Figure 34.--Henry B. Bigelow, Professor at Harvard University on the deck of the U. S. S. Grampus during the explorations in the Gulf of Maine (1912-14) conducted for the Bureau of Fisheries.

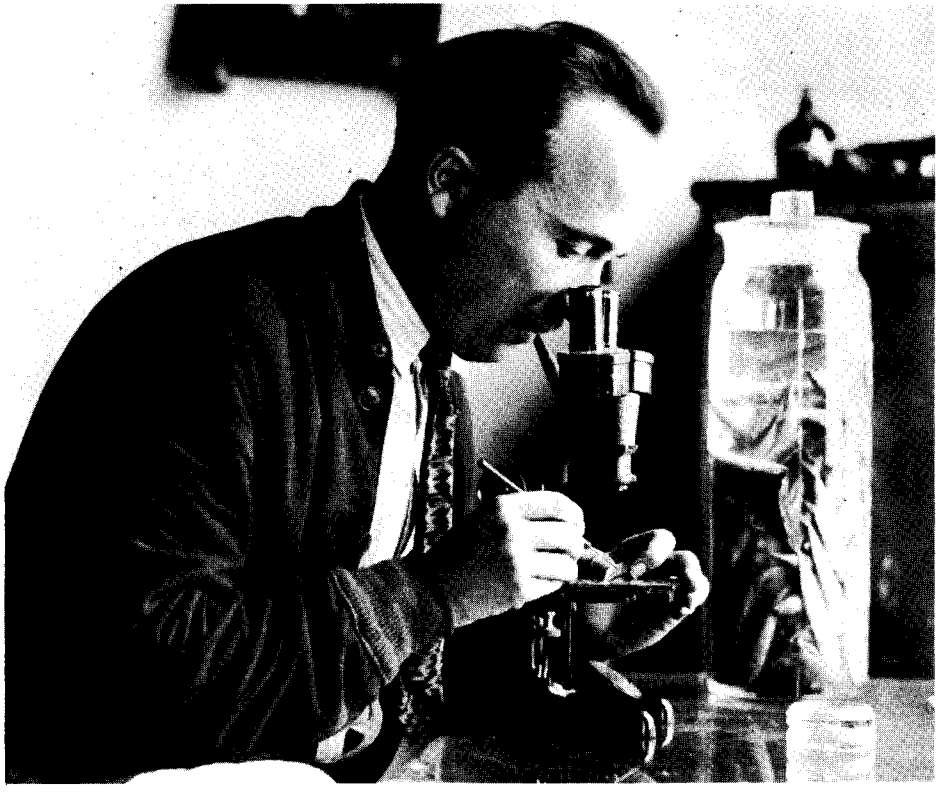

Figure 35.--O. E. Sette, Director of the Laboratory in 1929, examining larval mackerel.

In 1929, Sette (fig. 35), in charge of the North Atlantic Fishery Investigations, became Director of the Laboratory and served in this capacity until 1931. His laboratory studies on young mackerel and experimental tagging and schooling of mackerel comprised a part of a comprehensive investigation which later on was summarized in two large papers (Sette, 1943, 1950). The permanent office of the North Atlantic Fisheries Investigation was located at Cambridge, Mass. and Woods Hole was used as temporary headquarters for the mackerel investigations, which Sette conducted with the assistance of E. W. Bailey and George L. Clarke.

Studies on the physiology of oyster and oyster culture by Galtsoff and experiments on respiration in fishes by Hall and his group were continued. As usual, Cobb with a large staff occupied part of the laboratory, and Paul S. Conger pursued taxonomic studies of local diatoms. The laboratory

accommodations were extended gratis to several independent investigators not connected with the government institutions: A. J. Dalton--development of pelagic fish eggs; K. W. Foster --adaptation of Fundulus to a blue background; R. Macdonald, Mary Sears, and Alice Beale--coastal plankton; W. E. Bullington --spiral movements of the ciliate Frontonia; E. Linton--parasites of fishes; J. C. Hemmeter--histology of pancreas in Lophius; and C. E. Cummings with two assistants used the Laboratory for making wax models of local fishes.

In 1931, an unusually large number of fishery biologists of the Bureau were detailed for summer work at the Station. Among them were R. O. Smith (oyster investigation); Louella E. Cable (larval fishes); William C. Herrington (haddock investigation); L. Worley, Ernestine Jaffe, and H. J. Kumin (mackerel investigation under Sette). A. E. Parr, curator of Bingham Oceanographic collection of Yale University, spent several days gathering material for studies of the biology of young fish.

In the summer of 1931 the Woods Hole Oceanographic Institution, a new research organization, sponsored by the National Academy of Sciences, began its worldwide exploration of the sea.

The Act of Incorporation and the recommendation of the Committee on Oceanography of the Academy of Sciences state the following purposes of the institution: "Research and instruction in all branches of oceanography and allied subjects; coordination of the activities of governmental and private organizations in oceanography; and providing facilities for visiting investigators." From the very beginning there was close cooperation between the new organization and the Bureau of Fisheries, and many research projects were carried out jointly.

A steady decrease in the research activities of the Fisheries Laboratory began in 1932 and continued for many years. The Laboratory still served the needs of the Bureau's investigators, but lack of funds prevented the extension of its facilities to guest investigators. The long-established policy of the Bureau in supporting basic research in marine sciences established by Baird began to decline and no clear-cut policy with regard to the use of the station was formulated. As a result of the new attitude toward the oldest marine station, no summer Director was appointed. The Station was used by the section of Shellfisheries, Galtsoff in charge; North Atlantic Fishery Investigations, under Sette; and Middle Atlantic Fisheries Investigation, R. A. Nesbit in charge. Since no appropriations were available for running the Laboratory as an independent unit, the current expenses were absorbed by the three investigations. The oyster investigations, conducted by Galtsoff, were concerned primarily with the effect of the time of day on oyster activity, and with the control of starfishes. Sette used the Albatross II for a study of survival of

mackerel larvae on the offshore grounds; Nesbit conducted investigation of the year-mark formation on fish scales. L. G. Worley used hatchery equipment for an experimental study of the effect of temperature on the incubation of mackerel eggs. Experiments in rearing fish larvae were conducted jointly by Cable and Galtsoff. Parr used the Bureau's vessels in a study of the abundance and growth of young scup, sea bass, and squeteague.

The Albatross II was the reconditioned ocean tug Patuxent. It was obtained from the Navy Department shortly after the Bureau of Fisheries steamer Fish Hawk was relinquished on January 30, 1926. The first Albatross was decommissioned several years before, on October 29, 1921. The Patuxent, renamed Albatross II, was a two-masted steel steamer weighing 521 gross tons; her overall length was 150 feet; and her header was 29 feet 6 inches. She had a mean draft of 12 feet 3 inches.

In the summer of 1933 the activities of the Laboratory were even more restricted than before. Galtsoff with the assistance of R. O. Smith, conducted laboratory experiments on the growth and fattening of oysters, and Sette studied various methods of marking mackerel (fig. 36). Large schools of tagged mackerel were kept under observation in the outdoor pool of the Laboratory and in the aquarium, where the injuries caused by tagging could be easily watched.

Lack of funds for the operation of the Laboratory prevented the Bureau from providing facilities for independent investigators. At the same time the deterioration of the laboratory buildings and equipment steadily progressed. At this time, large research projects conducted by the Bureau in the North Atlantic were concerned primarily with the populations of oceanic fishes. The major emphasis was devoted to the statistical aspects, such as the analysis of catches, determination of the abundance of year classes, rates of growth and mortality, and movements or migrations of fishes. Laboratory work played a minor role in these investigations and, consequently, the demand for laboratory space by the Bureau's biologists diminished.

Fish hatching was still the major year-round operation while the Laboratory, having no permanent personnel, functioned principally during the summer. The division of administrative responsibility added to the difficulty, since the hatchery operation and maintenance of all buildings and grounds at Woods Hole were the duties of the Division of Propagation and Distribution of Fishes, while the operation of the summer Laboratory was under the Division of Inquiry. As a result, the Laboratory could not develop its own program of research and acquire solidarity as a scientific research unit.

Some of the members of the Bureau of Fisheries even suggested that the Woods Hole Station be declared "surplus property". This view was strongly opposed by Galtsoff, who on many occasions

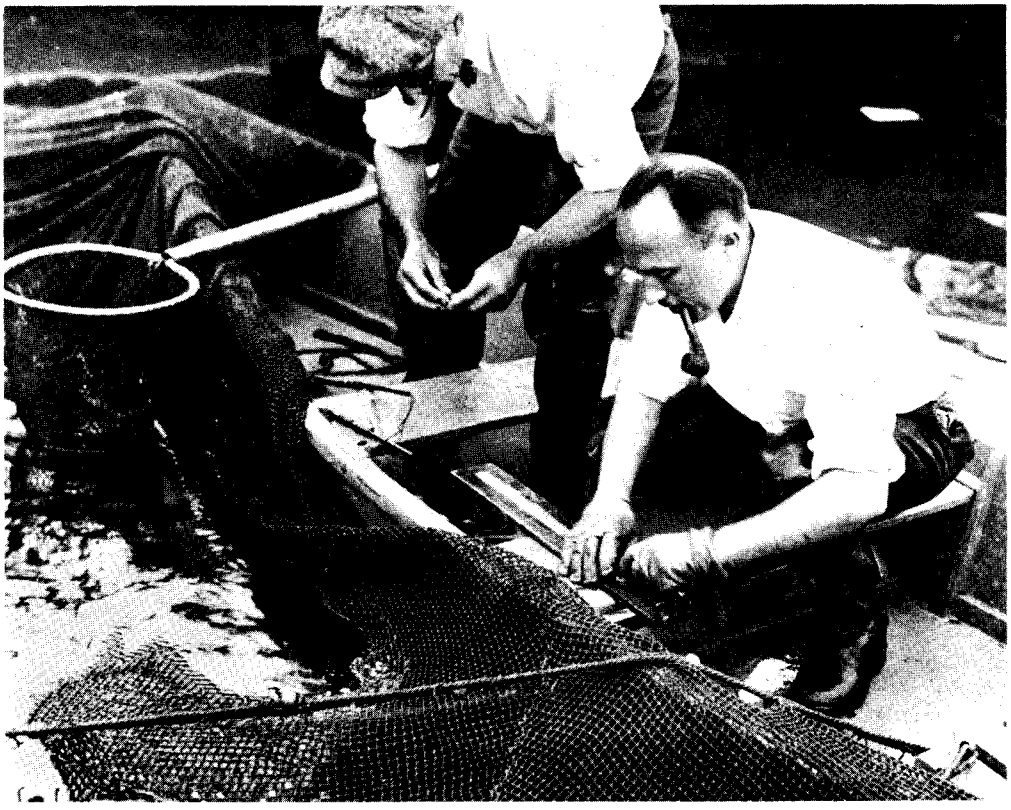

Figure 36.--O. E. Sette measures and marks small mackerel (not seen under his gloved hands) assisted by R. A. Goffin (at left). Summer of 1933.

pointed out the unique advantages of a place having sea water with uniform salinity, absence of wide daily fluctuations in temperature, safe anchorage for small boats and live-cars, and good docking facilities for sea-going vessels. The scientific climate of Woods Hole, the access to the best biological library in the country, lectures, discussions, conferences, and the presence of many outstanding scientists are conditions highly conducive to research. Futhermore, friendly cooperation with the MBL and the newly established Oceanographic Institution makes it possible, in emergencies, to borrow equipment and use the facilities of these institutions. Fortunately, the arguments were effective and the Shellfisheries Section was permitted to use the Laboratory for rapidly expanding work on oysters, but very little money was made available for repairs and rehabilitation purposes.

From 1935 to 1938 the Laboratory was without a formal Director, and administrative responsibility for the work of the Laboratory was assumed by Galtsoff. Experimental oyster investigations at this time dealt with the physiology of spawning, accumulation and storage of heavy metals in the oyster, seasonal fluctuations in the concentration of glycogen and heavy metals, oxygen consumption of oysters, and sex change. The latter study was continued for five consecutive years before its completion. In 1935-36, in connection with a special appropriation for oyster pest control, a survey was made of the distribution of starfish and drills in Buzzards Bay and Narragansett Bay. Under the supervision of Galtsoff, the survey was carried on by K. S. Rice and temporary assistants C. F. Reppun, G. Mishtowt, B. Boving, and C. D. Weber, who also assisted in the experimental study of metabolism and storage of metals in oyster tissues. Rice and Weber remained in the residence for the entire year in order to extend their observations throughout all seasons. Independent investigators were: H. M. Smith, F. G. Hall, F. H. McCutchin, J. W. Wilson, and E. Linton. In the summer of 1938 the following investigations indirectly related to fishery problems were conducted: R. Maluf--osmoregulative mechanism in crayfish; R. B. Root and H. Brown--effect of carbon dioxide on the respiratory function of blood of marine fishes; and J. M. Odiorne--behavior of melanophores of Fundulus.

The 1938 Hurricane

On September 21, 1938, the Station suffered a severe blow from a tropical hurricane and the storm wave which accompanied it. In the report to the Commissioner the damages caused by the hurricane are described by Galtsoff, acting Director, as follows: "Fisheries grounds littered with debris, boats, cars and silt present probably the most convincing picture of the ferocity of the tidal waves and wind that struck Woods Hole. The most serious destruction was done to the pier, three-quarters of which was carried away and deposited on the grounds nearby. Not only the wooden upper structures and planks were demolished, but the heavy stones forming the wall were lifted and tossed away. . . . Water filled the basements of the Laboratory and residence buildings and undermined the foundation, smashed the windows and considerably damaged materials and equipment stored there. Tile roofs of both buildings were ripped leaving several large holes, some of them about 10 feet square. . . . Fortunately the Laboratory boats and scientific equipment were not damaged". A rough estimate indicated that about $100,000 would be required to rehabilitate the Station. Such funds were not available, and in view of the uncertain future of the Station no efforts were made to request the necessary Congressional appropriation for rehabilitation. A sum of about $5,000 for the immediate and most urgent

repairs was allocated. It was sufficient to repair the roof, replace broken windows, and do other minor jobs. The seawall and wharf remained badly damaged.

In the summer season of 1940, two interesting projects were carried out at the Laboratory. Arthur Shlaifer of the New York Aquarium studied the social and respiratory behavior of young tarpon, and P. F. Scholander of the University of Oslo, Norway, jointly with L. Irving and S. W. Grinell conducted research on the respiratory adjustment to diving and asphyxia in harbor seals (Scholander, Irving, and Grinell, 1942). Half of the hatchery floor was set aside for bulky equipment, which included respirometers, electrocardiograph, and instruments for the automatic recording of pulse and respiration rates in seals. The animals were strapped to a special holder and were kept in air first, then they were automatically submerged into water. From 10 to 16 seals were kept in a fenced enclosure along the beach and boat slip. The experiments provided valuable information for understanding the physiology of diving, but the problem of maintaining and feeding a large number of seals presented many unexpected headaches to the Station personnel.

In the summer of 1941 the study on the deposition rate of shell material in oysters was undertaken by Galtsoff and Dorothy H. Algire. At the invitation of the Bureau, Chester I. Bliss conducted a seminar on statistical methods in biology and worked on the problem of standardization of toxicity experiments.

Shortly after the beginning of hostilities in December 1941, the Station was closed and the buildings were occupied by the U.S. Navy until the spring of 1944. The library, large stock of laboratory equipment, and chemicals were transferred for storage to the basement of the MBL. During the ensuing years shellfishery research, mostly dealing with the study of life history of the mud worm, Polydora ligni, and with physiology of the feeding of oysters, was conducted by Galtsoff and Edith Morrison in a laboratory room rented in the main building of the MBL.

During the war years Woods Hole presented an unfamiliar picture. The Fisheries grounds and the adjacent buildings of the MBL were surrounded by high fence, and became inaccessible to civilians. The gay crowd that used to assemble near the aquarium and around the seal pool was no longer there. Less than half of the MBL laboratory rooms were occupied. Bright-looking pleasure boats were gone, and very few fishing vessels were seen in the harbor. Even the New Bedford-Nantucket steamer lost its smart appearance under a coat of gray paint. At night everything was pitch dark and the streets were deserted.

The 1944 Hurricane

The Station was released by the Navy in 1944, and shortly after that (September 14) it was struck by a vicious hurricane. This storm did more serious damage to the buildings and grounds than those inflicted in 1938. Large sections of the roofs of the residence and Laboratory buildings were carried away; all chimneys were demolished; about 160 windows were broken in the residence. Damages caused by high water and storm waves were even greater. Sea water filled up the basement of the residence to the depth of about 7 feet, destroying the oil furnace, supplies, and equipment which were stored there. The seawall at the eastern side of the Fishery grounds was demolished and a deep gulley extended from the beach to the sidewalk, undermining the Spencer F. Baird monument. Porches, railings, and outside stairways were demolished, and the entire grounds were covered with slimy debris. At the height of the hurricane, which struck Woods Hole after darkness, the water at the southern end of the Laboratory stood about 6 feet above street level and a strong current was sweeping the grounds. All employees of the station and their families assembled in the corridor of the second floor of the residence, which was considered to be the safest place, and were strictly forbidden to go outside. Soon the chimneys began to collapse with a roaring noise, the roof was blown off, and all the windows facing the sea were smashed either by wind or by flotsam thrown by waves; it seemed that the old residence was going to collapse at any moment. Fortunately, the old, well-built structure withstood the onslaught of water and wind. Panic which threatened to develop among the children and some hysterical women, who wanted to run away from the building, was prevented and all were persuaded to remain indoors. Those of us who had previous experience knew that flying pieces of tile and strong currents running over the fishery grounds constituted the greatest danger. The next day many pieces of broken tiles were found embedded about one-half inch deep in the wooden buildings across the street, several hundred feet away from the residence. Fortunately no lives were lost and nobody sustained any injury.

The violence of the wind subsided about 5:00 a.m. and it was possible to step outside and examine the wreckage (fig. 37). For nearly a week Woods Hole was without electric power and gas. The highways were blocked by fallen trees, and the railroad tracks between Woods Hole and Falmouth had been washed away. The basement of the MBL buildings, where laboratory equipment was stored, was flooded but fortunately only the glassware placed on the floor and on the two lower shelves was under water. Optical equipment, analytical balances, and other more expensive apparatus were stored away in the cupboards and were undamaged. There

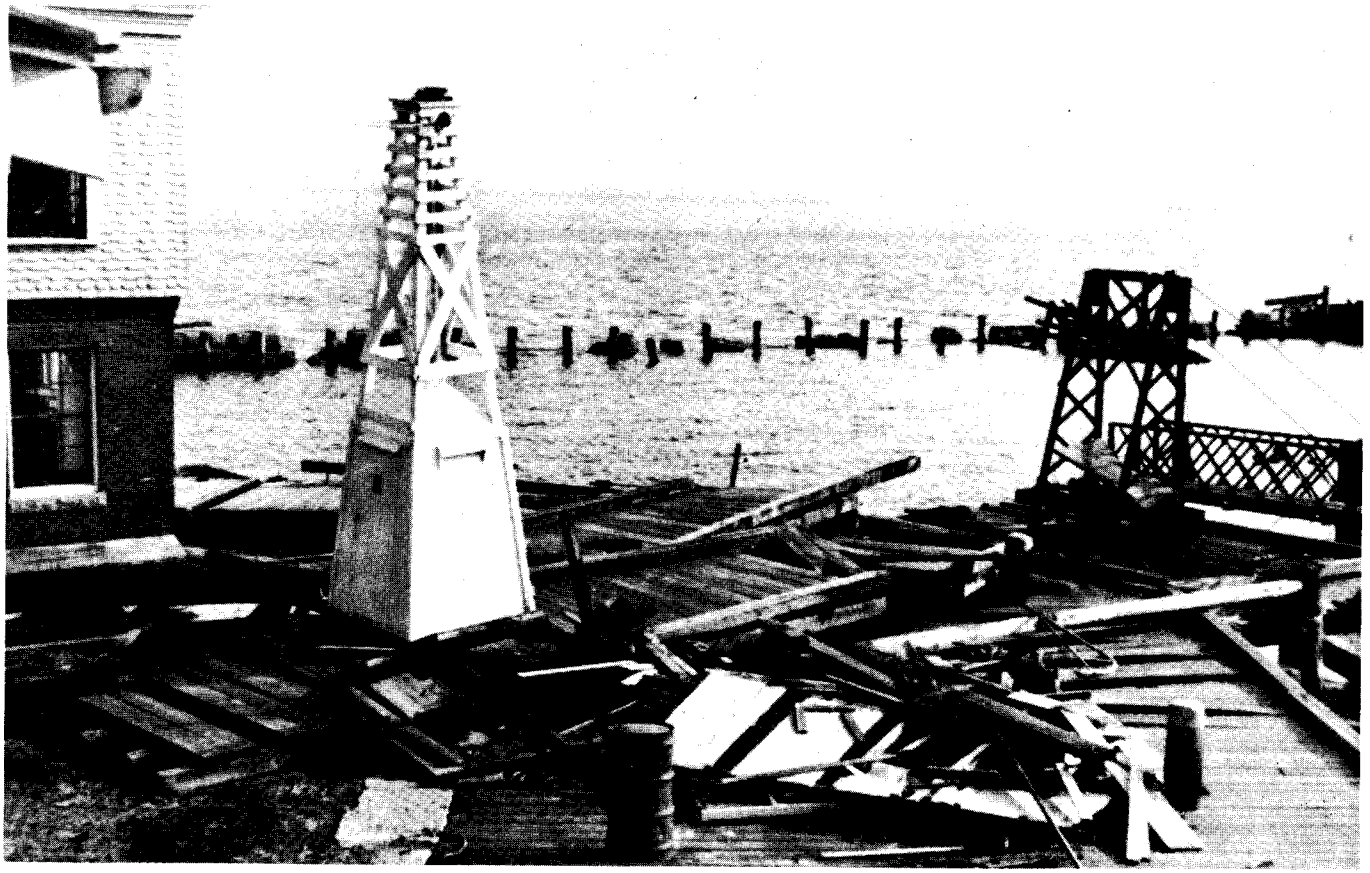

Figure 37.--The morning after the hurricane of September 14, 1944. Corner of damaged laboratory building (left), range light (white towerlike structure) washed from its base on the stone jetty which was destroyed by waves (background); remnants of swinging bridge (right).

were a multitude of problems to be solved right away. The most urgent ones were the general cleaning of the grounds, temporary patching of the destroyed portions of the roofs, and the boarding of broken windows.

Some of the alterations made by the Navy were very useful to the Station. For a long time the U. S. Coast Guard maintained a structure along the northern part of the Fishery grounds which was used as a messhall for the sailors on the Coast Guard ships, when the latter were in port. The Navy transformed this structure into a small hospital and dispensary and along side of it constructed an adjoining wooden barrack as quarters for WAVES. The barrack was not occupied, however, when the Navy returned the property to the Fish and Wildlife Service. The hospital building and WAVES quarters were rebuilt as apartments, which in the following years were occupied by the Superintendent, the Director, and the Administrative Officer of the Station To alleviate the acute shortage of housing facilities at Woods Hole, the residence building was turned over to the Woods Hole Oceanographic Institution as a dormitory for its wartime employees.

Operation of the hatchery, which was interrupted at the beginning of World War II, was now permanently discontinued. The personnel were retired or transferred, and the responsibility for maintaining the buildings and grounds was turned over to the Branch of Fishery Biology (formerly Division of Scientific Inquiry). The disaster at Woods Hole again raised the acute question of whether or not the Bureau should close the Station and dispose of the land. With the exception of the Shellfisheries Section, no other section of the Bureau at this time was interested in Woods Hole or considered that the Station was needed for their work. The great potential usefulness of the Station in connection with the rapidly increasing scope of scientific research in fishery biology and oceanography was again emphasized by Galtsoff in several memoranda submitted to the Director of the Service. Fortunately the Station had a good friend in Albert M. Day (fig. 38), who from 1945 to 1952 was Director of the Fish and Wildlife Service, U. S. Department of the Interior. The Fish and Wildlife Service was an agency formed by combining the Bureau of Fisheries and the Biological Survey. Thanks to his wisdom and foresight the Station was saved from approaching doom. Careful survey of the buildings indicated that in spite of old age and inroads of several severe storms and two hurricanes, the old structures were still sound and could be reconditioned and re-equipped at the estimated cost of about $175,000 to $200,000. The Director considered, however, that it was unwise to ask for such a large sum of money to be put in the old and inflammable buildings, and thought that eventually they should be replaced by modern structures. Small amounts of money were made available for the reconstruction of the seawall, new roofs, repairs to a portion of the Fishery dock, etc.