serious consideration to the possible destructiveness of fixed nets, traps, pounds, pots, fish weirs, and other stationary apparatus, he was fully aware of the complexity of the factors which may cause the decline in fish populations. He discusses this difficult problem in a paper entitled "Report on the condition of the sea fisheries of the south coast of New England" and published as the first section of the voluminous First Report of the Commissioner of Fish and Fisheries for 1871. Of the causes which may have contributed to the decrease of summer shore fisheries of the south side of Massachusetts and Rhode Island, a fact which he considered as well established by the testimonies of competent persons, he lists the following: (1) decrease or disappearance of the food of commercial fishes; (2) migration of fishes to other localities; (3) epidemic diseases and "peculiar atmospheric agencies, such as heat, cold, etc."; (4) destruction by other fishes; (5) man's activities resulting in the pollution of water, in overfishing, and the use of improper apparatus.

The biologist of today will recognize in this statement Baird's broad philosophical approach to the major problem of fishery biology. The outlined program combined oceanographical and meteorological investigations with the studies of biology, ecology, parasitology, and population dynamics of various fish species. Baird's program of research is as comprehensive and valid today as it was 90 years ago.

No time was lost in initiating this program. Woods Hole was selected as the base of the sea coast operations during the first summer. In spite of the insignificance of local fisheries, this locality offered a number of advantages which were recognized by Baird. Communication with Boston, New York, and Washington was good and promised to be better with the expected opening of the railroad branch in 1872. Being centrally located in relation to principal fishing grounds of New England and having good dock facilities and water of sufficient depth for sea going vessels, Woods Hole was a suitable base for visiting the offshore grounds. Furthermore, it was believed that the alleged decrease in food fishes was most clearly manifested in the region around Vineyard Sound. The small yacht Mazeppa of the New Bedford Custom House and the revenue-cutter Moccasin attached to the custom-house at Newport, R.I., were placed at the disposal of Baird; and the Light-House Board granted permission to occupy some vacant buildings and the wharf at the buoy-station on the west bank of Little Harbor (fig. 5). The Secretary of the Navy came to Baird's assistance by placing at his command a small steam launch which belonged to the Boston Navy Yard and by giving many condemned powder tanks which could be used for the preservation of specimens. Nets, dredges, tanks, and other gear were provided by the Smithsonian Institution. Cooperation of the various governmental agencies was authorized

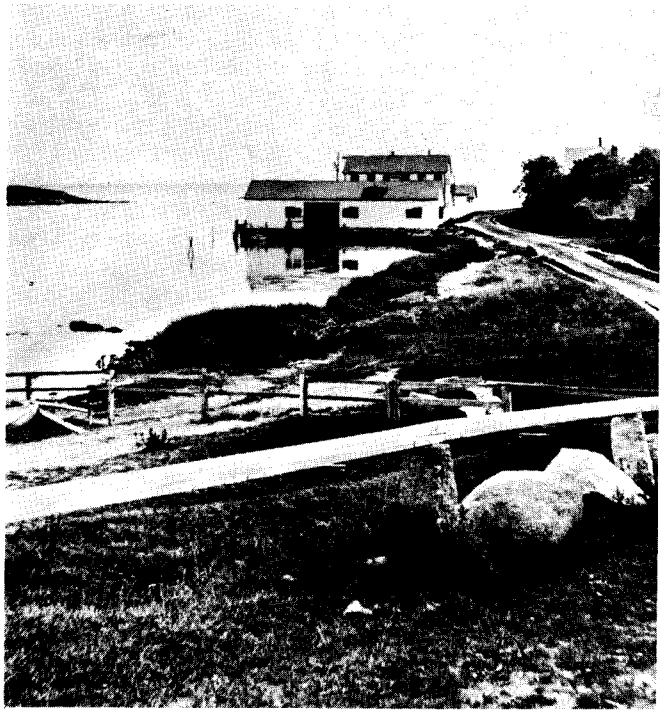

Figure 5.--Buildings of the Light-House Board on the west bank of Little Harbor used by Baird as temporary headquarters and laboratory. Courtesy of Norman T. Allen.

by Congress which in Section 3 of the Resolution specified that "the heads of the Executive Departments be, and they are hereby directed to cause to be rendered all necessary and practicable aid to the said Commissioner in the prosecution of the investigations and inquiries aforesaid."

This provision of the law was of great value. It is apparent, however, that the success in obtaining cooperation authorized by law depended a great deal on the personal characteristics of Baird, his great ability of getting along with people, and his remarkable power of persuasion. These qualifications played the major role in his success in organizing the Commission's work and also in obtaining the cooperation of scientists as well as that of fishermen and businessmen.

The investigation during the first summer consisted primarily in collecting large numbers of fishes and studying their spawning, rate of growth, distribution, and food. In the course of this work nearly all the fish pounds and traps, some 30 in number, in the

vicinity of Woods Hole, were visited and their location recorded. There was no difficulty in obtaining the owners' permission to examine these installations and to collect the needed specimens. Altogether 106 species of fish were secured, photographed, and preserved for the National Museum. Of this number 20 or more species had not previously been known from Massachusetts waters (Baird, 1873). Information gained in this manner was supplemented by the testimonies of various fishermen who presented their ideas either for or against the use of traps and pounds. Among them was Isaiah Spindel, who at the request of Baird, prepared a description of a pound net used at Woods Hole and explained its operation. In the following years Spindel became an influential member of the group of local citizens who supported Baird's plan of establishing a permanent marine station at Woods Hole.

The ship Moccasin under the command of J. G. Baker was engaged in taking samples of plankton animals, in determining the extent of beds of mussels, starfish, and other bottom invertebrates, and in making temperature observations.

One of the principal collaborators in the studies conducted at Woods Hole in 1871 was A. E. Verrill (fig. 6) of Yale University, a professor whom Baird appointed as his assistant and placed in charge of the investigations of marine invertebrates. Dredging for bottom animals during the first summer was carried out on a relatively small scale from a chartered sailing yacht Mollie and a smaller vessel used in the immediate vicinity of Woods Hole. Extensive collections were made by wading on tidal flats exposed at low water.

Zoological work attracted considerable interest among the biologists of this country. Many of them stopped at Woods Hole for greater or lesser periods and were encouraged by Baird to use the facilities of the Fish Commission. The group included such well known men as L. Agassiz, A. Hyatt, W. G. Farlow, Theodore Gill, Gruyure Jeffries of England, and many others.

The first year's work extended until the early part of October. Before returning to Washington, Baird commissioned Vinal N. Edwards (fig. 7) of Woods Hole to continue the investigation as far as possible. By the end of the first year a general plan of study of the natural histories of the fishes and the effect of fishing on fish populations was prepared with the assistance of the well-known ichthyologist, Theodore N. Gill. His old "Catalogue of the fishes of the Eastern Coast of North America from Greenland to Georgia", (Gill, 1861) was revised and the next text including the recently collected data concerning the Massachusetts fishes, appeared in the First Report of the U. S. Commissioner of Fish and Fisheries (Gill, 1873). The plan of investigation suggested by Gill was adopted by Baird (Baird, 1873) as a guide for the work of his associates for the purpose of "securing greater precision in the inquiries." The plan is composed of 15 sections, such as

Figure 6.--A. E. Verrill, Professor at Yale University and assistant to Baird at Woods Hole.

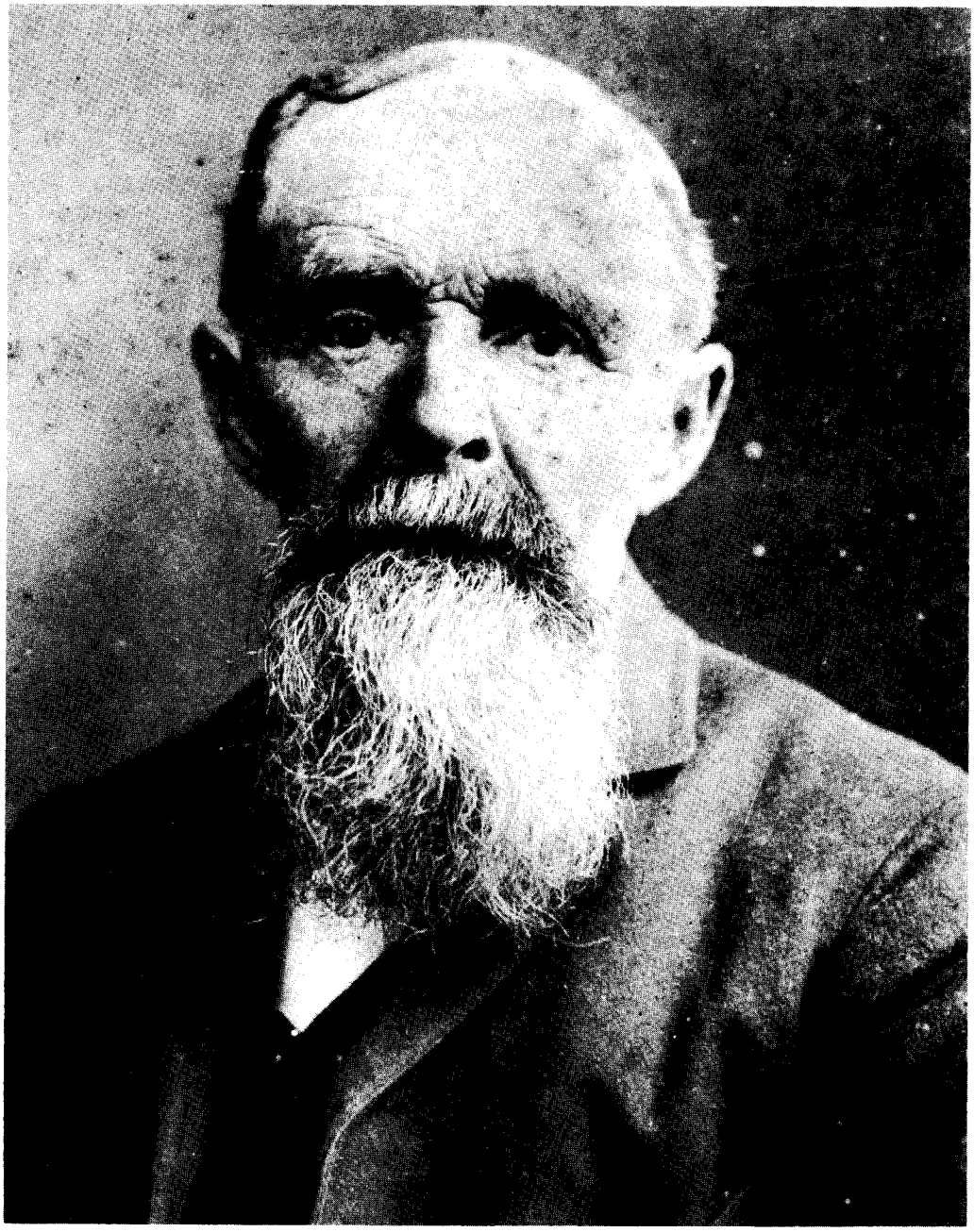

Figure 7.--Vinal N. Edwards, naturalist and collector for the U. S. Fisheries station at Woods Hole. About 1918.

Geographical distribution, Abundance, Reproduction, etc., with detailed subdivisions under each one. A questionnaire containing 88 different items was included in order to facilitate the inquiries conducted among the fishermen. The scope of the highly comprehensive program is complete enough to be useful today; marine biologists of today would probably only rephrase it, using modern terminology. During the first year of operations conducted at Woods Hole, Baird and his associates laid down the foundation of the new branch of science which we now call fishery biology or fishery science.

Edwards, whom Baird appointed as pilot and collector to continue the work which started in June 1871 at Woods Hole, was a most remarkable man. Without a formal scientific education he was a born naturalist who possessed the essential characteristics of a true scientist, with great ability for accurate observation, correct recording of facts, and enthusiastic devotion to the study of nature. Since the time of his appointment until his death on April 5, 1919, Edwards remained in the continuous service of the Fisheries Station at Woods Hole and became the person most familiar to the biologists working there. Devoid of any vanity he unselfishly assisted many scientists engaged on various research problems. No wonder, therefore, that his name was frequently mentioned in the many papers, especially those dealing with the local marine fauna. For more than 30 years he kept daily records of sea-water temperature and density at Woods Hole, recorded the catches of fish from the pounds, noted the appearance of sea birds and their nesting, and recorded the results of seining and dredging. Shore seining seemed to be his favorite occupation in which he engaged with an unquenchable enthusiasm. He frequently rowed his heavy skiff, loaded with a 200-foot seine, five or six miles and after seining for several hours returned home in darkness.

In a letter on file in the U. S. Bureau of Fisheries, Edwin Linton writes that Edwards' ability to forecast the weather for many hours ahead seemed uncanny to inlanders not familiar with the sea. He adds that "I think of Vinal's mind, when dealing with nature, as mirroring . . . . the region from Narragansett Bay to Monomoy, and I do not know how much farther. The set of the tides seemed to be in his mind as a moving picture which he could refer to on the moment, so that it was much easier to ask Vinal when it would be low water at Katuma Bay, on the coming Saturday, or when the tide would begin to make to the eastward at Quick's Hole on the following Monday . . . . . than it would be to attempt to work it out from the tide tables."

Edwards' enthusiasm for observation and collecting was known to Baird. This probably explains that in making his appointment he stipulated that "Mr. Edwards was to do no regular work on Sunday." Edwards' services to the Fish Commission and to the biologists who came later to work at Woods Hole were recognized by many prominent

scientists. Their feelings are well summarized by the words of E. B. Wilson, who wrote on May 12, 1919 after the death of Edwards, as follows: "It is hard to realize that the familiar figure of Vinal N. Edwards will no longer be seen at Woods Hole, and he will be greatly missed, especially by all the earlier workers who had come to rely so often upon his advice and judgment. No one could know Vinal Edwards without having the kindliest feelings toward him personally and without coming to realize that he was a man of rare character and attainments. I always associated him with Spencer Baird who I know had a very high regard for him and fully appreciated his important services to the Fish Commission . . . . Woods Hole will not seem the same without him." A commemorative plaque for Edwards was presented by friends of Edwards to the Fisheries Laboratory at Woods Hole and was mounted on a wall at the entrance to the old aquarium building. It can now be seen in the lobby of the new laboratory.

In the years 1872-74 the operations of the Fish Commission were shifted northward to the Bay of Fundy with the special purpose to study the fisheries of Maine and the adjacent portion of the British Provinces. In 1872 the headquarters was established at Eastport, Maine, where Baird was permitted to use the U. S. Revenue cutter Mosswood. The vessel was armed with a small gun on the forward deck and carried a number of rifles and cutlasses. The arrangement with the revenue office specified that if a suspicious craft should be sighted the dredging must be suspended while the suspect was overhauled and investigated. The records fail to show that dredging and seining were interferred with, since most of the smuggling was done at night. As in the previous year, several scientists, including A. E. Verrill, S. I. Smith, G. Brown Goode, Th. N. Gill and others, assisted in the work and collaborated in the identification of collected materials. The Commissioner of the Dominion Fisheries, William F. Whitcher, and his staff showed great interest in the fishery investigations and gave Baird valuable assistance and cooperation. A biologically interesting conclusion was reached by Baird regarding the probable cause of the reduction of cod and river fishes, both of which have declined in equal ratio. He states in his report for 1872-73 (Baird, 1874) that "the reduction in the cod and other fisheries, so as to become practically a failure, is due to the decrease off our coast in the quantity, primarily of alewives; and secondarily, of shad and salmon, more than to any other cause."

Early in 1872, the American Fish Culturists Association at the February meeting in Albany, New York, passed a resolution urging the U. S. Government to take measures for the introduction and artificial propagation of shad, salmon, and other valuable food fishes throughout the country, especially in the waters common to several states. An appropriation of $15,000 for this purpose was

Figure 8.--Steam tug Bluelight assigned by U.S. Navy to Baird for sea explorations along the coast of Maine. Courtesy of Norman T. Allen.

given by the Congress and added new responsibilities to the Commission of Fisheries. This action greatly influenced the work at Woods Hole where a marine hatchery was established as an integral part of the station.

In 1873 the field operations were based at Peaks Island in Casco Bay, Maine, about three miles from Portland. The location was selected as the principal area of the herring and cod fisheries. A Navy steam tug Bluelight (fig. 8) which weighed about 100 tons and was 100 feet in length, was placed under the jurisdiction of the Commissioner. This vessel was sufficiently large to provide an opportunity of trying, for the first time, the steam windlass for hoisting the dredges and trawls. This improvement of technique attracted the attention of the Secretary of the Navy who visited the headquarters and spent several days in examining the operations at sea. The assignment of the U.S. Coast Survey steamer Bache to the Fisheries Commission gave

an opportunity to extend the operations farther offshore between Mount Desert and Cape Cod.

As in previous years many visitors, including several scientists who attended the Portland, Maine, meetings of the American Association for the Advancement of Science, Maine Commissioners of Fisheries, representative of the New York Tribune, and others came to see Baird's explorations.

For marine investigations in 1874, Baird selected a locality in the village of Noank, Conn. at the mouth of the Mystic River on Fishers Island Sound. The place was sufficiently remote from the previously explored areas of New England waters to permit the notice of some important zoological differences. In addition to the waters adjacent to Noank, the Bluelight visited Montauk Point on the eastern tip of Long Island, Gardiners and Peconic Bays, Block Island Sound, and the eastern part of Long Island Sound. Verrill and his associates reported that over 100 species of invertebrates new to the fauna of New England were found. They also reported that some of the more southern species of animals were discovered in localities which had a higher sea-water temperature than others. In addition, the party conducted experiments in artificial propagation of sea bass and attempted to introduce young shad into salt-water rivers. Valuable background information necessary for selecting a place for the permanent location of the laboratory and hatchery was obtained through the four years of studies of the abundance, habits, and distribution of the more important species of fishes and invertebrates. The final decision had to be postponed until later years.

Baird, with his assistants, returned to Woods Hole in 1875 with the idea that a second survey of local waters would provide a means for determining the variation in the abundance of fishes as compared with the conditions recorded four years previous, in 1871. The need for a more permanent field accommodation for the Commission became acute. It was solved by the authorization of the Light-House Board to convert the large shed on the banks of Little Harbor into a two-story laboratory (fig. 9) and to construct a 5,000-gallon reservoir and a windmill for pumping sea water. The regular appropriation of the Commission provided funds necessary to cover the cost of the alteration, but laboratory equipment, including tables, shelves, tanks, aquaria, and plumbing, for which Government funds were not available, was purchased with the liberal contributions made by Mr. and Mrs. John F. Forbes of Naushon Island and Robert L. Stuart of New York. This laboratory greatly facilitated the work of sorting, identification, and preservation of the material collected at sea and made it possible to observe the behavior of various animals, and to study their spawning and the hatching of eggs. The opportunities

Figure 9.--Temporary laboratory at Little Harbor established by Baird in 1875 on the grounds of the Light-House Board. Sea-water tank to supply the aquaria and water tables on the right. Courtesy of Norman T. Allen.

for research in marine biology offered by the new laboratory attracted many outstanding biologists from New England colleges, as well as State fisheries Commissioners and the general public. Baird realized the importance of public support of his venture and encouraged the visitors to come and see the laboratory and the collection of live fish and other animals kept in tanks. He was pleased when popular accounts of the activity of the new institution appeared in the New York Tribune under the signature of William C. Wyckoff, the scientific editor, who on several occasions was his guest at Woods Hole.

The year 1875 should be considered the year of the establishment of the Woods Hole laboratory, although the construction of a permanent building had to be postponed for several years. During 1875 and in the following years the biological investigations continued under the supervision of Baird and his principal collaborators, George Brown Goode and A. E. Verrill. A number of students