DEPARTMENT OF OCEANOGRAPHY
UNIVERSITY OF WASHINGTON

Technical Report No. 20

PRESENT STATUS AND FUTURE DEVELOPMENT OF OCEANOGRAPHY

With An Appendix

EDUCATIONAL OPPORTUNITIES FOR OCEANOGRAPHERS IN THE UNITED STATES AND CANADA

University of Washington &
Office of Naval Research
Contract N8onr-520/III
Project NR 083 012

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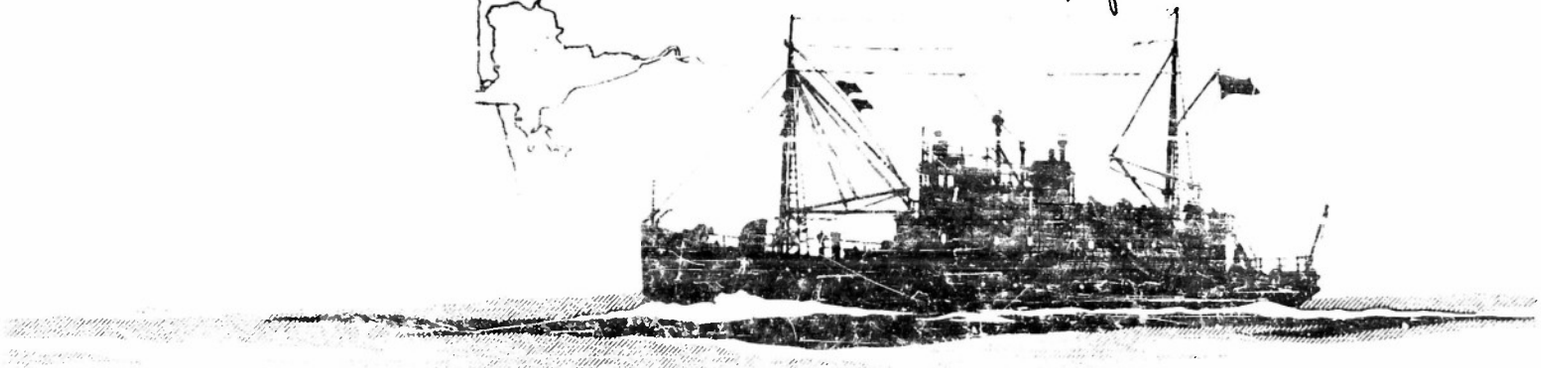

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by

Richard H. Fleming

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Richard H. Fleming
Executive Officer

The following paper was presented at the Eighth Pacific Science Congress, Quezon City, Philippine Islands during November 1953. It will be published in the Proceedings of the Congress at a later date.

Due to the number of requests for copies of the paper it was felt that it would be worth while to issue it in mimeograph form to interested individuals and institutions in this country. In order to insure wider distribution it is being released as a joint technical report of the Department of Oceanography and the Office of Naval Research (Contract N8onr-520/III).

Extra copies of this report may be obtained by request to the Department of Oceanography of the University of Washington.

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INTRODUCTION

Among those engaged in the ancient and honorable profession of teaching, it is often said that "the best way to learn about a subject is to have to teach it." To this I can heartily subscribe, and it is from the vantage point of the professor's podium that I am going to review some of the characteristics of oceanography and to indicate ways in which the scientific study of the seas might be fostered and developed.

Oceanography may be defined as the scientific study of the oceans and of their relation to man. This is intentionally stated in very broad terms. The science of the seas is developing rapidly, its content and concepts are changing, and at this stage of its growth it would be foolhardy to attempt to formulate a precise definition. Because it is a young science and because of the various approaches that have been followed by individual investigators, there is no general agreement as to the content and objectives of oceanography. It is, therefore, essential that I state clearly my own point of view. I repeat the definition: "Oceanography is the scientific study of the oceans and of their relation to man." I am sure that there can be little argument about the first phrase, but it is upon the impact of the seas on man that I wish to place particular emphasis. This brief phrase includes all of the innumerable problems of the applications of oceanography. Some of these are obvious and are well recognized; others are more obscure or have not yet received the attention they merit.

Possibly my position will be more clearly defined if I add the following objectives. I believe that it is the broad purpose of oceanography to understand the present conditions, to interpret past conditions, and to predict future conditions. Many of the most fascinating and important tasks of oceanography are in the borderline fields between the study of the present oceans and the interpretation of the geological and biological history of our earth. It is, therefore, obvious that a proper share of our efforts should be directed towards the development of what may be termed paleo-oceanography in order to properly understand the role that the oceans have played in the development and evolution of life, in the earth-shaping processes of erosion and deposition of sedimentary debris, and in the geochemical partition of the elements.

To turn to the other aspect of oceanography, the ability to predict future conditions, it is in this realm that we find most of the practical or economically-important applications of oceanography. We are dealing with many complex processes that are often beyond the grasp of existing theory. Some predictions, such as those for the tides, have been dealt with in a satisfactory way as far as practical needs are concerned, but it must be recognized that our understanding of the actual physical hydrodynamics of the tidal movements is only fragmentary. The development during the last decade of our knowledge of the growth and decay of wind-generated waves is an inspiring example of the progress that can be achieved when there is an urgent need for a method of forecasting.

I have said that I intended to speak to you as a university professor. This implies that I believe in the importance of teaching

and formal training in oceanography. The topics just mentioned would appear to fall more properly within the spheres of research and engineering applications. Once more to define my position I should say I feel that formal training, research, and practical applications cannot properly be separated. Teaching without research and regard for application is sterile. Applications without training and supporting basic research is self-terminating. Research on the sea without proper knowledge of the subject matter of the science can be wastefully repetitive and neglectful of the important basic problems.

DEVELOPMENT OF OCEANOGRAPHY

I have defined oceanography as the scientific study of the seas. The question may still exist as to whether or not oceanography has yet achieved the status of an independent science. If we briefly review some of the characteristics of a science, I am sure you will agree that, although it is still young, the science of the seas is an individual field of natural science.

To deserve recognition on its own merits, a science must have developed its unique techniques and its own individual body of knowledge. It is obvious that in the early phases of investigation in a new field the techniques employed are initially those of the older sciences. The unique problems involved in the investigation of the biological, geological, chemical, and physical characteristics of the seas can only be attacked by special devices, and the last seventy-five years have been marked by the development and use of techniques that are peculiarly restricted to such investigations. The sonic

depth finder and the GEK (Geomagnetic Electro-Kinetograph) might be cited as examples of what I have in mind.

Just as early techniques are drawn from the established sciences, so the results of early researches published in the existing scientific journals are assimilated into the knowledge of their respective fields. However, with the development of individual techniques and the growth and expansion of oceanographic knowledge, journals and other means of publication have been established and have grown to a point where the subject matter has long since outgrown the parent sciences from which oceanography can be traced. The rapid increase in the number of periodicals devoted to contributions in oceanography, as well as the ever-increasing number of individual volumes concerning the oceans, offers clear proof that there is now a unique body of knowledge that is not assimilated into the older parent sciences.

To achieve status as an individual science it is obvious that the field must be recognized as a profession; that is, experts in the field must be employed under the title of their specialty. This means that the government, industry, and the public in general must recognize that this is a unique profession. Last but not least, universities and scholars in general must accept the field as worthy of admission to the exclusive ranks of academic subjects appropriate for teaching as well as for research.

Oceanography, in the United States at least, has met all of these requirements and must therefore be prepared to accept the responsibilities as well as the privileges that accompany independence and maturity. These responsibilities involve not only the development of the science in all its aspects but also the broadening of the scope

of teaching and research so that students and investigators in other subjects may have the opportunity to glean from the harvest of oceanography those items of particular value to them.

CHARACTERISTICS OF OCEANOGRAPHY

Oceanography always has been and always will be a truly international science. The water masses and the life in the seas recognize no arbitrary man-made boundaries, and the problems that must be dealt with are common to all countries engaged in marine investigations. The oceans are so vast and their problems so complex that satisfactory progress in their study can only be achieved through the combined efforts of all nations.

If the observational data are to be accurate, easily understood, and readily usable, it is obvious that there must be uniform standards of accuracy, uniform methods of analysis, and generally accepted units for reporting of data. The world-wide use of Standard Sea Water (Eau de Mer Normale), prepared in Denmark, as the precise standard for salinity determinations is a classic example of the value of uniform standards. That this service is of importance on an international basis is shown by the fact that it now receives financial support from the United Nations Organization through UNESCO and is sponsored by the International Association of Physical Oceanography. As a step towards the standardization of methods of chemical analysis, treatment and analysis of data, the latter organization also has in preparation a "Technical Handbook on Physical Oceanography."

To further facilitate the exchange of new ideas and techniques and to attain the desirable uniformity in standards and methods, it is