities? I have done so because:

1) The two neglected elements of engineering education addressing the "doing of engineering" and the "use of technology" are directly related to the objectives of the Sea Grant Program.

2) Any substantial progress in these two areas requires close interaction and cooperation between industry, government and the universities.

My premise is that Sea Grant/university/private industry relationships aimed at ocean developments must be viewed within this general framework of interaction among federal government, universities and industry. Let us now look at the specific subsets of activities concerning ocean engineering and marine technology.

The U. S. needs for ocean engineering derive from military requirements and from the growing thrust for greater use of the oceans and their resources. The military programs in ocean engineering (including marine hydrodynamics, structure and power systems, materials development, naval architecture, sonar engineering, etc.) have been in existence for many decades, but federal ocean engineering programs for non-military purposes have been very slow in developing.

The major federal contributions to the development of U. S. marine technology and the systematic development of the foundations of ocean engineering were made by the U. S. Navy's R & D programs. From 1948 to about 1968, these military-sponsored broad R & D programs had a major impact on several commercial sectors such as shipbuilding, the general development of materials for use in the marine environment, marine power systems and deep sea diving developments. In addition, they laid the foundations for many other developments such as ships for deep sea drilling, mobile semisubmersible offshore platforms, ocean mining and deep sea completions of oil wells. However, since 1968 the U. S. Navy's R & D program in general ocean engineering has declined. Ocean engineering sponsored by such other government organizations as the National Oceanic and Atmospheric Administration, the U. S. Coast Guard and the Maritime Administration has been directed mainly toward specific developments usually using available ocean engineering foundations and in most cases, available technologies. In most cases, they showed little concern for expanding the technological base further; and even less concern for contributing to the foundations of ocean engineering.

Meanwhile, the offshore industry has become the largest private contributor to ocean technology by virtue of its drive to develop offshore natural gas and oil resources. This private effort has given the U. S. a unique position of leadership in offshore exploration, offshore production and offshore technology in general. A parallel and also private effort to develop offshore mining of manganese nodules was begun several years ago, but this has not yet reached the level of a well-established marine technology. We have here an illustration that there is a long way from the state of the art where we say: "We expect that we can do it," to the state of industrial practice where we can say: "We know we can do it because we proved that it works in industry."

In contrast to the ocean technologies benefitting from these large-scale efforts by the military or large industrial enterprises, there are the technologies supporting many small and intermediate-size marine resource industries: hardware

technology such as fishing boats and fishing gear, fish processing equipment, building of seawalls and piers, a variety of innovative efforts in aquaculture and biomedicinals, and software technology such as tools for fish resource modelling. In the United States these "smaller scale technologies" have had little systematic support to encourage advances. The demand for ocean engineering in support of modern ocean science must not be overlooked. It has also grown substantially, mainly in connection with large-scale ocean science programs. Modern large-scale ocean science is only possible, and becomes most effective, with the use of modern instrumentation and techniques as well as integrated approaches to data-taking, data-processing and model development. Typical examples are today's sophisticated technology, both hardware and software, for offshore geological exploration and the use of satellite technology for acquisition of oceanographic data.

As we look toward the future, I see the need for a systematic approach to ocean engineering aimed at advancing non-military uses of the oceans. New or expanded programs must be oriented to ultimately advancing the future use of living mineral and energy resources of the oceans, advancing marine transportation, reducing and controlling marine pollution, and facilitating coastal zone planning and management. They must address:

- The development and strengthening of the foundations of ocean engineering and the development of technologies.

- The effective transfer from "the state of the art" to "the state of industrial practice."

- The synthesis and integration toward operating systems which effectively respond to national needs.

The background I have traced with you leads me to the conclusion that better cooperation among government, industry and the universities would contribute substantially to the success of such new programs and to the national advance of ocean engineering. The National Sea Grant Program with its unique charter to couple a federal government agency with universities, and to encourage university/industry interaction, has created an environment and established a pattern and mechanism for better cooperation, not only for ocean engineering, but other fields as well. In the further discussions, I will confine my remarks to ocean engineering in the framework of the National Sea Grant Program.

Ocean engineering has played and is still playing a relatively minor role in the National Sea Grant Program because the main thrust of the program has historically been toward development of living resources. It is, therefore, not surprising that the

impact of sea grant projects in marine agriculture, biochemicals and pharmaceutical products, fishing industry and fish processing on commercial and foreign trade has been substantial,[2] while Sea Grant ocean engineering accomplishments and their impacts on industrial developments have been less visible. The ocean engineering program in Sea Grant is further complicated by the difficulty of obtaining matching funds from industry for ocean engineering, and the inherent problem of transferring technical advances from the universities into established marine industries and the free market. This is not to say that there have not been substantial ocean engineering contributions. Many do exist, but a summary report on the impact of Sea Grant ocean engineering developments and technological advances is not available.

The reduction of federal support of research on fundamental as well as applied areas relevant to ocean engineering on one hand and the increasing demands for imaginative ocean engineering on the other, establishes a particular need for a revitalization of systematic federal support for ocean engineering research. The National Sea Grant Program should play a major role in this revitalization.

STEPS TOWARD STRENGTHENING OCEAN ENGINEERING

In exploring steps to strengthen ocean engineering in the National Sea Grant Program, we must distinguish between advancing the foundations of ocean engineering which have the goal to make ocean engineering more effective; the actual development of technologies and technical products which ultimately must be transferred to the free market; and the synthesis and integration toward operating systems. The individual roles of government, industry and university are quite different in the three cases, and so are the steps toward improvements.

FOUNDATIONS OF OCEAN ENGINEERING

Strengthening the foundation of ocean engineering under the Sea Grant Program should address:

1) Present ocean engineering methods and practices to identify areas which could definitely be improved.

2) Application of scientific breakthroughs to ocean engineering methods, thus striving for benefits from new knowledge.

The process required to establish individual projects linking university programs to industrial needs and practices can

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[2] An Analysis of the Potential Commercial and Foreign Trade Imports of the Sea Grant Program, Report CPA 77-2, March 1977, Center of Policy Alternatives, M.I.T.

effectively build on the established industrial practice of obtaining services of professors as consultants, and the experience of those faculty members who already interact successfully with industry. At present, this practice has offered great benefits by bringing industrial experience resulting from such consulting into the classroom; providing a most effective means of transfer of new technology into industries; and often generating industrial grants for students and for research. New projects of the type I described for joint sponsorship by industry and Sea Grant, should take advantage of this already-existing connection between faculty and industry. The National Sea Grant Program should encourage such developments.

The process of establishing broader projects for joint sponsorship by industry and the National Sea Grant Program requires that problems common to a group of companies or new industrial opportunities be identified. A typical example was the indentification of needs for "Sea Floor Engineering" which was carried out by a Panel of the Marine Board of the National Research Council. The Panel consisted of representatives of a number of industries and universities. The National Sea Grant Progam (that is, the national headquarters as well as the participating universities) must cooperate with the engineering community in industry and the universities in the identification, planning and establishment of programs of this type.

Implementation of the proposed approach can be done as follows: The National Sea Grant office, in cooperation with Sea Grant universities and industry, identifies areas of ocean engineering which apparently would benefit from the proposed type of program, and industries could directly propose such areas to the Sea Grant system. NSGP would announce to the universities that the formulation of programs in those areas is desired, requesting nominations and applications of faculty members who are interested in carrying out the program formulation effort. The persons selected would work for a period of nine months (one academic year) or up to 15 months (one academic year plus the summer preceding that year as well as the following summer) for the National Sea Grant Program. This person would review the field carefully with the industries involved, the universities working in these areas, with relevant groups of the National Research Council and federal agencies, and develop a proposed program. The individual selected would also work with and report progress to an NSGP-appointed review group consisting of engineering leaders from industry and universities. The individual would also participate in introducing the proposed program into the NSGP and NOAA budget and, where appropriate, in discussions with higher levels in the Executive Branch as well as Congress.

In order to obtain the services of the best academic talent for

this type of program formulation (i.e., faculty members with a high academic standing, demonstrated engineering competence and a flair for innovation and entrepreneurship), assurance is needed that the proposed investment of time by a faculty member is supportive also of his academic career development. The proposed approach would be particularly effective if it were aimed at attracting faculty members who just received tenure. A "public service" of nine to fifteen months for development of an important program would be intellectually stimulating and rewarding, and it would broaden the individual's horizon substantially. However, provisions would also have to be made to assure easy reentry of the individual into academic life upon completion of a successful assignment. This could be done by honoring the individual who would accept the responsibility for development of a program formulation by a national Sea Grant faculty fellowship which would assure the individual a substantial research grant over a two-year period in the area of the study which the individual has carried out.

ACTUAL OCEAN ENGINEERING DEVELOPMENTS

The development of technologies and actual technical products and systems related to the development of marine resources and ocean uses is a most important dimension to be strengthened in the National Sea Grant Program as well as in the universities. The present university/industry interaction is again industry's method of using university professors as consultants. As valuable as this method is for bringing industrial experience into academia, it does not provide the opportunity to involve students in the actual process of product development and innovation. Steps toward involving the students in that process are a most essential contribution to the development of a balanced ocean engineering educational program.

The major problems with industrially-supported engineering development at the universities are patents because a third party, the U. S. government, enters into the case through the regulations governing federal support. Between industry and university, agreements can be reached concerning patents by means of negotiations but federal government rules and practices must also be accommodated. At present, the National Sea Grant Program requires that for any invention made under either full or partial support by the Sea Grant Program, the university has to apply for a patent. When such a patent is obtained, the university can apply to the Department of Commerce to have it assigned to the university with the proviso that no royalty will be paid for use of this patent by the U. S. government. Obviously, this procedure provides little incentive for private industry to join forces with any university and the Sea Grant Program because of the uncertainties for patent decisions.

If we want to overcome the present guarded approach by industry and develop strong interaction with our universities on Sea Grant projects which address technical developments, the Department of Commerce must rule that any patent developed with full or partial support by the Sea Grant Program will automatically be assigned to the university involved. Negotiations between the university and industrial enterprise in the establishment of joint projects would then be greatly simplified. A university would know exactly where it stands with respect to patents and could, for instance, negotiate during the establishment of a project to permit industry to share in the patent title; to have limited time, exclusive royalty-free license for the patent, and/or the right to buy out the government interest investment in the project so as to own the patent outright or jointly with the university, while still assuring the royalty-free use of the patent for government purposes.[3]

Establishment of cooperative projects in this new environment proposed for the National Sea Grant Program can build on the established industrial practice of obtaining services of professors as consultants, and the experience of those faculty members who already interact successfully with industry. The National Sea Grant Program should encourage such developments. Furthermore, it should acknowledge faculty consulting as a most valuable and important means of commercialization of scientific and technical progress; consulting for industry is actually an important "advisory service" in the general sense of the word. The universities should encourage arrangements where students can, as part of their education, participate in the university environment in selective product developments and in innovation.

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[3]For clarification, the present practice of NOAA vis-a-vis universities and patents will be reviewed: Under present Sea Grant Program grants, NOAA takes "title" to all inventions arising out of the sponsored research, while giving the university a royalty-free right to use the invention itself--but no right to license others. These grants contain a "patent rights deferred" clause which requires the university to report all inventions to NOAA since they have title. However, if the university wishes to file a patent application on an invention related to the grant, the university can petition NOAA for greater rights, i.e., for waiver of title to the university. If the petition for greater rights is not granted, title remains with NOAA, and the university is obligated to execute formal assignment documents, but without being reimbursed for filing expenses. If NOAA approves the petition for greater rights, title to the invention is transferred to the university and the government retains a royalty-free, non-exclusive, non-transferable license to make, use, and sell the invention on behalf of the government. Under the latter circumstances, the university

NEW PROGRAMS ESSENTIAL FOR MARINE RESOURCES DEVELOPMENT

The Sea Grant university community, in cooperation with the National Sea Grant Program, and with industry participation can also take initiatives toward identifying essential broader projects which are relevant for marine resources development. The increasing activities on the continental shelves of the U. S. (offshore oil and gas, fisheries, ocean dumping, etc.) would benefit from systematic developments such as:

Dynamic models of the circulations and mixing processes of the waters of the 200-mile economic zone.

Advanced methods for reliably and accurately measuring the actual extent of fishery resources.

Systematic efforts to develop dynamic ecosystem models.

U. S. port developments in the context of local, state and national interests, and changing marine transportation patterns.

Review of each of these topics can provide the base for the establishment of new programs which could then be carried out by the National Sea Grant network with or without the help of other academic institutions. A more specific discussion of the individual topics is beyond the scope of this paper.

COMMON FACTORS

Let us now address common requirements for projects and programs established under any one of the three approaches. These projects and programs must be scientifically sound to be accepted by the universities and relevant to the advancement of specific fields of engineering to be acceptable to industry. The technology transfer from university to industry must be assumed and would logically follow as a result of industrial participation in the formulation and monitoring of the programs.

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is free to negotiate a license with an interested company or with the sponsoring industrial concern.

Other governmental agencies having similar "patent rights deferred clauses" in most of their contracts/grants are NASA, DOE, DOI, and DOT. However, NSF, DHEW and DOD have granted Institutional Patent Agreements whereby universities automatically take title to all inventions arising from their sponsored research, with the government retaining a royalty-free, non-exclusive license to make, use, and sell for all governmental purposes.

To assure the success of the new approaches which I propose, it is important to be aware of the factors governing the successful Sea Grant projects analyzed in the study mentioned earlier. Many of these factors apply just as well to making the proposed joint Sea Grant/industry projects successful. The characteristics of projects with commercial potential are therefore quoted here:

1) The principal investigator was encouraged by strong user interest and by their direct support of his efforts often in application to his field of investigation.

2) Most commercially successful projects were directed toward a market or production need, rather than a scientific or technical opportunity.

3) The project had reached the developmental stage and the technical uncertainties were low.

4) The principal investigator was active in communicating the results to technical and user groups.

5) There was early and continuous involvement of users as well as extensive communication and participation of other scientific and technical colleagues.

6) The promise of high profitability often led to new enterprises being formed frequently with the involvement of the investigator or his associates.

7) Barriers to commercial success of technological innovations such as capital, industry structure, risk, etc., were not considered to be as significant as other "softer" issues such as environmental regulation, legal or institutional problems and market development.

8) Chances of success were enhanced when the university environment was highly supportive and had a strong experiment station or advisory service orientation.

CONCLUSION

The steps I have proposed are essential for advancing ocean engineering and marine technology for ocean uses in general and for the further evolution of the National Sea Grant Program which has matured during its first decade. During that period it has concentrated mainly on local and state-wide problems. The time has now come for the National Sea Grant Program to expand by adding program elements of regional or national scope in response to the foreseeable developments of ocean uses, particularly of the 200-mile economic zone, as well as the coastal zone. A vigorous and successful Sea Grant ocean engineering program

aimed at advancing the foundation of ocean engineering and the actual development of technology and its use must be created. In summary this requires the following actions:

The National Sea Grant Program should:

Provide systematic funding for ocean engineering research which is planned by university faculty in close cooperation with private industry or which demonstrates close connection to practical problems, with matching funds to be sought from industry where appropriate.

Provide systematic funding for development of technology and technical products based on plants developed by university faculty members in close cooperation with industry or assessments of the market, with matching funds from industry in most cases.

Establish a ruling that any patent developed with full or partial support by the Sea Grant Program will be automatically assigned to the university involved, but will require royalty-free uses of the patent for government purposes.

Encourage Sea Grant faculty members to consult for industry, and accept the consulting services which faculty provides to industry as valuable special advisory services which supplement the set of present Sea Grant advisory services.

Endorse the formulation of new programs essential for marine resource development and support their execution.

Universities having Sea Grant Programs should:

Accept and encourage faculty interaction with industry as an important function of faculty members.

Value application-oriented research and engineering developments by faculty members and students as important steps in faculty development and engineering education.

Establish an environment so that students can actively participate in university-based development projects.

Private industry should:

Recognize the value of cooperating with university faculty in identifying individual research tasks and research programs.

Participate with universities in and provide matching funds for ocean engineering research and development programs

which are planned jointly by industry and universities.

The proposed expansion of the National Sea Grant Program will require changes in the style of operation of the National Sea Grant Program; large changes in the nature and operation of the present programs at the universities in that increased interaction and cooperation among them will be required; and changes in attitudes in universities and industry in order to bring about an increased cooperation in the establishment of joint industry/university programs. The benefits which will accrue to the nation, to U. S. industries, and to the development of professional manpower at the universities are so great that the growing pains associated with getting these developments started must be accepted.

PANELISTS' PRESENTATIONS

ELMER P. WHEATON

Dr. Keil opened his excellent paper by asking a fundamental question: What should be the relationship between government (meaning both federal and state) and private industry for achieving the national objective of advancing all marine related technology and funneling such information for use through our free enterprise system for the benefit of economic gain and an overall benefit to society?

I would like to ask another related and perhaps more fundamental question: Is it national policy to advance marine technology with the objective of expanding the use of the oceans and their resources? It is true that the Marine Resources and Development Act of 1966 had that as a goal, but if one traces the history of national ocean policy through both administrative and legislative actions since that time, one cannot help but conclude that the national policy has become one of restriction and prohibition of the use of ocean resources rather than seeking to determine an advantageous juxtaposition of use and protection.

Environmental emotionalism appears to have completely overshadowed scientific and technological facts about the ocean. There is some evidence that the pendulum is swinging back to a more moderate position which will allow greater use of ocean resources, not due to additional technical or scientific knowledge as much as economics. Whether we like it or not, we have had a government which is operating on adversary principles and unless we have a capable federal organization that can develop and support arguments for legislation and regulations from a scientific and technical standpoint, we will continue to have difficulty in developing the nation's oceanic resources.

I am not proposing that Sea Grant undertake this role in the federal government. I believe that Sea Grant has, in many states, accomplished an outstanding job in supplying technical and scientific knowledge to state and local governments. There are several characteristics of Sea Grant that must be recognized. Due to the matching fund concept, it has primarily local and regional responsibilities. Another characteristic is that it is multidisciplinary. In fact, the Sea Grant Act states, "The term 'field-related to coastal and ocean resources' means any discipline or field (including marine science (and the physical, natural and biological sciences, and engineering, included therein), marine technology, education, economics, sociology,

communications, planning, law, internal affairs, and public administration) which is concerned with or likely to improve the understanding, assessment, development, utilization, or conservation of ocean and coastal resources." Thus, Sea Grant was designed to be particularly responsive to the immediate practical needs of industry, the public, state and local governments on a host of subjects relating to the sea.

State and local governments do not have available in house these broad capabilities and are loud in their praise and support of Sea Grant assistance in solving many of their coastal and marine problems. Numerous examples of the application of ocean engineering assistance in the solution of these problems exist.

It is true, as Dr. Keil stated, that large industry has not been heavily involved in Sea Grant projects. It is my opinion that this is not due to lack of interest nor a communications problem. Large industry has resources and staffs available to carry out their requirements in the fields of scientific research, engineering, economics, planning, law, etc., and can do this on a proprietary basis. As Dr. Keil stated in his paper, industry operates in a highly competitive environment, and thus would not put their money in the support of a Sea Grant project which would not give them a competitive advantage. On the other hand, I do believe that large industry does recognize the extremely important function that Sea Grant accomplishes in educating the public and government officials on marine resources in an unbiased fashion.

It should also be recognized that large industry has experienced public distrust of research findings by universities when the research has been financed by industry. There is the feeling that the results are biased and, therefore, not acceptable. I do not believe this opinion to be true, but it is a fact of life and must be recognized. Therefore, it may be unwise for large industry to place funds on Sea Grant projects and inadvertantly jeopardize the esteem Sea Grant enjoys with the public.

As I have already stated, I do not believe that Sea Grant should attempt to be the national focus for marine engineering. I do believe that there must be a strong civil ocean engineering organization within the federal government that has the capacity and stature to allow it to effectively influence the writing of legislation and regulations from a technical and scientific standpoint to the end that ocean resource development can proceed on a sound basis. In many areas this will require the research and development of basic standards and practices for ocean engineering and the communication of such findings to the engineering community. A considerable amount of the work could be done by the Sea Grant colleges under the new National Sea Grant Project. However, I believe that most of the

effort would be done by direct contact from the ocean engineering agency.

Dr. Keil's paper also discusses the problems of federal support of research and developments aimed directly at the commercial sector. A paper published in the April 11, 1978, issue of SCIENCE, "Fuel, Conservation, and Applied Research" by Gray, Sutton and Ziotnik, discusses many of the basic issues of the expenditure of government money for civil technology development and contains the following excellent policy statement: "The classical function of federally support R & D is to develop technologies whose eventual payoff is potentially high but which entails too much risk for prudent private-sector investment. The role of federally supported applied research is to provide the technical information that private industry needs to reduce its technical risks. In this way private industry can be encouraged to undertake innovative hardware development on its own, giving the federally sponsored applied research a much greater leverage on technology development than does the budget for federally supported hardware projects."

I hardly need to add in closing that I believe the biggest risks are in both federal and state legislation and regulation insofar as ocean resource development is concerned. Sea Grant has been of the greatest assistance in this arena within the various states, and its influence is now being felt at the national level. It should become stronger with the National Sea Grant Project. However, do not let it overwhelm the great strength of Sea Grant--the grass-roots or the bottom-up approach.

T. L. BREWER

I'd like to recognize that science is the key to understanding and its historic pre-emptive role is understandable. In today's international competitive environment, U. S. industry must focus on technology, the key to utilization. I guess that's the second definition you've had today of technology.

As pointed out in Dr. Keil's paper, this focus in the non-military, free market sector has been principally in those areas of potentially high return which would warrant the investments. The specialized and non-aggregated markets have not developed because of lack of support. This is truly an area in which the government and the Sea Grant Program could make a significant contribution. The question in these areas, as Elmer said, is not so much the question of protection of special know-how, as it is the cost of development. The costs are too large for small industries and the potential for return is not large enough for the large industries.

As Dr. Keil pointed out in his paper, the major federal contribution to the development of U. S. marine technology and engineering was made by the U. S. Navy's R & D program between World War II and about 1968. Budget cuts reduced this effort significantly and it was not picked up by other agencies. The non-military, non-space ocean programs are not aggregated as they are, say, in the Navy, which was the user agency and can maintain its relevance and insure technology transfer.

These are the major problems for the civil oceans industry. The maintenance of relevance and the achievement of technology transfer. I'd like to comment on those two areas for a moment.

A key problem exists with small industries because they have no mechanism to aggregate their requirements. NOAA must take the initiative here. The larger industries, such as offshore oil and gas have taken the initiative and NOAA will have to maintain a watchful eye. However, without a road map, NOAA will find it impossible to maintain an overall program focus considering all government agencies, large businesses, small businesses, universities, scientific communities and the Congress. What is needed is the centralization of the oceans' activity to the fullest practical extent into a single organization with effective stature within the federal organization structure for the realization of both the full economic potential of the ocean and the protection and conservation of the ocean environment, and an orderly and disciplined framework for defining and scoping the overall program for relating individual pieces to the whole.

It's this relating of the individual pieces and this traceability or relevance that is important.

A number of previous studies have concerned themselves with the gross economic benefits from increased ocean use. However, they did not specifically explore how these related industrial developments could be accomplished which would generate these benefits and what specific steps the federal government would have to take to facilitate and enhance these developments.

In 1978, the NACOA Committee is developing an approach which concentrates on identifying opportunities for improving existing ocean industries or new ocean industries. Gaining perspective on the extent of the economic benefits which can be obtained, identifying the road blocks (the lack of scientific understanding, technical deficiencies, regulatory constraints, present policies, etc.) thus showing the way for successful and effective government action. In order for industry to be more supportive of the Sea Grant Program, the program must have clear objectives defined with traceability of the technology to the utilization objectives. These objectives must also be planned on a definitive schedule.

In addition to industry's concern with the protection of the special know-how, as discussed in the paper, industries have a tendency to go it alone whenever possible to achieve a specific goal, on a defined schedule and within a planned budget. A closer link to industry might be possible if in the steps recommended in Dr. Keil's paper toward strengthening the ocean engineering, more goals oriented programs be considered with industry engineers as principal investigators or co-investigators.

The problem of technology transfer is critical. Having seminars and delivering papers does not transfer the technology. It does not transfer the enthusiasm of the investigator. You need an advocate and you must transfer the advocate with the program. You cannot transfer the program and leave the advocate behind. This is not a problem peculiar to the oceans industry, or to Sea Grant, but is generally prevalent in industry. Whenever we attempt to develop an idea from our own laboratories into a product, we are faced with this problem. One of the biggest problems and the area of greatest failure is in this technology transfer, so it's not unique, but it is, indeed, the problem that must be addressed, and I would stress that within the Sea Grant Program, it's not just sufficient to develop tenure and develop professors, but it is important that we develop engineers who can come into industry as advocates with enthusiasm to perpetuate those projects.

One area not addressed by Dr. Keil is facilities. Both large and small industries could benefit from specialized national laboratories which neither could afford to build or operate.

In the early days of aviation, NACA maintained and operated facilities for the use of industries. Large and small companies had equal access to these facilities. Major projects developed their own facilities and when their programs wound down, they then sold time to other users. The designating of specific Sea Grant colleges as centers of research with supporting facilities would be one way of encouraging "small-scale technologies." Thank you.

DAVID S. POTTER

Being the last speaker on a panel of this variety leaves me with several choices. One of them is to do the natural thing and that is try to comment on each of the other papers and do a rebuttal. I find that the remarks that I wrote some three months ago are not particularly germane and I no longer can remember what was bothering me and why I put them down in that order, but I am very aware of what's bothering me now, having listened to Al and Elmer and my colleagues.

I think that I would like to interpose a few observations with respect to this question of the Navy having carried a great deal of the R & D in the ocean for the time period 1946 to 1968, and what's transpired since then. The Navy did provide 20 years worth of support for ocean activities and I think anyone of my age who has been in the ocean business certainly understands that that was the root of the funding, back in the 1940s and the 1950s. In the mid 1960s, we in the ocean business considered that the ocean program had to be more broadly based and there should be a national interest and dedication, and hence divorced from the defense implications. There were commercial opportunities that should be pursued, and a number of us at that time pressed for what became a Sea Grant Program. At the same time, not at all related to the ocean trying to earn its day in the sun, was another phenomenon going on in the U. S. That was the restriction of defense budgets and other restrictive legislation that was passed by our Congress to make sure that the defense area stuck to its knitting. In particular, the thing that impacted the research community was the Mansfield Amendment which said that the Department of Defense could not indulge in or support research activities that were not directly related to its mission.

The Mansfield Amendment has had a major impact, I think, on all of the support activities of the federal government. It certainly has on the Department of Defense. Coupled with that, of course, were the budget cuts. However, I think either one, the Mansfield Amendment or the budget cuts, would have brought us to the situation that we are in today; that is, a dependence upon other sources of funding for the advancement of the commercial interests in the ocean or in any other area of commerce.

Al, I think, in his paper gave a very scholarly dissertation on what could happen in a national Sea Grant Program. I think he discussed quite ably the situation of the small research

activity, the fact that a lot of work can be done that will help small industry. He also noted that there was a large system of activity that now has to go forward. That system of activity having a broad scope for instance what to do with the new 200-mile limit. That's a kind of activity that was not visualized ten years ago when the Sea Grant arguments were being held, however. That's the kind of thing that might well be brought into the charter of a Sea Grant Program. I think that from Al's paper, one can conclude that we have had a very interesting first decade of the Sea Grant Program. A lot of good things were done and a lot of the initial formulation was right, but the time for a re-inquiry is here; the nation has different needs now. Those needs should be addressed and, I think, from panel discussions like this and internal discussions in the ocean community, one can decide which way to go. Then comes the time to once more mount the offensive, go to Congress and get the law changed to provide whatever legislative conveyance you need to have for a good ocean program.

I think Elmer in his discussion has brought up some other points that I will not dwell on and, in fact, I would only like to note that his arguments about regulation and the impact on the ocean business are very real, something that is not yet evident to our community-at-large and I think over the next few years you will see more and more of the impact of that kind of thing and will want to address those problems. That would suggest that the research effort ought to go in that direction, too, so you'll be prepared for the arguments of that kind when they come along. My guess is that will be sometime in the early 1980s.

I'd like to pick up on one of the points Al made at the outset of his paper which was that initially the Sea Grant Program was to support and promote research into ocean-related areas where such research could have a positive economic impact by facilitating business ventures. I served on the initial Sea Grant Advisory Panel and we argued out the matter of how one does that. Early in our discussions the path the program should take was given a great amount of time. I think we realized then, as you realize now, that given the size of the Sea Grant budget, the financial resources available, that one could have almost no impact on something whose scale approached the scope of the offshore oil industry -- that that was not what Sea Grant was going to impact at all. In fact, one would have to chart a path which took that into account. Large, muscley industries like the oil industry have plenty of resources to do the research once the economic need is shown. Instead, we decided to concentrate our efforts into other large but fragmented areas in industry, and fishing is the classic industry of this type. In the aggregate, fishing is not a small business. In the aggregate, it becomes a large business. I think even by government definitions, it is a big business, although a

typical operation consists of an owner-operated ship or a few ships. At most, fleets of 100 are about the largest fleets I know of that are owned by industries. Obviously, the operations of this type just do not have the expertise, they do not have the budgets, and they do not have the management talent or time to devote to research and development of technologies that can improve their operations. They have the need, but not the wherewithall. This is a situation where the Sea Grant Program, through its member universities, can have a significant, positive impact on business activities. Aquaculture is another example of that kind of thing.

Each of these situations is analogous to farming and the needs that were met and the roles played by the Land Grant system and its university members. I'm sure you've heard this analogy until you're sick of it. Nonetheless, it's worthwhile to go back and recall that that's where the phrase came from. That was what Athelston Spilhause thought about when he invented the phrase, and a lot of the early life of the Sea Grant Program was spent trying to reason by analogy from some of the successes of the Land Grant Program.

In both the Land and the Sea Grant Programs, there was and there still is a very large, but fragmented, industry that has large collective needs, but no collective capital. Because of the numbers of citizens involved, the government stepped in to underwrite activities through grants to local colleges and universities, and, in return, the institutions then and the institutions today which participate have agreed to define and develop needed techniques and technologies. As an aside, let me remind you that the reason for a Land Grant Program largely came about because the academic institutions of the time not only failed to recognize that a problem existed, but rejected the notion that they had any part in the solution. My alma mater, at that time, required both Latin and Greek to enter. Chemistry was taught without benefit of a laboratory. I think that they went back to the ancient Greek writings, and that was the chemistry of the period. The Congress, I think properly, was annoyed with such a situation and developed an entire range of schools in answer to their needs. The schools that have developed all through the Midwest and the West have their antecedents in the Land Grant Act. I have suggested on other occasions of this variety, just to get my university colleagues upset a little bit, that the needs of the nation have once again changed. The universities are not responding to those needs, and it's not at all unlikely that Congress will, once again, adopt the technique that they adopted some 120 years ago, and create a new brand of institution labelled something else that will take care of those needs, and then what happens to the old institutions is, of course, moot. Having said that, you can chew on it and we'll get it at the questions and answers.

I think the Land Grant system, as you are well aware, took the whole process one step further. In the statement of the Land Grant schools, it was realized that developing the local educational institutions as centers of excellence was useless insofar as the majority of the citizenry was concerned, if that excellence stayed on campus. And, for that reason, the Land Grant system also developed the County Extension Agent. He was the one who disseminated the knowledge out into the countryside and brought back the problems. Similarly, the Sea Grant Program attempted to embody the same concept. And, as far as I know, is still adequately going at it today. It was believed that if there were such an agent available, the same sort of transfer would take place. But under those circumstances, and only under those circumstances, would ocean-based, small enterprises benefit from what was going on on the campuses. The thesis was that small businessmen surely would benefit from the existing store of knowledge and there was a lot available in the universities at that time that simply hadn't been disseminated. I think John Isaacs had done an awful lot of work of use to the California fisheries that had not been disseminated. These businessmen would then benefit from the interaction of the County Agent. At the same time, with some additional feedback from the field, if one had a real active fellow out there, the researchers would be better able to identify and focus on those areas where businessmen and the small industries would receive a benefit from a perceived need. It was with this thought that the notion of County Agent or the equivalent was put forth. I think this sort of thing is the mechanism for escaping what Al has rhetorically categorized as a situation in which you have businesses unattractive to industry and you have research programs unattractive to industry. Active County Agent programs interacting with industry can provide a necessary feedback so that it is not unattractive to industry.

I think there's another potential pool of beneficiaries and, therefore, also benefactors to your programs. That pool lies in the various coastal municipalities. To some extent they differ from the small marine businessmen. The municipalities usually are not so under-capitalized as the small fisherman is. Further, they have a vested interest in preserving and also developing their shoreline resources and the industries of those resources with the eye to the future. As a result, they frequently are in a position to underwrite ocean-related projects that meld with their economic and aesthetic needs. Here, too, some sort of system which could communicate the kinds of information and expertise that are available and the needs that exist could contribute to making the Sea Grant engineering programs that impact municipalities both vigorous and effective.

There is another point that I'd like to bring up. There are two

mind sets that are common to most of us which can work against the growth and the development of the engineering programs, and one of these is the idea that business is a monolithic entity with a specific set of needs and interests. One tends to equate industry as just a group over there on the side. They all have the same desires, they have the same culture, they have the same personalities -- not so. General Motors is not General Electric, is not Lockheed, is not at all the same thing as Ralston-Purina or many of the other industries. These are very different animals. They have different characteristics, different personalities, different needs, and one must understand that, I think, in order to interact with them.

When I was with GM Santa Barbara operations, I had an experience with our own GM industry that brought this home very strongly. At that time, we were desperately trying to get marine products into General Motors. We thought that was the desireable thing to do, and I had decided all by myself that General Motors really ought to produce the marine conversion kits for engines. I thought it was a silly thing for us to have to go out and buy somebody else's product to put on our engines in order to put the things to sea. I went to talk to our carburetor people at Rochester Products in New York. One of the things that you have to do in marinizing a carburetor is to take off all the corrosive parts and put in chrome or brass or something like that. So I went to visit the chap and explained what we needed and he kept nodding his head, saying, oh, yeah, that's very easy to do, sure, we can do that. And when I finished, he noted that it would just be no problem at all. He could make all those product changes, hardly cost a nickel, and was pleased with the notion of getting some increased business. And then he said, "But how many of these carburetors are you talking about?" I was at that time a great optimist and I told him, just to get the bait up there, it could be as high as 10,000 or 20,000. He looked at me and he said, you know, I'm not going to rip up these lines for a day's production.

The point I'm driving toward here is that businesses do come in all sizes and shapes and it's necessary to interact with these businesses on their terms. It's necessary to understand what those terms are. Some very fine firms, Precision Instrument Makers, for instance, operate on a small annual gross, a quarter of a million dollars perhaps and they manage to make good profits and contribute to the ocean development. Other corporations have gross receipts that are more than a hundred thousand times that size and, obviously, their needs are vastly different from those of the smaller firms. The needs, indeed, the characters of the firms change with each order of magnitude of their business, and researchers who are searching for funding need to keep this in mind. Potential savings or profits that may sound mind-boggling to the average person, may not be

worth pursuing to the very large corporations. In all candor, if one does not count the portion of ocean-based funds involved in the petroleum industry, the total gross nautical product is not sufficiently large to interest General Motors. The corrolary to this idea is that many of our ideas ought to be directed toward solving relatively small problems. All engineers would rather be working on big, glorious and popular projects, like the underwater habitats or the deep diving submersibles or things like that. Who wouldn't? But the city commission or the mayor of a seashore community is more interested in funding a study of ocean currents that might lead to the development of structures that effectively stop beach erosion or improving his dock building technology. These are things that interest your likely constituents. Similarly, I think the engineer who can contribute to the fishing industry will find the fishing world beating a path to his door.

While I think it's overkill to label this kind of engineering sterile and unproductive by nature, and I've heard that said by academic folk, it probably is accurate to classify it as mundane or prosaic. Nonetheless, that's the kind of engineering that I think is needed and the kind that is likely to be sponsored. Now, using sponsorability as criterion for selecting research and development areas can sound, I realize, a little crass and self-abasing, but at the same time, I would urge that each of us remember that the original purpose of the Sea Grant Program was to forge a partnership between academia and industry, to develop the potential economic and social benefits of the sea, and as in any partnership, each side has to give a little. I think industry has to be willing to contribute to research type activities. On the other hand, the universities have to be willing to contribute to applied research, and those of us who dream of heavy industrial funding for ocean-related projects, I think, must tailor those projects to meeting real world, outside needs.

The real key to strengthening Sea Grant's programs for ocean-applied engineering, in my mind, lies in the word applied, and it's here that I think one should stress the future programs. And, with that, I'd like to close.

Mr. Savage: We have some ideas that have been put forward and now I'd like to throw the floor open to questions. There are two mikes in the center aisle there which can be activated. I think the front one requires pushing a button and perhaps the rear is the same, and I would ask you to use those so everybody can hear the questions, particularly the people in the front of the room. They get lost, as I recall, and so who would like to ask the first question of our panel?

Mr. Deerborn: Mr. Potter, I was bothered by what I thought were inconsistencies in what you just said. You pointed out the lack of funding or the low level of funding for the Sea Grant Program as compared to the Land Grant Program. Then you discussed the variety of marine industries, especially the small ones, which did not aggregate easily. That make me think of the variety of technical needs there as opposed to agriculture during the development of the Land Grant system.

It occurs to me that even the small, non-aggregated companies have technical needs of a sophistication which may not be easily handled by the marine advisory agent or the extension agent as originally developed in the Land Grant system. We follow through, saying we've developed a Sea Grant which is like Land Grant, but then compare it to the different levels of technologies which ought to be met. I didn't find in your discussion a solution to meeting problems that were not just fishery problems, but these other, very sophisticated problems. I was hoping you would help us out.

Mr. Potter: First, I'm sorry for inconsistencies.

I think the issue here is the kind of technology that a Sea Grant Program, at least in its original formulation, can pursue and transfer as distinct from the very sophisticated technologies of the small instrument business, for instance. Times may have changed, but several years ago, ten years ago, five years ago, the small instrument makers did have talent, usually one or two or three engineers who were very capable, and it was unlikely that something developed in the university was going to go into the small instrument makers' business. That is, you wouldn't decide

deliberately to go out and make a small instrument, and then try to get the small instrument maker to take it on. At that time, it was too specialized and too rare an occurrence for one to really be very concerned about it. I think our thesis at the time was a small instrument maker was doing pretty well by himself and didn't really need this sort of thing, wouldn't contribute his dollar to it.

On the other hand, the fisherman did have a problem. He really did have a problem, as did the coastal engineer; they had real problems and almost no resources. One of the things considered in our early thinking about the subject has not come about, i.e., that the localities would put up much of the money. The local university that was to be the recipient of the grant could also put up the money. That is, it simply had to be from outside. It wasn't labelled industry money. It had to be outside, non-federal money, and I think our concept at the time was that the locality should put it up, the local university should. It was the local economy that was going to profit and we didn't really visualize the necessity for going out and pounding on industry's door to get money. Hence, in our view, there was a real separation between the needs of fishermen, aquaculture types, small scale coastal engineering, and sophisticated, though small, industries like the instrument makers.

Mr. Marshall: There's a gap troubling me here that comes to mind as I listened to Dr. Potter. That is, the role of Sea Grant in research that would relate to the various industries which are small, but in aggregate have problems. Then there are the industries with tremendous muscle that Sea Grant obviously cannot serve in the same sense. They have all the power in the world financially and otherwise to employ their own manpower to tackle their problems, to set up their own laboratories and what-have-you, but they have to have a manpower source to draw upon. They can hire them, but they don't educate them. They may educate them on the job to some extent, but somehow this manpower capability has to be generated through the educational process. I think Dr. Keil was seeking to address that, and I think it's a little lacking in the portrayal of the role of Sea Grant as you, Dr. Potter, were expressing it.

Dr. Potter: Well, now, is that a question, Nelson?

Mr. Marshall: It was my statement. I regard it as at least a

provocative statement that requires an answer.

Dr. Potter: There are several different issues, but I'll take one of them, the training of engineers and, in this specific case, the training of engineers for an ocean program. I was a user of that output for a good many years and I had pretty well defined ideas as to what I wanted out of an educational institution and I didn't want an ocean engineer. I wanted a good electrical, a good mechanical, a good chemical; whatever it was, I wanted a good engineer. I wanted him to understand the environment that I had to work in, and that one could easily have been done in a Master's program on fishing tackle for somebody, but what I, as the industrial user of your product, wanted was a good engineer. The transfer to ocean engineering can be made in a university. It can be made in the industry. I think big industry is quite prepared to support that sort of thing and General Motors does. In fact, we support educational institutions and the magnitude of our support is about the same as the whole Sea Grant Program, but we do that for our self interests in educating engineers for our business and we're perfectly happy to do that. But that's not what the Sea Grant Program was sold as. The time has come to change the charter, at least, that's my notion. Education is not separate from the Sea Grant Program, but calling out Sea Grant was for the economic benefit of the total nation and I had education really as a different subject.

Mr. Wheaton: I would like to agree with that, Dave, from my experience from Lockheed to a similar standpoint. I'd like to get good fundamental engineers and then give them, either in industry or as a graduate program, training in the environment of the ocean. That might come through efforts within Sea Grant, but I do not think that Sea Grant was set up as a basic training for the quantity of engineers we need.

Mr. Savage: Another question?

Dr. Keil: I appreciate the statements which have been made by Dave Potter and Elmer Wheaton, but I want to re-emphasize what I said earlier, that the universities are struggling to educate engineers. You remember I said earlier in my paper that the universities have been educating engineering scientists and with that education went the motivation not to go into engineering, but to go into the research labs. Not to go into the doing of engineering, into doing innovation and

developing new approaches, my plea here was to industry to help the academic environment to strengthen the engineering side of the engineering education as separate from the education in fundamentals. If they are just educated in fundamentals, they may never show up at your front door.

Mr. Savage: Yes, sir?

Mr. Doelling: I'd like to address the issue that's been raised several times about whether or not Sea Grant can make contributions to large corporations or, indeed, whether Sea Grant ought to receive contributions from large corporations lest we become tainted. I'll have to agree with Mr. Wheaton that two or three years ago when I first received a check from the Gulf Contributions Committee, which was well known for its associations with Mr. Nixon, I felt some trepidation and fear. Their interest was not maligned, however. It was simply their way of supporting our MIT Marine Industry Collegium. I'd like to talk about that particular instance because I think it's a good case in point.

Perhaps it's somewhat audacious to suggest that a relatively small institution can make an impact on the oil industry, but some work done in the Ocean Engineering Department at MIT, with respect to vibration response of offshore structures and how damage might be detected through the characteristics of the vibration, was presented to an industry group in a Collegium meeting. As a result we received from the Gulf Oil Company proprietary data on vibration response of one of their structures. They thought the vibration techniques, the analysis techniques, the work that we had done was unique and different and we're subjecting their data to that kind of analysis. I suggest that was good for Gulf as well as being good for us. I'd like to stress the importance about being good for us in developing engineers. That further led to participation by Professor Vandiver in some very proprietary experiments offshore on newer structures. Again, while the specifics were proprietary, the problems and the issues were made known to us through that experience, and I would add Gulf has been very active in advising on what they perceive as appropriate directions for ocean engineering research; it's something that our faculty has been extremely responsive to. So I guess point one is that I feel in our modest way, we can make contributions to this monolithic offshore industry and to the public safety associated with that.

We've talked a lot about technology transfer. Graduates are probably the most important mechanism we have, but we also try to contribute some other ways.

We tend, I think, to underestimate the extreme importance of technology transfer from industry -- particularly from large corporations, to our programs. Interaction with industries provided one of the major benefits to the MIT Sea Grant Program. Our Collegiums provide a mechanism whereby your people address problems to which our professors are extremely responsive. The professors value these meetings as a different kind of peer review that's important to them.

Finally, I'd like to suggest a novel thought. I think there's always a little bit of trepidation on the part of industry that when academia says cooperation, we merely have dollars in mind. Perhaps some transfer of people from the industry to our campuses for a year or so at a time would be extremely helpful to us and might also be extremely beneficial to you. I note in that regard that in one of our longer-standing research programs at MIT, i.e., underwater welding, which is run by Professor Masubuchi, the Japanese, very wisely in my mind, provide us with post-doctoral students at their expense and they learn a great deal. I think perhaps U. S. industry should look to Japanese industry for ways of accomplishing technology transfer. Thank you.

Mr. Wheaton: I can agree with many of the items you said. In the case of Lockheed, during the summertime we always had professors out of the various engineering schools working in the plant to help this transfer. We also had arrangements whereby our people would go and work at a university for a period of time. Also, we have placed contracts with universities for doing certain work.

I think the main thing I'm trying to keep clear is the difference between Sea Grant and the relationship with industry to the universities. I'm not going to try to stretch this out in any fashion, but it goes back again to the problem that industry has had with the government. I can just see Senator Proxmire getting up and saying, look, the money we're putting into Sea Grant is being misused because big industry is taking advantage of it and what are they getting? A free ride! And it's that sort of problem that I think big industry worries about. I'm perfectly in agreement with the rest of the efforts of education

like that, but let's keep Sea Grant clean in the way it was set up, as Dave Potter and I have both tried to point out.

Mr. Savage: Any other questions?

Mr. Gray: I have a comment. When Dr. Keil endorsed Dick Frank's suggestion for people participating in the federal apparatus and the people who gain tenure necessarily need a break. I have an acquaintance who just achieved tenure after three years and one of his colleagues sent him a card congratulating him on his retirement.

The question I have for Dr. Keil relates to his feeling that private consulting services can be represented as advisory work and perhaps that benefits accrue to the advisory program, for example, at MIT through the private consulting apparatus. I'd be curious if you would tell me how you think, as a former Sea Grant director at MIT, Sea Grant would perceive this?

Dr. Keil: What I was referring to is the following pattern: If a faculty member is a consultant in an ocean-related enterprise, he would certainly pick up ideas which could be pursued. Quite frequently, he is able to obtain some industrial support which could then be meshed with a Sea Grant project and become a major project or a medium-sized project or whatever. It is in that sense that it leads to the matching funding which must be developed. Does that answer the question?

Mr. Gray: Yes.

Mr. Horn: I have to respond or ask Elmer to comment on his question relative to the issue of patents. Certainly, it's recognized that large industry probably is not much bothered by the existence, or nonexistence, of patents; proprietary information is far more meaningful. However, I think in the case of small industry, particularly when we're getting into a development area, they're very, very sensitive to their subject. We have a recent case in which we just concluded a patent license agreement with Wharf Forge and Welding in Boston to go into manufacture of a new streamlined trawl door for fishing boats. To take the project on, they felt they had to have a patent or a license. With this agreement they went on to contribute roughly about $8,000 and matching services and kind services; ideal from a Sea Grant standpoint. I think that as Dr. Keil pointed out, the inability to make any pre-commitment inhibits Sea Grant from taking advantage

of opportunities to sponsor developments for small industries.

Mr. Wheaton: Dean, I don't think there's any question about that. Each department in our government has sort of different patent policies that have developed, and the Department of Commerce has some of the poorest as industry sees it. The problem that you have here is quite broad and there has been discussion of trying to fix it up, but it never has been. The only comment I could make is that he ought to have contacted you as the university, paid a little bit more money, and handled it without Sea Grant being involved.

Mr. Horn: Well, except that this came about as a secondary benefit, having a Master's thesis on the concept, then wanting to carry it into a full-scale, hardware proof.

Mr. Wheaton: Well, I know, but I'm just telling you, being practical, about how you would look at it.

Mr. Horn: I have one other comment, if I may, and that is, you've talked about industry's participation with Sea Grant, the problem of the money perhaps being tainted, the inability of small industries to contribute and support Sea Grant in some of the activities in which they are vitally interested.

It hasn't been mentioned here, but it came out of a discussion about a week and a half or two weeks ago in a conference with ocean engineering industries, and that is, how about a tax incentive? The federal government provides tax incentives to industry at all times and how about some sort of an arrangement whereby tax incentives, particularly from small industries, could be allowable for contributions toward university development?

Mr. Savage: Anybody on the panel want to comment on that proposal?

Mr. Potter: I think there's a general issue of incentivizing industry to do things that are innovative and try to catch up to, or at least stay even with, our competition from Europe and from Japan. Tax incentives are a very obvious way to do it. Now, you have made it particular with respect to the sea programs and to the interaction with the universities. I think that may be a way to start. I would certainly support, and I think most of industry would support, any relaxation in tax laws or any modification in tax laws which made

it logical to do things that are innovative instead of putting money in the bank. I can only agree with you and I think, however, you have touched on a very specific illustration of a general problem in this country.

Dr. Isaacs: Talking about tainted money sort of reminded me of the story of Mark Twain when a friend of his talking about a rich man said that his money's tainted, and Mark Twain says the only thing wrong with his money is it taint mine and it taint yours.

There has been some discussion about the government taking over big, risky projects, and I was really wondering how you turn the government off once it starts such a thing? I agree that (INDISCERNIBLE) got turned off, but successful or unsuccessful or unnecessary demonstrations I don't understand. I sometimes get a Rip Van Winkle syndrome listening to some of the discussion, I decide that's where I came in a long time ago because one of my first memories was of oil shale demonstration plants which seem to have gone on every decade. New ones apparently with no information running from one decade to another. In 1885, when Krakatoa blew up, the reason people knew more about this pressure wave as it went around the world was that there were gas filters for coal gassification, gas that bounced up and down and made the register of the microbarographic pressure, not because the scientists had any microbarograph. And so did heaters. They were all over Los Angeles at the turn of the century for heating houses and heating water, particularly. All these things the government now proposes to have in demonstration. Well, it may be the government isn't big enough, and I suppose maybe that's the reason we want to do this sort of thing.

I was just contemplating that the total value of the world's fisheries is now as much as a fortnight's expenditure of the U. S. government. I think we ought to cut that proportion down a little bit, get it down to a week or a few days' expenditure of the U. S. government, and I think was can help do that by closing demonstrations.

Dr. Potter: Let me get a crack at that. I want to tell you first, John and I have been associated for many, many years and I know it's been rumored that he was a co-colleague of Mark Twain's. That's just not true.

We've discussed this in the past, so that's why I asked

to be able to pick up on the theme. The thing that we've always said to ourselves is that the government should invest the money because the risk is too large and no single industry is capable of mounting that kind of effort, whatever it may be. I sure did believe that the first time around and I guess it was the second time around I began to get a little bit disenchanted with the notion, and by now, I've come to a different view. That was where I used the fact that there are industries that are too small, too fractured, too fragmented and those are the ones that you really have to worry about. The big ones will take risks that they shouldn't take. That's why they go bankrupt. It's been my observation in the business world that given four or five big industries all waiting, poised on making an investment, one of them will go too early. It just turns out that way. One of them is willing to risk more than he should and the record is fairly clear on that. I surely agree with John that a lot of these demonstrations will be undertaken as soon as industry even smells a carrot out in front, and once they smell it, somebody is going to go. The four that hang back are hanging back just nervous as the dickens because they may be very right and save the shareholders a lot of money; on the other hand, if they're wrong, they're dead. So the carrot for industry to go ahead is large and ordinarily that will happen.

Once again, I think that the area in which Sea Grant can offer the most is for the small, fragmented industries that just plain don't have any capital. There is no capital.

Dr. Isaacs: Dave, on a more serious vein, I think one of the problems that faces Sea Grant is on the small sorts of demonstrations, like aquaculture, where how long do they carry them on, at what point are they really viable, and industry doesn't take them over because they're doing it, or are they not viable? And that's a very difficult problem, I think, for Sea Grant in general. That's a bit more serious.

Mr. Wheaton: Dave, I'd like to make a comment on that, also. On the quote that I gave from the energy group about the risk. The real risk is this regulatory legislation and that aspect. It's not the technical risk and the companies are well enough financially as Dave said, there's no question on that.

Mr. Savage: Yes, Arthur?

Mr. Alexiou: You mentioned earlier that in the beginning of Sea Grant, a lot of hard thought was given to the question of what contribution Sea Grant could make in ocean engineering business and it was recognized at the time that there were these big oil companies with great resources that were endowed enough to the point where they could handle all their problems and do whatever research was necessary, set up their laboratories and so forth; and Sea Grant was not going to make the impact with its few hundred thousand dollars that it spent in engineering in that business.

At the same time, it was recognized that the level of the kind of research and the knowledge in the universities and what was being taught in ocean engineering, even in the graduate schools, was far behind the level of technology that had already been developed and was proceeding at a very rapid rate in industry. The question was, how does that information get transferred back, on the two-way street of technology transfer, into the universities to bring them up to do so that they're working on problems a little bit closer to the frontier, if they're not pushing the frontier themselves? Well, over those ten years, we've been following that original philosophy that we stay sort of clear of those big industry activities in the ocean. It's been my observation, however, that this gap has been increasing over the ten years between what's happening in industry in terms of technology development and what the universities are capable of doing and I wonder if we have to re-think that.

Mr. Potter: Yes, you're right, that was a worry that there was a gap and I suspect you're right that it's even increased and I would second the motion of re-thinking it. One's memory of a decade ago is always sort of glowing and you remember how smart you were and all the wise decisions, but you forget about the ones that didn't turn out right. I think you're right to question the whole proposition. We didn't adequately worry about this increasing gap between the educators and the practice in the field. I guess my silver cloud with the pink lining gets a little bit grey as to that area. Yes, that is something to worry about. You bring it up as an area in ocean engineering, but let me only say that it is wide-spread. It is not just ocean engineering, but it's in some of the other active frontiers of engineering that, the educational process having failed to keep up, one worries about the practice running ahead of education. I would put in one other thing. Art reminded me of some of our

earlier discussions in which we recognized one other thing about Sea Grant that is still present. It is, I think, a vital element, a national experiment in how one handles a national concern. The national concern, although it wasn't followed up, was how to get into the ocean, and the Sea Grant Program was a mechanism for doing it. Several of us worried about the precedent-setting nature of Sea Grant and how that someday might be transferred to other areas where the U. S. needed help of a technological variety, and we were very concerned about how one interacts with the universities. Not just because of Sea Grant, not just because of the ocean business, but because the nation had not and still has not come upon an administrative solution for solving these national problems.

Mr. Wenk: Thanks very much. Edward Wenk from the University of Washington. I'm a little embarassed to address a question to a group of old hands, experts and friends of mine like this, but I'm going to do it anyway.

It seems to me that the theme of the discussion so far has been pretty much along the line, how do we get our act together? And if you pursue that metaphor a little bit further, you begin to ask the question, act toward what scenario? And it's at that point that as an old, dumb engineer myself, I begin to think about the way of approaching some of these questions in terms of, what is it we really want to do? What are the problems to be solved? We certainly don't have such a vacuum of imagination that we're scratching for problems, and I'm going to be explicit in a second, but my basic point here is that engineering is not a science. Science can pursue the frontiers of the unknown in an abstract way simply to build up the reservoir of knowledge. Engineering has a purpose and it adds to the complexity of the intellectual life of the engineer of having to build a bridge between knowledge production at the science end and the knowledge consumption at the client end.

Now, what are some of these problems that we ought to be wrestling with? Let me just recite two or three for you that strike me as being of great portent to the country and to many of us as individuals. Number one, maritime safety. It is a scandal that we continue to have something on the order of 7,000 major casualties a year among ships over 300 tons in a population of about 30,000 ships worldwide. Imagine how satisfied we'd be if the rate of aircraft accidents were that high, or even automobile accidents, and yet we do not

seem to be developing the technology necessary to improve that safety, whether it's the paucity of the imagination of the engineer, or whether it's the lack of incentives in the industry, and that's broadly, not just the shipowners and shipbuilders, but the insurance people, is the question. The fact of the matter is that we end up tackling the wrong question. We end up with the question, should we keep the tankers out or let them in? That's not the right question. What we're after in maritime safety is how to maximize the use of our waterways and minimize risk. Engineering is the way to have your cake and eat it too, and it is, to me, a travesty that federal government today is spending only about $1.5 million a year on maritime safety. And industry is spending very little. The problem isn't just more Mickey Mouse hardware. The problem gets to the man/machine interaction and a large number of casualties are human error. I've made a study of casualties of crab boats on the West Coast. It turns out the casualty rate among those is the highest of any class of ships and the lives lost is the greatest. The cause of accidents to the extent of 70 percent is human error. But human error, ignorance, blunder and mischief can be handled by engineers, too. You can make things relatively foolproof, and it's not being done.

The institution of the Marine Traffic Control System in Puget Sound has been of great benefit. It turns out that it is violated something on the order of two or three times a day. We do not know what the portent is of those violations in terms of how serious they might be. We have no data on near-misses, and yet that's the way the whole aircraft industry begins to decide where it puts its attention.

The whole field of marine traffic safety, it seems to me, is a disaster waiting to happen, and it's really already happening. Therefore, when we talk in the abstract about how to get organized, it seems to me we have to ask organized for what? This is one example.

Let me give you a second one. Those of us in the maritime business occasionally sail our own ships and we are unmindful of the multi-billion dollar a year recreational boating industry in this country. Any of you who have bought any of these boats recognize how poorly engineered they are. You find, among other things, that the question of safety only lies in terms of buoyancy and nothing else having to do with control

of the ship. Also, you find that from the point of view of components, there is very little consideration given to maintainability, the whole question of durability, and finally, how do you provide a ship that idiots can run? In very few states, if any, is there any licensing required to demonstrate competence. We wouldn't think of letting people drive on the highway today without such licensing. The minute you raise a question of this sort, there is a large, loud, violent popular outcry against licensing, and it doesn't happen. So, for the time being, at least, we're going to have to live with people who are interested in how many miles they get to a quart of beer rather than a gallon of gas who are running an awful lot of these boats, and the question of maritime safety is at stake.

The third and last point with regard to this area, and I could cite you other little vignettes in every one of these fields, is that Boeing has just been running an experiment with a hydrofoil ferry out in Puget Sound. One side says it's a success, one side says it's a failure. The fact of the matter is that nobody sat down and thought about a transportation system, and just throwing a ferry out in Puget Sound that runs a little bit faster on some days is not going to really meet the problem. You visit a city like Sydney, Australia, and you find ferries bringing commuters in at the rate of about one ferry per minute during the busy hours. Here's a city that hasn't fully solved its problem, but it's been doing this for decades. It strikes me that from the point of view of traffic congestion, there are a lot of our coastal cities that have opportunities for water transportation where a few experiments have been tried. Just like the one there, I know there was a hydrofoil that was tried in Long Island Sound. There have been other experiments, but nobody's really looked at the water traffic system from the point of view of how it could help and how this technology could be integrated.

My last question is, how do you approach this from the point of view of what is the problem you're trying to solve? This question, to me, of partnership between government and industry is not a philosophical question. It is an absolute necessity and as I had occasion to mention previously, in my view, the United States has a long history of that partnership no matter how ideologies get polarized. The fact of the matter is we're a free enterprise society and we're going to survive that way. We bring government in because we think we want to protect against excesses, and maybe

we've brought in too much in the way of regulation. The main point is that I don't think the issue is only this question of the partnership. What are we really going to do?

Mr. Savage: Dr. Keil would like to have about four or five minutes to sum up his thoughts, having listened to his colleagues, and then that will be the end of this session.

Dr. Keil: I will try to make it brief. First, I am extremely happy with the discussion which we had. Certainly there were disagreements, but, in general, there's a positive note about the disagreements. There are different ways of accomplishing what we are all striving for. I want to strongly endorse what Elmer said that beyond the questions which I had raised, there is the question, is it really national policy to advance marine technology with the objective of expanding the use of the oceans and their resources? I think that we see the developments with offshore oil industries and many other exciting operations in ocean industries struggling along. What is really hindering these developments, and what is hindering the development of the general ocean engineering efforts in the long term, is the lack of a stated federal policy that we want to develop the resources of the oceans. Now, we got the 200-mile limit with the understanding that it was for economic benefits, but then we have only one conditional commitment for protection of the environment, and we don't say we have a parallel national policy for the definite development of the use of that resource, and we need that. We need that statement out of Congress and out of the executive office.

I also support the statement Elmer made that somehow we need a capable federal organization that can develop and support argument for legislation and regulations from a scientific and technical standpoint. Until we do that, we will have continuous difficulties in developing the nation's oceanic resources.

I have too many different notes here, but I would like to get back to my key statement. I deeply appreciate the comment which Tom made on the need for facilities. This was a point which I hadn't raised, but that is a real important point and somehow in the general discussion of the national scene, not just with respect to Sea Grant, there is a need for development of facilities. If we don't have facilities, we become paper tigers. That means we do paper studies and that

is not really moving us forward. We need experiments to guide our theories, to check out the theories, their validity, and they would certainly be helpful for the development of the industries.

I also endorse strongly the statement which both Elmer and Dave made about the unbelievably large impact of regulations on the operation of our industry. I was chairing the session on offshore oil and gas at a recent NACOA meeting that was concerned with offshore oil and gas where a representative of the oil industry made the following statement: If we just now discovered offshore oil on our continental shelf and we would try to develop an offshore industry, we would not be capable of moving into a leading position in the United States. The world would overtake us and we would not be the international leaders in that area. That's a very sad statement to me and I believe it is true. There was a statement made that we can't have any impact on the oil industry, that it's too large an industry. There is one example on how we could make an impact, and there are others, but this one which I want to mention is really one of information, and I refer here to the Georges Bank study which a colleague of mine did some six years ago which described what could happen if we would find oil and gas on Georges Bank. Naturally, it had to be a kind of a (INDISCERNIBLE) study. You didn't quite know where it was, how much it was, but what would be the impact with respect to pollution, the spreading of the oil, in which direction would it come, would it come to the beaches, would it go out into the deep ocean at different parts of the year and so on and so on. The interesting thing about that study was that it didn't advocate anything. It was a factual study and, because of that, it became a document which was used by the Regional Council. That means by the state government. It was used by the Sierra Club. It was used by the oil industry and provided a common base for the discussions and that is, I think, a valuable contribution one can make to an industry such as the oil industry.

Now, last but not least, I want to endorse the statement which the fellow made at the end on relevant engineering. Relevant engineering means just sufficiently sophisticated to serve the purpose, and much of the Sea Grant engineering has been described as mundane, down-to-earth, simple, simplistic. If it serves the purpose, that is just the right kind of engineering, and what we have to be aware of is not to get carried away, of going to such sophistication for sophistication's sake.

SESSION IV

TOWARD OCEAN POLICY

Guest Speaker: Dr. Edward Wenk, Jr.
Director, Program in Social
Management of Technology
University of Washington

Panel: A. H. Keil
Professor of Ocean Engineering and
Ford Professor of Engineering
Massachusetts Institute of Technology

Virgil J. Norton
Chairman, Department of Agricultural
and Resource Economics
University of Maryland

John H. Steele
Director
Woods Hole Oceanographic Institution

Moderator: Donald F. Squires
Director, Sea Grant College Program
SUNY/Cornell

TOWARD OCEAN POLICY

EDWARD WENK, JR.

INTRODUCTION

History has a perplexing quality of repeating itself. It is happening today in the field of marine policy. Indeed, one of the most conspicuous features of American marine activities over the last three decades has been the need to redefine goals and to regain political viability. Notwithstanding the hopes, the expectations and the rhetoric that attended the creation of NOAA in 1971, there are widespread perceptions today that we entertain another period of decline. And so we witness the same old pattern of frustration, concern, hand wringing over neglect, and the trotting out of retired proposals for reform.

This paper is not directed at yet one more recipe, prepared by another cook in the marine kitchen. Rather, it will be an attempt to paint the backdrop of considerations which heavily influence both the generation of marine policy and the prospects of effective implementation. While I should warn you that these subtle but influential constraints on policy-making may contribute to dismay, I will not duck the responsibility as speaker of attempting to point out where lie some of the brighter spots on the policy horizon.

RECENT HISTORY OF MARINE POLICY INITIATIVE

It has always been a paradox that our nation, settled by marine explorers, deriving its early economic vitality from its maritime activities, and depending continuously upon the oceans, both as a barrier to military aggression and as a highway of trade and cultural connections with the rest of the world, should prove so indifferent to the oceans and the need for sustained national policy. A historical review of high level attention to the oceans, at least as measured by federal investments, reveals peaks of activity only in times of war -- in 1863, in 1918, and again during World War II. Each peak was followed by a sharp decline, and it was in that state of concern soon after World War II that the National Academy of Sciences undertook a study of the feeble level of oceanographic research effort and hatched its then second report on the problem in 1949. Nothing happened.

In 1956, the Academy was asked to restart engines. This time its report, delivered in 1959, proved a fulcrum for new energies of policy attention. It is of some import that the sensitivity to a mismatch between national needs and national capabilities was

far greater in the Congress than in the Executive Branch.

President Kennedy's budgetary add-on in 1961 signalled new recognition by a president of the relationship of the oceans to our national interests. There followed strong support for development of policy components through the Interagency Committee on Oceanography, operating under the congenial encouragement and even advocacy of the Federal Council for Science and Technology. Yet, by 1963 that rocket had fizzled out and the Congress again took up its cudgels.

Their response was the landmark legislation of 1966, the Marine Sciences and Engineering Development Act, PL 89-454.

With prompt implementation by President Johnson, the marine community now generally acknowledges a golden age of marine policy. From 1966 to 1970, some 65 statements on features of marine policy were issued by the President or the Vice President, including a treasured focus of attention in the State of the Union Message of January 1968.

During this interval, budgets for civilian marine affairs sharply increased and the nation's oceanographic research capability, that began to be strengthened in 1961, reached a unique and unprecedented level of both strength and quality.

A different set of concerns then occupied center stage: How to relate the oceans to national affairs, and how to focus energies of 17 agencies on a coordinated set of goals and programs. The congressionally generated 1966 act created both the mandate to the President and apparatus to assist. An advisory commission was charged with another task.

The problem attacked was one of government structure. In the belief that "the medium is the message" there was widespread support for consolidating marine functions that had been spread among a wide range of federal agencies into one more powerful and more visible independent agency that might be able to fend more successfully and more durably for both funds and policy level attention than had been true in the past. As you know so well, this was at the heart of recommendations by the Stratton Commission. President Nixon, however, initially rejected these propositions, and again primarily under pressure from the Congress, NOAA was created. It did not, however, incorporate the full recommendations of the Stratton Commission, although as I shall point out later, that shortfall in structure may not be the primary reason for NOAA being unable to sustain the upward ratcheting of policy level attention that was expected.

Another event occurred shortly after NOAA was created. The Marine Sciences Council that had been established by the 1966 Act to

advise and assist the President with implementation, was itself disestablished. It is widely understood that the reason for its demise lay in the roots of the legislation itself which had created the Council as a temporary body as a condition for resolving the House-Senate stalemate while the legislation was being generated. There were other reasons as well. Vice President Agnew did not bring to the post of chairmanship the same talents as his predecessor, Vice President Humphrey. Moreover, the Congress perceived that weakening and withdrew its support for the Council. But the final nail in the coffin was driven by NOAA itself in its recommendations to President Nixon that the council would be unnecessary now that there was a major new marine agency in the federal constellation.

During every one of these cycles of decline, including the one that is perceived today, the oceans were growing in importance to the nation. Indeed, they have been growing in relation to all members of the world community. Social needs to which the oceans contribute also continue to be sharply drawn, that is, in relation to national security, to transportation, to energy and mineral resources, food resources, coastal industries, recreation, and waste disposal.

Nevertheless, as we outline the situation today, clarity and coherence in policy is lacking. Neither political power nor political will supports policy development. Financial support is uneven. And finally, in the absence of high level leadership and coordination, endemic bureaucratic diseases within government lead to more fragmentation, to the adoption of low profile, low risk, and low energy programs. So the situation is one where the nation's stake in the sea is itself threatened.

DIAGNOSIS OF THE PROBLEM

This shortfall, incidentally, has been widely perceived. Organizations such as NOAA and NACOA are undertaking studies in relation to the problem. So is The Cousteau Society. So are leading journalists in the marine field. So are a few interested members of Congress. The problem, incidentally, is also perceived in the White House.

All too often, recital of the recurring disease of apathy at high levels is accompanied by adherence to earlier diagnoses, that the marine field lacks a strong enough lobby to compete in the pressure cooker of Washington. We still smile at the phrase, "the fish don't vote." Inside the government there has been growing disarray, lack of initiative, and the absence of what has been in the past the magic of presidential messages of interest to get the Executive Branch act together. So a familiar battery of prescriptions are advocated, beginning with the classical notion of federal reorganization. Many say we need a

new independent agency for the oceans, or at the very least, a conspicuous ocean component in a new federal department. Others who take note of the high level of effectiveness of the Marine Sciences Council under Vice President Hubert Humphrey, urge its reactivation.

In studying broader questions of the adequacy of government policies and practices to steer science and technology generally, there is a growing belief in my own mind that to prime the marine policy pump, putting old wine in new bottles will not have the hoped-for intoxicating effect.

SOCIAL, POLITICAL AND ECONOMIC BACKGROUND TO POLICY

Almost all technology related policies have been developed within the narrow boundaries of the technology involved, such as air transportation or weapons systems. Moreover, they have been pushed by advocates whose interest in policy outcomes must be admitted as parochial. While this approach proved rather effective in the past, we are finding in case after case that the technology based policies are falling short in social performance and only recently have we begun to ask why. Are there indeed some overarching considerations that define the policy theatre and which may suffer pathologies that infect all policies and their development? If so, these circumstances will also condition the design and performance of marine policy. Our first assignment therefore is to sketch the cultural, social, economic, legal, political and technological setting which today confronts the government, private institutions and the citizens.

These factors which influence policy include:

1) The general mood of the country.

2) The crises which pump policy generation.

3) The focus and political energies of advocacy, i.e., the lobby.

4) The policy-making style of Congress, the President and interest groups.

5) The governmental capability for policy design.

As to the mood of the country, we have to recognize a sharp turnaround from the uncritical support of science and technology in the 1950s and 1960s to first a ho-hum boredom and now even hostility to the role of technology in our society because of some of the social effects. Technology has increased complexity; it has forced interdependence; it has required the acquisition of unfamiliar technical skills and created information overloads. At the same time, technology has increased in importance as an

element of government policy-making at the same time that the attitude with regard to government itself has deteriorated with not only alienation and cynicism, but now a mindless rush toward proposition 13.

As to the crisis setting, a number of topics instantly come to mind as occupying newspaper headlines--inflation, unemployment, energy policy, arms control, prospects of water shortages, a wide range of technological threats to survival that include, among other things, nuclear terror.

At the same time, we find that the political scientist's description of our form of government as a pressure group society takes on even more muscular form. Every institution and institutional group appears to be grinding its axe more energetically and in far more sophisticated fashion than ever before, including public interest groups. We thus suffer from institutional tribalism and a litigious social environment. We seem to have wall-to-wall elbows.

When we come to the question of policy-making style, we find that today the politics of an issue occupy attention of the decision-maker sometimes far more than the substance. The high visibility of political acts on television screens pumps that unfortunate development even faster.

In the perception that far stronger capabilities are necessary at high levels of government to facilitate technology based decisions, new capabilities were created in 1972 in the Congress with OTA, and in 1976 in the President's office with the Office of Science and Technology Policy. Neither, however, has developed glowing track records of performance. In the case of OTA, an entire new reform in style is being undertaken with great hopes in the new Director, Dr. Russell Peterson. OSTP still seems to ignore the charge imposed upon it by the organic act that they were to function as a policy planning unit for the President in a far different mode than their precursor, OST.

On the topic of capabilities for policy design, we find that with the demise of the Marine Sciences Council, no similar policy planning group exists either in NOAA or in the Executive Office of the President. What is even worse, what thin policy planning capabilities for the oceans exist in the Executive Branch at all, have been diverted for several years now to the Law of the Sea.

In my view, that focus of attention has two serious consequences. First of all, distraction of that policy energy has left untended the necessary connections between ocean capabilities and social needs across the board. But secondly, the substance of the Law of the Sea, as I see it, will in the long run backfire to the detriment of this country and in fact of the less developed

countries. Yet, the engines in the bureaucracy which are driving so hard for resolution of a treaty, cannot find a single document to defend our policy positions on the basis of rational analysis that takes into consideration the 10 and 20 year time frame during which the treaty would be implemented.

NEGLECT OF THE FUTURE

Indeed, we find one major defect in policy-making at all levels is an unfortunate concentration of attention on the short run, with almost complete neglect of the long. Unfortunately, the advocates of a balanced consideration between the short and the long term have either been long-range planners whose professional status in our society has never reached a level of widespread credibility, or they have been idealogues who talk of future generations in the abstract. What has been forgotten is a fundamental characteristic of public policy itself.

By its nature, policy is a bridge between the present and the future. The reason is very simple. When you consider the various steps between problem identification, policy design considering alternatives, negotiation and decision, then implementation by steps of authorization and appropriation, and finally, action to fulfill policy goals, we find a time interval stretching all the way from five to fifteen years. What then happens is that the circumstances existing at the time the policy was generated, have now, in a technological culture, changed. The policy no longer hits its target.

Those of you who hunt ducks know full well the necessity for "lead." As a hunter, if you aim at a duck, you are sure to miss. You always aim at where you think the duck will be when the shot arrives. That notion of lead, of looking ahead at the dynamic nature of our society, and of technology itself, is missing. The outlook is very much cast at the present, if not in the past.

In my view, that same situation surrounds the advocates of federal reorganization for the oceans or recreation of the Marine Sciences Council. Circumstances which condition policy design and performance are very different today than they were twenty, ten, or even five years ago and they are sure to be different five years hence. Thus, if the marine field is to be re-energized, vital steps are necessary to reform cardinal features of a democratic system to face the future on a far more sophisticated basis than simply working within the narrow boundaries of marine policy.

A NEW CONTEXT FOR MARINE POLICY

It is not enough to report that a more holistic and unparochial approach, future oriented, is necessary to advance the marine

field. Special attention is also needed to two features which distinguish contemporary marine activities and opportunities from those in the past.

First, there is now a recognized interconnectedness among policy domains, so that marine policy cannot be developed in isolation from such key areas as foreign policy, energy policy, policy for economic growth and for protection of the environment. The oceans and these activities much more clearly become means toward social ends rather than ends in themselves. Thus, the potential of the oceans to contribute to society as a whole has to be thought of less and less as isolated and promoted as an entity along with the others which distinguish departments of government. These departments and independent agencies have historically been created in relation to an identifiable social goal, and that practice continues today. Thus, the organization of government has been and will continue to be very different from the management considerations of industry that are primarily driven by economy and efficiency.

Secondly, U. S. domestic policies can no longer be generated for a field as geographically ubiquitous as the oceans, without consideration of global dimensions. Thus, the springboard for development of any national policies for the oceans will have to be a deeper and richer consideration of a set of global principles that should form the basis for the development of domestic policies by every maritime nation.

The Law of the Sea conspicuously fails to meet this need. It caters far more to nationalistic ambitions than it does to common concerns. And yet, as we look ahead for the next two decades, we almost universally agree that either we find more and superior means for international accord, or we will fail as a society altogether.

Let me assure this group, that notwithstanding the high minded idealism which such principles and policy recommendations will represent, behind them must lie some tough minded and explicit propositions on the basis of which a turn-around in outlook can occur.

There is very likely to be an announcement from the White House of an entirely new statement of policy for the U. S. space effort. It is not out of the question that this could well be followed by a similar policy statement on the oceans.

In my mind, if such a policy statement incorporated the essential ingredients of contributing to that list of public concerns that were outlined earlier, you would find a new level and durability of support for the oceans that I am not at all sure can be guaranteed by any of the current measures that are underway at the present time to reorganize.

That proposition has always been admired as a new broom sweeping clean, or a technique of purifying the bureaucratic blood. But I believe experience has taught us with the creation of NOAA, and more recently with the creation of a Department of Energy and its unfulfilled expectations, that playing musical boxes with federal organizations has only a marginal probability of meeting our contemporary problems. What is at stake is an entirely new approach to the generation of policy; an approach which considers more intimately than ever before how to make the citizen feel a part of government, how to focus on the important issues and not simply the urgent, how to embed a balance between short-run and long-term considerations.

THE MARINE SCIENCES COUNCIL REVISITED

If earlier remarks suggest that your speaker as an observer of the political scene, is not wildly enthusiastic about the prospects of federal reorganization solving the problem, then you have heard correctly. No matter what mix of agencies one might now try to re-consolidate, there would still be left a large number of legitimate marine interests scattered elsewhere throughout the government. Moreover, these functions may have stronger ties to the primary missions of those agencies--the State Department, the National Science Foundation, EPA, the Department of Energy, etc.--such that to excise the marine component for purposes of administrative tidiness might weaken the opportunity for the oceans to contribute to national needs rather than to strengthen it.

It is also clear that a widespread sentiment exists for the alternative of restarting engines of the Marine Sciences Council. That route was recommended by NACOA. It has been supported by a number of scholars in the field. It may seem ironical that your speaker, who was one of the individuals who participated in drafting the original legislation to create the Council and then served as agency head during its more productive years, should raise a cautionary note.

Again, because the times, the circumstances and the individuals in power are very different than they were 12 or 14 years ago, I have less confidence than previously that this is the primary route to go. Nevertheless, I think it would be instructive to evaluate the functions which the Council performed, to determine whether or not these remain valid and whether other apparatus of government or techniques of policy development may still make it possible to achieve the performance record of the Council, even if it were not explicitly recreated.

Let me review some of these salient Council functions:

1) The Council operated as advisory apparatus to the President, who was himself charged by the Marine Sciences Act of 1966 as the national leader to relate marine activities to national affairs and to orchestrate the bureaucracy. That charge, incidentally, remains alive today.

2) The President wanted the Marine Council to fulfill its statutory function and was very clear in assigning that responsibility to the Vice President as Council chairman.

3) The Council operated to generate policy initiatives for the President, starting not from the marine dimensions of their role, but rather from the problems of society which the President had himself identified on his own priority list.

4) The Council acted as a maritime presence in the White House in the defense of these initiatives at high levels of government. We were thus better able to bring to the President marine related options, and we had continuing access to highest levels to, at least attempt to, protect these initiatives as they were being shot at in the heated competitive struggle for attention at that level.

5) The Council assisted the President in trying to focus the energies of separate federal agencies on common goals and integrated their capabilities to foster coherence in programs and minimize unwanted duplication or even competition.

6) While the Council advocacy inevitably had dollars associated with the programs and thus was able to help subordinate elements of government in the agencies with their own budget defense, the Council also serve the President to discipline expenditures and thus somewhat increase the probabilities that the funds would be prudently spent.

7) The Council earned respect and support from both Houses of Congress for its activism, its competence, its candor and its understanding of the role of Congress as a partner with the President in making policy. And they came to appreciate that the Council focused as much on social ends as on means.

8) Finally, the Council acted as a hub of a network of communications to the Congress and to the universities and private sector in an effort to reflect the fact that all of these elements in our society had to be marching in cadence if an otherwise immature field of policy development was to survive in the Washington furnace.

There seems to be widespread agreement that the Council served the President and the nation as well as the marine community very well. One outside observer, William D. Carey, said in

testimony before the Congress: "While this Council might have been mere window dressing, in fact it has been a very lively body. When Vice President Humphrey had the chairmanship, he never failed to show up. He ran the meetings as though he were presiding over a working committee of the Congress. Before each meeting, the individual members of the Council received pointed notes from the Vice President suggesting that he would be disappointed not to see them, and there was a remarkable attendance record. The Marine Council did not hesitate to advise the President. In fact, I have reason to believe that he received somewhat more advice than he cared for. It comes down to saying that this interagency body was an outstanding success story."

Notwithstanding that accolade and the parallel reality of a very talented and activist Vice President, Walter Mondale, I am not at all certain that President Carter would look favorably on creating another piece of administrative apparatus in the Executive Office of the President at a time when he is endeavoring to set the stage for reducing rather than increasing government.

This is not to say, however, that the whole range of functions listed earlier do not deserve attention, but these could well be treated in the context of alternatives to creating new apparatus.

SUMMARY

Almost everyone would agree that human activities are conspicuously, albeit imperceptively, affected by the pervasive marine environment. The role occupied by the oceans in the destiny of humankind and of individual nations is closely linked to the entire political theatre. Yet, the nexus between policy and the sea which we are exploring here today, continues to reflect a randomness and feebleness that does not serve the national interest.

In this summary I hope to bring together a few of the key points that have been made earlier and to suggest some direction for next steps.

The political, social, economic and technical climate that attended the resurgence of interest in marine affairs in the late 1950s has markedly changed. The love affair which Americans had with science, sharply inflamed by the Soviet space shot in 1957, no longer continues. On the contrary, there is another cloud over the entire technological enterprise with a recognition that notwithstanding the benefits intended to be derived from technological initiatives, they often produce unexpected and unwanted side effects. A new challenge thus arises for everyone concerned with technology-related public policy to improve the steering capability of government in order that technology produce socially satisfactory outcomes.

Paralleling that backdrop is the general loss of confidence in government and the increasingly strenuous nature of decision-making brought about by complexity, by interdependence, by inadequate balance of the long- with short-term considerations, by institutional tribalism, and by the adversarial culture.

The starting point to analyze the future of marine policy thus strikes me as having to be derived from a much broader base than represented by the marine community alone, and it must have a sensitive recognition of the close interconnection between marine policy and other broad policy areas that attract priority attention of the citizens as well as the leadership.

Most important, any test of the validity of propositions advanced today, either with regard to marine policy or policy process, must project the consequences of alternatives in order to test which among them, 10 to 20 years hence, will prove the superior route.

By good fortune the marine community now has far more members of breadth and depth of perception about these relationships than was true 20 years ago. In short, marine science affairs has itself grown up and has begun to emerge from its narrow parochialism which began when many oceanographers who provided leadership to their scientific colleagues approached the study of the oceans as though the planet were uninhabited.

My proposals for the future, therefore, would be:

1) To define far more explicitly and persuasively the manner in which the oceans can contribute to solution of broad national problems that range from a planetary scale of world order to a more domestic concern over inflation.

2) That every possible means be found to get more effective management of marine affairs so as to gain greater effect from inevitably limited budgets.

3) Far more concerted efforts be made to link together the scientific community with industry and with citizen groups in order that they may share in a common advocacy rather than to treat each other and the government itself, as adversaries.

Finally, however, we cannot ignore the enormous power that exists in the office of the President. The present incumbent brings to that office a different style, a different perception of humanity, and a commitment to improve responsiveness of government. He has turned his attention to some of the key dilemmas that face our society and our nation today.

We must find ways and means by which the opportunities afforded by the oceans can be brought into his ambit of interest and concern.

Dr. Norton: It has been a real pleasure to review Dr. Wenk's paper and to listen to his comments. Throughout his paper, Dr. Wenk has made excellent points and, as a beginner, I certainly agree with his comments about organization. NOAA and other agencies have been through so many organizations and re-organizations lately that we hardly know, first of all, what we have. Nothing has been given an opportunity to really work. I think his query "Why aren't the right questions being asked" and statement that "it's not really necessary that we look around for fancy answers" are extremely to the point.

In thinking about this whole panel, I could not help but come up with the thought: What do we really mean by marine policy and what criteria do we have so that we'll know when we actually have one? I don't have these answers.

I hope that we all generally agree that a marine policy must be more than just a collection of opinions and more than just political pressure to generate more marine activities: That whatever the policy may be, we'll also be interested in the costs of obtaining the goals implied, as well as the benefits. As Dr. Keil said this morning, technology for technology's sake doesn't take us in the direction we want to go. I think Mr. Frank reflected on this same issue yesterday when he raised the question of the appropriate role of the government in technology development.

Dr. Wenk made a very important point by indicating the critical question: in what manner can the oceans contribute to the solution of broad national problems? I'd like to add to this my own interpretation of the question by saying that we have to be concerned not only about the manner but also the relative efficiency in which the oceans can contribute. The dangers of relying on political pressures alone without proper analysis and justifications, are, I think, great. We have to realize that Congress or the President may come up with statements, perhaps like this: Our policy will be to establish the proper environment to assure that the oceans achieve their potential in terms of contribution to the physical, social and economic well-being of our society. I think we've heard many statements like this.

However, when we come right down to it, we know that when such a statement is interpreted, we still have to deal with the relative efficiency of the oceans versus other contributions. Any program still has to go through the basic brass tacks of OMB review. And, as Dr. Wenk pointed out very aptly here, because of the length of time in the budget cycle, the priorities may change in the time between proposing a program, having it approved, having the funds authorized, and then finally having the funds allocated for a particular program. Therefore, we must have justification and analysis that will stand up under these changes in priorities. I would suggest that the only way that ocean activities can be assured of proper financial attention by the federal government, is to have a justification for pay-off that will more or less ride the waves of changing political interest and fiscal priorities.

We often, for example, hear the question of marine policy related to the space program. The argument is that the nation achieved a statement and establishment of a policy, and its goals. The goals were achieved because we had this policy. I think, though, that there is not a parallel with ocean policy. At the time of the lunar landing, we did have some policy objective to do something about the prestige of the United States and there were decisions made to put a man on the moon at whatever cost. I don't think we have similar situations now related to the ocean and we certainly can't count on it. There is and there must be concern about efficient contributions. Right now, we have two very important considerations: inflation and control over spending. I think these are going to be with us for a while. Recently, someone in OMB indicated that they really have control over only about 25 percent of the total national budget. There is really very little they can do about things like national defense, mandated programs, etc. Therefore, programs that fall in the 25 percent have particular pressure on them. This is where all of NOAA's budget would fall, and we need more than just the average justification.

This, to me, relates to another important point made by Dr. Wenk. That is, the proper ingredients for policy formulation and fulfillment. He mentions that alternatives must be identified, considered and appropriate actions set out. He says that long-run consideration is essential. Those of you who were in here last night for the Fishery Conservation and Management Act informal discussion heard about how

short-term rather than long-term considerations seem now to be guiding the entire fisheries management activities.

Another point that Dr. Wenk mentioned was that ocean activities must be considered as a means toward social ends, rather than ends in themselves. I think this is very critical. I liked Dr. Wenk's analogy with a hunter: if he wants to take down a duck, he leads the duck and shoots where he feels the duck is going to be in a little while. To me, though, this implies a considerable amount of knowledge or analysis beforehand. We have to know, for example, that the duck is not smaller than a thimble or larger than a truck. In other words, we don't go with either a BB gun or a cannon. Likewise, we have to know something about what it's going to take to start that duck in motion, the general direction it will most likely take, and how fast it will travel. Then we know something about where to aim.

I believe that in ocean matters we must recognize that we're dealing, first of all, with a market system and that this system is guided by various forces such as prices and costs, and certain political and cultural aspects. We are continually operating under specific technical or biological constraints. This is where generating ocean activities is different from planning to put a man on the moon because we're talking about activities that eventually have to make it in the marketplace. We can design all kinds of policies, goals and objectives, but if we don't pay attention to the forces that are really going to be making the final decision about whether our policies are taking us in the right direction and how they affect the flight, then we're likely to come home without our bag limit in ocean activities.

I can think of two or three or more examples. A few years ago, NACOA came out in a report setting a particular poundage goal or objective for fisheries which was about twice our domestic catch. It was unbelievable to see what went on in the federal agency in trying to establish policies and directions and so forth that would make movement in that particular direction. It was the wrong direction to take because it wasn't economically feasible. There was a considerable amount of wasted activity, wasted money and so forth. NMFS, at one time, thought they would take off in the technology development area. They proposed a major plan and it was forwarded to OMB. Part of the

plan dealt with what they were doing at that time and what they intended to do. OMB looked at the plan and said, "Why do you want to do this? You're saying you're doing all kinds of things, but not what it's going to accomplish or what it's going to contribute. In fact, we're happy that you called to our attention that you're doing these other things because now we'd like you to quit those things." The result was a major budget cut.

There are other examples. All of a sudden, policy decisions are made to the effect that we're going to have tremendous trade in fisheries. In fact, I was rather surprised and a little concerned when I heard that people in NOAA and NMFS were off in Japan trying to sell fish to the Japanese because we've been through trade development several times. There's always the question; if our fishermen can't compete, then all the promotion and everything else you do just isn't going to sell the fish.

What I'd like to do now is talk about one of the last points in Dr. Wenk's paper, and speak more directly to what I think happened under NOAA; not in the broad aspects, but something that I am somewhat more familiar with.

Dr. Wenk mentioned that at one time there was a major interdisciplinary group at the very top level of NOAA. In the Bureau of Commercial Fisheries, before NOAA was created, there was also an interdisciplinary group. The Bureau of Commercial Fisheries, at that time, was organized with a director, a deputy director, a legal and legislative advisor, and three divisions: biology, technology and economics. This group daily had what they called "sunrise services." In other words, these people got together every morning. They talked about the issues that were facing them. Each had major programs under them: The biologists had biology programs, the technologists had food technology and the economists had economic programs. These people didn't work in a vacuum. They worked together and they decided on what the particular policy issues were. The important point was that when it came to identifying a biological problem or an issue that was a particular constraint, there was a biologist involved or a technologist or an economist, and then these individuals could interpret. For example, the economist could interpret the economic questions, take them down to the people to do the analysis and bring the analysis back up and put it directly into the policy actions.

When NOAA was created, for some reason--perhaps because the people who were involved in the organization hadn't really had previous experience in some of the social sciences--the group was disbanded. It was a minor decision, but to me it turned out to have major effects. The re-organization cut top economists off at a deputy level so, from then on, there no longer was an economist, for example, involved in any of the morning sunrise services or the discussions about the policy issues. At that point, in these major policy discussions, the economic issues were always identified by non-economists, who decided what they felt the issues were and these were passed down. Well, it didn't take long before economics, in that structure, no longer was an analysis group to provide input into policy making, but rather a justification group for justifying decisions after they were made. Needless to say, this didn't survive. The economists objected to that role, the administrators at the top felt the economists weren't being responsive and the entire structure was terminated. You can look back at National Marine Fisheries Service and see that major publications were coming out in those early days. Most of the fishery plans now refer back to things that were done by these groups in 1969 through 1972, but nothing since then. I would argue that for practical purposes NMFS, and in general, NOAA, has not had any economics input since that period. Economics isn't the only input, but it's a major input when we're dealing with issues that are greatly affected by the market forces. This, to me, is something that doesn't take a major re-organization. It doesn't take any particular fancy answers. But I think the direction should be clear.

Mr. Squires: Thank you very much, Virgil, for some provocative thoughts and for protecting the turf of the economists. Our next speaker will be Dr. John Steele.

Dr. Steele: Thank you very much indeed. I'm grateful for this opportunity that was phrased, I think, as the second bite of the cherry.

I would like to refer to two of the conclusions that Dr. Wenk has discussed. One is the particular range of problems that we're concerned with, which he said covered the scale from world order down to domestic concerns. The second point, that many people have made, is that we are very much in a world of limited budgets. This implies that we must be very much concerned with priorities. I want to discuss this and limit myself to how this affects oceanographic science.

One of the main things in the last ten years has been the emergence, in oceanography, of so-called big science. The best example of that, I guess, is the deep sea drilling project. Dick Frank referred to the next stage as an order of magnitude increase if and when the Glomar Explorer comes into the program. I rather hesitate to mention the subject with Fennan Jennings here, but undoubtedly, the International Decade of Ocean Exploration, IDOE, was a major change in the structure of funding in oceanography. It brought in the concept of, at least for oceanographers, large projects. But, to me, one of the interesting things about some, if not all, the IDOE projects is that although they were quite complex in terms of the scientific structure and their management, many of them were very small-scale geographically. The Mid-Ocean Dynamics Experiment (MODE) was concerned with a small area of Bermuda. The upwelling studies, again, were relatively restricted geographically.

What seems to be happening now, as we look towad the future, is that the problems will both be large in terms of science and will also be very large-scale geographically. Also, many of them will be much more defined by external policies or politics. I think the very obvious ones are the energy-related problems as they affect the oceans, and this has very much the kind of crisis structure that Dr. Wenk referred to. One could say that the oceanographic community is responding very well to these problems, or you could say that everybody's trying to get on the bandwagon as much as possible. But, certainly, there is going to be a very large amount of activity at scales which are global. Dr. Wenk has mentioned interrelation to climate, the CO_2, the NO_X problems. There are similar ones on a large scale that arise in the southern oceans which, again, are a mixture of science, economics, and political background to the activities there. High level radioactive waste disposal is another example.

So it's very obvious that we are going to be looking at very large-scale problems both scientifically and geographically. I think it is of interest that this has been recognized in the recent publication of Continuing Quest, which follows on from the IDOE program and looks toward the future. Particularly in terms of physical and chemical oceanography, we see in the future the ability to tackle ocean problems at the large scale. This, again, is part of the recycling because that's what Bob Worthington

and others would say they were doing 20 or 30 years ago. But it's nice to get back to where you started from every so often, as John Isaacs said. Given these very large programs and given limited budgets, there is this question of priority. As I said, the priorities of the problems that are arising now may be set outside the oceanographic community, outside the science. I think the fact that they are, and that this should be so, is to be expected in the present political climate mentioned earlier. At the same time, there is this need to balance these large-scale, politically effective, programs against smaller scale research. As John Isaacs mentioned, we mustn't let ourselves be carried away by the scale of some of these large programs. So, I see this problem of balance between the large and the small affecting our future priorities and the way in which policy comes into effect in the oceanographic community.

One of the most interesting cases here is the Sea Grant Program because, in terms of shelf and coastal oceanography, we are faced with the question of shall we have, as we do in general, an aggregate of relatively small-scale projects? Is this something that derives from the nature of the problems, from the terrific variability in the environmental problems within these zones, and only relatively small-scale funding? Or, are we going to look in the future to Sea Grant and to other means to attempt to produce large-scale coherent programs in these regions?

As I said, we have to recognize both nationally and internationally this impact on priority from outside, and particularly through big science. Personally, I hate to think that we will see a dichotomy develop with the big science being driven by external forces as, to some extent, applied problems are, and to small-scale research being funded from the academic sources. I think it would be a terrible mistake to have this kind of division in terms of balance, in terms of policies or the application of the policies which will give us the correct spectrum of both large and small scale activities in our study of the ocean. It will also give us a correct balance between the forces driving it externally in terms of policies and internally in terms of the actual scientific structure. Thank you.

Mr. Squires: Thank you very much, John. It'll be interesting to see how the current status of research under Law of the Sea and your large scale global problems are

going to mesh. Our last panelist is Dr. Alfred Keil.

Dr. Keil: Many of the things which I want to say have already been said. But I would like to stress that Ed Wenk's presentation is the most challenging one we have heard during this conference. It is extremely important that we are forced to think in the terms in which he spoke. I repeat: public policy is a bridge between past and future, not a matter of meeting today's needs. We have to think of the future needs. We must outline the future in a more sophisticated manner. Policy cannot be discussed in isolation; ocean policy cannot be discussed in isolation. Following these statements, Ed spoke about the need for policy design. I think there is hardly ever any good policy design. Under the realism of the world, policies are a response to some immediate pressures, and in a technological society, this is the greatest danger that that society faces.

As we design policy, I think we really must have a reasonable understanding of how to implement the policies so that the expected benefits will occur. I'll try to relate Ed Wenk's speech and what I've said up to now, to the first day of the meeting. Trying to make inputs into ocean policy by using a very restrictive simplified model based on obsolete technology and to make inputs into decision-making on priorities for the various tasks of ocean activities by the approach of macroeconomic modelling may not help. On the other hand, if we look toward the future, we cannot just think of today's needs, though this is an obvious thing to try. It is just as hard to think about projected or technical opportunities as technology assessment. We must make a projection of national needs because the needs of our society are changing--it is part of the moving target. It's not only the opportunity for doing something that is the moving target, but also the needs to be met that are the moving target. So it's really a double barrel gun with the two barrels set into motion in separate directions in order to come up with a sensible approach to the problem.

I agree with the comment that one has to expect unexpected things and the options must be kept open for unexpected things to happen. When I was Dean, I had a map of the South Pole in my office. The South Pole was in the center. It was a very interesting map and everyone who came in there was baffled when they looked at it. It was there with a purpose because as soon as they asked why do you have the map there, I said, well, it teaches you a lesson: It all depends on your

perspective. So, again, I would like to thank Ed Wenk for the stimulus he has provided and the challenge he put before us. I don't think we should be frightened by it. The work has to go on. If we don't have a long-range picture in mind, we can't make our decisions from day-to-day, and this is, I think, the greatest contribution he made with that speech. Thank you.

Mr. Squires: We've referred quite a bit this afternoon to one of the key phrases used by Dr. Wenk -- that policy is the bridge between the present and the future. It seems quite clear that our future in ocean research and ocean policy is going to be increasingly involved with much more complex global problems, together with a mix of small-scale local problems. As John Steele mentioned, the latter often require rather detailed attention by small groups -- the former probably requiring international cooperation in their solution.

We are in a far more complex society than we were yesterday, or in the last decade or in the last century. Aspirations of the underdeveloped and developing world are going to put new pressures on this country, ones which we haven't had to face squarely. The nature of the problems we face is going to be complex and is going to require that we approach them in what we, in Sea Grant, often say we do so well, that is, in interdisciplinary and multi-disciplinary fashion. I think Virgil Norton's anecdote in regard to the National Marine Fisheries Service cum Bureau of Commercial Fisheries was most telling in that respect in that it suggests ways in which the complexity of the organization of government loses some very vital communication functions.

It is time now to turn the session to our audience and ask for your questions and your comments.

Mr. Ross: I guess for many years I agreed with Ed Wenk, who said that we don't really have a marine policy. But something you said today made me wonder that maybe we really do. You said the Law of the Sea is sort of a waste of time in diverting a lot of our energies; I agree with that. I also agree that it might fail. But it seems to me, now that I'm thinking about it, that what we're saying of the Law of the Sea is that it is a statement of a lot of U. S. policies and maybe it is telling us how important certain things are and aren't. For example, to simplify the matter, maybe marine science is not that important when you compare it to freedom of passage of military ships through

straits and we'll trade one issue for another. If I'm not oversimplifying, we're getting a very clear statement of some U. S. policy as refers to the ocean in what's coming out of the Law of the Sea. I don't know if it would be passed by the Senate, but nevertheless, it seems there's a policy statement there.

Dr. Norton: Dave (Ross), I have to associate myself completely with your observation. If there is a Law of the Sea finally negotiated, and, indeed, we do have a history of living by our treaty obligations, and if it gets through the Senate, then we will have a policy, no question.

What worries me is whether or not, in retrospect, it will prove to be not only the wrong policy but completely counterproductive in terms of the other goals of our society and of our nation. It's interesting to me, coming back to this notion of parochialism that I alluded to earlier, that the questions about the connection of the Law of the Sea and its policy implications were not exposed in relation to this whole range of other values. Let me just refer to one little anecdote of my own experience.

Back in 1967, a different policy perspective was being generated within the administration. It followed a statement by the President: No colonialism on the seabed. A whole policy framework began to emerge afterwards. That was even before Pardo made his famous speech at the UN. The roots of that policy remained until May of 1970. The interesting thing is this; that policy was worked on through the federal government to try to get one policy. Each agency approached it from their varying, narrow perspective. The State Department assumed the role of the umpire. That, to me, was complete abdication of its role from the point of view of the connection between all of this and U. S. foreign policy. Why didn't the State Department come into any of those negotiating sessions, all within the government, in terms of a foreign policy principle? Why not a long-term look at what Law of the Sea meant to other foreign policy goals which the U. S. is obliged to develop and explain on a crisis-by-crisis basis time and time again? The federal government was, in my view, poorly equipped to do this. The consequence is that as other forces worked their will in the early years of the Nixon administration, all the other policy perspectives became blurred. The behavior of the government, as we generated policy then on the open and highly visible stage of the UN, was entirely

a reactive response of trying to meet sometimes purely emotional positions of other countries or groups of countries without having a clear position of our own. Any one of us who has ever been in a bargaining situation knows how vulnerable we are if we go into it not knowing what we really want. Although freedom of the sea and so on was one of the key points, there were a number of questions that were never asked once the UN machinery got rolling. So, in short, my great concern about the Law of the Sea is not that it will not create policy. You are absolutely right. It will. I'm fearful of it being the wrong one.

Dr. Isaacs: I thought it was a particularly insightful and provocative discussion. But you're talking a lot about targets and it reminds me some months ago of sitting and watching a dragonfly sitting on a reed. Great big eyes: presumably a marvelous computer that nobody's even approached yet. It watches an airplane go over, which looks to me about like an insect going over, and it watches it, but it doesn't launch an attack. A fly goes over: no chase, just direct intersection. But then you should see it when a butterfly goes over--his head goes up and down and he shakes his head and quits, or makes an abortive attack. To some degree, the kind of hysteria that the public has for different problems as they come along kind of reminds me of the dragonfly. How does a scientist really ever focus on one of these targets because they're always somewhere else.

Dr. Norton: Even though John Isaacs doesn't ask a question, he inevitably stimulates a response.

Let me make just one comment with regard to flutter and flounce in the policy apparatus, whether it's like a butterfly or not. My feeling about the future can be expressed very succinctly. First, it is always going to be uncertain, and second, it is always going to be somewhat dangerous. Therefore, the question is--what is the appropriate stance one takes as an individual or as a society given that situation? We have certain problems that we know we are going to have to tackle, but we cannot be sure of the future.

The answer, in my view, lies in notions of flexibility and versatility. This, incidentally, applies to how people will cope in the twenty-first century. This, to me, is my statement of the death knell of the specialist in the sense that, as I see the question of survival in the face of the unknown, copeability is going to lie in these qualities which are not very

pronounced in our society today. The trouble is that the minute you think a solution requires more government, you immediately introduce, in Newtonian terms, the guarantee against flexibility.

Dr. Knauss: I listened to your (Edward Wenk) position paper and I agree with a lot of it. But I must say that while listening to it, I thought I could perhaps make a strong counter-argument with almost the same information that you had, and come out with a somewhat contrary conclusion. And so, for the purposes of argument, I will try to do so.

You pointed out that we need an architect with respect to ocean policy and you used some analogies about building barns as distinguished from taking random lumber and so forth. But I think you also hinted at the idea that ocean policy is a bit more complex than a variety of other policies. It's not quite the same thing as NASA getting a man to the moon. It's not even as simple as the Department of Energy policy of Energy Independence, to minimize cancer or various communicable diseases and this kind of thing. The ocean policy is extraordinarily complex. The Stratton Commission, in some sense, tried to put together a blueprint of ocean policy. It had recommendations ranging from Law of the Sea to defense policy; science to fisheries and coastal zone management. You could say the Stratton Commission didn't lay out a blueprint of what ocean policy should be for the future, but it's hard to put your finger on it because it had a lot of recommendations.

It would seem to me, looking back at the past ten years since the Stratton Commission, if my job happened to be in the White House as the advisor to the President, and if I'd done nothing and my only job was essentially to write an annual report each year saying where we have come with respect to ocean policy, what great things have we done in the last few years or the last year, I think I could write a pretty good annual report. We really have made considerable progress with respect to coastal zone management. We have done a considerably better job with respect to managing our own fisheries, if for no other reason than that we're trying to manage them rather than trying to do it by international organization. We've made considerable improvement with respect to ocean science work, with respect to the IDOE program. I think one could list a variety of legislative or executive decisions that have been made which would argue very coherently that

we have a strong, well-organized ocean policy and that all you have to do is package it to essentially make that case. Now, you may think, as I think, that a lot of this policy is misguided. A lot of things haven't been done that should be done. But I don't think it's quite fair to argue that there hasn't been a somewhat coherent ocean policy in the past ten years.

Dr. Wenk: I guess I'm called upon to respond.

First of all, I don't find it agreeable to sound like either a pessimist or a critic because it's not in my nature. I'm a builder. On the other hand, I guess I am a perfectionist. As I look at the situation, there is a question of how satisfied one is with a disparity between aspirations and accomplishment. To say there is no accomplishment is wrong. There has been accomplishment. The question is whether or not the totality of these accomplishments or even progress in these fields has matched the social need, not the marine science need. In coastal management, I think we have a classical case of success. The roots of that go back, incidentally, to 1967; the first draft of that legislation being done in the Marine Council in 1969. It was done surrepti iously, incidentally, because the drafting was done in the President's office for a member of Congress, and introduced by a member of Congress, but with knowledge by at least the Vice President of what was going on. The interesting thing to me is that the Act was passed in 1972 and most of us, in our remote regions, can see the benefits. We can also see where it has fallen short and where it is challenged. But that doesn't mean it isn't a great accomplishment. In my view, this is a classical example of a good piece of work and relatively effective implementation. The people in the federal government deserve credit and I think an awful lot of credit should go to the people in the states for what they've done.

One of the reasons why this has worked, incidentally, has nothing to do with science or scientists. It has to do with the people who live in the coastal zone who became sensitive to the threats and who asserted their interest through provisions of the legislation. If I were to award any gold stars from the point of view of the heroes in this business, I would award them to the individuals in the states who resisted the well-known and muscular pressures for development. Any of us who have been present at these processes recognize how that works. That's a very healthy sign.

So I want to say that your point's well taken about not being completely negative. What I'm looking at, though, is a broader set of questions that are on the agenda of the nation today. Some of these have been on the agenda for a long time. We all seem in agreement here about the role of the future and the role of lead time. It turns out, I feel, that some of these issues should have been addressed a long time before now and certainly before they heat up to the point of political confrontation. This strikes me as the role of good policy planning and the role of technology assessment to try to get at the issues and to try to identify the alternatives before positions are so frozen and advocates' feet so heavily dug in that we have only confrontation. I use the level of confrontation today as the measure of malperformance and I would say that it pervades the marine field as much as it does others, and I don't think we can say we have a distinguished record of immunity in the marine field from that situation.

I would go on to other areas of short fall. I'll recite a couple, but in so doing, I have to tell you my approach to this is not to try to assess blame. I think that is one of the most fruitless exercises people engage in. For one reason, you usually can't find the culprit, and sometimes when you do, they were just well-meaning--or as John (Isaacs) says, they were crazy but not stupid. My own feeling is that the IDOE had a potential to head off, by virtue of an exercise in international collaboration, some of the claims of territorialism that many people should have identified ten years ago. If that's a policy matter, the IDOE could have followed its original objectives and this is not to demean its value for what it has been. But from the point of view of its objectives, there would've been some rehearsals for cooperation that we never had. It's no small wonder then that in the absence of such rehearsals, we have the type of political confrontation that is exhibited at the UN.

Mr. Squires: We have time for one more comment.

Mr. Larson: I'd like to come back to the Law of the Sea and the UN. Somewhat in the spirit of Dr. Knauss, it seems to me that it also is not a total failure, as you seem to characterize most of it. That is, they've been in process of direct negotiation for five years. It seems as though it's been a difficult, awkward, learning experience for many if not most, but that they have achieved something significant and substan-

tial. So it's in that context I would ask you to be more specific or precise as to what you think has not been successful or what specifically has been counter-productive. You've talked more in general terms and I just wanted to see if you could be more precise.

Dr. Wenk: We should not enter the world petroleum situation fragment by fragment in the next five to ten years in ways that will not be helpful as far as the world energy policy is concerned. I have the same feeling with regard to the development of fisheries. I won't elaborate on that. Some of the major questions such as those of trying to establish some international body to deal with areas of dispute have been focussed on the marine mining issue, and I think this is indeed unfortunate. I, for one, do not believe there is much in the way of revenue to be obtained from deep sea bed mining. The numbers that I tripped over ten years ago have changed only because of inflation. No one has looked, as far as I can see, at the relationship of this mining to the economies of those countries which already mine some of these products domestically and whose own economic health will be threatened. There has not been an adequate examination of the pollution question with regard to processing at sea. Yes, there is a project looking at the mining as it disturbs the bottom. But most of the companies, I think, will say that sooner or later, in economic terms, we're going to have to process this material at sea and so far, that research hasn't been done.

The key point is that the focus of all of this political energy has been on the question of apparatus without being prepared as yet to deal with the substantive questions of marine mining. Let me just finish with this one comment. The notion of a 200-mile economic zone carries with it all of the qualities of territorialism, and to put it in crass terms, greed and selfishness that constitute themselves some of our threats to survival. A different approach would've been the notion of a zone of stewardship, a zone of responsibility, and associated with that is the notion of -- to be sure, some self-restraint, even a moratorium in some cases until the climate for some sort of collaborative effort was possible. Now why do I home in on the oceans in particular?

The oceans, at that stage in history, had a very low political temperature compared to other types of disputes on the planet and I come back to the notion of rehearsals again. We're going to have to find some

way to get along on this planet and the only way I know as humans develop habits of this kind is through rehearsals. Idealist that I admittedly am, and I'm not reconstructed in terms of that idealism, I look on it in tough-minded terms with regard to the whole question of how we're going to deal with the Third World and so-called new economic order, which I do not believe was taken into account in any of these Law of the Sea developments.

Dr. Knauss: Ed (Wenk), the point is that was the U. S. position back when we started.

Dr. Wenk: Oh, I know what the tactics were. The Third World insisted we go the other way. The U. S. had its own options open and regardless of where the Third World was at that time, I think it's fair to say that in their long-term self-interests, they were absolutely wrong.

Dr. Knauss: I would agree to that, but as you know, it takes two to change.

Mr. Squires: With this, I shall declare the last session of the Sea Grant Association's national conference, Our Nation and the Sea: What's Ahead?, adjourned.

REMARKS

RICHARD A. FRANK, ADMINISTRATOR
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

I appreciate your generous invitation to be a part of your program, particularly when it affords me the opportunity to meet with so many of you in a location as beautiful as Wentworth by-the-Sea. The fact that your Association chose a spot just next door to the home in Portsmouth of John Paul Jones not only offers special appeal, but also seems compellingly appropriate for the theme of your conference: "Our Nation and the Sea: What's Ahead?"

As the Administrator of the National Oceanic and Atmospheric Administration, or NOAA, the question "What's Ahead?" comes up every day. I'm referring to our National Weather Service. So before I go on a trip, I always call my National Weather Service Director to find out about the weather.

I called him not too long ago when I was going down to Baton Rouge to take part in ceremonies designating Louisiana State University as a Sea Grant College. As you might recall, we had a tropical storm kicking up around that time, and because I was leaving Baton Rouge to go out in the Gulf on a shrimp boat, I had some serious reservations about that storm. When I called my Weather Service Director and asked, "What's ahead?", all he said was "GO ahead!", and I'm still wondering whether my fears might not have been his hopes.

I'm glad that everything turned out okay, however, because if it hadn't, I might not have had the chance to meet Jim Smith. I'm sure everyone's met Jim, because he meets all the guests coming here. He's what I'd call one of the last true innkeepers in America. He's owned and operated this place for 35 years, so if there's anything you want to know about the area, just ask Jim. I asked him about that big white building that you can see off in the distance at the back of the hotel. I thought it might be another hotel--one to pick up the overflow guests from this place. Any overflow, he assured me, probably came in this direction. It's the former Portsmouth Naval Prison. The prison, by the way, as well as the Portsmouth Naval Shipyard, aren't in New Hampshire at all. They're in Maine. The Navy seems to have that trouble, though. Down in Virginia, the Norfolk Naval Shipyard is located in Portsmouth.

While I'm looking in that direction, I would like to tell you that Secretary Kreps asked that I offer her best wishes for a productive meeting and a successful year ahead. We have just returned from an international trade meeting in Japan where I think we made significant progress with the Japaneses government. Sometimes it pays to be a lower person on the totem pole. She goes back to beautiful downtown Washington, and I come back to New Hampshire to stay in, of all places, the same hotel that housed the Japanese and Russian delegations to the 1905 Japanese-Russian Peace Treaty.

The question "What's Ahead?" for our oceans is, indeed, an intriguing one. As your program outlines, the question stems from a report of the Commission on Marine Science, Engineering, and Resources entitled "Our Nation and the Sea." The report was issued in 1966, the same year the Sea Grant legislation was enacted. As a matter of fact, if you haven't realized it, Sea Grant came into being 12 years ago this month. Happy birthday!

In those 12 years, Sea Grant has proved itself an innovative and successful program--a program that not only has generated significant marine research, major advancements in oceanic education and training, and important progress in public service, but also has established a pattern of partnership between the federal government and the nation's academic institutions that will long stand as a pattern for others to follow. I would like to pay tribute to the Director of the National Sea Grant Program and to all of you in the Sea Grant system for the manner in which collectively you have worked to forge this wonderful association.

I have watched with considerable interest the development of many of the Sea Grant projects in the universities and colleges. I have been impressed with the widespread national, and even international, attention many of them have received in the press and other media. I have been impressed with the acceptance Sea Grant has achieved in the scientific communities on our nation's campuses. And I am continually impressed by the support Sea Grant has managed to develop and maintain in the halls of the Congress.

The only reason the program didn't receive a greater budget increase than it did for fiscal year 1979 is because the Congress had difficulty in allowing such a large increase for one program when most of the others were being cut. At one time, however, the people on the Hill were talking about a 16½ percent increase for Sea Grant. And in a year when the name of the game is economic curtailment of government spending, that's a compliment of the highest order. As matters turned out, you were given a $3.2 million increase, or 10¼ percent. And that isn't bad, believe me.

In retrospect, Sea Grant has gone from a budget of $23.1 million in fiscal year 1976 to $35 million in fiscal year 1979. That's not what you'd like the amount to be, I know, but an increase of $12 million in three years is quite an achievement--particularly for a research program. There could be no more meaningful expression of confidence in your Sea Grant Program.

During this past session, Congress helped in some other ways, also. For example, it changed the law to make clear that Sea Grant could receive pass-through funds so that the expertise that exists in the Sea Grant system could be utilized more effectively in helping to overcome some of the problems facing the nation and in assisting to take advantage of the opportunities that exist in our seas and oceans. As a result of that legislative change, Sea Grant has been able to use pass-through funds from at least four federal agencies outside of NOAA and from eight inside NOAA, not counting that portion of my own discretionary funds that I made available for economic research related to the Amoco Cadiz disaster.

The program has made what I think is remarkable progress in the development of national projects. In response to the 1976 legislation, and through consultation with other sections of NOAA and the Sea Grant system itself, the Sea Grant office put together a list of projects that not only emphasize high priority national needs, but also tie Sea Grant much closer to the long-range goals of NOAA itself.

As you are aware, Sea Grant launched its first national project last year under an experimental management program involving several institutions in the Sea Grant system. The project was aimed at determining what happens to sediment along our shorelines as a result of all the interacting forces that impact on the sediment.

Considerable progress already has been made in the project, and next week the scientists involved in the investigation will start one of the most comprehensive and well-instrumented experiments ever conducted in this particular area of research. Several different types of instruments have been developed and field tested already. They are being placed in position now off the California coast and will remain in place for a month. As a result of this research, scientists should have a much clearer understanding of just what is taking place in the nearshore areas as a result of wave action, tides, currents, sediment motion, and changes in the ocean profile.

I know that many of you have been involved in the development of the 15 areas that have been outlined as national needs and problems. They cover a wide range, as you know, and we are looking to you to come forward with the creative research efforts that will help resolve the problems and exploit the opportunities

that have been designated so important to the needs of the nation.

The program has made significant progress in the development of projects associated with the International Cooperative Assistance Program. With the cooperation of Congress, you were able to broaden the program to include meaningful assistance to the underdeveloped and deprived coastal nations of the world. Through funding from the State Department, Sea Grant has launched a significant effort of oceanographic research in Spain, with schools and laboratories in that country working closely with programs under the Sea Grant system. The program with the Spanish institutions is also expected to grow in the future.

Another key factor in the strides that Sea Grant has made, and I'm sure will continue to make, has been the reorganization of the Sea Grant office itself. By organizing the staff along more functional lines, the monitors are able to maintain a much better handle on what is taking place in the entire Sea Grant system. Additionally, they are accumulating system-wide background that already has proved extremely useful in their informational exchanges with other agencies and officials in Washington and with Sea Grant directors and scientists in the field.

In my position, I take pride in the partnership that has been developed between an office within NOAA and the academic community. I want to assure you that the relationship will continue, and I want to promise you that you can expect it will get even better.

I say that because I would like to see NOAA take a much more active and supportive role in that partnership. Although we have seen some changes already because of the pass-through fund arrangements this year with some NOAA offices, the situation in the past has been one in which Sea Grant primarily has worked well with other federal agencies and with the states, but really has not realized much cross-fertilization with NOAA agencies themselves. This has been reflected, I think, in the small amount of NOAA's research that has been done through colleges and universities. Furthermore, NOAA's in-house research has traditionally not involved the level of academic participation that I believe to be necessary. Indeed, I am concerned about the inadequacy of NOAA and academic interfaces at all levels. Many of the steps I have taken in the reorganization of NOAA were made expressly in the hope of changing this situation. However, Sea Grant will continue to be the centerpiece of this effort and must serve as the principal existing mechanism for building a strong and broadly-based coupling between our agencies' missions and the talent that exists in our universities and colleges.

In line with the importance I place on research, I established an Office of Research and Development as one of the four line units in NOAA. We have Ferris Webster, a widely recognized and highly respected scientist in charge of that operation. We had had Ned Ostenso wearing a second hat as Acting Deputy Assistant Administrator of R & D, and we've now dispatched Bob Wildman there for a three-month stint. So you can see how we are using our own Sea Grant talent internally.

Furthermore, we have named George Benton as Associate Administrator of NOAA. George comes directly from being chairman of the Sea Grant Review Panel and a long association with the Sea Grant Program. I'm sure that most of you know him well enough that you are not going to be bashful about making your own recommendations to him. As many of you are aware, I have asked George to head a study on strengthening NOAA's university relations. This is an on-going effort that I believe to be of the utmost importance.

As I look ahead, I am impressed by the challenges that face all of us. It is manifest to the nation that we try to negotiate those challenges in a manner that will result not only in improved usage of the potentials of the ocean but also in the development of a greater appreciation of those oceans by the American people. In may ways, the challenge that looms ahead is an intellectual problem--one that cries out for greater educational efforts across the nation, in the school systems throughout the country and for young and old alike. One of the fundamental weaknesses in our system has been our inability to explain convincingly to the public the great potential of this immense oceanic frontier. As good as we may be, we will never develop an acceptable national ocean policy until we have a public with an understanding and a conviction about our oceans. The public must be made to recognize that our oceans represent a national treasure. It must be made to appreciate that the oceans represent more of an opportunity than a risk . . . that they represent a contribution of immense value to the nation and to humans everywhere.

The problem, then, as I see it, lies in the fact that there is no constituency for the oceans. Someone onces declared that "fish don't vote." We also have had a White House spokeman indicate that responses to government reorganization from the community were so few as to be almost insignificant in having an impact on the people responsible for realigning the government structure. Thus, while we must continue our resolute research, we must not overlook the importance of explaining the significance of our oceans in the national interest.

To date, Sea Grant has been doing an outstanding job in marching forward to create wider public understanding. I applaud you for that, to be sure. And as I look at "What's Ahead?", I look to

sea Grant to play an even more vital role in facing the challenge in the future. Most importantly, I look forward to a broad participation of NOAA in the vital partnership that has developed over the past dozen years between the Office of Sea Grant and yourselves.

Again, happy birthday!

1978 SEA GRANT ASSOCIATION AWARD RECIPIENT

PROFESSOR JOHN D. ISAACS
DIRECTOR OF THE INSTITUTE OF MARINE RESOURCES
UNIVERSITY OF CALIFORNIA

I greatly value this important award and the overly generous introduction. Actually the small contributions that I have been able to generate toward the advancement of marine science were mainly from my having been in the right field at the right time. Also, I believe, being a little mad has helped.

It is not unlike the hero in the old story which, to one or another version, most of you have already been subjected, when a truck driver started to pull off the highway into the shade and inextricably jammed his truck under a highway overpass. Presently the highway patrol had closed some lanes, several large tow trucks had vainly attempted to pull the truck free, and the local fire department was about to start on the truck with cutting torches, when a man shouted through a heavy fence off the highway: "Why don't you just let some air out of the tires?" This they did and the truck was soon free. Later, the highway patrolman, recognizing the fence as the enclosure of the State Mental Hospital, went to the man and asked, "How come you're in an institution when you can come up with ideas like that?" And the inmate replied, "Well, I may be crazy, but I'm not stupid!"

Now, let me make it perfectly clear that this story should not be thought to reflect in any way on Scripps, which is also an institution, nor, for that matter, on Bill Nierenberg, who as many of you know is our Head Keeper.

Let me compound apologies. Bill Nierenberg is a man of remarkable insight. As an example, I had gotten myself into talking to the Berkeley Physics Seminar about one of my less-believable ideas, the effect of U. S. right-handed automobile traffic in imposing cyclonic torque on the atmosphere and thus exacerbating the number and, perhaps, the intensity of tornadoes. Before leaving that morning, I dropped into Bill's office and said, "Bill, you have no idea what a brave thing I'm doing today. I'm going to Berkeley to present the case on automobiles and tornadoes at the weekly Physics Department Seminar."

Without a moment's reflection, Nierenberg said, "John, it's the only kind of physics department in the world to give that talk to. If you talked to the physics department at Brokenback

College, they'd rip you to death on trivia. At Berkeley they will understand the fundamental principals and your findings." That observation, naturally, presented me with a fine entree, repeated in my opening remarks that afternoon!

I am, of course, deeply honored by having been chosen as the recipient of the annual Sea Grant award, but at the same time, I am humbled. I am humbled by the knowledge of the many unrecognized people who have contributed to the small role I have played in the penetration and demonstration of the vast and vital potentials that the sea holds forth for the future well-being of humankind. These potentials that were so presciently foreseen by the early leaders of marine science, evolved by the genitors of the Sea Grant concept, are being expanded and pursued by the dedicated leaders and participants in the Sea Grant Program in these times.

On this occasion, I would like to spend a few moments presenting my views on some fundamental problems and challenges with the aim of emphasizing the unique opportunities that Sea Grant holds for penetrating these problems and meeting these challenges.

I will briefly meander over or maunder about my conceptions of our unrecognized possibilities, the sea as a challenge to present science and institutions, the essential but precarious role of multidisciplinary science, the modern denigration of both usefulness and lay understanding, and the deep, narrow and unbridged gulf that so frequently cleaves policy and decision from knowledge and understanding.

It has been suggested that I expand my remarks but still take not too much time, and hence, I may become guilty of putting forth my perceptions as what appear to be mere personal platitudes. Perhaps those points that you most earnestly question can be clarified in later responses. Also I hoped to present clear ideas, but in reading my notes I am not happy with the results. If I sound overly critical of science, government research, and bureaucracies, this is because I hope to point out Sea Grant's unique opportunities to avoid their ubiquitous ills (remember I do not have a bumper sticker that reads, "I love America, it's the government I can't stand," nor do I often refer to the District of Columbia--in the Spanish Desierto federal).

As I have previously pointed out, it was mainly the challenge of the sea that lifted medieval European man out of the Dark Ages. His exploration of the oceans of this planet, his discoveries of new continents, his development of navigational instruments and ships led to new confidence that he could surpass the accomplishments of the ancients and lift himself above the inadequacies of his institutions and the darkness of his times.

I submit that the sea again challenges our sciences and our institutions and again possesses the potential of leading into a new and future world, but, if, and only if, we recognize those challenges and possess the wit to design and to execute mid-course corrections to our present trajectory.

High on my list of incubi is our poor definition of problems. They tend to become defined in some sort of public acclaim rather than by any analytical process. At worst they are set forth by advocates, scientific and otherwise. The problems, large and small, often are defined narrowly, symptomatically, capriciously or erroneously. Often the solution is not even contained in the specified approach! The program for the desalination of seawater is a classical case. Potential solutions to the underlying problem, which was the need to increase agricultural production, were not approachable through this single-minded and static program. Hundreds of millions of dollars were fruitlessly spent in a specified, yet impossible, approach. Only recently have very small efforts been established in much more defensible approaches: wetland agriculture, and the culture and breeding of xerophytes and halophytes (aridity-tolerant and salt-tolerant plants), the latter under Sea Grant.

I feel that national objectives must be cautiously and analytically scrutinized to ascertain whether the fundamental problem and the range of possible solutions (or <u>any</u> problem or <u>any</u> solution, for that matter) is included within the definition. Too often we encounter the position of the king in the fable who ordered his ministers to discover the height of an ancient and loftly monument which he wished to surpass. The ministers engaged a powerful magician who caused the monument to prostrate itself on the ground, whereupon they measured it, and the magician then caused it to rise again. But the king could not accept the results. "For," he said, "I told you that I wanted to know the height of the monument, not its length!" (It sounds like some government specifications, doesn't it?)

Also our society treats problems as a non-renewable resource. Problems, real or otherwise, have become our new frontier! <u>We have come to value problems more than their solutions!</u> As Meg Greenfield recently pointed out, we colonize them! Presently such throngs of agencies, research scientists, politicians, subsidized industries, and even special publications have gleefully homesteaded the problem that we dassn't attack it effectively lest it be damaged and some of its colonists dispossessed. In fact, much time, money and effort is spent in repair and refurbishment of the problem so that it will continue to present a fresh, wholesome, and worthy appearance down through the fiscal years.

Much of this disability stems from agencies acting under statutes that may specify perpetually frozen and often fundamentally impossible approaches or nonexistent problems.

Fundamentally important problems have become the modern wooly mammoths, buried in paper moraines of ponderous glacial inaction.

All of this is not unrelated to several factors, which among themselves are also interrelated. These include the caste system in natural and social sciences; specialization; the denigration of lay knowledge and of research directed toward useful objectives; and our poor communication of scientific understanding to the political and industrial decision makers.

I will briefly sketch my view of these factors.

This planet and this creation is a complex system, with periods of relative quiescence between brief dominating episodes. At those quiescent times it is a system adjusting to the effects of those powerful episodic inputs with a spectrum of strong and weak interactions. Yet the world is viewed as a slowly and fundamentally deterministic changing system. Ecologists working on an array of transects in Chesapeake Bay felt that they were just beginning to understand how it operated, when along came hurrican Agnes and washed both Chesapeake Bay and their transects to sea. "What a foul trick," they said. "We were just getting somewhere!"

Like many natural and social scientists, they studied the background and failed to recognize the signal--the message as it were--when it arrived. Agneses and Hazels dictate how Chesapeake Bay works! It is ever adjusting to the last violent episode.

On a larger scale, the detonation of Santorini in 1487 B.C. in the Mediterranean probably set back western development for a thousand or more years, and altered human progress for all time. And, of course, our present interglacial, our Garden of Eden, has existed for just a brief geological instant--or for that matter for only a brief instant in human history. In respect to this, remember our best planning spans only a billionth part of the probable habitable life of this planet.

Even the broadest scientists necessarily possesses only a restricted vision and competency in only a few fields, yet the components of this universe (and particularly of the sea) are wholly unaware of the artificial barriers by which man has compartmented and subcompartmented his knowledge. The chemicals, the winds, the currents, the spinning earth, light, and the living entities that inhabit the ocean realm act and interact without regard to the intellectual barriers that man erects within his mind and knowledge and between his specialties.

As H. G. Wells said in his discussion of the demise of the University at Alexandria: "We have yet to discover how to defend our centers of research and learning from darkening and caking accumulations of dingy-spirited specialists. . . the ashes and clinkers of intellectual fires."

It is no wonder, given the confrontation of these inadequate or constrained or erroneous definitions of problems, the non-problems that we often pursue, the specialist's narrow viewpoint, and the public's statutorially expressed narrowness and urgency for solution, that the scientist is increasingly placed in the position of the man with the bucket and shovel behind a rampant society, and increasingly denied his proper role--the role of the scout--seeking new vistas from which to discern new and future worlds.

Woven into this maze is a present hierarchal view that commonly denigrates research toward useful ends, as well as the ideas of lay persons.

We suffer from the self-fulfilling prophecy that new fundamental principles will not emerge from applied research. Under this erroneous prophecy, workers in applied fields and programs most often neither seek nor expect to uncover new fundamental understanding. This is a myth, of course, and history relates quite a different tale. Cannot, the engineer, set forth the second law of thermodynamics with much more fundamental understanding than did the physicist Kelvin! The entire history and fundamental advances of chemistry, bacteriology, immunology, solid state and nuclear physics, thermodynamics, meteorology, etc. most frequently stemmed from practical objectives. Even Newton was working under an admiralty contract on ballistics when he set the initial stage for the perpetration of this myth of purity in science, as well as the myth of a celestial clockwork order and perfection in the universe, myths which, particularly today, haunt our views of nature and of science.

On lay knowledge, from Ecclesiastes' "The poor wise man's word is not heeded nor his name remembered" to Steinbeck's example of the utter repudiation of native intelligence--the sign above the fly-specked bar, which was to be pointed to in response to any display of knowledge: "If you're so God damned smart, why ain't you rich?"--we mostly fail to value and profit from the astonishing insights of the formally untutored members of our race. What if Jenner had <u>not</u> listened to the cowmaids, who had made all of the observations, conclusions and recommendations on vaccinations? How many more scientists have <u>not</u> acknowledged their lay sources?

Of the scientific insight of lay people, I am particularly

conscious, for I have spent much time with fishermen, loggers, seamen, and others. When I was a commercial fisherman 40 years ago, much of the behavior and temperature responses of albacore tuna and salmon, waves and wave-current and wave-depth interaction and other principles (that I now see newly discovered and published in reports) were common currency of fisherman talk. In fact, in those days I wrote to a certain famous oceanographic institution in California, describing some of my observations, but the responses seemed to me to be irrelevant. (I concluded that they needed my services, and applied for a job.)

Classical Chinese tales often pit the uneducated against the educated with the outcome sometimes one way or the other. Some involved scientific matters of considerable interest, including marine ones.

For a non-scientific example, in one story the farmer brother of a philosopher (that is, a Ph.D.) regains the family rice lands lost in a "battle of wits" between the philosopher and an oracle. As the tale goes: In the dawn, after a sleepless night, the young farmer placed some tools in a cart and pushed it through the village to the mouth of the oracle's cave. He shouted loudly, "Mr. Oracle, I would challenge you to a battle of wits." The oracle assented. "And for a thousand pieces of gold," added the farmer. "So be it," responded the oracle. Then from the cart the young man removed a large scale or balance and ostentatiously suspended it from a limb of a nearby tree. And taking out a long cane knife and feeling its keen edge with his thumb, he faced the orace and demanded: "Mr. Oracle, tell me, how much does your head weigh?"

Perhaps this aspect of Chinese culture is the reason for the present success of the "barefoot physician," where respected wise memebers of villages are exposed to modern medical principles, an approach that is being extended to other fields.

I have taken too much time already, so I will only mention what is probably the most downright serious aspect of our present times, the common failure of scientific, social and historical understanding to influence policy.

The ills of this failure of communication include the emergence of the scientific advocate on one hand and, on the other, the retreat of many scientists into some area remote from the practical test. Both often resent the intrusion of lay understanding and applied programs that might solve problems. Both contribute to our poor definition of problems and the deep misunderstanding of the public and the government on the nature of this creation.

Let me sum up a bit. As I warned you, I have not taken time

throughout this response to point out, item by item, my views of the guidance that these conditions afford Sea Grant. I hope that these have been apparent. Obviously, I am exceedingly enthusiastic toward Sea Grant and its future.

Clearly Sea Grant can escape from the dominance of specified and perpetually frozen approaches to perpetually frozen and oftimes meaningless objectives, which beset many large national programs. It can profit from the flexibility of small approaches, taking a long-shot and discerning the unexpected or even, perhaps, discovering the inconceivable. It can profit immensely from the synergism and intercommunication of new mixes of intellectualities and proclivities: intelligent and informed lay persons, broad scientists, specialists (excepting, of course, dingy-spirited ones), engineers, technicians, industrialists, and politicians. It can avoid being entrained in the common misconceptions of the sea. It is and can remain a refreshing, revivifying and evolving force working around and over and perhaps even disinterring the frozen mastodons now buried in the vast terminal moraines of large and static programs. Perhaps it is time for Sea Grant to beard some giant problems, the disposal of high level nuclear waste, for example, or fundamental multi-species fisheries theory for another.

One last tale. A wise man once came upon three masons working on a long wall. He approached the first mason and asked, "What are you doing?" and the fellow responded with some asperity at the question's obviousness, "I'm laying bricks!" To the same question the second mason said, "I'm building a wall." But the third pointed his trowel upward and acclaimed, "I am creating an edifice."

It is for that reason I believe the aspirations of Sea Grant are best compared to those of the third mason that I feel particularly honored to have been selected for the Sea Grant Award and also for the opportunity to have imposed some of my ideas on you.

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