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Oceanic Research.

IN his presidential address to the British Association at the Cardiff meeting of 1920, the late Sir William Herdman suggested that the time had come for a new deep-sea expedition on the scale of the *Challenger* voyage of 1872–74. This proposal was discussed at various Association meetings; a tentative scheme was approved and was then submitted for the consideration of other scientific bodies. The time, however, was regarded as inopportune and the proposal was not taken up. Now, it appears, the movement may come from the United States.

In 1923, Dr. H. C. Hayes, of the U.S. Navy, developed a very ingenious method of taking almost continuous ocean soundings by means of a sound-wave transmitted to, and reflected back from, the sea bottom. This "echo-sounding" presented such possibilities for oceanographic surveys that definite suggestions were made for a national expedition, and, after considering these, Col. Theodore Roosevelt, the Acting Secretary of the U.S. Navy, summoned a meeting of representatives of government departments and extra-governmental establishments. This was held in July 1924, and was addressed by the Hon. Curtis D. Wilbur, Secretary of the Navy. A committee then prepared a report which was adopted by the conference and sent to the Secretary.

The report recommends that a vessel, with officers and crew, should be supplied by the Navy. A scientific staff, consisting of an oceanographer, a biologist, and a geologist—all men of outstanding attainments—with six or more scientific assistants, will, it is expected, be provided from sources other than government funds. The cost of the first year's work, apart from the maintenance of the vessel and the salaries of the scientific staff, is estimated at about 57,000 dollars. How long the expedition will be away is not considered, but it is contemplated that a naval vessel will be permanently employed on oceanographic research.

The problems upon which the expedition is expected to concentrate are briefly outlined—they constitute a programme which is new, in some ways, and particularly attractive. The work of the *Challenger* was very comprehensive, but, in the main, it was biological in its attitude. Now, since 1872, the science of geophysics has been developed, and more attention is being directed to the morphology of the ocean floor. Existing oceanic soundings are so few that they are of little use in detailed studies, and so the method of finding the depth by echo-sounding must be largely used in any new oceanic expedition. During the last twenty years or so, a very extensive investigation into the subject of isostatic compensation in the earth's crust has been made by

the U.S. Coast and Geodetic Survey. The work accomplished has, however, been practically restricted to the North American continent, and its extension to the ocean floor and the deeps is most desirable.

Other geophysical problems demand close observations of the precise forms and positions of the deeps—the question, for example, of the downward warping of the ocean floor along the continental margins suggests the need for great numbers of new soundings in all regions. Evidence of submarine upheavals and dislocations, and of the occurrence and frequency of submarine earthquakes and volcanic eruptions, is urgently needed. There is necessity for a renewed investigation of the deposits on the ocean floor. Determinations of mean ocean depth in chosen places are needed. Oceanic tides have scarcely at all been investigated, and even ocean currents are not so well known as they ought to be. The forms, heights, and velocities of ocean waves also require study.

Further, the great development of radio-telegraphy and telephony has suggested problems for which a much extended knowledge of electrostatic and electromagnetic fields in the atmosphere is required. Since the ocean covers five-sevenths of the earth's surface, most of this kind of investigation must be undertaken at sea. The distribution of icebergs on the margins of steamship routes is already being studied by the U.S. Government, but a great extension of the field of investigation is necessary. Now, in addition to all these subjects of investigation, there are, of course, the routine physical and biological methods of research into the ocean water itself and the fauna of the sea floor. This would be done as a matter of course, but it is very interesting to see how "up-to-date" in its attitude to growing science is the programme for this new expedition.

It is recommended that the area of investigation should (at first) be the Gulf of Mexico and the Caribbean Sea. Then the research is intended to spread through the Panama Canal and to take in the North Pacific on one hand, and the North Atlantic on the other. At the present time oceanographic investigation of the Pacific Ocean is by far the most attractive side of the subject. There we obviously have ocean basins and continental margins *in the process of making* (for in the greater part of the Atlantic something like stability has been reached, and the problems there centre round sedimentation on the region of the continental shelf). A geophysical expedition dealing with the oceanic part of the earth's surface (for that is evidently what the present trend of scientific discovery suggests) cannot afford to concentrate on any relatively small part of the Pacific and Atlantic areas—the whole of the former region requires multitudes of ocean soundings at the very least. If, then, this big American expedition begins work very soon (and there is every likelihood that it will do so), the question of co-operation ought to be considered: it is a pity that such action was not discussed, and proposals of some kind made, at the conference.

At all events, the time is ripe for a consideration of the position of oceanographical investigation by Great Britain and other countries. For a long period now the objects of deep-sea expeditions have been very much the same as those of the *Challenger*—that is, the study of abyssal and pelagic ocean life, with the investigation of the physical conditions that influence the distribution and density of faunas and floras. Since the beginning of the work of the International Council for the Exploration of the Sea, oceanic research has had a strong fisheries bias, and, at the present time, a great deal of such investigation is actually in progress in the north European region: this is likely to develop still further its utilitarian and fishery objects, and its interest tends to become a very specialised and even an administrative one. We plead here for an interest which is much wider and should be purely scientific. During the last twenty years or so (and largely because of the original work of the International Council) oceanographic physico-chemical methods have been well developed. Hydrodynamical methods, on the mathematical side, are remarkably well developed and are far ahead of the observational side of the science. This is also the case with theoretical geophysical research: it waits for a sound and very extensive basis of observations, and that cannot be given by any amount of geological work on the land, for research on the five-sevenths of earth surface that is occupied by the ocean is urgently required.

Every consideration points, therefore, to deep-sea investigation on rather new lines, and the progress of geophysical and hydrodynamical research on one hand, and of oceanic meteorology on the other, suggest what these new directions ought to be. Now that a lead has been given by the proposed American naval expedition, it would be very gratifying if a similar British naval one could be planned out, and if it could be arranged that a large measure of co-operation of aims and methods were secured. In spite of all that has been done in Great Britain on fishery investigation, it is nevertheless true that scientific oceanography has been neglected ever since the time of the *Challenger* expedition, and we cannot see any reason why a small fraction of the resources and interests of our Admiralty should not be directed to the prosecution of pure oceanic research without a necessary utilitarian object.