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SUMMARY OF STATEMENT BY DR. REVELLE

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*Needs for* INTERNATIONAL COOPERATION IN OCEANOGRAPHY

In considering the needs for international cooperation in the Marine Sciences, it is convenient to divide the problem into three parts: research, oceanic surveys and assistance to under-developed countries.

By oceanographic research we mean: attempts to discover new principles, testing of hypotheses, development of new techniques, conduct of experiments, and exploration of unknown areas in order to define scientific and technical problems. In general, oceanographic research, like many other kinds of research, is best done by individuals or small groups working independently. However, there are some research problems that require international cooperation. For example, the exploration of an almost unknown area such as the Indian Ocean can be accomplished more rapidly and more effectively by the cooperative efforts of ships and scientists from many countries. Scientific problems that require nearly simultaneous observations over a wide area or over the entire ocean also demand international cooperation in taking the observations, and close coordination to insure comparability of results. An example is the present attempt to determine the total carbon dioxide content in the atmosphere and the change in this content with time as a result of the input from fossil fuel combustion and the loss to the ocean and biosphere. One of the questions we are asking is: Where is the carbon dioxide absorbed by the ocean? Does it remain in the surface layers or does it extend throughout the ocean volume? Another example is the proposal to study the transient state of the sub-surface currents in the Indian Ocean under the action of the changing monsoon winds. To attack this problem, synoptic observations made by many ships in a relatively short period of time are needed.

By oceanic surveys we mean the systematic collection of data which will enable us to make maps. Three kinds of surveys can be envisaged:

1. Bathymetric, magnetic and gravimetric surveys of the deep sea floor and the sediments and rocks beneath the sea. Except for the shallow rims of the oceans, our maps of the ocean basins today have about the same accuracy and detail as maps of the land areas of the earth made in 1720. Thus, in our oceanic maps we are about 250 years behind the maps of the land. One of the reasons for this is that the techniques for making maps of the deep sea floor have been developed only within the last twenty years, and the needs for making such maps have evolved only very recently.

2. Measurements of the properties of the ocean waters, temperature, salinity, oxygen, plant nutrients, and density and currents where possible. We want to know not only the average annual conditions, but also the seasonal variation in these conditions, and to obtain synoptic pictures which can be compared from year to year.

3. Surveys of the biological conditions and the rates of organic production in the ocean. No one knows at present how many fishes there are in the sea, and experts differ in their estimates of the total organic production in the oceans. Because of differences in the methods used and in the interest of the scientists involved, biological data from different areas cannot now be compared. Consequently, it is important to make meaningful biological maps of the ocean as a whole.

All three kinds of surveys can be conducted with the required accuracy and detail by engineers and professional surveyors working under the guidance of a relatively small number of oceanographers.

In assisting the development of the Marine Sciences in the under-developed countries, the primary need is for training young scientists, to teach them not only how to make observations but also how to interpret their observations, to understand the purposes of making the observations, and the results that can be obtained in attacking scientific problems of the oceans.

International cooperation in research is probably best carried out by voluntary agreements among participating scientists, backed up with funds by governments. In the marine sciences, the Special Committee on Oceanic Research of the International Council of Scientific Unions represents an appropriate mechanism for planning and coordination, because it represents the scientists who want to carry out the research.

All three kinds of oceanic surveys are probably best conducted by governmental agencies. For example, in the United States, the Hydrographic Office, the Coast and Geodetic Survey, and the Bureau of Commercial Fisheries have surveying as one of their primary missions. In surveying, the role of international organizations should be one of coordination: agreement on areas, insuring that the measurements are comparable and accurate, and arrangements for the free exchange of results between the countries.

As for helping under-developed countries by training their young scientists and in other ways, this is most appropriately a UNESCO project. UNESCO can stimulate the countries to help themselves, and it can provide experts, fellowship programs, needed equipment and support of regional cooperative arrangements. One of the ways in which UNESCO might help these countries most effectively might be through support of an international oceanographic ship which would serve as a new focus for oceanographic activities and training in the areas where it operated.