Figure 38.--Albert M. Day, Director of the Fish and Wildlife Service, 1945 to 1952.

A great deal of the work inside the building was made by the Superintendent and Station carpenter.

By the summer of 1947, the Station was sufficiently restored as a laboratory to be used by a small number of investigators. During that year Galtsoff, acting Director of the Laboratory, assisted by J. Griggs, made observations on the density of oyster blood under various environmental conditions, and made toxicity tests of the water and plankton associated with the blooming of Gymnodinium brevis, a microorganism which causes "red tide" along the west coast of Florida (Galtsoff, 1948). Development of the nervous system and the reactions of fishes were studied by H. C. Tracy and a group of his students, supported by a grant from the U. S. Navy. For brief periods the Laboratory space was used by two visitors from South America: Horacio Rosa, Jr., of the Division of Protection of Fishes in Sao Paulo, Brazil, and Antonio Landa, of the Guano Company in Lima, Peru. Landa was a Peruvian fishery trainee, studying the problems and methods of investigation in fishery problems in the United States. Other visitors to the Laboratory were: Jacques Monod of the Pasteur Institute, Paris, France; George Teissier, Director of the Biological Station at Roscoff; Paul Tchernia, Major General of the French Navy in charge of fishery investigations; and G. N. Mitra, Assistant Director of Fisheries, Cutack (orissa), India.

The major investigation carried on in the Laboratory in 1948 was an experimental study of the toxicity of crude oil absorbed by carbonized sand. This investigation was undertaken at the request of the U. S. Navy. The technique of using carbonized sand in combatting fire of oil spilled from naval ships was developed during the war and proved to be effective as a fire prevention measure. A heavy slick of crude oil on the water's surface can be eliminated in a few minutes by sprinkling it with carbonized sand. Granules of this specially prepared sand readily absorb oil; they form large lumps and sink to the bottom carrying with them oil globules. The experimental work conducted for the Navy by Galtsoff and Walter Chipman showed that the oil absorbed by sand remains toxic and that water soluble materials which are gradually extracted from oil affect bottom animals in varying degrees (Chipman and Galtsoff, 1949). This work lead to the development of the method of bioassay which later on was employed in the toxicity tests of all pipes and materials used for the construction of the new Fisheries Laboratory. Study of the respiration and sex change in oysters was continued by Galtsoff, and the exhibits of the Public Aquarium were prepared by him with the assistance of A. R. DeMetriff (fig. 39).

Intensified interest on the part of the New England fishing industry on the depletion of groundfish resources and renewed interest on the part of the Fish and Wildlife Service on the value of oceanographic studies on fishery resources resulted in a rebirth of the Laboratory. A new era started with the transfer of

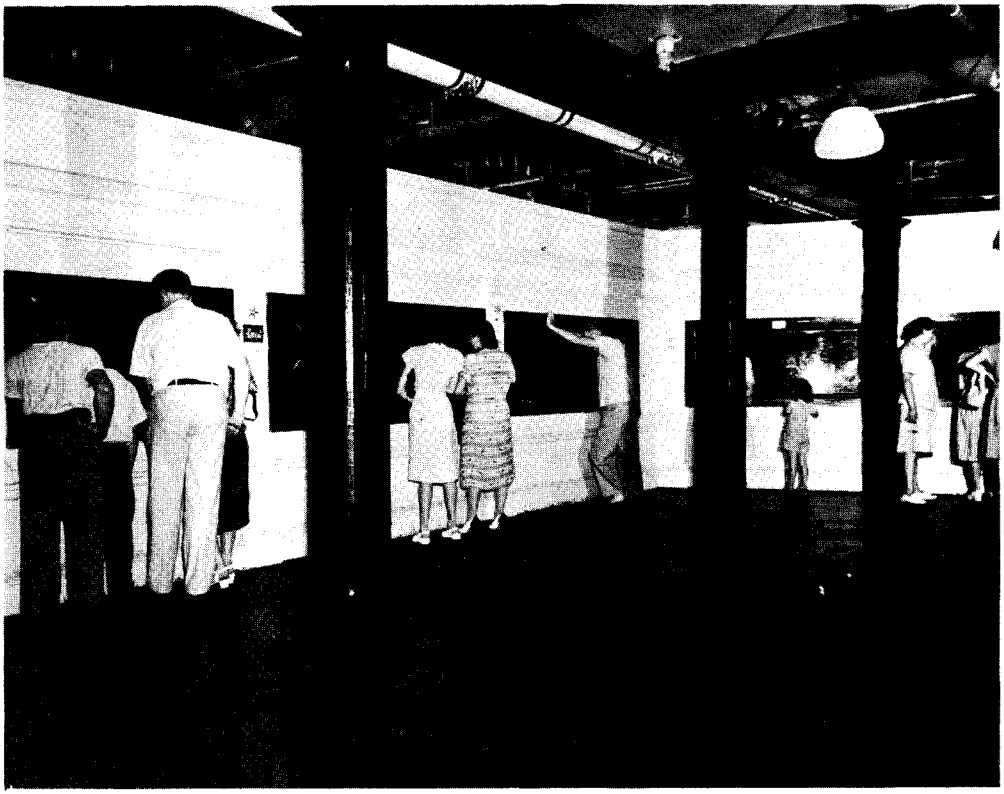

Figure 39.--Old aquarium of the Fisheries Station restored after the hurricane of 1944.

the office of the New England Banks Fishery Investigations (previously called North Atlantic Fishery Investigations) from Cambridge to Woods Hole. A new vessel, Albatross III (fig. 40), was available for the explorations of offshore fishing grounds. The vessel was commissioned at ceremonies held at Boston Fish Pier on March 19, 1948. Formerly named Harvard, she was built in 1926 as a steam trawler and before being "sold" to the Fish and Wildlife Service for $1 she was credited with catching and landing about 35 million pounds of groundfish. When World War II broke out, the Harvard was in a shipyard being converted into a research vessel. She was immediately requisitioned by the U.S. Navy for the Coast Guard, renamed Bellefonte, and returned to the Service in 1944. The Bellefonte was laid up at Woods Hole in semi-operative condition until plans were made and funds allocated to reconvert her back to a fishery research vessel under the name Albatross III. Due to insufficient funds she was operated only intermittently

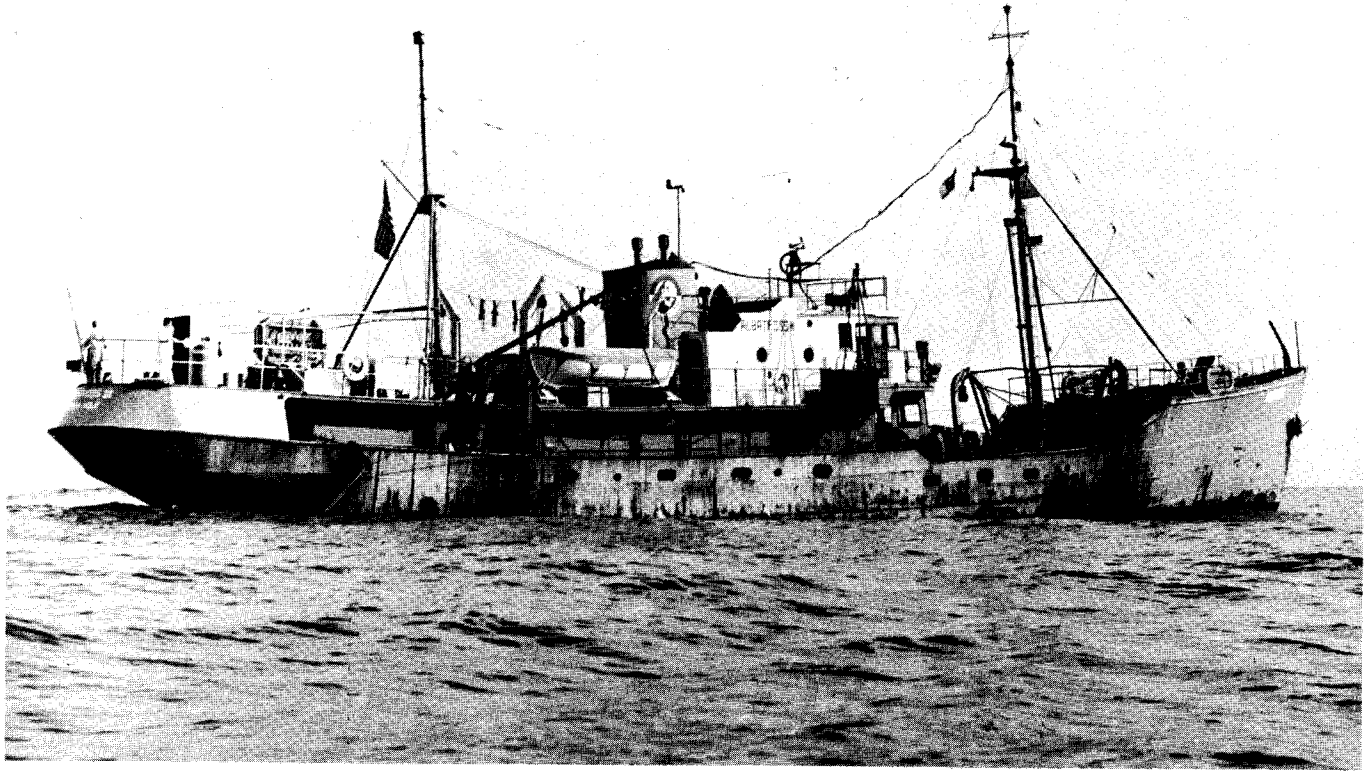

Figure 40.--Research vessel Albatross III assigned to the Woods Hole Station in 1948.

during the period 1948-54. In 1955 the Saltonstall-Kennedy funds made possible the full-time operation that lasted until 1959, when she was decommissioned. During that period of service she made 128 cruises, most of them to Georges Bank and adjacent waters. In 1951-52 the Albatross III was loaned to WHOI for trans-Atlantic hydrographic cruises.

The principal activities of the Albatross III that were started in 1948 were concerned with a census of groundfish on the New England banks. The results of these surveys provided a basis upon which prediction of abundancy are now being made to the fishing industry.

The determination of natural mortality and growth rates, essential in all population studies, formed an essential part of this research. Previous investigations conducted by the Bureau showed the necessity of protecting small haddock (two years old or less) from destruction, which during the war years reached enormous proportions. It was estimated that at least 17 million baby haddock were killed during this period and discarded on the New England banks by the otter trawl fleet using small (three-inch) mesh nets.

William F. Royce, Chief of North Atlantic Fisheries Investigations, became Director of the Laboratory in 1948. Part of the Laboratory was set aside for shellfish investigations under Galtsoff. The number of investigators working at Woods Hole year-round was materially increased. The following principal projects were carried out: effect of otter trawling on productivity of the bottom by Royce; study of the population of haddock by H. Schuck; and abundance and yield of groundfish by A. Perlmutter. Seven other investigators and fishery aids were engaged in various phases of fishery research. A small number of independent investigators used the facilities of the Laboratory: H. C. Tracy and his associates continued a study of the development of nervous system and behavior in larval and young toadfish; Dr. and Mrs. J. Lein of Syracuse University studied the clotting mechanism of lobster blood; A. Goldstein and Dora Goldstein of Harvard University Medical School investigated the cholinesterase in marine bacteria and invertebrates. Eugenia Galtsoff of George Washington University, in cooperation with P. S. Galtsoff, made experiments in transplantation of toadfish embryos (Galtsoff and Galtsoff, 1959).

In 1949 Albatross III completed 23 cruises before being laid up from January to May because of the shortage of funds. The main research project for which the ship's operations were required concerned the haddock fishery and movements of haddock on Georges and Browns Bank. The effect of the commercial catch on changes in the size and composition of the stock

of New England haddock was demonstrated by the analysis of the data accumulated in previous years (Schuck, 1949). Other investigations were concerned with the flounder fishery, census of all fish populations over the entire New England banks area, and hydrography of fishing areas.

Shellfish investigations were conducted by Galtsoff only during the summer. These studies pertained to the physiology of feeding of the oyster and with the fertilization and cleavage of oyster eggs. All cytological work was performed by Eugenia Galtsoff. The Laboratory was also used for the study of the material collected by Galtsoff during his expedition to the Gulf of Panama and Gulf of Chiriqui to determine the cause of the precipitous decline in the pearl fishery. Tissues of the pearl oyster, preserved during the expedition, were microscopically examined, and the mollusks and other invertebrates found in association with the pearl oyster were identified. Only four independent investigators used the facilities of the laboratory.

Pending the proposed transfer to Boothbay Harbor, the administrative headquarters of the Clam Investigations were located at the Woods Hole Station. Observations on the feeding of the soft-shell clam were made jointly by John Barlow and personnel at WHOI.

The headquarters of the shellfishery investigation at College Park, Md., were closed in 1950 and Galtsoff, former chief of the section, was permanently assigned to the Woods Hole Laboratory to conduct research necessary for the preparation of a comprehensive treatise on oyster biology. The Woods Hole Laboratory was also used in the preparation of a comprehensive book about the origin, waters and marine life of the Gulf of Mexico. In connection with this undertaking, a large bibliography comprising several thousand cards was prepared and is now kept in the library of the Fisheries Biological Laboratory and in the library of the MBL at Woods Hole. Additional copies were distributed among the participating institutions of the Gulf area.

III. Woods Hole Laboratory, Center for International Fisheries Research

In 1951, Herbert W. Graham replaced Royce as Chief of North Atlantic Fishery Investigations and Director of the Laboratory. This year marks the beginning of new work for the Fisheries Laboratory at Woods Hole. In addition to its function as a fishery research center for the North Atlantic area, it became the center of American research activities in relation to the International Commission for the Northwest Atlantic Fisheries (ICNAF). The International Commission originated with the convention of 11 countries in Washington, D. C., in January 1949. They entered into an agreement which was ratified on July 3, 1950, by four signatory governments, namely, Canada, Iceland, the United Kingdom, and the United States of America. At present (1962) 12 participating governments comprise the Commission.

The activities of ICNAF extend over a huge area, nearly two million square miles, of the ocean west of longitude 42° W. and north of latitude 39° N. Along the west coast of Greenland the area covers about one-half of the width of Davis Strait and extends in a northwesterly direction into Baffin Bay where it terminates at the point of latitude 78°10" N. and longitude 73°30" W. The entire area is subdivided into five subareas. In order to carry out the Commission's objectives for the investigation, protection and conservation of fisheries, a panel has been established for each subarea. The representation of governments on each panel is reviewed annually by the Commission on the basis of "current substantial exploitation in the sub-area concerned with fishes of the cod group (Gadiformes), of flat fishes (Pleuronectiformes), and of rosefish (genus Sebastes) except that each contracting government with coast line adjacent to a sub-area shall have the right of representation of the panel of sub-area" (Article IV, International Commission for the Northwest Atlantic Fisheries, Report No. 1, 1951). The United States is primarily concerned with sub-areas four and five, and has membership in panels three, four, and five. Subarea five, in which the U.S. Government conducts extensive studies on haddock and sea scallop, covers the entire area of Georges Bank. Since the organization of ICNAF, the Fisheries Biological Laboratory at Woods Hole entered into a new phase of activities as research agency for the international organization concerned with the management of oceanic food resources.

The Commission is a voluntary international organization, and no government is compelled to join or to abide by its regulations. The participating governments are honor-bound to respect the conservation measures that may be designed by the Commission, to provide the statistical data requested, and to participate in the program of research activities agreed upon at the annual meetings

of the convention. It is understood that the participating governments share substantial interest in the conservation and in maintenance of a sustained catch from these fisheries. Its success is an outstanding example of the benefits derived from international cooperation.

As the work of ICNAF was organized, additional projects were added to the program outlined during the first ICNAF meeting. Correspondingly, the staff of the Laboratory was increased. In 1952, 19 service biologists (including the Director) and laboratory or fishery aids were on the Federal payroll at the Station. By 1962 the number of biologists and aids increased to 37.

After the first meeting of ICNAF in Washington, the Canadian and American advisers met at Woods Hole in 1952 to formulate a program of research which included the study of: the quantity of small haddock destroyed at sea; mortality rates (fishing, natural and total) of fish before and after regulation; total contributions (in pounds) of year classes of groundfish species of known abundance before and after regulation; growth rates of young fish before and after regulation. It was decided also to undertake the following studies: determination of a mesh size which would permit escapement of small fish which are destroyed by small mesh nets; and preparation of regulatory measures for the consideration of the Commissioner.

The use of Albatross III made it feasible to resume the observations necessary for various research projects. Since March 3, 1953, cruises have been devoted to the collection of redfish, surveying the distribution of haddock and cod eggs and larvae, taking groundfish censuses, and conducting experiments in mesh selectivity.

Haddock research reached the stage at which it was possible to predict the relative abundance of each year class of fish with a high degree of accuracy, although the causes of the fluctuations in the abundance of fish of each year class are still unknown (Taylor, 1953). On the basis of the analysis of research data, an international mesh regulation was adopted. After it became effective in this country on June 1, 1953, the fishing for haddock on Georges Bank or in the Gulf of Maine with a net having meshes less than 4-1/2 inches (inside diameter) was illegal (Graham, 1952).

A new project concerned with the whiting fishery was initiated with the view of determining the species involved and developing the technique of age determination.

In 1950-53 the Station's chemical laboratory and part of the general laboratory on the second floor were occupied by the Public Health unit for the study of bacteriological aspects of shellfish sanitation. Also, an office was provided for the use of George A. Rounsefell, in charge of the editorial services of the Branch.

In the shellfish laboratory, studies were made of the movements of drills and conchs in search of food; and the spawning and setting of oysters in Onset and Chatham Bays. A survey of tidal waters of Cape Cod was made with reference to determining the extent of setting of oysters in the estuaries; results showed that oysters set prolifically in almost all protected bays and ponds. Because of the lack of interest and jurisdictional policies exercised by local communities over shellfish grounds, this latent oyster resource is not utilized.

During the summer of 1952, 10 independent investigators spent several weeks each in special studies of various physiological problems. The aquarium and other exhibits, prepared in cooperation with WHOI, were opened to the public during the summer months. The research vessel Albatross III was loaned to WHOI for the year.

The Laboratory continued to attract scientists from foreign countries. The list of visitors includes marine biologists from Canada, England, Scotland, Thailand, Peru, Norway, Iceland, and India. Nine independent investigators used the facilities of the Laboratory to conduct research on problems of physiology of marine organisms. Six of these received accommodations through an agreement with the MBL for the exchange of facilities of the two institutions.

On August 31, 1954, hurricane "Carol", the third since 1938, struck Woods Hole and caused extensive damages to the Fisheries grounds and buildings. Albatross III, which was moored to the dock when the hurricane struck, was fortunately saved by determined members of the Laboratory staff. The salt-water system, already deteriorated by previous hurricanes, was badly damaged again. No funds were available for a complete rehabilitation of the salt-water pipes and pumps. The aquarium was closed and not reopened until the new one was constructed a few years later.

The new project undertaken in connection with the study of oceanic fisheries was the investigation of sea scallop, supported by Saltonstall-Kennedy funds. The rapidly expanding scallop fishery reached such proportions that it is now one of the major fish industries in New England. Extensive population studies of sea scallop were instituted under the direction of J. A. Posgay.

Plankton surveys of the Gulf of Maine and Georges Bank were continued by J. Colton and R. Marak with the view of determining the drift of eggs and larvae in the area studied (Colton and Temple, 1961). These observations were supplemented by the release of drift bottles and their returns. To learn about the food habits of haddock, the contents of stomachs of 2,000 fishes taken from 41 locations were studied.

The haddock investigation was particularly concerned with determining the type of tag most suitable for marking fish and

with determining the percent escapement of each size through the net. To improve the observation technique, an underwater camera of special design was constructed and tested. Also several biologists of the Laboratory took training in sustained underwater swimming with the aqualung.

In the shellfish program, studies were made of the structure and elastic properties of shell ligament and on the rate of deposition of shell materials during different seasons. The electron microscope available at the MBL was used for these studies.

In the following years, 1955-57, the program of groundfish investigations was continued for the purpose of suggesting to ICNAF further regulations. The following research projects were conducted: mesh regulation for haddock fishery; population biology of haddock (Taylor, 1958); redfish (Kelly, et al., 1959, 1961a, 1961b), whiting, yellowtail flounder, industrial fish, and sea scallop; fisheries of Delaware Bay; and plankton ecology with reference to the abundance and dispersal of haddock eggs and larvae. Study of bottom organisms over the Georges Bank was undertaken in order to determine the relationship between the distribution of fish to the availability of the food supply. Various types of gear, such as scoops, dredges, and a ring net mounted on a sled were used to collect animals attached to, or burrowing in the bottom and those which live in water close to the bottom. Tools of research were augmented by the use of an underwater television camera, the specifications for which were drawn up by the electronics equipment specialist who was added to the Laboratory staff.

For the preparation of a treatise on oyster biology, several physiological and histological studies were made regarding the structure and function of the mantle, labial palps, and gills. On the basis of physiological and ecological investigations, a method was advanced for a quantitative evaluation of oyster bottoms. With the cooperation of the West Chatham, Mass. oystermen, an experimental study of raft culture of oysters was undertaken in Oyster Pond River near Chatham, Mass. This project demonstrated that oysters suspended from a raft may reach marketable size in 2-1/2 years instead of the usual 4 or 5 years, and that their mortality due to drills and other enemies may be reduced to a minimum. The method is particularly suitable to the inshore waters of Cape Cod which are well protected from storms and surf.

Efforts for complete rehabilitation of the Station initiated after the hurricane of 1944 by the Director of the Fish and Wildlife Service, A. M. Day, and continued by his successor John L. Farley brought results in 1955 when Congress voted $930,000 for the replacement of the old buildings with a modern laboratory and aquarium. The reconstruction of the breakwater and rebuilding