XI

To theoretical immunologists the present transitional stage is the most interesting period since Pasteur and equally pregnant with potential clinical victories. To applied immunology, however, it is a period of humiliation, loss of faith in the guiding axiom of our forefathers, a new faith not yet sufficiently grounded for clinical application. A chaos in certain immunological specialties, with few immunotherapeutists "certain in their own minds whether they should be enrolled in future medical archives as honest empiricists or as ignorant charlatans." It is little comfort for them to realize that the basic guilt is not theirs, but rests in the archaic physiology in which they placed such implicit faith.

Above all the present is the dawn of a new perspective in American philanthropy and in American research administration. During the last three decades these agencies have made lavish provision for what the coming generation will inevitably regard as superficial pseudoresearch in immunology, feverish clinical application of unproved physiological hunches. At the same time, they have made negligible provision for the basic theoretical work by which alone the truth or falsity of the accepted postulates might have been established. The recent quarter million dollar grant to an American medical school for basic theoretical research, with the specification that the grant must not be used for purely practical applications of present knowledge, heralds the dawn of a new efficiency in conventional medical research.

A NEW METHOD OF DEEP SEA OBSERVATION AT FIRST HAND

By Professor HENRY FAIRFIELD OSBORN
HONORARY PRESIDENT OF THE NEW YORK ZOOLOGICAL SOCIETY

IMMEDIATELY on the receipt of a cable announcing the first successful descent of the Barton bathysphere I cabled to Director Beebe for a brief official report to be published in SCIENCE.

This is the thirteenth expedition of the Department of Tropical Research of the New York Zoological Society under the direction of William Beebe. It is the fifth year of oceanographic research of this department, and the third season at the Bermuda Oceanographic Station at Nonsuch Island. In the year 1928 the twenty-five acre island of Nonsuch, formerly a health and quarantine station erected by the Bermuda government, was placed at the disposition of the Zoological Society for oceanographic research. The seasons of 1928 and 1929 were devoted to the study of both the shallow and deep water fauna.

The buildings at Nonsuch were "transformed . . . into a comfortable and efficient Marine Zoological Station. The two large buildings were practically new and in perfect condition. The three large rain water tanks were overflowing." The relations with the government were excellent. "We were given every assistance, even to having the wreck of a large tug raised in St. George's Harbor, towed across Castle Harbor and sunk near our landing-place, forming a perfect breakwater for protection in rough weather. We had an excellent outfit both for laboratory work, shallow water investigation, and deep-sea trawling. Our electric light plant furnished light for sixty-odd bulbs, a frigidaire, aquarium pumps, etc. A pumping engine at the landing-place furnished three hundred gallons of salt water an hour for our aquariums."

The regular staff under William Beebe included seven assistants and from time to time was aided by Dr. J. Newton Harvey, Dr. C. J. Fish, Dr. Henry P. Bigelow, Professor William K. Gregory and other visiting experts.

In the recent report of the Zoological Society it is stated: "We secured over two hundred species of shallow water fish, about two thirds of the entire fish fauna of Bermuda, and gathered much material for life histories. The midwater depths—an area which we found most difficult to study—yielded many strange organisms. The deep-sea fish were taken from a restricted locality, five miles off shore, eight miles in diameter, and one half mile to one mile below the surface. They were collected in the course of five hundred and twenty-eight hauls, and in abundance and specialization surpassed our utmost expectations."

SEASON OF 1930

Although the most modern trawling devices were used and diving methods at shallower depths were highly successful, for the two seasons past Director Beebe has felt it of great importance to be able to carry on observations at greater depths. Mr. Otis Barton and the director have been working for two years on various problems of deep sea diving, at first studying a cylinder but finally designing a sphere or diving tank, illustrations of which have already begun to appear in the scientific reports from the Station. Director Beebe's own report of June 21, 1930, is as follows:

Director William Beebe and Mr. Otis Barton have just completed a number of dives in a deep sea chamber or bathysphere in the open ocean to a depth far beyond where any scientific observations at first hand have ever been made. This bathysphere was designed for and financed by Mr. Barton, who in frequent consultation with Dr. Beebe, has worked on it for a year. The barge from which the dives were made was kept anchored off Nonsuch Island where the New York Zoological Society Oceanographic Expedition has its headquarters, and the descents were made in the open sea in connection with and within the limits of the area of intensive research which Director Beebe has carried on for two years past, 1928–1929.

The length of cable at the greater depths was checked and rechecked both by hydrographic meter-wheel and by measuring off and marking one hundred foot lengths of the cable, the difference between these methods being two feet in one thousand four hundred and twenty-six.

On June 6th a descent was made to 803 feet, and on June 11th to 1,426 feet, or beyond a quarter of a mile, with both Beebe and Barton in the bathysphere. The sphere is 57.3 inches in outside diameter, and 1½ inches thick, and at the greatest depth withstood a pressure of 652 pounds to the square inch, or a total of 3366.2 tons on the whole surface. The exact locality was 32° 16′ No. Lat., and 64° 39′ West Long., five miles south of Nonsuch Island, Bermuda.

Fifteen dives have been made altogether, three to a depth of 800 feet. At Mr. Barton's own wish he took charge of the telephone communication and the supervision of the vital instruments and chemicals, while Dr. Beebe carried on ocular and instrumental observation at the window and controlled the depths. The more unusual fish and the extreme spectroscopic readings were also observed and confirmed by Mr. Barton.

The two most surprising phenomena were, first, the abundance of life observed, and the clarity and certainty with which it could be seen and identified, and second, the blue brilliance of the watery light to the naked eye, long after every particle of color had been drained from the spectrum. Another unexpected fact was the presence of fish and invertebrates at these upper levels which, in trawling nets, have been taken only hundreds of fathoms lower. At 700 feet the spectrum, as seen close against the quartz window, was quite devoid of color, the lightest portion being at the 510th wave-length. The last color to disappear was violet, which, many feet above, had completely overlaid the blue.

The visual degeneration of the spectrum was read every fifty feet, and rechecked on different dives and by both divers, and the radical color alteration in known species of fish agreed with the shifting spectrum. An intensity meter was read in connection with the spectroscope.

A strong, electric search-light illuminated the outside water to a distance of many feet, a bag of decayed fish and baited hooks served as a lure, an outside thermometer was easily read, and perfect telephone communication and dictation were carried on without interruption.

Luminous fish and shrimp swam close to the quartz window, about a dozen species of true bathypelagic fish being identified and seen again and again. Among these were *Myctophum, Diaphus, Serrivomer, Idiacanthus, Stomias, Leptocephalus, Cyclothone* and *Argyropelecus*. Puzzling results of the trawling nets were explained, and every possible ecological fact noted and dictated.

A second very important phase of the work proved to be dangerous but exceedingly interesting. This was to lower the bathysphere in shallow water, and as the guiding vessel slowly drifted seaward, to do contour exploration down the Bermudian insular shelf. The risk was the possibility of suddenly sighting a wall of reef too near to be cleared by reeling the sphere quickly upward. Four such descents, to a maximum of 350 feet, yielded unexpected results, revealing an entirely new fish fauna at these offshore depths and opening an absolutely new future field, for the study of the unknown bottom life connecting the shore with the deep sea faunas. The most notable thing about the recognizable shore fish was their great average size.

The only dive when Beebe and Barton were not together in the bathysphere was Dive Number 8, when General Assistant John Tee-Van and the technical associate Gloria Hollister went down to 400 feet and made many interesting observations.

Great credit should be given to Assistants Tee-Van and Hollister for their days of recording work on the deck of the barge. Mr. Tee-Van had full charge of the deck crew and the hoisting machinery and carried on without accident or mistake. Miss Hollister received and correctly and instantly transmitted the scores of orders and observations, contending often with bad static and with confused, over-enthusiastic diction from a quarter of a mile beneath the surface.

The satisfactory margin of safety and the ease and accuracy of observations of fish and other bathypelagic organisms have ensured the advisability of the continued use of the bathysphere for another year.

NONSUCH ISLAND,
JUNE 21, 1930