THE WORK OF THE MARINE BIOLOGICAL STATION OF THE U. S. BUREAU OF FISHERIES, AT BEAUFORT, N. C., DURING THE YEAR 1909

A STEAM launch was available for a portion of the year for the use of the station. Another launch, equipped with a 9 H.P. gasoline engine, was available throughout the year, except for a brief period in the spring when it was detailed to the Edenton station. A large sailing-boat and a number of row-boats were also a part of the general equipment of the station.

A new 30 H.P. boiler was installed in the power-house. This furnished ample power for operating the electric-light plant and for supplying the station with running salt and fresh water. A mess was maintained from the latter part of June to the middle of September by the investigators and assistants. Board cost each member of the mess five dollars per week.

In connection with the experiments of Professor Binford an apparatus was installed for supplying the station with salt water at temperatures higher than that of the surrounding water in the harbor. The apparatus, while not perfected, was practicable, and it is available for similar experimental work in the future.

A large concrete pound, begun late in the previous year, was completed for carrying on experiments looking toward the culture of the diamond-back terrapin. The pound was so arranged as to give the terrapins free access to salt water, marshy land and sand. The experiments with the terrapins were begun too late in the season for securing as good results as would otherwise probably have been obtained. Eggs were laid, however, by the terrapins and a number of the young were hatched. Experiments were begun with a view of rearing the young. At the end of the year the experiments were being carried along successfully. Professor W. P. Hay, of Washington, D. C., had general supervision of the work.

What is planned to be a comprehensive study of the molluscan life of the Beaufort region, including a study of its general relation to the Transatlantic province, was begun with work on the lamellibranchs. Considerable dredging was done as well as other collecting from more accessible places. The material will be supplemented by collections made from the dredging done by the *Fish Hawk* off-shore near Beaufort in 1907.

A detailed study of the breeding habits of the common clam, *Venus mercenaria,* was begun. Work during the summers of previous years, principally by Dr. H. E. Enders, showed that the sexual elements were abundant during the summer season, but that the eggs could be fertilized only sparingly in the laboratory. Examinations made at intervals of about nine days each, beginning the early part of November, showed that eggs and active sperm were present both during November and December. Dr. Enders reached the conclusion that the breeding season of *Venus mercenaria* extends through several months, during which a small quantity of eggs is discharged at short intervals under natural conditions; and it may be that the spawning period extends throughout the year. The temperature, however, may prevent the development of eggs during the colder portions of the year.

The laboratory collection of fishes was increased by a gift of a number of specimens from Mr. Russell J. Coles, of Danville, Va. These specimens were collected from Cape Lookout in 1909. The collection included two specimens of *Narcine brasiliensis* (Ölfers), a species which, it is believed, has not heretofore been recorded from anywhere along our coast north of Florida.

The facilities of the station were utilized by a number of investigators, each working on problems related more or less closely to the work of the bureau. They have kindly furnished abstracts of their work, which are herewith included. They were:

Dr. H. V. Wilson, professor of zoology, University of North Carolina, Chapel Hill, N. C. Dr. Wilson studied the structure, behavior and regeneration of the epidermal layer in some monaxonid sponges (*Stylotella* and *Reniera*). The epidermis in these forms

was found to consist not of separate cells. It is a syncytial nucleated sheet of protoplasm without cell boundaries. The epidermis is regenerated over a cut surface in about twenty-four hours. The union of the mesenchyme cells to form it was followed. Some new facts as to the way in which pores close were made out.

Dr. G. H. Parker, professor of zoology in Harvard University, Cambridge, Mass. Dr. Parker investigated the reactions of the shore sponge, *Stylotella.* No physiological evidence of nervous tissue was found, though the sponge reacted to changes in the environment by opening and closing its oscula and pores, and by moving its body as a whole. These movements were produced by tissue resembling a primitive kind of smooth muscle. They were apparently caused by the direct stimulation of the contractile tissue. The conclusion was reached that in phylogeny muscular tissue had preceded nervous tissue in time of origin.

Dr. E. P. Lyon, professor of physiology, St. Louis University School of Medicine, St. Louis, Mo. Dr. Lyon worked on the following problems: (1) The catalase of echinoderm eggs before and after fertilization. An apparent large increase of catalase is found after fertilization. The results of this investigation were published in the *American Journal of Physiology* for December, 1909. (2) The comparative autolysis of eggs before and after fertilization. The chemical work on this problem has been continued since leaving Beaufort and the results are nearly ready for publication.

Dr. E. W. Gudger, professor of biology in the State Normal College, Greensboro, N. C. Dr. Gudger was chiefly occupied in continuing his investigations of several years' standing on oral gestation in the gaff topsail catfish, *Felichthys felis,* and in collecting material for the study of its embryology. He was successful in pushing back its life history by several days and lacks only the segmentation and invagination stages of having a complete series of eggs and embryos.

He also began a study of the viviparous top minnow, *Gambusia affinis,* and collected various unusual and interesting fishes the data concerning which have been embodied in a paper now in press.

Dr. Alvin S. Wheeler, associate professor at the University of North Carolina, Chapel Hill, N. C. The composition of the sea water at five points near the laboratory was accurately determined. The results agreed closely with each other but showed certain differences from deep-sea waters and shore waters in other parts of the world.

Dr. I. F. Lewis, professor of biology, Randolph-Macon College, Ashland, Va., completed his study of the flora of Shackleford and Bogue banks, and his report has been submitted to the commissioner of fisheries.

After a brief discussion of the geology, soils, physiography and climate of the region, the plant formations are considered. The vegetation is treated under the following heads: I., sand strand vegetation—(1) treeless (open), (2) trees and shrubs (closed); II., marsh vegetation—(1) salt marsh, (2) creek marsh, (3) dune marsh, (4) tidal flat.

Under these heads each plant association is described, and the characteristic species noted. Following this discussion of what may be termed the units of vegetation, a general account of the vegetation of the banks is given, in order to present as clear a picture as possible of the conditions obtaining on the banks at the present time.

The present plant covering was found to be in process of destruction by certain physiographic agencies. Measurements showing the rapidity of action of these agencies are given, and methods suggested for the conservation of the vegetation. In this connection the soil-building and sand-binding plants of the region are described and their value indicated for reclamation work.

The geographical distribution of the plants occurring on the banks is discussed, and comparisons instituted with other points on our South Atlantic coast and with the littoral flora of Alabama. The littoral floras of North and South Carolina and Alabama are found to be typically austro-riparian in char-

acter, though many of the plants common on the mainland are absent from the wind-swept sandy reefs.

The report closes with a classified list of the 268 species of ferns and flowering plants collected. Of these, 11 are new to the flora of North Carolina.

Dr. W. D. Hoyt, Bruce Fellow, Johns Hopkins University, Baltimore, Md., continued the study of the marine algæ, begun in previous summers. This region, unlike most of the southern coast, is found to have a fairly rich algal flora, one hundred and nineteen species being recorded up to the present time. The location of Beaufort, intermediate between the northern and southern regions, makes this flora of special interest, since many forms reach their northern limit here, while others have this for their southern boundary. The presence of a submerged coral reef off the coast gives a supply of subtropical forms on the beach.

The study that is being made includes the conditions of growth, the distribution of the algæ, and the factors controlling this distribution. Collections were made throughout the winter (1908–09) and kept for study, thus giving a view of the algæ throughout the entire year. The work was extended to the coast south of Beaufort, visits being made to nearly every accessible point between this place and Tybee, Ga. Notes were obtained which will furnish interesting comparisons of the distribution and conditions of growth with those of Beaufort. The final report will soon be submitted.

Mr. Raymond Binford, professor of biology in Guilford College, Guilford College, N. C., worked on the life history of the stone crab, *Menippe mercenaria*. A large number of crabs were kept under observation in tanks in the laboratory and in floats at the wharf. From these the spawning habits were observed and the development up to the third larval stage was worked out. The period from spawning to hatching covers eleven to thirteen days, from hatching to the third larval stage about four weeks. At this time they have not yet reached the megalops stage. The strength of the claw muscle was tested and the molting habits observed. Crabs were collected varying in size from 4.5 mm. to 132 mm. across the carapace. A study of the frequency of molting and the increase of size at each molt indicates that they reach the egg-laying size, 56 mm. across the carapace, within a year from the time of hatching. About a thousand of these stone crabs were caught in and about Beaufort Harbor during the summer. There is a ready sale for them at 65 cents per dozen.

Eggs from other species of crabs were hatched in the laboratory, viz., the mud crab, the oyster crab, a crab found in the *Atrina* (*Pinna*) shell, one taken from the *Chætopterus* tube and the blue crab, *Callinectes sapidus*. *Callinectes* was followed through six molts beginning with the megalops stage. It made those molts within a period of thirty-seven days and reached a size thirteen millimeters across the carapace. Some experiments in hatching and rearing the young were undertaken. It is proposed to continue work along this line during the coming summer.

Mr. B. H. Grave, Johns Hopkins University, Baltimore, Md., spent two months at the laboratory studying the anatomy of *Atrina* (*Pinna*) *rigida* Dillwyn. The greater part of the time was spent in injecting and dissecting the vascular system. Experiments were carried on to ascertain the rate and method of the growth of shell and an attempt was made to determine whether the calcium salts, used in shell growth, are taken directly from the sea water or from the blood of the mollusk. The results of this work will soon be ready for publication.

Mr. W. H. Kibler, of the department of science of the Durham High School, Durham, N. C., was engaged in a general study of the fauna of Beaufort and a study of the embryology of *Arbacia, Toxopneustes* and *Turritopsis*. In studying the fauna observations were made upon about forty common forms, and in addition a dozen or more species of fishes were collected and identified. The eggs of *Arbacia* and *Toxopneustes* were artificially fertilized. The development was normal and

reached the stage of the fully developed pluteus. Later stages of young echinoderms were obtained in tows. The eggs of *Turritopsis* developed through the planula stage. Eggs of *Chætopterus* and *Thalassema* were artificially fertilized.

Mr. George W. Corner, 3d, medical student at the Johns Hopkins University, Baltimore, Md., spent the months of July and August collecting and studying the invertebrates.

HENRY D. ALLER,
Director

SPECIAL ARTICLES

PRELIMINARY NOTE ON THE LIFE OF GLACIAL LAKE CHICAGO

EXCAVATIONS made for the new sanitary canal, which will extend from Willmette to the North Branch of the Chicago River at Bowmanville, have disclosed a series of beds filled with organic remains which reveal very fully the characteristic faunas of the several stages of glacial Lake Chicago. The cut at the Bowmanville end of the canal is a mile long; the depth is about twenty-five feet, fifteen of which are in boulder clay (glacial till) undisturbed by water action. The upper ten feet are composed of alternate layers of sand, clay, peaty material and shell beds. These strata quite fully portray the biologic history of the lake.

The area through which the canal is cut lies behind (west of) the Rose Hill bar and the strata exihibited in section were successively the bed or floor of Lake Chicago. These strata may be described as follows: Above the till there is a bed of sand from two to twelve inches in thickness. This doubtless represents the Glenwood stage and, as would be expected, no life is present. Above the sand is a bed ten to eighteen inches thick, composed of clay mixed with peaty matter, logs of wood and leaves of trees (oak and spruce). Molluscan shells of the genera *Planorbis, Physa, Lymnæa, Ancylus, Sphærium, Pisidium* and *Amnicola* abound. The presence of this extensive deposit, which can be traced the entire length of the canal, beneath deposits unquestionably of Calumet time, strongly supports, if indeed it does not prove, the early contention made by Dr. Andrews of a post-Glenwood low-water stage. The species of mollusks are mostly those found in swamps or along the edges of shallow bays or lakes.

Above the clay is a deposit of sand and gravel, two to nineteen inches in thickness, on the surface of which is one of the thickest beds of naiades the writer has ever seen. There are upwards of a dozen species, including *Unio gibbosus, U. crassidens, Quadrula undulata, Q. rubiginosa, Q. trigona, Q. verrucosa* and *Q. pustulosa.* With these are associated *Campeloma, Sphærium* and *Goniobasis.* The shells are species which frequent large streams of more or less rapidly flowing water, as the Illinois and Mississippi rivers, which fact, together with the unassorted character of the sand and gravel, shows that there was a rapid flow of water from the lake to the Desplaines outlet behind the Rose Hill bar. This deposit is believed to represent the Calumet stage. The presence of *Unio crassidens* is of great interest, as this species is not now found north of La Salle County in Illinois.

Above the Naiad deposits there are alternate beds of clay and sand, with occasional pockets of shells, the aggregate thickness being about thirty-two inches. The presence of peaty matter and wood afford evidence of a second low-water stage. In one of these deposits the humerus of a small bird was found as well as several fish spines.

Above this deposit there is a bed of molluscan shells forming a compact mass from one and one half to five inches in thickness. These are of swamp or bay species of the genera *Lymnæa, Planorbis, Physa, Valvata, Campeloma, Amnicola, Sphærium, Pisidium,* etc. Naiades are uniformly absent. This deposit was formed during the early portion of the Toleston stage, when the area behind the Rose Hill bar formed a reed-bordered bay. Above the shell bed is a deposit of clay seven to twelve inches in thickness, and above this, a typical peat deposit three and one half to eight inches in thickness. This deposit was formed in a small lake or pond, as it is of small extent. The region at this time was of