

Education and training in marine-related occupations

by

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Abstract: Education is an important force in bringing about social change, as witness the effect of the Land Grant College on the rural population in the U. S. The economic, social, and political importance of the oceans is growing for all coastal nations, developing as well as developed. The recent establishment of Sea Grant Colleges in the U.S. is an important factor in the education and research necessary for the development and wise management of the oceans and their resources. Some parts of the sea grant program may be applicable outside the U.S.

As a member of the educational establishment, I address this subject from a certain perspective or bias. Let me make these points first. In my view, formal education is the single most important method to bring about lasting social and economic change. Who one educates and how one educates are critical issues which override the particular subject of this symposium, "education and training in the marine sciences." To illustrate this point, consider the Land Grant College of the U. S. which I plan to say more about. The decision to establish a system of higher education for what in many countries would be regarded as the peasant class, was perhaps the single most important institutional step of the last century to insure equality of opportunity for the people of the U. S. What is perhaps more important to the subject of this conference, the Land Grant College has been the means of developing the science and engineering knowledge and skills that have played such an important role in the development of U. S. agriculture.

My second point is self-evident but, I believe, worth restating. There are a number of differences between the developed and developing world. Some of these differences have to do with availability of natural resources, gross national product and access to capital for development. But there is one area in which there appears to be no inherent difference between the developed and developing world, and that is in the intellectual capacity of its people. Scholarly studies abound which suggest that, given equal opportunity and environment, it is apparently impossible to find any meaningful statistical differences between the intellectual capacity of persons of different races or nations.

I am less certain, however, that the apparently obvious corollary follows: namely, that successful educational programs in one country can be transplanted

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successfully to others. I feel very uneasy discussing marine education and training in the U. S., and by implication, suggesting that these same institutional arrangements will succeed in Latin America. They might, but probably not without at least some modifications to meet differing social structures. However, if there is any contribution I can make to this subject it is to discuss a few of the things I am familiar with and not to speculate too much as to whether these ideas can be transplanted elsewhere. I leave that to others who may be better informed.

First, let me address the opportunities in marine-related occupations since there is little point in discussing education if there is no opportunity to practice the skills one learns. I began my career as a marine scientist immediately after World War II. At that time interest in the oceans was very limited in the U. S. With the exception of a few dreamers, such as Roger Revelle, one of our co-arrangers of this symposium, the interests were limited to a few naval and fisheries persons, and even their interests in the ocean were very limited by present standards.

Today, one does not need to be a dreamer to recognize the importance of the oceans and their resources, and by implication, the role of education and training in marine programs. One measure of the importance which governments attach to the oceans can be found in the continuing Law of the Sea Conference where some 150 nations have been struggling since 1973 to write a new international agreement, including jurisdictional boundaries, resource management, and a host of other activities, including the very important issue of marine scientific research.

Regardless of how the treaty from Law of the Sea (LOS) Conference is resolved, it is clear that we now have a new zone in the ocean, the 200 mile zone. In Latin America it has often been referred to as the "patrimonial sea." In the language of the Law of the Sea Conference, it is the "exclusive economic zone." On a worldwide basis this zone covers an area equal to about 36% of the ocean: 36% of the ocean is an area almost as large as the total land mass of the earth. Within that zone each nation will have near exclusive jurisdiction over its economic resources such as fish and oil and will have certain rights and authority over such matters as pollution control and marine scientific research, although the exact language of the treaty which will determine the extent of these jurisdictions has not been agreed upon.

Even if the LOS Conference should fail to agree on a treaty, most observers assume that the concept of the 200 mile zone will soon become what jurists refer to as "customary international law". Thus, regardless of the treaty details, it is clear that every coastal nation will have both a great opportunity to develop the resources of this area as well as a great responsibility to manage these resources wisely. Coastal nations will have to decide whether to develop these resources by themselves or to lease or rent these rights to others. Historically, most nations have opted to invite the big international oil companies to develop their offshore oil reserves for a price. They will now have the same opportunity with respect to the fishery resources in their 200 mile zone.

Whether nations decide to develop the resources themselves or sell the development rights to others they will need well-trained geologists and fisheries experts who can represent the coastal nations in these negotiations and to monitor the development of these resources. Fisheries management is a particularly complex field. In the view of many of my colleagues, there are not enough well-trained fisheries management people in those nations with major fishing programs, let alone in those nations with embryonic fishing industries. We in the U. S. are very concerned about our own ability to manage this resource wisely. We lack sufficient

knowledge and sufficiently well-trained persons. I believe the problem is universal.

For a nation such as the U. S. which plans to develop its own fisheries resources we must be concerned about more than fisheries management. We are concerned about the lack of skills of many of our fishermen, and perhaps even more important, our ability to process and to develop markets for the fish we catch. Thus, development or expansion of a fisheries resource requires well-trained people in a variety of skills from economists, food processors, and fisheries biologists to those who can maintain fishing boats and mend nets.

As an example of the rapidly expanding interest in the oceans I think it worth noting the number of traditional land-based professionals that now have a marine equivalent. We now have "marine farmers" for the development of mariculture, marine engineers for the development of offshore structures for deep water ports or offshore nuclear power plants, marine health scientists to study marine pollution, marine resource economists who understand resources of the sea, lawyers who specialize in law of the sea, and planners and architects who are concerned with multiple use conflicts in the coastal zone. The point I wish to emphasize is that the variety of marine-related professions is growing rapidly. Twenty years ago most of these occupations did not exist, or provided very limited opportunities. The range of opportunities and the number of opportunities is growing rapidly and, in my view, it is going to continue to grow.

How then does one develop an educational and training program to meet these needs? I am convinced there is no single, best solution, but in the U. S., at least, we have had considerable success in the past ten years in the development of what we call Sea Grant Colleges. The name "sea grant" was chosen to connote the marine equivalent of Land Grant Colleges. Every state in the U. S. has a land grant college and it is our goal to have one or more sea grant colleges in every coastal state in the U. S. A unique feature of land grant colleges is that they combine education, research, and public service activities on the food and land resource needs of the region. They teach the latest in agricultural sciences; they engage in research on local agricultural problems, and most important, land grant extension agents work with the local farmers, assisting them in their problems. These extension agents provide a bridge between the research and education of the college and the user groups in the field.

Those familiar with the Land Grant College system in the U. S. know that the programs are much richer and more diversified than I have indicated. For example, there are strong engineering programs in Land Grant Colleges, and the agriculture programs are not limited to the growing of food, but include processing, marketing and nutrition, as well as programs in economics and business-related matters. A special feature of all Land Grant programs, however, is that each focusses on the special needs of the people of the region and each has closely interlocking programs of education, research, and public service directed towards these needs. As noted earlier, the Land Grant College system has been an extraordinarily potent force for social change in the last hundred years for the farmers and rural populations of the U. S. And Land Grant Colleges are given much of the credit for the development of the marvelously efficient and productive food producing system in the U. S.

The Sea Grant program in the U. S. is barely ten years old and is patterned in many important ways on the land grant system. It combines education, research, and working closely with the marine community. It has a heavy emphasis on fisheries, but it is not exclusively a fisheries program. Sea Grant supports a variety of education, research and public science programs in such disparate fields as

marine pollution, studies of estuarine circulation, coastal zone management and marine law. Much of the research is applied research, in the sense that it is directed toward the needs of the local community. Many of the ideas for these applied research programs come from the extension agents in the field who report back to the university on vexing and interesting problems they have encountered.

Equally important, many of the Sea Grant professors are involved in all three activities. By working with user groups in the field, they gain a better understanding of the problems that need solving in the laboratory, and their classroom teachings reflect the relevant needs to the students who will soon be out of college and earning a living.

The results of the Sea Grant program are already evident. A small but growing number of modern-trained fishermen are entering the fishing fleets. New fishing techniques are being developed as well as new markets for the fish caught. We have recently embarked on a major national program in the U. S. directed toward better utilization and management of the coastal zone. Sea Grant has been responsible for much of the research and studies which have provided the basis for these coastal zone plans, and Sea Grant trained persons are deeply involved at all levels of this coastal zone program; its national director is a Sea Grant graduate.

In my experience, the interaction of students, faculty, and extension agents; of research, education, and public service; of applied research and basic research combine to provide a unique intellectual ferment and excitement which cannot be matched in any government or industry laboratory. In the U. S., at least, I am convinced it produces beneficial results that are difficult to duplicate in any other way.

I am unsure whether or not such a program can be transferred successfully outside the U. S., but I think it can, at least in part. A number of us have been working hard the past few years for the development of an international Sea Grant program. I am pleased to say that under the continual urging of Senator Pell of Rhode Island, it appears we are about to have modest funding for the start of such a program. The guidelines for its development have yet to be clearly formulated.

In closing this discussion of Sea Grant, I would like to say a few words about the role of continuing education. I mean by that term a variety of nontraditional educational programs designed specifically for those people who have completed their formal education. Continuing education in Sea Grant takes many forms; let me note just a few we have been involved in at the University of Rhode Island. We have run a series of special courses for fishermen and shipyard persons on repair of diesel engines. We have run special two week programs for officers of the U. S. Coast Guard and NOAA Officers Corps on fishing techniques and practice. These gentlemen are charged with assisting in the regulation and enforcement of U. S. fisheries regulations and they have found it useful to have firsthand experience in learning professional fishing techniques and practices. We have run a series of one- and two-day workshops on a variety of programs, everything from developing marine science materials for elementary school teachers to explaining recent development in coastal zone planning to groups charged with coastal zone regulations. We have run a few international programs in conjunction with the UNESCO: one in cooperation with Woods Hole and the U. S. Navy Oceanographic Office on oceanographic data management for scientists from developing countries and a two week seminar of our own on marine affairs for a group of mid-management marine specialists from Ecuador. Perhaps our most ambitious effort in what might be loosely defined as continuing education is a one year

mid-management program which leads to a Master of Marine Affairs degree and is primarily designed to give persons with some science or engineering background a broader understanding of economics, law, geography, and coastal zone management as it relates to marine activities.

By listing programs at the University of Rhode Island I do not mean to imply that we are unique in this field, because a number of other universities run somewhat comparable programs. What I do wish to emphasize, however, is the importance of such programs. Too often discussions of education and training concentrate on the more formal and traditional modes of education. In my view two-day workshops, and two-week seminars are also important means of education, as are formal educational programs especially designed for those who have completed their traditional education some years previously.

So far this discussion has been primarily about the education and training of those who use the ocean and its resources. Let me close with a few words about the education of those who study the ocean; the marine scientist. I was trained as a marine scientist and am associated with an oceanographic program that graduates about 25 Master's and Ph. D. students a year in oceanography. Advances in instrumentation and computers have opened up a spectacular set of problems for attack and eventual solution. Our understanding of the geologic processes of the earth has undergone a revolution recently. The theory of plate tectonics has provided a conceptual base for understanding geological processes which is somewhat analogous to that provided to biologists 100 years ago by Darwin. The basis of this geologic theory came from oceanographic observation of the earth beneath the sea. There have been major developments in other fields of oceanography as well; in our understanding of ocean circulation and internal waves, in the cycle of chemical species in the ocean and in the processes controlling primary biological productivity.

Twenty-five years ago most marine scientists had their formal training in biology, chemistry, physics, mathematics or geology. Few had any explicit training in marine subjects, let alone a degree in oceanography. Their education in oceanography began *after* they left the university and began to work on ocean problems. Today the picture has changed considerably. It is still possible to become a marine scientist without any formal training in marine subjects, but proportionately fewer are doing so and I believe it is becoming more difficult. I think the reasons are twofold. First, there has been a sharp increase in the number of first class Ph. D. programs in oceanography and related fields. Thirty years ago there was only one institution in the U. S. that had a formal educational program in oceanography as such. In the United States today there are about 10 programs with 100 or more graduate students and there are perhaps another 50 with at least 20 graduate students. Second, the knowledge explosion in oceanography has been staggering. As a result it is no longer as easy as it used to be for a bright young Ph. D. chemist to move into oceanography and compete with an equally bright young scientist with a Ph. D. in chemical oceanography. It is my belief that there will always be room in the oceans for those trained in the more traditional disciplines; but it is also my view that in the future, these persons will be in the minority and not the majority, as was the case a few years ago, and is perhaps still the case today.

In summary, I am optimistic about the opportunities in the ocean, and therefore, the need for trained people. The opportunities extend beyond the traditional fields of oceanography and marine science, as I was brought up to understand the field, and include a number of the social sciences, as well as training

at all educational levels from high school through the Ph. D. The Land Grant College system which combines education, research, and public service has played an important role in developing the present social structure of the U. S. and in developing our magnificent agricultural program. We have reason to hope that our relatively new Sea Grant Program will achieve similar results in marine-related areas. I suggest somewhat hesitantly that perhaps, at least some parts of the Sea Grant Program concept might be transferrable to Latin America.

RESUMEN

La historia nos enseña que las mejoras sociales corren parejas con el nivel de educación de los pueblos que las promueven, testigo de ello es el efecto que han tenido las universidades agrícolas estatales sobre la población rural en los Estados Unidos. La importancia económica, social y política de los océanos va cada día en aumento para todas aquellas naciones con costas marinas, ya sea las desarrolladas o las que aún se encuentran en su fase de desarrollo. El establecimiento reciente de universidades estatales dedicadas al estudio de las ciencias marinas en los Estados Unidos es un factor importante en la educación y la investigación necesarias para el desarrollo y el buen manejo de los océanos y sus recursos. Aunque no siempre se puede aplicar la tecnología de un país a otro de condiciones y costumbres muy diferentes, algunos aspectos de estos programas sobre estudios marinos se pueden aplicar fuera de los Estados Unidos.