

began with the work of Professor Marsh in 1859 and has continued with distinguished success and fine results until the present day, a period of 80 years. For a long time vertebrate paleontology in North America was practically confined to Philadelphia and New Haven; and in 1880 Sir Archibald Geikie published in *Nature* an article headed "Yale College and Palæontology," which was an enthusiastic description of the marvels that he had seen during a visit to Professor Marsh.

Another aspect of this work which deserves to be emphasized is the gratifying cooperation it indicates between all the museums of the country, such an infinite improvement over the state of more or less declared hostility and warfare in the days when the famous Marsh-Cope feud overshadowed all the paleontological work of the country.

W. B. SCOTT

RESPONSE BY THE MEDALIST

To paraphrase part of a note recently received from Japan: It is with "the greatest honour and unutterable throb of heart I feel in offering you this word of thanks."

I am in a sense a successor of Othniel C. Marsh, for twelve years president of this august body, whose vast collections at Yale and the United States National Museum have not only greatly enriched our science but given those of us who followed him a duty and a privilege beyond compare.

Marsh's collections were made with a view to monographing in succession great groups of animals. Of his projected memoirs but two were completed in his lifetime—the Dinocerata and the Toothed Birds. For the others beautiful lithographic plates were prepared and many species described in a great number of papers published in the *American Journal of Science*. Upon Professor Marsh's death in 1899 my own preceptor, Henry F. Osborn, succeeded him as vertebrate paleontologist to the United States Geological Survey and proposed to carry out Marsh's original plan. He realized that this was too great a task for any one man to accomplish, and, while reserving for himself the Brontotheres or Titanotheres, the Proboscidea and the Sauropod Dinosaurs, he delegated other problems to his associates.

One of these, the Ceratopsia, was entrusted to J. B. Hatcher, to whom Marsh had given the task of collecting Ceratopsian material from the famous locality in the Lance formation of old Converse County, Wyoming. Hatcher succeeded so well that he secured 30 odd skulls and much skeletal material now in the Yale Peabody and National Museum.

Hatcher worked diligently at his task and had finished the discussion of the history of discovery, the morphology and systematic descriptions when his hand

too was arrested by death, leaving a bulky typescript but no further notes. My own connection with the work arose through having had some field experience in collecting Ceratopsia and in describing a skull which I had helped to collect, and as a consequence I was asked to complete the Marsh-Hatcher memoir. This was done, using so far as possible the conclusions of my predecessors, and the finished manuscript was presented to the United States Geological Survey for publication. A delay of one, two and finally three years made me begin to think that a strange fatality was in some way connected with the exploitation of these creatures of old, as in the case of King Tutankhamen's tomb, but by the grace of Providence I survived to see the memoir in its published form in 1906.

Since that time new discoveries have been made, especially in the Red Deer region of Alberta, where new forms came to light, dimly known in part from the earlier collections in the Judith River of Montana, but here displayed with such beauty and perfection of detail that one soon realized the incompleteness of the story as set forth in the memoir of 1906. Most of this new material was described by Lambe, Brown, Parks and others, but the need of assembling in memoir form the knowledge they had gained became more and more apparent. Having the facilities offered by a richly endowed chair at Yale and the courteous privilege of study in the several American and Canadian museums, we undertook the work, the result of which you have honored to-night.

It was fascinating to study the Ceratopsia, not as dry bones, but to visualize them as living creatures in an environment such as they may be found on earth to-day and to try to imagine their mode of life, their endowment of weapons and prowess, and why such apparent fitness availed them nothing when in the fullness of time their extinction came. Our task is that of a resurrectionist, for, as Robert Dick put it years ago,

Hammers and chisels and a'
Chisels and fossils and a'
Resurrection's our trade
For by raising the dead
We've glory and honor and a'.

And when to this is added recognition by the National Academy of Sciences, one's cup is filled. For this culminating honor I thank you!

RICHARD SWANN LULL

PRESENTATION OF THE AGASSIZ MEDAL TO HARALD ULRIK SVERDRUP

It is an honor to introduce to you as the duly selected recipient of the Agassiz Medal of the National Academy of Sciences for the year 1938 Harald Ulrik Sverdrup, Knight of the First Class of the Order of St. Olaf, member of the Academy of Science of Oslo, hon-

orary member of the Royal Meteorological Society of Great Britain, the German Meteorological Society and the geographical societies in many countries; the recipient of the Vega Medal in gold awarded by the Swedish Geographical Society, and of other medals and prizes; professor of geophysics in the Christian Michelsen Institute in Bergen, Norway, and director of the Scripps Institution of Oceanography of the University of California.

Before mentioning the accomplishments which constitute the basis of the award of the Agassiz Medal to Sverdrup a brief note will be made on the previous recipients of this medal. The medal was established in 1911 by Sir John Murray as a memorial to his friend, Alexander Agassiz. It was first awarded in 1913 to Johan Hjort. Between the establishment of the medal and 1938 it had been awarded sixteen times in thirty-four years. The countries of those to whom the awards had been made are as follows: Germany 1; Monaco 1; Netherlands 1; England 2; United States of America 3; Norway 4; Sweden 2; Denmark 2.

Prior to 1938 of the sixteen medals that had been awarded eight had gone to residents of Scandinavian countries, and four of the Scandinavians were Norwegians. We now add another Scandinavian, a Norwegian, to this list. Out of seventeen awards of the medal five have gone to Norwegians, giving clear evidence of the world leadership in oceanographic research of that country.

Before 1918, when Sverdrup took charge of the scientific work on the vessel *Maud* for Amundsen, although only thirty years of age, he had already published several important scientific papers. In fact, Sverdrup became an active producer of scientific papers as early as 1914, when he was only twenty-six years old, and he has since then, except while frozen in the ice on the north Siberian Shelf, had an unbroken record of important publications down to the present. In 1918 Sverdrup joined the *Maud* under Amundsen's general direction for a drift across the ice of the Polar Seas. The winters of 1918, 1919 and 1920 were spent frozen in the ice on the north Siberian Shelf. In 1921, however, the vessel needed repairs, and it went to Seattle, Washington, for reconditioning. During that time Sverdrup came to Washington, D. C., and spent his first winter here. The *Maud* left Seattle on June 3, 1922, and the winters of 1922, 1923 and 1924 were again spent frozen in ice in the Arctic Region. The expedition finally reached Nome on August 22, 1925, and the members of it were again in touch with civilization after an absence of three years and two months. On December 5, 1925, the party arrived at Seattle, Washington. Sverdrup spent, in the waters off the north Siberian Coast, six winters frozen up in the ice, except one escape. During this time he had many interesting experiences, some of which I trust

that he will at least mention to you. During the winter of 1919, the one escape, he went from Ayon Island and joined the Chukchi tribe, with whom he spent seven months.

Sverdrup says in his general report on the expedition, "When the ship was underway under her own power, the scientific work was very limited and restricted to ordinary meteorological observations because the ship had no special crew, and we had all of us to act as sailors. My duties were, for instance, to take care of the navigation of the ship and of the cooking. When we were drifting with the ice the scientific work was, on the other hand, given much time and the scientists received assistance from every member of the expedition." It is not possible in the brief time allowable for this introduction to say more regarding the reports on the *Maud* expedition than that they contained numerous valuable contributions to different aspects of oceanography, particularly tides and currents, and to many aspects of geophysics.

In 1931 Sverdrup had charge of the scientific work on the submarine *Nautilus* with Sir Hubert Wilkins for an expedition to the Arctic, and he was author of the reports entitled, "Part I, Introduction and Narrative," and "Part II, Oceanography."

Sverdrup has prepared reports on the results of other expeditions such as the one conducted by Sir Douglas Mawson in Antarctic waters, and he contributed one chapter to the discussions of dynamical oceanography in the reports of the Discovery Committee on its operations in south Polar Seas.

Since going to the Scripps Institution of Oceanography at the end of August in 1936, Sverdrup has made many cruises in the waters within a few hundred miles of the California coast and has published a series of brilliant papers. During March of this year he organized and took part in an expedition to the Gulf of California which has given us the first really scientific information on the fundamental oceanographic features of that most interesting body of water.

From what has been said it is obvious that Sverdrup has taken part in many oceanographic expeditions. He has not only prepared reports on the results of these expeditions but has been one of the leading contributors to the theoretical aspects of oceanographic problems. He is also one of the world leaders in modern dynamical meteorology.

Enough has been said to make it clear that the Agassiz Medal is being awarded to the proper person, but before closing these remarks something should be said about Sverdrup the man. He has spent a great deal of time in America. It has already been mentioned that he was in Washington during the winter of 1921. It was then that I first became acquainted with him. He spent some time in Washington while he was preparing the scientific reports on the results

obtained on the *Maud*. He was entrusted with the preparation of those parts of the report on the results of the *Carnegie* expedition in 1928 and 1929 that deal with dynamical oceanography and other physical and chemical aspects of the sea. While these reports were in preparation he was in Washington for some time. He was one of the advisers for the National Academy Committee on Oceanography and went to Woods Hole during the summer of 1928 and spent some time with the members of the committee. I well remember the pleasure I felt when my wife and I reached Bergen in October, 1932, and Sverdrup was standing on the pier to welcome us. Our first meal in Norway was in his house. Numbers of Americans not only know Sverdrup's scientific work, but have an intimate personal acquaintance with him. He is a man of the finest character in every way, who has made friends with every one in this country who has had the good fortune to know him.

Mr. President, in presenting the Agassiz Medal to Harald Ulric Sverdrup you give worthy recognition to scientific achievement of a very high order of merit and give pleasure to the friends of a man who has endeared himself to many in this country.

T. WAYLAND VAUGHAN

RESPONSE BY THE MEDALIST

I WISH to express my deep appreciation of the honor which has been bestowed upon me by the award of the Agassiz Medal for contributions to oceanographic research. It makes me especially happy that the award has been made by the National Academy of Sciences of the United States, because it has been my good fortune to be associated with American institutions since my very first contacts with scientific work. As a graduate student I became in 1911 research assistant to Professor Vilhelm Bjerknes, who, thanks to a grant from the Carnegie Institution of Washington, was able to start young men on scientific careers. Thus, at that time I was already indirectly connected with that institution, which later on cooperated with the *Maud* Expedition, and of which I have been a research associate since 1928. Through my contact with the Carnegie Institution I have made friends in this country, and it is thanks to these friends that I now can take pride in being a member of the faculty of the University of California.

Dr. Vaughan has said too many kind words about my contributions. It is a somewhat doubtful pleasure to listen to a review of one's own merits, but for reasons which I should like to explain I am glad that Dr. Vaughan mentioned my work in the Arctic. Certain mental hardships of scientific Arctic exploration are rarely discussed. I am thinking of the feelings

of uncertainty which often arise and which can not be dispelled because there is no adequate literature available for reference and no possibility for discussion with men of similar interest. On the *Maud* we started new investigations, we built new instruments, and I spent considerable time in theoretical studies of tidal currents. Although there were periods when I was so completely absorbed in the work that weeks and months passed quickly, there were other periods when I wondered and worried for fear I had made some elementary mistake, for fear the new investigations were suffering from systematic errors, for fear our new instruments did not perform as they should or that my theories were unsound. In such periods there was no one to consult, no literature to look up. Thinking back now I find myself again walking the deck of our vessel, turning the questions over in my mind, trying to find some flaw in my reasoning. In the end I always had to tell myself that, right or wrong, I was doing my best and would have to go on doing so, hoping that I was on the right track. Perhaps you will understand that an occasion like this brings ample compensation for all the hours of worry and uncertainty.

There is another matter I wish to mention to you. During the last winter in the Arctic, in 1924-25, we used to discuss what we wanted to do after returning to civilization. One of our party wanted to go to Peru, cross the Andes and, instead of drifting with the ice, to drift down the Amazon River on a raft. He did. I used to say that I should like an opportunity to do oceanographic work in the Pacific Ocean. It took me much longer to reach that goal. Although in 1930 I came into intimate contact with the problems of the Pacific through discussion of the excellent data collected by the *Carnegie*, it is only within the last three years that my wish has been actually fulfilled. In 1924-25 I thought of the Pacific Ocean as a pleasant contrast to the Arctic; now I am more than ever impressed by the tremendous amount of work as yet to be done in the Pacific Ocean, and by the fact that, in spite of the pioneering of Alexander Agassiz and Sir John Murray, large areas in the Pacific Ocean are still completely unknown from the point of view of the oceanographer. This fact has again and again been emphasized by Dr. Vaughan, who during his years as director of the Scripps Institution of Oceanography, greatly stimulated the interest in the exploration of the Pacific.

The Scripps Institution has a fortunate location and adequate resources for intensive studies of limited areas off the coast. While it can attack some of the many problems of the Pacific, a general exploration of the Pacific Ocean is an undertaking of such dimensions that no single institution can contemplate it.