# U.S. Marine Scientific Research Assistance to Foreign States

## PROCEEDINGS OF A CONFERENCE

Second Edition

Ocean Policy Committee
Ocean Affairs Board
National Academy of Sciences

25-27 March 1974

NATIONAL ACADEMY OF SCIENCES
Washington, D.C.

NOTICE

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Ocean Affairs Board
National Academy of Sciences
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

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## CONFERENCE SYNOPSIS

### *25 March*

Conference Scope, Objectives and Background Issues

### *26 March*

U.S. Academic Institutions - Marine Scientific Research Assistance Programs

Open Forum

Fisheries Research Assistance Programs

Open Forum

### *27 March*

Federal Marine Research Assistance Programs

Open Forum

Panel Discussion on Needs and Interests of Developing Countries

Workshop

# PREFACE

With funding provided by the National Sea Grant Office of the National Oceanic and Atmospheric Administration, the Ocean Policy Committee of the Ocean Affairs Board organized a conference on marine technical assistance by the U.S. marine science community to foreign nations.

The United States occupies a leading position in marine science and technology. This position provides both an opportunity and an obligation to furnish assistance to the growing marine science activities in the developing countries, including an effective transfer of scientific knowledge and supportive technology. The level of such assistance and cooperation is known to be high; however, the nature and content of this assistance and cooperation are poorly known. The conference provided an opportunity to survey the scope and character of previous and existing marine science technical assistance programs of both U.S. academic institutions and nondefense federal agencies and to assess their capacity to respond to the perceived needs of foreign States.

The conference was divided into the following sections: background issues; academic programs in marine science; fisheries programs and problems; overseas programs and problems; and programs of federal civilian agencies in marine science assistance. Prepared papers were presented on each of the topics, followed by discussions to construct a framework of needs, conflicts, and problems involved in marine science assistance programs.

These proceedings, consisting of the prepared papers, panel discussions, and workshop discussions are made available to those individuals interested in the multifaceted implications of marine technical assistance programs. It is hoped that the results of this conference will help to increase the effectiveness of such efforts in the future.

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# U.S. MARINE SCIENTIFIC ASSISTANCE CONFERENCE

## INTRODUCTION

Certain prospective provisions of the Law of the Sea (LOS) treaty, which is scheduled for negotiation in Caracas, Venezuela, this summer, hold special significance for members of the U.S. marine scientific community. During the preparatory discussions held in Geneva and New York, it became increasingly probable that the LOS regime would provide for a zone of some 200 nautical miles offshore. This zoning would allow each coastal state to exercise some power to regulate access to the resources of the sea and seabed, including access for purposes of research. Similarly, it seemed likely that an international authority would be established to regulate to some measure research in this area. Whether the power to regulate research in each of these areas will differ greatly from that power relative to resources exploitation remains to be resolved when the treaty language has been settled.

Basic to the resolution of this question of power is the concern of the less industrialized countries (LICs) about the technological advantages enjoyed by the industrially advanced countries (IACs) in discovering and exploiting marine natural resources. The IACs, in turn, fear that an absolute requirement of consent to conduct research, either in coastal waters or the high seas, would seriously interfere with the continuation and extension of their ongoing marine scientific research programs. Moreover, a relationship of interdependency between these two sets of interests has been established by the desire of the LICs to develop the scientific and technical capabilities required to investigate and exploit their marine natural resources and by the ability of the IACs to assist them in doing so.

The conference on U.S. Marine Scientific Assistance was organized by the Ocean Policy Committee of the Ocean Affairs Board (OAB), National Academy of Sciences, in part to wrestle with this problem and in part because the nature and content of cooperation with, and assistance to, LICs were unknown. Although academic institutions, research institutes, and nondefense federal agencies have responded in a variety of ways to the technical needs of developing countries, little information exists concerning the scope and impact of these efforts.

During the conference, a number of obstacles emerged that must be removed before marine research can be effectively related to the coastal countries' marine resource potentials. In particular, there is the lack of general U.S. policy and program for marine science activities, especially for marine scientific assistance. The information provided both formally and informally at the conference showed the lack of a comprehensive framework for the support of oceanographic and other marine research, the absence of any national commitment to marine technical assistance, and consequently, a small volume of activities that could be classified as making some contribution, however slight, to the development of the marine scientific capabilities of the LICs. Institutions conducting these last-mentioned activities, however, were typically ignorant of each other's activities even when located in neighboring states and engaged in similar technical assistance efforts *vis-à-vis* the same foreign country. This gave rise to the suggestion that the OAB explore the possibility of establishing a data-base of U.S. efforts to assist developing countries to create or improve their marine scientific and technological capabilities.

The absence of a national commitment to marine technical assistance was manifest in several ways. One was the lack of any mechanism for funding technical assistance in the marine field specifically. In rare

cases it has been possible to finance programs whose main thrust has been toward aiding a developing country. More often than not, however, such assistance has been rendered as a by-product of research or teaching undertaken for other reasons. Conversely, the paucity of individuals and institutions with experience or even an active current interest in technical assistance in the United States seems to clarify the lack of funding.

Another obstacle is the marine scientific community itself. As a whole, it has little understanding of the assorted capabilities needed and wanted by the LICs for rendering technical assistance effectively. An important contribution of the conference, therefore, was its emphasis on the need to look at technical assistance from the perspective of the recipient countries. A large number of concrete suggestions were put forward by those with experience in this area about how such programs should be initiated and executed.

Before technical assistance programs can begin, however, a great deal of preparatory work must be done. As one of the participants in the conference observed, it would not at this moment be possible for the U.S. marine scientific community to launch a substantial program of assistance to LICs, even if ample funding were made available. Requisite knowledge and understanding of what needs to be done and how to do it are just not available. For this reason, many of the participants agreed that early steps should be taken to overcome this programmatic deficiency, and the hope was expressed that the OAB would take this in hand.

As the result of a subtle change in perspective during the conference proceedings, it thus became clear that the real question to be faced by the U.S. marine scientific community was whether it should seek to initiate and maintain new and carefully programmed technical assistance efforts and, if so, how and on what scale.

Many conferees favored an affirmative answer to this question. Several expressed the strong conviction that the United States had a moral obligation to assist the LICs to develop the capabilities to make better use of their marine resource potential. Many others also emphasized the benefits to be derived from widening and deepening our technical assistance efforts. The benefits would include not only those intended for the LICs but a great many that would accrue to the United States both directly and indirectly from the enhanced capabilities of the LICs.

# THE NEEDS AND INTERESTS OF DEVELOPING COUNTRIES IN MARINE SCIENCE RESEARCH ASSISTANCE

J.W. WINCHESTER

Conference participants were most articulate when discussing experiences of U.S. ocean scientists while working with persons from developing countries to build academic marine science programs there. Accounts of the needs and interest of scientists in the developing countries were given in a personal way as well as accounts of the personal satisfaction of U.S. scientists in engaging in the assistance effort. In spite of arrangements difficulties, including a shortage of funds and an abundance of red tape in obtaining clearance for research vessels in territorial waters, the needs of the developing countries for the assistance were regarded as very great and well worth the effort to overcome these difficulties. At the same time, however, some doubt was expressed about the real value of training developing country scientists to engage in highly technological ocean research and about the real competence of U.S. ocean scientists to provide the most needed marine science assistance to developing countries by means of additions to research cruise programs.

Conference participants were least articulate when discussing where the best self-interest of a developing country lies as it contemplates building up a marine science program. There was no presentation of an economic analysis of living and non-living marine resource potential in any developing country, even though most conference participants assumed that economic development should be the primary consideration. There was no socio-

political analysis of science policy and economic development in a developing country, even though some conference participants recognized that technical assistance efforts should ultimately attempt to assist governments, not just academic scientists, in formulating prudent science policy. There was no in-depth analysis of the nature of the self-interest of the developed countries in engaging in marine science assistance to developing countries, even though the participants tended to regard many marine resources as common world goods requiring global efforts at conservation and which will certainly attract increasing international competition for their exploitation.

Agreement was expressed by the conference participants on the following points:

1. Assistance in marine science to developing countries is an important issue both to the developed countries and to the developing countries. Unfortunately assistance programs are underfunded by the U.S. and other developed countries relative to their actual importance, and there is evidence that many developing countries, in spite of some public pronouncements to the contrary, also rank them too low in their national priorities.
2. Assistance programs are most effective if they are in response to clearly understood national needs expressed by the developing country. These needs are assumed to be economic development, and the importance of marine science is assumed to be in maximizing the return on living and non-living marine resources to the developing country. Consequently, assistance programs should be tailored to the economic development strategy of the developing country, not to the potential for low-cost spin-off from U.S. ocean research programs.
3. Most U.S. marine science assistance to developing countries is at present in the area of fisheries, and the needs and interests of developing countries were expressed at the October 1973, Marine Science Workshop in Bologna, Italy, most clearly in fisheries resource development. However, the interests of

developing countries are certainly much broader and include seabed mineral resources. Moreover, since a significant fraction of the ocean fisheries yield from developing countries is exported for cash return on the international market, rather than reckoned in value for domestic protein consumption, it is a possibility that future development of marine resources by many developing countries will take place in an international economic context and not one determined primarily by domestic factors.

4. Marine resources, including fisheries and petroleum and other seabed minerals, are rising in world importance, and a significant fraction are controlled by developing countries. It is probably in the best interest of the developing countries to have indigenous capability to evaluate these resources and to design the strategy for maximizing the economic return from them rather than rely heavily on advice and expertise from other countries. Scientists from developed countries are ready to assist in building up this indigenous capability.

Disagreement was expressed by the conference participants on the following points:

1. Because of the complexity of the task of building a marine science effort closely linked with national economic goals in a developing country, it is not at all clear that this should be undertaken primarily by oceanographers as an added responsibility to their research. Moreover, it is not clear that training developing country scientists to carry out research similar to that pursued by high technology laboratories in the U.S. will greatly aid these scientists in meeting their national objectives of marine resource and economic development. However, the initiatives taken by oceanographers in the U.S. and other developed countries in assisting colleagues in the developing countries are commendable and should be continued. The point at issue is not the propriety of such initiatives but their adequacy.

2. Concern was expressed that assistance to academic scientists in developing countries, either on an individual scientist basis or on an inter-institutional basis, may not provide an effective input of scientific judgement into governments of developing countries or provide an improvement through science and technology in the well-being of the public at large. In a number of countries a transformation of the science infrastructure is needed to provide the links between advanced education and research and meeting social needs. Sometimes links exist mainly with a social elite who, through control of their governments, wish to assure that they be the principal benefactors of marine science assistance. Oceanographers participating in the conference were not sure how to deal with this problem.
3. The agent whom a developing country is most likely to turn for scientific advice on marine resource questions was predicted differently by different conference participants. On the one hand, individual scientists found that their colleagues in developing countries turn readily to colleagues in developed countries for a broad range of formal and informal help on marine science affairs. On the other hand, governments of developing countries are viewed by some as being suspicious of the motives of developed country governments which are considered as less than altruistic. Even UN agencies, some felt, are not completely effective as sources of impartial scientific judgements because of the feeling by some countries that they are controlled by developed country interests. However, others considered that it is still likely that a developing country, in wishing to assess the potential of a particular resource, such as OCS oil and gas reserves, may turn to corporate expertise in a developed country. However, most participants appeared to agree that a developing country should move as swiftly as possible to build its own expertise in handling marine resource questions and then work cooperatively with other countries.

In conclusion, a better assessment than we have now of the true needs and interests of developing countries in marine science is needed, and this must be carried out, not mainly by oceanographic research scientists in developed countries, but with the initiative taken by governments of developing countries. Unless this is done soon, much may be lost in the increased world competition for exploitation of living and non-living marine resources.

# PROGRAMS AT ACADEMIC INSTITUTIONS

V.T. NEAL

Academic institutions in the United States have been involved in assisting foreign nations with educational and research programs in marine science for many years. Examples of this assistance were given in reports on a) the Cooperative Research Programs carried out at Woods Hole Oceanographic Institution, b) the Latin American Oceanographic Educational Center at Oregon State University, c) the International Center for Marine Resource Development at the University of Rhode Island, and d) the International Marine Biology Program at the University of Miami. These programs demonstrate the many forms in which assistance may be given: (1) acceptance of foreign students into graduate programs in marine science; (2) provision of reprints, publications and reports to foreign scientists and institutions; (3) exchange of professors; (4) provision of opportunities for foreign scientists and students to participate in oceanographic cruises; (5) cooperation with foreign scientists in developing and carrying out research programs; (6) advisory service for educational and research programs; and (7) short term training programs for foreign technicians.

Since World War II some major programs have provided the basis for substantial international cooperation in oceanographic research. Most notable are the International Geophysical Year, the International Indian Ocean Expedition, and the establishment of the International Decade of Ocean Exploration (IDOE) programs.

In spite of the emphasis placed on international cooperation in the programs mentioned here, participation of foreign scientists on cruises of oceanographic ships

operated by U.S. educational institutions has been very low. For example, on the three large ships operated by Woods Hole, only about five percent of the scientists on board during the period from 1967 to 1973 were from foreign countries. It is estimated that less than half of these foreign scientists were from lesser developed nations. The low rate of participation is difficult to rationalize since many of the U.S. ships spent almost half of their time at sea operating within 200 miles of foreign coasts. In some cases the lack of participation by scientists from lesser developed nations may be because of the lack of suitably trained personnel in a given country. Another reason may be lack of communication, i.e., the announcements of the cruises (if sent to the countries involved) may not reach the correct people in time. The most effective way of getting participation has been person-to-person contact between the chief U.S. scientist on the cruise and the scientists in the other countries.

Although the presentations given were prepared independently and described different types of programs, they all tended to point out similar problems and needs. They also indicated that a considerable amount of effort, albeit fragmentary, has been given to assistance programs, particularly in Latin America.

The basic problems and needs that were frequently mentioned not only in the papers given but also in the discussions that followed are summarized below.

1. Personal (scientist-to-scientist) contacts are very effective and should not be handicapped by unnecessary bureaucracy.
2. The U.S. image suffers from an apparent lack of continuing commitment. Vacillation in U.S. attitudes toward foreign assistance programs and a seeming lack of direction are major causes of skepticism.

3. Those academic units in the U.S. that try to establish and maintain good assistance programs with lesser developed nations have great difficulty in finding the necessary financial support.
4. It may be difficult to arrange and carry out effective programs because of communication problems. This may be because of the time factor (i.e., bureaucratic deadlines) or cultural factors or physical factors (distance between countries and operational problems within mail systems).
5. U.S. scientists involved in cooperative programs need patience and sincerity and must be diplomatic. In addition, they need to have an understanding of the history, culture, politics, and language of the other nation(s).
6. Needs of the other nation can be better appreciated by U.S. scientists if they teach and do research under the conditions that prevail there.
7. Although it is helpful to have some of the foreign students educated in the U.S., there are definite advantages to be gained by teaching students in their own region.
8. Foreign scientists are sometimes asked to attend meetings and conferences to help set-up recommendations for assistance programs that will be helpful to them.
9. Foreign nations wishing to obtain assistance must have a commitment to marine science, must have jobs for those to be educated or trained, must have realistic long range plans and goals, and must establish national priorities.

# FEDERAL AGENCY ACTIVITIES IN MARINE SCIENCE ASSISTANCE TO DEVELOPING COUNTRIES

H.B. STEWART

The steering committee of this conference specifically restricted consideration of federal activities to those of the civilian agencies. It is well known that the Department of Defense, primarily through the Naval Oceanographic Office, does provide considerable marine training and equipment to developing nations; however, the conference preferred to concentrate on those activities that were initiated for reasons other than any military ones.

Although almost all federal agencies with marine responsibilities carry out international activities to some degree, it was decided to limit consideration to those activities of the five agencies with major involvement in international marine science: the National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF), Smithsonian Institution (SI), Environmental Protection Agency (EPA), and the Agency for International Development (AID).

The papers that follow provide the details, but it was clear from the formal presentations and from the discussions that followed them that the present level of marine science assistance by the federal agencies to developing countries is extremely low. The AID effort, for example, has been seriously curtailed over the past two years. Their total personnel has been reduced by 28 percent, and their present funding is focused on concluding the existing programs rather than initiating any new ones. Projects in the marine field have suffered along with others. NOAA has no funds whatsoever for providing marine science assistance to other nations,

and such work as they have accomplished in this area has either been funded by AID or UNESCO or else done as part of some other program through internal reprogramming, e.g., the 1972 education and training cruise aboard the DISCOVERER as part of the Cooperative Investigation of the Caribbean and Adjacent Regions (CICAR).

The National Science Foundation contributes both through its Office of International Programs and through the program for the International Decade of Ocean Exploration (IDOE). Although NSF funding for this work was described as reaching "barely to the non-trivial level," the IDOE program over the past year has taken on considerably more international flavor. More foreign co-investigators are involved, and more IDOE activities are taking place in foreign waters than was the case earlier. However, these programs are still directed primarily to the interests of U.S. scientists, and any advantages that may accrue to developing nations are incidental.

The Fellowship Program of the Smithsonian Institution puts investigators from other countries on an equal basis with those from the United States in competing for fellowship support, so there is no significant participation in this activity by persons from the less developed countries. Utilizing primarily PL480 funds, the Smithsonian has carried out foreign programs at the rate of about $4 million per year, of which a small portion is directed towards marine science. Their major contribution has been the establishment and operation of the Marine Biological Sorting Center in Tunisia which provides both a service to the Mediterranean nations and a training facility for biologists in the region.

Of the five agencies represented, only EPA seemed to approach an adequacy of funding for its international activities. Even this agency's work overseas is not directed specifically toward assisting other countries, but rather its international mission is "to engage

directly with other nations in activities of specific interest to EPA." They support informal exchanges and visits of experts as well as funding pollution-related programs in Canada, Mexico, western Europe, Tunisia, Yugoslavia, Poland, Japan, India, Israel, Egypt, and the U.S.S.R.

Although each federal representative gave an adequate presentation of what his own agency was doing in marine science that might assist the developing countries, it was obvious that only AID had a specific mission to assist such countries, and even that effort is essentially phasing out for lack of funds and personnel. The only conclusion possible is that the present policy of the federal government does not recognize marine scientific and technological assistance to developing countries as an activity deserving of support. In the present budgetary climate where program support depends so heavily on expected returns on the investment, the marine scientific community has so far been unable to justify any real federal effort to transfer U.S. marine science and technology to the developing countries. If we can demonstrate the pay-offs, show an expected return on our investment, a well conceived and clearly enunciated program plan might elicit the federal support that is needed if the United States is ever to mount an effective federal effort in marine science-both abroad and at home.

# FISHERIES

J. LISTON

The fisheries section of the program was divided into three topic areas: 1) capabilities of U.S. institutions involved in Fisheries education and research; 2) 2) recent, ongoing, and projected inter-institutional overseas programs in Fisheries; and 3) problems encountered in operating overseas programs. It was clear both from presentations by speakers and from floor discussion that there is a substantial *de facto* training program for overseas students at most universities offering Fisheries work. This takes the form of a variably large enrollment of foreign students in these institutions, but only in a few cases are special programs offered. The need for specific training, or at least individual attention, was underscored by a number of speakers, who emphasized in part the desirability of relating the training experience to needs and conditions in the trainee's home country. Many examples were given of the discontent of inappropriately trained foreign students and the frequency with which they return to the U.S. seeking work. It was suggested that this problem could best be met without disruption of departmental curriculum by extending training beyond the University to governmental or industry laboratories and by selecting research topics for foreign graduate students which relate to problems in their home country and which involve methodology which can be used in the home country (i.e., avoiding dependence on very expensive or sophisticated equipment). Curricula from various U.S. West Coast institutions were compared and found to be reasonably comprehensive in coverage, offering foreign students a number of alternative programs. However, deficiencies were noted in the training available in the fishing sector itself, though this could be compensated for partially by actual shipboard experience. It was pointed out that at least

one East Coast institution has a comprehensive fishing technology training program. The emphasis on young scientist training which dominated the first topic area discussions was appropriate--as later topics were discussed, it became obvious that the dominant theme was that to be effective, international programs must be directed towards people rather than instruments or facilities. Successful programs involved a very high level of person-to-person contact at all stages of development, with cooperation rather than dictation of the functional *modus operandi*. Most speakers emphasized the need to work with professional personnel in developing countries as colleagues, rather than as trainees. One even made the important observation that young scientists of less developed countries (LDC) should be "allowed to make their own mistakes." The requirement for an easy, cooperative relationship should not, however, detract from the equally important need to establish a well thought-out program plan with phased operations leading in a stepwise fashion to a defined set of ultimate goals. These goals must be set in terms of the LDC needs and, ideally, should arise as an LDC scientist initiative, through joint discussion between developed country and LDC people in face-to-face situations. The need for flexibility in the timetable of such plans and the actual operational steps was emphasized to permit a natural development and to enable new and unexpected opportunities to be seized. This was illustrated in the accounts of the program of cooperative assistance between Universidad Catolica de Valparaiso (UCV), Chile, and the University of Washington (U of W), Seattle, which formed the core of the presentations of a number of the speakers.

This program, which was started at the request of the Chilean faculty and developed through discussion, written communications, and much personal contact, was designed primarily to upgrade the Escuela de Pesca in terms of staff qualifications, curriculum, teaching effectiveness, and other aspects of the instructional

role, and also to improve its usefulness as a resource institution for industry and government in Chile. Moreover, since the school was unique in Latin America in the scope of its coverage of Fisheries topics, it was agreed that one suitable objective would be to develop it as a center for Fisheries Training in Latin America. In fact, most of the aims and objectives were achieved in the course of the total program, which has extended to date over nearly eight years of cooperative activity, though only four of these were in fact years of funded activity.

The base-line funding for this program was provided by the Rockefeller Foundation, but flexible operational planning permitted the concomitant utilization of support from U.S. AID, Peace Corps, OAS, the Chilean government, FAO, and the Ford Foundation. This not only helped to accelerate achievement of the primary goal of international development, but extended the impact of the program into the areas of government planning and development, resource utilization, industrial development and improvement of artisanal fisheries. Emphasis was placed on the need for concomitant development of expertise at various levels in university development programs. This is only possible, of course, where some competence does exist at each level, as in the case of the UCV-U of W program, and underscores the advantage of building upon existent structures in education, rather than trying to develop new systems from scratch. This was shown to be a major factor in the success of the Chilean program and the extent of its influence on extra-University fisheries affairs. Projects funded by the Chilean government or other international sources and involving students and faculty of UCV and U.S. faculty were an early and continuing feature of the UCV-U of W program. Moreover, in the latter stages of the total program, one U.S. participant worked directly with artisan fisheries groups, extending the effort down to the roots of the fishery problem and involving students, faculty, and government people in this project.

It was felt that in the developing countries, where trained professionals are in short supply, this type of mixed approach is not only desirable but necessary, even where the primary focus is university development. On the other hand, it was also emphasized that the ultimate goals of the program must always be kept in mind, and diversity of effort within the program should not be permitted to blunt the thrust towards their achievement. This is one area where the experience and scientific objectivity of the developed country scientists can be applied effectively. A warning was sounded against excessive "bigness" in programs, since this attracts a bureaucracy which siphons off money from program operations and can greatly impede the rate of progress towards the objectives. In addition, bigness can strain the capabilities of the U.S. participating institution, forcing it to a choice of devoting an increasingly large portion of its efforts to the overseas program, thereby undermining its domestic base and ultimately reducing its capability to meet either domestic or foreign needs. In such a situation, it was suggested that a consortium type arrangement be considered in which a number of U.S. institutions agree to act jointly in an overseas project. However, a warning was sounded that the consortium organization itself should be firmly based in the operating departments and not at the institution administrative level. In this way, bureaucratization can be minimized and decisions can be made and acted upon quickly. Such an arrangement requires much forbearance and trust on the part of institutional administrations, but the example of the Consortium for the Development of Technology (CODOT) was cited as proof that such an arrangement can be made. CODOT involves cooperation at the department head level between Food Science and Technology departments at the University of California (Davis), Michigan State University, the University of Rhode Island, University of Washington, and University of Wisconsin. The business office is situated at U.R.I.,

which generously provides the necessary financial and other services, but operating decisions are made by the executive committee of department heads (or their representatives), who are actively involved in the ongoing overseas programs.

The general importance of technician and sub-professional training was emphasized by a number of participants. The serious deficiencies of present programs for training fishing skippers and middle management personnel were clearly presented. Present programs commonly supported by U.N. agencies emphasize quantity production. Facilities are usually excellent but the quality of teaching is variable and frequently inappropriate to the needs of particular developing countries. There is too little emphasis on fishing technology, and there is insufficient depth in background science and engineering. This limits the usefulness of trainees as potential middle management people in a developing industrialized fishery. While it was recognized that in-country (i.e. LDC) training is ultimately the most effective procedure, it was suggested that instructors for such programs should be prepared through a program in a well equipped U.S. institution such as U.R.I. This also relates to another major concern of participants - the artisan fishery. It was pointed out that these small boat fisheries frequently account for the great bulk of the fish landed for domestic consumption, and yet there was doubt that the artisanal fisherman could best be helped by industrialization. Several participants described programs of mechanization for artisanal fisheries which effectively increase their productivity and provide for cash income without completely changing the social structure within which they lie.

The value of foreign national participation in research cruises or other aquatic research activities of U.S. universities or other institutions was also raised. The highly personal nature of the U.S.-Foreign contact here was felt to be particularly useful and uniquely

effective. However, it was stressed that it is important to treat such foreign participants as colleagues and co-investigators, rather than as junior personnel to be directed. Participation must be as equals, even though a great difference in qualification may exist. Real participation should be arrived at in planning, execution and evaluation of results. Working together means more than simply standing around observing.

The many multilateral and bilateral arrangements in fisheries in which the U.S. participates were not discussed at this meeting. Since most of these are essentially organized at the government level, it was decided that they would not fit well within the Institution to Institution concept on which the conference was based. However, these arrangements may in fact involve technological transfer and are, in any case, important to groups involved in international activities. They should not be ignored.

In general, those conferees who have participated in overseas programs, whether structured or unstructured, felt that the experience was beneficial to them as individuals and to their institutions. Apart from the obvious personal satisfactions of helping to fulfill human needs, the U.S. participant acquires new knowledge, new viewpoints, and, of course, access to areas of scientific research which may not be available in the U.S. Nevertheless, it seemed to be agreed that present efforts of technical assistance in fisheries were too small and, in view of the tremendous importance of fish as a source of protein food for the LDC's, that a stronger national commitment was needed with sufficient funding and a program management system which would facilitate rather than impede effective technology transfer.

# PROBLEM OF MARINE SCIENCE RESEARCH TO FOREIGN STATES

W.S. WOOSTER

The problem of marine scientific research assistance to foreign states comes urgently to our attention because of recent developments in the law of the sea, and particularly the issue of "freedom of oceanic research." Yet many of the programs to be discussed at this meeting have been underway for the last ten or twenty years, long before restrictions on oceanic research became detectable, let alone onerous.

Why did marine scientists and their institutions get involved in technological transfer long before the phrase was even coined and certainly before they were forced by circumstances? First, because it is a natural attribute of science to disseminate its results. Science without publication is like the legendary tree that falls unheard in the Siberian forest. The very process of achieving understanding cries for the sharing of this understanding. It is natural for science to be overt, not covert.

Second, marine science in the U.S.A. has been largely an activity of academic institutions whose responsibilities include not only the acquisition of new knowledge, but also dissemination of knowledge, both old and new, and public service whereby such knowledge is made applicable to problems of mankind. It is natural for academic institutions to train people and to contribute to the solution of societal problems.

Third, oceanography is a global science and puts its practitioners in contact with people and problems in other countries. If one, for example, studies

eastern boundary currents, he may be limited by what he can understand in the California Current. He then looks for analagous but more tractable or strongly developed phenomena, finds himself in the Peru Current where he is faced not only with fascinating scientific opportunities but also with a developing country, richly endowed with marine resources, concerned to build a marine science capability, and deeply involved in the political problems of the law of the sea. It is natural for marine scientists to be interested and to become involved in cooperative activities with scientists in other countries.

Discussion during the next few days will illustrate the extent to which U.S. marine scientists have shared their results and have participated in training and the other aspects of technological transfer. Yet, despite the magnitude of this effort, the positions and attitudes of the developing countries in the law of the sea debates suggest it has been a failure. Their positions on controlling oceanic research by foreigners reflect a lack of confidence that the findings will truly be shared and demonstrate our failure in developing scientific attitudes in these countries. Was our effort too small, was it misguided or badly focused, or is the problem entirely too complex for the type of effort applied?

These questions are important because the U.S. is desperately bargaining to preserve the possibility of conducting oceanic research beyond the limits of U.S. jurisdiction. One bargaining chip is to promise to share results and to assist coastal countries in the application of those results. Suppose the bargain is struck, and we are committed to an active program of identifying and meeting the perceived needs of developing countries with respect to the marine research in which we engage. Can we determine from an analysis of what we have been doing, how effectively to meet this commitment?

I think that just the inventory of what we have been doing will serve some useful purpose. The effort has been significant, has been largely bootlegged from research funds, and has been little recognized, not only abroad but also in this country. Beyond this, there are undoubtedly some lessons to be learned from this review. I suspect, if we are really critical, they will include some of the following points:

1. We have not been sufficiently serious in our commitment in timely fashion to process, analyze in at least a preliminary manner, and distribute in usable form the results of our investigations. The developing countries -and the NODC- are getting tired of our excuses.

2. We have seldom involved scientists from developing countries in the planning phase of our investigations, even where this would have been helpful, and not commonly in the synthesis of their final results.

3. We have been lax in meeting our commitments to share samples and to return labelled reference collections.

4. While accepting foreign students generously in our educational programs, we have not gone out of our way to discover and alleviate their special problems, or to identify their special needs and interests.

5. We have given insufficient attention to identifying and developing the possible applications of our findings, insufficient not only for our international, but also for our national, obligations.

If funds were not limiting, how might we go about carrying out an active, even aggressive, program of technological transfer in marine science? I can think of several possible actions, none of them dramatically new, and I'm sure you will have others in mind.

1. Provide educational opportunities for research personnel, at the master's and doctoral levels, in U.S. universities, with programs closely tuned to the students' needs and opportunities for work back home.

2. Establish training courses for middle level staff-technicians and super technicians--at appropriate in some cases, tropical universities, with curricula specifically designed for the qualifications and work objectives of the students.

3. Provide facilities for repair and calibration of instruments, with funds for spare parts and for specialists who would travel to other countries to train users and maintainers of such equipment.

4. Organize interdisciplinary teams of scientists to assist developing countries upon request in planning and evaluation of programs; selection, procurement, use and maintenance of equipment; interpretation and application of data, etc.

5. Support U.S. laboratories engaged in field work in distant waters at such a level that scientists from developing countries can be involved in meaningful ways throughout the life history of research projects.

6. Fund long-term "sister relationships" so that the flow of scientists and students between institutions could proceed at an adequate scale and for sufficient time beyond the "incubation" period to where the mutual benefits would be firmly established.

But my task has been to introduce the topic of marine science assistance to foreign states, not to solve its problems, a responsibility that I bequeath to my successors on the program.

# LAW OF THE SEA CONFERENCE

J.A. KNAUSS

As Chandler Morse and Warren Wooster noted, I think it fair to say that the genesis of this meeting has been the discussions directed toward the Law of the Sea Conference. However, in my view, this conference has an importance independent of the Law of the Sea Conference, a point to which I wish to return.

The concern of scientists in the Law of the Sea Conference is straightforward. It appears that after the Law of the Sea Conference it will be more difficult for those who will wish to continue to do research on the oceans; the question to be settled is how much more difficult. There is a high degree of probability that there will be something equivalent to a two hundred mile resource zone negotiated at the Law of the Sea Conference, and unless we are very lucky, we might think of that 200 mile resource zone as a territorial sea as far as science is concerned; that is, the coastal nation will exercise the same kind of control over scientific research in a 200 mile resource zone as it now exercises in its territorial sea.

The area of the ocean involved is not trivial. Something like 37% of the ocean is within this resource zone, and 37% of the ocean is an area about equal to the land masses of the world. We made a calculation at the University of Rhode Island recently, using the last five years of TRIDENT cruises, and concluded that TRIDENT spent something like 45% of her time over the last five years doing science in other people's 200 mile zone. More recently, both Woods Hole and the University of Miami

have made a similar calculation and have arrived at about the same figure. Thus it would appear that approximately 30-50% of the effort of the U.S. academic fleet is spent in these proposed 200 mile zones of other countries.

Transfer of technology is another item on the Law of the Sea Conference agenda. To some extent this item has been coupled with the scientific research issue. For example, both items were assigned to the same subcommittee. I have not been involved in transfer of technology discussions very long, but having discussed the subject with economists, political scientists and others, it is clear that this subject means different things to different people and I am less confident than I used to be that I understand this subject at all. Chandler Morse has just presented a very broad conceptual approach to the subject of technology transfer and I have no quarrel with his thesis. I wish to limit myself to one small part of this total problem; namely, technology transfer as it may relate to the scientific research issue in the Law of the Sea Conference.

As a substitute to an explicit consent regime in the proposed resource zones, the U.S. has suggested, among other things, that we will share our data, encourage participation, and guarantee open publication of results as the *quid pro quo* for the continued right to conduct research in these areas. As Warren Wooster has indicated, the response to these suggestions has not been very enthusiastic. The reasons for this lack of positive response are several but amongst them is the fact that there is insufficient scientific expertise in most developing countries to make use of information and opportunities provided. In some cases they can make little or no use of the kinds of information we gather. As a consequence, the question has been raised as to whether a marine science assistance program would facilitate the freedom of science issue in the future. Although it is an intriguing idea, I know a number of people in this room who have been close to these negotia-

tions feel as I do; namely, that this is a very tenuous hypothesis, and although I have been one of the more outspoken advocates for this approach, I am not all that confident of its success.

On the positive side it is quite clear that it is easier for scientists to cooperate with one another when they have a commonality of interest, that is, when they are dealing with one another as scientific peers. Thus, it is comparatively easy for U.S. scientists to develop joint programs with their colleagues in the United Kingdom, France and Germany, for example. One can argue, therefore, that if we could develop a high level of scientific expertise in all coastal nations we could alleviate the most difficult parts of any possible consent regime. Of course, it is not quite that simple. U.S. and U.S.S.R. oceanographers are scientific peers and are interested in many of the same kinds of problems, yet both groups have had difficulty in trying to work off each other's coasts for reasons having nothing to do with science or scientists. If two scientifically sophisticated nations have these kinds of problems, we should not expect even the most successful marine assistance program to remove all barriers. Amongst the developing countries, at least, the question of a 200 mile resource zone is linked to attitudes of nationalism, a state of mind with many of the same qualities of irrationality that the term "national security" evokes in the U.S. and U.S.S.R.

From my listening to the debates on scientific research in the LOS preparatory meetings, the attitude that comes through most clearly is the fear of the unknown. These countries do not understand the nature of the science programs; they do not know what is going on; they do not think that the science that is being done is neutral, let alone in their best interests, long-range or otherwise. Thus, I am hopeful that if the U.S. could develop some kind of a realistic program in

marine scientific research assistance or technology transfer, call it what you will, that it would help the science issue at the law of the sea negotiations.

Note that this plea for a technical assistance program is based on law of the sea arguments alone and is independent of the most important reason for marine scientific research assistance. I realize it is somewhat out of fashion these days to discuss foreign aid but along with many other scientists, I believe, as I think many of you in this room believe, that development of science and technology is critical to the salvation and well-being of the developing world. I think we in the developed countries owe it to the world to foster the development of this type of expertise in the developing world.

My last point is that I think there is a danger in tying marine technical assistance too closely to the law of the sea even though, as I have indicated, the impetus for this conference can be largely traced to the law of the sea days. Let me give a few examples to indicate the nature of the problem as I see it.

Senegal may decide that the marine science assistance it needs most is that which would help develop or manage its fisheries. This means that a University of Rhode Island expedition to that area to study the propagation of edgewaves or post-Pleistocene sedimentation, for example, is not really contributing very much to the problem that Senegal has listed as number one on its marine science assistance agenda. Even when you take a program such as the Coastal Upwelling Experiment, which is related to biological productivity, there can be a technology mismatch as could have been graphically demonstrated by a visit to ATLANTIS II before she sailed from Woods Hole recently with all of the University of Washington equipment aboard. Even those of us who think we understand what is going on in science these days have to be impressed with the extraordinary amount of high technology instrumentation involved in this

program. It is not clear to me what kind of an impact this ship would have on scientists from developing nations who might participate. They might wonder whether meaningful cooperation is really possible.

If you ask yourself, is participation in a study of edgewaves or a high technology coastal upwelling program the most efficient way to build scientific research expertise in fisheries management, I think the answer is probably no, it is not the most efficient way. Does it do any good at all? I think the answer to that question is probably yes. But on the other hand, I think it is also true that what we at the University of Rhode Island do in Narragansett Bay and Rhode Island Sound is probably of more use to most developing countries than the research we conduct from our research vessel TRIDENT off their coasts.

There is a second kind of problem I see in tying scientific research assistance too closely to participation in research in the resource zone, and that has to do with the continuity of effort and the pattern of our research. We work where there are interesting scientific problems, and, at any given time, interesting scientific problems are not equally distributed around the world. For example, research ships have almost been queuing up to work in the waters surrounding Iceland because of its special importance to problems in global plate tectonics and for the next few years it appears we will all be working near the Galapagos for similar reasons.

In addition to the fact that we tend to concentrate in some areas more than others, there is the added fact that, to a coastal nation, our activities must appear somewhat irregular. A ship from one institution may go off the west coast of Africa to study one kind of thing and it may be several years before it will be back; in between another ship from another institution will be in the area to study a different kind of problem. If

marine science assistance programs are tied to specific operations, is this the most efficient way to build up expertise in a developing program? Again, I think the answer is no.

In conclusion, I would like now to return to my introduction where I noted that, although the genesis of this conference was the idea of exploring what could be done to help the freedom of science issue in the Law of the Sea Conference, I think that we would be making a mistake in these two days if we restricted ourselves to this particular issue. It seems to me that our real interests are to try to develop a marine science expertise in the developing world. I think it is clear that the best way to do this is not to tie such a program too closely to any given cruise or to any given project. I think that if we attempt to do so we will fail in the long run because such a program will be geared toward solving our scientific problems, not theirs, and the two are generally not identical.

# SOCIAL SCIENCE ASPECTS OF TECHNOLOGY TRANSFER IN MARINE SCIENCE

G. PONTECORVO

When Chandler Morse asked me to give this background paper, he also asked that I focus it on the social science aspects of technology transfer in marine science. I have picked three of these to talk about. I hope this emphasis will assist in relating the technical assistance and ocean science issue to the more general problem of economic development. I hope also that this approach will highlight some of the complexities facing those who are designing programs of technical assistance.

The three things that I want to mention are: first, the role of technical assistance and technical diffusion within an historical context; then I want to say a little bit about the question of time horizons--more exactly, the degree of freedom of action with respect to several alternative policies that various states have at any point in time; and finally, I want to talk a little bit about the framing of those alternatives, i.e., the question of national priorities and the appropriate social discount rate for alternative investment opportunities of which investment in marine science is one.

In order to organize our thinking in an historical sense about this process, consider three simple models: 1) observe the Pilgrims' landing on Plymouth Rock in 1620. Let's assume, first of all, that the technology available to them in terms of hardware, organizational techniques, etc. was fixed or constant, and also assume that after that initial landing, there was no further contact with or supply linkage to Europe; 2) in our second

situation, let us relax the second assumption and assume that there was a supply linkage with Europe but that technology there and here remained constant, i.e., did not evolve; 3) finally, let us assume what in fact happened, that there was a supply link with Europe and, in fact, technology constantly evolved.

At the time of the landing, it seems to me the Pilgrims had one very definite technological advantage, and that was in the area of social organization. We may say, to use the jargon of the economist, that they were pragmatic short-run profit maximizers, shiftable and adaptable, and that they had a very strong cultural focus. This cultural focus took many forms, one of which in later years we came to describe as a sense of manifest destiny. This social adaptability and cultural focus were conditions which the Indians could never easily understand or cope with very well.

The rest of the technological relationships between the Indians and the Puritans were not so clear cut. The Pilgrims had a gun, but the Indians knew a little bit more about agriculture and the conditions of life in North America. In other words, the margin of technological superiority, it seems to me, outside the political and cultural areas was relatively slim. If, therefore, we assume the condition of our first model, that there was no technological change and no linkage with Europe, it is reasonable to surmise that the initial colony would have ultimately, as in the case of the Jamestown colony, either been exterminated or absorbed by the native Indian population.

If we move to the second case, where the technology was constant, but where there was maintained a supply linkage to Europe, then it is hard to say what would have happened. In all probability, however, we would not have seen the rapid westward movement of American civilization. In this context, it is important to recall that it was the canal, the river steamer and the railroad that really

opened the West. In the absence of these techniques, the rate of return from the free land of the West would have been much lower and accordingly, the rate of movement slower. We may conclude, therefore, that what really made the difference was the linkage to Europe and the continuous evolution of European and subsequently American technology.

The Indians played a losing game, with ever greater disparity emerging between the rich and the poor. As long as the Indians insisted on having their own identity (or refused to accept the white man's on his terms), they had little chance to develop in the sense of increasing their material well-being.

In 1620, everybody at Plymouth was poor. By the time we came to Wounded Knee, the gap between the rich and the poor--between the native population and the white middle class--was indescribably large. This gap could not easily be overcome and, if it was to be overcome at all, it had to be done in terms of the cultural absorption of the Indian peoples.

This analogy is useful in that it gives us some inkling as to the schizophrenic attitudes and thinking of the LDC's toward the problem of technological transfer.

Now, to digress for a moment, there are two strains within Western scientific development--science and technology-- and their history is different. When we think about science we may think about Newton, Bohr, Maxwell, Einstein, etc. and when we think about technology in this period, we think about people like Townshend, Newcomn, Watt, Maudsley, Whitney, North, and so on. Historically, these two strains were not directly linked, even it seems to me, in a personality like Franklin. They were, of course, indirectly linked in the general fabric and educational activity of the society.

In this connection, keep in mind that little more than a hundred years ago, the basic temperate agricultural areas of the world were really not very inhabited. The trans-Mississippi U.S., Canadian West, Argentina, Australia, Siberia, etc. were not open to agricultural exploitation. The basic innovations that made the exploitation possible were, of course, the tramp steamer, the railroad and the harvester. It is important to note that these innovations which provided such a high rate of social return in the opening up of the interior of the continents had very little direct identification with formal science.

However, science was introduced effectively into the industrial process by the end of the last century, so that we begin to see such examples as chemistry entering metallurgy. Recall that the early Bessemer process which had little or no understanding of chemistry produced a highly uncertain product. By the end of the 19th Century you began to link very closely science and technology. And, in fact, the LDC's see this process--the so-called industrial revolution which really isn't a revolution but an ongoing process--as one of ever greater disparity between rich and poor, and one in which science and technology are today inexorably linked in the industrial development of the West.

Their immediate concern, however, is with those aspects of the process, the technological, which provide the higher immediate rate of return. Now notice that this concern also extends into the area of political, economic and social organization. These are also instruments in this process of development. On the social side, the developed states have utilized devices such as color bars, wage differentials, employment conditions that cannot be met, etc. to maintain their differentiated position. On the economic side, specifically you have the changing of the whole structure of production in certain states into so-called basic raw material producers of crops, such as cocoa, rubber and so on, and the justification of this on the grounds of a rationalization, the theory of comparative advantage. This has led to

turning whole societies into raw material producing areas for a world market economy. This process completely reorients these countries and forces changes in their social structure, but not in ways to which those societies have easily adjusted.

Incidentally, as a footnote to this, one of the things that the LDC's observe is that a key to upward mobility within Western society is the educational mechanism. The educational mechanism obviously interests them as a possibility for repeating the development process themselves. This, I think, as Professor Morse indicated, seriously misrepresents and misspecifies the conditions under which economic development actually takes place. And, it hides considerable confusion between the existence of science and technology or its presence in a society and its utility to that society.

Now, the point of this discussion about Indians and social organization is that when you start a technical assistance program, what you're really asking the LDC's to do is to ignore the heritage of five centuries of Western expansion. This includes renouncing a basic element in their ideology; that what we do is to our advantage and not necessarily to theirs. We are asking them to deal pragmatically with the here and now, while in a sense ignoring, as I say, their whole heritage of experience with us in the development process.

I would also point out one other thing that I think sometimes gets overlooked in this context. Technical assistance, if it is successful, actually threatens the societies it is designed to assist. Particularly in traditional societies, the infusion of a highly qualified technical elite which has a different set of values and a Western orientation which stresses rationality will create social tension and strife. States, such as Saudi Arabia, for example, find that increased revenues from the production of petroleum, a massive technical assistance program, is a mixed blessing.

Let us put aside our discussion of the implications of Western history for technical assistance and talk for a moment about time horizons. Theoretical models in the social sciences tend to be long-run equilibrium systems, and only recently have we developed the capability to introduce uncertainty into these systems. There is a constant tension, therefore, between the present and the future in our theoretical model building-- and this, I suppose, is best articulated on the popular level in Keynes' well-known dictum about the long run. But what this theoretical illustration means and why it's important in this debate is that we must inquire about how much time any society has to experiment with before it produces results that are socially and politically acceptable. Notice that this question of the length of the time horizon in any society is not independent of the level of social control in the society. All societies have a self image, in Tawney's phrase--there is a magic mirror that reflects the society and the image. The clarity of that image is really what suggests the extent to which any society may force itself to sacrifice the present to the future. But most developing societies in the world today do not have that kind of image of themselves, they do not have the kind of national cohesion, they are not willing to sacrifice current consumption for future higher returns for a national interest. Chandler's remarks about alternative societies' rates of development bear very heavily on this particular point. For example, consider the relative rates of development of China and India and the relative degree of focus and diffusion of those two societies.

I want to say this a little more precisely and perhaps make it a little clearer. Investment involves a transfer of consumption from the present to the future. If one is close to starvation, it is difficult not to consume what is available at the moment. Therefore, in most developing states, the time horizons get very short, and the social surplus that may be used for alternative purposes is limited. Only when the activities imply

relatively immediate returns can they be considered on any scale. And certainly, the more you have uncertainty with respect to those returns, the greater is the pressure to shorten the time horizon.

Finally, let me say a word about social priorities The simplest way of looking at this problem is to say that there is some rate of social discount which is ascertainable in a society, and that we can attach a net rate of return to each project and proceed to activate each as our limited resources permit. This, of course, is a welfare criteria based on the growth of output that maximizes the gross national product.

Now, the difficulties inherent in actually carrying out this process, and they are, of course, significant, should not deflect us from the importance of insisting on a process of rational choice, this process based upon specifying the alternatives and examining each, including marine science. Now, an interesting clue to this level of recognition of the implication of alternative choices in the marine area in developing countries, is contained in the report of the Johns Hopkins Bologna meeting on technical assistance. I'd like to read to you, if I may, a list prepared by Yohum Artus, the Chief of Marine Research Section, Hydrobiological Research Institute, University of Istanbul.

In compiling a list, Mr. Artus wrote, "The following priority list:

a) Fisheries problems and management and to some extent the use of pollutants toward obtaining a better yield.
b) Additional water supplies for domestic, industrial, and agricultural uses.
c) Protecting of the marine environment for recreational purposes against the hazards of pollutants.

d) Obtaining new resources, such as mineral resources, oil, natural gas, and protein from the ocean.
e) Obtaining a better understanding of the oceangraphic parameters in order to improve marine construction, including harbors, boats, quays, and so on.
f) Forecasting changes in the movements of the oceans and their biotic resources."

You will note that this gentleman specifies a list essentially in terms of applied technology and that, therefore, his social priority list includes those things which will bring the most immediate short-run returns to the developing state.

Let me conclude by indicating what I think are some criteria that the Conference might consider. These could be utilized to escape from some of the difficulties that I have alluded to here tonight.

1) First of all, I think that the objectives of any program should be kept limited and be specified precisely, and I think that probably means minimizing academic educational components.

2) I would make certain to the degree possible that the projects considered are visible. That is, that they have linkages--visible linkages--that the body politic in the developing society regards as significant for the society in question.

3) Any project should be able to demonstrate a flow of net benefits. And the project should be designed in such a way that the net benefits are ongoing and tend to cumulate. These might be thought of as scientific monitoring stations where employment opportunities and actual scientific activity, though at a relatively low level, may be an ongoing activity. Continued employment for nationals of a country will serve to develop a constituency for such a program, those in a particular developing state that actually have a vested interest in it, and can articulate this in terms of their own political environment.

4) And, finally, I think that you should begin with those projects that have the greatest prospect for quick visible success--the simplest ones.

# TECHNICAL ASSISTANCE IN MARINE SCIENCES

W.T. BURKE

It was a thoughtless moment when I agreed to serve on this panel to provide "background" information for this meeting. I am a lawyer, not a marine or fisheries scientist, and apart from not knowing anything about marine or fisheries sciences, I also acknowledge having a tremendous fund of ignorance about technical assistance. In short, it is not clear to me whether or not I have any fruitful role to play in providing useful background information. However, as one of the instigators of this session, it perhaps is desirable and perhaps even useful to try to recall what the idea was in suggesting the meeting in the first place. This requires mention of some relatively ancient history.

When Wib Chapman finally succeeded in 1968 in getting NASCO to include more than hard science and more than concern for the health of oceanography within the scope of the committee, the step they took was to create a sub-group to be concerned about the relationship of marine science with international legal, political, social and economic issues, including the then beginning concern over LOS negotiations. Although this group, called IMSAP then, and now with a broadened mandate and terms of reference, the OPC, soon stuck its nose into all kinds of business without being asked, I think it is fair to say that a goodly number of us spent more time discussing the question of technical assistance and with less effect than any other matter we were concerned about or with.

We began discussing this question in 1968, immediately after IMSAP's formation, and continued at it throughout the life of the group. Most of those concerned

besides myself had had a good amount of practical experience in various forms of assistance activity including Wib Chapman, Benny Schaefer, Warren Wooster, Giulio Pontecorvo, Carroll Wilson, Hiroshi Kasahara, and Clare Idyll. However, the interesting part of this is that we never really could come to grips with the subject or provide, though requested to do so, any useful advice on current assistance problems. Then, just as we were beginning the final phases in 1970 of a study which we began in late 1968 on various aspects of international marine science affairs, including a part on technical assistance, our two most energetic and creative members died (Wib and Benny) and while we managed to creep across the finish line I think we were not very satisfied with our treatment of technical assistance.

What we did essentially was make some *ad hoc* recommendations but reached one major conclusion, namely, that there ought to be a comprehensive study of this problem. Naturally after our failure to do much with the matter it only made sense to suggest further study.

Soon after completion of our report in January, 1971, IMSAP agreed to make this problem one of its top priorities for future work. And we did attempt to enlist the interest and assistance of others, almost always unsuccessfully. With the support of Roger Revelle and the Board he then chaired in NAS on Science and Technology for International Development, NASCO and IMSAP got a hunting license to find $100,000 to do a pilot study. The only trouble with this was that the hunters could never locate a likely target. Interest in the Academy varied from enthusiastic to lukewarm although mostly I think the support was very positive if not productive of cash.

All this time, I should add, it seemed very plain to all concerned that there should be action on the technical assistance front not only for its own sake but also because there was a strong link between such activity

by developed countries and the fate of marine science research in the LOS negotiations. In fact we felt that there was a potential gain politically if we could induce even some serious study of the problem by a qualified group. It is true that in 1971 the LOS preparatory meetings were just getting under way but it was already apparent from UN discussions and events in the IOC dating back at least to 1968 that marine science research was in trouble. From its beginning to the present IMSAP, along with NASCO and now the Ocean Affairs Board (whatever this may be at the moment), devoted particular attention to the freedom of science issue. The IOC became involved with this in 1968, had a major fight over it at the Sixth Session in 1969, and soon thereafter the focus shifted to the UN and the Seabed Committee. Throughout it seemed clear that the LDC's were disturbed over this issue and that at least some of the disquiet existed because of the great disparity in competence to carry on investigations at sea. This disparity no doubt reinforced, or was reinforced by, still other disparities of a graver nature.

The reasons for believing there was and is a connection between technical assistance and freedom for research are more difficult to establish. Among factors important for considering the existence of this connection are the following:

1) Suspicion that the benefits from research are going to widen the gap between developed and developing states. This assumes, and with ample basis, that LDC's were fully aware that the gap was already growing wider and that the developed states (especially) the U.S. were not doing much to narrow or appreciably reduce the widening.
2) Suspicion that research actually served, immediately and directly, both military and commercial interests not compatible with or agreeable to developing states. This was supported by perception of large military support for research.

3) The belief that research or other assistance could serve the needs and interests of LDC's at least under certain conditions.
4) The conviction that if research was to assist LDC's it would be necessary to exercise control over it to assure its orientation and application were appropriate to that end.
5) The belief that if developing coastal states are assured of protection of their concerns *vis-à-vis* the effects and activities of research in offshore areas that they will be more conducive to legal provisions offering reasonable protection from coastal obstruction of science.
6) The belief that if coastal states are given assistance aimed at their effective use of the information developed by foreign research offshore they will be more friendly toward U.S. science.
7) The awareness by LDC's that freedom of research is an important, if not dominant, interest of the developing states and that threatening restrictive controls over research may inspire offers of concessions in order to dissipate the potential obstructions.
8) An apparent perception by U.S. policy makers that freedom of science does serve U.S. and world interests.
9) A willingness, in principle, by the U.S. to offer resources through multilateral agencies to support assistance efforts. I take it that this statement of U.S. policy, occurring as it did in our first major policy speech on freedom of science, establishes that, on the policy-making level in the LOS delegation, it is accepted that there is a connection between assistance and political positions within LDC delegations on freedom of research.

It is fair to say certainly that for quite a few years there has been a strong and widespread feeling that assistance efforts in marine science need improving. After its first few years, the IOC was beset with this issue and there has been discontent all around on its failure to function more effectively in improving assistance efforts. In the past two years there have been numerous recommendations from the IOC or its WG on Training, Education and Mutual Assistance but these have not had much effect. In short, for whatever reasons it is generally agreed that assistance efforts in marine science need improvement.

One major difficulty that has frustrated discussion of the problem in the United States has been the lack of comprehensive inventory of ongoing efforts in our educational institutions and laboratories, the problems they confront, the methods employed, effects achieved, changes made, assets invested, and assessments of what ought to be done in the future to improve matters. It has been felt, by some at least, that it was not too productive to talk about an improved U.S. assistance program without having in hand a pretty good idea of the scale of the present effort and enough details about it to reach conclusions about future activities. Clearly the need is for this information on a global basis (including certainly the operations of IGO's and NGO's) but certainly for the American institutional scene for which information ought to be forthcoming most readily.

One would think this information could be gathered with some ease and occasionally we have been assured that at least one federal agency had full information on its assistance activities which it could make readily available. Somehow it never seemed to be forthcoming and the scale of federal effort has not been, so far as I am aware, ever identified with usefully precise description. And, of course, all are aware that much goes on through agencies other than the federal government.

So after waiting for a couple of years for a financial angel to show up, burning with eagerness to know more about assistance to LDC's by the U.S., we decided to quit waiting and try by means of a meeting of persons involved to elicit both a useful core of information and an initial assessment on how to proceed with improvements.

It no doubt hardly needs emphasis that the views of U.S. institutional participants in assistance are by no means dispositive of the direction of the future. The general perspectives on need and interest held by scientists, administrators, and policy makers within LDC's are indispensable ingredients to progress. The combined views of both groups -- the assistors and assistees -- are needed and ideally they should be developed simultaneously. For the moment, at least, we cannot proceed with the benefit of both sides together, but we do have the benefit of the workshop of developing nation scientists held in this subject in Bologna, Italy, in October 1973. It will be of interest to learn how their views mesh with those of the Americans who seek or might seek to furnish assistance.

Whatever else the present meeting produces on the positive side, it could have a negative effect if it somehow leaves the impression that nothing further needs to be done. My own belief is that the role of the oceans in resolving the critical problems of developing states is too obscure, too varied, and too complicated to yield to the efforts represented by this meeting, however strenuous they have been. However, the fruits of these discussions are important and hopefully will lay a firm foundation for progress.

# LEADERSHIP POSITION OF THE UNITED STATES IN MARINE TECHNOLOGY AND NEEDED ASSISTANCE TO DEVELOPING COUNTRIES

T.A. CLINGAN

The objectives of this workshop include an examination of how the leadership position of the United States and other developed countries in marine technology can best be utilized to provide the needed assistance to developing countries. At least two questions have already been raised which, in my judgment, provide us with excellent themes for discussion.

The first, which I think is of first level importance, is one that all speakers thus far have touched upon. Since our discussions of marine technology tranfer must be considered in the light of the need for freedom of marine scientific research, the question is what, if any, direct or indirect linkages can be found between the two issues? In most public discussions, it is assumed that the offer of technology can be used as the carrot to coax recalcitrant "consent-oriented" countries to make concessions with regard to the presence of research vessels near their coasts, or with respect to the number and kinds of restrictions they might be inclined to enforce upon the conduct of research by those vessels. It is no longer clear that that assumption can be easily made.

Clearly, there is a need for various kinds of assistance to developing countries. The point has been made that this need should be satisfied regardless of its linkage with the freedom of research issue. It can be evaluated in terms of training requirements, in terms of equipment, or in terms of sharing and exchange of data

and samples. That much is self-evident. But to what extent does the ability to conduct marine scientific research depend upon making these things available? If the demand to control research stems from purely political considerations, then the presence or absence of offers of technology may be a significant factor in the decision. If, on the other hand, the right to regulate marine scientific research is claimed because of underlying feelings of nationalism or mistrust, then offers of assistance would obviously be of less consequence to the negotiator.

There are unfortunately few clues that will assist us in responding to this kind of question. One can draw some fairly obvious conclusions, however. Professor Burke has given you an excellent list of clues or hints to the fact that there is a true linkage between assistance and the conduct of research. It is certain that a lack of scientific sophistication on the part of some of the developing nations has contributed to attitudes of mistrust, hence opposition. An increase in the level of understanding on the part of these countries certainly would not impede the attainment of the objectives of the developing countries in the forthcoming negotiations. At the same time, mistrust arising from emotional factors would not lead to the same result.

One of the clear signals Professor Burke listed was the offer by the United States to provide substantial support in terms of monetary assistance for marine technical assistance. Another clear signal of a linkage is the agenda that was prepared for the meeting of the third subcommittee of the Seabeds Committee, which includes both the topic of freedom of scientific research and the question of technical assistance (or mutual assistance) for simultaneous consideration. I believe that this is an indication of the intention of the drafters that both topics are important, and that both should be considered together. This is bolstered by the fact that both were assigned to the same working group for consideration.

Less clear, however, has been the general scope of the question of technical assistance. Some of the discussion from the floor of the Seabeds Committee suggested that the kind of technology developing countries were really interested in was in the area most people would call proprietary. If so, the linkage of issues is weakened. The statement of the delegation of the United States, however, made clear that they contemplated no assistance in areas other than purely scientific research. I would hope that sometime in the course of the discussion during the next two days some attention will be paid to the degree to which we really find ourselves in a realistic trade-off situation, or whether we have not yet established an open channel of communications on the same frequency between all parties concerned. We also must discuss the best way to deal with these issues in a negotiating mode.

Secondly, I believe the excellent opening remarks make it quite obvious that we are framing a discussion of institutional arrangements designed to achieve the effective utilization of any valuable programs we might be able to identify. Certainly it is not the purpose of this meeting *per se* to discuss institutional arrangements. Nonetheless, I believe that it would be helpful to the evaluation of the utility of various programs if we could ask the kind of institutional arrangement most likely to be successful in putting those programs into action, and the degree to which various institutional arrangements might either facilitate or hinder objectives. With that kind of discussion, we might begin to get a better feel for the degree to which we are interested in single-level systems with limited objectives and correspondingly limited costs, or whether we need to consider some kind of a flexible institutional framework such as has been discussed in a recent paper by Dr. Chandler Morse, which has the capability of subsuming a rather large number of individually tailored, *ad hoc* subsystems designed to meet a variety of needs and levels of technical requirements depending upon the demands and problems of

individual developing countries. With respect to the former, I might emphasize that the question of cost may become an extremely important one to research institutions, for it may well be that they will be called upon to absorb increased costs generated by new, severe restrictions on the conduct of research. If this occurs, it may be that less research will be done.

Some statements were made last summer by developing countries, but they were very few. And of those made, there was a general lack of substantive content regarding the transfer of technology. This includes the intervention by the United States. All this indicates, as of that time, a general lack of strong sentiment regarding the subject, although much of it may have been due to the lateness of the formation of the appropriate working groups.

All of the above indicates, Mr. Chairman, that questions of linkages, costs and institutions are fair game for this workshop. The degree to which we improve our understanding of their parameters is a measure of the likelihood that we will be prepared to meet the demands of negotiations this summer. And, in concluding, while the subject is outside the immediate scope of our discussions, I might mention that there are a number of existing institutional problems, mainly legal, within developing countries, that may be a bar to the conduct of effective transfer of technology. Negotiations leading to programs within individual countries will have to take these legal impediments into consideration.

# TRANSFER OF RESEARCH TECHNOLOGY

D.L. MCKERNAN

Mr. Chairman, I would very much like to bring before this audience some different and challenging points of view, if I can. It is fair to say that the United States government has linked the issue of the freedom of scientific research or the conduct of scientific research off foreign shores with the transfer of research technology because it becomes clear that one of the concerns of the Less Developed Countries was that only the Developed Countries could take advantage of ocean research. In speaking about the view of developing countries, though, there is some confusion. Most developing countries consider the transfer of technology or hope that the transfer of technology is the transfer of technology to explore and exploit resources. That is to say that they are really not talking about, or many of them are not talking about the question of simply building a national academy of sciences or a marine science capability in these countries; what they are talking about are the kinds of technology transfer that will permit them to drill oil, catch fish, or mine manganese nodules. We are not talking about that; we, in fact, probably cannot deliver on that kind of transfer of technology. That kind of information in this country is held among private entrepreneurs, and the government can't really commit companies to reveal company secrets.

This meeting is going to take up a number of subjects, and I would like to see the conference challenge, for example, the basic assumptions of our government with respect to the relationship between conduct of

scientific research in the ocean and the transfer of technology. John Knauss, you will recall, talked about his not being convinced that there should be a linkage, and in fact, we might even be better off if we could keep them separate. I now pose the question of John, do we now have any alternative? That is to say, I don't think the United States can decide if the subjects are going to be linked or not; they are linked, and there are going to be articles dealing with the conduct of scientific research in any law of the sea convention and there are also going to be provisions for the transfer of technology more than likely.

It is reasonable to assume that whether there is a successful Law of the Sea Conference or not, the coastal states are going to assume a greater control and jurisdiction over resources lying off their coast, and in fact, to some degree at least all maritime activities off their coasts than in the past. It seems to me this is reasonable to assume, whether we like it or not. If one takes a look at the various proposals on various issues before the Law of the Sea Conference, staring in Caracas in June, almost all concede a greater degree of control over resources--at least off the coast--and it varies from simple control over resources to a very absolute control or claim of sovereignty over the water column itself as well as the seabed. So one can assume that, if there is to be a sucessful convention coming out of this conference, one is going to see some major control over coastal resources by coastal nations. It seems to me that at this meeting, this conference, the delegates are well qualified to discuss--from our point of view, of course, not from the developing countries point of view--the desirability of--and talk to each other about--sharing the opportunity for research and results. By this means, we can gain some degree of opportunity to carry out research within an area or zone under the partial control by the coastal states.

Another question that I hope will be raised is whether the oceanographers, in fact, need the kind of opportunities for ocean research activities that the United States government is demanding at the present time in its proposals before the Seabed Committee.

The government's position in this respect -- by the way--has, to a considerable degree, come from the scientific community, if I can use the term. Warren Wooster and John Knauss in their remarks tonight and Bill Burke as well have mentioned some of the history and background of the problem developing concerning access to near shore waters for the conduct of ocean research. Most of you have read some of the papers that Benny Schaefer wrote in the late sixties on this subject. Dr. Roger Revelle recently in Science has also indicated that, in his view, a consent regime within the 200 miles would very likely see the end of the "golden era" of oceanographic research.

It seems to me that this assumption of the need for such freedom might be challenged because a number of research institutions at the present time seem to pursue their research programs satisfactorily and do so by getting coastal state permission to carry out the research. It does seem to me that there is evidence that political officials from developing countries are absolutely paranoiac about the operations of vessels--research and others--in waters that they consider to be under their national control, and the requirements that are being established by those countries for consent are totally unreasonable and impossible in many instances. We should examine more critically the question as to whether or not the oceanographer does require the kind of freedom to operate on and over the Continental Shelf that we have been led to believe is necessary. That is to say, I am not suggesting that we don't need such access; I am saying that it seems to me that this group assembled here is perhaps better able than any other group to develop strong arguments for the case that we're now making. And if we

can't develop good arguments and sustain these arguments, I think that we're in for a difficult time at the conference.

The question as to whether or not the transfer of research technology is possible or even evidence of good faith on our part is another question that I hope we can examine. It doesn't weaken our case for other countries to know that we are doing some soul-searching on this question. Can we, in fact, bring together the energies and efforts of scientists and government in the United States in a meaningful way to assess the results of research and take advantage of this assessment for their economic development. About two years ago, in an intervention at the Seabed Committee meeting, we said that we wanted to provide for the transfer of research technology. We indicated that if we just had some good projects, some good ideas, that we'd try to furnish the funds to carry out such a program. However, to the best of my knowledge, there is no money in any budget within government or any funds from without government to give us an opportunity to develop this concept. In essence, we have failed to carry through with our commitment.

It seems to me that there's a real question as to whether or not we can proceed, whether or not those of us who are making these statements, serious as we may be, and with all the best intentions in the world, whether or not we can deliver, given the present framework of government funding for scientific research in our own country as well as for aid for the development of research technology in other countries.

It seems that one might even be a good deal more critical if one wants to question the direction of the effort. If there is a possibility that we can live with the requirements of developing countries or reasonable requirements for consent to carry out our research on and over the Continental Shelf, should we be putting our

scarce funds into an attempt to develop the scientific capability of foreign countries at this time. And this is particularly true when one sees so little real interest in the LDC governments themselves. That is to say, what if we did drop a billion dollars in this particular program? I think that we ought to consider whether that, by itself, would in fact provide for a real possibility of the transfer of research technology unless there is some evidence of national interest in science, or what science can do by the LDCs. I think that it is not unreasonable to conclude that one sees too little real interest in ocean science or any other science in the developing world at the present time. How many instances can we think of where the funds that have been put into the transfer of science or training of scientists have in fact provided for lasting commitments from these countries? There really aren't very many to the best of my knowledge. And incidentally, and in conjunction with some things that were said a few minutes ago by Giulio Pontecorvo, I couldn't disagree more with his view. His point of view that we should refrain from training experts is contrary to my point of view. The only instances that I know of anyway, of where there has been development of marine science capability in these developing countries, has been through the development of expertise in universities and governmental agencies. It might very well be that we would be spending our money better to provide either money or population control, or public health facilities or pollution control, or using the few dollars that are available in some other way. It seems to me to be fair enough for us to question our priorities. I hope we can do so at this meeting.

Mr. Chairman, I raise some of these questions so that in the course of our discussions in the next two or three days, we can critically review the hypothesis upon which this discussion really is based; that is, the idea that we have an obligation to furnish assistance to the growing marine science activities in developing countries, including an effective transfer of scientific knowledge

and supportive technology. I think that one might question whether we do have such an obligation or whether that course of action is the most effective means of assisting the LDCs to raise their level of participation in the use and development of the sea and its resources.

# COOPERATIVE RESEARCH PROGRAMS AT WOODS HOLE OCEANOGRAPHIC INSTITUTION

D.A. ROSS

## INTRODUCTION

The Woods Hole Oceanographic Institution is a private, non-profit research institution founded in 1930. There are over 800 employees working in our laboratories on Cape Cod, Massachusetts, of which about 200 are professionals, either on our resident scientific or technical staff. We have three large modern oceanographic research vessels and several smaller ships. At present, we have a formal educational Ph.D. program in Oceanography with M.I.T. We can also give our own Ph.D. degree and have less-formal cooperative educational programs with several other institutions. We also have a non-degree program in Marine Policy and Ocean Management for pre- and post-doctoral students in the social sciences who are interested in working on marine-related problems.

In the short time I have today I wish to tell you something of our past experience in cooperative research programs including our educational and sea-going ventures. I will mainly emphasize our experience with foreign programs and scientists. Then I will briefly describe in more detail some of our more recent and future efforts and finally make some recommendations on how such activities can be improved in the future.

## PAST EXPERIENCE

I think most of you in this audience recognize that oceanography is truly an international science. This point was also realized by the founders of the Woods

Hole Oceanographic Institution who included funds in our original budget to bring foreign scientists to Woods Hole for annual visits. We still receive numerous visitors each year for varying periods of time.

In 1933, when the Institution was only three years old, the International Ice Patrol established its base of operations at Woods Hole and remained here until 1963. In 1937, a joint research venture was initiated with the Bermuda Biological Station to study variations in the North Atlantic Drift.

During World War II and the years immediately following, the Institution was mainly involved in defense activities and little cooperative or foreign research was done. In 1955, a cooperative program between Woods Hole and the Institute of Meteorology of the University of Stockholm was established. Professor Carl Rossby was in charge of the program and divided his time between the two institutions.

One of the first multi-national cooperative investigations of the ocean began in 1957 as part of the International Geophysical Year. Two of our vessels, ATLANTIS and CRAWFORD, participated in this program. Interestingly, both of these ships have gone onto further international involvement--the CRAWFORD is now at the University of Puerto Rico and ATLANTIS, now called the EL AUSTRAL, sails as a research vessel under the Argentinian flag.

The success of the IGY led to development of SCOR or the Special Committee on Oceanic Research whose membership included several oceanographic unions and representatives from twenty-eight nations. They organized what was eventually called the International Indian Ocean Expedition and between 1959 and 1965 over forty ships from twenty-three countries worked in the Indian Ocean. During 1962-1964, Woods Hole planned, organized, and administered (with funding from the National Science

Foundation) the Biology Program of the International Indian Ocean Expedition. Over 180 scientists from twenty countries took part in this cooperative program.

Perhaps as a result of the successes of the Indian Ocean program, the following years saw a considerable increase in international cooperative ventures. There have been two recent ones which are worth noting. The first is a continuing effort in the Red Sea made in the past with German and British scientists and more recently as part of a program funded by the Saudi Arabian Government. One startling discovery of the research was the finding of sediments enriched in copper, zinc, silver, gold, and lead having an *in situ* value in excess of two billion dollars. The process forming this deposit is still active and we are observing the actual formation of a mineral deposit. This finding, coupled with similar discoveries on the East Pacific Rise, have opened a new field of research concerning mineral formation on oceanic ridges. Over twenty scientists from seven different countries contributed to a symposium volume on this subject that was published in 1969.

The second was a cooperative venture in 1969 aboard ATLANTIS II to the Mediterranean and Black Seas. Again, there was considerable international cooperation, and scientists from over fourteen countries participated in the six month expedition. The Black Sea part included a visit to Yalta on May Day. A symposium volume of the Black Sea studies will be published in a few days and sixty-eight authors from ten different countries have contributed to this study.

Similar cooperative studies have been made by Dr. K.O. Emery working with ECAFE (Economic Commission for Asia and the Far East) which made geophysical surveys of the East China and Yellow Seas, and by participation in some of the large IDOE (International Decade of Ocean Exploration) programs like GEOSECS, MODE and

the geological and geophysical study of the west coast of Africa. Before I discuss a few specific scientific programs, I wish to comment briefly on two things: first, the composition of the scientific personnel aboard our ships and second, the foreign participation in our education program.

Woods Hole ships have sailed over two million miles since the Institution was formed. Although most of the mileage has been in the North Atlantic, as you can see from Figure 1, we have spent considerable time in the Mediterranean Sea and the Indian Ocean. We, like most institutions, have taken foreign scientists aboard on our cruises (Table 1). Although we generally don't make a deliberate effort to take foreign participants, we have taken a relatively high percentage when compared to other organizations. We took 49 of 175, or about 28 percent of the foreign scientists taken to sea on UNOLS ships in 1972. Although this is a respectable percentage, as we shall see in a minute, it leaves something to be desired.

I have examined the cruise records from our three large ships (ATLANTIS II, CHAIN, and KNORR) to see if there was any pattern to the composition of our scientific party. The results were a little surprising. Looking at the data, we find that over the period 1967-1973 there was about 5 percent foreign participation, 25 percent from other American institutions, and about 69 percent Woods Hole participation (Table 2, Figure 2). Obviously a large contingent from Woods Hole is necessary to run the equipment, etc. on the ship, but the amount of foreign participation is surprisingly low when you consider the relative amount of our ship-time that is spent within 200 nautical miles of the coasts of other countries A study of our cruise tracks shows that a considerable portion of our time was spent in what may potentially become foreign waters (Table 3). Now it does not follow that the percentage of foreign participation should equal the amount of time we spend in these nearshore waters, but there does seem to be a discrepancy--and remember here

TABLE 1 FOREIGN SCIENTISTS PARTICIPATING ON UNOLS SHIPS IN 1972
(data from UNOLS Office)

University of Alaska

ACONA: Japan-2
TOTAL: 2 scientists

Scripps Institution of Oceanography

AGASSIZ: Mexico-1
MELVILLE: Argentina-1, Brazil-3 Chile-5, India-2, Mexico-1
OCONOSTOTA: England-1
E.B. SCRIPPS: Denmark-1, England-1, Ecuador-1
WASHINGTON: Chile-8, Ecuador-2 Peru-3
TOTAL: 30 scientists

Lamont-Doherty Geological Observatory

CONRAD: Brazil-19, Argentina-7
VEMA: Germany-1, Norway-1
TOTAL: 28 scientists

Duke University

EASTWARD: Denmark-14, Jamaica-26
TOTAL: 40 scientists

Miami

CALUNUS: Ghana-1
GILLISS: Chile-1, France-2, Germany-2, Italy-1, Peru-1, Netherlands-1
ISELIN: England-2
ORCA: England-1
TOTAL: 12 scientists

Oregon State

CAYUSE: Mexico-2
YAQUINA: Ecuador-1, Peru-4
Total: 7 scientists

University of Rhode Island

TRIDENT: England-1
TOTAL: 1 scientist

Texas A&M University

ALAMINOS: Colombia-1, Italy-1 Venezuela-2
TOTAL: 4 scientists

University of Washington

THOMPSON: France-1, Spain-1
TOTAL: 2 scientists

Woods Hole Oceanographic Institution

ALVIN/LULU: France-1
ATLANTIS II: Argentina-1, Brazil-6 Congo-1, England-1, France-1, Portugal-2, South Africa-11, U.S.S.R.-2, Spain-1
CHAIN: Chile-1, Italy-1, Pakistan-1, U.S.S.R.-1, France-2, W. Germany-2
GOSNOLD: Argentina-1, Ghana-1, Guatemala-1, Indonesia-1, Korea-1, Mexico-1, Philippines-1, Thailand-1
KNORR: Argentina-1, England-1, Scotland-1, Puerto Rico-3
TOTAL: 49 scientists

SUMMARY:

| | | | |
|---|---|---|---|
| Argentina-11 | France-7 | Japan-2 | Portugal-2 |
| Brazil-28 | Germany-5 | Korea-1 | Puerto Rico-3 |
| Chile-15 | Ghana-2 | Mexico-5 | Scotland-1 |
| Colombia-1 | Guatemala-1 | Netherlands-1 | South Africa-11 |
| Congo-1 | India-2 | Norway-1 | Spain-2 |
| Denmark-15 | Indonesia-1 | Pakistan-1 | Thailand-1 |
| England-8 | Italy-3 | Peru-8 | U.S.S.R.-3 |
| Ecuador-4 | Jamaica-26 | Philippines-1 | Venezuela-2 |

TOTAL: 82 Cruises -- 175 Scientists

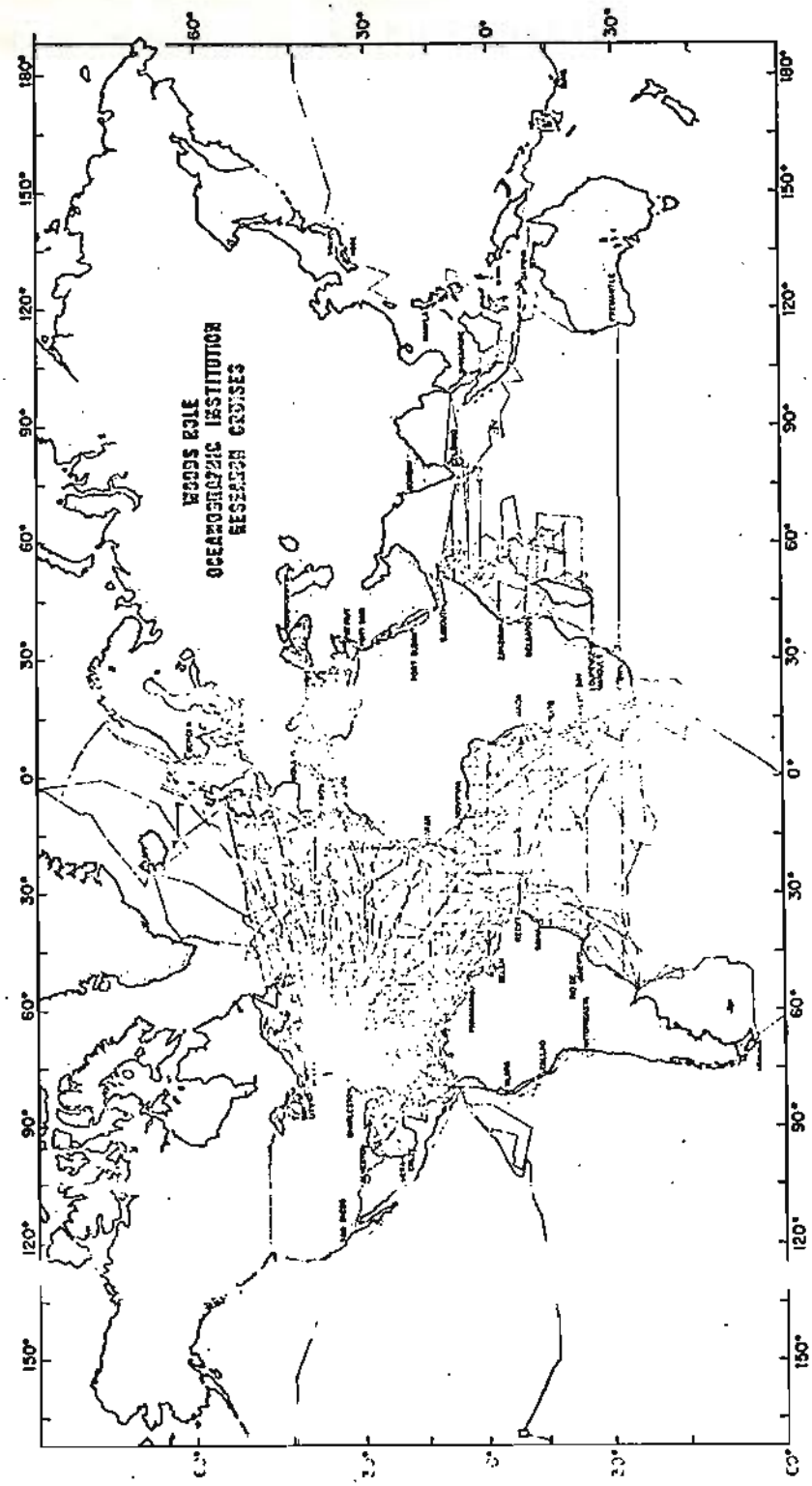


Figure 1. Woods Hole Oceanographic Institution research cruises, 1930-1973.

that Woods Hole has a relatively high percentage of foreign participation when compared to the rest of the oceanographic community (Table 1).

Looking further into the oceanographic character of the cruise, be it biological, physical, chemical, or geological and geophysical oceanography and comparing this to the composition of the scientific party (Figures 3 and 4) shows some trends. The geologists and geophysicists tended to have the highest amount of foreign participation whereas physical oceanography has the lowest (Table 4). I don't think that much can be made of this point other than it may just reflect foreign scientists' interest in things like sea-floor spreading or mineral resources.

On some of our cruises, we have had exceptionally large numbers of foreign scientists and without exception this was due to a definite effort on the part of the chief scientist of the expedition. What does become obvious is that getting mechanisms for having foreign scientists aboard research vessels needs improvement--and I will come back to this in some recommendations I will make later.

In the field of education of foreign scientists, the Woods Hole Oceanographic Institution, which (remember) is primarily a research organization, seems to have done very well (Table 5). We have accepted foreign students into four of our main educational programs: our joint Ph.D. program in oceanography with M.I.T.; our post-doctoral program (including some in our Marine Policy and Ocean Management group); our summer program (which is mainly a geophysical fluid dynamic program); and special programs (which is generally sort of an independent study program with one of our staff). In the period from 1968 to 1973, we had 69 students in these four categories. To put this number in better perspective, our present graduate program with M.I.T., which is by far our largest program, has only 64 students.

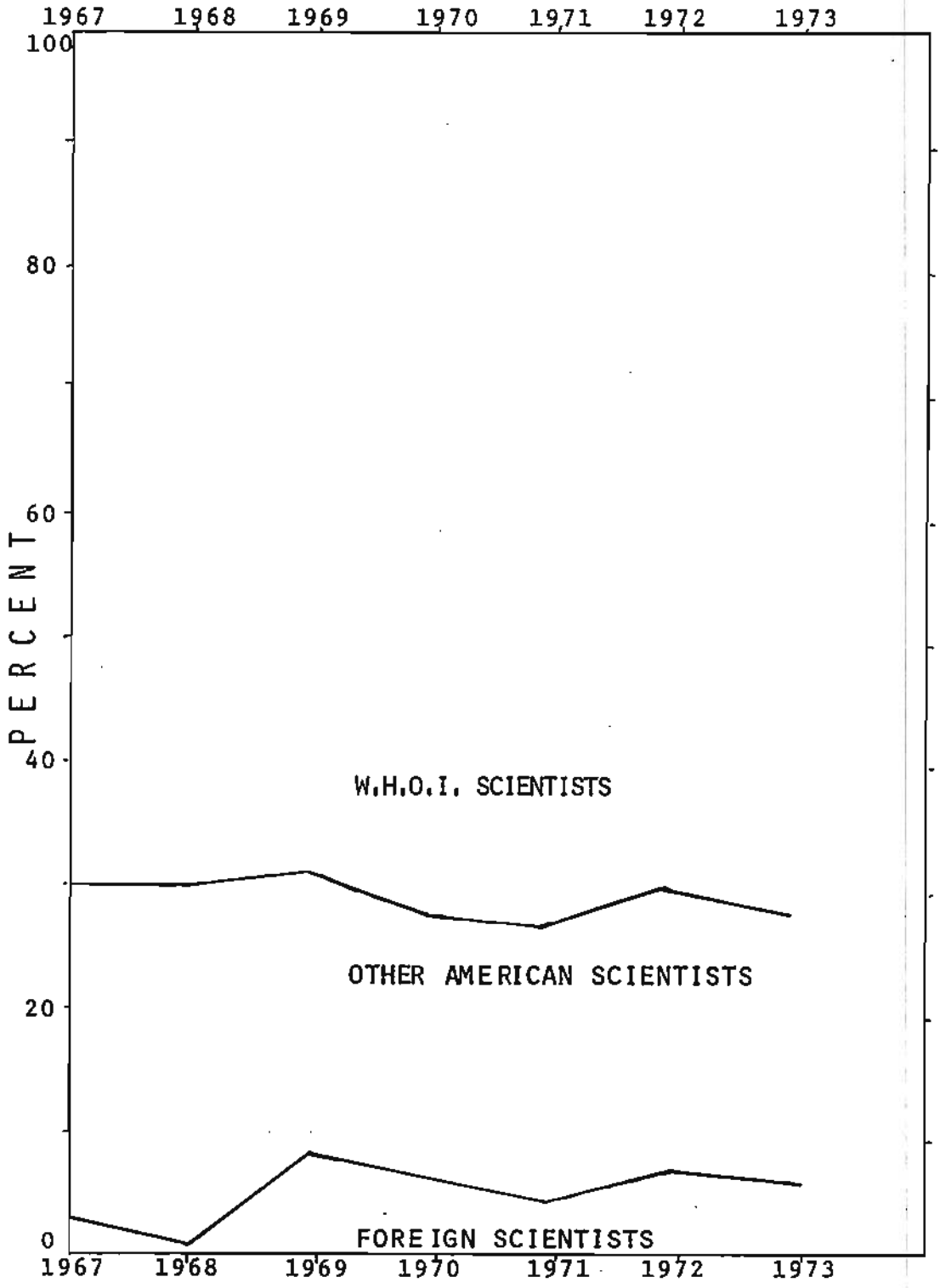


Figure 2. Scientific participation in Woods Hole Oceanographic Institution cruises, 1967-1973.

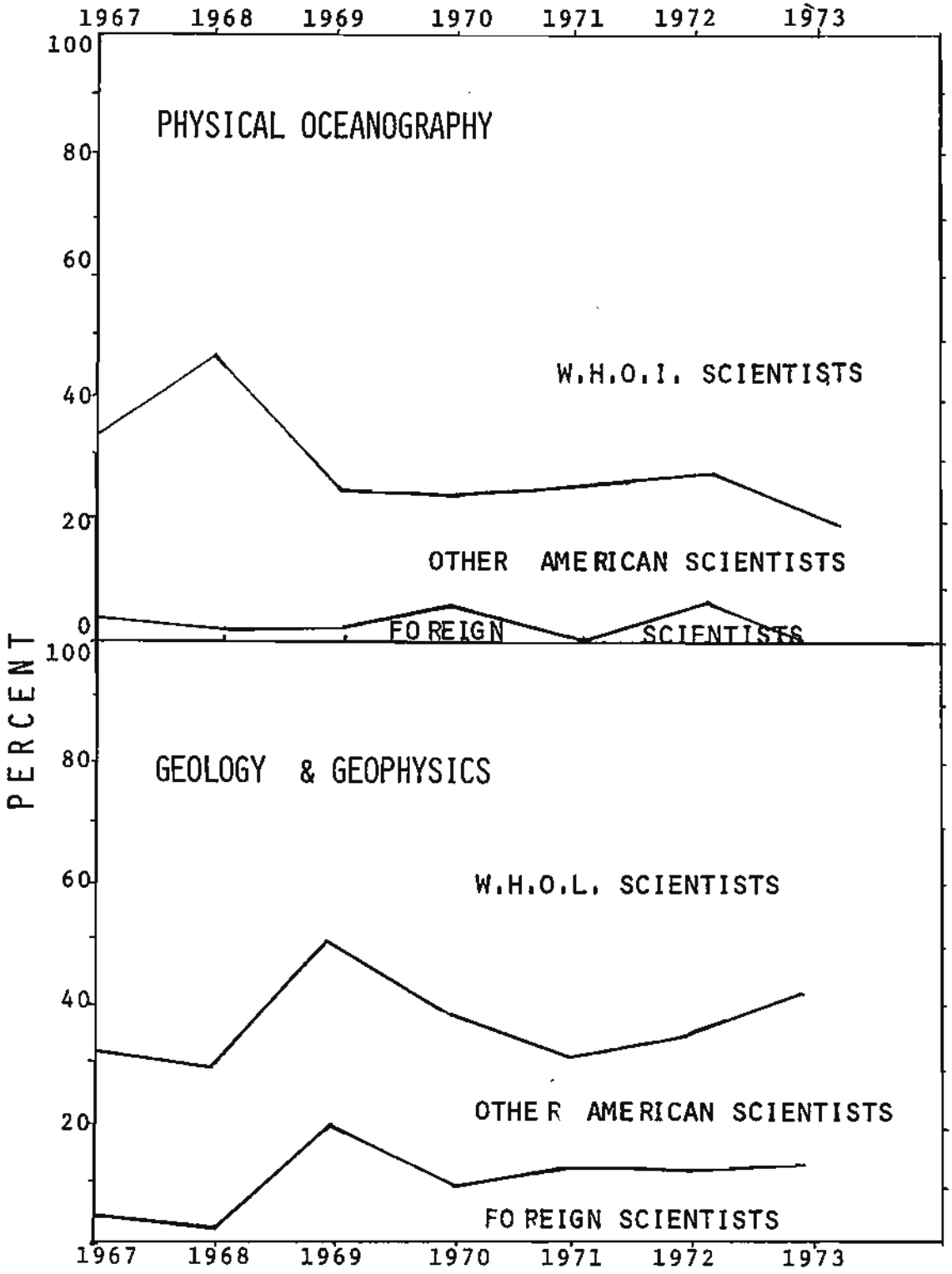


Figure 3. Scientific participation in Woods Hole Oceanographic Institution cruises by oceanographic discipline-Physical Oceanography and Geological and Geophysical Oceanography.

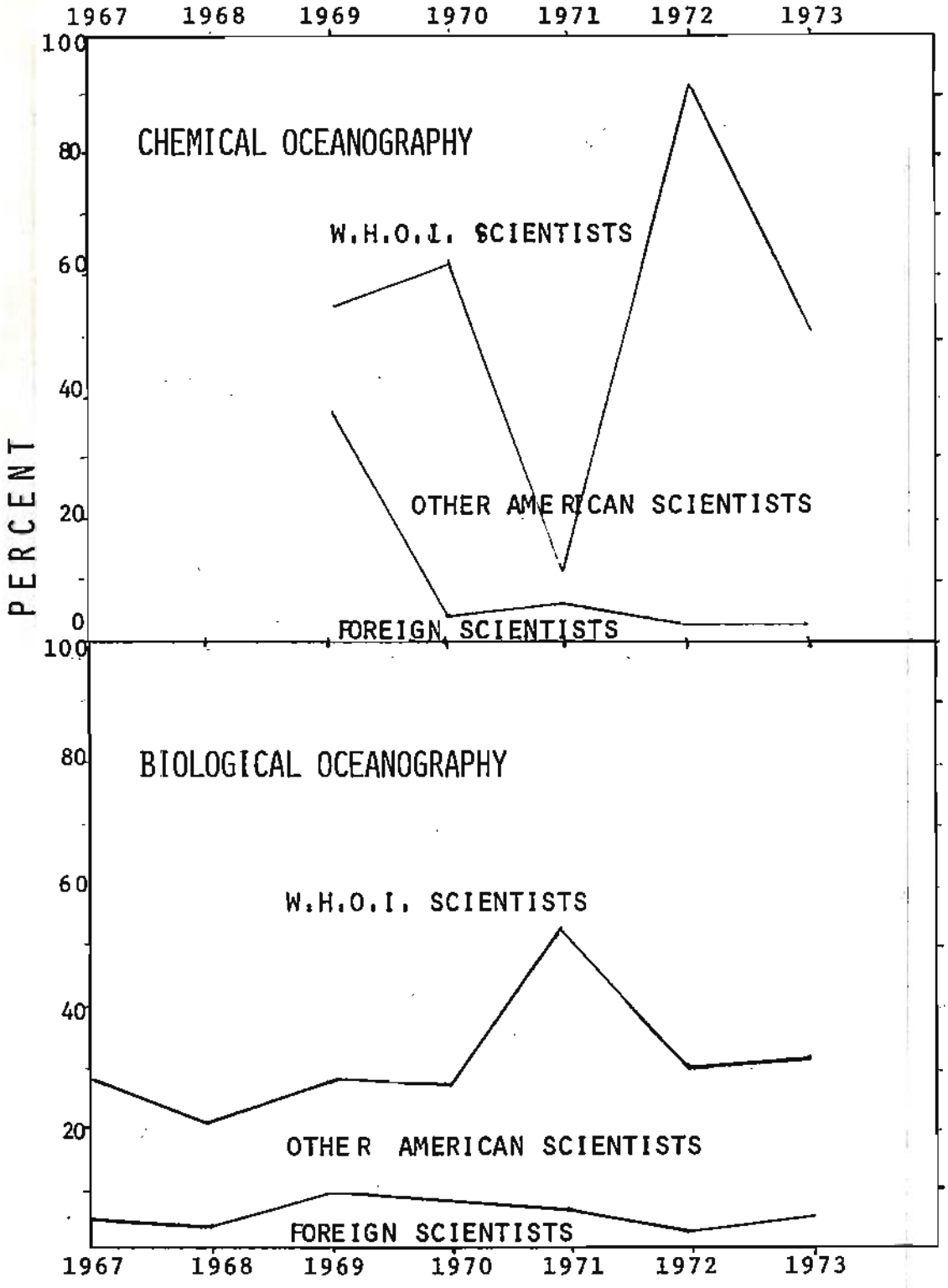


Figure 4. Scientific participation in Woods Hole Oceanographic Institution cruises by oceanographic discipline - Biological Oceanography and Chemical Oceanography.

TABLE 2 Scientific Participation in Cruises of the Woods Hole Oceanographic Institution

| Year | WHOI (%) | Other American Inst. (%) | Foreign (%) | Total |
|---|---|---|---|---|
| 1973 | 519 (64.9) | 241 (30.1) | 40 (5) | 800 |
| | 515 (70.5)* | 176 (24.1)* | 39 (5.4)* | 730* |
| 1972 | 410 (54.8) | 298 (39.8) | 40 (5.4) | 748 |
| | 398 (68.6)* | 143 (24.7)* | 39 (6.7)* | 580* |
| 1971 | 358 (71.7) | 120 (24.1) | 21 (4.2) | 499 |
| 1970 | 394 (70.6) | 130 (23.3) | 34 (6.1) | 558 |
| 1969 | 284 (67.3) | 104 (30.9) | 34 (8.1) | 422 |
| 1968 | 317 (68.2) | 144 (30.9) | 4 (0.9) | 465 |
| 1967 | 293 (68.3) | 122 (28.4) | 14 (3.3) | 429 |
| Average 1967-1973 | 69.3% | 25.7% | 5% | |

*Revised data after eliminating IDOE sponsored multi-institutional GEOSECS cruises which has an unusually large non-WHOI contingent since WHOI ship was used for all Atlantic work.

TABLE 3 Percentage of Time that WHOI Ships Spend Within 200 Nautical Miles of Other Countries' Coasts Compared to Foreign Scientist Participation in WHOI Cruises (1969-1973)

| Year | % of time within 200 nautical miles of other countries | % Foreign Scientist Participation |
|---|---|---|
| 1969 | 39* | 8.1 |
| 1970 | 51 | 6.1 |
| 1971 | 49 | 4.2 |
| 1972 | 30 | 6.7 |
| 1973 | 25 | 5.4 |
| Average | 39 | 6.5 |

*Does not include time spent in port.

TABLE 4 Distribution of Scientists Aboard Woods Hole Oceanographic Institution Ships as Related to the Principal Type of Oceanographic Program on Cruises (1967-1973).

| Year | Physical Oceanography | | | Chemical Oceanography** | | | Biological Oceanography | | | Geological-Geophysical Oceanography | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *WH | O | F | WH | O | F | WH | O | F | WH | O | F |
| 1973 | 187 | 44 | 6 | 88 | 86 | 1 | 93 | 38 | 4 | 151 | 73 | 30 |
| % | (79) | (19) | (2) | (50) | (49) | (1) | (69) | (28) | (3) | (59) | (29) | (12) |
| 1972 | 187 | 55 | 16 | 15 | 163 | 1 | 83 | 33 | 3 | 125 | 44 | 21 |
| % | (73) | (21) | (6) | (8) | (93) | (1) | (70) | (28) | (2) | (66) | (23) | (11) |
| 1971 | 167 | 60 | -- | 42 | 3 | 3 | 52 | 48 | 6 | 93 | 25 | 16 |
| % | (74) | (26) | -- | (88) | (6) | (6) | (49) | (45) | (6) | (69) | (19) | (12) |
| 1970 | 214 | 52 | 15 | 13 | 20 | 1 | 82 | 20 | 9 | 85 | 38 | 12 |
| % | (76) | (19) | (5) | (38) | (59) | (3) | (74) | (18) | (8) | (63) | (28) | (9) |
| 1969 | 133 | 46 | 2 | 25 | 10 | 21 | 89 | 22 | 11 | 54 | 34 | 21 |
| % | (74) | (25) | (1) | (45) | (18) | (37) | (73) | (18) | (9) | (50) | (31) | (19) |
| 1968 | 71 | 65 | -- | -- | -- | -- | 84 | 19 | 3 | 112 | 46 | 1 |
| % | (52) | (48) | -- | -- | -- | -- | (79) | (18) | (3) | (70) | (29) | (1) |
| 1967 | 118 | 50 | 3 | -- | -- | -- | 83 | 28 | 4 | 102 | 44 | 5 |
| % | (69) | (29) | (2) | -- | -- | -- | (72) | (24) | (4) | (68) | (29) | (3) |
| Average | 154 | 53 | 6 | 26 | 40 | 4 | 81 | 30 | 6 | 103 | 43 | 15 |
| | 72% | 25% | 3% | 37% | 57% | 6% | 69% | 26% | 5% | 64% | 27% | 9% |

*WH = Woods Hole Oceanographic Institution
O = Scientists from Other American Institutions
F = Foreign Scientists

**Chemical Oceanography data for 1972 and 1973 includes 11 legs of GEOSECS cruise which had an exceptionally large amount of scientists from other American Institutions.

TABLE 5 Foreign Graduate Students Enrolled at the Woods Hole Oceanographic Institution during the Period from 1968-1973

| Courtry | Graduate Program | Postdoctoral Fellows | Summer Program | Special Programs | Totals |
|---|---|---|---|---|---|
| Canada | 8 | 1 | 1 | -- | 10 |
| Taiwan | 2 | 3 | 3 | -- | 8 |
| England | 1 | -- | 6 | -- | 7 |
| Belgium | 1 | -- | 3 | -- | 4 |
| France | 1 | -- | 2 | 1 | 4 |
| Japan | -- | -- | 1 | 3 | 4 |
| India | -- | 2 | 1 | -- | 3 |
| Israel | 2 | 1 | -- | -- | 3 |
| Sweden | -- | 1 | 1 | 1 | 3 |
| Korea | 1 | -- | 1 | -- | 2 |
| Romania | -- | 1 | -- | 1 | 2 |
| Norway | 1 | -- | 1 | -- | 2 |
| Iran | -- | -- | 1 | 1 | 2 |
| Cuba | 1 | -- | 1 | -- | 2 |
| Sri Lanka | 1 | -- | -- | -- | 1 |
| Denmark | -- | -- | 1 | -- | 1 |
| Sudan | -- | -- | -- | 1 | 1 |
| Burma | 1 | -- | -- | -- | 1 |
| Holland | -- | 1 | -- | -- | 1 |
| W. Germany | -- | -- | 1 | -- | 1 |
| Saudi Arabia | -- | -- | -- | 1 | 1 |
| Czechoslovakia | -- | -- | -- | 1 | 1 |
| Malaysia | 1 | -- | -- | -- | 1 |
| Kenya | 1 | -- | -- | -- | 1 |
| Australia | -- | 1 | -- | -- | 1 |
| Spain | -- | -- | -- | 1 | 1 |
| Argentina | -- | -- | 1 | -- | 1 |
| TOTAL | 22 | 11 | 25 | 11 | 69 |

I now wish to briefly mention three of our cooperative research programs--one with Brazil is partially complete; one with Spain is just starting; and one with Egypt is in the planning phase. This is only just a small sample of our cooperative efforts and over the past few years we have had programs with Saudi Arabia, Puerto Rico, Israel, the countries off the west coast of Africa, and numerous other areas. In the future, we hope to work with India, Pakistan, Iran, Saudi Arabia, and other countries of the NW Indian Ocean, New Zealand, Russia, and Australia. Almost all these programs started on a scientist-to-scientist basis and I think that this is an important point.

## BRAZILIAN PROGRAM

This cooperative program was initiated by Dr. John Milliman, a geologist at Woods Hole. Petrobras, the Brazilian oil company, had noted several years ago that it had few scientists with marine geology experience. One came to Woods Hole and with Dr. Milliman developed a two-phase program for a geological and geophysical study of the Brazilian continental margin. The program had several hurdles to overcome--one of which was the fact that the Brazilian Navy had control over all research carried out within 200 miles of their coast; another was the Brazilians lack of equipment. These were eventually solved, the former by persistence and the latter by purchase of equipment and transfer of it to Brazil. The first phase involved 5 1/2 months of Brazilian ship time and cost about $260,000 all of which came from Brazil. The program emphasized the nearshore oceanography and marine geology and geophysics (Figures 5 and 6). Twenty-five different Brazilians were aboard the ship during the cruise, but the chief scientist was always from Woods Hole. Prior to the cruise and continuing after it, fifteen Brazilian scientists have spent a total of 7 1/2 man years at Woods Hole learning our techniques and working on the data collected (sediments, bathymetry, sparker

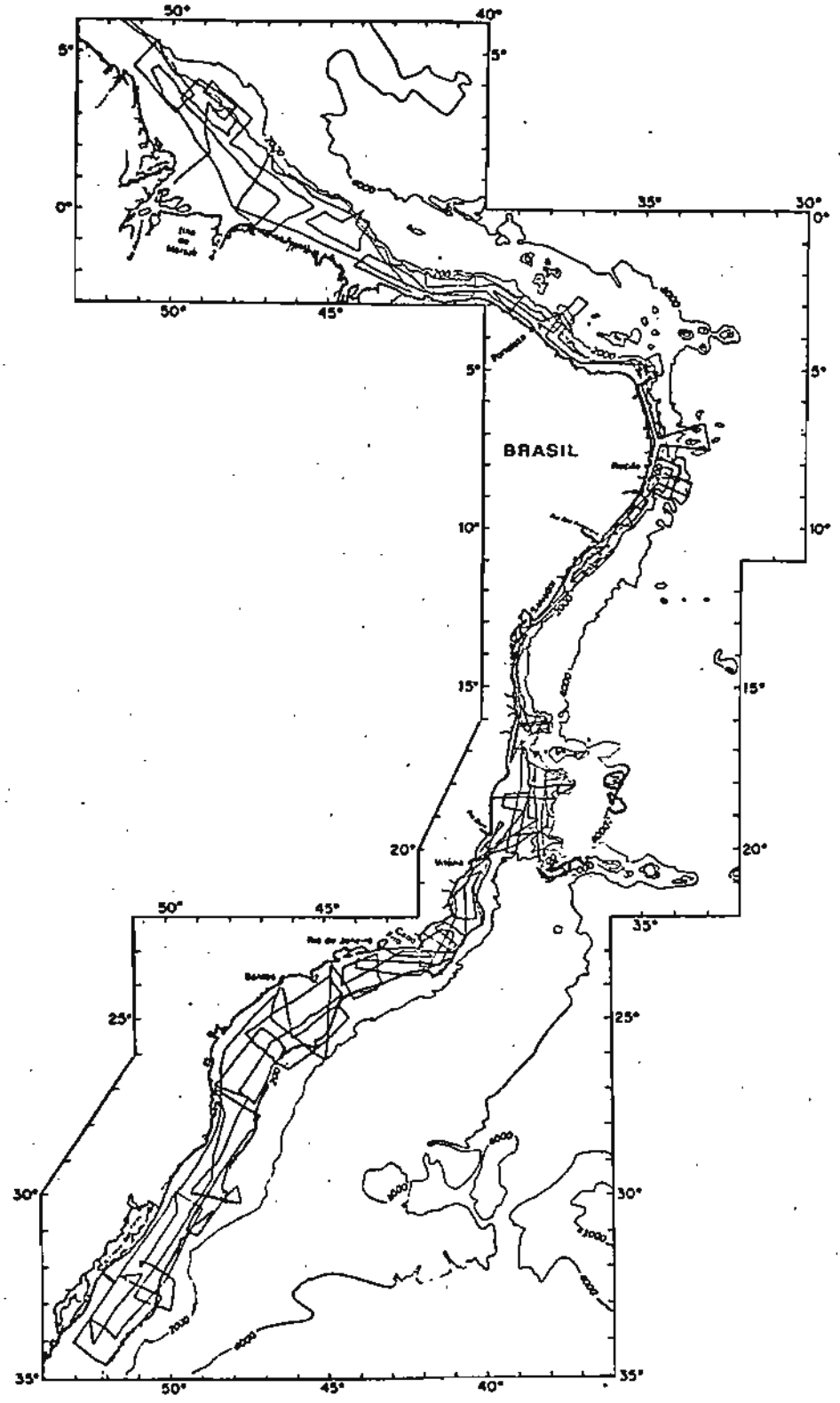


Figure 5. Track of the N/O PROFESSOR W. BESNARD during the nearshore phase cruises of the W H O I -Brazilian Program.

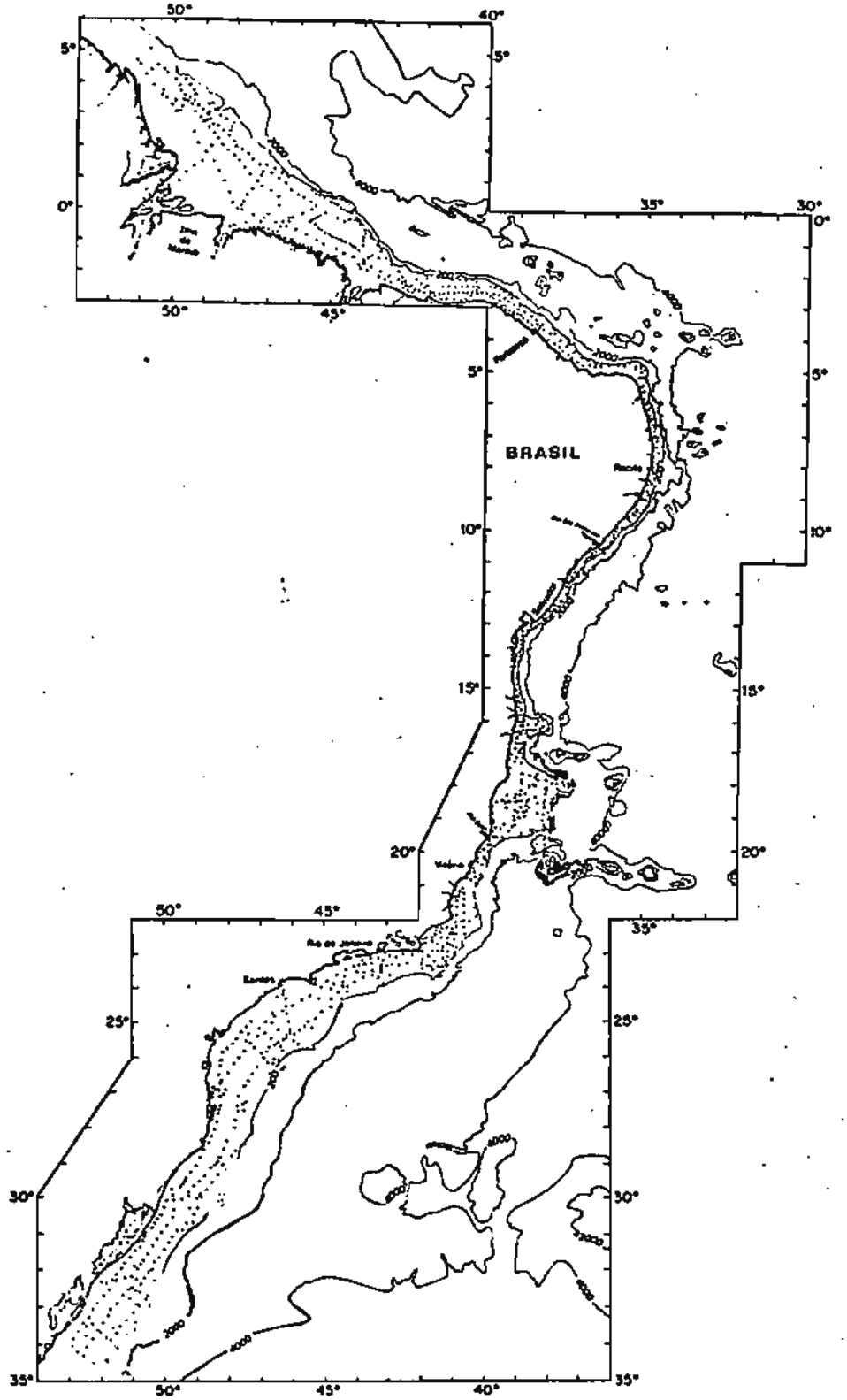


Figure 6. Positions of sediment samples collected during the nearshore phase cruises of the W H O I -Brazilian Program.

profiles, and magnetics). Splits of all samples and copies of all records are at both places. Several atlases and up to twenty papers are expected to result from this project.

Our main reason for doing this work is that we had a similar project along the east coast of the United States for several years. The Brazilian continental margin is almost a mirror image of the east coast of the United States with the added advantage of the Amazon River supplying a large source of sediment. The Brazilians wanted to learn more about the continental margin and train some scientists. We saw it as a logical opportunity to expand our work.

Was it successful? --Yes, in most ways, although the training and educational aspects could have been improved considerably if a mechanism for this had been available. The latter phases of the program will be a study of the offshore areas of Brazil and will hopefully be funded by American agencies.

## COOPERATIVE INVESTIGATIONS IN SPANISH COASTAL WATERS

This program, which is just beginning, also developed from a scientist-to-scientist contact--in this case with A.R. Miller, a physical oceanographer who has done considerable work in the Mediterranean. It also involves one of our biologists, Ken Tenore as well as W.R. Wright and Joseph Chase, who are physical oceanographers; Mr. Miller is the principal investigator. There are three main objectives to the program:

1) To provide general aid and assistance to Spanish oceanography.
2) To help establish a long-term policy for managing the highly productive rias along their Atlantic coast.
3) To begin a determination of productivity potential of NW Spain.

Several of the rias of the Spanish coast have very well-developed mussel-raft aquaculture programs. One ria, the Ria del Arosa, produces about 150,000 metric tons/year of mussels. However, little is known of the hydrographic and nutrient conditions in the rias that lead to such productivity. In addition, little is known about the rest of the food chain relationships within this man-controlled, intensively harvested environment, which also produces large catches of fish, clams, and eels. Thus, the area offers a most interesting opportunity for our scientists to learn more about food chain dynamics.

The program was developed jointly by scientists of both countries and is mainly funded by U.S. agencies. The Spanish have recently built several very modern oceanographic laboratories and are making a serious effort in marine sciences.

Educational aspects of the program will include the practical experience of making the hydrographic and productivity measurements, the giving of oceanographic instruction in Spain and having some of their students come to the Woods Hole Oceanographic Institution for a while. Our scientists will also gain by working with Spanish colleagues who are very good in descriptive and morphological aspect of marine biology.

Equipment has been bought in the United States and sent to Spain. Data is copied and sent to both places and reports are translated into both languages. Procedures books for measurements are being developed.

The progress and future aspect of this program seem very good.

## EGYPTIAN PROGRAM

This program, which is mainly in the future, has as its main objective a geological and geophysical study of the Nile Cone and Nile Delta. Besides having good oil

potential, the area has not been studied in any detail. We hope to establish a structural framework and unravel the geological history of this region. There are several ancillary problems to be considered such as the effects of the damming of the Nile on water and sediment characteristics. I am the principal investigator on this project, and I have had some experience in working in the Middle East, particularly in the Red Sea and with Saudi Arabia. I started by writing a potential project, in part encouraged by the PL480 funds available in Egypt. Then I sent copies to several Egyptian colleagues asking for comments and whether they were interested. They were interested and eventually the proposed program reached the Egyptian Academy of Scientific Research and Technology. The President of the Academy liked the program and invited me to Egypt to discuss it in more detail --which I did (just before the war). The Egyptians were most enthusiastic and were anxious to incorporate our work with their ongoing coastal oceanography programs. Because of a lack of large ships, almost all of their oceanographic work is in the coastal zone and they want to extend their research into deeper waters. Thus, although the plans were made here, they have been modified to reflect the Egyptian interests. I have submitted a proposal to the National Science Foundation to have a seven-week cruise in the area in 1975.

## RECOMMENDATIONS

Based on our personal experience and discussions with other scientists, I would like to make three rather simple suggestions.

1) That the scientist-to-scientist mechanism for developing cooperative programs always be maintained, and even be encouraged. Most of my colleagues feel that the less official bureaucracy involved (at least in the beginning), the better the chances of success for the program.

2) It is not clear why so few foreign scientists participate in cruises of American research institutions. Certainly part of the reason is that they are not aware of them, another is the travel cost to meet the ship. I suggest that a newsletter or perhaps the UNOLS report be sent to all institutions and organizations with an interest in the ocean and that instances where space is available be clearly indicated. I also suggest that a travel fund be established, perhaps on a sharing basis, to allow foreign scientists to participate in our expeditions.

3) That some formal mechanism be established for training foreign oceanographers in the United States. I am not suggesting that informal arrangements or that training within the foreign country be eliminated but that a large program with a definite schedule be established here, perhaps in cooperation with several university or research institutions. I visualize something like the Naval War College system in which a definite period of time at some facility is set aside for education of foreign scientists. Marine scientists could teach both introductory and advanced courses. The subjects could be varied--one time emphasizing one theme such as marine biology, another time the theme of resources, etc. Participants chosen from different countries could come when the subjects of their interest are taught. This teaching would be followed by a short cruise or field work at a cooperating institution. Further research could be done on a similar basis. The program could be advertised via the United Nations or other organizations and could be made available to students and professionals from all countries. The participating country should pay travel expenses and perhaps some living expenses. The remaining costs should not be too high and could be borne by an American agency. The goodwill, personal contacts, and exposure of these scientists to our approach to the ocean should pay immense scientific and even political dividends in the near future.

# LATIN AMERICAN EDUCATIONAL PROGRAMS IN OCEANOGRAPHY AT OREGON STATE UNIVERSITY

V.T. NEAL

## BACKGROUND

The first serious efforts to assist and cooperate with a Latin American institution were in 1966. At that time, we at OSU received a request from Universidad del Norte, Antofogasto, Chile, for assistance with their fisheries oceanography program. They wanted someone from Oregon State University to spend a year teaching at their institution. Since they had no funds to support such an individual, we began a careful search for funding. At that time the most likely source seemed to be the Fulbright Commission. Unfortunately, that organization would not assure us that one of our professors would be selected for a grant (if he did apply) or if he were to be selected that he would actually go to the institution requested. At that time it did not seem wise to risk involvement under such nebulous conditions. In spite of not being able to provide the professor as requested, we worked with Universidad del Norte in an effort to get at least one of their students into our graduate program. The student they selected did not have a bachelor's degree and so could not be admitted to our graduate program in oceanography. That student did receive a LASPAU (Latin American Scholarship Program of American Universities) fellowship but was required by LASPAU to attend another institution in the U.S. for work in fisheries. In effect, that was the end of our efforts to work with Universidad del Norte!

Our interest in assisting Latin Americans again increased when Dr. Wayne Burt (who was then departmental chairman) participated in a cruise on the Canadian research ship HUDSON. On board the HUDSON, he worked extensively in the coastal waters and fjords of Chile. After the cruise, Dr. Burt visited several institutions in South America that were either involved in or planning to become involved in oceanographic work. He became aware of the great need for education and research, especially in physical oceanography. It was evident that, in spite of the apparent needs, none of the countries at that time seemed to have enough trained oceanographers to launch a suitable program. Therefore, he encouraged them to send students to Oregon State University for graduate training in oceanography. Upon graduation, these students could form the nucleus for research and educational programs when they returned to Latin America. The greatest response came from Chile.

When Dr. Burt returned to OSU, he discussed his observations with our staff. Several of our staff members displayed keen interest in working with the Latin Americans and developing future research programs with them. After several discussions, we decided we should establish a Latin American oceanographic center at Oregon State University. The main purpose of the center would be to train Latin Americans for work in oceanography. One of the advantages sought for OSU was to facilitate operations of our own research ship in South American waters.

We did attract and continue to attract students from Latin America. As a result, we have trained and/or are training students from Chile, Mexico, Peru, and Brazil. At the present time, we are expecting to accept students from Ecuador and Venezuela. These students generally work for the M.S. degree in one of our special fields: physical, chemical, biological or geological oceanography. We have had one complete the Ph.D. and others are working for the Ph.D.

Unfortunately, we have been able to find surprisingly little financial support for Latin American students. Nearly all of them have had to obtain support for themselves.

## PROBLEMS ASSOCIATED WITH TRAINING LATIN AMERICAN STUDENTS IN THE U.S.

Since many Latin American students have had little practice in daily conversational use of English and are not familiar with the U.S. educational system some problems may arise. As we are accustomed to producing graduates who seek positions in the increasingly competitive U.S. market, our rules for admission and performance are not generally designed to accommodate the Latin American student. Allowances must be made such as making slight variances in admission policy and performance standards for the student. Frequently this means a slightly different program with a decrease in course load, especially the first year.

Admission procedures for foreign students take considerably more time and consideration. It is not so easy to interpret grades from several institutions in several countries. Nevertheless our results have been good so far, i.e. we have only admitted one student who could not complete the degree program. We have had to waive, at least in ome cases, the GRE exam simply because of the difficulties of arranging for foreign students to take it and because of the additional cost to them. We do require TOEFL or other acceptable English language tests since use of the English language can be the most serious problem faced by the new student from Latin America. We have learned to have patience and allow him time to adjust to reading, listening, and writing in English. We usually allow lighter schedules, and do not push the students into a full course load until they have adjusted. We have required some of them to take English after they are here. In some cases, we have had U.S. students (who speak Spanish) act as

helpers for those having difficulty. In general we expect to give more personal attention to these students than to U.S. students especially the first year. Furthermore, not all of those needing to come to the U.S. are really going to need research capability but must be considered for admission because of their political or administrative roles.

We have had to help orient those on our teaching staff, who have not had experience in Latin America, so that they will be more sensitive to the problems faced by Latin American students. We find it necessary to also orient the Latin American students. To speed up this process, we find it advisable to require students coming from Spanish speaking countries to share offices with U.S. students. This practice provides daily practice in conversational English and allows the new students to learn about general conditions in the U.S. while also providing U.S. students with an opportunity to learn more about Latin America.

## GOALS OF THE PROGRAM

Although we continue to encourage Latin American students to enter our graduate programs, we have refocused our efforts since 1971. In that summer we were pleased to have Mr. Hellmuth A. Sievers, from Chile, visit our department. He is head of the Oceanographic Department, Instituto Hidrografico de la Armada, in Valparaiso. He also worked part time with the Universidad Catolica de Valparaiso. He was visiting various oceanographic institutions and funding agencies in the U.S. seeking support and assistance for oceanographic programs being planned in Chile.

Mr. Sievers was able to give us the benefit of his own experiences, having obtained his oceanographic training in the U.S. and then returning to Chile to work. In our discussions, he pointed out that the students from Latin America need to talk to each other at their own

level about oceanographic problems in their own country. If only one or two have been trained outside the country and then return, they find no one else to talk to who understands what they are trying to do or why they want to do it.

This leads to such frustration that such people may leave their home country to take jobs in the U.S., Canada, or Western Europe. It is also important for those who are teaching them to understand the local problems and to realize the state of the art in the given countries. Therefore, it is better if U.S. scientists teach courses in Latin American institutions.

By the end of Mr. Siever's visit, we had a better feeling for what was needed by the Latin Americans. We decided that we should continue accepting Latin American students into our graduate program but, in addition, we should develop a cooperative program whereby several of our staff members assisted an institution in Latin America in educating students there. Thus, more students would benefit from our efforts and the best graduates could be encouraged to go to the U.S. for more advanced work. In effect, by cooperating with an institution in Latin America, we would have an OSU Oceanography Center there as well as at OSU. Such a center would be operated most effectively if most or all of the visiting staff (at least in the initial stages) came from the same U.S. institution, OSU. In this way, continuity of the educational programs would be assured. In addition, this method would provide the sound basis needed for developing truly cooperative research programs. As the local institution built up its staff it would become less and less dependent upon OSU for teaching. We could then assist them with development of research programs of local interest.

Our revised general goals can be stated as follows:

1. To assist Latin American countries in developing oceanographic educational research programs.

2. To improve our own capability of working with Latin American nations and to keep abreast of oceanographic research in those regions.

3. To establish long-term cooperative research programs with Latin American oceanographers.

## PROPOSED METHODS

We now propose to help set up educational programs at one or more existing Latin American institutions by having our staff members assist in planning and teaching programs until those institutions have the necessary staff to assume these duties. We plan to continue admitting promising students for advanced work at OSU. We also plan to assist Latin American oceanographers with their research programs by providing advice as requested and providing technical advice and training assistance as needed. Technical assistance would be accomplished by an exchange of technicians, by holding workshops either in Latin America or in the U.S., and by holding seminars in Latin America. The ultimate step is the arrangement of bilateral (and in some cases multilateral) cooperative research programs between our staff and Latin American oceanographers. As part of this program, we hope to bring Latin American oceanographers to OSU on an exchange basis. In order to obtain the best results, we plan to arrange within the School of Oceanography at OSU an internal educational and orientation program designed to better equip our staff and students to participate in the Latin American program.

## PRESENT STATUS

Up to this time the only factor that has prevented full implementation of the program is lack of funds. We have been able to make some progress in some areas by a sort of "hand to mouth" existence. For example, in 1973, I received a travel grant from SEED (Science and Engineers

in Economic Development) Program to spend two weeks at the Catholic University of Valparaiso to assist them in designing a curriculum for training physical oceanographers. One of their greatest problems with instituting that program is the lack of physical oceanographers on their staff to teach. Therefore, we are hoping to have one of our physical oceanographers obtain a SEED grant to spend about nine months in Valparaiso teaching and otherwise assisting with the initiation of the program.

We have one biological oceanographer working with Colombia by means of a Fulbright grant. At this moment, we are considering a request to send one of our staff to Ecuador as an advisor.

## COOPERATION IN RESEARCH

We have been very successful in developing cooperative efforts in IDOE sponsored research programs. For example, the CUEA (Coastal Upwelling and Ecosystems Analysis) and NAZCA PLATE programs have resulted in our staff working with scientists from Peru, Ecuador, Colombia, and Chile. In addition, we have worked out some cooperative research efforts with Mexico (with some support from Mexico and from regular NSF research funds). It now appears that in the new Antarctic program, ISOS, (International Southern Ocean Studies) cooperation with Argentina and Chile will develop. As part of the work in the Antarctic, the NSF Office of Polar Programs has signed an agreement whereby the Argentine navy will operate the ELTANIN, now renamed ISLAS ORCADAS. This operation will require close cooperation between U.S. and Argentine scientists who are working on that ship in the Southern Ocean.

## FRUSTRATION FACTORS

Obviously there are many factors contributing to the frustrations which develop when attempting to set up good cooperative and assistance programs. Some of these problems

originate in the Latin American country and some in the U.S., while others originate both places. One of the difficulties encountered in the Latin American countries is the attitudes of decision-makers, i.e. they may not really understand the needs and problems involved in setting up oceanographic programs. In a few countries, some of the decision-makers may still suffer a little bit from the "Mañana" philosophy, at any rate it is sometimes very difficult to get responses to letters in reasonable time. However, we must remember that their vacation and work schedules are different in the southern hemisphere. Furthermore, the problems associated with communications may take many forms. One is simply not fully understanding each other's language. However, a more common problem is the vast distance and delays in letter deliveries which tend to cause a "communications gap." It is more difficult to keep things going when you don't have frequent contact with the other party. Therefore, it is necessary to use methods in addition to mail. One of the most effective ways is for frequent personal visits between the principals involved. However, in this regard we must realize they do have other things to do than to go back and forth or to chauffeur us around. Therefore, in some cases telephone communication may be the most effective route.

Frustrations may also arise because the program planned is too ambitious. The fault may be either ours or theirs. Good communications are necessary in order to resolve this problem.

A very important factor that has in some cases been very critical is the inflation rate such as that experienced in Chile about a year ago. The problem coupled with a rigidly controlled exchange ration was nearly disastrous for efforts based on limited U.S. funds.

The political problems in Argentina virtually stopped cooperative University programs in oceanography in that country last year.

The changing attitudes in the U.S. are also posing problems. The isolationism that tends to arise periodically, associated with the mistrust of foreign aid programs in general, is harmful to cooperative efforts because continuity is impossible.

FUNDING PROBLEMS (U.S.)

One of the major problems we have encountered is obtaining timely information from funding sources. One reason for this problem is our remoteness from Washington. Another reason is that certain agencies and organizations do not publicize their changing goals and policies. There are several potential funding sources, each one operating in its own mode. I will list some major sources and comment on each.

AID is operated by the U.S. Department of State. Funding seems to be decreasing and the operational plans are changing. No public announcements are made regarding these program changes. AID sponsors the SEED program by providing funds to NSF. The Office of International programs (NSF) actually operates the SEED program. The SEED program seems to be very useful even though the funds are limited and must cover a wide range of subject areas in many countries.

In NSF, the Office of International Programs sponsors a new program "Cooperative Science Programs in Latin America". The goals of this program are excellent. Unfortunately it still has a small budget with which to support programs in science and engineering. Unfortunately competition between U.S. institutions for these funds may put undue pressure on the foreign institutions. That

is, the foreign institutions may be tempted into programs they don't need and really can't afford. Furthermore, the way the program is set up, Latin American scientists are required to follow the same procedures we use in this country. That is, parallel proposals must be submitted for review both in the U.S. and in the cooperating country. Needless to say, this arrangement causes considerable delay. Delay can be disastrous for many U.S. oceanographers who have to live on research grants. Dependence of oceanographers on research grants also puts them in a poor competitive position for these limited funds.

The NSF Office for the International Decade of Ocean Exploration (IDOE) has provided an excellent method for developing international cooperation on large projects. However, it was not designed for assisting with development of facilities and programs within foreign countries. It does not provide for small programs which may be more suitable to the needs of other countries. Likewise, at this time, it does not have a mechanism for joining in LOC-IDOE programs originating in other countries.

Another NSF office that has provided very limited educational support for Latin American students is the Office of Polar Programs. A limited number of fellowships have been provided in special cases. That office does support international cooperative research efforts in polar regions but, again, funding must cover all science disciplines.

Other sources of U.S. funding include Fulbright (relatively limited funds and generally not devoted to any given field); Ford Foundation (objectives and areas of support are changing); and the Rockefeller Foundation.

There are sources from which the Latin American countries can seek funds such as the Organization of American States (OAS); United Nations Development Program (UNDP); and the Food and Agriculture Organization of the U.N. (FAO). In addition, the IOC (Intergovernmental

Oceanographic Commission) has devoted considerable thought and effort to training, education, and mutual assistance programs. I will not attempt to assess these programs here.

In summary, I can say that the U.S. funding situation is disorganized and fragmented with apparently no guiding philosophy behind it. It seems to be a "jerry-built" program.

## PREREQUISITES FOR PROGRAMS

The following is a list of elements that seem to me to be necessary before a program can be successful.

1. The cooperating nation must have a national commitment to oceanography. This may require some educational program for the decision makers in that country.
2. The nation must have jobs for those to be trained but must seek a balance to avoid either a surplus or a deficit of trained people.
3. The nation should seek and obtain funds from UNDP, OAS, FAO or other international agencies.
4. Plans must provide for development of a nucleus of scientists around which to start building. These people will generally have to be trained outside the country.
5. The nation must provide the organizational and administrative arrangement for coordination of its program.
6. Efforts and goals must be planned at a level commensurate with the national need and finances.
7. The priorities must be established early (outside advice may be needed).
8. The U.S. institution involved must have a good administrative record as well as good teaching and research records.

OPERATIONAL FACTORS (For the U.S. participants)

Once the prerequisites have been largely met success may well depend on the following operational aspects.

1. Exchange visits and personal contacts should be frequent.
2. U.S. institutions must continue to devote considerable and careful attention to all details of the program.
3. Patience is an absolute necessity with sincerity and flexibility close followers.
4. An understanding of the history and culture of the nation involved is important as well as an awareness of current political developments within the nation. Orientation and indoctrination must be provided for U.S. staff and students involved.
5. U.S. scientists and administrators must learn and use proper chains of command and be introduced to correct officials. Tact and diplomacy are of course essential.
6. Key people must learn the language.
7. One of the key elements is to choose participating staff on the basis of personality, attitude, understanding, personal dedication and sincere interest. The name of the game is cooperation NOT coercion; there is no room for a condescending attitude.

In conclusion I will offer the following recommendations and comments.

1. The U.S. funding and planning agencies must coordinate their activities and present a united approach.

2. Oceanographic programs need special consideration and should not be put in competition with all science and

engineering programs. Long-term planning and funding is necessary to bring programs to fruition. Even though competition for funds must be held down within the U.S., information must be provided to all interested as well as all participating institutions. Good publicity and public relations here and abroad should improve the operations considerably. People are more willing to make the sacrifices needed if they are at least given some glory and appreciation for what they have done.

3. University to university arrangements are, in general, desirable but care must be exercised in determining which universities are best suited to a given region. This does not mean that a region is ever the exclusive territory of one institution; rather, one institution acts as a coordinating agent for oceanographic programs in a given region.

4. Although regional international centers are economically attractive I doubt if they can really be very satisfactory for the countries involved. It is somewhat like trying to get one county to close its schools and send all students to a unified district in another county. Although it can be done, it loses something for those counties no longer having a school. Therefore, I think it would be more reasonable to urge each country to consolidate and coordinate its own activities. In the early stages an international regional center may be desirable and helpful for very small nations, but it must be considered a temporary learning center and nothing more. Each country will want some educational and training program.

5. It is better to train as many working oceanographers in their native countries as possible. That is the most effective way to build up local capabilities and to keep an active viable program going.

6. The U.S. institutions should prepare themselves by orienting staff and students for work in the chosen region. Language studies are necessary.

7. Frequent personal contact and personal attention between countries is essential.

8. Last but not least we need to do LESS TALKING and more WORKING. It isn't realistic to expect people in oceanography from smaller developing nations to run about the world attending meetings. Their services are needed at home and we should keep that in mind. It appears we spend more time and money talking about what perhaps should be done, what we would like to do, what they would like us to do, etc., and less and less money actually on constructive programs.

# THE PROGRAM OF THE INTERNATIONAL CENTER FOR MARINE RESOURCE DEVELOPMENT (ICMRD) OF THE UNIVERSITY OF RHODE ISLAND

N. MARSHALL

The International Center for Marine Resource Development was created in 1969 to provide an international outreach to the University of Rhode Island's interdisciplinary marine resources work, previously limited to the domestic front. Like the Sea Grant Program, ICMRD does not have its own faculty but can and does successfully draw upon the participation of interested faculty throughout the University. To provide cohesiveness we have organized this participating faculty as a body of center associates, now totalling thirty-one and representing a dozen academic departments, with an average of 15-20 percent time contributed to international undertakings. A 211(d) grant from U.S. AID enabled us to launch this institution-building activity. The University has contributed substantially and, from our deliberate efforts to broaden the support base, we now have funding from the National Science Foundation and Resources for the Future, plus contracts from foreign countries that have received development loans. There have also been a number of consulting arrangements for individuals cooperating with FAO, OAS, the U.S. Department of Agriculture, the University of Illinois, etc.

Our activities may be described under two broad headings: (1) guidance of development programs and (2) educational institution-building.

A program, now in the background study stage in Puerto Rico, is our major effort of the development guidance category. While we immediately note that this is not truly international, we derive satisfaction from the fact that it is intercultural and that it builds our capability to reach further into the Caribbean region. We also derive satisfaction in that this is an inter-university program with the Puerto Rico Nuclear Center of the University of Puerto Rico. Under the title, "A Research and Development Mariculture-Fisheries Project in Puerto Rico," it is contemplated that the continuing undertakings will involve further cooperation with the Commercial Fisheries Laboratory in Puerto Rico, provisions to strengthen fisheries investment loan programs in the Commonwealth, and guidance in the development of a fisherman's training school at the University of Puerto Rico's branch in Aguadilla, all linked with both fisheries and mariculture research and planning. Though this is presented as an example of one of our development guidance activities, you will note an element of institution-building with respect to the Aguadilla school; also there is the hope and likelihood of further inter-institutional ties with the cooperating group in tropical marine studies at the University of Puerto Rico.

Our chief educational institution-building effort (category 2) at present involves our response to an invitation from the University of Dar es Salaam in Tanzania to help consider plans for an Eastern African Center for Marine Resources. We conferred in some detail with the University of Dar people in conceiving, initiating and planning the conference. We supplied substantive background material and have provided the University with a summation of what might be needed in staff and facilities for a regional center. Key people from both FAO and UNESCO headquarters have encouraged this planning effort and are participating in the conference. As a vehicle for pursuing further the

anticipated goals of such a planning session, a conference proceedings with recommendations will be released in a few months.

Having elaborated, by illustration, on two broad categories of assistance, let me now run down (using the same groupings) a list of added Center activities underway or seriously contemplated.

(1) Guidance in Development Assistance:

Seminar and Workshop on Coastal Artisan Fisheries in Central America

We anticipate this will be funded by U.S. AID, will be held in Costa Rica next fall, and will involve representatives of the fishing industry and fishery administrations in the area. It is expected that FAO and OAS representatives will be among the key participants. Hopefully, follow-up assistance to the coastal artisan fishery will be arranged, presumably linked to Inter-American Development Bank loans in the region.

Azores, Assistance in Fisheries and Agriculture

Rhode Island's cultural ties to the Azores have prompted those of us at the state university to consider development assistance that might be extended to these islands. Three of our faculty members, who have recently visited the Azores for the specific purpose of projecting further activity there, have formulated a plan for assistance undertakings in fisheries and agriculture. How, when and whether this will be funded remains to be seen.

Oil Development Advisory Services

A member of our resource economic faculty, working cooperatively with his peers and with faculty in geology and engineering, has pulled together advisory information as will be needed by developing countries which face the new experience of negotiating with investors interested in offshore oil. Such information, forthcoming in this manner from a disinterested party, should prove useful to these countries. We intend to expand our capability in this regard and to publish relevant advisory statements, probably in the native language where desirable.

(2) Educational Institution-Building

Advisory Services to the Escuela Superior Politecnica del Litoral

Professor John Sainsbury has advised this university with respect to its plans for a techniques training program for fishermen. Wilmo Jara, the designated leader of this program, is presently visiting URI for further planning and Sainsbury plans to return this summer to be on hand as the instructional program is initiated.

Contemplated Cooperative Program with the Universidad Catolica de Valparaiso

The Escuela de Pesquerías y Alimentos of this university initiated planning sessions with URI over a year ago; oceanographic

interests there also approached Oregon State University. Now fisheries and oceanography are in one school within the university where they are contemplating a substantially strengthened effort building further on the assistance already rendered by the University of Washington (note presentation by Lynwood Smith at this conference). Sergio Gonzales, the director of that school is currently in the United States and is in the audience. I plan to visit the Universidad in May. We foresee the possibility of a consortium approach on the part of U.S. universities. URI participation could in time overshadow our other institution-building activities and will surely be in marked contrast with anything we might undertake in Eastern Africa where so little university marine work has been done.

Participation in a Consortium Relating to the College of Science and Technology in Nigeria

This consortium is being organized by the Education Development Center to assist the College of Science and Technology in Port Harcourt, Nigeria in developing its overall curriculum. The intended URI contribution to the consortium is in the area of fisheries and marine resources.

Institution-building, we might note, seems particularly compatible with university interests and has the added advantages of being wanted by developing

countries anxious for cultivation of their own technological capability. Though often intangible, such work can provide a greater return per expenditure than most other assistance ventures.

The above list is by no means complete. It doesn't touch upon very significant participation by key members of our faculty, well-known to many of you, in international law of the sea affairs. Furthermore, we could offer a long list of individual faculty pursuits in the form of research, consulting activities, etc., that involve significant international resource development activity. One such individual study is directed to an evaluation of representative marine resources assistance projects undertaken in developing countries. If some of our earlier ideas for a conference on a Sea Grant role abroad fail to materialize, we may instead hold a research workshop on the evaluation theme.

The above listing also fails to enlarge on the fact that the education of students from overseas is woven inseparably into all of the efforts; in fact, there are close to sixty foreign students involved in University of Rhode Island marine programs. Three of these students are in the audience. Finally, the above account fails to elaborate on the role that Professor C.O. Chichester, supported by our International Center, has played in organizing and administering the Consortium on the Development of Technology (CODOT). This is guided by food technology leaders from five state universities--California, Washington, Wisconsin and Michigan State as well as URI--and carries very substantial projects in Brazil and Central America, with other activities pending.

We were asked to elaborate on how this type of work is unfolding and to comment on the problems experienced in the execution of these undertakings. The chief requirement is patience. Obviously, in dealing with foreign countries, action is hampered and delayed

all along the line by communications difficulties, both physical and cultural. However, the need for patience applies even more at home as our government vacillates in program planning, gets bogged down in bureaucratic indecision, and generates false starts which not only hurt at home but lead to misunderstandings abroad.

I never cease to be amazed at the administrative busy-work, accomplishing very little, that is involved in this overseas thrust. For a program even as modest as ours, we find it necessary to have an executive assistant to the director plus a highly able secretarial corps. And I would advise anyone considering such endeavors not to proceed without special business services geared to work on international affairs (this means at least one administrator plus secretarial help). Finally, each unit undertaken overseas has to be set up with its own administrative provisions.

Incidentally, I would strongly recommend special library services. The support literature is somewhat unique though it ranges widely. We find that a very modest staff, if competent, can cover acquisition, maintenance and library research services. We find, I should add, that no amount of research, personal contacts and correspondence seems adequate to surmount the problem of keeping informed, to avoid duplication and overlap if nothing else, as to what other groups are doing abroad. I could cite examples not only of our own oversights, but of comparable problems encountered by institutions with much more experience in international work.

It must be apparent that our approach to international development work involves launching numerous trial balloons. If all these were to meet with success, we would be swamped, yet the whole endeavor could collapse. The approach is highly precarious to say the least, and we could not possibly venture into such overseas work without a significant commitment from the

University's central administration. The precariousness to which I refer is largely generated within the United States by the vacillations and uncertainties mentioned in the previous paragraph, yet it would seem quite easy to conceive of a plan whereby, without spending any more money for overseas assistance, we could offer solid, continuing programs bolstered by competent advisory back-up and peer review. I have been disheartened on getting the impression that there is a groundswell of opposition to the suggestion that Sea Grant should take on an overseas role. I was never an unqualified advocate of this but had hoped that, if we could find some effective interlocking of the U.S. AID commitment with the Sea Grant know-how in fostering marine resources programs, we might readily evolve the much-needed approach.

In closing, let me note that I am greatly impressed with the numerous common denominators that are unfolding as the speakers, particularly those with experience in international work, elaborate on the need, the problems, and the desired approach needed to effect technical assistance abroad in the marine resources area.

# INTERNATIONAL RESEARCH COOPERATION IN MARINE BIOLOGY AT RSMAS UNIVERSITY OF MIAMI

G.L. VOSS

The University of Miami's marine biological programs, because of our geographic location, from their inception have been strongly oriented toward the other countries of the Caribbean.

The first oceanographic cruise made by Miami scientists was in fact a joint operation of the Cuban Hydrographic Office, the University of Havana and the University of Miami aboard the Cuban Navy research vessel YARA led by Dr. Smith and Dr. Luis Howell Rivero. This was the beginning of close relationships both in research and education between these institutions which continued until the present Cuban government came to power. During this period, about a half dozen Cuban scientists received post graduate training and higher degrees at Miami. There is still considerable literature exchange and what might be termed "arm's length" collaboration or research exchange between our scientists and those at the Instituto Nacional de Pesquerias in Havana.

In reviewing our marine biological cooperation, is clearly evident that our extensive cooperation has been almost entirely on a person-to-person basis and not through governmental sources. Latin students have been attracted to Miami not only because of the strong programs in marine biology but also because they can react and live with a large Latin population; there is excellent air service; many of the biologists at Miami have a working

acquaintance with Spanish; and our research interests, being directed toward the tropical fauna and flora, coincide with their own. Our experience in this area has convinced us that the best cooperation usually, if not always, is the result of a one-to-one scientist interaction. In most cases where either government has intervened, only troubles have ensued. For fruitful cooperative efforts on a larger scale, extramural funding is required.

The major involvement of my colleagues and me in international marine research began in 1964 when we commissioned the R/V JOHN ELLIOTT PILLSBURY. Our first biological cruise was to the Gulf of Guinea during the summer of 1964. Our operations there well exemplify our subsequent procedures and may be used as a pattern.

Prior to our departure from Miami we contacted Dr. Francis Williams, Director of the Guinean Trawling Survey being conducted by the Organization of African Unity, and suggested that our own work should, where possible, be complementary to his. On arrival in Nigeria, we held consultations with him and planned, with our gear, to extend his shelf studies down the slope and out onto the basin floor. We invited faculty and students from the University of Ibadan to visit the ship and have gear and instrument demonstrations. Some of our people visited Ibadan and gave several lectures at the university. No Nigerians joined the ship because, at the time, they had no programs in marine sciences.

On this cruise and all subsequent ones made in my programs, a running scientific journal was maintained by me or other Chief Scientists. On return to Miami this journal was edited, a cruise track chart prepared, and the report sent to Dr. Williams for his use. At the request of Dr. Thomas Austin, a computer print-out of all stations at which commerical shrimp were obtained was sent to him for distribution.

The first volume of our scientific results was published in 1966 and copies were hand-carried to the UNESCO-FAO meeting in Abidjan. A copy was given to the scientific representatives of each of the countries bordering the Gulf of Guinea. A second volume was published a year later and copies sent to appropriate sources in Africa. Manuscripts are on hand for two more volumes but no funds are available for publication. Several Nigerian scientists at the University of Ife are working on material from our cruises and have already published several papers. In 1973 Professor Caleb Olaniyan, Dean of the School of Science of the University of Lagos, spent a sabbatical with me studying our educational and research systems, working on Nigerian collections and writing. He proposed and is attempting to set up a collaborative program between Miami and the five Nigerian universities involving professorial exchanges, special courses, student exchange, and cooperative research programs. So far, no funds have been found to establish what could become an important Nigerian-U.S. international program.

Our relationships in Latin America similarly have never attained full potential but in a number of countries very close associations have been formed through personal contacts. Three examples should suffice.

Panama. We have made three extensive cruises in Panamanian waters--1966, 1967, and 1972. Our first cruise on the Caribbean coast was cleared by the Department of State. Personal contact was made through my old friend Dr. Luis Howell Rivero, then UNESCO Marine Sciences Advisor to Panama. He introduced us to various officials and brought a busload of students and faculty over to Cristobal to visit the ship and have informal talks. The full report of the cruise was sent to him when completed, as well as a copy to the head of the Bureau of Fisheries, Mr. Juan Obarrio. Both asked for additional copies.

Clearance was again asked through State in 1967 for work in the Gulf of Panama. I personally invited Panamanian scientists to join the cruise and Dr. Alfredo Soler, Assistant Professor of Biology and a specialist in phytoplankton, joined us. Later he spent a year in Miami working with Professor Wood before returning to Panama.

Again in 1971, we requested clearance through State for work from Escudo de Veraguas northward. Because of our timing, and intervening holidays, State refused to request clearance. My personal request to the Minister for Foreign Affairs resulted in permission within 24 hours.

Our final cruise in 1972 was such a disaster that it nearly eliminated all further cooperation between our two universities. Because State had complained about obtaining personal clearances, I this time again asked State to obtain clearance for our ship, the R/V JAMES N. GILLIS. I informed Dr. Soler, now Dean of the School of Science, of our visit and requested participating scientists. He declined but thanked us for the invitation.

We arrived in Panama two days late because of a rough passage and began work in the Gulf of Panama beyond the continental shelf. Two days later I received a cable from the U.S. Embassy in Panama accusing us of having passed through the canal several days early, refusing to pick up two participating Panamanian scientists and ordering us back to Panama. I solved the problem by radio with our Ambassador and Drs. Soler and Howell but, on our return to Panama, was surprised that no one showed up for our open house planned for students and faculty of the University of Panama. Later Dr. Soler came aboard and told me that an Embassy official had ordered him to come down to see me and had reportedly told the Panamanian officials that no other Panamanians would be permitted to come aboard our ship. Through personal friendships, apologies, and denials

of all knowledge of these actions, personal friendships were maintained but all real collaboration ceased as of these importunate misunderstandings.

Prior to this, we had established publication exchanges, we had shipped several boxes of scientific papers to the university through my office, we made specimen identifications for them, free xeroxing, and library research. We interceded for them with the Smithsonian Institution and obtained collaboration between those two institutions. We arranged for exchange of professors and regular acceptance of students for higher degrees. Because of lack of financial support and the incidents mentioned, this has ground to a halt to our mutual regret.

Colombia. Our associations with Colombia have been most cordial. Several marine scientists in that country received their Ph.D. degrees from us and one is in residence now. At various times during the past fifteen years officials of the University of Cartagena and the University of Bogota have requested a formal agreement with us including summer courses to be taught at Cartagena. On one occasion, these progressed to the point of only a few days from the time of departure of our faculty members. On this occasion, it was canceled because of naval maneuvers at the base where the course was to be taught; another time it was canceled because we could not come up with the necessary funds from the United States. However, a number of Colombian scientists and students have participated in our cruises.

In 1971 in our cruise along the Central American coast, we requested from State clearance for work at Providencia Island, one of Colombia's major tourist and recreation resorts. State refused to request clearance because it apparently supported Nicaragua in its claims to the island. One of my graduate students, Mr. Palacio at my request, called his government and obtained clearance within two days. The Colombian government was very pleased to obtain our final report on Providencia.

In 1972 on our Pacific cruise, State requested clearance for us from Colombia but that country refused permission on the basis that we were a fishing vessel, apparently because we use trawls in our work. Fortunately, Mr. Palacio was on board and as his uncle had just been appointed Consul General to Panama, on our arrival in Cristobal he vouched for the fact that we were a research vessel and permission was naturally immediately granted.

Mexico. We have made numerous cruises in Mexican waters outside the Gulf of Mexico in participation with Mexican scientists. We have four Mexican graduate students at Miami at the present. All of these are supported by their own government or universities with occasional tuition support from us. Most of this cooperation has been through the efforts of individuals such as Dr. Ayala at the University of Mexico and Dr. Enrique Schaeffer of the Technical Institute of Monterey, the latter one of our former students. We hope that this type of collaboration can be continued and expanded, but efforts to put this on a formal basis through first the International Biological Program and later the IDOE have met with failure.

In looking at the general picture of our involvement in international programs the outsider must be puzzled to see an institution located perhaps the most favorably of all U.S. universities for involvement in Latin America and Africa having no formal international marine research assistance programs.

Let's pause a moment to look at the credit side. Firstly, there is hardly a country or island in Latin America that does not have one or more marine or fisheries biologists who were trained or received their highest degrees at Miami. Most of them are still young men but some have already reached senior status and are making their mark upon marine work in their countries. Secondly, as most of our marine research is tropically oriented, we are deeply involved in research programs

in the Caribbean and West African waters and wherever possible, this has been in cooperation with foreign scientists. Thirdly, usable scientific reports have been processed and sent to the countries whose waters we have worked as soon as such reports have been finished. These have been of considerable interest to them and in some cases have started new profitable fisheries. Fourthly, the University of Miami has long been a source of scientific literature research, xeroxing and bibliography to these countries, mostly free of charge, and our research collections are open to study by faculty and students of institutions throughout the area. Fifthly, we initiated a Certificate program which allows foreign students and professionals to enroll in courses of study at Miami leading to a Certificate in a given area. This has permitted students to enroll whose undergraduate work either was not at the level of similar U.S. students or ones whose achievements could not be evaluated according to our system. If their achievements are of the same level as our regularly enrolled students, thus showing superior attainment, they may apply to transfer over to the regular degree program. Otherwise, and sometimes at their own request, they continue in the Certificate program. This program has been unusually successful and Certificate holders are now working in a number of countries, particularly Indonesia. Their superiors are enthusiastic about the program. Sixthly, we accept a limited number of students under special arrangements with their governments or home institutions to enroll in a non-degree status for graduate studies. Upon completion of a certain number of credits with grades of B or better, they may be allowed to enter the degree program. These last two options permit us to accept tentatively students whose backgrounds we are unable to judge adequately, observe them in courses and research, and either admit them or keep them in the *status quo* without loss of face to themselves and without jeopardizing the standards and qualities of our advanced courses and degrees.

Another very successful program has been the Nordic Exchange. This is run under the auspices of the University of Miami and the Nordic Council, embracing Norway, Sweden, Denmark, and Finland, presently chaired by Dr. Hans Brattstrom. Each year one or more exchange professors or students is nominated by the Nordic Council for work at Miami. We provide working space and general facilities including space aboard our ships or small crafts. The Nordic Council supports the Nordic Fellow as far as salary and living expenses are concerned. In turn, the Nordic Council will provide similar services and working space for U.S. recipients selected by the University of Miami. Unfortunately, because of lack of funds over the ten to fifteen years in which this cooperative program has been in existence, only two U.S. fellows have been able to go to Scandinavia. At the same time, a Nordic Fellow is almost constantly in residence at Miami. Regardless of the one way operation, we have strongly benefited from the program and it should be a model for other programs emanating from Latin America or Africa.

Finally, I should mention one of our major programs in information exchange with Latin America--the Gulf and Caribbean Fisheries Institute--founded in 1948 at Miami. Mr. Richard Kahn, Chief, Economic Section, USFWS stated in his opening address "This Institute means the beginning of a program of the Marine Laboratory of the University of Miami which is unique in the history of universities and institutes of higher learning. The Fishery Institute comprises not only biologists and conservationists, but also fishermen, representatives of commercial enterprises and economists. It represents not only national aspects, but also the international aspects of the Caribbean area." The inaugural session was attended by representatives from the Bahamas, British Guiana, Martinique, Barbados, British Honduras, Venezuela, and Cuba. It has met every year since 1948 in such places as Havana, Curacao, Jamaica, New Orleans and many others besides Miami. Partially supported by the U.S. Sea Grant Program, it has had a profound effect upon the

entire Caribbean region in arranging cooperative research, personnel exchange and particularly in the exchange of industrial and scientific information. Over the years, practically every nation bordering the Caribbean Sea has participated in the meetings and all have benefited from them.

Now let us look at the debit side. To place this in its proper perspective, you must realize that Miami is a private university and thus faced with strong financial stringencies. We have thus, through necessity, had to turn to national funding agencies and foundations. Here we have met with a singular lack of success.

One of our first major attempts to develop international programs was initiated by the Inter-American Conference on Marine Science held at Miami in 1962 under the auspices of the National Academy of Sciences. This met with tremendous enthusiasm and promises and spirits ran high during the meetings at Key Biscayne. Programs were developed at the conference and submitted to the United States and to the participating nations. To my knowledge, not a single biological program came to fruition and instead of helping to develop cooperative programs it cast a pall of gloom over the participants upon their return home. I believe the meeting, by raising hopes and then dashing them, hurt the United States in its relations with South and Central America. It was just another case of "Gringo empty promises." The questionnaire summary prepared in 1962 is just as pertinent today as then. Reading it makes me wonder about the need for the meeting today.

Similarly in 1969 I was asked by OAS, the Pan-American Union, and AID to develop a cooperative program between the University of Miami and scientists in Panama, Colombia, and Venezuela. The idea was that Miami would prove a catalyst and a data and resource bank for the other countries who would have actual control of financial disbursements in their hands. Plans progressed well; numerous discussions were held with participating

institutions; a draft was prepared; and a request was made for funds to call the participants together for a final organizational meeting. At this point, and without warning, the organizations decided they were no longer interested in the program which they had requested. Those involved at this stage, especially in Panama, were rather bitter.

When the IBP marine program was being developed a meeting of representatives from universities around the Gulf of Mexico was held in Biloxi, Mississippi to prepare a research program for the area. The one adopted by the meeting was for a broad study of the Gulf and its estuaries and involved strong participation with Mexico. For some unknown reason the convener never transmitted this plan to the central committee, although Dr. Ketchum told me when he heard of it later that it was just the type of study they had been looking for. By then it was too late to have it reconsidered.

In looking at the history of our efforts in this field, I am more than ever convinced that governmentally run international programs are nearly impossible under present structures, at least in biology. I quote here from the Academy summary mentioned previously. "The opinion was expressed that intergovernmental councils are not desired, but rather an organization of working scientists, without political affiliations. It was stated that such an organization could be of real value in increasing governmental support and interest in each country."

One of the final recommendations was the establishment of an inter-American council of marine scientists, non-governmental, but consisting of working scientists. It was on this basis that the meeting in Miami was organized. It is indeed a pity that its objectives were never carried through by the Academy but died aborning.

Last year I was one of a group of oceanographers who met here to discuss problems of marine research in relation to the Law of the Sea. After participating in the conference I am as convinced as ever, in fact more so, that most of our problems have been brought about by a cavalier attitude toward other nations. This was well expressed by Panamanian professors concerning their relations with the Smithsonian Institution, the Battelle program on the sea-level canal, and the visits of oceanographic ships. As their views were echoed by Colombia, Venezuela, and many others, they are worth citing.

Concerning the Smithsonian Institution, they pointed out that they were not asked to participate in SI's research programs so that no skills or knowledge were passed on to Panamanian students and faculty. The university was not even the recipient of nor on the list of publications. The SI would not xerox necessary papers for them and they had difficulty obtaining identifications of organisms from them. When important biologists visited Panama to work at Barro Colorado or the SI's two marine stations, or came to work on Battelle projects, in almost all cases the Panamanians first learned of their visit from newspaper articles published upon their departure from Panama.

As I and several of my colleagues are Honorary Associate Curators of the Smithsonian Institution, I presented the problem to the SI but it took several years and repeated requests before the situation was, I hope, finally cleared up. In the meantime, Miami, at our expense, had been providing many of these services.

As for the oceanographic ships, the common complaint has been that, because clearances are requested via the governments, the local scientists have no opportunity to participate either for themselves or their students. Usually the government places a naval officer aboard the ship rather than scientists in the disciplines represented by the cruise. This is an unhappy and unproductive

relationship at best. Private arrangements can ensure local scientific participation. Most resented, however, are lack of prior information concerning ship visits permitting lectures, visits or demonstrations, and the terse, scientifically worthless cruise reports submitted by U.S. institutions. Our running scientific journals are in sharp contrast, providing real input for local scientists and are always in large demand. Our own scientists have found them invaluable and they have a distribution request almost equal to published scientific results. I might add that these reports are only produced by my own program and are not customary from other divisions at RSMAS.

There has also been much discussion concerning collections made in foreign waters. While governments again are requesting that these collections be turned over to them or shared equally, this is not the attitude of the scientists. University scientists with whom we have worked do not want unworked nor shared collections: they do not have the expertise to work them up and they become liabilities rather than assets. What they want is the opportunity for their students to be able to work on these collections as assistants to the U.S. specialist and to obtain for their use identified sets of animals and plants so that they may become increasingly independent in their own home research. Our policy is to return as much useful material as possible, both in reports and specimens, to the country of origin. This policy has been greatly appreciated and the result is that, despite the present restrictions on territorial water research, I can obtain clearance and full cooperation locally from any of the countries in whose waters I have worked. This is because we have had true scientific collaboration in the best sense of the word.

My time is getting short and I would like to address the last few moments to where I think we should go from here. It is obvious that I do not believe in governmentally operated nor directed cooperative efforts. I believe

that to be successful, these programs must be largely originated by the scientists in the foreign country. They must enter it as equals, regardless of their training and background, and the U.S. scientists must be dedicated to the program and not use it just as an opportunity to do foreign travel and research for their own ends.

The programs developed should be professorial exchanges where possible, so that both parties are aware of the other's problems; should involve special courses in the foreign country designed to acquaint the foreign students with marine subjects and methods of research, and include student exchange and participation by both students and faculty in ongoing research programs in both countries. Training and work toward a higher degree should be in a field that the recipient can expect to work in on his return to his native country (a job at home should be ensured), and not in such a highly specialized field that in order to pursue it he has to remain in the United States, as so often has been the case in the past.

The Nordic Council-University of Miami program has been a viable one for many years between groups of highly developed countries. The program that we now are attempting to develop with Professor Olaniyan in Nigeria is, unintentionally, modelled somewhat after this but on a broader scale. While beginning with the five Nigerian Universities, Professor Olaniyan hopes that it will eventually embrace all of the nations bordering the Gulf of Guinea. For a viable program, both we at Miami and the Africans will need financial assistance. Hopefully this will come from agency sources.

We see the need for the same type of cooperative programs in South and Central America where we even now fill a certain role as the main source of marine data for many laboratories, museum services and central libraries. We are already so heavily involved in research in

Caribbean and African waters that research participation does not involve major new funding but primarily funding necessary for support of service facilities and in particular support of travel, salaries, and subsistence on a two way road toward mutual scientific advancement.

In ship operations necessary for such shared programs, I have long felt that the block funding now in operation should be expanded to cover the cost of publication and distribution of the more comprehensive type of cruise reports that I have described before and that other funds should be made available for one day science seminars at ports of call including a day at sea demonstrating ship board gear and its use the same as we do at home with our graduate classes. I think the dividends in good-will would be enormous.

In conclusion, I would like to point out that while the first quarter of a century at our institution has been primarily directed toward growth, both scientifically and materially, I believe that our future growth lies to the south and east in strong involvement in the scientific development and destinies of our neighbors through mutual assistance in our studies of the biology of the seas.

# FISHERIES PROGRAMS AND PROBLEMS
# U.S. ACADEMIC INSTITUTIONS
# WEST COAST

D.G. CHAPMAN

Though the fishing industry is quite important on the West Coast, the number of fisheries programs is relatively small. Table 1, however, includes not only fisheries and marine-oriented food science programs, but also the marine science programs. In the first place, I think it is only this broad umbrella that includes all programs that may be of interest to those concerned with research assistance to foreign states. Secondly, with the increasing difficulty of access to certain types of programs, e.g., some fisheries programs, it may be useful and desirable to look at the wider spectrum and consider alternatives.

Programs listed offer a complete degree spectrum unless otherwise noted. Food science programs with a marine orientation are important since they treat the processing of the products obtained from the sea. Their role may be even more important in our assistance to developing nations than it is in our own country.

The first comment to be made about Table 1 is that most programs in the marine science field are academically oriented. Specific fisheries programs are to be found in five institutions with only two (University of Washington and Oregon State University) having a complete range of degrees and a fairly substantial range of offerings. Food science is limited to three institutions--the two mentioned and the University of California at Davis.

TABLE 1 Marine Programs--West Coast

| Programs | Institutions | Degrees Offerred |
|---|---|---|
| FISHERIES | University of Washington | |
| | Oregon State University | |
| | California State Univ., Humboldt | B.S., M.S. |
| | University of California, Davis | B.S. |
| | University of Alaska | B.S., M.S. |
| FOOD SCIENCE (marine emphasis) | Oregon State University | |
| | University of California, Davis | |
| | Universtiy of Washington | |
| OCEANOGRAPHY | Univ. of California, San Diego (Scripps) | except B.S. |
| | University of Washington | |
| | Oregon State University | |
| | California State Univ., Humboldt | B.S. |
| MARINE BIOLOGY | Univ. of California, San Diego (Scripps) | except B.S. |
| | University of California, Berkeley | B.S. |
| | University of California, Santa Barbara | B.S. |
| | University of the Pacific (Pacific Marine Station | B.S., M.S. |
| OCEAN ENGINEERING | Oregon State University | except B.S. |
| | University of Southern California | M.S. only |
| MARINE SPECIALIZATION IN OTHER DEPTS. | University of California, Berkeley | B.S. |
| | University of California, Irvine | |
| | UCLA | |
| | University of California, Santa Cruz | |
| | California State, Fullerton | B.S., M.S. |
| | California State, Humboldt | B.S., M.S. |
| | California State, San Francisco | B.S. |
| | Moss Landing Marine Laboratory | B.S., M.S. |
| | Universtiy of Arizona | M.S., Ph.D |
| | University of Southern California | Ph.D. |
| | Hopkins Marine Station | |
| | Walla Walla College | |
| | University of British Columbia | |
| | University of Washington | |
| | University of Oregon | |

TABLE 1 Marine Programs--West Coast

| | |
|---|---|
| GEOLOGY | University of California, Davis<br>University of California, Los Angeles<br>University of California, Santa Cruz |
| ENGINEERING | University of California, Berkeley<br>University of Washington |
| OTHER PROGRAMS | M.P.A. in Marine Affairs, Univ. Southern California<br>L.L.B emphasis Marine Affairs, Univ. of Washington<br>Marine option program for undergraduate major, University of Hawaii |

Table 2 gives a listing of courses in two fisheries schools. Naturally, there is basic work in fisheries biology and ecology--built usually on a substantial foundation in basic biology, chemistry and mathematics. Then there is a program in aquaculture--dealing both with fishes and invertebrates. This may include work in pathology and genetics. Incidentally, in some cases, the prime emphasis in vertebrate aquaculture in the Northwest is on salmonids. Secondly, there is a program in population dynamics and fisheries management. This includes the classical methods of evaluation of fish populations and their management by regulatory agencies, such as state fisheries departments or international commissions. It may also include courses in resource assessment by quick and dirty methods that are necessary for developing fisheries. Thirdly, there is a series of courses having to do with pollution problems--these affect fisheries but also a large proportion of our present graduates are employed in positions dealing with such problems.

While graduates of aquaculture are likely to be employed in the private sector by firms primarily concerned with fish production, the balance of the graduates are more likely to be employed in federal or state

TABLE 2 Courses in Fisheries--Oregon State University and University of Washington

| Course | Course Credits |
|---|---|
| OREGON STATE UNIVERSITY | |
| Economic Ichthyology | 5 |
| Economic Ichthyology | 4 |
| Wildlife Law Enforcement | 3 |
| Fishery Biology | 5 |
| Fish Culture | 3 |
| Fishery Limnology | 3 + 2(lab) |
| Commercial Fisheries | 5 |
| Invertebrate Fisheries | 5 |
| Water Pollution Biology | 3 |
| Parasites & Diseases of Fish | 5 |
| Fish Genetics | 3 |
| Population Dynamics | 4 |
| Pollution Problems in Fisheries | 3 |
| Functional Ichthyology | 3 |
| Systematics of Fisheries | 3 |
| Special Topics in Ichthyology | 3 |
| UNIVERSITY OF WASHINGTON | |
| Functional Anatomy of Fish & Shellfish | 4 |
| Methods & Instruments for Fishery Investigations | 3 |
| Applications of Digital Computers to Biological Problems | 4 |
| Recreational Fisheries | 3 |
| Fisheries of the World | 3 |
| Literature Search in Fisheries and Food Science | 3 |
| Classification of Economically Important Fish | 5 |
| Economically Important Mollusca | 5 |
| Economically Important Crustacea | 5 |
| Principles of Fish Physiology | 5 |
| Life History of Marine Fishes | 5 |
| Physiological Effects of Water Pollutants | 3 |
| Fisheries Genetics | 3 |
| Reproduction of Salmonid Fishes | 5 |
| Nutrition and Care of Fishes | 5 |
| Aquatic Food Chains | 5 |
| Water Management and Pollution Studies | 5 |
| Fisheries Management | 5 |
| Aquatic Radioecology | 3 |
| Radionuclides in Aquatic Environment | 3 |
| Systematic Ichthyology | 5 |
| Invertebrate Pathology | 5 |
| Research Techniques in Shellfish Biology | 5 |
| Shellfish Sanitation | 5 |
| Topics in Fish Physiology | 3 + 2(lab) |
| Ecology of Marine Fishes | 3 |
| Metallic Effects of Chemical Pollutants | 4 |
| Population Dynamics | 3-3-3 |
| Methods of Stock Assessment | 3 |

management positions or in situations that may deal with aquatic problems but not fishery ones. Some of these programs include some work in field sampling and fishery gear but most do not, or if it is included it is only part of a course under another title.

Another aspect of the programs is the absence of courses which relate the disciplines of law, economics or public administration directly with fisheries. Many of these institutions undoubtedly require some courses in these fields as part of the undergraduate training, and some students are encouraged to work in one or more of these areas. Such areas are given in the basic departments and may or may not interweave the basic social sciences with problems of fisheries. Many of our visitors and many of our inquiries are concerned with economics in fisheries--perhaps dealing with coast benefit analysis, perhaps with the economics of the exploiter or the processor. They come from semi-controlled or controlled economies and therefore view the situation differently than those of us who are training for management in a free market economy.

While the College of Fisheries at the University of Washington has a fairly venerable history by U.S. West Coast standards, it was preceded for quite some time by the Imperial College of Fisheries in Tokyo. This college was established to train fishermen--that is, the personnel to man Japan's already expanding fishing fleet. It is clear that our colleges by and large do not provide such training, and for this reason I have included in Table 1, a list of institutions that provide technical training. This list is expanded in Table 3 to show specifically the type of training offered.

Many of these are two-year colleges which therefore are not degree-granting institutions. Some of these programs have been facilitated by the Sea Grant program, though others are much older than this.

TABLE 3 Technical Training Programs

| Institution | Training Offered |
|---|---|
| CALIFORNIA | |
| California Maritime Academy | Marine engineering, nautical service, training for merchant marine |
| Fullerton College, Fullerton | Oceanographic technician |
| Orange Coast College, Contra Mesa | Marine technology |
| San Diego Community College | Marine technology |
| Santa Barbara City College | Marine Technology (including diver training) |
| OREGON | |
| Clatsop Community College, Astoria | Oceanographic technology, marine engineering technology, commercial fishing technology, marine technology |
| WASHINGTON | |
| Grover Park Education Center, Lakewood | Commercial fisherman, crewmember |
| Grays Harbor College, Aberdeen | Fish & Game management |
| Highline Community College | Diving technician |
| Peninsula College, Anacortes | Associate of Applied Arts (Fisheries) |
| Seattle Central Community College | Marine engineering technology |
| Shoreline Community College, Seattle | Oceanography technology, marine biology technology |

On the food science side, I have listed in Table 4 the courses at the two major West Coast institutions with a marine orientation. It is clear that these cover, in addition to basic principles, applications in biochemistry and microbiology and some parts of food engineering. These are perhaps more oriented to developing countries' problems, though again the lack of interaction with economics may be commented upon.

These represent the training programs that are available to students from other countries, unless a special program is arranged. They may be suitable for some but undoubtedly not for all trainees from other countries. There has been a steady demand from foreign students despite our high tuition fees--extremely high for out-of-state students. Moreover we have now additional problems-- many schools have fixed total enrollments and it is hard to meet the instate demand for fisheries and food science training. Should we diplace instate students to provide additional spaces for students from other countries? Since state legislators appropriate fund for the education of their own population, it is difficult to resist the pressure to assign to out-of-state and foreign students a lower priority than instate students.

This is the training situation. We can explore the research side of the picture in West Coast academic institutions by sampling some of the Sea Grant research projects now underway. There are, of course, other research projects being carried out besides Sea Grant projects; since Sea Grant funding tends to emphasize applied research, these are the ones most likely to be exportable to developing countries, and such researchers are most likely to be able to provide support for foreign aid programs.

TABLE 4 Food Science Offerings--Oregon State University and University of Washington

| Course | Number of Hours |
|---|---|
| OREGON STATE UNIVERSITY | |
| Food Quality Evaluation | 2 |
| Food Processing | 3,4,3, + 2(lab) |
| Food grades and Sanitation | 2 |
| Food Science | 3,3,4 |
| Federal & State Food Regulations | 2 |
| Food Analysis | |
| Quality Control Systems | 3 |
| Food Packaging | 3 |
| Food Engineering | 3,3,3 |
| Microbial Contamination Control | 4 |
| Dairy Microbiology | 4 |
| Food Microbiology | 4 |
| Carbohydrates in Foods | 3 |
| Food Flavor and Evaluation | 3 |
| Lipids in Foods | 3 |
| Food Preservation | 4 |
| Pigments and Color Evaluation | 3 |
| Proteins in Foods | 3 |
| Enzymes of Foods | 3 |
| UNIVERSITY OF WASHINGTON | |
| Principles of Fishing Gear & Vessel Development | 3 |
| Principles of Fisheries Technology | 3 |
| Environment Food & Technology | 3 |
| Introduction of Food Technology | 5 |
| Principles of Food Analysis | 5,5 |
| Principles of Food Processing | 5,5 |
| Deteriorative Processes in Food | 5 |
| Principles of Technological Research in Food | 3 |
| Biological & Chemical Origins of Foods and Food Components and their Functional Characteristics | 3 |
| Advanced Marine Food Processes | 5 |
| Microorganisms in Foods | 4 |
| Advanced Unit Operations in Food Processing | 3,3(lab) |

Of course, many of the Sea Grant programs deal with aspects of aquaculture, particularly culture of salmonids, though others touch on many aspects of the problems of raising other fish and invertebrates. Oregon State in particular is emphasizing oyster seed production, as well as, other problems of oyster growing. Some of the California projects (California State University, at San Diego and at Humboldt) are studying the use of thermal effluents or sewage lagoons for aquaculture projects. At the University of Washington aquaculture projects include a number of salmonid projects, particularly in saltwater penculture, but also in improving invertebrate mariculture. These include isolation and identification of causes of pathogenicity in oysters as well as studies or environmental and economic factors of raft culture of oysters and clams.

In all programs there are a number of studies of biological resources: this may involve actual shipboard programs or assessment of survey data to systems analysis studies and computer models. For example, the University of Alaska Sea Grant program includes a systems analysis of the Alaska snow crab (genus *Chionoecetes*). At the University of Washington we have the Norfish project which is directed toward a total quantitative approach system to management of North Pacific coastal zone resources. Also of interest for assistance to developing countries are the projects on acoustical techniques of resource assessment--these involve actual usage as well as evaluation of the techniques at several levels.

Oregon State also has a project to assess its resource of a species of tanner crab (*Chionoecetes tannerei* Rathkin) and one to assess fishing stocks off the coast of Oregon as a unit.

Another set of projects in all Sea Grant institution has do with the development of new marine products or overcoming problems associated with products not yet

fully utilized. Many of these have to do with problems of present seafood products or with improved processing. For example, some Oregon State University projects are exploring the extension of shrimp meat with minced fish flesh and of minced fish flesh with non-protein products. At the University of Washington work on problems associated with FPC (fish protein concentrate) are continuing. The aim is to obtain total utilization of the fishery raw materials. Some of the studies are fairly basic, as they must be in this field--towards understanding the organic chemicals in marine organisms (U.C., Riverside) or a search for potential pharmaceutids in marine products (U.C., San Diego).

This sample of work from over a hundred separate (but hopefully integrated) projects suggest that the Sea Grant program is supporting a research program which could provide input to and a model for research assistance to developing countries.

# FISHERY PROGRAMS AND PROBLEMS
# U.S. ACADEMIC INSTITUTIONS
# EAST COAST AND THE GREAT LAKES

J.L. MCHUGH

When I accepted the invitation to participate in this conference and to speak on this subject I wrote to various friends and acquaintances in key academic institutions along the Atlantic coast and in the Great Lakes area. Early in February, fifteen letters were mailed. Replies to six of these were received by mail; one responded by telephone. Such a high return (almost 50%) might gladden the heart of a pollster, but I found it disappointing, especially since most of the replies offered little help. With some outstanding exceptions, for which I was grateful, these replies led me to conclude that technical assistance to developing nations in fishery matters is not important, or if it is important this is not recognized in most academic institutions in the regions assigned to me.

One of the most responsive replies dealt with domestic interstate cooperation and joint U.S.-Canadian programs, and emphasized the role that the National Sea Grant program is playing, but this had no direct bearing on assistance to lesser developed nations. Another mentioned matters which also were stressed at the recent Workshop in Bologna*, such as the need for adequate and

*Report of the Marine Science Workshop held by the Johns Hopkins University, Bologna, Italy, 15-19 Oct. 1973. The Johns Hopkins University, School of Advanced International Studies, Washington, D.C. 20036 (issued Dec. 1973).

continued funding, and the need to understand the local situation in countries where assistance is contemplated. Lack of such understanding has led to past mistakes. Another cited active interrelationships with Caribbean countries, which have been underway for a quarter of a century. One interesting feature of the program at the University of Miami Laboratory is the arrangement for certification of candidates whose academic backgrounds can not be evaluated in terms of University of Miami admission standards, thus allowing students to enter who otherwise might not be admitted. Yet another correspondent mentioned the possibility of using PL480 funds in support of technical assistance and hazarded the view that most academic scientists are totally unaware of this potential source of funds. This correspondent also enclosed a brochure describing a new International Training Program in Marine Sciences at Duke University. The other replies showed no interest in, or understanding of technical assistance to developing countries.

It is likely that I failed to correspond with some individuals or institutions which are interested in and understand the question of technical assistance in fishery matters, and that I have thereby missed some important programs or interests. But the impression remains that, with notable exceptions, most academic institutions in the eastern United States are not aware of a need for technical assistance in fisheries, are not sympathetic to such a need if it does exist, or are not attuned to world affairs. With due credit to those institutions and individuals which see this as an important and neglected responsibility, I interpret the general tenor of the replies to my letter as evidence that no problem exists. This gives me the freedom to impose my personal biases and prejudices upon this audience.

## Digest of Responses

Most universities pointed out that they train students from other countries. This may or may not be useful because these students, if they return home, may

not get the financial or technical support that their training in the United States prepares them to expect. Thus, they may end up in occupations far removed from the subject of their professional training. Training in the United States, unless it is very carefully attuned to social and technological realities in the student's native country, may be counterproductive.

The fishery program at the University of Miami, perhaps because it is close to Caribbean and Latin American problems, has pioneered in Latin American fishery affairs. The Gulf and Caribbean Fisheries Institute has been an important force in this effort. I note that the report of the Bologna Workshop (loc. cit.) refers in more than one place to the Cooperative Investigations of the Caribbean and Adjacent Regions (CICAR) as an outstanding example of international cooperation. I am no longer familiar in detail with CICAR but am sure that the fishery group and others at Miami were important forces in its success. The laboratory at Virginia Key also has had effective interactions scientifically and educationally with the countries surrounding the Caribbean.

I would judge that the interest in technical assistance exhibited by some Atlantic coastal universities is a direct result of personal experience and interest (Duke), active research programs off foreign coasts (Woods Hole, Rhode Island, and Miami), or proximity to other nations (Miami).

Has the U.S. any fishery technology to offer?

Aside from contributions made by Americans to the work of FAO and other international organizations (and these contributions have been many), training of foreign students in the U.S., or export of professors and other experts to other countries, we may not have much to offer. In some respects, fishery training in this country is out of tune with reality--we teach population dynamics when

the real problems of our domestic fisheries are social-political. This is not to say that training or research in population dynamics or any other aspect of fishery research is bad. It does, however, represent a strong personal belief that the social-political aspects have been severely neglected.

Our record of marine fishery management at home is a record of massive failures (McHugh, 1972, 1974) and a few small successes. Marine fishery policy in U.S. coastal waters, if there is indeed any policy at all, has been to make much noise about the small or the imaginary problems and to avoid the really difficult but important issues. Perhaps we could best help developing nations by urging them to profit by avoiding our mistakes, not to emulate them. Kasahara (1973) has pointed out that the developing countries may be receptive to this approach. He says that since the history of their modern fisheries is relatively short, they have not built up the strong social-economic-political resistance to rational management that exists in countries like the United States.

In addition to some of my correspondents, Dr. Chapman, in his paper at this Conference, has mentioned two ways in which Sea Grant could contribute to technical assistance in fisheries: 1) by direct action and 2) as a model for assistance programs. Some people complain about the preoccupation of Sea Grant with practical and immediate results. But a certain amount of pushing is a healthy thing, especially for fishery research, in which many people have been content to fiddle away at minor issues and ignore the burning questions, and have been allowed to get away with it. Sea Grant has the opportunity to solve one of the major problems of our domestic marine fisheries--translating the end product of the scientist, the scientific paper, into public educational and action programs. I believe that Sea Grant made a wise decision when it decided to invest a substantial part of its resources in advisory services. This could break the

deadlock that Dr. Geyer mentioned last night, of scientists communicating only with scientists. I thoroughly agree with Chapman and others that we should use Sea Grant techniques where appropriate to stimulate technical assistance to other nations.

I think it is probable that the U.S. can be more helpful to developing nations by transfer of technology and expertise in preserving and processing fishery products than in communicating conventional concepts of resource management.

It might also be useful if someone were to undertake an in-depth critical review of the history and outcome of past attempts at technical assistance in fisheries. This could be especially useful if it were done in comparison with the performance of the U.N. family of organizations. In fisheries, I am convinced that too often we have been eager to get out in the field to gather new information when it might have been more profitable to examine the record to try to determine why we have done so poorly in the past. I suspect that the conclusions of such a study might be that technical assistance in fisheries is perhaps better provided by international organizations like FAO, which can call upon expertise in this country or anywhere in the world. Assistance from an international body, as Dr. Vanucci (1973) pointed out at Bologna, usually is more palatable than unilateral help.

## Summary and Recommendations

1) In the Great Lakes region and along the Atlantic coast of the United States, with a few outstanding exceptions, there appears to be little interest in technical assistance to lesser developed nations in fishery matters.
2) Training students from other countries in American institutions may not accomplish the desired result unless the program is delicately attuned to the needs of the student's country of origin.

3) The best advice and training in fisheries that the United States may have to offer to other countries is not to emulate our poor domestic performance but to profit from our mistakes.
4) The U.S. National Sea Grant Program may in some respects be a useful model for technical assistance in fisheries, where such assistance appears to be warranted.
5) Transference of technology and expertise in preservation and processing of fish and fishery products may be more helpful than tranference of conventional concepts of fishery management.
6) As a basis for examining the merits of technical assistance and planning programs where assistance appears to be needed, it might be useful to study in-depth past attempts at unilateral assistance as compared with the performance of international bodies.
7) One possible conclusion from such a study might be that the United States should support international programs actively and avoid unilateral involvement.
8) Full use should be made of PL480 funds in countries where such funds are available.

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# A COOPERATIVE TRAINING PROGRAM BETWEEN THE UNIVERSITY OF WASHINGTON AND THE CATHOLIC UNIVERSITY OF VALPARAISO

L.S. SMITH

The program I am describing today began in the early 1960's as a discussion in Seattle between Dr. John Liston, Director of the Institute of Food Science and Technology of the University of Washington's College of Fisheries, and Sr. Enrique Torrejon, Director of the School of Fisheries and Foods at the Catholic University of Valparaiso in Chile. There was further informal correspondence and finally Dr. Liston made a site visit in Chile, so that nearly five years elapsed before a proposal was promoted and then funded by the Rockefeller Foundation. The cooperative training program between the two schools actually began in January, 1967.

The training program was developed to alleviate a number of interrelated problems in Chile. Fisheries training in Chile was being taught at the technician level mostly by persons who had graduated from the same program. Most of them taught on a part-time basis so that there was almost no resident faculty to interact with students on a day-to-day basis. Books and equipment were almost nil, so classwork consisted mostly of transferring antiquated lecture notes from teacher to student on a rote learning basis. Thus the effective exploitation of fisheries resources in Chile was being inhibited on the one hand by lack of technologists trained to use modern methods for catching and processing fish. On the other hand, there were few jobs for trained persons because the fishing companies, with the

exception of a few foreign-based firms, were equally antiquated. In addition to this kind of vicious circle, the University was housed in old, crowded facilities and structured academically in the antiquated Spanish style of small, closed institutes, each giving its own degree and teaching all of its own courses. This meant that most of the courses, other than those in their own specialty, were poorly taught. Thus the program to upgrade the School of Fisheries also had to face a number of much broader problems.

The major objective of our program was to upgrade the fisheries and food technology program at UCV as rapidly as possible. To work out the academic and administrative details of this, Sr. Torrejon made a trip to the U of W. Later, Dr. Richard Van Cleve, then Dean of the College of Fisheries, made a similar visit to the Rector of UCV and greatly solidified the commitments of both universities to the program at the top administrative levels in terms of money, facilities, and personnel and generally made sure that the program was truly a cooperative one.

Shortly after Torrejon's visit, the first phase of the exchange program began. First two and later three additional faculty members from UCV came to Seattle for six-month training programs which were a combination of course-work and direct experience with local fisheries. These were carefully planned so as to be relevant to Chilean fisheries' problems and to the faculty member's area of teaching responsibility and subject matter specialization. Then, shortly after the first two trainees returned to UCV, Dr. Liston went there for three months to help establish new courses thereby teaching these courses jointly with the newly-trained faculty. He also reviewed the entire curriculum of the School, helped to plan further changes in the curriculum and how to implement them. Eventually, three other U of W faculty members took three-month leaves from the U of W, one more in food science and two in fisheries biology, each carrying out similar programs in his own area of specialization. Two U.S. graduate

students also participated. Most of us worked at a variety of levels including teaching students, teaching and consulting with UCV faculty, giving seminars to all interested persons in the area, and performing simple research projects with both faculty and students.

The second phase of the program began shortly after phase one started and involved selected members of the UCV faculty undertaking Master's Degree programs at the University of Washington. Persons were selected for this on the basis of how well they had performed on their six-month visit or on our personal evaluation of them during our visits to Chile. Also considered was whether their teaching responsibilities could somehow be continued in Chile during their absence and how they would fit into the revised curriculum on their return to Chile. These decisions obviously had to be reached jointly by all parties concerned.

Keeping the School of Fisheries operating in Valparaiso in a normal and even upgraded fashion during all of these faculty absences was no small problem, and a variety of solutions was used. Probably the most important method was recruiting Peace Corps Volunteers to fill faculty vacancies. This was a fairly neat solution because the PCV two-year term of service was about the length of time needed to complete a Master's Degree program. However, it also involved the arranging of a major change in the kinds of people which Peace Corps recruited for working in Chile. Instead of social worker types for projects in the outlying villages, the School needed PCVs with at least Master's Degrees and often Ph.D's as instant expert faculty. In other cases, new Chilean faculty were hired so that the staff would be expanded upon return of the original faculty member to UCV. And sometimes the junior faculty member also came to the U.S. later. In still other cases, certain UCV faculty were chosen as being indispensable and stayed behind to keep things running until the first round of Master's Degrees was completed.

At the same time that these training programs were continuing over several years, the rest of the world was changing, too, both in Chile and elsewhere. Student strikes at UCV had evicted the Jesuit rector and replaced him with a non-sectarian one. A new Director of the School was also elected. The closed institute system was modified so that fisheries students could take their basic science course work in the institutes of math, chemistry, biology, etc. Part-time faculty were replaced with more competent, dedicated, full-time faculty which tended to upgrade teaching competence throughout UCV. This new set-up was called "the American plan" at UCV and modelled to a considerable degree after the curricular innovations which we helped to produce in the School of Fisheries. The School also moved into larger quarters which were not new or even modern by U. S. standards, but were a great improvement over their previous ones and served as a great morale booster for both students and faculty. Our role in these changes was difficult to assess and perhaps mostly a case of being in the right place at the right time and in some cases just assisting to make changes that would probably have happened anyhow. In other cases, the successful continuation of the program resulted from a lot of hard work by the School's new Director, Sr. Sergio Kaiser, and by us, as can be fully appreciated only by someone who has already experienced the amount of arranging required to get anything done in a Latin American bureaucracy.

A number of features of our program had, we believe, rather large effects in proportion to their relatively small cost. For example, each Chilean coming to the U.S. was given a small allowance for books, small equipment, and thesis research costs. He carried the books and equipment back to Chile with him when he returned and thus was able to function immediately there in his newly-trained role. Having even minimal research support in Seattle also gave the Chileans more freedom to pursue thesis topics relevant to Chilean problems. Faculty from

the U of W also took books and equipment appropriate to their needs in Chile, even to the point of supplying some of the materials and small equipment for classes to be taught in Chile. These kinds of purchases largely circumvented the worst equipment shortages there, as well as the time lag involved in buying them through Chilean channels. It also kept most of the administrative functions in the U.S. rather than allowing them to become snarled in the more complex ones in Chile. Books were also donated directly to the School to establish a fisheries library there. The idea of sending an experienced U.S. faculty member to help newly-returned Chileans translate their U.S. training into workable teaching and research programs in Chile was also significant in getting things moving rapidly in Chile.

In turn, the Chilean faculty spent considerable time and effort assisting the U of W faculty in travelling around Chile, giving us a broader insight into their problems than could be seen in the immediate area around Valparaiso. This insight was also assisted by language tutoring paid for by the project, some in English for the Chileans, but especially in Spanish for the U of W faculty. In my case, even a minimal ability to speak Spanish greatly increased my usefulness there and greatly lessened the amount of time and effort required by the Chileans to look after those needs which required greater language facility than I possessed. These needs were usually outside of my university duties since most in-school work was carried on in English so that UCV people could practice their English in anticipation of coming to the U.S. To the extent that we could not look after our own affairs, we "Norteamericanos" there added to the workload of the UCV faculty and staff because the usual things that we needed help with were arrangements for housing, transportation, money exchanging, etc., which was outside of their usual university functions. Thus, the making of arrangments and general coordination of the program was one full-time job, although in actuality it was spread over several people.

We tried a couple of ideas on a strictly experimental basis and were gratified with the results. Once when we had no U of W faculty available to send to Chile to teach courses there, we sent two pre-doctoral graduate students, one in food science and one in fisheries biology. They had sufficent training to be respected as professionals by the UCV faculty and yet were young enough to relate very well to Chilean students, so both sides were highly pleased with the results. Our graduate students also benefitted, and both are now involved in overseas programs--one heads an exploratory fishing project in the Red Sea and the other works for a non-profit group sending food overseas.

The other idea we had was to promote professionalism among the School's faculty by helping them to do professional things, like attending professional meetings and presenting papers. In Seattle, they presented their thesis before professional groups, and we even paid the cost of transporting some of them from Chile to present papers at U.S. meetings. Even more important was helping the School organize a fisheries symposium at UCV with invited speakers and the whole traditional setup. The effect on attitudes, on communication among different agencies, on individual perspective and on general morale was really amazing. Many Latin American scientists are very isolated and provincial, and the symposium opened up whole new vistas of international cooperation for many of them.

The successes of the Rockefeller program and also the Chileans own vigor led them to seek additional funding elsewhere. Equipment grants were obtained from both France and Germany. Visiting scientists were arranged for with U.S. AID, OAS, and Japanese funding. The Ford Foundation in Chile and also the Chilean government gave support to students getting degrees in the U.S. One faculty member obtained his own scholarship at the University of Toulouse in France and completed a degree there which is intermediate in level between our Master's and Ph.D. Degrees. In a way, this is also a form of pro-

fessionalism, which we call grantsmanship and which the Chileans learned early and well.

Thus, even though the Rockefeller funding was phased out in 1971, the program still effectively continues without it. For example, two of the early six-month trainees who retruned to Chile to keep things going while their co-workers earned master's degrees, are now finally getting their own Master's degrees. One of them is at our school; the other, Sr. Sergio Kaiser who directed the school during the first three years of the training program, is now getting his master's degree at UC-Davis in fruit and vegetable technology. The latter diversification away from fisheries in both training sites and subject matter is good, we believe, now that a firm foundation in one basic area has been established. The school is also starting programs in fishery economics and fishing technology in collaboration with universities other than ours.

At the present time, seven years after its inception, a tally of the changes at UCV is impressive. The degree awarded to students graduating from the school has been upgraded from a two to a four year degree, making the degree equal to that of most of the engineers and similar professionals in Latin America. The faculty has more than doubled, and almost every faculty member has at least six-twelve months of specialized training beyond his basic four-year college degree. Well over half of the Fisheries and Food Science Faculty already have or soon will have master's degrees. Other South American countries rank the school as the best in South America and are sending students to Chile for undergraduate training. When the school's present Director, Sr. Sergio Gonzales, was in my office recently, he was looking forward to having some of his faculty members earning Ph.D. degrees soon and offering graduate work at UCV.

The actual costs of the present achievements are very difficult to determine because of their many sources. The Rockefeller funds continued for four years at $30,000-40,000 per year. The Chilean government's contribution, mostly as capital outlay for expanded facilities for the School and support of increased numbers of faculty, was also substantial, but difficult to evaluate because of the rapid inflationary devaluation of Chilean money throughout the whole period. U.S. AID, Peace Corps, and OAS perhaps made only slightly smaller contributions. As a wild guess, the total input of U.S. dollars through all of the various direct and indirect channels may have been half a million dollars --a bargain, I would say, considering the long-term benefits to all concerned.

As important as money is, however, this story is really not about money and what it can buy, but about people and what they can do. Let me tell three short anecdotes to illustrate what I mean.

Dr. Liston was the first U of W faculty member to teach a course to UCV faculty in Valparaiso, and one of his first labs there involved the testing of some fresh fish. First the fish had to be filleted and when he walked into the lab to do this with the class he found each of the Chilean faculty wearing a spotless white lab coat and standing behind a lab helper who was going to do the actual dirty work. After a moment's hesitation, he picked up a knife and a fish, took a deep breath, and said, "And now we are each going to fillet our own fish!" There was a much longer hesitation and then slowly the helpers stepped back and each faculty member proceeded to fillet his own fish. That was the end of learning by proxy at UCV.

When I was there in 1970 as a fisheries biologist, I became quite disturbed about the large numbers of egg-bearing shrimp and langostino being brought into port and to the School's pilot plant with no regard for closing of the fishing season to protect the breeding

population. I was told that there were no government regulations because there was no scientific data on reproductive seasons or on the age structure of the population in general. "But," I said, "this is stupid because you get a population sample delivered to your front door twice weekly by the School's own trawler, and all you have to do is get a student to count and measure them!" "No," they said, "it wouldn't work that way," and I couldn't ever get the subject re-opened again. A month later I found out the real reason when I went out on the trawler. The crewmen were skimming the top quarter off the catch by picking out the biggest and best individual specimens to take home for personal use. The seaman's unions were so strong and the skimming practice so entrenched that the School's biologists couldn't get a sample that wasn't hopelessly biased. They even have a word for it --"media pollo"-- which means half a chicken. After that, I was somewhat more cautious about advising them how to run their program. Incidentally, I'm told that a realistic population assessment is now underway under proper circumstances.

During this last summer, the Allende government requested an assessment of Chile's progress and problems by the universities of the country, each department reporting in the areas of their expertise. So the School of Fisheries gathered together its faculty and some of the recent graduates and spent about a solid week evaluating the available data, most of which came from the government's own reports. The resulting evaluation was highly critical of government policies and several faculty members were fearful of reprisals if they submitted it. However, it was finally submitted. Somehow the press obtained copies of the report, even though it was supposed to be confidential to the government, and so UCV was immediately a front page and TV headliner. The doomsayers had a field day predicting that the School would never get another dime of support, etc. To us, submitting such a report would seem the only ethical thing to do, but in a system where one's university

position is politically vulnerable regardless of academic competence, it takes considerable courage to stick with one's convictions, even when they are scientifically sound. Now, of course, it is history that the Allende government fell only one week later, leaving the School of Fisheries and Foods in a highly favored position with the new military junta and with the new rector of UCV, who is a naval officer. The School has been given even more responsibility and power in determining the future of Chilean fisheries, even to the extent of reducing the responsibility and power of the government agencies which formerly had that power. They had become political footballs and were increasingly ineffective during the Allende government and so were demoted by the military junta. I would like to believe that the scientific training and competence of the UCV faculty was responsible for their present favorable position, rather than just political luck.

In summary, our experience in a cooperative exchange program between the two universities has been a good one. We identified capable people there and supported them. As a result, significant and beneficial changes occurred in the fisheries and food technology capabilities of the School which are now beginning to be felt elsewhere in South America. Further changes are continuing to occur in the same direction, even though the formal funding which started the whole process was phased out several years ago. We believe that a number of factors contributed to this result.

1. The program was a truly cooperative one in terms of funding, participation, and administration. We carried out the program <u>with</u> UCV, not <u>for</u> UCV. It also operated at several levels simultaneously to speed up the results. Further, as a university-to-university program, we escaped much of the stigma of government-sponsored projects which are immediately suspect there of being exploitive.

2. There is a continuing personal involvement and commitment from both parties--many persons did things for the benefit of the project which cost them personally in money, time, and effort.
3. Partly because of the personal involvement noted above, the program has been a long-term one. Even with its present 7-year record of achievements, the program is perhaps only half way to its goal of making the School a fully professional one on an international scale. A crash program of 1-2 years would produce little lasting benefit.
4. The program, at least our part of it, invested directly in people more than in material things or administrative structures. We found capable people, trained them and trusted them to make good decisions on their own. This is somewhat in contrast to the usual practice of granting agencies which set up elaborate rules and exhaustive reporting procedures to prevent financial abuse. We had very little administrative superstructure. It is perhaps noteworthy then that the program survived three Chilean governments, three UCV rectors, and three heads of the School. It has not only survived, but has grown stronger. Further, all but one of the people in whom the program invested are still with the School and continuing to provide a beneficial return. Similarly, all of the faculty who went to Chile are still involved in Latin American projects and building on that background.

5. Finally, the small degree of investment in material things was put where it had the greatest leverage--by making it possible for the Chileans to do things in Seattle which had the greatest relevance to Chile and then getting similar projects started upon their return to Chile.

The future for UCV is presently very bright and everybody wants to participate in their successes. Peace Corps is becoming more active again in Chile, NOAA's National Marine Fisheries Service is planning a cooperative research program there, and several agencies such as AID, the Inter-American Foundation, and OAS, are waiting in line to set up proposals. The new director of the School is just now touring the U.S. and Latin America to coordinate these offers of assistance which have the potential of really making UCV the multinational center for study of the sea of which they have dreamed and worked so hard.

The moral of the story is that there is probably nothing unique about either UCV or U of W and that similar centers could be developed elsewhere with similar long-term support at the university level, personal commitment and cooperative endeavor.

# OVERSEAS EXPERIENCE

R.A. GEYER

Technical assistance programs (TAPS) can take many forms and include a broad spectrum of degrees of involvement, such as numbers of persons, types of facilities, funding and time span. But the most significant common denominator is the people participating. This includes their attitudes, ideas, skills, needs, preferences, motivations, goals, dedication, and even mores. These factors determine the degree to which any international cooperative program will succeed in achieving its goals and objectives.

The term "skills" has been selected purposely, rather than "professional training" or educational background, because it includes not only persons with advanced scientific training, but those who generally are referred to as being on a technician or non-professional level. They perform just as important a function in assuring the success of either a basic or applied scientific research or training program, as a scientist with an advanced graduate degree. In other words, it is imperative to train not just "chiefs" but "Indians" as well. This important fact is all too often not given sufficient emphasis or even ignored sometimes in training aspects of TAPS. Similarly, the effect of mores is often overlooked, but these can be an important factor in determining the success or failure of TAPS. For example, I have been involved in training programs where, in addition to such more obvious difficulties that arise from eating with or sharing quarters with other personnel, a scientist would not move or even set up a light piece of scientific equipment to make an observation. This

activity would result in "losing face", necessitating this "demeaning" act to be performed by someone on a lower echelon. Such an attitude is not conducive to the efficient conduct of scientific studies, but it must be faced and coped with at times.

Another important intangible but nonetheless sometimes an overriding consideration is the psychological or perhaps even philosophical attitude of the recipients of a TAP. They may feel that participating in such a program reflects adversely on their national image or stature that might even be considered sometimes as bordering on a form of "colonialism". Still another important intangible factor that sometimes raises tangible adverse barriers that must be overcome in organizing a TAP is the interplay, or to put it more bluntly, the rivalry between different agencies or groups as candidates for a potential TAP. This should come as no surprise, because people are people regardless of where they are living on this globe; and it occurs even in the organizational phase of a major TAP by potentially sponsoring groups in this country.

Let us not dwell on these important negative aspects that are inherent, but which must be considered and overcome in the design and implementation of a successful TAP. Instead, we will accentuate the positive for the remainder of this discussion.

The Department of Oceanography at Texas A&M University was founded in 1949 and hence has a long history in TAPS of varying types and dimensions. Because of the Department's proximity to the Gulf of Mexico and to the Caribbean, it is not surprising that emphasis on such programs has been with many countries bordering those waters. However, these efforts have included a number of countries in Europe and Asia as well as in Latin and South America. The programs conducted by TAMU have taken many forms including the following major categories:

I. Education

1. Training of personnel in the Department of Oceanography for:
   a. Degree candidates: M.S. and Ph.D.
   b. Special students
2. Training of personnel during cruises aboard ships operated by the Department; and
3. Department of Oceanography personnel giving lectures and/or seminars at institutions outside of the U.S.

II. Research

1. Research training of persons aboard ships operated by the Department;
2. Outside investigators conducting research aboard our ships sometimes involving an extension of previous research projects of their own, as well as new research projects;
3. Outside investigators conducting research aboard our ships involving a portion of a research project conducted either as a individual or as a chief scientist of a particular cruise or leg of a cruise;
4. Outside investigators analyzing and interpreting research data obtained as part of II (item 2 or 3), but at the Department of Oceanography laboratories;
5. Making specialized laboratory facilities available at the Department of Oceanography to investigators from institutions or universities outside of the U.S.;
6. Scientists from the Department of Oceanography working with scientists in their own countries, using their land or shipboard facilities to gather data and/or helping in the analysis or interpretation of existing data obtained previously by the resident scientists; and
7. Department of Oceanography scientists giving lectures and/or seminars at institutions outside the U.S.

During the last decade, six Ph.D. degrees have been awarded graduate students from four countries, namely, China (Taiwan), Egypt, S. Korea and India. Several of these now hold responsible positions in their own countries, including the Directorship of an oceanographic R&D institution. One is head of the Department of Marine Sciences in a maritime academy in the U.S. Similarly, seven coming from Brazil, China, Egypt, Greece, Hong Kong, Mexico and Venezuela have received Masters' degrees, and some are continuing their studies toward the doctorate elsewhere. Three others, one each from Hong Kong, Mexico and Egypt, are currently enrolled for advanced degrees.

Five came here as special students not enrolled for advanced degrees for a year or more in order to study under certain of our professors, because of their international reputation in certain fields of specialization. They returned subsequently to their own countries to continue their studies for advanced degrees. They came from Argentina, Israel, Mexico and Venezuela and are interested specifically in certain aspects of acoustics, algology and carbonate sedimentation, as well as geological and physical oceanography.

More that two dozen foreign nationals from about a dozen countries including Argentina, China (Taiwan), Colombia, Egypt, Japan, Malaysia, Mexico, Puerto Rico and Venezuela participated in cruises directly aboard our ships and/or under the guidance of one of our professors aboard his antarctic cruises on ELTANIN. Similarly, thirty-eight foreign nationals including both graduate students and professors from about a dozen countries used our laboratories to work up data obtained during cruises on our ships; or to take advantage of our specialized laboratory facilities or of the outstanding expertise in certain areas of the professors in the Department. These included investigators from Argentina, China (Taiwan), Egypt, Hong Kong, Israel, Japan, Mexico, Norway, Peru, S. Korea and Venezuela.

In a final category, a number of our professors have participated by special request in instructional cooperative programs by presenting invited lectures and seminars from two days to several weeks' duration, which were presented in Argentina, Australia, Colombia, France, Mexico and Venezuela. This listing does not include many more lectures in these and other countries which were presented in a more informal basis by request when they happened to be visiting in their countries during the course of their travels.

TAMU has also made contributions through the Sea Grant program toward disseminating information of practical use to other nations in the development of living resources. For example, in June 1973 it prepared and distributed a manual for marine processing plant personnel on seafood quality control. This manual was published in Spanish as well as in English and can be of great help to Spanish speaking countries of the world. The potential exists also for extending these programs into countries contiguous to the Gulf with emphasis on mariculture projects.

In this connection, the interest of the UN Office for Economics and Technology should be mentioned with regard to a possible series of more comprehensive regional pilot projects in such areas as the Gulf of Mexico and the Caribbean as well as in the Persian Gulf and the Gulf of Guinea. The IOC plans, in conjunction with the seventh session of CICAR early in 1975, to include *ad hoc* groups on regional training needs in the Caribbean. Similarly, the UN Conference on Human Environment (Action Plan H89) is considering the establishment of international centers for interdisciplinary studies on tropical oceanography. These would emphasize ecological implications of pollution in food chain dynamics and regional processes of dispersion of pollutants. Broad research programs in tropical oceanography should include also the study of living and non-living resources in such areas as the effect of coastal upwelling and changes in major current systems. Preliminary exploratory conversations on this subject have

been held by several members of the faculty with staff members of certain institutions in the Gulf and Caribbean.

In summary, the specific involvement in numerous phases of educational research activities ranges from formal training programs, to making available time on our ships and space, equipment and guidance in the Department laboratories. In these ways, we have had an important educational and scientific impact on graduate students and scientific investigators, totaling about 100 persons from fourteen different countries.

With this broad background of experience and capabilities to draw on, we would be more than pleased to continue on an expanded scale, and in a more formal and even more effective manner, to provide the capabilities of our diversified instructional and research activities on future TAPS. However, this can only be done more effectively if not only additional funds become available, but also the total effort in this field be conducted in the future in a more efficient and coordinated manner than heretofore. It is to be hoped that this will be one of the significant results arising from the deliberations of this meeting and from subsequent workshops dealing with this important subject.

It should be emphasized, in conclusion, that the Department of Oceanography at TAMU has acquired recently expanded facilities in the form of a new and completely equipped building, a new ocean-going research vessel, and a new two-man submersible with a depth capability of 1200 feet. These capabilities together with the availability and interest of a faculty of twenty-nine, a dozen research associates and senior scientists, and over 100 graduate students, together with its long history of international cooperation, places the Department in an excellent position to make significant contributions to a wide variety of future TAPS.

At the moment, we are well along in negotiations on several programs, specifically with three countries in Latin America and the Middle East, involving also pertinent U.S. scientific government agencies. These programs qualify as TAPS and involve teaching, research and the use of one, and possibly two, of our ocean-going oceanographic vessels. We have received recently also inquiries by mail and by personal visits regarding additional possible cooperative programs in Brazil, Chile, Egypt, and S. Korea.

In addition to the direct involvement of the department in inter-institutional overseas programs, important contributions have been made in furthering teaching and research programs in the Gulf and Caribbean by the extensive publications on the results of our research in these areas. These take the form not only of papers published in scientific journals, but also by the recent publication of three referred books and two folios describing this research in more detail than can be presented ordinarily in scientific papers.

These three books published by Gulf Publishing Company each dealing with the biological, geological-geophysical, and physical oceanography of the Gulf and Caribbean total more than 800 pages. The material presented in Folios 20 and 22 of the American Geographical Society covers biological, chemical and physical oceanographic aspects of the area. Folio 20 emphasizes the crustacea and is of special importance in obtaining a more complete understanding of the fisheries and other living resources problems that must be solved. In this regard, the information on chemical and physical oceanography has definite application in this field. Many pertinent papers are to be found in the Department's "Contributions to Oceanography" series now in its 20th year, of which Volume 16 will be available soon.

Oceanography is truly an international as well as interdisciplinary science. Therefore, I know of no better way to further the case of international understanding and ultimately world peace than by expanding and incorporating the cooperative efforts of the United States oceanographic institutions and certain federal agencies with those of their counterparts in other nations, through a series of well designed and realistically funded TAPs. However, for these to be successful requires the complete cooperation of all concerned. This includes a recognition of the need to consider the sociological and psychological as well as educational and research aspects of each program, in addition to having the assurance of sufficient and continuing financial support. Only in this way can we expect to achieve the diversified objectives of these technical assistance programs in all their ramifications.

# OVERSEAS FISHERIES EDUCATIONAL AND TRAINING PROGRAMS

J.C. SAINSBURY

In this discussion, I shall concentrate on the education and training of personnel for the commercial fishing industry. That is, the people who actually have to make a viable operation out of the various policy decisions and development plans. After reviewing briefly my interpretation of the present situation in fisheries education and training associated with countries intent upon developing their commercial fisheries, I shall identify some the more immediate problems and needs. Finally, I should like to offer some ideas regarding the direction of future activities, indicating two specific areas where the United States has particular competence and where an immediate "transfer of technology" could make a unique contribution.

It seems to have become generally accepted that people trained in the various sciences applicable to fisheries, such as fisheries biology, food science, economics and oceanography, have a particular role to play in the development of marine food resources. Students in these fields from countries engaged in fisheries development have a choice from among a wide range of university curriculums in the well-developed nations and are, increasingly, taking advantage of these o opportunities. At the same time, often in association with research institutions, an increasing number of national or regional institutions providing education and training in scientific aspects of fisheries are being established in the less developed nations, often

in conjunction with fisheries development projects. All these functions are vital to fisheries development; however it has been my observation that very few of the people concerned are equipped through desire, knowledge, or ability to become involved in the technology and implementation of actual commercial fishing activities.

At the other end of the scale, a wide range of programs exist which are devoted to the training of crews for fishing vessels and personnel for shore based sectors of the industry.

The majority of development programs, whether multilateral or bilateral now include a "training component", and a number of bilateral assistance projects are devoted primarily to such activities. In addition, funds for training of appropriate personnel are being included in development bank programs.

Typical of the type of operation associated with development programs are various training centers established under UNDP/FAO and similar auspices, such as those in Korea, Indonesia, Malaysia and Singapore. Bilateral assistance has been prominent in establishing schools in such areas as Ghana, the SEAFDEC organization and Central America. An example of development bank training is the program to train personnel to operate new tuna seiners in Ecuador.

For one reason or another, most of such programs are concentrated on vocational aspects, preparing crews for specific types of vessel or operations in shore plants. Very little, if any, attention is given to providing a wide ranging background in commercial fishing or the inclusion of training other than that directly applicable to individual operations. Depending on local crew certification requirements, these programs are often divided into "deck" and "engine room" sections, the training being provided at a breadth and depth

appropriate to the type and size of vessels in use. Where larger types of fishing vessels are concerned, this may extend to some considerable depth of technical knowledge and trade skills.

Many of these programs are more than adequately funded, situated in facilities constructed or developed for the purpose, and provided with a wide range of top class equipment including at least one relatively large modern training vessel.

Usually, these schools are expected to produce what I would consider to be quite large numbers of graduates from programs varying in length between a few months and two or three years, depending on the extent of technical and skill proficiency required. Sometimes, the production of graduates meshes with the developing industry requirements and sometimes not. In some cases, the expected personnel needs do not materialize as no industry develops (as in Singapore) and in other cases the changeover from expatriate to local crews may be delayed beyond expectations (such as in Indonesia).

Perhaps the banks could be somewhat less concerned, in many cases, with requiring training programs specifically for crews to man new vessels they are financing. In normal circumstances, new vessels in a fishing fleet rarely have problems in attracting high standard crews as fishermen usually prefer the better working, living and earning conditions found aboard such vessels. It is the older vessels in a fleet that normally have problems attracting competent crews.

Principal administrative and instructional staff are, in the early stages at least, almost always expatriate experts specifically recruited under contract for the task. In some cases, a commercial company may be contracted to supply the desired training. In all cases, local nationals are involved as associates working

alongside expatriate personnel in an "on the job" form of preparation for future total responsibility for the programs.

Expatriate experts appear to be recruited from a number of sources which may include people who have been associated with fisheries training in their home country, experienced commercial fishermen, specialists in particular fisheries or areas such as ships engineering or processing, and younger people having some exposure to various aspects of fisheries.

There can be no doubt that, in many cases, appropriately qualified people for these tasks are difficult to find. Nations such as Japan and the U.S.S.R. can provide people having experience in training, but it may not be in methods and skills applicable to a particular training program. Commercial fishermen are usually extremely experienced in particular methods of fishing and skills which may or may not be directly appropriate for use, and are usually unskilled in passing on their knowledge. The younger people are often very energetic and willing, but lack the detailed knowledge, skill and experience, and teaching exposure. For some programs it may be very difficult to attract experts willing to live in particular areas.

The expert himself, if he is fairly new to such work, may despite briefing sessions, encounter problems in adapting to ways of working in a particular country and find himself unfamiliar with local applications. If local nationals experienced in the particular adaptation of methods to their specific area are employed as associates, a lack of confidence in the expert's abilities may develop during the period the latter requires to familiarize himself with such techniques. In such a case, the expert is placed in an unenviable position for the remainder of his stay, and the value of the whole assistance effort may be reduced.

Some of the locally recruited nationals are likely to have undertaken education abroad with an accompanying development of their width and depth of commercial fisheries knowledge, but others will not have had this opportunity so that they are restricted in experience to local operations and procedures, finding it difficult in many cases to adapt to proven techniques new to them.

In addition to focusing on particular fishing operations and vessels, curriculums may also be governed to varying extents by national certification requirements for fishing vessel officers and engineers. These, if in existence, may well be based on the operation of much larger general merchant vessels, may contain the standard types of examination syllabi used in this application, and be quite inappropriate for fishing vessel personnel. If such certification is required for fishing vessel operations, there is little alternative but to include applicable units in the curriculum to ensure trainees have the necessary knowledge to pass the examinations. This may well place a strain on experts who are unfamiliar with those particular subjects and, at best, take up time which could be better used for fisheries applications.

Facilities and their arrangement to perform the teaching function are continually developing. The usual problems of working at a distance from equipment distributors are intensified by the need to arrange laboratories and workshops to provide simulation of practical fisheries situations. Establishment of practical training facilities usually present problems to staff not possessing experience in the design and utilization of such arrangements.

I do not need to stress the obvious need for training of vessel crews and operators needed to staff the developing industrialized fisheries. All these programs therefore fulfill a very real function in providing

pools of manpower having proficiency in various skills needed by the industry. In any educational effort, it is to be expected that a few of the students will demonstrate outstanding ability, and hence, if interested, be available for leadership roles in industry development. It would appear necessary, however, for them to be provided with a wider range of general commercial fishing knowledge, and a greater depth of exposure to associated fields of engineering, science, economics and business operations if they are to adequately fulfill leadership roles.

It seems to me that two rather wide and important gaps exist which are not satisfied by the existing arrangements, and that some action is needed to plug these gaps.

In general, very little attention is given to training people for aspects of commercial fisheries which require a wider and deeper range of background, knowledge and abilities. Leadership and support roles require skills in business operations and economics, ability to assess and utilize newly developed equipment for particular operations, ability to design and install engineering and gear handling systems, and the ability to assess, design, construct and operate fishing gear and vessels to their optimum. Basic, of course, to all these developed studies, is proficiency in the various areas of fishing operations included in the vocational form of programs discussed previously. Graduates of any training program which includes all these areas might be expected, depending on individual inclination, to be prepared for responsible positions aboard fishing vessels, in management positions, in engineering, electronics and business support activities, and following progressive experience to undertake leadership functions in industry development.

That this approach does in fact work is born out by our experience at the University of Rhode Island where there is available the only applied commercial

fisheries curriculum at a U.S. university. I believe, and hope I am not too presumptuous in remarking, that the growth and development in terms of vessels, gear, and progressive outlook of our local fishing port--Point Judith, Rhode Island--has been promoted greatly by graduates of our program, many of whom are associated with commercial fisheries at the port. This growth has accelerated while other ports in New England appear to have shown a static or declining position. Graduates are now involved as vessel owners, skippers, mates, engineers, shore plant management, supporting services and teaching roles. Experience with the program has enabled some conclusions to be drawn regarding areas in which additional width and depth of coverage would be advantageous.

I have been encouraged in my conclusion regarding the need for this type of educational program by recent developments in two differing areas, intent upon developing their commercial fisheries potential. In Ecuador, a program is being instituted at the Polytechnic Institute in Guayaquil which is based on the approach described above. In Indonesia, programs at the Fisheries Academy are expected to be further developed along similar lines. As might be expected, each of these programs is being adapted to local needs, but is based on the same general concept. The Directors of both programs have expressed to me that their principal problem is that of finding and training qualified teaching staff for these new ventures. In this context it may be appropriate to mention that the Director of the newly established School of Fisheries in Guayaquil is presently on a two month visit with us in Rhode Island and that two of his potential faculty are undertaking applied fisheries training in Rhode Island.

The other major gap is in training for artisan fishermen, having the aim of increasing both local food production and living standards of the fisherman. Training required in this case must be geared more to

assisting the development of simple, more inexpensive techniques than applicable to the more industrialized fishing operations. Perhaps what may be appropriate is the demonstration of individual and group assistance concept coupled with a training program covering areas somewhat similar to those discussed earlier but with the approach and content adjusted to suit the background and needs of the particular groups of fishermen. Whatever finally proves successful, it will require the services of teachers and extension type personnel having a very wide knowledge of commercial fisheries and the particular operations and skills appropriate to development of artisanal operations, coupled with a sound background in simple engineering and boat systems. This type of work may be particularly appropriate for volunteer organizations, providing the people involved are carefully chosen and trained.

Experience with the present approach, utilizing small vessels with varied types of gear, being developed in the South Pacific could well be watched closely and the experience built upon. It must be remembered, however, that vessels and techniques applicable to one place may not be immediately transferable to another area without, in many cases, considerable modification. Once modifications to simple vessels and equipment become at all extensive, the whole aspect of the operation changes.

I suggest that the United States is in a unique position to provide assistance in the field of commercial fisheries education and training, assistance which seems to me to be vital to the rational development of fisheries potential.

Programs of a wide nature similar to the one being established in Ecuador have been proven effective through development within this country, so that required exper-

tise is available. Establishment and development of such programs requires a team approach, utilizing specialists having backgrounds in engineering, vessel technology, fishing gear, electronics, seamanship, navigation, meteorology, oceanography, and fish technology; all applied to commercial fishing.

A problem noted repeatedly during my previous discussion has been the need for experts and instructors, both expatriate and local nationals, having the required background in fisheries and teaching. I suggest that this also represents an area where the United States could make a most valuable contribution. It is worth reiterating at this point, I think, that fisheries biologists and oceanographers are not appropriate for more than a very small part of this work. What is necessary is that instructional personnel possess the necessary practical fisheries skills coupled with a depth of engineering, science, and mathematical background. Training of this type of person is presently being undertaken on a small scale in Rhode Island, but there is a proven need for such training.

Whether this should be undertaken on a local, regional or worldwide basis needs consideration. The relatively small numbers of instructors needed would appear to make it unrealistic to undertake their training in national programs. Regional training programs for fisheries instructors might appear attractive, but it is my observation that there are definite problems in deciding in which country to base such efforts and in persuading other countries in a region to provide more than nominal support, and actually send their people for training. There are also the problems inherent in providing an efficient operation in a developing area, in overcoming the reluctance of nationals to believe that they can be trained in another country of their region rather than by travelling to one of the developed fishing nations. I believe therefore that the most appro-

priate place for establishing a worldwide training program for fisheries instructors is in one of the developed fishing nations. What better place than in the United States.

# MARINE FISHERIES ASSISTANCE EXPERIENCES IN SOUTH AMERICA

W.T. PEREYRA

Let me begin by congratulating Professor Morse and the organizers of this conference for their foresight in convening this most timely analysis of our marine science assistance efforts to foreign states. I feel particularly fortunate in being able to speak with you today, as I have just recently returned from two years in Chile, where I worked directly with various university and government institutions in formulating and implementing a variety of fishery research programs. In my presentation, I plan to draw heavily from these experiences and observations while in Chile plus my experiences associated with participation in activities of the NSF-sponsored research vessel ANTON BRUUN off South America in 1966. As such I hope to be able to provide an introspective view at the working level as to what I feel constitutes meaningful marine science assistance to emerging countries. By nature of my involvement I will be examining marine science assistance from the standpoint of fisheries as opposed to oceanography or some of the other marine disciplines with people as the focal point.

Before I proceed further, though, I want to state that the views which I am about to express are strictly my own and should not in any way be construed as representing the official position of NOAA or the National Marine Fisheries Service with whom I am now employed.

The Chilean Experience

I want to begin by discussing my recent involvement in Chile, and in particular my experiences at the Fisheries School in Valparaiso. Dr. Lynwood Smith has given you ample discussion into the aims and mechanisms of the cooperative program between the institution and U.S. universities so I will not elaborate on this aspect. What I would like to do though, is say a few words regarding a supporting research activity which I initiated and with which I was intimately involved.

Supporting research activities were considered as an integral part of the overall educational program--not only for their instructive value in a scientific sense but also as a means of orienting students and scientists towards fisheries issues of greatest national concern. As a case in point, I would like to take a few moments to share with you my experience in assisting the Fisheries School in establishing an applied fisheries research program with considerable potential, both nationally and as a model of change to be replicated in other developing countries.

For some time it has been recognized that the Chilean artisanal fishermen--those small-boat, inshore fishermen, who make up more than 60 percent of Chile's fishing population, fish almost entirely by manual methods and yet account for the majority of the food fish production-- are economically deprived due primarily to technological stagnation. In an effort to bridge this impasse and promote the economic, social, and cultural development of the artisanal fishermen and their families, we initiated an applied educational and demonstration program to focus on the economic gains and improvements in working conditions that the artisanal fishermen could realize through technological innovation and change. The primary aim was to demonstrate to the government agency which was responsible for assisting the

artisanal fishermen with helping themselves, that simple hydraulic-powered fishing systems were applicable in their fisheries. The systems envisioned did not represent new ideas or require the development of new harvesting methods but merely the transfer of existing technology which had proven successful in similar artisanal fisheries in other more developed countries. Input was solicited from government agencies, cooperative leaders, artisanal fishermen, and other interested groups to insure that program aims and specifications for the mechanized fishing systems were realistic in terms of the aspirations of the artisanal fishermen, their technological skills, and the characteristics of the target fisheries. A Chilean scientist from the Catholic University of Valparaiso was sent to the U.S. under an AID training grant to receive instruction in the mechanization of small boats. Capt. Barry Fisher at Oregon State University was responsible for his training program. He also served as an informal critic of project goals and directions, as well as various technical aspects.

An underlying precept of this work was the notion that, for this effort to be successful in a social as well as an economic sense, it had to be carried out within the existing artisanal cooperative infra-structure in Chile. It was felt that to do otherwise would be contrary to the interests of the artisanal fishermen and their families and thus counter-productive. Our approach contrasts sharply with that extolled by others who feel that it would be better if the artisanal fisheries were developed into semi-industrial enterprises with a greater degree of centralized control.

To date the mechanization and demonstration program has been well received. The Chilean scientists who are now running the show are doing an outstanding job. This is especially gratifying to me in view of the tumultuous political and economic situation which has existed in Chile for the last couple of years.

Those programmatic aspects associated with mechanizing existing fishing systems to increase productivity and reduce manual labor have been well accepted. On the other hand, strong opposition and criticism have been voiced at our attempts to introduce a new fishing craft (Pacific City dory) which departs radically from existing designs, even though the new craft would appear on paper to offer greater utility. This resistance to change appears to me to be most likely a reflection of the fisherman's desire to preserve a way of life which he understands and can relate to rather than an inability to comprehend or apply new technology.

As might be expected, one of the largest hurdles we encountered was funding. Our need for hard currency in order to acquire certain equipment and system components made it necessary for us to seek outside financial assistance. Although we approached various international granting agencies, it wasn't until we made contact with the Inter-American Foundation based in Washington that we were successful in acquiring the necessary funds to launch the program. At this point, I would like to express my sincere appreciation to the Inter-American Foundation for their support and encouragement. They took a chance when others wouldn't.

Now for a brief point on how I think educational assistance activities of the type being carried out in Chile might have an impact on U.S. cooperative marine science ventures in the future. At the present time, most of the developing countries are in somewhat of a self-defeating educational cycle in that the majority of their marine scientists receive their advanced training in the educational institutions of other countries, many in the United States. By and large, our degree programs are structured to provide an educational experience oriented towards the high technology science which is consistent with marine science needs as we see them--not as they may exist in the visiting student's home country. This creates somewhat of a paradox for the

student when he returns home in that he has difficulty relating to or appreciating the marine science problems of his own country. Furthermore, he may become frustrated in trying to carry out what seems to him by nature of his advanced education to be meaningful science, in that he lacks the computers and sophisticated instrumentation which he had been trained to rely on as part of his educational experience. *A priori* it is not suprising then that this highly educated, highly motivated scientist is better able to embrace and participate in the marine science efforts of the states where he received advanced training, even though these may be of marginal value to his own emerging country.

I am in agreement with those here today who have pointed out that scientists of developing states must be involved in all phases of marine science assistance activities from planning to execution and analysis phases if these are to be of value to them. Yet, I don't believe that these efforts can be truly productive until such time as the developing states have the capacity to train themselves and thus be aware of the totality of marine science options which are available to them. The Valparaiso fisheries program is aimed at establishing such self-sufficiency.

## Other Cooperative Marine Science Programs

I would now like to switch from those activities associated with the Valparaiso Fisheries School and look at some other cooperative marine science programs in which I have been involved or have specific knowledge. In this regard I will try to contrast recent efforts by the U.S.S.R. and U.S. off the west coast of South America.

During the three-year period when Salvador Allende was President of Chile, the Soviet Union noticeably increased the scope of its marine assistance programs in

Chile. In my view, the character of the programs carried out *vis-à-vis* the spectrum of marine science areas which were available for investigation is probably more significant than the actual level of Soviet investment.

In practically all cases, the studies and investments were marine-resource oriented. For example, several fishery research vessels were operated for a considerable period in Chilean waters in a cooperative program with Chilean scientists to establish the fisheries potential of the large, but relatively unknown, saury resource off the northern coast of Chile.

Another research vessel, the AKADEMIC KNIPOVICH which incidentally happens to be one of the largest fisheries research vessels operated by the Soviet Union, made several trips into Chilean coastal and Antarctic waters to delineate the extensive *merluza de cola* (a type of Hake), and krill resources.

Now let's contrast the type of cooperative marine science programs which the U.S. has pursued with that of the Soviet Union. Our cooperative efforts have centered more around studies and investigations which have been designed to "increase man's knowledge of the oceans" in a broad sense rather than to solve or alleviate particular social problems. In this regard, I would classify our marine science programs as being more basic in nature, rather than applied as in the case of the Soviet Union. In general, our cooperation involves a higher percentage of specific projects at the individual scientist level as opposed to broad-based institutional investigations. The studies themselves are quite often merely extensions of U.S.-generated scientific interest at levels of sophistication beyond the capabilities, and for that matter, needs of the emerging countries. It has been my experience that the requirements of "third world" scientists and scientific institutions for information on the adjacent marine

environment and its resources are usually on a considerably lower level in the evolutionary hierarchy of oceanographic and fisheries science than we find in the U.S.

The first order of business it seems to me is for the developing countries to define their adjacent marine resources and ascertain their availability. Next would be the establishment of schemes for their orderly exploitation including, if necessary, the development of suitable harvesting technology. Lastly, consideration should then be given to the managerial and forecasting aspects of marine science. Thus, for the U.S. to emphasize the more scientifically advanced aspects of marine science to the exclusion of more fundamental inventorial studies at the current level of sophistication of marine science in developing countries may, in my mind, be a mistake.

The marine science activities of the U.S. research vessel ANTON BRUUN is a case in point. In the mid-1960's the National Science Foundation operated the BRUUN off the coasts of Chile, Peru, Ecuador, and Colombia as part of a multi-national program to undertake cooperative oceanographic and fisheries surveys to better understand marine resources in that part of the world. Due to operational limitations of the research platform though, the investigations did not produce the quantity of useful outputs to these emerging states that had been anticipated. For example, fishery surveys carried out from the ANTON BRUUN were unsuccessful in delineating any large unknown resource blocks even though some were suspected of occurring off the South American west coast. Subsequent to these surveys though, the Soviet Union, conducting a cooperative fisheries survey of Peruvian waters with a dedicated fisheries survey vessel, established the magnitude of a large underutilized hake resource in Peruvian waters in the same area as previously investigated with the ANTON BRUUN. Based upon these Soviet finds, the Peruvians have now initiated a program to greatly expand utilization of this resource for internal consumption and export.

Understanding and appreciating why the earlier U.S. program failed to delineate any new latent fish resources while the Soviet program was successful in this regard is important to the formulation of future cooperative fishery programs. Certainly the fact that the U.S. lacked, as it still does, a dedicated fishery survey vessel to be assigned to cooperative international fishery programs of this type is significant. In the case of the ANTON BRUUN, this vessel was the converted ex-presidential yacht WILLIAMSBURG and thus lacked the capability to employ standard fishery survey sampling gear (large trawls, seines, pots, etc.). I feel that this fact alone contributed greatly to her ineffectivness. Had a U.S. fishery survey vessel been used, perhaps more meaningful fisheries science, both to the cooperating developing countries and the U.S., would have been obtained.

Another factor which I suspect contributes in some measure to the low output of marine fisheries resource information from U.S.-directed cooperative ocean surveys is the strong influence of the scientific oceanographic community in formulating and directing these surveys. I do not want to go on record as having said that oceanographic studies are not needed or that the individuals involved are not capable, dedicated marine scientists, but rather that our programs or their chronological sequencing may not be balanced in terms of the information needs of the developing countries at this point in time. We need to address ourselves to this question of whether or not we are placing our ocean priorities in the right areas and whether or not our cooperative international marine science programs are reasonable in terms of the needs of the third world. Certainly the projected food requirements of the exploding populations in emerging countries together with the incomplete body of knowledge regarding the marine food resources which are available off their shores is reason for introspection.

Summary

In summary, then, if U.S. marine science assistance programs are to be truly cooperative in nature and directed at assisting the developing countries with helping themselves, it is mandatory that U.S. scientists and institutions solicit developing country input from the beginning in establishing the priority area where U.S. assistance could be beneficial. Also, it follows that U.S. marine science expertise should be secured in response to these needs rather than seeking a *raison d'etre* for certain kinds of U.S.-generated marine science effort.

Certainly if fisheries science is recognized as an investigative area of high priority, it follows that U.S. scientific input should come from established fisheries organizations rather than marine institutions without operational experience in the field of fisheries.

In the final analysis, helping developing countries to better understand and utilize the adjacant marine resources would seem to warrant high priority in light of the need to increase food supplies, in particular critical animal protein. Additionally, such activities should help to (1) lessen dependency on foreign food supplies, with concomitant benefits to foreign currency reserves; (2) they should enhance internal stability and thus contribute to world peace; and (3) they should increase the world supply and trade of fishery products with benefits to both the developed and emerging countries of the world.

In closing I would like to leave you with a parting thought regarding a particular subject which appears to be on the minds of many at this conference--freedom of marine research. If our marine science efforts were properly oriented with regard to the needs of the third world, might not the restraints on marine research that are envisioned by many in the scientific community as a result of extended jurisdiction and a consent regime in Law of the Sea, be lessened or disappear altogether?

# PROBLEMS AND DIFFICULTIES OF OVERSEAS PROGRAMS AT THE INSTITUTIONAL AND GOVERNMENTAL LEVELS

G.M. PIGOTT

During the past decade, I have had the opportunity of working with a wide variety of educational institutions, government organizations, and private industries in many Central and South American countries, as well as selected areas of Southeast Asia. Perhaps the major personal benefit that I have received from this experience has been a better tolerance for bureaucratic processes in this country which I had formerly considered second to none in inflexibility. On the other hand, the unique combination of frequently working in a given country at different times as a University representative and then as a private consultant has certainly revealed to me the ignorance of those flippant adversaries of the widely varying government systems in the developing countries.

Bearing in mind that conclusions drawn from even the most varied contacts by one individual must be biased by previous background, let me share some of these experiences with you today.

## Chile

Dr. Smith has elaborated extensively on the Rockefeller Foundation's cooperative program between the University of Washington and the Catholic University of Valparaiso, Chile. His conclusions are most valid, and perhaps an emphasis should be made on patience. In noting the relative success of this program as compared to similar attempts, one must be impressed by one major

difference. The people chosen to take advanced education in the U.S. were established faculty members at the school, who had families and personal ties in their country. For this reason, they had a greater driving force to return to their country and apply the newly acquired professional skills to the benefit of Chile. This is a major change from the typical situation, whereby a bright young student is given grant support to study in the U.S. The norm, rather than the exception, is for this individual to seek employment in the U.S. where the personal gain motive overshadows any desire to help his country. Draining the top "brains" from developing countries certainly does not assist in their development. Only if foreign students are educated in a skill essential to their country and then return to the country can our higher educational systems assist in the upgrading of life in developing countries. In addition, on-site teaching and working experience by experienced U.S. professionals greatly assists the returnee in applying his new found knowledge.

Argentina

In 1970 an NAS study group was sent to Argentina to discuss with government and university officials the fishing potential of the country and to recommend a program for its development. Based on even a rather limited survey, it is apparent that Argentina could become one of the world leaders in catching, processing, and exporting of fishery products.

The country has a complex and unwieldy organization of government-sponsored research and development. It was quite obvious that research for the fishing industry and, in fact industry in general, was completely overshadowed by agriculture, which has a government organization similar to the USDA. Furthermore, it was apparent that rather strong feelings prevailed between

private industry and government research organizations on the one hand and various university groups on the other.

The study group strongly recommended a program that would bring together the various biological and oceanographic groups in a concentrated effort to study the marine resources before developing long-range plans for processing plants. It was also apparent that the University program in Food Science and Technology and Fisheries should be taught on a broad basic concept, rather than specializing in specific phases of the industry, or with specific products. The U.S. educators felt that Argentina had a highly trained cadre of both university and government people who could re-orient their own programs to accomplish the educational and research aims. However, it was felt that a cooperative program with U.S. universities should be established to assist in the establishment of an extension program encompassing both continuing education and field assistance. This is an area particularly familiar to Land Grant and Sea Grant Colleges with viable extension programs.

The review of the draft report by Argentina resulted in a request two years later that we cover less specifics and emphasize a more general approach to upgrading the country's food program. My response to this request was, "I doubt that I could be of much help to your re-writing of the report, since I believe the only way it can be effective for Argentina is to recommend specifics and not the general whitewash report...." Thus, another study was filed in the archives of "nice tries."

In this instance, the question arises as to whether the problem was that our cumbersome group, from a wide variety of disciplines, was too unwieldy to effectively establish communication, rather that the problem being the reluctance of Argentine university and government groups in accepting assistance. One is impressed that

this may be the case for, on another occasion, a consulting job on a one-to-one basis resulted in a significant industry improvement.

Peru

An interesting experience in Peru exposed some internal problems that must be understood before an outsider can effectively participate in a development program. As everyone knows, Peru is a world leader in fisheries, even though their catch has been drastically curtailed over the past few years. However, the industry was developed primarily for non-edible products for export. Furthermore, most of this development came from foreign companies that brought in the necessary investment capital and technology.

Interestingly, Peru has a highly educated group of professional technologists and biologists in both the government and universities. However, the ambitious National Development Program (1971-1975) for food fishery development has fallen well behind in schedule due to:

1. Lack of effective communication between the Ministry of Fisheries and other government organizations. This is partly due to overlapping work assignments that create competition for the same job.
2. Insufficient manpower skilled in the food fish industry.
3. Government by-passing the viable private sector of the fishing industry in creating new industry complexes. This is not only creating over-capacity, but is costing much more than if the present companies were encouraged to expand in the food fish area.

In analyzing the potential areas for U.S. participation in developing the Peruvian Food Fish Program, it is obvious that we must be most careful in not becoming

identified with either industry or government groups, but if possible should work with a well established neutral group which is active in the development.

Ecuador

In 1972 Dr. Lyn Smith and I had a rather unique opportunity to study the Ecuadorian Marine Science Program under sponsorship of the Partners of the Alliance, Partners of the Americas Program. The purpose of the trip was to make observations of the relationship between school and university training and industry, and to recommend a program of U.S.-Ecuador cooperation in upgrading the school and university training.

In contrast to countries such as Chile and Peru, Ecuador has few technologists trained in food technology and fisheries biology. Furthermore, there are fewer technicians trained in fishing or plant operation. For this reason it was recommended that a concurrent program of technician training be instigated with a four-year program encompassing Fisheries Biology and Food Technology and Engineering.

It may be well to emphasize at this point a fact often overlooked by U.S. scientists. In Central and South America, a professional engineer enjoys a prestige far above that in our country. For this reason many of the university programs, as well as the professional areas are dominated by engineers. They are often quite jealous of other fields such as fishery technology gaining an equal professional status. If this fact is not considered in working with Latin American countries, many of the best planned programs are doomed to failure. In Ecuador, for example, all of the fisheries and food education is currently within engineering departments or schools. Our contacts during the study were almost entirely limited to naval, civil and mechanical engineers.

Central America

The University of Washington has been working with other U.S. universities in assisting the jointly sponsored Central American Institute of Industrial Investigation and Technology (ICAITI). Dr. Liston has made numerous trips to Guatemala as our representative in the program. As with most programs of this nature, patience is a necessary virtue.

In 1972 I made a rather extensive trip throughout the five Central American countries (Costa Rica, Nicaragua, Honduras, San Salvador, and Guatemala), during which essentially all of the fish processing companies were visited. My major conclusions of the entire trip were:

1. The average owner and operator of plants does not understand fishing boats, fishing operations, sanitary maintenance of fishing boats, or the personnel requirements involving a successful fishing venture. For this reason, many of the boats are poorly maintained (looking as if they have many more years of service behind them than is the actual case). The crews, while they might be able to properly navigate and handle a vessel, are extremely poorly versed in shipboard sanitation and general care and maintenance of a vessel.
2. With few exceptions, the sanitary conditions involving catching, shipboard processing, icing, unloading, transporting to processing plants, handling in plant, and final freezing and product storage are most inadequate and, in some cases, extremely dangerous from a public health standpoint.

It is a major accomplishment for the Central American countries to have succeeded in establishing a central organization for upgrading and developing industry. Although fisheries is not the sole activity of the Institute, it is of major importance, since there are extensive marine raw materials in all five countries. We have advocated short-term training (non-degree) programs for ICAITI personnel prior to sending students for long-term advanced degree programs. The success of the Chile Program has shown that initial short exposures to U.S. training with subsequent sending of U.S. technologists to the country for on-site participation, greatly accelerates the technological development. I might emphasize that the U.S. representative, to be effective in this preliminary phase of a program, must be a self-starter who is most practically oriented toward commercial harvesting and processing of fishery products.

Brazil

Brazil stands out quite separately from other Latin American countries in that they have the potential natural resource wealth and an aggressive approach to developing this potential. Although many of the same political roadblocks are prevalent there as other countries, the system tends to "walk over" many of the obstacles. This was felt in all phases of Brazilian activity from the private sector through the government organizations. On the other hand, this aggressive attitude draws an outsider into their program many times telling, not asking for what they want.

Although projects move rapidly once they begin, many times the "bigness" of planning results in large expenditures over that required. For example, a pilot plant often ends up as a small commercial operation. While this may result in excellent development of one given process, it limits the adaptability of the facility for many future research and development projects.

The Brazilian program between the Institute of Food Technology, Campinas (ITAL) and the U.S. University Consortium was proposed two years ago and is now being actively instigated. With joint Brazilian and U.S. AID funds, students are currently enrolled in several U.S. university fishery technology M.S. programs. They are working on research projects pertinent to Brazil. In addition, at the end of 1974 it is anticipated that a student exchange program will send U.S. graduate students to Brazil for six months or more, working on some of the projects instigated in the U.S. Also, faculty members will spend varying amounts of time in Brazil, both in teaching at the university level and in applied research projects.

## Conclusions and General Observations

Our experience in developing countries has afforded many views of programs supported by research foundations, the Peace Corps, AID, Organization of American States, National Academy of Sciences, United Nations, Partners for Peace, and private industry. Some of the general problems that face the various projects designed to further fisheries are rather basic and can be enumerated as follows:

1. Many of the fishery people in the countries are well trained to a degree but are often working beyond their capabilities; thus the requirement for outside assistance in further training. This applies to all levels from the deckhand operating a fishing vessel to the B.S. or less graduate teaching and administering research programs at the graduate level.
2. Many of the outside agencies enter into programs of fishery development with preconceived ideas that are not applicable in a given area. This also extends to the government of the developing country itself, where

local planners have little contact with the on-site problem. This situation can only be corrected within the country when groups realize the situation and, either through education or outside assistance, upgrade the participants in the planning groups. The problem from outside agencies usually is due to either lack of knowledge of a local situation or the assigning of just plain incompetent people to the overseas jobs.

3. The developing countries must be made to realize that any successful project must be tripartite in nature, involving government administration, institutional research and development groups, and industry. Inter-group conflicts or deletion of one of these important areas greatly reduces the effectiveness of any planning and subsequent implementation of a program.

In summary, my experience in developing countries has convinced me that we have an obligation to assist in improving their ability to better clothe and feed themselves, and that marine resource development is of major importance in the overall effort to upgrade life. However, realizing that no two developing countries have identical problems, we must better prepare ourselves prior to participation in joint efforts. Furthermore, self-motivation within a country is of utmost necessity before any program can be successful. Perhaps we should embark upon a new course of action to develop the empathy necessary to better understand our friends.

# OPERATING DIFFICULTIES OF OVERSEAS PROGRAMS AND SOME SUGGESTED SOLUTIONS

J. LISTON

I would like to preface my comments here since Dr. Pigott initiated this process, with a short story that some of you may have heard me give before, but I think it does apply to our overseas technical aid programs. In the very early days of the world, when everyone was bright and young, and animals spoke to each other, there was apparently a horse walking down a country road that came upon a small sparrow lying on its back with its feet in the air. The horse, which was a large Clydesdale, stopped and looked down at this insignificant creature and said, "Why are you lying like that?" And he said, "Well, haven't you been informed? The sky is going to fall down in another few hours." And he said, "Oh, that's terrible, but what purpose do you think lying like this would do? How could a little person like you influence the crushing effect of the sky falling down?" And the little bird looked up at this great shaggy Clydesdale and said, "One does what one can."

In a very real sense I think our overseas operations frequently amount to "doing what one can."

What I would like to do as briefly as possible is to try to integrate some of the things which you have heard in terms of technology transfer operations at the university level. Fortunately, a paper which I

prepared for a completely different meeting zeroes in rather effectively on most of the points, or many of the points, which have been raised. I'd like to go through it, skipping the inappropriate parts. Finally, I'd like to try to show how single university efforts are limited and how in many cases it is necessary to go into a conjoint program of some kind, and I would like to give you a little more information on the consortium idea as we're operating it, primarily in the area of food science and technology but applicable, I think, to the marine program.

In one sense, or in the basic sense, technology transfer is an attempt to better the condition of a population by quickly bypassing the tedious and often uncertain processes of discovery, testing, application, and commercialization. Sometimes this works, and sometimes it does not. It must be remembered that behind the successful application of technology in the West there lies a long history of mechanical innovation and a tradition of accepting, indeed of welcoming, new applications of science to ameliorate the risks and unpleasantness of daily life and increase the productivity of industry and agriculture. This tradition, I would submit, is absent in most of the developing countries. One important component, then, of the technology transfer process is an attempt to develop a new viewpoint in the recipient population so that innovations are accepted and even welcomed. Otherwise, the new technology which is introduced successfully in the initial phases will fail and die.

It is part of this thesis that to establish acceptance and also to provide for the continued support of the new technology introduction and its further development in a country, it is absolutely essential to assist the country in developing its own means of training and producing the specialists or technologically and scientifically trained people needed to maintain this

new economy. Therefore I feel, and I think my colleagues do too, that contrary to Dr. Pontecorvo's view, education, at least in the sense that we see it, is an absolutely essential component of the introduction and maintenance of the new technology in recipient countries. Moreover, it is important again, in our view, that this type of educational activity should be provided by people who are best qualified to do these things; that is to say, people who make their living teaching and educating, and not part-time scientific researchers brought into suddenly created institutes to establish one-at-a-time programs which never seem to be maintained.

I think many of us, particularly those of us that worked in South America, have seen the monumental and magnificent, almost Romanesque, ruins that scatter that sub-continent of internationally funded training facilities which consist mainly now of empty halls, rooms laden with equipment which nobody uses, and indeed look more like Rome just after the Goths had come through than a training system.

In short, one must integrate training programs into the normal educational process of the country, so that they acquire a permanence and a clientele beyond the immediate group that short-term projects are often directed to.

Sometimes this is not easy. We have heard of some countries in the course of this discussion where it would be extremely difficult to follow this path because the sub-university education has not yet reached the level that can immediately support programs at the necessary level. But, in most developing countries, there is a strand of such education, and one can develop thickenings of the strand and swellings, and thereby establish a program.

How does one go about doing this kind of thing? The initial contact is important. In my experience, the classical point of contact between universities and different countries or between programs in different universities is usually a highly individual one, between people who know each other in one country and people who know of the other people in the other country. This, I submit, is the type of contact that yields best results. The kind of approach that involves government delegations moving to countries to talk with other government delegations about the "needs of education" frequently results in the blossoming of enormous programs which go nowhere, spend a great deal of money, and have little lasting impact.

Once a contact is made, it is then necessary for each side to assess the other. I would stress reciprocity here because there is no point in an institution from a developed country offering its services to an institution in a developing country if the latter institution is really unable to grow to a point whereby there can be effective cooperation between the two universities or institutions in a reasonable period of time. On the other hand, there is little point in a developing country institution seeking support for a program of growth and education from a U.S. institution which is so heavily committed to a domestic program, or so directly slanted along a single particular path of study and education, that no benefit will result. So you have to get together. You have to visit each other's institutions. You have to have a frank exchange of views on what is needed, and you must agree on the path to be followed.

The university department from a developed country which agrees to enter a cooperative assistance program finds itself faced with a multiple set of problems, all of which are related and all of which are important. First, the obvious problem of helping to develop the

existing sister department to a point where it can effectively produce trained scientists of sufficient quality to meet the needs of the country. This typically involves staff training, curriculum development, assistance with facility and equipment development, and initiation of applied research projects aimed at the real needs of the country. However, there is also a need, expressed directly or indirectly, to assist government departments or industry with their technical problems in the interim period while the sister institution is itself developing.

Furthermore, there is usually a crop of students going through the system of the developing country which has to share the benefits of the development. Finally, there are the recent alumni from the old program who are concerned with the effects of the new development on their position and status, and these often request upgrading also.

How does one set about dealing with the situation? In my view, the first rule of operation should be to set a realistic departure date. I mean by this that the primary objective should be to make the developing country university department self-sufficient and capable of independent operation as soon as possible. A continuing sister-department relationship can be envisioned for the future, but a dependency situation should be avoided at all costs.

The second rule is that the program should be seen to be as much a product of the developing department's efforts as of the assisting department's. This is important psychologically and also practically, since it leads to true independence, inspires confidence, and insures that rule three is followed.

Rule three is that the program should reflect the needs of the country and fit the pattern of education in the country. There is always a temptation to apply a successful U.S. system "holus-bolus", but this rarely

works, since it requires a high level of technology, a complex and sophisticated infrastructure, and more funding than is usually available in universities in developing countries.

With these rules in mind, you can attack the practical problem. First of all, it is desirable that members of the faculty who are to be involved with the program learn the language of the developing country. We have heard the reasons for this discussed at length, and I need not dwell on it further, except to emphasize that this is crucial to ensure mutual understanding.

Secondly, faculty and student training should be linked directly with the technology transfer. It is important that an actual exchange of personnel take place at the earliest possible stage. This enables the program to move forward quickly and provides for a scale development of the department. As you've heard from other speakers on the University of Washington-U.C.V. program, we recommend short-term training in the initial phases--three-to-six-month visits which provide a longer look at the developed country university, some installation of concepts and ideas, and the beginning of a new program. Outlines of new curricula and ideas for useful applied research are often developed at this stage. Secondly, the U.S. faculty should move into the country, most effectively after the short-term trainees have gone back, to help develop things there. Actually, this has a value which has not been stressed, and that is the value of providing prestige for the department in the developing country university. Frequently, they feel in a very insecure position *vis-à-vis* the attorneys and economists and engineers, etc. who belong to well-established, traditional academic disciplines, and they need some support which can be provided by the presence of the developed country's scientists from prestigious institutions.

Longer-term training projects should be initiated as soon as possible once suitable individuals have been identified. Sometimes this can be done during the short-

term training period. Similarly, long-term working visits of U.S. scientists should get underway as soon as some trainees have returned. There has already been some discussion of the utility of filling temporary gaps in the teaching faculty due to overseas training in the developing country by university professors from the U.S. or by specialists from Peace Corps and so on. This not only helps fill the gaps, but provides for rapid development of curricula, the initiation of applied research projects, and, very importantly in my opinion, interfacing between the university and industry and government. In our experience, the universities, at least in Latin America, quite frequently have little real contact with the industry of the country, even though, paradoxically, they share common staff as a result of the part-time professor system. It's a remarkable situation, and there is need for a third-party individual without clear industry or government affiliations to act as an intermediary or contact point.

Also, we feel that even at this early stage one should begin to think about extension activities. Now I know this may sound a little foreign to many of us in the more basic sciences, but it is essential, after all, that the developments of science should be transmitted to the user. One of the ways in which this is done effectively in the agricultural sphere is through extension services. We are beginning to see these develop in the marine sphere, and certainly this is a recent technology development in the U.S., which should be transferred to the developing countries.

A word on something again which has been touched on before in this conference. Research involving sophisticated equipment or expensive and difficult to obtain chemicals should be avoided by the trainees as much as possible. This is not to argue for a "Mickey Mouse" approach to foreign student training nor to exclude such

individuals from learning the use of advanced equipment. It is a plea to avoid dependence on expensive toys when this is not absolutely necessary. Scale the project to the condition of the foreign institute, but keep the intellectual challenge high. Good thinking does not necessarily require a computer. In fact, in my experience sometimes it can be obstructed by a computer.

The third phase is one that interests me particularly as a university individual, and this is the exchange of students between the institutions. It is remarkable how early in the program one can effectively move U.S. graduate students into the local department. Now these students have to be prepared for the scientific and cultural shock of not being able to reach around the corner and find a Gilford spectrophotometer, but probably only an old DU, if they're lucky, or more likely nothing at all. On the other hand, these students bring a wealth of experience, since we select them from people close to their degrees, and a freshness of viewpoint which is sometimes lacking in middle-aged professors. Perhaps because of this they usually show an ease and facility of communication with the dominantly young population which constitutes the professional groups in developing countries. I am sure those of you who have visited such countries have noticed this. We look pretty old when we go down to most of these countries. Most of the population is under twenty-one, and it often seems this is true even for the professors. That can be quite embarrassing. I have become accustomed to the U.S. idea of first names, and it does embarrass me when I go to Latin America, and I get the "Herr Doktor Professor Director" treatment. I wonder whether this does not interfere with communication in many cases.

At the outset of the program, jumping back now, there should be discussion between the entire faculty of the developing department and the staff responsible for the program at the U.S. university. A full and frank discussion of the program is necessary to avoid future sabotage by disgruntled individuals on both sides. This

is the time to emphasize the collaborative nature of the operation to find out what the needs are and what needs to be done. It is a time to listen, as well as to argue. A definite plan with a timetable should be worked out and mutually agreed upon. It is necessary, too, to talk with the senior administrators in the university and make sure they understand what is being done but not to become involved in the toils of the administrative bureaucracy.

Curriculum development is an essential part of technology transfer, since what is taught is central to the whole issue. Curricula should be worked out wherever possible by modification of the existing program. It is then possible to work on a course-by-course basis with actual individuals and to avoid interrupting too radically the program of the existing students.

Course preparation should also involve the preparation of laboratory manuals, because it's quite difficult in many of these areas to find appropriate lab manuals or textbook materials, and sometimes you have to write them as you go. This is actually easier than it sounds. The manual can be prepared conjointly with an LDC colleague, ensuring proper use of language and correct interpretation of ideas.

Finally, one can attempt and sometimes succeed in making a direct injection of technology into the government and industry of the country in which you are working. This can be done through conjoint activities, research projects, industry visits, speeches to the local equivalent of the Kiwanis Club, and of course the initiation of a kind of extension service which I have discussed before.

In closing this section, it seems appropriate to re-emphasize that all of this is based on a belief that education and the development of capability for training in a country is essential for the sustained benefits of technology transfer to be maintained.

Now a word about the consortium idea. It's perhaps more obvious in the food technology area that there are so many disciplines involved that it becomes difficult for one institution to supply expertise in all of them. However, I really think this is also true in the marine area, where at the least we have those aspects of oceanography which relate to the movement, location, supply, etc. of fish, ranging from the food chain work through currents and much more. We have the fishery biology input which covers a wide range of sub-disciplines, and we have the processing and technological aspects which also do not constitute a single subject. In addition to that, as has been pointed out (even by Dr. Pigott), we do have economic input; we have sociological problems; and we may sometimes encounter legal problems. At the least, it is a good idea to have a lawyer around to bail you out of the "hoosegow."

All of this means that if a single university department becomes involved in an inter-institutional program, it will quite frequently find itself overextended, with its domestic program suffering and, as a secondary consequence, its effectiveness in the international program also diminished.

One obvious solution to this problem is to enlarge the U.S. capability by conjoining the capabilities of several institutions operating as a consortium. Where there is community of interest among the participating institutions and good personal relationship among the responsible operating faculty, this provides a good solution. The Consortium for the Development of Technology (CODOT) provides a good example of a working system. Functionally, CODOT consists primarily of the Food Science and Technology departments of University of California (Davis), Michigan State University, Univsity of Rhode Island, University of Washington, and the University of Wisconsin. The organization is controlled by an Executive Committee composed of the chairmen of these departments or a designated representative, with Dr. C.O.

Chichester of URI (the originator of the group and its principal organizer) as chairman. URI acts as the business representative, handling primary financing. The participating universities have acknowledged through a letter of agreement the participation of the departments in the arrangement, but policy decision-making and operational control is held at the Executive Committee level. This requires a strong measure of trust by the institutions in their department heads, but permits speedy and effective decision-making and action. I feel that this is essential to the effective operation of a consortium of this type.

Each university unit has primary but not complete responsibility for its particular area of expertise (e.g. Dairy Science in Wisconsin, Tropical Fruits & Vegetables in California, Seafood Technology at Washington). Total responsibility is, however, shared and experts are drawn from whichever institution has them, regardless of institutional discipline area. Indeed, experts may be obtained also from institutions outside the consortium or from industry or government sources where appropriate. Thus, we work together as a team almost as simply as does a single institution.

Actual programs are run by operating committees composed of U.S. and Developing Country counterparts, one in Fisheries and the other in Seafood Technology. We conjointly arrange for training, research, and other operations within the scope of a project area defined by the total contract.

Communication is an even more important factor in a consortium operation than in a single institutional program. In our CODOT programs we try to ensure this through continuous personal contact among the managing group and by scheduling two program committee meetings in the developing country and one in the U.S. each year. The U.S. meeting coincides with an Executive Committee meeting to ensure full briefing of the policy-making body. Of course, there is strong overlap in membership between each of these groups

to further enhance information flow. Operating decisions and policy input are both provided principally by people actually engaged in the work of the program. Developing country input is continuous through the program committees and operates at the policy level by direct communication and at the annual meeting. The rights of all are provided for and, more importantly, the system permits continuous re-evaluation of the program and sufficient flexibility to adjust projects in response to results or changing circumstances. So far, it is working well and should continue to do as long as individual programs are kept small enough to be handled in this way.

I would commend this type of arrangement to my colleagues in the fisheries and oceanographic sciences. Besides being a useful operating system, it might provide an excellent route whereby fisheries and oceanography departments who have been quite unnaturally separated in this country could come together again to operate as a group in the solution of problems which are common to both of them.

I could talk for a long time on the overseas view of oceanography as compared to our own, which I think you all know well. All I can say is that coming here from the United Kingdom, I was surprised to find that oceanography was apparently unrelated to fisheries. This just doesn't make any sense to me, and it does not either to the developing country people that I deal with. I think the coordinated activity of two or three institutions, some strong in oceanography, some strong in biological oceanography, some strong in fisheries science, with the associated capabilities that are present in most universities of resource economics, law, etc. could provide a very effective striking force, if you like, or a very effective working group, to deal with the problems of technology transfer in the marine sciences to developing countries.

# MARINE SCIENCE ASSISTANCE PROGRAMS WITHIN THE NATIONAL SCIENCE FOUNDATION

L. BROWN

There's an inherent advantage in starting off the morning. I had updated my remarks last night on the basis that I would lead off this morning--and Dr. Stewart has already covered two of my major points. Before I begin my remarks, I'll comment on the arrangements that were made for this meeting.

The Columbia Journalism review has developed an interesting system for criticizing the press. They have a column that appears in each issue of their quarterly journal which awards darts and laurels to the papers it criticizes.

Well, I'd like to follow this same procedure and award a laurel to the Academy for finally having taken the bull by the horns by calling this meeting. I would also like to award them a dart for having very carefully scheduled a meeting of the Ocean Affairs Board this morning, thus resulting in ensuring that some of the people who should be hearing what we have to say this morning aren't here.

I'd also like to comment on one remark that Dr. Stewart made about the 100 BT's that were given to the IOC. Many of us were very concerned as to what the after effects of that offer would be. We don't have the after effects yet, but I'd just like to note for the record that the IOC has received requests for approximately 280 BT's in response to their initial circular letter.

Well, basically NSF's objectives are to sponsor and encourage and develop basic scientific research. We have no specific mission to conduct scientific assistance programs.

Thus some analysts have been surprised to note that NSF has actually provided a great deal of scientific assistance to scientists in developing countries and to their institutions and governments as well.

Most of these programs have been what I would term implicit--that is, they are not specifically scientific assistance programs, but rather have been done through NSF support of U.S. oceanographic research, through grants which have employed among others foreign graduate students; through ship support which has provided berths for foreign scientists on cruises; and through contracts which have resulted in dissemination of scientific data and results. Contrary to the view of some, scientists in many parts of the world can understand and benefit from the dissemination of our data and scientific results. In Nouadhibou, Mauritania, the only characteristic that distinguishes the main street from the desert is that the dunes in the street are a little bit smaller. However, in Nouadhibou there is also a small but adequately financed and maintained fisheries research station that no one in the U.S. seemed to know anything about. They are staffed with two competent fishery biologists who are fully prepared to analyze and evaluate the plans that our scientists presented to them for the Joint-1 Experiment off the northwest coast of Africa.

There may be communications problems between U.S. and foreign scientists, but I think we often tend to underestimate the competence of our foreign colleagues, particularly their competence to understand and benefit from the results of our research.

There is one problem however, that I would like to identify. We have not undertaken a critical--a truly critical-- analysis of the effectiveness of these implicit programs, especially the providing of opportunities for participation by foreign scientists in oceanographic cruises.

One of the criticisms that has been leveled at this program is that it has been ineffective and should be built up into a program that provides not only for participation in the cruises, but participation in the preparation for and the follow-up of these cruises as well.

However, U.S. agencies and institutions have been reluctant to undertake the finanacial burden of such a program until we are convinced of its worth. We had been hopeful that this workshop would take a look at this problem, and perhaps this might be considered in our forum discussions later.

To get back to the NSF Programs *per se*, in addition to our implicit programs, we also have started to conduct fairly recently some explicit programs. Two of these have been the SEED program and various components of the IDOE.

In the SEED program, NSF has assisted in the development of an oceanographic curriculum at the Catholic University of Valparaiso; has supported a lecture series on ocean mineral exploration at the Oceanographic Institute in Guayaquil; and has assisted in the establishment of an oceanographic data center at the Marine Scientific Institute in Djakarta.

Obviously, oceanography is only one component of the SEED program, but efforts such as these are expected to continue on at least the current scale on a regular basis.

Under IDOE, there are significant scientific assistance components, especially in the coastal upwelling project and in the continental margin studies. Let me

describe one of these--the Coastal Upwelling Project and Joint-1 Experiment in particular. Three U.S. vessels and at least one aircraft are participating in a coastal upwelling study off the coast of Mauritania. Mauritania and the other coastal states in the region will benefit from this operation implicitly in the ways I've already described. In addition, Mauritania will participate directly in the experiment. The Fisheries Ministry of the Government of Mauritania has chartered a fishing vessel and will provide sub-surface truth for the Joint-1 sea-surface observations by running a series of trawls to compare the size of catches and the distribution of species with observed variations in both space and time of the oceanographic parameters in the upwelling area. Regular and frequent direct communications between the trawler and the research vessels will provide rough analysis on a real time basis. Scientific equipment is being provided to Ghanaian scientists to conduct complementary current studies to the south. Consideration is also being given to similar cooperation with scientists in Senegal and the Ivory Coast.

Limited support is also being given to the Environmental Data Service of NOAA to provide satellite reconnaisance photographs of the Joint-1 area in quasi-real time to obtain space truth for Joint-1. These photographs are also being provided to the Service Meteorologique in Morocco to assist them to improve their production of biweekly sea-surface temperature charts. It is hoped that, in the long-term, this latter program will develop into a fairly broad-scale system for issuance of fisheries forecasts off Northwest Africa.

The IDOE office has also provided limited funding for other even more explicit scientific assistance programs. As noted by Dr. Stewart, we have funded the latest session of the NODC, UNESCO course on the acquisition and utilization of oceanographic data.

We have also provided $50,000 to the IOC fund-in-trust to convene workshops of working level scientists, especially from developing countries, to develop ideas for new IDOE programs.

IDOE and NSF's Office of International Programs are jointly supporting a moderate scale program with scientists in the Republic of China, a program that we expect will result in a significant improvement in these scientists' capabilities to undertake oceanographic research programs. They are, in fact, now working directly with us under the NORPAX program.

NSF has also, as pointed out earlier, made the ELTANIN available to the Government of Argentina. Meetings to develop a joint scientific program for the ELTANIN, now renamed the ISLAS ORCADAS, will be held in Washington next week. These first meetings will involve only Argentine and U.S. scientists. Later we hope that scientists from other countries will have the opportunity to participate in the program.

At NSF we are also looking at the need to establish programs to assist developing countries to cross over from developing country status in science to developed country status. AID programs normally only take the developing country so far, and yet, when AID programs finish, these countries often are not yet able to participate with us as a full colleague in a cooperative scientific program. We refer to the efforts we're looking at as 'cross-over' programs, and although we're not sure at this time how far we're going to pursue this, we are looking into it very carefully.

In our view, all of these programs, implicit as well as explicit, are of significant value to the scientists in developing countries who participate in them and to their governments as well. This is evidenced very simply yet very clearly by their continued and long-term interest and by their participation in these programs.

Yet the aggregrate of these programs and those sponsored by other U.S. agencies and by other developed countries reaches the barely non-trivial level on a global scale. The reason for this is very simple. It's the reason already mentioned by Dr. Stewart. It's the same as the reason stamped on checks returned by your bank--'insufficient funds'--and the reason behind the insufficient funds is equally simple --insufficient return to the investor. No one has yet made the case that scientific assistance will result in profit to the investor, either economically or politically or legally. Certainly no one has yet made the case that scientific assistance can be used as a negotiating tool in the LOS negotiations.

Ed Miles on Monday night very succinctly enunciated the view that vague promises of scientific assistance plus a quarter won't buy us a tamale in Caracas. I am not quite so pessimistic but almost. In that saloon full of lawyers, a firm promise of scientific assistance plus a million dollars might buy a tamale, but it would probably be full of maggots.

At NSF we learned long ago that the only good lawyers are those who are either working for the scientific community or ex-naval officers. As my esteemed colleague Norm Wulf puts it, "If you take all the other lawyers in Caracas and laid them out end to end, it would be a good idea." However, LOS is not the only forum where the lawyers have had an input and an increasing input. IOC is another.

Ed Miles has, in other forums, also made a very perceptive analysis of the IOC. Ed has suggested that the IOC's effectiveness is sharply limited by two restraining factors: first, the inability of the major developed states to agree on the priorities and parameters of major programs; and second, the unwillingness of the major countries to provide meaningful scientific

assistance to the IOC's less-developed member states. I suggest that this analysis is almost equally applicable to the scientific research negotiations in the LOS Conference. I suggest further that the utility of scientific assistance as a negotiating tool in LOS will be determined in large part by our ability to overcome these two limitations.

We must first be able to provide meaningful and specific scientific assistance, and we must second convince the other developed nations to assign a high priority to scientific assistance, to agree with us on the parameters of the programs to be offered, and to add to the financial support for the assistance. In my view, it is also necessary to get those countries to agree to take the position that we can pay for scientific research only in scientific research coins, i.e., scientific assistance. It must also be acknowledged that our 'kitties' in this area have essentially a fixed limit so that if the costs of scientific research skyrocket, then the funds available for technical assistance will plummet.

In my view, if these objectives can't be achieved, then we will obtain little return for scientific assistance. I think that this return could be very significant, particularly after the negotiations reach their final stages in which the votes or the support of a few countries could be crucial to the resolution of key issues. If, however, these basic questions cannot be achieved, then a unilateral offer by the United States to provide scientific assistance will very likely benefit U.S. oceanographers and their research programs in the long-run but probably will have little effect on the outcome of the scientific research negotiations in the LOS Conference.

One basic question that could be asked is: Even if everything goes right and we get all of the developing countries to go along with us, why do I feel that our returns on this area may be limited?

Part of my answer to that was supplied by Giulio Pontecorvo on Monday night. The answer is: basically, we can only offer scientific assistance coin for scientific research purposes, and the 'kitty' available for this purpose is limited, even if we're able to convince our friends to go along with us. It's not going to be enough to assist coastal states to mine for minerals, build fishing fleets, or operate beach resort complexes. All in all, scientific research seems to be much lower on their overall system of national priorities than it is on ours. Until this situation is changed, I don't think we can expect them to look at scientific research in LOS the same way that we do.

By the way, as I mentioned Monday night, I don't feel anybody should be surprised if the LDC's don't talk much about scientific assistance in anything except generalities at the LOS Conference. As has been noted earlier, only a few of them can benefit directly from scientific assistance at the present, and the others might well fear that if the limited funds available in our ocean science 'kitty' go to scientific assistance, only these few will benefit, and the others will receive no benefits at all. More basically, and perhaps more importantly, these countries recognize the possible utility of scientific assistance as a negotiating tool for us. If they simply refuse to talk about their specific needs for scientific assistance, then perhaps we won't know how strong or weak this tool is, and we won't know where or where not to apply it.

# NOAA'S ACTIVITIES IN MARINE SCIENCE ASSISTANCE TO THE DEVELOPING COUNTRIES

H.B. STEWART, JR.

Before I start on NOAA's activities in assistance to developing countries in marine science, there are three points I want to make based on what I have heard at these meetings since Monday evening:

1) Although the up-coming Law of the Sea Conference may have been the stimulus for this particular meeting, I would stress that it is not the major reason--or perhaps even a valid minor one--for the involvement of the U.S. marine science community in providing assistance to less developed countries--and by this I mean less developed only in the area of marine science. It is a big ocean, and anything we can do to upgrade the ability of other countries to contribute meaningfully to understanding the ocean in all its complexity is useful to us ocean people, as Doug Chapman used to call us, and it is also useful to the United States. This is the major rationale insofar as I am concerned, and I will let others worry about LOS, balance of payments, political implications, and the other reasons that have been put forward for helping other countries in the ocean business.

2) There have, over the past day and a half, been occasional references to the the problems of funding programs in marine science and technology in other countries. The complaint has been that what little funding there is, is scattered in very small pockets in quite a few locations. To this, I can only reply "be glad that it is", for a big line item for programs of this sort probably would not get by OMB and certainly would not get through the Hill. We just have not yet sold the Executive or the

Legislative Branch on the need for a well-funded effort in this area--let alone ocean science in general, and until we can, be glad that a few small bags of coins are secreted here and there--in the Federal Government and out--that can be used for this purpose.

3) We speak of the "Less Developed Countries" as though they were a large group of countries all of whom are at the same level of marine scientific development, or lack thereof, and this is far from the truth. The degree of development of marine science and technology in those countries with less sophistication in this field than we in the U.S. have attained, runs the full gamut from those with none at all to those with just a bit less than ours. All of these are in fact "less developed" than we are. Therefore, we are dealing with a rather broad spectrum of degree of development. Many of the sweeping generalities we have heard in relation to the LDC's just apply to one relatively narrow portion of this spectrum and can not reasonably be applied to all of the countries who are less developed than the United States. This means that we must consider each country as a separate case and as a function of its own level of development in marine science and technology and of its own needs in this area.

But what about NOAA's efforts to assist less developed countries in the field of marine science and technology? One major NOAA activity has been that of our National Oceanographic Data Center (NODC). The oceanographic interest of developing countries cover broad geographical areas, and data are frequently collected off their coasts by other nations. It is believed oceanographic programs of the developing countries could be significantly and inexpensively enhanced by enabling them to acquire and use data pertinent to their developmental objectives.

The idea of a Training Program in "Acquisition, Processing and Utilization of Oceanographic Data" to satisfy this need was originated at the Agency for International Development (AID) which provided the initial funding. The NODC devised and implemented the program, and the Intergovernmental Oceanographic Commission of

UNESCO distributed announcements, received and screened applications, and made travel arrangements. The first three sessions were intended as pilot projects, the main purpose being to establish the framework and provide an initial impetus for significantly increasing the capabilities of developing countries of Africa, Asia, and Latin America to acquire, process, and effectively use information about ocean resources near their coasts and ocean conditions that affect their coastal activities.

The first class began in June 1971, the second and third in October 1971 and June 1972 respectively, the fourth in September 1973. The continued demand for additional sessions prompted the National Science Foundation, Office of the International Decade of Ocean Exploration to fund a fourth session. During the last of the four sessions there was a shift of emphasis from visits to international organizations (UNESCO, WMO, and FAO) to other data centers. More emphasis was also given to training in management practices, and the potential of documentation and information retrieval to foster oceanographic knowledge.

Thirty-five marine scientists and administrators from twenty developing nations have now completed their training. They are geographically distributed as follows:

| | | |
|---|---|---|
| Africa: | Arab Republic of Egypt | 1 |
| | Ghana | 1 |
| | Tanzania | 1 |
| | | 3 |
| Central & South America: | Argentina | 1 |
| | Brazil | 1 |
| | Chile | 2 |
| | Colombia | 2 |
| | Ecuador | 1 |
| | Guatemala | 1 |
| | Mexico | 3 |
| | Peru | 2 |
| | Uruguay | 1 |
| | | 14 |

| | | |
|---|---|---|
| Asia: | India | 2 |
| | Indonesia | 3 |
| | Korea | 3 |
| | Pakistan | 1 |
| | Philippines | 2 |
| | Thailand | 4 |
| | | 15 |
| Europe: | Greece | 1 |
| | Malta | 1 |
| | Yugoslavia | 1 |
| | | 3 |

Sixteen countries sent trainees to the first three training sessions. Of these, three countries have former trainees in charge of their NODC: Chile, India, and Mexico.

Seven countries will start a National Oceanographic Data Center before the end of 1973: Colombia, Ecuador, Indonesia, Korea, Peru, Philippines, and Thailand. Three more countries have definite plans for establishing a center, but at a later date: Ghana, Guatemala, and Pakistan; and only three countries of the sixteen have no definite plans to utilize knowledge acquired by the trainees to create or operate a data center: Argentina, Brazil, and Uruguay.

Additional activities have centered in World Data Center-A (Oceanography), now also under NOAA's wing. With the assistance of FAO, WDC-A (Oceanography) has initiated a data and information exchange program with thirty FAO/UNDP supported activities which collect oceanographic data in conjunction with fisheries investigations. These activities forward data to WDC-A, which in turn arranges for data processing facilities as well as other services, as required.

To date, WDC-A has received oceanographic data from FAO-UNDP activities in India, Ghana, Ivory Coast, Senegal, Sierra Leone, Mexico, and Tunisia. Technical reports have been received from UNDP's in Venezuela, Colombia and Senegal.

The U.S. NODC recently prepared vertical station plots showing a comparison of various parameters for Mediterranean Sea station data for WDC-A transmittal to Dr. Wilhelm Brandhorst, of the FAO/UNDP Fishery Survey and Development Project in Tunisia. This work was done under terms of a $3,000 contract between the FAO Department of Fisheries and WDC-A, Oceanography. These charges were levied by WDC-A in order to recover machine processing costs incurred by NODC in preparing these plots.

Through the Technical Assistance Division of NOAA's Office of International Affairs, some 85 foreign nationals were supervised in their training in fisheries and related sciences during 1973. These included 2 Europeans, 9 from the Near East and South Asia, 10 from Africa, 22 from Latin America, and 42 from Southeast Asia and the Pacific. The Agency for International Development sponsored 43 of the 85. FAO sponsored 40, Japan 1, and one was privately financed. I have their names and countries, and the universities where they studied, but for this report, it suffices to say that the Philippines with 16 and Thailand with 15 lead the list, with Mexico, Ghana, Venezuela, Vietnam, Korea, Chile, and Brazil each with three or more, and 20 other countries with two or less.

Thirty-five of the eighty-five worked in National Marine Fisheries Service (NMFS) laboratories for varying periods of time in fields as diverse as fish larval studies, tuna tagging, and the operation of salmon hatcheries. This number includes only those working under some sort of formal arrangement. Many students and scientists from developing countries spend varying periods of time in NMFS laboratories, often under very informal circumstances.

In addition, the NMFS furnishes expert personnel to AID for work in developing countries. Recent examples are Korea, Vietnam, Dahomey, Brazil, and Laos, where NMFS personnel are working on salmon culture, oyster culture, estuarine fishery development, etc.

NOAA's National Oceanographic Instrumentation Center (NOIC) has no funds of its own for assistance to developing countries but has been of help in providing assistance through AID and OAS. NOIC is concerned with standards, instrumentation calibration and testing and is providing advice to developing countries in defining uniform calibration methods and procedures.

In early 1971 the Agency for International Development (AID) of the Department of State awarded a grant of $450,000 to the Organization of American States (OAS) for the purchase, acceptance, and calibration of oceanographic equipment as well as training of personnel. The grant was specifically for four OAS member countries: Mexico, Colombia, Venezuela, and Argentina. The National Oceanographic Instrumentation Center (NOIC) of NOAA was designated to advise OAS on the purchase of the equipment, perform necessary services such as calibration, etc., and also conduct training courses for their personnel.

In summer 1971, the director of NOIC accompanied by an OAS staff member visited the four countries to familiarize himself with their existing facilities and capability. After his return, recommendations for purchase were made, and eventually a list for each of the four countries was developed. NOIC prepared equipment specifications, assisted in the selection of vendors, while OAS issued purchase orders. The equipment was shipped to NOIC where it was inspected, tested, and calibrated, as required. After completion the equipment was shipped to the respective countries.

While this work was progressing, two training courses were conducted for engineers and technicians of the recipient countries. A total of seven men participated. The first group consisted of two engineers each from Mexico and Argentina. The second group of two technicians from Colombia and one oceanographer from Venezuela. The principles of physical oceanography, measurement techniques, and management of an oceanographic instrument laboratory were reviewed, and the men were trained in the methodology of testing, evaluating and calibrating of oceanographic instrumentation.

This assistance program continued for a period of over two years and is now essentially complete.

NOIC disseminates, free of charge, information on the performance of oceanographic instrumentation in several series of publications. The Instrument Fact Sheets report in a concise form the results of the instrument test program. Tests in Progress Sheets summarize the test schedule program. Thirty developing countries are on the mailing list for these publications.

NOIC has made a commitment to furnish UNESCO-IOC with 100 mechanical bathythermographs in good working order for distribution to developing countries. IOC has mailed announcements, and to date requests for some 265 have been received.

Probably NOAA's major recent contribution, especially to assist developing countries, was NOAA-Carib, a two-month education and training cruise for Latin Americans carried out in the fall of 1972 aboard the DISCOVERER.

In response to repeated expressions by the CICAR countries for opportunities for their marine scientists and students to obtain at-sea training, the National Oceanic and Atmospheric Administration (NOAA), planned and carried out NOAA-Carib. The cruise extended from October 9 to December 15, 1972, and included cooperative work with scientists and students from Mexico, Jamaica,

Puerto Rico, Trinidad and Tobago, Venezuela , and Colombia plus one man each from the Netherlands Antilles and France.

In contrast to most cruises on which one or two bunks are reserved for foreign scientists in the capacity of joint investigators or observers, NOAA-Carib was set up to accomplish research work planned completely by the participating nations. Participating scientists from each country decided what research work would be done, where it would be accomplished, and who of their own people would take part. Participants from each country included both senior researchers carrying out their own work, and junior faculty and students who received at-sea education and training in oceanographic operations. The U.S. participation was limited to the provision of senior specialists in the various disciplines in which each nation wished to work.

In addition to the actual research work at sea, the major port stop in each country included a one-day education and training cruise for 50-60 students, and an open house day on which the public was invited to inspect the ship and to listen to discussions and lectures about the equipment and about the work being accomplished. On both the open house and the one-day cruises, those scientists from the country being visited who had been aboard for the previous week played leading roles in the discussions and lectures--in Spanish in the Spanish speaking ports.

Through arrangements made with the U.S. Navy, twenty-three reconditioned and calibrated mechanical BT's were provided to the NOAA Ship DISCOVERER for distribution to the participating Latin American countries. These were presented to Mexico, Jamaica, Trinidad and Tobago, Venezuela, and Colombia in ceremonies at the end of each one-day cruise. In addition, the NOAA National Marine Fisheries Service provided sets of bongo nets and neuston nets to Colombia and Venezuela so that the re-

sults of their plankton sampling will be compatible with those of other CICAR nations by utilizing these standard CICAR nets.

In summary, 401 Latin American scientists and students received at-sea training aboard the DISCOVERER during NOAA-Carib for periods ranging from one day to two weeks. Work at sea included:

| | | | |
|---|---|---|---|
| bathymetry | (6714nm) | gravity observations | (6245nm) |
| biological tows | (185) | magnetics | (4519nm) |
| casts for water samples | (53) | salinity samples | (462) |
| cores | (7) | STD casts | (42) |
| deepsea camera stations | (3) | seismic reflection profiles | (1066nm) |
| dredgings | (15) | XBT's | (346) |
| grab samples | (5) | | |

plus uncounted meteorological balloon releases, oxygen and nutrient samples, chlorophyll samples, and pH measurements.

Funding in the amount of $2,000 was provided by UNESCO to assist in paying for the transportation of Latin American nationals to and from the DISCOVERER, and for printed information on oceanography including volumes of the AOML collected reprints and other publications, which were provided to each country.

The participating scientists and students have been most complimentary in expressing their appreciation, and I honestly believe that this person-to-person education and training at sea is a most effective mechanism for providing very real assistance in marine science to developing countries.

In conclusion, NOAA is doing what it can in assisting other nations that have less marine science capability than the U.S., but it is a pitifully small effort. Support

is either from outside (AID, UNESCO, FAO, etc.) or by internal reprogramming (NOAA-Carib). It is an unsatisfactory way to work, and the results are appropriately unsatisfactory. It seems to me that for the situation to improve in NOAA--as well as in the other federal agencies with marine responsibilities--it will require some sort of national commitment at the highest levels of government. Perhaps these meetings are the first step in that direction.

# EPA'S INTERNATIONAL RESEARCH ACTIVITIES IN THE MARINE SCIENCES

H. QUINN

I would like to change the pace and review EPA's ongoing international research activities in the marine sciences with emphasis on a few specific projects. The Environmental Protection Agency is the new guy on the block when you look at the traditional agencies involved in marine sciences. The predecessor agencies of EPA have a long history of research activity. However, the international programs were limited in scope in the marine area prior to the establishment of EPA. This is rapidly changing since most marine pollution comes from the land.

I should also emphasize that EPA has a strong mission-oriented responsibility to work with environmental problems. This involves solving contemporary problems and using environmental assessments to avoid future problems. Despite this, we support basic and applied scientific research and the development of institutional capabilities, both at home and abroad, to do high quality research in the marine field. We do this from a different perspective, however. We start with the problem end of the cycle and try to define which research areas should be stimulated or which technology should be demonstrated. Therefore, our international research activities include finding support--intellectual support, research support, policy or economic support--to help us understand what's happening in the global environment as a result of man-made pollution.

My goal is to describe what we've done internationally in this area. EPA recently had its third anniversary. It takes time to create strong institutions. You will see

where we are on the spectrum of things. We have had a very active, and I think successful three years. I will describe to you very briefly some of the examples of projects that we have undertaken abroad, particularly with developing countries. I will try to summarize how we approach these programs and describe our basic philosophies concerning developing programs abroad. If these activities relate to your interests, we would appreciate hearing from you. EPA faces immense pressures and short-term requirements to control environmental pollution. We, therefore, seek the support of the academic community, and other agencies such as the National Science Foundation, Smithsonian, and the Agency for International Development to work with us in conducting the baseline studies and other collaborative projects. Often they have the manpower, the resources, and the traditional responsibilities to work in these areas. So we are actively, especially in our international programs, looking for partners to undertake these projects. I hope that in some instances it will trigger your interest or your curiousity to find out in fact how you can be involved in EPA's international programs.

The examples should show you the variety of ways that we are working. These are not the only ways or perhaps the best approaches, and we are still very definitely on a learning curve. It's been fun and exciting, and we hope to keep it on that kind of scale. I think in order to do this, we're going to need a lot of help across the board.

In the marine area, national borders have little meaning. The oceans are the classical case of the "Tragedy of the Commons." As is evidenced by our participation in international forums such as IMCO, Ocean Dumping Convention, and Law of the Sea, we accept a responsibility for helping clean up and for protecting the

oceans. At the policy level, these are our most important activities. The issues raised create the need for much research and policy analysis.

We found problem-solving, or better yet problem-avoiding, approaches to be very acceptable overseas. We'll go into a foreign laboratory or government office and basically describe what we see as an important international or common problem, such as pollution of an estuary, the creation of a new deep-water harbor or offshore oil drilling. Most of the countries, developed and developing, planning to undertake these kinds of activities are interested in working with the U.S. in avoiding the obvious pollution problems. In many instances these coastal regions are also in the heart of their tourism industry. Although, as was said earlier, it's hard to sell the research investment at a local level on the basis of scientific potential, you can certainly persuade them with economic arguments. What, for instance, if the Yugoslavs developed the coast of the Adriatic as an industrial facility--what is going to happen to their tourism industry? The same trade-offs must be frequently applied to environmental and development problems.

Taking the "problem approach" with foreign nations gets attention at the very highest level of government. We find that by working this way, we are able to get more support for scientists, I think, than we would if we were approaching it from the other angle. The reason we take this approach is because this is also the bias within EPA. Initially, we want to find out what the potential or actual problems are, and then proceed to develop the capabilities and the institutional competences to avoid or solve those problems.

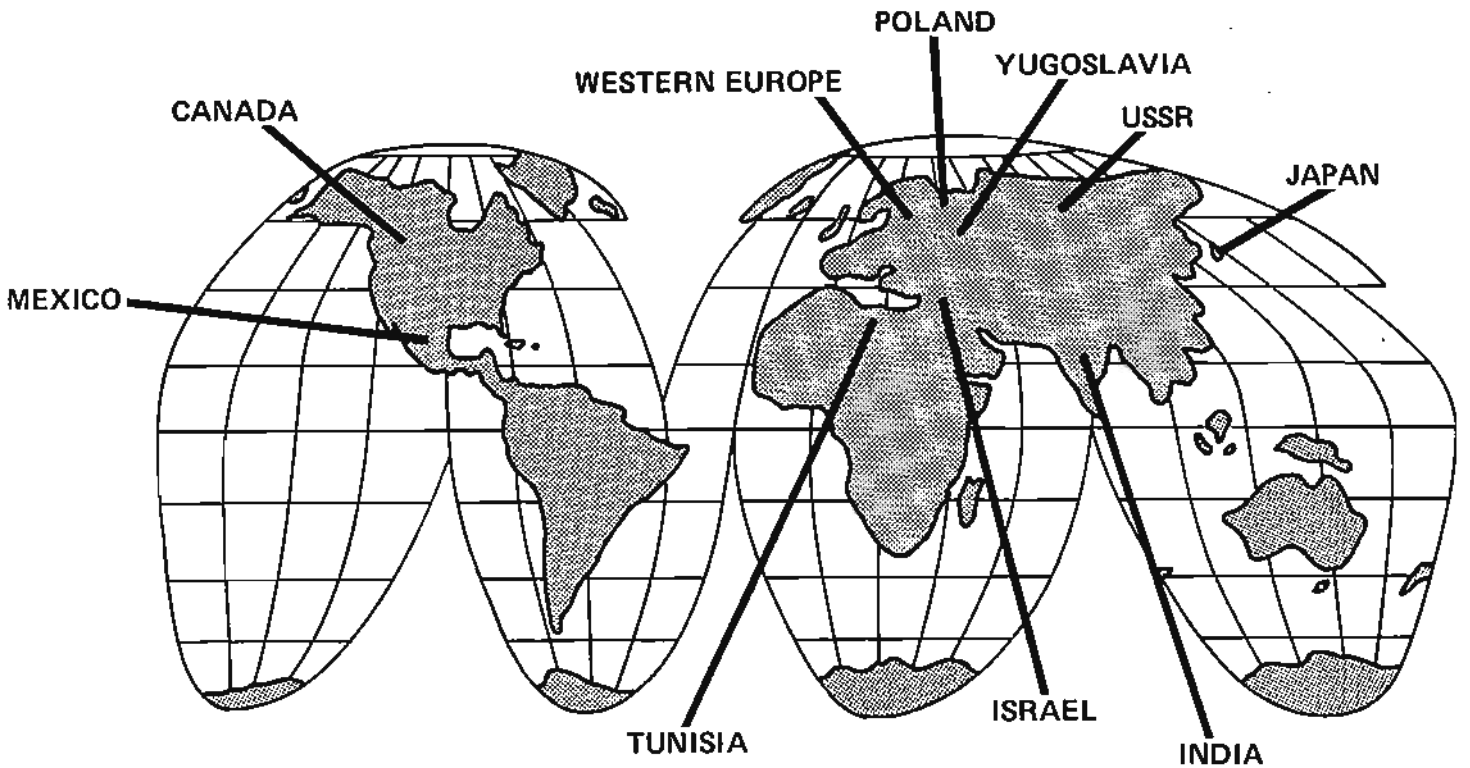
EPA has had good results from our R&D experience abroad. We start by seeking to identify really first-rate or promising foreign investigators. If we can't do this, we usually don't proceed. We occasionally follow the NSF patterns of responding to U.S. scientists that are willing

to undertake the scientific leadership in these projects. We, however, have been successful in identifying a number of highly qualified foreign scientists in the marine sciences. At this point we offer the foreign institution support. This support is usually U.S.-owned excess currencies, sometimes limited dollar support and always professional collaboration.

We have found that foreign investigators always want U.S. scientists to collaborate with them. The negotiation process very rapidly leads to--'Can you arrange to have so-and-so spend some time with us?' We have been successful in arranging these informal professional exchanges. It's an approach that's been highly successful based on the contributions of the American scientists to the research effort, and at the same time we are upgrading and training a foreign scientific team.

Let me quickly go through actual examples. This will also give you a rapid overview of our international marine programs. We try to focus on those things that extend EPA's domestic program. The principal participating countries are shown in figure 1. We have a number of activities that work to support the goals of the United Nations. We were very active in the Stockholm Conference and worked closely with the development of the United Nations Environmental Program. We have several formal programs with the World Health Organization in the field of environmental health.

We also work with other international agencies, such as European Economic Commission, OECD, and the Economic Commission of Europe. Most of the man-made pollution comes from the developed world. Therefore, EPA's international activities are focused on strengthening relationships, especially at the policy and organizational levels, with the developed countries such as Canada, Japan, West Germany, USSR and other Western Europe nations.




Countries Where EPA Has Major Bilateral Activities

We are constantly developing mechanisms to get people to work together. We have no really major exchange "Programs" with a capital "P". If, however, there's a foreign scientist that wants to work with us, we take it on a case-by-case basis and try to arrange it so he can. In some instances, it means arranging for him to work with an American university, or in other cases we work with the Agency for International Development in developing training courses for foreign scientists and engineers interested in learning about environmental sciences, management, and engineering.

We have hosted a number of study tours. For the most part, our foreign visitors are interested in finding out how the U.S. established an environmental protection organization. We give them very detailed briefings on the U.S. organization, including other agencies and CEQ. We expose them to labor and industrial leaders as well as environmentalists. We give them direct contact with the regional people, the state and local people, to help them understand the complications and the political and institutional milieu in which you have to work. It is a good day at EPA when the Administrator is not sued twice. He's usually sued by both sides of the fence. We try to demonstrate to them this kind of conflict and activity within the U.S. environmental protection programs.

The major international bilateral contacts are obviously with Canada and Mexico. The Canadian program is related to the Great Lakes, and that is probably our number one international priority in terms of solving a problem. We find ourselves often in the position of having the Canadians pushing us, and quite frankly it's because the problems of the Great Lakes are about 85% American-caused. Cleaning up our side of it is a bit more difficult.

If you define the marine as "salt water", the salinity in the Colorado River is the major international environmental problem concerning Mexico. EPA is actively

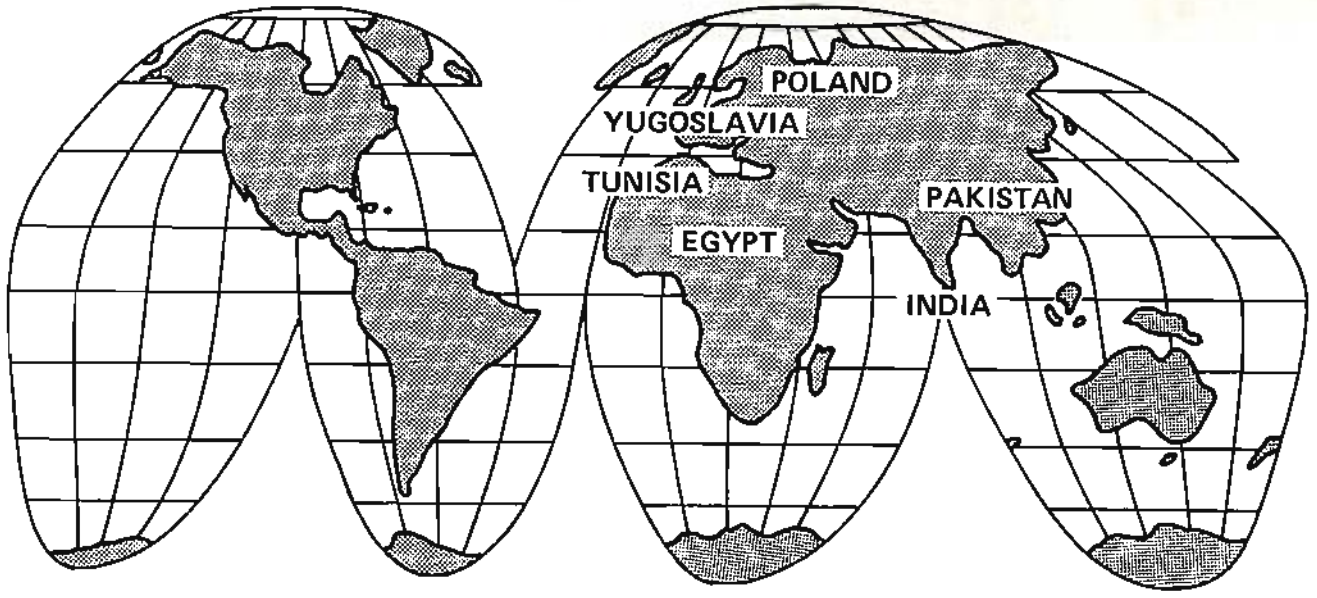
involved with the Department of the Interior and the State Department in coming up with alternative solutions for this problem.

We have developed a number of bilateral research programs. We have under our Special Foreign Currency Program currently about $20 million worth of ongoing research and development covering a five-year period. The participating countries are shown in figure 2. In terms of the developing nations, we're primarily working with Tunisia, India, Poland, Yugoslavia, and Egypt. These countries have major marine access. Without exception, we have worked with the universities and the governments to develop some kind of a marine program in each of these countries. We haven't been successful in all cases; we have in most.

Let me review one specific program in some detail to give you an idea of what we hope to gain from it. We funded Dr. Velimir Pravdic, a physical chemist at the Center for Marine Studies at the Ruder Boskovic Institute in Rovinj, Yugoslavia. His research program is aimed at understanding the interfacial problems of pollution in the marine environment. This includes both the air/sea interface and the interface between the sea floor and the water. Dr. Pravdic's work is basic in nature. In terms of a research task it could compare with any scientific study that would be sponsored by any agency like the National Science Foundation or any Academy of Sciences around the world.

Our support to Pravdic, and in a sense to the Center for Marine Studies, has far broader implications. Our goal is to not just support tasks but to create a better process for understanding the full implication of marine pollution in the Northern Adriatic.

There are many sources of pollution, both from municipal and industrial sites, along the coast. In some instances this "pollution" is a stimulant for a




SPECIAL FOREIGN CURRENCY PROGRAM

nutrient-poor sea. In other instances, it is persistent toxic materials such as heavy metals or pesticides.

Pravdic's team is highly qualified and generally well-equipped. Often they need certain talents and equipment that have to be negotiated for through the government of Yugoslavia or provided by EPA. EPA partially supported reconstruction of the 25 meter VILA VELEBITA II which offers laboratory space and accommodations for six scientists and a crew of three. This research vessel will be used on a number of projects. In other instances, the Center for Marine Research wants to use things like remote sensing data from aircraft and satellites. It's often difficult for them to get it in Yugoslavia. We try to build a relationship with that institution, and the other American institutions such as the Department of Interior or NASA and our own people in EPA, to understand pollution in the Northern Adriatic.

This project is a little over a year old now, so we obviously haven't yet had any earthshaking scientific results. I will invite you to watch it with me to see where it goes. We are quite optimistic. Much of the pollution of the Northern Adriatic comes out of the Po River in Italy. The Yugoslavs, therefore, need to also work with Italian institutions to understand how one can move to solve this problem, because again we're interested in solving the problems not just documenting them. We're also working to add an Italian component to it.

I have before me a list of half a dozen other projects at the Ruder Boskovic Institute that we're interested in and for which we are seeking funds. So far we've only funded partially, the reconstruction of VILA VELEBITA II and the research of Dr. Pravdic. There are two other projects which we would like to fund in the near future, if we can get through some bureaucratic hurdles.

The Yugoslavs plan to build a major deep-water harbor near Rijeka. There is other industrial development taking place in this region. The possibility of the pollution problems has now reached the point where the government of Yugoslavia is spending several million dollars in cooperation with the United Nations Development Program to understand basically the environmental impact of development on this region. Economically the Northern Adriatic is a very valuable resource. It's obviously going to be under continued stress for tourism and industrial development in Yugoslavia and Italy. Our combined efforts may help minimize the environmental stress of this development.

The Lake of Tunis is another serious environmental problem in which EPA is involved. The Lake of Tunis is a coastal lake near Tunis, Tunisia. It's about 45 km square. It's very shallow, approximately 1.5 meters. Each year, because of wind conditions, temperature, and also the nutrient input into this lake from the city of Tunis, there's a major fish kill. Odor from the lake seems to be tied to the influx of tourist from Western Europe. Ecologically it's probably perfect timing to get rid of the tourists, but unfortunately President Borgibu wants them. The solution of this problem, at least a year ago, was his number one priority. EPA is not in the business of fixing President Borgibu's lake, but on the other hand we have lakes like this along the southern part of the United States. They are eutrophic and under the threat of fish kills and of algae blooms causing anaerobic conditions. We're also dumping sewage in them. On one hand, they're highly productive in terms of fisheries. On the other hand, they're obviously an aesthetic nuisance. The Lake of Tunis study evolved from a plan on the part of the government of Tunisia to divert the sewage from this lake. We will monitor the changes carefully with the help of a team from Duke University. Drs. Orrin Pilkey, Richard Barber, and a number of other scientists from Duke will be monitoring the physical,

chemical, and biological characteristics of the lake and measuring the recovery process. The lake has limited exchange with the open ocean. It may be necessary to take engineering approaches to increase the exchange. There is an interest in aeration of the lake and in dredging part of it.

The lake is highly productive. The Tunisians want to fix the problem without creating any other problems. They like the fish production, but on the other hand they want to solve the odor problem. So the politicians have to face that sort of conflict. If they solve the odor problem, but on the other hand limit the fish production, that's their career down the drain.

We have a new research program on the Baltic in the Gdansk region of Poland. This project is fairly broad. It studies the environmental impact of heavy metals and nutrients going into the Baltic. The Baltic is basically a closed oxygen-poor sea with remarkably stable stratification. We are trying to understand the fate of pollution under these conditions. The development of processing industries and population growth on this coast causes disturbances of the natural hydro-chemical balance of the sea. This program is funded for a period of five years.

The research team is totally Polish; the Principal Investigator is Dr. A. Trzysinka. EPA's Project Officer is Dr. Donald Baumgartner of our Corvallis National Environmental Research Center. The Polish team will do this research and report back to us. The results are applicable to large bays and lakes in the U.S., such as the Great Lakes and Puget Sound.

The Poles are anxious to visit American institutions and American labs. We also are anxious to have them. If you have any interest in having them visit your university or institution or lab, we would welcome the chance to arrange this.

We also actively seek individual consultants to visit them--to work with them for short periods of time. This will transfer to them the thoughts and the knowledge that has developed in this part of the world.

We don't yet have marine studies in Egypt, especially if you define marine as the salt-water environment. I just returned from Cairo last week. We have, after about two years of negotiation, obtained full approval to study the environmental impact of the Aswan Dam on the Nile River. This program is under the direction of Dr. K.H. Mancy, The University of Michigan, and Dr. F. Ramadan, Egyptian Academy of Scientific and Technological Research. I'm sure you understand the significance both of the Nile River historically and the environmental changes caused by the Aswan Dam. There is excellent background data on the flow characteristics of the Nile. The records go back several thousand years.

The Aswan High Dam cost about $5 billion and is an important development for Egypt. There are many statements and questions about the impact of this dam on the Mediterranean environment. They range from the elimination of the sardine fisheries in the Mediterranean to guessing what is happening to the coastal area in terms of erosion. Very little good data is available and the positive aspects are rarely mentioned.

We are interested in finding out what is happening to the water quality in terms of changes in the biology, the physics and the chemistry of Lake Nasser. We view this as a comprehensive system study of the impact of a large dam. The resulting models will be transferred to other countries and to the United States. It will also hopefully have an impact on the information available to decision makers in Egypt. The water from Lake Nasser is now being used for irrigation. Many additional thousands of acres of land will soon be under cultivation. The

Egyptians will use artificial pesticides and fertilizers on that land. The environmental impacts of these changes are quite important on an international scale.

The Nile River study is a different example in terms of how EPA approaches program management. This overall program is under the principal technical direction of the University of Michigan with individual tasks directed by Egyptian scientists. Egypt is a country that has apparently something like five thousand American trained Ph.D.'s. Egypt is a big country and there's a lot of talent there. The Michigan team includes about twelve people. This program so far is funded totally with American-owned Egyptian pounds by EPA. There is some possibility of additional dollar support from either EPA or private foundations. The five-year program just started on the first of March 1974.

This covers part of what EPA is doing abroad. I reviewed with you a few actual examples. The scale of our international research programs is on the range of around 20 million dollars ($5 million annual level of effort) at this point. To the extent possible, we base our programs on finding competent foreign scientists, then we try to find ways to back them up with U.S. institutions and U.S. capabilities. If I had to say what they wanted most from America, I think, it would be that they want the relationship with the American scientists more than they want the money. We have also found that when you're supporting a good institution--the kind of things that you want to support are the things that they are also interested in. We try to help them do this better and use the results in our own programs.

# MARINE SCIENCE ACTIVITIES OF THE SMITHSONIAN INSTITUTION

R.P. HIGGINS

Unlike the preceding organizations represented so far in today's presentations, the Smithsonian Institution is not a government agency, nor is it just a museum on the mall. It is an independent establishment under a Board of Regents which was created when James Smithson entrusted his fortune to the Congress of the United States for the "increase and diffusion of knowledge among men."

The Institution, as distinguished from executive agencies of the government, assumes a dual role in being both private and governmental.

The Smithsonian, therefore, performs research, educational and other special projects supported in part by grants and contracts from governmental and private sources. The first part of my remarks relate specifically to foreign assistance elements that are supported by Smithsonian funds, not from outside grants, AID contracts or other organizations.

The Marine Science activities of the Smithsonian Institution are under the jurisdiction of the Assistant Secretary for Science. Liaison of oceanographic research within the Institution proper, and between institutional and governmental agencies, is provided by the Oceanography and Limnology Program, now a part of a new office called the Office of International and Environmental Programs.

Within the Institution there are approximately seventy-five federally employed professional marine scientists, most of whom are involved in systematics and ecology of marine organisms and investigations of biological and geological phenomena of marine environments.

Support services are provided in sampling, sorting, identification, curation, and data management of natural history specimens. The primary bureaus, centers, and offices of the Smithsonian Institution involved in marine science activities are the National Museum of Natural History; the Oceanography and Limnology Program, which operates both the Smithsonian Oceanographic Sorting Center in Washington, and the Mediterranean Marine Science Center in Khayr Ad Din, Tunisia; the Chesapeake Bay Center for Environmental Studies; the Smithsonian Tropical Research Institute (Canal Zone); and privately funded Fort Pierce Bureau (Florida).

Of these organizational units, the first three have activities relevant to the topic of Marine Science Technical Assistance programs. I am going to preface all the further remarks by pointing out that, in fact, no unit of the Smithsonian Institution has a specific program in Marine Science Technical Assistance in the generally accepted use of this phraseology. Technical Assistance is in the form of both a personal and a programmatic desire to help counterpart colleagues and organizations improve their capabilities in marine science activities. Most of these activities are related to a natural history orientation rather than physical and chemical oceanographic marine science.

The Smithsonian scientists for the most part operate as academically oriented independent investigators, whose interests are not necessarily in the applied nature of the scientific problem but are directed toward the basic research aspects of the problem. The Smithsonian scientist's mode of operation with colleagues is to share

in the project planning, funding, use of equipment and facilities, and in the actual research process and its resulting information.

Educational opportunities and research opportunities are available to scientists from foreign states through a special program that is administered by the Smithsonian's Board of Academic Studies.

The Smithsonian encourages the fullest practical use of its facilities, its staff specialties and reference resources by visiting scholars and scientists. The Institution particularly encourages the appointment of visiting investigators who seek research training supplementary to their own university instruction on a pre-doctoral and post-doctoral level.

For the purposes of research training, the Institution offers a small number of fellowships for the support of visiting investigators at Smithsonian facilities. These fellowships are awarded for not less than six nor more than twelve months. As a general rule, the twelve-month fellowships are not renewable. Applications for renewal must be considered competitively with all new applications. Applicants must propose to conduct research in some field in which the Smithsonian has particular research strength, and must offer a specific and detailed research proposal indicating clearly why the Smithsonian is the best place to conduct the work proposed. Fellowships are granted only to investigators pursuing research training in the Smithsonian facilities and with Smithsonian staff members, and are not granted to support research outside of the Smithsonian and its facilities. Fellows are expected to spend their tenure in residence at the Smithsonian except where arrangements are made for a short period of field work or research travel.

We also have a rather flexible program of research and study in our facilities and with staff members for a variety, other than pre- and post-doctoral investigators.

Individuals may engage in supervised research on projects either proposed by them or by the Smithsonian staff members. Each individual's capacity to pursue independent research at the Smithsonian will depend on his background and training.

Primarily through the use of its allocation of PL480 special foreign currency funds which is equivalent to some 4 1/2 million dollars a year, the Smithsonian provides funding for cooperative projects in subject areas which include marine sciences. These are basic research projects for the most part, and they must include a U.S. scientist principal investigator, in collaboration with a counterpart co-principal investigator, in one of the several countries where such funds remain available. Over the past ten years, approximately 3 million dollars in foreign currency funds has been used in such marine science programs involving U.S. scientists, whether they were members of the Smithsonian staff or scientists from academic institutions, or combinations of these two, with their counterparts in such countries as Ceylon, India, Israel, Morocco, Pakistan, Yugoslavia and Tunisia.

The primary users of these funds within the Smithsonian Institution are the National Museum of Natural History and the Oceanography and Limnology Program of the Office of International and Environmental Programs.

Perhaps the most significant project using these funds is the Mediterranean Marine Sorting Center located in Khayr Ad Din, Tunisia. Patterned after the Smithsonian's Oceanographic Sorting Center here in Washington, the Mediterranean Marine Sorting Center processes marine biological specimens in support of regional marine science programs--not merely those of the U.S. and Tunisian governments. This center is a biological center for an international program called the Cooperative Investigations of the Mediterranean.

In addition to the sorting process, the Center functions to provide a reference collection of Mediterranean marine biota. Specimens are, by agreement, shared by the local museum and the U.S. National Museum and part of these reference collections are sent to other museums in Europe, as requested.

U.S. scientists, as well as scientists throughout the entire world, are brought to the Center as consultants and/or researchers to assist in some of the local problems as is practical, and to help identify the specimens in these reference collections. In most instances, however, the collections of assorted specimens are sent out to expert scientists at their request. Upon completion of the research and/or subsequent identification of the specimen, suitable portions are returned and then shared by the cooperating U.S. and host country institutions.

In this process, the Center provides limited training for technicians from developing states mainly from within the region. The training is primarily in the processing and management of marine biological collections and data. The center works closely with UNESCO in this area. We hope to cooperate with the government of Egypt in developing a more advanced reference collection and research program at Alexandria. We are working on another program similar to this with the government of Pakistan.

Using this particular Center in the Mediterranean as an administrative and logistical support facility, scientists from the National Museum of Natural History, as well as scientists from U.S. universities who have in turn received financial support from the Smithsonian Foreign Currency Program, conduct basic research with their counterpart scientists. The basic research provides as much technical assistance in the form of training,

supplies, and equipment as can be justified by the research project, but the orientation of these projects, I must repeat, is not necessarily in terms of foreign assistance.

In the case of the Mediterranean Marine Sorting Center we hope that we have assisted in the formation of a permanent organizational structure within this region. Upon the expiration of available funds, or the agreement under which the Center operates, it is the Smithsonian's intent to turn over all PL480-purchased equipment and facilities to the collaborating institution for the continuation of this program in its present form, or whatever form is preferred. Also, we have been discussing the possibility of the United Nations Environmental Program using this Center as the basis of an International Environmental Monitoring Center for the Mediterranean region.

It is also conceivable that the services, provided for this program to date by our foreign currency funds might be offered to the region under contract funding and thereby provide a continuing service for marine scientific research in the region, especially environmental monitoring activities, and in turn provide a source of revenue for Tunisia.

Another bureau of the Smithsonian Institution which plays an important role in marine research assistance to foreign states is the Smithsonian Tropical Research Institute. With two marine laboratory facilities at either end of the Panama Canal, and a staff of several prominent marine scientists, the expertise and facilities of this bureau cooperate with the governments of Panama and Colombia, their local universities, museums and other scientific organizations. Agreements with both governments have been drawn up and are expected to be signed shortly. In addition to their research, several post-

doctoral research fellows of this bureau and its staff members have taught formal courses at the University of Panama.

Construction and purchase of physical facilities in the sense of real property is not generally allowed by the foreign currency programs the Smithsonian operates; however, a project now under consideration is contemplating the purchase of a small research vessel or the rental of a research vessel for oceanographic work. Some years ago, the Smithsonian was encouraged by special foreign currency countries to use these funds in the modification of a Smithsonian vessel, but our assumption that these funds could be used to support the research operation of the vessel was unfulfilled without any official reasons being given. However, we assumed that the reasons for failure included the undesirable necessity of converting local currency for the purchase of fuel and other commodities, which the country must obtain by using its hard currency salary components augment the local currencies in terms of the operation of the vessel on an international basis rather than within territorial limits; and there were also a myriad of politically sensitive issues as well. So this did not turn out to be very practical.

In the long run, if I were to summarize the Smithsonian's primary difficulties in operating with PL480 currencies, I would categorize them as follows:

First of all, difficulties in acceptance by the host country that these funds, unlike "Foreign Aid," are intended for our use in the host country in cooperation--and there is the key word--in cooperation with counterpart scientists and their institution. And here as Herb Quinn has mentioned, we <u>do</u> find that the scientists themselves desperately want <u>to</u> work with us as we do with them, and this makes it all really worthwhile.

Secondly, difficulties which arise when we, the Smithsonian Institution, by Congressional restriction cannot supplement the project with federal funds. Several spokesmen of countries where we have pursued the use of these funds have told me that the use of these funds can only be achieved by adding a dollar component because other "agencies" do this and other "governments" do this.

About the only way we can counter such arguments is to point out that we are providing a salary in dollars for Smithsonian employed participants and the universities using the PL480 funds are also being funded salary-wise by their universities.

Third, difficulties in finding technical expertise capable of carrying out tasks of the project itself.

And lastly, perhaps, difficulties in justifying basic research with or without practical applications.

Now the Smithsonian Institution also has capabilities within the same bureaus of providing elements of assistance--technological assistance--primarily in reference collection assistance, museum technology, partially due to the National Museum Act and through contract funded assistance. We do have some programs supported by U.S. AID programs and UNESCO. For example, the Smithsonian Oceanographic Sorting Center has provided some support to the Mexican Sorting Center, partially with our funds, and partially with UNESCO funds.

# AID'S ACTIVITIES IN MARINE SCIENCE

W. LITTLEWOOD

AID, the Agency for International Development, is an agency with declining resources. The Congress seems to have less and less interest in assisting developing countries, and you may have noted an article in the March 22, Washington Post, entitled "AID Battle Reopens in Congress." I'll just quote one short paragraph:

> "At stake is an American commitment to provide $1.5 billion over four years for the International Development Association of the World Bank, the main source of loans for the poorest nations."

AID has lost 28% of its direct hire personnel in the last three and a half years; its financial resources, which flow from the Congress, have declined similarly. There is no sign of any upturn, and therefore, as you might expect, the agency's focus has turned toward saving those programs which are more or less half finished. It is difficult to elicit interest in starting new programs in such a climate.

AID has, consequently, had to narrow its priorities in this declining situation of fewer people and funds to work with. The Congress has concurred with our current priorities. We are more or less locked into them.

These priorities that AID has now, and which will continue over the next few years, I'm sure, are food, that is, feeding the developing countries; health, including nutrition; family planning; and education--by education I mean education at the lower levels, literacy for example, or utilizing innovative educational methods.

In addition, there is a smaller program permitted for some other selected activities. My office-- the Office of Science and Technology--is involved in these, and we're also having our own difficulties with budget and personnel cuts, I assure you. We include in our program science policy development; natural resource development, and under this natural resource category we keep at least a finger in the field of oceanography; public works technology, such as housing and communication; small scale industry development; and environmental quality improvement.

There is also some activity in the Agency on the topic of disaster relief.

One should also remember that AID contributes to many international organizations, like the UNDP and the OAS. We don't have much to say about how these funds are utilized. They are generally included in AID's total funds flowing from the Congress, go on to the Department of State, and then finally to the international organizations.

In the past, when our financial and other resources were a little better off, we had more activities in marine science than we have now, on the horizon. I'll briefly describe some of these activities, and if anybody is interested in more detail on any particular item, they can see me after this session, and I'll be happy to provide a summary page on the activity.

Let me run through some of the things we have been doing. In 1971 AID gave a special one-time, $450,000, grant to the Organization of American States for the pur-

chase of oceanographic instrumentation requested by marine institutions in Colombia, Mexico, Venezuela and Argentina. We and the OAS agreed on several conditions for that grant. We asked that NOAA's National Oceanographic Instrumentation Center (NOIC) be employed to assist these Latin American institutions in finding the best instruments for the various oceanographic jobs they wanted to do. NOIC should also make sure that the instruments were calibrated, and that the people who were going to operate these instruments were trained in their operation and maintenance. This program has been completed, and I think it has proved quite successful.

I believe that Lou Brown has mentioned the recent program, "Training in Acquisition, Processing, and Utilization of Oceanographic Data." This was a program run by the National Oceanographic Data Center (NODC), in collaboration with UNESCO and the IOC staff at UNESCO, but with the entire funding for the program, both to UNESCO and NODC, deriving from AID. The program consisted of consecutive sessions of about five months each of training, primarily in the processing of oceanographic data. The first three sessions were sponsored by AID as demonstration and experimental sessions, and included the training of twenty-three students from sixteen developing countries. Many of those countries have already started to establish their own oceanographic data centers. I think Lou Brown mentioned that a fourth session last autumn was sponsored by IDOE funds, and personally I am hoping that NOAA will ask IDOE again for money for a fifth session next autumn.

It's interesting to note that at one of the recent IOC working group sessions, a Russian delegate after hearing some laudatory remarks about this data processing program, said that the Soviet Union would like to establish a similar program in 1974 or 1975. From our viewpoint, we have no objection to their doing this. We only hope, as

I mentioned, that there will be one more U.S. sponsored session to fill in the interim, as I suspect the Soviet bureaucracy will not move by 1974.

Some of you may know of AID's earlier trials and tribulations with "FPC", fish protein concentrate. It has left a somewhat bad taste in the mouth of the AID bureaucracy, even though FPC is supposed to be tasteless. But I don't think there's time to go into this history. There is a remnant FPC program in Chile, however, and some FPC activity has been transferred to UNIDO, with some work in Morocco. But essentially the FPC experiment was a failure from AID's viewpoint.

AID has contributed to a U.S. Geological Survey tectonic mapping program in East Asia, centered around Indonesia. AID has also contributed in past years to Dr. K.O. Emery's services to the CCOP, the "Coordinating Committee for Offshore Prospecting," of ECAFE, the Economic Committee for Asia and the Far East, a regional United Nations organization. The CCOP is now under UNDP (United Nations Development Program) funding. I understand the CCOP program has been going very well, and K.O. Emery's contributions were the key to its success.

AID has contributed $200,000 to the establishment of the Southeast Asian Fisheries Development Center, located near Bangkok. "SEAFDEC" is the acronym. The organization is essentially designed to train fisheries boat captains and engineers. A related research center is located in Singapore.

Under a contract with the National Academy of Sciences, AID finances S&T workshops in various developing countries on many different topics, depending upon what is desired by the developing country. Several of these workshops have been in the marine area. There has been one in Chile, one in the Philippines, and one in Taiwan, all focused wholly or partly on oceanography.

AID has a "participant training" program for people from developing countries. The developing country, acting through the local AID mission, asks for the training either short, medium, or long-term. Such training may be on almost any subject, meaning that a certain percentage, about one percent, falls in the fisheries area. About forty people a year on the average get marine fisheries training in the United States under AID sponsorship. It is difficult to enlarge this program, because as I said, it depends on the interests of the developing country which must request the specific training in the United States.

AID also has a program utilizing the personnel of the National Marine Fisheries Service of NOAA as short-term experts to assist developing countries. This program has been particularly useful in Viet Nam and Korea.

AID has a program of institutional grants to American institutions, spoken of as "211(d)" grants ["211(d)" is the section of the Foreign Assistance Act that authorizes such grants]. Their purpose is to strengthen a U.S. institution's capabilities so that it might become a world center of excellence, particularly oriented toward the needs of developing countries.

I think I can give an illustration of the 211(d) grant concept. Auburn University has for many years been working on the raising of catfish in the State of Alabama. This has benefited the people of the State of Alabama, and therefore state funds are used to support the program. So Auburn has developed into a local center of excellence in this particular field of fish farming, or "aquaculture"; other states in the area have drawn upon its expertise. AID then gave Auburn a 211(d) grant so that it might expand it capabilities to be useful also to developing countries, by exchanges of people, by learning about aquaculture and its problems and potentials in developing countries, by being able to provide expertise, by build-

ing up its specialized library and expanding its research program, that is, including research on non-U.S. tropical fish like *tilapia* or milk fish.

Auburn's work is really about 99% freshwater aquaculture. Technically, its expertise is useful in salt water aquaculture, too. But rather than speak further about Auburn as an illustration of the 211(d) concept, I'd rather report on the oceanographic 211(d) program at the University of Rhode Island.

In 1969, AID gave a five-year 211(d) grant to the University of Rhode Island, and there are good possibilities in 1974 of a three-year extension. The grant was to assist the university in developing a program of training and education for both developing and developed country students to learn such subjects as development and marine resource economics, marine biology, oceanography, ocean engineering, fisherman training, fishing gear research, marine food technology, and marine resource extension work. This AID grant has been the back-bone of the development of the University's International Center for Marine Resource Development.

AID several years ago sponsored an environmental study by the Smithsonian Institution, and this project included a study of the Indonesian coastal areas, particularly the environmental effects of oil production from the offshore areas of Indonesia.

I think Lou Brown, mentioned the "SEED" travel grant program at NSF--Scientists and Engineers in Economic Development. (We sure live in a world of acronyms!) SEED has included several people working in oceanography. In the last couple of years there has been one oceanographic SEED grantee to Ecuador, one to Indonesia and one to Chile. All funds for this program are provided by AID.

We also try to do some other activities which essentially require time, not funds (usually my time, which must be split among many other duties). I can report two successes in recent years in this area. One is successful encouragement to NOIC to establish an international component in the NOIC program. The U.S. Government was able to announce to the IOC last spring that NOIC was prepared to give without charge advice on oceanographic instrumentation to any country that desired it, and that NOIC could also perform calibration, testing and training services on a cost-reimbursable basis.

The other success was in encouraging the Navy Department to transfer some mechanical bathythermographs, for which they had little use, to the NOIC, and the NOIC in turn to make them available to needy developing country marine institutions, as well as to American institutions. Acting through the IOC, we promised at least 100 bathythermographs to developing countries. We then asked the IOC to make a survey of which developing countries needed them, and for what purpose. I have learned just recently that the survey responses totaled requests for 265 BT's. NOIC appears to be able to provide the additional 165 mechanical bathythermographs to fulfill all requests.

Now, looking toward the future, I hoep, I indicated at the beginning of this report that things are not very promising from an AID outlook. Under our AID guidelines to concentrate on food, health, education, and family planning, you can see that there isn't too much rationale from a parochial viewpoint for making a good case for oceanographic projects. The one area where we can perhaps do something more is the area of aquaculture, but this really means primarily freshwater aquaculture. Another recent focus that the Congress has given to us is that more attention be given to the rural farmer, the poorest of the poor, in the developing countries. (The rural farmer, by the way, represents 60 to 80 percent of

the populations of most developing countries.) Again, it is difficult to relate marine science to the problems of the rural farmer.

Meanwhile, we've had some good "oceanographic assistance" ideas, but we really don't know how we can implement them given our recent priorities and our general shortage of funds. We've thought of suggesting and assisting the establishment of a regional marine resource and oceanographic training center somewhere in Latin America either as a centralized or decentralized institution. Something that appeals to me after monitoring the successful experience of NOIC working with the OAS in the area of improved oceanographic instrumentation, is the concept of establishing regional, "mini-NOIC's" in the developing countries. In many cases, instruments given to or purchased by developing countries end up being misused or out of order because the manuals are in English, or they don't know how to calibrate them, leading to incorrect data, or in a few months the instrument doesn't work at all because it wasn't maintained or used properly.

I'm sorry to close on such a pessimistic note, but that's the way it is. I assure you that as far as my individual actions are concerned, I will look, for all opportunities within the agency to promote something in the marine science area. As far as I know, I'm the only oceanographer, albeit now a "paper oceanographer", in AID, but I do try to keep current with what is going on in marine science and to participate in governmental and in international oceanographic activities, as well as I can.

# THE BOLOGNA WORKSHOP ON MARINE SCIENCE

H.B. STEWART, JR.

In October of 1973, the Johns Hopkins School for Advanced International Studies with support from the Office of External Research of the Department of State sponsored a five-day Marine Science Workshop at The Johns Hopkins Center in Bologna, Italy. There, representatives from some twenty-two different nations met to exchange ideas on the needs and techniques for providing assistance in marine science to those countries that desire it.

The formal report, available from the Johns Hopkins School of Advanced International Studies here in Washington, lists some sixteen recommendations growing out of this workshop, and I would refer you to them. To those of you who have attended international conferences and tried to arrive at formal wordings that all members of an international drafting committee can agree to, the problems we encountered in preparing these recommendations are all too familiar. They are good recommendations, however, and hopefully they will be picked up both by developed and developing countries as well as by the several international and regional bodies concerned with assistance in marine science.

Today, however, I would like to give you my personal ideas on the results of the Bologna Workshop. My own conclusions stem from sitting in on all the plenary sessions, participating in some of the smaller concurrent discussion groups, and long luncheons and evening discussions with Asians, Africans, and Latin Americans.

Not everyone concurred in these ideas, but they seemed to reflect a general consensus of the majority of participants:

1. The development of a viable national marine science capability is not accomplished instantaneously. It is a long, slow process, but it can be considerably speeded up by capitalizing on the experience and capability of nations which have been involved in marine science longer and have advanced farther down the road toward an independence in their ability to deal effectively with the ocean and its resources.
2. "The Lord helps those who help themselves" is the way one speaker expressed the idea that a nation can not sit back and wait for an outsider to solve its marine science problems. Each nation must initiate its own efforts, establish national goals and priorities, hopefully obtain a national commitment to learning about its ocean and the resources it contains, and be willing as a nation to commit a portion of its own manpower and funding to this effort.
3. The marine science and technology needs of each coastal nation wanting to move ahead in this field must be carefully studied, evaluated, and documented. The international agencies may be the best means for accomplishing this, but the present marine scientists of the country must be involved in the elaboration of these national needs. Future requests for assistance must be relevant to meeting those national needs.
4. The universities in each nation, as the traditional fountainhead of knowledge, must be heavily involved in the national marine science program, for the role of the university is not only the imparting of knowledge but, in fact, the generation of new knowledge. Marine science also provides an intellectual stimulus and challenge that if properly met can provide the intellectual outlet that man as a reasoning being demands.

5. Although intellectual stimulation is an admirable national goal, for many countries it ranks on the list of national priorities well below those of adequate animal protein for a growing population, optimum of marine resources, and improvement of the national economic base and gross national product. The development of a sound scientific basis for meeting these needs must rest in the universities, and it is essential that they be a viable element of any national program in marine science.
6. The development of a marine science capability and the increase in the effective recovery of a nation's marine resources must go hand in hand, must proceed cooperatively together. This was not a unanimously agreed upon concept by any means. Those who disagreed felt "give us the fish and the oil, and we will worry about the science later." The general feeling, however, and examples were cited, was that any project involving off-shore resources--be they living or non-living--involved the accumulation of data that could contribute to the overall understanding of the systems and regimes that impact the resource. Developing understanding is the business of research, so the two are natural allies and should proceed together--resource development and management and research.
7. Numerous programs in the past between developed and developing countries as well as programs of international agencies carried out in developing countries have, upon their termination, left nothing behind. There was a complete consensus that local marine scientists and technicians must be heavily involved in any assistance program to the extent that they can carry on work when the formal project is completed.
8. No global solutions are possible, but rather each nation must be considered as a separate case with unique national needs, present capabilities, degree of national commitment, abundance of off-shore resources, and desire for assistance. These must all be considered in any plan for assistance.

9. Cooperation nationally among the university researchers in marine science and the non-university groups involved in oceanic affairs (navy, industry, fisheries agency, geological survey, weather bureau, foreign office, etc.) is essential if a firm basis for the receipt of bilateral or UN agency assistance is to be developed.
10. Means must be found for generating a marine enthusiasm among the students who are attracted to science and technology as their life work. Visiting lectures and berths on visiting research ships can contribute to this kindling of an oceanic interest.
11. National mechanisms must be developed whereby the leading marine scientists have a meaningful contribution to the formulation of national policies affecting the ocean and marine resources.
12. The major marine science need of developing countries appears to be the development of an adequate critical mass of manpower adequately educated and trained in technology to provide the base for intelligent resource management and recovery.
13. Although fisheries received the major attention among the possible recoverable marine resources, it was pointed out repeatedly that there are other reasons for nations to learn about the sea. These include mineral resources (oil, gas, sand and gravel, the minerals in manganese nodules, phosphorite, and dissolved minerals), the disposal of man's wastes (radioactive and others), weather forecasting, commerce, national defense, recreation, and providing an outlet for man's innate curiosity about the seas around him.
14. The results of an experiment of study offshore by any nation must be integrated into the local framework. This entails the providing of results in the form of data and/or published results as well as specimens for the local reference collection.

15. In general, assistance is more welcome from UN agencies than from bilateral arrangements, because the receiving nation is part of the agency itself, and the level of trust is higher than for bilateral arrangements in which there may be some degree of mistrust of the motives of the more developed country. However, bilateral arrangements are often preferable where there are social and political ties or where a particular and perhaps unique capability is desired.
16. Sophisticated and expensive equipment should be shared on a regional basis with the most advanced nation acting as the overseer.
17. Developing countries should be accorded the chance and provided with the ability to make their own decisions.
18. Developing countries do not need to start out with the sophisticated equipment in use in the more developed countries. If the degree of accuracy of a measurement is known, the degree of precision is less important.
19. Data *per se* are useful only as they contribute--through scientific endeavor--to knowledge. This reinforces the need for good university departments in marine science.
20. High priority should be accorded to the development of human resources, and this should probably be the first rather than nearly the last of this series of items on which there appeared to be general agreement.
21. Visiting "experts" must be carefully selected. Even though a developing country can benefit from even a visit of short duration, it is desirable to have these experts remain in the country for two to three years if maximum benefits are to be realized.
22. For the more developed countries that have some expertise, it is often more desirable to develop cooperative bilateral arrangements whereby they can carry out joint projects to the material benefit of both nations.

The twenty-two concepts are ones that either were generally agreed upon in the full meetings or in the working groups or in smaller luncheon groups. During the smaller working group sessions, there were some interesting ideas that surfaced; and even though they were not all brought up for general discussion I have selected four of these to be noted in a summary such as this one.

1. We appear to be concentrating heavily on the methods and techniques of obtaining assistance from the larger developed countries and UN agencies when in fact we can do a good deal to help ourselves on a regional basis. No two countries have developed their marine science capabilities in exactly the same manner and to the same degree. So each nation in a region should identify its own strongest areas in marine science and those of its neighbors and mutually arrange the exchanges or other mechanisms to insure the maximum effective transfer of these capabilities among the region. For example, Chile and Peru need not go to the United States for help in developing a seismology program when Colombia has a well developed effort in this field and in addition is more familiar with the South American area and has no language barriers.
2. Mutual assistance projects on an institute-to-institute basis developed through personal scientist-to-scientist contacts can be particularly useful and have the added advantage of avoiding the delays and constraints often associated with the usual negotiations between governments or with the international agencies.
3. If any of the developing countries finds itself in the almost enviable position of having over-produced marine scientists--that is, having more new Ph.D's than its own marine science community can absorb--every effort should be made to see that funding is provided so that these recent graduates can work for an extended period in the developing countries. Probably a U.N. agency such as UNESCO should act as the manager for any such program to insure that

national needs are matched to available personnel and to avoid the mistrust or feeling that ulterior motives are involved on the part of the assisting nation. Use of this possible manpower source through bilateral arrangements, however, should not be ruled out.

4. Senior scientists in other countries who are willing to assist foreign graduate students should be identified and put in correspondence with students working in their field of specialization. This would augment local university capabilities and would upgrade the research and thesis levels of graduate students through the providing of guidance by a recognized authority in the field, the providing of reprints and literature references, and the assurance that the research is scientifically meaningful. Particularly attractive is the fact that little or no funding is required.

In conclusion, we in the United States too often exhibit the marine science big-brother syndrome. We tend to feel we know what is best for the other country. It is for this reason that I feel it was extremely worthwhile to spend those few days in Bologna finding out what the potential recipients felt that they needed--and we did. I commend the Bologna Report to you and would urge that you keep its recommendations in mind in your own planning for assistance to other countries in the field of marine science.

# CRITERIA FOR SUCCESSFUL IMPLEMENTATION OF TECHNICAL ASSISTANCE IN THE MARINE SCIENCES

H.T. FRANSSEN

On various occasions and at various international forums, developing countries have expressed great interest in technical assistance in the marine and other sciences, in order to bridge the gap between the technological "haves" and "haves nots", and to improve the rational exploitation and management of coastal resources.

While the discrepancy between the science capabilities of the developed maritime powers and the developing countries is vast (see table 1), actual bilateral and multilateral aid (except for fisheries surveys) has been very small. Of all developed maritime nations only the United States has pledged technical assistance in the marine sciences at a meeting of the Preparatory Conference on the Law of the Sea in Geneva, on August 11, 1972. Its potential success will depend on Congressional action and on the outcome of the ocean science debate at the U.N. Conference on the Law of the Sea, which is scheduled to begin in Caracas, Venezuela, in June of this year.

Donor and aid-receiving nations alike are aware of the discrepancies in marine science capabilities, but few if any studies have been made to examine the needs and priorities of developing coastal states in relation to their actual and potential resources. The wealthy nations can afford to allocate sizeable resources on "science for the sake of science" programs. Developing countries on the

other hand have to consider short-term and medium-term economic and social spin-off, because of serious shortages of skilled manpower and capital.

Tables 2, 3 and 4 provide data on the comparative strengths and weaknesses in the marine sciences in more than seventy developing coastal states of Africa, Asia, and Latin America. Comparing committed resources of developing countries with those of even the smaller maritime powers reveals that the former are far behind in terms of available scientific personnel, technicians, research and development funds (R&D), research vessels, etc. Unfortunately available data are four to seven years old, but although actual capabilities will probably have improved somewhat, it is unlikely that the gap between the scientifically and technologically developed and developing nations has narrowed during the last few years.

Within the group of developing nations, Africa, and particularly Africa south of the Sahara, is least endowed with marine science facilities. Moreover, a recent OECD study showed that almost 70 percent of all scientists in this part of the world are expatriates from France, Britain and a few other western countries. Oddly enough, in spite of Africa's growing needs in the marine sciences, the continent has received much less aid than Latin America and Asia. Almost all developing countries are weak in ocean science, but most have at least a minor strength in fisheries research and/or marine biology. Physical and chemical oceanography have received less attention, and very few have any facilities to conduct marine geological and geophysical research. The uneven development is in part related to the colonial past, when administrators frequently established fisheries survey stations as part of their general resources development programs. Only much later, when major fisheries programs were developed, did the need for physical and chemical oceanography arise. During the colonial era, this research was usually conducted by scientist from the mother countries in their own home laboratories. Marine

G&G studies of the continental shelf, of great importance to indicate petroleum potential, involve large capital investments and very sophisticated techniques. Today, even few developed countries can boast to have a major capability in this area.

Comparing R&D expenditures in the marine sciences also reveals a significant gap between the scientific "haves" and "have nots". The seriousness of this gap becomes evident when comparing actual R&D outlays with the cost of developing the smallest possible "critical mass" of four scientists equipped with the most essential facilities, occasionally borrowing ship-time from the navy or other agencies. According to a 1965 study undertaken by Dr. Brodie of the New Zealand Institute of Oceanography for the Intergovernmental Oceanographic Commission of UNESCO, such a team of four scientists would cost at least $100,000 (1965 U.S. dollars) annually. About one-half of the countries listed in tables 2-4, spent less than this amount on ocean research in 1967. It should be noted that a critical mass of four scientists is the smallest possible size for a credible program in oceanographic research. Countries desiring to build up a a significant institution of marine science, with capabilities in all subfields, will need significantly more money and personnel. Larger institutions may need their own research vessels (it costs at least $500,000 annually to operate a vessel for coastal research in the U.S.), additional sophisticated equipment, funds to invite foreign experts and to send graduate and post-doctoral candidates to institutions abroad, and so forth.

Prior to committing scarce manpower and capital for the establishment of a marine science institute, countries need to examine priorities and opportunity costs. A first step in this direction would be to assess actual ocean activities (fishing, raw material development, etc.) and, with the assistance of outside expertise (bilateral or U.N.), survey potential ocean resources of the continental

shelf and of the superjacent waters out to at least 200 nautical miles. This would include all area of ocean space likely to become subject to national jurisdiction upon conclusion of the pending Law of the Sea Conference.

Tables 5-7 are an attempt to measure ongoing activities in the coastal waters of over seventy developing nations. To complete the resources survey, one could include tourism, production of sand, gravel, and placer deposits, and competitive land use of coastal wetlands. Few hard dara on oil and gas potential in these countries are available, but ongoing exploratory efforts and geological studies do provide some useful information. Annual maximum sustainable yield of coastal fisheries are usually not available on a country-by-country basis, but excellent regional studies have been made by the FAO. Aquaculture and mariculture potential in other areas than Asia are known to be significant, but there are few data on Africa and Latin America.

While in-depth studies of coastal resources of countries interested in building up a domestic marine science capability are essential, existing data already supply us with important information on a regional basis.

On the basis of available data we can draw some tentative conclusions. For example, studies indicate that the overall maximum sustainable yield of all fisheries in the Mediterranean is less than one million metric tons. While the various species caught all warrant careful studies, it does not seem necessary to establish fisheries and marine biology institutions in each one of the fifteen surrounding states. Instead, a few specialized regional centers of excellence could combine the resources of the region. Similar efforts to establish regional institutions in the Mediterranean could be made for geology and geophysics, physical and chemical oceanography. The common thread of eco-

catastrophe in a region as dependent on a 'healthy' sea as the Mediterranean could perhaps overcome the natural tendency to go-it-alone.

Another example of an area where research overlap should be minimized is the Caribbean sea. Fisheries resources in the area are too limited to warrant the establishment of more than one or two research institutions. According to Dr. K.O. Emery of the Woods Hole Oceanographic Institution, the potential for oil and gas in the Caribbean (except for Trinidad & Tobago, Cuba, and Venezuela) is very small. Emery has proposed to conduct a survey of the entire area, in cooperation with scientists from the Caribbean nations. The survey would eliminate very poor prospects from further studies, and could lead to substantial savings for those governments that otherwise might have invested in an indigenous marine G&G capability. On the other hand, tourism is among the most important sources of income of the islands. Hence, research related to marine pollution, beach erosion, competitive land use, etc., might turn out to be of great value to the region. The Caribbean nations are aware of their limitations in terms of skilled manpower and R&D funds, and efforts to establish a regional research institution were made during and following the Santo Domingo conference of 1972. Disputes over the location of the institute slowed down progress towards the establishment of the institute. At some point, it was suggested to consider a roving institution, moving from island to island.

Optimum use of scarce resources calls for regional centers of excellence, particularly for smaller countries. Unfortunately, experiences with regional efforts in areas other than the marine sciences, suggest that great difficulties must be overcome in order to expect success. Only regional institutions conducting "pure research", i.e. research conducted without practical applications in mind, have been successful, while regional efforts with a potential economic spin-off have a long history of failures.

In Europe, the only big regional research organization that has met with considerable success is CERN, an organization of European states engaged in nuclear research. The research in particle acceleration involved investments of hundreds of million dollars, with little expectation of economic spin-off.

Most other European cooperative research ventures have either failed or resulted in only marginal successes. The European space program, Euratom, the proposed high power data processing system, and other multilateral efforts with potential economic spin-off failed to meet expectations due to economic nationalism. Each participant insists on a *juste retour*, i.e. whenever a country pays in a certain amount of money, it demands purchases from the organization for an equal amount. As this was frequently impossible because of the different industrial infrastructures, nations pulled out of the organization or obstructed its efforts.

Hence, past experiences in regional cooperative science efforts suggest that research leading to practical applications is most difficult to coordinate and most likely to fail. As developing countries are primarily interested in applied research, successful development of regional marine science institutions of the kind they want, is not likely to succeed.

## Removing Bottlenecks

Not all developing countries are equally poorly endowed with marine science capabilities. While some conduct virtually no ocean research at all, others, like India, have developed a viable research organization. However, several bottlenecks stand in the way of further progress. India needs better training centers for marine technicians, more sophisticated laboratory equipment, foreign exchange to send scientists to conferences abroad and to educate graduate students abroad in

specialized fields. These and other bottlenecks could be removed by providing assistance. Some countries are well developed in some areas of oceanography, but are still underdeveloped in other fields. Other countries may need research vessels or foreign experts. Removing bottlenecks in countries with existing capabilities will improve overall research efforts significantly with proportionately little inputs.

## Science, Development, and Time-lags

There are some parallels between economic and scientific development. Economic development takes place in several stages, gradually moving from the "take-off" stage towards the final stage of self-sustained economic growth. Development of indigenous scientific and technological capabilities also follow several stages; from total dependence on foreign science and technology, to the development of an indigenous research capability, capable of making considerable contributions to existing knowledge and helping to solve the country's most pressing needs. To move from total dependence (much of Africa today) to the final stage, will take a few generations. While there are no short cuts as such, internal and external stimuli, such as war, disease, discovery of significant resources, but above all government commitment, can accelerate the otherwise very slow process. For example, in the field of oceanography, the International Indian Ocean Expedition, organized by UNESCO in the early sixties, did indeed accelerate the development of India's oceanographic capability.

## Need for Indigenous Research

Many economists have argued that rather than allocating scarce resources for the development of indigenous scientific institutions, developing countries

should instead rely primarily on imported knowledge. Aside from the fact that countries need at least some capability in the marine sciences and technology to evaluate nations, there are sound reasons for establishing domestic or regional research institutions.

In the first place, a great deal of research in the advanced nations is directed towards saving imported materials and unskilled labor. In developing countries, capital is usually the scarcest factor; labor and raw materials are frequently relatively abundant. Hence, capital-saving technology should be emphasized over labor-saving technology.

Aside from the need to acquire technical know-how to exploit ocean resources, nations want to know more about their offshore resources in order to improve management of fisheries and raw materials. In their efforts to gain economic independence, the developing nations consider it essential to control their natural resources. Knowledge of resources is considered a resource by itself. It is regarded as the first step in the direction of complete control over resources and ultimate economic independence.

Moreover, they frequently suspect research efforts by outsiders with an interest in the resources. For example, Indonesia has concluded a number of joint ventures in fisheries with Japan. The Indonesian government has little knowledge about the maximum sustainable yield of the various species in its internal waters. In order to determine how much fish should be caught annually, Indonesia will need a marine science capability. Because of Japan's poor record in forest development on Kalimantan, Indonesian officials are likely to suspect Japanese research efforts which might be geared towards serving Japanese fishing industry. Scientists from other

developed countries with little if any interest in these fisheries, are not likely to spend many years of research on essentially local phenomena.

Finally, successful development of the scientific and technological potential of developing nations depends on the interplay of the two forces. Scientific discoveries will reinforce technological capabilities, and *vice versa*. To narrow the gap between the developed and developing coastal states in marine science and technology, the latter need to acquire basic capabilities in both.

Table 1

Annual Expenditures for Marine Research, Number of Scientists Employed, Number of Research Vessels over 15 Meters.

| | R&D | Scientists | Vessels |
|---|---|---|---|
| United States | $. 438,000,000* | 2,000 | 118 |
| Canada | 38,550,000 | 509 | 22 |
| United Kingdom | 25,000,000 | 650 | 28 |
| France | 24,000,000 | 475 | 18 |
| U.S.S.R. | 18,000,000 | 1,600 | 110 |
| Japan | 10,000,000 | 1,600 | 42 |
| West Germany | 8,000,000 | 300 | 17 |
| Netherlands | 3,780,000 | 95 | 8 |
| Australia | 2,300,000 | 85 | 8 |
| South Africa | 2,100,000 | 78 | 12 |
| Thailand | 2,090,000 | .. | 5 |
| Norway | 2,003,000 | 95 | 9 |
| New Zealand | 1,793,300 | 71 | 5 |
| Portugal | 1,330,000 | .. | 10 |
| Mexico | 1,304,000 | 67 | .. |
| Venezuela | 1,060,000 | .. | .. |
| Sweden | 872,000 | 50 | 9 |
| Monaco | 816,000 | 50 | .. |
| Iceland | 776,326 | .. | .. |
| Chile | ..... | 113 | .. |
| China | ..... | 81 | .. |
| Argentina | ..... | 70 | 10 |
| Peru | ..... | 70 | .. |
| Austria | ..... | 45-65 | .. |
| Denmark | ..... | .. | 11 |
| Poland | ..... | .. | 10 |
| All other Asian Countries | 788,300 | 48 | 15 |
| All other African Countries | 679,200 | 196 | 6 |
| All other Latin American Countries | 1,466,498 | 64 | 6 |

Source: United Nations, Ecosoc, Marine Science and Technology: Survey and Proposals, Report to the Secretary-General, New York 24, 1968, pp.35 and 36.

* U.S. research expenditures include capital outlays for research vessels. This accounts for the much higher figure.

Table 2

| Country | Ocean Scientists | Research Activities Phy. | Che. | Bio. | G&G. | Fish. | Vessels | Research Exp. (1967, $.US) |
|---|---|---|---|---|---|---|---|---|
| Algeria | 13 | | | x | x | | | |
| Cameroon | 1 | | | | | | | 20,400 |
| Congo (Brazza) | 8 | | | | | | 1 | |
| Dahomey | 4 | | | | | x | | 20,400 |
| Egypt | 33 | x | x | x | x | x | 1 | |
| Ethiopia | | | | | | | | No research org. |
| Gabom | | | | | | | | No research org. |
| Gambia | | | | | | | | No research org. |
| Ivory Coast | 12 | x | | x | x | x | 1 | 490,000 |
| Ghana | 5 | x | x | x | | x | 3 | 100,800 |
| Guinea | | | | | | | | Insignificant |
| Kenya | | | | | x | | | |
| Liberia | | | | x | | | | |
| Libya | | | | | | | | No research org. |
| Malagasy Rep. | 14 | x | x | x | | x | 1 | |
| Mauritania | | | | | | x | | |
| Mauritius | 3 | | | x | | x | 3 | |
| Marocco | 6 | | | x | | x | 1 | |
| Nigeria | | | | x | | x | 3 | |
| Senegal | | | | | | x | 1 | |
| Somalia | | x | | x | | x | 2 | |
| Sierra Leone | 4 | x | x | x | x | x | 2 | 28,000 |
| Sudan | 1 | | | | | x | 1 | 28,700 |
| Togo | | | | | | | | No research org. |
| Tunesia | 7 | | | x | | x | 1 | 100,000 |
| Tanzania | | | x | | | x | 1 | |

Table 3

| Country | Ocean Scientists | Research Activities Phy. | Che. | Bio. | G&G. | Fish. | Vessels | Research Exp. (1967, $.US) | |
|---|---|---|---|---|---|---|---|---|---|
| Argentina | 70 | x | x | x | x | x | 11 | 285,700 | Strong on bio.+phy. |
| Barbados | 2 | | | | | x | 1 | | |
| Bahamas | | | | x | | | | | Small US inst. |
| Brazil | 137 | x | x | x | x | x | 12 | | Strong inbio. +f |
| Chile | 113 | x | x | x | x | x | 4 | 67,800 | |
| Colombia | | | | x | | x | 1 | | |
| Costa Rica | 1 | | | x | | | 1 | | |
| Cuba | 13 | | x | x | | | 9 | 390,398 | |
| Dom. Republic | 2 | | | | | | | | |
| Ecuador | 12 | | | x | | x | 1 | 200,000 | |
| El Salvador | 2 | | | x | | | 1 | | |
| Guatemala | 2 | | | | | | | | |
| Guyana | | | | | | | | No research org. | |
| Haiti | | | | | | | | No research org. | |
| Honduras | | | | | | | 1 | | |
| Jamaica | 5 | | | x | | | 1 | | |
| Mexico | 67 | x | x | x | | x | 1 | 1,304,000 | |
| Nicaragua | | | | | | | | No research org. | |
| Panama | 6 | | | x | | | 1 | | |
| Peru | 70 | x | x | x | x | x | 2 | 499,600 | Primarily Bio. |
| Trinidad&Tobago | | | | | | | 1 | | |
| Uruguay | 11 | | | x | | x | 1 | 23,000 | |
| Venezuela | 24 | x | | x | x | | 10 | 1,060,000 | |

Table 4

| Country | Ocean Scientists | Research Activities Phy. | Che. | Bio. | G&G. | Fish. | Vessels | Research Exp. (1967, $.US) |
|---|---|---|---|---|---|---|---|---|
| Burma | | | | | | | | No research org. |
| Cambodia | 1 | | | | | x | | |
| China, Rep. of | 19 | x | x | x | | x | 3 | 175,000 |
| China, Peoples Rep. | 28 | | | | | | 2 | |
| Cyprus | 4 | | | | | x | | 22,400 |
| India | 161 | x | x | x | x | x | 19 | Strongest in bio.r. |
| Indonesia | 40 | x | | x | | x | 4 | 26,300 |
| Iran | 1 | | | | | | | |
| Israel | 20 | x | x | x | x | x | 2 | |
| Korea, Rep. of | 50 | x | x | x | x | x | 9 | Strongest in bio.r. |
| Kuwait | | | | | | | | No research org. |
| Lebanon | 4 | | | x | | x | | |
| Malaysia | 5 | | | x | | x | 1 | 80,000 |
| Pakistan | 46 | x | | x | | x | 9 | |
| Philippines | 36 | | | x | | x | 5 | 96,300 |
| Thailand | 26 | x | x | x | x | x | 11 | 2,090,000 |
| Saudi Arabia | 2 | | | | | x | | 6,000 |
| Singapore | 6 | x | x | x | | x | | 41,000 |
| Sri Lanka | 14 | | | x | | x | | |
| Syria | 1 | | | x | | | | |
| Turkey | 23 | | | x | | | 5 | |
| Vietnam, Rep of | 30 | x | x | x | x | x | 2 | 134,000 |

Sources: F.A.O., doc. FRV/T93, Rome, 1969; F.A.O., doc. FR:FRC/68/WP-GEW, Rome, 1970; F.A.O., International Directory of Marine Scientists, Rome, 1970

United Nations, Ecosoc, doc. E/4487, New York, April 24, 1968, annex V, pp. 1-8

Table 5

| Country | World Catch Per Country--1971 A | B | C | D | E | F | G | Imp/ Exp. | Fish landings in US dollars | Aquac. (Ton) | Oil and Gas Prod. Expl. (Offshore) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Algeria | | | | | | x | | E | 7,397,000 | | | |
| Cameroon | | | | | x | | | I | 7,338,000 | | | x |
| Congo, Rep. of | | | | | | x | | I | | | x | x |
| Dahomey | | | | | | x | | I | 6,189,000 | | | x |
| Egypt | | | | | x | | | I | | | x | x |
| Ethiopia | | | | | | x | | I | | | | x |
| Gabon | | | | | | | x | I | | | | |
| Gambia | | | | | x | | | | 696,000 | | | |
| Ivory Coast | | | | x | | | | I | 14,723,000 | | | |
| Guinea | | | | | x | | | | | | | |
| Kenya | | | | | x | | | I | 4,248,000 | 122 | | |
| Liberia | | | | | x | | | E | 6,116,000 | | | |
| Libya | | | | | x | | | I | 5,156,000 | | x | x |
| Malagasy Rep. | | | | | x | | | E | | 615 | | x |
| Mali | | | | | x | | | | | | | |
| Mauritania | | | | | x | | | E | | | | |
| Mauritius | | | | | | | x | I | | | | |
| Marocco | | | | x | | | | E | 18,691,000 | | | x |
| Nigeria | | | | x | | | | I | | 127 | x | x |
| Senegal | | | | x | | | | E | 48,345,000 | | | x |
| Somalia | | | | | | x | | E | | | | |
| Sierra Leone | | | | | | x | | I | 4,316,000 | | | |
| Sudan | | | | | | x | | I | | | | |
| Togo | | | | | | x | | I | 1,060,000 | | | |
| Tunesia | | | | | | x | | E | 12,993,000 | | | |
| Tanzania | | | | x | | | | E | 15,702,000 | | | |
| Zaire | | | | x | | | | I | | 1,406 | | x |

Table 6

| Country | World Catch Per Country---1971 A | B | C | D | E | F | G | Imp/ Exp. | Fish landings in US dollars | Aquac. (Ton) | Oil and Gas Prod. Expl. (Offshore) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | | | | x | | | | I | 20,208,000 | | | x |
| Barbados | | | | | | | x | E | 968,000 | | | |
| Bahamas | | | | | | | x | E/I | 1,543,000 | 9,967 | | x |
| Brazil | | | x | | | | | I | 98,195,000 (1969) | | x | x |
| Chile | | x | | | | | | E | 27,386,000 (1967) | | | |
| Colombia | | | | | x | | | I | 20,541,000 (1967) | | | x |
| Costa Rica | | | | | | x | | E | 4,773,000 | | | |
| Cuba | | | | x | | | | E/I | 28,830,000 (1967) | | | |
| Dom. Republic | | | | | | | x | I | N.A. | | | |
| Ecuador | | | | | x | | | E | 10,103,000 | | x | x |
| El Salvador | | | | | | x | | E | | | | |
| Guatemala | | | | | | x | | E | | | | |
| Guyana | | | | | | x | | | 13,354,000 | | | x |
| Haiti | | | | | | | x | | | | | |
| Honduras | | | | | | | x | E | | | | x |
| Jamaica | | | | | | x | | I | | | | |
| Mexico | | | x | | | | | | 95,052,000 | 53,467 | | x |
| Nicaragua | | | | | | | x | E | 9,629,000 | | | x |
| Panama | | | | | | | x | | | | | |
| Peru | x | | | | | | | E | 187,210,000 | | x | x |
| Trinidad & Tobago | | | | | | x | | | 6,830,000 (1968) | | x | x |
| Uruguay | | | | | | x | | E | 881,000 | | | |
| Venezuela | | | x | | | | | E | 28,862,000 | | x | x |

Table 7

| Country | World Catch Per Country--1971 A | B | C | D | E | F | G | Imp/ Exp. | Fish landings in US dollars | Aquac. (Ton) | Oil and Gas Prod. Expl. (Offshore) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Burma | | | | x | | | | E | 80,065,000 | 1,494 | | x |
| Cambodia | | | | x | | | | E | 43,985,000 (1968) | 5,000 | | |
| China, Rep. of | | | x | | | | | E | 208,758,000 | 68,945 | | x |
| China, Peoples Rep. | x | | | | | | | | | 2,240,000 | | x |
| India | | x | | | | | | | 341,900,000 | 483,800 | | |
| Cyprus | | | | | | | x | I | 1,543,000 (1967) | | | |
| Indonesia | | x | | | | | | E | | 144,403 | x | x |
| Iran | | | | | | x | | E | | | x | x |
| Iraq | | | | | | | x | E | | | | |
| Israel | | | | | x | | | I | 15,010,000 | 10,220 | | x |
| Korea, Rep. of | | | x | | | | | E | 282,826,000 | 99,040 | | x |
| Kuwait | | | | | x | | | E | | | x | x |
| Lebanon | | | | | | | x | I | 4,107,000 | | | |
| Malaysia | | | | x | | | | E | 114,460,000 | 54,498 | | x |
| Pakistan | | | | x | | | | E | 238,299,000 | 37,540 | | |
| Philippines | | | x | | | | | I | 650,835,000 | 97,073 | | x |
| Saudi Arabia | | | | | | x | | | | | x | x |
| Singapore | | | | | | x | | I | 7,084,000 | 674 | | |
| Syria | | | | | | | x | I | 2,419,000 | | | |
| Thailand | | x | | | | | | E | 260,600,000 | 90,264 | | x |
| Turkey | | | | x | | | | E | | | | x |
| U.A. Emirates | | | | | | | | | | | x | x |
| Vietnam, Rep. of | | | x | | | | | I | 122,238,000 (1966) | 16,500 | | x |
| Yemen, Rep. of | | | | | | | | E | | | | |

Tables 5, 6, 7

A = 5,000,000 tons of fish or more

B = Between 1,000,000 and 5,000,000 tons

C = Between 500,000 and 1,000,000 tons

D = Between 100,000 and 500,000 tons

E = Between 50,000 and 100,000 tons

F = Between 5,000 and 50,000 tons

G = Between 1,000 and 5,000 tons

Imp/Exp.: I = net importer

E = net exporter

I/E = imports and exports almost equal

Figures include both marine and fresh water fisheries

Sources: F.A.O. Yearbook of Fisheries Statistics, Rome, 1972
F.A.O., FI:FMD/73/S-47, pp. 21 and 33.
John P. Albers, et al., Summary Petroleum and Selected Statistics for 120 Countries, Including Offshore Area, (Washington, D.C.: Government Printing Office, 1973).

# PLANNING OF THE BOLOGNA WORKSHOP

A. HOLLICK

I am part of a group of social scientists--specifically a political scientist--and my relation to the topic today stems from my involvement in the management of the Johns Hopkins University Marine Science Workshop held at its Bologna Center. In addition, I have followed the Law of the Sea negotiations for some years. And thirdly, I have had some experience, living in Asia, with the results of Technical Assistance and training--in Sri Lanka in this case.

Harris Stewart has comprehensively and concisely covered the substantive results of the Marine Science Worshop. All I can add is some information regarding the way the Workshop was conducted. I should point out that although thirty-one scientists and ocean resource experts from twenty-two countries participated, the process preceding the selection of those people was fairly comprehensive. Final participants were chosen from a group of over 100. We were assisted in the initial complilation of names by foreign delegates working on Law of the Sea, by U.S. officials, and by scientists in this country and in other countries. Then we had the awesome task of reducing the group in size, keeping in mind the desirability of an equal number of people from each region. We would have more nearly succeeded on the regional balance had the middle eastern war not broken out and restricted the travel of some of our participants from North Africa.

When the group was selected, we requested each participant to advise us in the preparation of the agenda. As a result the Workshop was, from the initial planning the participants' workshop. The proposals for the agenda were their proposals. We simply structured them. When the Workshop began some participants feared there might be a hidden agenda. It did not take long to firmly establish that that was not the case, that the agenda was up to them. The Workshop participants worked together with a highly cooperative attitude and drew up the recommendations themselves. The Report that resulted, and which was described, represents, insofar as was feasible, the views of scientists and ocean resource experts from developing countries.

Given the diversity of levels of development as well as the number of developing countries, it is not possible to ensure that the views of any single group are representative of the developing world as a whole.

To reiterate a couple of the recommendations of the Bologna Workshop--first of all the participants stressed that the initiative to build up a marine science capability must arise in the host government. The point made on the first evening of this conference that those countries that have developed successfully and that have used technology successfully are those that have initiated and controlled the process themselves. It was never done from the outside. The Bologna Workshop participants were experienced in the areas of marine science and technical assistance. As such they were not interested in establishing further relationships of inequality.

Law of the Sea issues were, by design, left out of the open discussions. When LOS was raised by a scientist working in Yugoslavia, it was promptly ruled out.

Real concerns about Law of the Sea were expressed in private conversations, and I think that in a group like this some of those concerns should be stressed. Several of the participants indicated that they do not appreciate having work conducted off their own shores and having no access to the results of that work nor participation in that work. While the major offenders were generally described as the Soviets and the Japanese, that might have been an effort to be polite, and certainly if one pressed further it turned out that there were a number of American institutions that were faulted on these grounds.

As the last speaker this morning, I would like to make a few general points beyond the Marine Science Workshop with regard to the main issue areas that have come up in the course of this conference: 1) the marine science technical assistance needs of developing countries; 2) the activities of private and public marine science institutions in the United States; and 3) the future diplomatic resolution of jurisdictional conflicts in the oceans and the impact this is going to have on the scientific community. In trying to make just a few points that bring these three subjects together, I must raise the fundamental question that has gone sometimes unstated--the question of why U.S. institutions should get involved in technical assistance in the area of marine science.

One of the participants suggested that it might be preferable for the oceanographer to do what he does best, namely oceanography. Perhaps that sentiment reflects differences in interests between the oceanographic institutions in this country. Apparently the same differences that exist in the U.S. fishing industry exist in the U.S. scientific community. Some of you do not conduct research off the shores of other countries and some of you do.

What this poses in the way of problems for those of you who do not, I cannot say. I suspect that whether or not you do research in distant waters, you do have a lot of foreign students who are studying oceanography and so the problems of training come home to you in one way or another regardless of the location of your work. Thus to some extent, the questions of technical assistance are relevant to all.

The original question--why get involved in technical assistance? One answer given has been the political answer that it would presumably benefit some of the U.S. oceanographic institutions; namely, that we hope to buy off the coastal states so that they will not impose a consent regime on scientific research within what seems to be the trend of the future--the 200-mile economic or resource zones. That's putting it very bluntly. My own reaction to that particular reason for engaging in technical assistance is fairly similar to that of John Knauss. He's been following this for a long time, and he expressed pessimism on Monday night about the possibility of staving off what seems to be the growing restrictions of all sorts in economic or resource zones.

I think the term "economic zone" is particularly significant for the scientists, because it brings up all the issues of what developing countries expect to do with those areas. It's obvious to all of you that the type of research that a Japanese fishing fleet conducts is immediately applicable to what the fleet is doing. Soviet activities also have applications. It's a legitimate concern of the coastal state that some activities not be conducted, while other activities that are more acceptable be conducted with benefits that would accrue to the coastal state.

Now, I suspect that one of the reasons that the consent regime is a probable outcome (and I'm not advocating it--I am just predicting it) is that the scien-

tists of developing countries, as well as the diplomats of those countries (and there are distinctions) don't want to continue relations of inequality. They envision themselves in a situation of control in expanded areas of offshore jurisdiction of control. They can then say, "Alright, we have something to give to you; namely, access. You can give something to us; namely, assistance, participation, samples, sharing of data and interpretation of data." One of their goals in expanding jurisdiction is obviously the establishment of relationships of equality, and this goes back to the types of efforts that you all are making. Insofar as U.S. institutions that are conducting research in cooperation with foreign countries are concerned, the manner of behavior is all important. The relationship of equality may be established in one way or another and probably in a way that would be less acceptable to the distant water marine oceanographer.

Given such a pessimistic forecast for free marine science research in the coastal waters of developing nations, what would be the reasons for the United States to become seriously involved in any kind of technical assistance and for academic institutions to engage in greater efforts in the realm of technical assistance?

The first is one that has been brought up: obviously it's good, it's humanitarian, and it benefits other countries. That's the moral rationale, and it's certainly a very real principle, I feel, in the conduct of American foreign relations. There's a high element of humanitarianism in this country, for better or for worse, easily subverted, but nonetheless there.

A possible political reason for technical assistance would be that, even if a 200-mile zone with a consent regime is established, the initiation now, and the continuation of cooperative institutional and personal links between U.S. institutions and foreign institutions

will facilitate access to those zones. Cooperation and the establishment of good faith in interactions with foreign scientists as well as governments is going to be more beneficial than any situation of misunderstanding and hostility, with all the difficulties that breeds.

By the way, I should make explicit something that was implicit in this and previous comments I've made. There is a genuine distinction between the scientists of developing countries and their diplomats, as there is in this country. And that makes for all sorts of problems in the establishment of legal principles to govern scientific research. From what we could tell in Bologna, there was not as much contact as one might have expected--perhaps it should not have been expected--between the scientists of these developing countries and their diplomats. So you're dealing in a universe of problems of linking. In this country we happen to have a fairly close relationship between the scientists who are concerned with problems of marine research and the officials who are engaged in formulating U.S. policy, but that is not the case in most of the developing countries.

The third and final reason, and one that I would hope would be appealing to those of you who are scientists or who engage in technical assistance, is simply that cooperative research which includes technical assistance will increase overall knowledge in the area of the oceans. Many scientists from developing countries were trained in institutions of developed countries. They are very able people. They have a high level of competence, and if approached and dealt with on the basis of equality--and that would include additional efforts at technical assistance training for their associates, providing them with ongoing documentation, providing them with things that they need to continue to be top-flight scientists--there are benefits to be gained from cooperative research with them.

In concluding, I would like to say that, given the responsibility of science and the scientific community for initiating the changes that we are seeing in the ocean today, you have an even greater responsibility to plan for the future. Whether you are engaged in distant water research or coastal research, I think it would behoove you to keep abreast of the legal and political parameters that will be informing and guiding the conduct of marine scientific research in the future.

# WORLD BANK ON TECHNICAL ASSISTANCE

A. KAMARCK

As I was listening to the talks this morning, I became convinced of the fact that if I had any qualification for being here, it was that I knew nothing at all about the subject.

As far as I know, we have only one certified scientist in the World Bank group, the scientific advisor, Mr. Weiss.

What I thought I might do is to try to present a somewhat different perspective here--"perspective" being defined as what you talk about when you don't know anything about the central subject of the Conference--and describe how the Bank Group is trying to cope with a somewhat similar problem to that which you are dealing with.

Over the years, one of the lessons that the Bank has learned is that one of the biggest obstacles to economic development in the poor countries of the world is the fact that nobody knew much about tropical agriculture. If you look at the world you see that the poor countries of the world are mostly in the tropics. The problem of economic development is not a "north-south" problem at all: a country in the south temperate zone is generally much better off than any country in the tropics. It's a tropical-temperate confrontation not a "north-south" confrontation.

If one wonders why it took the Bank so long to discover that one of the big problems was the fact that nobody knew much about tropical agriculture, the only excuse for the Bank is, if you read development economics, you will discover that most development economists haven't yet discovered the fact that there is anything different about tropical agriculture from temperate agriculture. There are books written about agriculture in the developing countries that never even mention the fact that most of the developing countries are in the tropics, and therefore have different problems than temperate agriculture.

At any rate, we came to the conclusion that we needed to know a lot more about tropical agriculture, and therefore research had to be encouraged.

We ran into the problem that Mr. Franssen mentioned earlier; that is the problem of comparison between costs and benefits. In the case of a National Research Institute, the costs are all national but the benefits are usable by a large number of countries. The national benefits, except in extremely rare cases, are not likely to be so immediate and so large that it would be clearly in the advantage of the country to fund the research by itself.

Now this is exactly the point that the LDCs or less developed countries made at the Bologna meeting when they said, you need regional cooperation. You need to have someway of having all of the countries that are going to benefit from a piece of research pay part of the costs. You have also heard from Mr. Franssen about the enormous difficulties there are in organizing regional cooperation, whether it's in the more developed countries or the lesser developed countries, and about all the failures that have come about in trying to organize it.

In tropical agricultural research it turned out that there were at least two examples of successful international research, the institute that had been set-up by the

Rockefeller Foundation in Mexico to work largely on grains, and the International Rice Research Institution financed largely by Ford and Rockefeller, that was set-up in the Philippines.

Based on these examples, the decision was made to try to approach the whole field--the problems of agricultural research in the tropics--on a somewhat similar basis. What has been accomplished in this regard is one of the least publicized accomplishments in the whole field of development, whereas it is probably one of the most important steps in helping the less developed countries over the last 25 years.

After several years of negotiations the position is as follows: there is a Technical Advisory Committee made up of the best agricultural research people in the whole world picked from the developing countries and the developed countries.

The Technical Advisory Committee, with a secretariat provided by FAO (Food and Agriculture Organization), is making a thorough study of what the needs and what the priorities are for research in agriculture in the tropics.

The Committee reports to what is called the Consultative Group on International Agriculture Research. This consultative group has been organized by the World Bank Group with the help of FAO and the U.N. Development Program. The Secretariat and the Chairmanship are provided by the World Bank.

The members of this group, in addition to the interested international organizations, are the principal bilateral donor countries, and the principal foundations in the world that are interested in helping finance research, plus representatives from the developing countries.

This Consultative Group receives the recommendations of the Technical Advisory Committee, as to what needs to be done. For example, if there is a priority need for research in a particular aspect of agriculture which is clearly separable from other types of research, the Group then sets about organizing a new international institute. Now, in addition to the two institutes that I mentioned, there is an institute in Nigeria and one in Colombia on different tropical food products, one in India on semiarid agriculture, an institute to be organized on arid-agriculture somewhere in the Middle-East, an institute doing research on potatoes in Peru, and one on livestock diseases in East Africa.

The Consultative Group, in addition to the responsibility of organizing these new institutes, also takes on the responsibility of providing a program of financing that will make it possible for these institutes to carry out research programs without having to worry from year to year where the financing is going to come from.

The Consultative Group has only been operating now for about three years, and during this period of time, the amount of financing has gone up from something around eleven million dollars to around thirty million dollars a year. And its going to about fifty or sixty million dollars in a few years.

In this field, consequently, for the first time there is a systematic international approach to ascertaining what needs to be done, to organizing the research institutes to do it, and to organizing the provision of financing. For the first time, there is a solid foundation for tropical agricultural research and a thought-out strategy and direction.

Now that it is agreed by experience that this approach works, the international development community is moving on to a new field. This initially is a some-

what smaller problem but also very important: there are a number of countries in western Africa where one of the principal problems in economic development is a disease --river blindness.

The extreme case of this is Upper Volta. Upper Volta has very little of anything in the way of resources. It survives largely by the young men going down to the coast and working on farms in the Ivory Coast and Ghana. The main resource that it has that is worth anything is the fertile soils in the river valleys. Also, in the river valleys there is a black fly, related to the black fly in Maine that is such a nuisance in the early summer. In Africa this black fly, with the very apt name of Simulium Damnosum carries a worm, and when it bites people, the worm is transmitted from one person to another. If one is bitten enough times, he is partially or totally blinded.

The result of this is that the river valleys are largely uncultivated, and when people are forced by hunger to cultivate them, a large number--hundreds of thousands of people--have become partially or totally blind.

Nothing can be done to secure a major improvement of life in these countries until something is done about this fly. Here again, there is the need of trying to find answers. There has been a certain amount of research done by WHO and particularly by some French government financed research in the area. The U.S. AID started pushing the Bank several years ago to take the lead to get something started in this direction. With the successful experience in organizing agricultural research, a similar approach is being tried on river blindness. A consultative group has been organized by the World Health Organization, the World Bank Group, and the principal bilateral donors, the United States, France, and a few others. A twenty-year program has finally been

approved for research and control activities to cope with the fly. Again, the pattern has been to block out the problem, organize research and set up an international organization that would ensure that the program would be carried out.

Now I'm certainly not advocating that this is necessarily the way to go about organizing work in marine science in the developing countries, particularly at the present time. We have heard from Mr. Littlewood about some of the problems that the economic aid agency in this country is facing. All economic aid agencies in the world are facing a problem that in the last twelve months has become a crisis situation. As a result of the quadrupling of oil prices, the developing countries in many cases are facing a real disaster. Over the next couple of years, the developing countries even after using up all the reserves they have and taking advantage of every asset, are going to need something like eight to ten billion dollars additional to the aid that they have been getting, just to survive. So that at this point particularly all the energies are being devoted to trying to get through this particular crisis situation. This also, of course, involves the food problem because the price of fertilizer is affected by the price of oil.

The international development community also is trying to keep working on longer term development problems other than those longer term problems that I have mentioned, but at the present time it is difficult to get any action on any new initiatives because of the preoccupations of the present world crisis.

# WHERE SHOULD WE GO FROM HERE?

CHANDLER MORSE: As a result of the session, sponsored by the Ocean Policy Committee of the Ocean Affairs Board, the question, "Where should we go from here?" follows naturally. What needs to be done? How can it be done? What can and should the Ocean Affairs Board do?

There are two ways to think of this: (1) What should the world distribution of ocean science and technological capabilities look like five or ten years from now? (2) How should we get there? Both of these speak to the global programmatic approach. Although certainly relevant to "where" should we go from here, the "what", the Ocean Affairs Board or the Ocean Policy Committee should do with respect to moving in this general direction over the next five or ten years is more important. Providing that we are moving in the right direction, what should OAB do over the next few months in order to take the first step on this journey of a thousand miles? In short, I would like to focus, as far as possible, on the courses of action to be taken.

To suggest a possible focus for our attention, and perhaps to make people disagree with me, let me suggest that it seems to me, not a full-fledged member of the club by any means, that three sets of interest have emerged or been discussed here: (1) freedom for scientific research that would not be of particular interest to the developing countries; (2) freedom for scientific research that would probably be of interest to developing countries, but is not accessible to them (that is, the perpetuators of the research such as navy people, oil people, and nodule people might not want them to have access to it);and (3) interests on the part of scientists who are genuinely

concerned about providing technical assistance. This last-named group would probably not have any problems with respect to freedom of scientific research under a consent regime because their research interest would be almost automatically taken care of under their technical assistance programs.

Whether this third group will become legal tender by which freedom of scientific research can be bought by either or both of the other groups, I do not know. I am inclined to think, however, that the answer is not to care. Namely, each of the first two groups should take care of the problem in its own way, and the group that feels that if sufficient benefits from technical assistance can be accrued to the nation as a whole or to the law of the sea regime as a whole, we would expect it to proceed along that line. From this perspective, the question would not concern freedom of scientific research and the law of the sea regime, *per se*, but what can we do, what should we do in order to further, to expand technical assistance and marine science and technology.

DOUGLAS CHAPMAN: I think I am in agreement with your points; that is, although this conference may have been set in motion by the concern for freedom of research in the oceans by the upcoming Law of the Sea Conference, these two issues should be detached. Freedom of research is an important issue, obviously of a greater importance to some members of the group than to others. Those involved in fisheries and related problems are not as likely to be concerned as those performing deep ocean research. I think it is appropriate that we acknowledge the importance the Department of State has attributed to this issue. I believe it was Mr. Weiss (World Bank) who indicated that the United States is going to have to pay for this in someway; however, I don't think that an indefinite promise in mutual aid is a very satisfactory or sound way of paying for it. In particular, I think this

development must come not only from the United States but from other countries as well. I am not sure mutual aid to technical assistance may help. Furthermore, it is my understanding that support from developed countries important to executing these and in furthering the Law of the Sea Conference remains to come. This support may prove different from that supporting the freedom of the seas from scientists of other developed countries; this kind of support has been discussed and some steps have been taken, but not very many nor very successful ones. Those scientists in developed countries need to gain access to their governments and their delegations to apply pressure that is apparently needed if we are going to make any progress in obtaining freedom of the seas.

Again, I accept and I think summarize your point of view that the technical assistance and aid programs are valuable in themselves. These programs should be endorsed. Some, for instance, that we have been involved in do provide mutual benefits. I think it is most important that the United States share its know-how with the rest of the world, and I feel this could be done in a variety of ways such as through individual approach programs, some of which have been discussed, or the international Food and Agriculture Organization, although their programs have been criticized during this conference.

It is fairly clear that the exchange of information is needed. How one elects to communicate needs to be discussed.

An omnipresent problem with all research is beginning, i.e., obtaining seed money. Of course, foundations provide some, as do federal agencies. But is there something more that could be done in this direction? Could we recommend improved means of securing initial financing?

EDWARD MILES: As most of you know, I feel that the relationship between technical assistance in the marine sciences and freedom of scientific research should be separated. Because I do not think it is possible to derive very much, if anything at all, from technical assistance in the law of the sea negotiations. In short, I think we are talking essentially about the possibility for long-term effort in developing capabilities in marine science around the world. During the planning stages of this conference, the intended value for some of us, including myself, was to broaden our scope of information on what was being done by U.S. institutions as well as by other countries. We did have a pretty good idea of what was being done by UNESCO and FAO, but we needed to catalog this information in order to see what was being done by others and to see what the effects might be. This is what I want to try to do right now. Let me begin with the caveat that my remarks are based on the information presented earlier in this conference.

Let's assume three things. First, that the standard deviation on the data, as presented by Dave Ross concerning the extent of foreign involvement in U.S. marine science institutions, is not that great. That's a fair assumption, I think. From the total effort, with anywhere from 3-8 percent foreign involvement, we have to subtract the participation of scientists from developed countries. In short, we are talking about one percent or less involvement by developing countries.

Second, let's assume that French, Danes, Norwegians, British, and Japanese, for instance, handle involvement with developing countries as we do. If their performance and experience were very different from that of the United States, we would know about it. Thus, programs would not differ spectacularly from the United states programs.

This leads me to the third assumption. UNESCO and FAO tend to measure their productivity--that is, the productivity of their programs--on the basis of the number

of people who participate in their training program (a distorted measure in my opinion). Instead, let's use employment and process effects that come out of those programs as measures.

On the basis of these three assumptions, let me suggest the following conclusions: The total effort is both miniscule and fragmented; consequently, the effects are not only very dispersed but we exert little control over them. They are also superficial. Further, there appear to be very few serious structural impacts. Since I am most concerned with the transformation of the research infrastructure in these countries and the capacity to develop science policies, to make decisions on the basis of how much investment to put in marine science as opposed to agriculture, etc., none of these programs stands up very well.

I was particularly intrigued by the attention given the Catholic University of Valparaiso (UCV); however, one would have to look a little more carefully at the case to see whether the success reported has spilled over into the larger Chilean governmental sector with respect to science policy, or, as I expect, whether it is encapsulated within a fairly narrow range. I'm also struck by the rather large management cost that seem to be attached to these programs; we seem to be generating jobs for administrators. I don't think that's what we're after, but again, maybe I'm wrong. Given the stringent measure of what <u>impact</u> these programs have and/or can have on developing countries to develop capabilities and to make rational science policies, I can only conclude we haven't done very well. Can we do better?

Doing better is a function of the amount of money invested in the program. Is there any assumption that we are likely to get very much money in the future out of the U.S. government for this? My answer is no. What then should we do? My initial reaction is to despair, which may be the

the only course of action available. However, if you assume that the effects of 200-mile limit--that is, 200-mile economic zone--will be to proliferate multilateral bargaining between developed and developing countries, quite outside of formal organizational framework, we create a world in which new patterns of political dependencies may be emerging out of quite sophisticated technologies. Is this a good thing? From my set of values, no. Is it likely to lead to significant conflicts in the future? Yes. Where do we go from here? I don't know.

WALTER PEREYRA: A continuing remark on your comment about what the possible impact of the UCV program has been on the Chilean marine science policy. As I was initially involved in that activity, maybe I can provide some insight.

I think from the beginning the impact of the program was probably not given enough consideration. The reason I say this is that the Ford Foundation, about half way through my tour down in Chile, became very interested in the Catholic University and the possibility that this somewhat apolitical institutional structure could provide some sort of long-term continuity in marine science within Chile, and perhaps within other Latin American countries. With this in mind, they approached me with the possibility of staying on a little longer; it was understood that if I stayed, I would try to establish channels of communication between UCV and the Institute Fermento Escaro, a National Fisheries agency started by FAO. The latter, a five-year, UNBT project, was unable to maintain itself after FAO left and it was hoped that UCV might provide the science support required to keep that organization. Also, it was anticipated that channels of communication could be opened between UCV and the National Science Planning Group CONACET, the Institute for National Pastacion,

which is responsible for developing the small fishery activities in Chile. In pursuit of this end, about five or six science activities were initiated.

Now, if you look at the activities of the UCV scientists in Chile over the past four or five years, you will see much larger participation; in part this is due, I think, to the sheer number of UCV scientists, as well as to an increase in their technical capability and a recognized need for them to participate in this work. The most recent example of this, I think, occurred when the military government took over; at the time they removed certain leftist factions in the National Fisheries Institute and immediately turned to the Catholic University to provide the sort of follow-on expertise needed to maintain their fishery science program. As a result, the UCV has a much stronger voice and role in the National Fisheries science policy in Chile.

DONALD McKERNAN: Following Ed's logic, we should all pull out our knives and cut our throats. Although I too am inclined to be pessimistic, I do think there are some alternatives to despair. First, I do not agree that we ought necessarily to separate the law of the sea--freedom of research issue from the transfer of technology program. If we get strong coastal state controls, to pay in someway to do the kind of research that we have been doing and that needs to be done to further an understanding of the ocean and the earth, is not a disadvantage.

I do not think payment has worked very well in the past, which is not to say that payment *per se* will never ever work. Also, I think that as we get closer to the law of the sea, we come closer to considering the elements of an agreement on all aspects of this law of the sea from the questions of territorial limit to control of ocean pollution. The United States is going to have to make some important decisions. For one thing, I'm quite optimistic that, in the final analysis, it is still going to be

worth something to nations to have the United States sign on to a convention. I think that a law of the sea convention is not worth very much if all maritime nations are not party to it. You can have all of the land-locked nations and all the nations of Africa in the convention, but if you do not have half a dozen nations--such as Japan, the Soviet Union, the United States, Great Britain, and France, you've go a pretty empty kind of convention.

And so, I think that our national resolve in what we will accept, is going to play quite a role. Although our provisions for scientific research might not be as good as we would like, in the final analysis--if we're willing to accept certain undesirable characteristics in a law of the sea convention--it seems to me that we may well get elements that are significantly less than an absolute consent zone. For that reason, we ought to develop the program further. We ought to take another step as you have suggested if for no other reason than to lessen the problem for countries of accepting something less than an absolute economic resource zone, providing that some benefits, such as in the transfer of research technology, will be accured. I believe it would be a mistake if we were to try to separate these issues completely. Further, it's probably safe to assume that we are going to pay for a complete absolute consent zone by coastal states in order to carry on research. Finally, I do think the Academy has contributed substantially to the formulation of this nation's position on this issue, and I think will continue to exhibit this kind of constructive leadership. In short, I think we ought to persist. I think that even after we have cut our throats and are bleeding and crawling along the floor, still we may be able to patch the old throat up and come out of this with something less than complete loss of our capability. Opportunity to carry on research within this resource zone, or whatever, will come out of it.

CHANDLER MORSE: It seemed to me that what Don McKernan was saying was that the United States is going to get what it gets, just because it's the United States. It isn't going to have to offer anything except its refusal to sign the convention if it isn't the way we want to sign it. It seems to me this is a realistic position, and I do not see that the offer of technical assistance is going to add anything at all, because it would only be an empty offer--like the 1972 offer. The 1974 offer is not going to have any more content; in fact, it will probably contain less content. Furthermore, it seems to me that we would be in a much better position with respect to our image with the developing countries if we separated freedom of scientific research from technical assistance. We are now perceived as the great giant that won't give a nickel without a dime's worth in exchange, and it seems to me that we are most apt to perpetuate this image if we try to exchange freedom of scientific research for technical assistance.

Second, I'm not entirely in agreement with the despair position. There is no question that the Congress is reducing aid money and is dragging its feet on AID; however, it seems to me that it may be mainly, or partly, because it is tired of these old programs. If a shiny new program in a shiny new field of marine science and technology with untold possibilities of benefits to all mankind were presented, I think some congressmen would not only listen to, but welcome, somebody else asking for money for a different purpose. So it seems to me that we ought not to despair, but to use our imaginations to think up a serious program of technical assistance and then to present that to Congress and to appropriate administrative agencies for their support, and see where we get. We may get nowhere, but I don't see ourselves getting anywhere whatsoever by going to Caracas, or anywhere else, and saying, "We will give you this in exchange for that." I think that would just be more empty "gringo" promises, to use a phrase that somebody used here earlier.

WARREN WOOSTER: I think it's useful to separate the technical assistance issue from the freedom of scientific research issue because it can't otherwise get a fair treatment. As long as you keep them coupled, your motivation remains obscure.

It seems to me, if you isolated the technical assistance programs, you would come out with an assessment something like that posited by Ed Miles, despite his use of hyperbole. Much of what we call technical assistance isn't that at all; it's streaking from one form to another. It serves our purposes and, as such, does not affect these other countries. In short, you come down to a very low key, small effort.

Even that effort isn't very well known, as we discovered in the discussions about the Catholic University of Valparaiso. I suspect that even with this miniscule program, there would be some benefit to improving communication among the players. You know, it would be worth investing to keep track of any developments and so inform others. Beyond this, the "what" case for what we really want to do in the way of technical assistance has not yet been assembled. I mean, why should we ask the taxpayers of the United States to spend $X million to transfer marine science capability into, if you will, or take it beyond, technology. It seems to me that we have to think this case through; certainly, to sell this to the Congress, we need to clearly define our "whats" and "whys".

Supposing the Congress decided to award $5 million a year to begin a "meaningful" technical assistance program. Given the magnitude of the problems, such an amount would not get you very far. But it's almost $4.9 million more than we have now. Further, if you could plan a good program with $5 million, you might be able to expand it. Frankly, I wouldn't know what to do if I were given $5 million today and told "OK, Buddy, set up a marine science technical assistance program." How

would I proceed? How would I invest this money to get the most out of it? It seems to me we still do not know how to proceed under such circumstances.

GIBERT VOSS: I would like to revert to what Harris Stewart called earlier the "Voss method" and to explore the reason why I think this is important. In the past ten years I have worked in about 44 nations, over 24 of which were in the Caribbean (of these 24, only 6 were cooperative). Many of these countries have no technical abilities whatsoever, and those with scientists are almost entirely concerned with their own in-shore, limited problems. If we go to the problem of consent of agreement here, I don't know how we are going to operate if we have to give a trade to some 48 nations. I see no method by which we can set up any kind of an overall program that's going to be able to give all of these nations something in return for working in their waters within the 200-mile limit; yet working in the Caribbean, I am going to work across the borders of at least half a dozen or more on any one particular cruise.

There should be a way to relay good information to the country as to what you have done in its waters. This is perhaps one of the biggest problems that is repeatly voiced. After the ship has left, the country receives a cruise report sometime in the future. This 1 to 1 1/2 page report typically reveals nothing more than the ship has been there, has run so many stations with such and such type of gear, and left. I feel that it is inherent upon us if we expect to work in these waters to give these countries something as soon as possible after we leave that will be useful to them. I keep a scientific journal--a running log or account of what we have done, what I have seen, what we aboard the ship have decided concerning various sampling, and so on-- which I then present to officials when we get back into port. The only other person I know of in the oceanographic

community who does this consistently is K.O. Emery from Woods Hole; he follows this same procedure and has met with the same success. I think that if we can present to them a document resulting from the work done in their waters, we will have alleviated much of the problem that faces us now. I don't think that it is ever to late to start such a policy.

Furthermore, this kind of communication instills interest in students from the particular country. They have met and talked with some of the professors about the kind of work, their institution or university, what are the problems of bringing students into it and so on. From this you'll start getting a good student exchange. I feel that the well-trained student who returns to his country is going to enrich his country in the marine sciences more than will the big programs that usually dissipate because of lack of funds, thus disappointing many people. Obviously, if we're going to go into this, we're going to need funds. Certainly, block funding could provide for the processing and dissemination of papers and reports. It's expensive for the individual to carry this out on his own research grant. Similarly, block funding ought to pay for going into port for these purposes. It's expensive everytime you make a port call in terms of days. In brief, I believe that a larger bureaucratic organization will practically doom a project to failure. With a little bit of common sense and an "upfront" attitude of telling the nations what you have done and what you are going to do in their nation and providing person-to-person support in this--faculty and students--we can go a long way in alleviating the present situation.

WILLIAM LITTLEWOOD: Regarding the effectiveness of technical assistance as it relates to the law of the sea and freedom of research, it must be recognized that most

developing countries do not have any mechanism to enable their scientific community to influence their politician, their administration, and their diplomats. There is a difference between the scientists and the diplomats, between the scientists and the administration, and between the scientists and the politicians. In this respect the United States might well be considered a developing country too. I don't think our scientific community has found the right mechanism to influence our Congress as far as positions and funds are concerned for the scientific development of this country. The point I wanted to make is that when you do give technical assistance from an American scientific institution to a developing country's scientific institution, it does not automatically follow that assistance is going to influence the position of that country in an international forum. We've found that this is not just characteristic of the marine science community, please understand, it's all across the board. We've worked a bit with the Academy in Thailand, for example, and we've found that their five-year economic development plans for the country had no inputs from the scientific community, and Thailand is still struggling with how to get the scientific voice into their economic development plan. It's just a factor that should be kept in mind; that is, there's a huge gap between convincing an institution in the country that we should work together in the future and have scientific freedom and convincing their administration in that country and their diplomats and their politicians. Yet it's these latter people that will decide the positions in the Law of the Sea Conference and others.

CHANDLER MORSE: The basic point that I wanted to make, has been talked about and around; that is, whatever happens, restrictions are going to increase, which means increased cost. Now irrespective of whether an individual scientist feels he can do this work as easily scientifically in an

area two years from now as he did two years ago, he's going to have to pay more for it, and so are the sponsoring agencies. If the oceanographic "kitty" remains the same, less research is going to get done. It may be a lot less research.

Most of my questions and comments are addressed to Ambassador McKernan. You implied that if there's a link between technology--science assistance--and freedom of scientific research made by the United States and LOS and we win, we're all right. As I see it, if we go with this link and we lose, are we going to be hurt by it more than if we hadn't made the link in the first place? You also mentioned that the U.S. threat to refuse signing a LOS agreement would have a great deal of influence. I agree with that. But it seems to me that a failure for us to agree with developing countries on science is not going to be sufficient grounds for the United States to withhold their signature for such an agreement. Furthermore, I think most of the developing countries feel the same way.

ROBERT MORSE: It was the intention of the Ocean Affairs Board in sponsoring this conference to solicit a variety of opinions and try to find some answers to questions. We really weren't that much interested in our answers to them. The kind of questions that we would like to see addressed, and we all know that they're not easy ones, are those questions that have been raised here. I think the most telling questions in a way, are two questions that Warren Wooster raised: What kinds of programs would you have if you could have them however you wanted them? What difference would they make? Are we dealing with the problem of where our interests lie as Americans or as developed country scientists? Are these really commensurate with the kinds of problem that we're trying to apply

them to? Or are we really talking about two separate problems? One is the development of a developing country, the other is marine science as we practice it. Are these really in the same universe so that one has an effect on the other?

TJEERD van ANDEL: I don't think we're getting much closer to really accomplishing anything beyond informing each other. As a result, I'm going to make a number of fairly concrete proposals to see how you will react to them. To begin, I think I should backtrack for a moment. I think it's appropriate at a meeting like this that recommendations be made to the sponsoring organization, and I don't know that we can go farther than that. In making such recommendations, I should think that we ought to be very careful because it's probably impossible within the confines of an afternoon to be both detailed and concrete. Usually, the one concrete course of action that results is recommending a committee for study, and that's exactly what I'm going to propose: First, I recommend specifically that the Ocean Affairs Board establish a very small mechanism to keep abreast of what is going on, so that we don't have to have an annual meeting like this to find out that two institutions, only 200 miles away from each other are both fostering the same university on the other side of the globe without knowing about each other. I think that's simple and worth the money.

Second, I would like to propose the answers to two questions--raised by Warren Wooster, "What is it that we want to do if we had the money" and "if we could to it, would it do any good?" Many suggestions have been put forward. You've all heard them, and some of them make a great deal of sense. I personally am partial to the well-designed long-term program that ties a sponsoring institution to one or a few receiving institutions somewhere else in the world, rather than a much larger but short-

term approach. But these things I think we cannot decide here, so I'd like to suggest that one good recommendation would be to ask the Ocean Policy Committee to develop such a study and not to make it so large that it will be three years before we hear of it. These things change very rapidly with time, and as the Law of the Sea Conference goes on, we will probably find ample reason to modify many details.

The study should be relatively concise and review the following points:

> What can we do? What would it cost if we do it? At that price are we gaining something, or are we losing something? (Losing might be the case because we might be tapping out of the same till that we are already tapping, so we're in a trade-off situation, and that was something that Lou Brown has also addressed himself to. I think he's perhaps a bit pessimistic, but not very much.)

CHARLES WEISS: The Law of the Sea Institute has given rise to much discussion about what is it that developing countries really want from us. Unfortunately this kind of exchange does not take place often enough. To a certain extent I suppose it happens inside AID in the context of the three or four priority areas, but the same discussion could take place in a very large number of other sciences, with many of the same general or analogous points being made. Possibly this fact is more important than whether or not technical assistance is a good bargaining chip with which to buy freedom of scientific research. Technical assistance may be a good bargaining point, but not necessarily for obtaining what scientists want i.e., freedom of scientific research.

I would like to translate some of the suggestions that we've heard into slightly more programmatic language because, if the United States ever gets to the point where it wants to announce a program, it had better have a sound idea of what is to be accomplished. As someone pointed out, at the moment, there really is no program. There's no U.S. conception of what the U.S. wants to achieve by its technical assistance in marine science or, for that matter, in most other sciences.

First, what are you trying to do and who is supposed to benefit? Are you trying to get something out of the Law of the Sea Conference? Then you probably want something that will make good headlines. That's a constraint already. Are you in it for humanitarian development? Are you trying to benefit American scientists or developing country scientists? Are you trying to prepare the way for American companies that are involved in exploitation of natural resources? Are you going to aim your program at something that would help LDC elites? Are you going to specifically aim it at something that will help poor people in LDCs--artisan fishermen or small farmers who are going to do agriculture? Your conception of who your target group is is going to affect what you do.

Second, are you talking about science, or are you talking about technology? If technology is too hot to handle, maybe you want to do science. If you want to grasp the nettle, and you decide technology is the crux of the issue, then you'd better do it.

Now we tend to classify proposals by the size of the bill of fare, which is another way of deciding what's the scarce resource. Are funds to be allocated from a big pot of money or are they to come from small grants? Deciding this issue in part will determine what kind of program you're going to have.

As a representative of the World Bank I am often privy to such things at UN meetings as, "Let's set up a consultative team for this thing," whatever it is---urban problems, water supply, you name it. It's the first thing that comes up at a political gathering. I'd like to explain what a consultative group is good for and what it isn't good for, a topic addressed by Andy Kamarck earlier. A consultative group is a mechanism for collecting large sums of money. The consultative group on agricultural research raised $35 million last year, and it's going to raise $50 million in the future. Now that's not necessarily a bad thing. There are some proposals that start with a political agreement; money is sought and obtained; and then people sit around and try to figure out what to do with that money. For example, the Institute for Applied Systems Analysis in Vienna was established in order that the United States and the Soviet Union do something together. $100 million was perceived as a nice sum, and Vienna was chosen as the site because its a nice neutral place; it was decided that systems analysis be explored because that's something we're all interested in. They found a director, and now they're trying to figure out what to do with that money. That's fine if politics is your aim, and I imagine that if what you really want to do is to make headlines in Caracas you might succeed. So much for my definition of a consultative group. But it doesn't have to be so. We could begin with an idea and a series of questions. What are we trying to accomplish? What are the real research needs? What are the real technology transfer needs? Who's the real target group? From answers to these questions, priorities could be established and a list of institutions or programs presented to a funding agency.

A second place where you could use a substantial sum of money if somebody wants to put in a substantial sum of money, is the kind of technology transfer "kitty" that was briefly discussed. Again, this isn't a recommendation; I'm just trying to say what's a cat and

what's a dog. O.K. That's what you could do with big money, and maybe other people have other ideas about what you could do with big money.

Now, at an intermediate stage of $0.5, $1, and $2 million, there are a whole class of things that could be done. Oh, an aside, I would suggest that if you're talking about a consultative group, you're talking about multilateral administration; you're talking about the FAO or some other bank or UNDP, or some other multilateral agency. Now, smaller amounts of money seem to fit better into bilateral administration. (Bill Littlewood may disagree.) When you're talking about U.S. institutional grants, curricula, and training programs; you're talking about doing things that will create a career pattern for the experts you intend to train either here or in the LDCs; you're talking about technical assistance programs and about programs to help artisan fisheries, if that's what you want to do. Some of these training programs could be in companies as well as in universities, if you want to get more into technology and less into science, on the grounds that much of the expertise that you need is acquired only by experience or by contact with people who are actually technologists not academicians. And you are talking about programs of scientific collaboration with equipment money, with substantial funds behind them.

Finally, a third category, of small amounts of money, includes support for specific projects--i.e., a trip to Chile to collaborate on a particular thing with a particular scientist in a relatively short period of time; links between institutions at the communication level; links between scientific organizations, between professional associations, between departments. These specifics have to be administered in quite a different way, because now you are talking about making a lot of little grants, and you'd like to do it so as to minimize administrative expenses. But you have to acknowledge that administrative expenses per dollar are going to be

higher, and you have to set-up with this in mind, because that's your purpose--to give out a lot of $10,000 grants efficiently, instead of giving out a small number of $1 million grants.

Now all of the above are different from another cost that I think everybody is sort of resigned to, and that is the increased cost of doing oceanographic business. Such an expense must be absorbed in some way or else be translated into larger research proposals.

JOHN COSTLOW: I feel obligated to rise to the defense of the U.S. oceanographic community. Reference was made to the fact that we don't do this very often; we should do it more frequently. In the last five years, largely through excess currency programs sponsored primarily through NSF, I know of any number of members of the U.S. oceanographic community who have spent all sorts of time talking with friends in other nations, in some cases LDCs about ways in which they can improve their own programs. For example, and I'll just run through a couple of them, I've made four trips to India with NSF acting in one case as a consultant for a six-week all-India symposium on marine biology. Cochin in the middle of the summer leaves much to be desired, but I think that I made a great number of friends with the Indian community, and it was a worthwhile venture. Shortly thereafter, I went back for a binational review of the university and college curriculum in the marine sciences and the biological sciences for India, which led to a tremendous draft to the Indian government that would, if it were ever adopted, completely change the Indian university and college curriculum. I understand that there were two other such groups, one in physics and chemistry and one in mathematics, all supported by the NSF Excess Currency Program. And you can go on and on and on. I'm not aware that at any time that I've been there I've had any kind of a bargaining position. I went as a friend. I went to do something in an area that my colleagues felt

needed doing. Just to make sure that the record is straight, I think that the U.S. scientific community, and in particular the oceanographic community, has talked on numerous occasions, not necessarily in the sweeping generalities that we're talking about now, about how to approach specific problems and how to contribute to these specific problems, and rarely did we talk from any sort of a real hard bargaining position. We were there because we were friends.

CHARLES WEISS: I'm not in any disagreement with that. I think that the strength of the American scientific effort has been precisely that individual scientists have gone to a hell of a lot of trouble as friends. There's nothing like a sort of an adversary system to concentrate the overall system on the sweeping generalities. And that's all I meant by that. It was not an attack on the oceanographic community by any means.

I'd certainly hope that scientists will never act from a bargaining position. If the bargaining position results in a U.S. program that, in the aggregate, will amount to more than many individual efforts, then the requirement of coming to this will have been worthwhile. I, for one, would be much happier if we could get something out of the U.S. government without having to appeal to a bargaining position.

LYNWOOD SMITH: I'd like to speak more also to this position as a friend. Most of you probably heard my talk the other day about doing just that with the Catholic University of Valparaiso on a very small scale, very much on a one-to-one relationship. I got jumped on this at the cocktail hour after that and beat upon at some length, and it finally began to sink in about five o'clock this morning as to what some of these things were about and, at least for myself, resolved for my own

mind that really there are two things that we're talking about here. Two rather different kinds of things, and just what our friend from the World Bank said, I hope scientists never have to talk from a bargaining position. I believe that such haggling takes a particular kind of person working at the bargaining table between nations; it was finally explained to me, or at least pounded through my thick head, that this is largely a nonpersonal or apersonal-type thing. That is, these are rules that are hammered out for the conduct of nations or the conduct of governments. As I think I demonstrated earlier, the interpersonal program that we have developed at the Catholic University of Valparaiso survived a number of governments and a number of different people on a person-to-person basis. I do think that the bargaining and the interpersonal program that ensues are complementary, that is, the politicians have their realm and do very well in their own sphere, in their own way of thinking. The interpersonal situation has its own sphere, its own way of operation, its own effects, and operates very much on a small *ad hoc* scale and maybe is even best that way. With this distinction these two can be separated, but they need not be separated. They can help each other, that is, have the international effect of easing the overall rules and setting up ground rules on a negotiation bargaining basis, and the politicians can do that for us scientists if we scientists will communicate. On the other hand, the interpersonal scientific interaction builds understanding and trust, thus making it easier for the politicians to negotiate.

Another bone of contention I'd like to air stems from the perception that, "Chile is typical of other Latin American countries." I'm not so sure this is true. I think we may have had quite an unusual experience there, although the consortium now set up in Brazil may be the test of that. The argument that was given was "Well, you guys bombed out in Argentina." Argentina, in general, has said "Yankee, go home." They would like a 200-mile limit to protect their own resources, and there are some large untapped resources there that are going to waste because

their biological resources are being unharvested. The politicians say, "Well, this is a crime, because here is protein to feed people with." But this is really no different than the California anchovy fishery situation; their resource is about the same size and remains untapped because of the local political interest of California sports fishermen. There is even a much larger resource that at present remains largely untapped in the Antarctic. According to our Soviet co-workers who sponsored a seminar recently in Seattle, the potential krill resource is of the order of magnitude of 200-300 million tons in the Antarctic, which is two and one half to three times the present sustainable yield or estimated sustainable yield of all of the world's fisheries put together. The Soviets have sort of tapped it a little bit, but it is largely an untapped resource.

A prime objective in the Valparaiso program, one that I think made it and continues to make it successful was to instruct the faculty members there, to bring them up to our level of knowledge, treating them as independent, self-supporting, ongoing co-workers. Now, this leads to a number of conclusions. One of the most important, also voiced by Gilbert Voss of Miami, is allowing them to make decisions as equals. This also means that you have to allow them the privilege of being wrong. And I think we forget this because of ingrained big-brotherness. We have been wrong in many cases, but we tend to overlook that. I did hear somebody say, "Yeah, maybe some of these developing countries can avoid some of our mistakes." I think one of the main objectives of a technological and scientific assistance program should be to view these less developed countries as equals, treat them as equals, and make them in fact equal as rapidly as we can. From there perhaps we can proceed as one world, which in the end might prove to be of least economic cost to the United States.

WALTER PEREYRA: I've been involved in these marine science assistance programs to foreign states at practically every level--multiship work; International Ocean Expedition, 1963, off South America; 1965 again with ANTON BRUUN; the educational work at Catholic University of Valparaiso; and more recently, this artisanal fisheries development work which is the lowest level of technological transfer. Also, U.S. marine scientists are extremely benevolent in terms of the cooperative activities that they are willing to become involved with. However, we quite often have a poor understanding of the priorities of our activities relating to the developing countries and this idea has been discussed by several people this morning. Before we proceed any further, we are going to have to ponder over the conclusions reached at the Bologna conference and then reorder our priorities so that our future activities can be more meaningful.

GILBERT VOSS: I think whatever comes out of this meeting and out of the Ocean Affairs Board and the Law of the Sea --and I'm very leary of trade-offs--we've got to be careful that we don't go overboard constructing a big national program for international assistance that makes bold promises to everyone, enabling us to do research in other peoples' waters. I don't like trade-offs, and I don't think that they're going to work. I cannot conceive of an international program developed by the United States that is going to take care of all of the different nations in whose waters I want to work. What good is an international program in Pakistan, India, Mexico, Chile, and a few others that have been mentioned, when I want to work off the waters of Dominique or British Honduras or Trinidad and Tobago. These last-named won't benefit from my being there and don't ever expect to get anything out of it. In Dominique, a mammoth program with mammoth funds isn't going to do any good for anyone other than to aid artisan fisheries. That's all that they have there, and I don't think that they'll ever have anything more. I can

Department of State, they have to meet the requirements established by the coastal state in order to do their research.

What we don't have at the moment is the manpower or the statutory authority to go much further than that, in other words, to try to enforce regulations like that by penalizing institutions. I'm not sure that even in the future such will be desirable. On the whole, we don't have many problems with institutions submitting their data. The biggest problems are in communicating between foreign countries and institutions. One good example is Ken Emery's work. Ken has probably been one of the most conscientious scientists in trying to get the results of his work to scientists in the countries off whose coasts he's worked. One of the problems he had is that although he's brought the scientists from the countries aboard, given them copies of the data when they walked off the ship, sent copies of the data to the institutions and agencies in the countries that he knows of, he still doesn't know them all; namely because the countries don't tell us. The State Department gets a message back from a foreign government that says, "We grant your clearance, and we'd like to receive one copy of the data." When the data are available, the State Department tries to make sure that the data gets to the agency in the right amount of time. They don't really have a good follow-up mechanism because of the lack of manpower in ocean affairs; generally speaking, however, it gets done. What happens to the report after it gets to the foreign country, we have no control over. Very often it seems not to reach many of the people it should reach. Just as in this meeting, scientists who are engaged in working here in marine affairs programs at U.S. universities have come to listen to some of our problems and have told us that they see us creating problems by working with a particular university or particular institution.

How do we find out which institutions to work with? We receive a proposal or letter or an idea from somebody at one institution in a foreign country. This guy has had the

just see a whole big program, of course, of artisan fisheries specialists sent all over the world to help all these nations and soon because I want to work out in their waters. I'm beginning to believe as I listen here and as I listened last year that we are absolutely no further. We don't need any program at all and we ought to just go ahead and do our research. If you don't like particular universities or particular programs, o.k., let that university or that institution find its way to work in collaboration or in some other way build the friendships and bridges that have collapsed in order to be able to go back. I don't like to build trade-offs. I don't care for it. I see the same thing here. It's against my feelings, like it is to have to document every one of my contributions to charity in order for the IRS to believe that I've done it. I think this kind of thing is wrong. If you can't do things through friendship because you want to do it, then I think that the other kind isn't going to be effectual anyhow. As I say, at this stage, I would like to see some mechanism by which every ship and every ship operator delivers a report meaningful to that nation within a certain period of time. You are going to send your scientific papers to the people in that nation as soon as it comes out. You're going to send them a bibliography of what you've already done and whether it's available or not. You are going to make arrangements for the participation that you would like aboard your ship, or you don't get the funds to operate your vessel out of our block funding. And that would cut out a lot of the talk today and in the past.

LOUIS BROWN: First in response to the last suggestion, we already do it. Between them, NSF and ONR have established requirements that oceanographic institutions must meet when they send in proposals and are awarded grants to do oceanographic research. In cooperation with the

cleverness, the originality, and the determination to find out who in the United States he should contact, and he's contacted us. If his idea sounds good, we encourage him. We encourage him to contact his U.S. colleagues and start working on a joint program. We do not go further than that. We do not, for instance, try to consider how many other universities or institutions there are in this scientist's country that we should also contact. That would put on us an almost impossible administrative burden. So, in that sense, this type of problem that was mentioned earlier is going to continue to some extent. We often don't know who to contact. Even in the United States, we have a similar problem. What do you do when you get a proposal from an individual scientist or an individual institution, and he has a good idea? Do you fund him directly? Or do you say to the community at large, "Gee, we've got this idea for this kind of program; let's get everybody together so that everybody can get their divs in." Right now we use both approaches depending on the idea and the type of program involved. Obviously, there's no simple solution. Basically, however, I feel that NSF and the other funding agencies in the Department of State are responding well to clearance requests and to the official requests of foreign countries. Also I feel the institutions and the scientists on the whole are doing a good job of responding to the needs of the scientists that they've worked with on a particular cruise. There are times when you can't do anything about a situation in which the data have been pigeon-holed due to higher priority projects or to the fact that the data are not that good. There may be a requirement for the institutions to process the data anyway and get it to the coastal state. If we insist, they'll do it. But the results may not reach the coastal state within a year or even within two years, and the results may prove insufficient for their use.

Another problem area has been identified as relating oceanographic work done off the coast of a foreign state to the needs of that coastal state. The proposal that the United States made before the Law of the Sea Conference

last year in the draft articles on scientific research, included a provision that the United States would assist coastal states in interpreting the results of research that we sponsor off their coast in light of their needs. We've gone through a long and detailed evaluation of how to do this, which we're still wrestling with because we don't have a mechanism yet to do it. The implications of this are overwhelming for U.S. oceanographic institutions.

One alternative might be to ask the individual scientist who did the research to interpret the results of his work as they affect the coastal state. But coastal state's interests are in fishery and his is in internal waves, it may be difficult for him to do that. He may have to obtain assistance elsewhere. We could set up some kind of central facility for doing this type of work. We could attach it to an oceanographic institution or to a federal agency, but then such institutional capability would be removed from the individual investigator. We would lose the benefit of his experience with the work. It would probably become more costly.

Another alternative is to look to an international organization, probably an intergovernmental organization, to perform this function. Some effectiveness might be lost, but a very effective buffer might be gained between the scientists who did the work originally and the coastal state. We might then be able to say for every research contract that we award, here's an additional 10 percent, we're going to save, that then goes toward the "kitty" of the international organization. The coastal state should look to the international organization to analyze the results of the research for the needs of the coastal state. The responsibility to assist the coastal state is one that we have indicated that we are willing to accept. Probably, no matter what comes out of LOS, this is a responsibility that we are going to have to accept. It's very hard to drop back when you've already proposed such

assistance. U.S. institutions are going to have to accept some responsibility to relate their work more closely to the needs of the coastal states. Although this increases the cost to the researcher, this is a responsibility that must be assumed. I think many of us are assuming it poorly because we feel that this type of responsibility is something we should have accepted a long time ago.

HAROLD FISHER: I'm getting fuzzier the longer we go on here. I don't mean to terminate it by any manner or means, but I'd like to just state a couple of conclusions that I am beginning to form that might be a little bit helpful. We keep talking about science and technology and technology transfer. I notice the agenda here is scientific assistance this afternoon, but other documents on this same kind of a conference or even on this conference have referred to technology transfer. I think we might get into that, but then we talk about freedom for science and the relations between freedom for science and the law of the sea, and so on and so forth. I would like to suggest that we narrow our considerations down to science. Having a commercial background, I don't want people to think that I'm trying to rule out the transfer of technology. I'm not, but I just think it gets too big and too complicated.

I'd like to just review very quickly the situation. The first time I came in contact with the problem of technology transfer, it really was almost a trade-off for a freedom of science position and the law of the sea. This, as I understand it, has pretty much disappeared as a possibility. I'm not sure it was ever a good trade-off anyway because of the time factor involved and the fact that you didn't really have time to sell to all the countries what you had to sell, before the Law of the Sea Conference was about to make decisions, and so forth. It seems to me that what this has developed into now--this science, technology, whatever you want to call it--is the development of a science capability. Even though

it is not directly related as a trade-off for the law of the sea or freedom under consent regime or anything of that sort, it's somewhat the same thing in a way, in that it's a belief. I think that having a science capability in another country would make them more acceptable to either a revision of the law of the sea or to a reasonable method of giving consent when I wanted to develop a cooperative program.

Confining my thoughts to science, for the moment at least, I don't think any of these countries are going to be able to afford science programs just for the sake of science. In other words, they're going to have to see it closely related to their own economies. It's very important that this be kept in mind, but you can't do it when you're talking about one hundred or more countries. We ought to keep narrowing this thing down. There are probably some countries to which it's more important to give scientific assistance than to others because you value their cooperation or you want to work in their area more than you do in some other places. We have to narrow down what it is we're offering as our contribution and perhaps narrow down the number of countries we're talking ing about selling on this idea, because this is a selling proposition. You either have to sell them on the Law of the Sea Conference or you have to sell them later on under a consent regime of some sort. So it's really a sales proposition, much as we scientists, if I may call myself one for the moment, don't like to get involved in trading situations.

JOHN LISTON: I'm not quite sure I understood precisely what the last speaker was getting at. In a negative way, however, he touched on an important point, particularly in relation to science capability transfer or whatever one wishes to call it. One has to recognize the complete and direct linkage between science and technology. These are not separate items. One arises out of the other, and one

influences the other. In our society, and I tried to make this point earlier, we are so used to science-based operations that we do not see the continuum nature of this whole process. And in looking to technology transfer or science transfer, or whatever one wishes to call it, I think it's necessary to consider this in relation to the whole and to look, as you said, to the development of a science base in a country that clearly has some kind of payoff in technological terms that can be seen by that country and not sell it simply as an intellectual need that we are trying to satisfy. Of course, we are trying to satisfy an intellectual need. I tried to make the point in my rather hurried address the other day that, in many developing countries, part of the task is to re-orient the thinking of the decision-makers in more scientific lines. They don't think in scientific lines. They think in terms of traditional nonscience concepts that are very strong in many otherwise seemingly sophisticated countries where religious aspects and almost submagical concepts are substituted for a rational scientific view of life. I think this has to be changed in some way, if in fact the country opts for a technological society. I would submit, then, in effecting this and at the same time in supporting any technology transfer, it's necessary to develop a science competence that is directly linked to the practical benefits of science, i.e., technology.

CHANDLER MORSE: To bring this to a conclusion, I would like to say just a few words that occurred to me in the last few minutes. First, I wonder if it might not be helpful to focus our minds in a somewhat different way, to think of what we're trying to do as the transfer or creation among countries of the capabilities to exploit their marine resources. I mean that's what they're really interested in. Once you start with that, then any scientist will know how to proceed. He has to know what the resource is; he has to know its characteristics. This requires some research. He also has to find out, in the

case of the oceans, what resources there are that nobody knows about as yet. This requires other kinds of research. Once you know that, you also have to know something about what the needs of the country are that this kind of resource or these resources might satisfy. This leads you in still other directions for research and, finally, for organization of production and so forth.

Now we have in this country something that has not been mentioned in this conference, i.e., agricultural extension services, which really operate exactly this way. In the land-grant colleges, you have agricultural extension research specialists who teach and do research. The results of their research can and do go out in two directions. In one direction, they go out to the field extension men who are in continual contact with the farmers and who convey the information from the research specialists down to the practical farm level. In the other direction, they go out to industry, so that industry can manufacture the equipment or introduce the product innovations that have been implied by the research. Since this conference is financed by Sea Grant and since Sea Grant is under legislative mandate to look into and to come up with a report on the possibility of an international Sea Grant program, it seems to me that it is appropriate to consider extension services as one of the components of what we're trying to do here. In that connection, however, I think we have to remember one thing. Our own extension services provide careers for people in the United States. This is very easy. It provides careers at various levels. What about an international Sea Grant extension service? Would most of them have to be, at least, the actual people with whom people from abroad would be in contact? Would they have to live abroad for long periods of time? Is this a possibility? I'm inclined to think it is. In any case I think we might try to take some note of the colonial civil services in keeping professional people abroad. I'm not talking about

administrators, I'm talking about the scientific people, the irrigation people, and so on; i.e., those people who will live abroad for twenty years to do essentially the kind of thing that we've been talking about as necessary for the developing countries. So, if Jerry van Andel's suggestion of a study is to be made, I hope that it will not only focus on the needs of the developing countries, the need to determine what resources they have and what problems have to be solved, but also will consider the possibility of generating an international extension service approach to this whole problem.

APPENDIX A

## ABBREVIATIONS

| | |
|---|---|
| FPC- | Fish Protein Concentrate |
| GEOSECS- | Geochemical Ocean Section Study (IDOE program) |
| G&G- | Geology and Geophysics |
| IBP- | International Biological Programme |
| IGO- | Intergovernmental Organization |
| IMSAP- | International Marine Science Affairs Policy Committee |
| MODE- | Mid-Ocean Dynamics Experiment (IDOE program) |
| NASCO- | National Academy of Sciences Committee on Oceanography |
| NGO- | Non-governmental Organization |
| OMB- | Office of Management and Budget |
| R&D- | Research and Development |
| R/V | Research Vessel |
| S/T- | Science and Technology |
| USDA- | U.S. Department of Agriculture |
| WDC-A- | World Data Center-A |
| WG- | Working Group |
| WMO- | World Meteorological Organization |

APPENDIX B

# OCEAN POLICY COMMITTEE

# CONFERENCE ON

# U.S. MARINE SCIENTIFIC ASSISTANCE

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