beneath the cranium. It gives rise to the lower part of the cochlea, the promontory and lower part of the oval window, the round window, the lower arm of the posterior semicircular canal, the lower part of the facial canal, the jugular fossa, the carotid canal, and the floor of the tympanum.

The mastoid portion of the petrosal is produced, subsequent to the complete coalescence of the prootic and opisthotic, by outgrowths from the posterior and external semicircular canals. The outgrowth from the posterior semicircular canal first shows itself externally in the broad plate of cartilage which forms part of the cranial wall between the squamosal, the parietal, and occipital bones. It makes its appearance as an elliptical islet just in advance of the occipital. In this condition it has been viewed by Professor Huxley as a distinct ossific centre, to which he has given the name of the *epiotic*, regarding it as the specially mastoid part of the mastoid portion of the temporal bone. In my preparations, the elliptical islet has appeared as a continuous growth from the most prominent part, outwardly, of the posterior semicircular canal, after the completion of this by the co-ossification of its arms, which spring separately from the prootic and opisthotic. Later, a second element of the mastoid portion of the petrosal, as an outgrowth of the external semicircular canal, makes its appearance as a quadrate islet in the cartilage intervening to the elliptical islet and the squamosal. The two islets quickly unite, and thus together form the mastoid portion of the petrosal; the notch between them, above, still remaining at the upper extremity of the latter, at birth. From the anterior or quadrate islet, the mastoid process is subsequently developed, and not from the supposed epiotic, as has been asserted.

The squamosal and petrosal commonly anchylose in the external portion of the petro-squamosal suture, near the time of birth; and this portion of the suture is usually obliterated during the first or second year subsequently. Sometimes traces of it remain as irregular chinks, and rarely the greater extent or the whole of it may be retained, as represented in the accompanying fig. 3, from one of several similar specimens in the university museum. The suture is observed to descend from the notch at the upper border of the bone to the point of the mastoid process; and it thus indicates that the anterior third of the mastoidea pertains to the squamosal, while the rest alone belongs to the petrosal. The internal portion of the suture, commonly after some years, is but partially obliterated, and frequently remains, to a variable extent, as a fissure defining the tegmen of the petrosal from the inner surface of the squamosal.

The mastoid process, scarcely marked at birth, becomes conspicuous only after a year or two. The mastoid antrum is developed at birth; but the surrounding mastoid cellules undergo but little development until after puberty.

The external auditory meatus is produced after birth. The auditory plate forming its roof is gradually more differentiated from the rest of the squamosal, and its tympanic scute becomes more distinct by the production of spongy substance between it and the roof of the meatus. The floor and sides of the latter are produced from the tympanal ring, which becomes the tympanic plate of the more mature bone. Lateral processes grow outwardly from the ring, expand at the ends, and conjoin to form the auditory process, leaving an aperture in the tympanic plate. The aperture is obliterated about the third or fourth year, but occasionally is retained as an imperfection, closed by fibrous membrane. From growth downward and backward from the tympanal, the vaginal process and posterior extremity of the tympanic plate are produced.

FIG. 3.—Temporal bone, one-half size, exhibiting the outer part of the petro-squamosal suture, permanently retained, and indicating the division of the mastoidea into a squamosal and a petrosal portion.

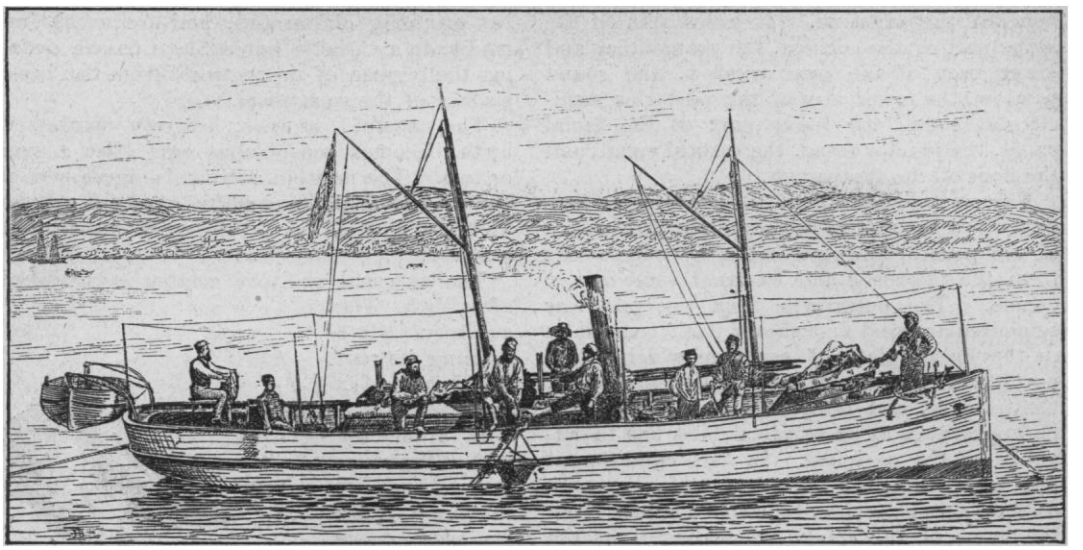
JOSEPH LEIDY.

THE NAPLES ZOÖLOGICAL STATION.[1]

II.

THE fleet of boats belonging to the station, to whose efficient services the constant supply of material is due, consists of two steam-launches and a number of row-boats and sail-boats. The larger of the steamers, named, after the great German biologist, 'Johannes Müller,' was given by the Berlin academy of sciences; while the smaller, the 'Francis Balfour,' was bought by the station. These are used for long excursions, being absent in summer sometimes for three or four days.

[1] Concluded from No. 17.



THE JOHANNES MÜLLER.

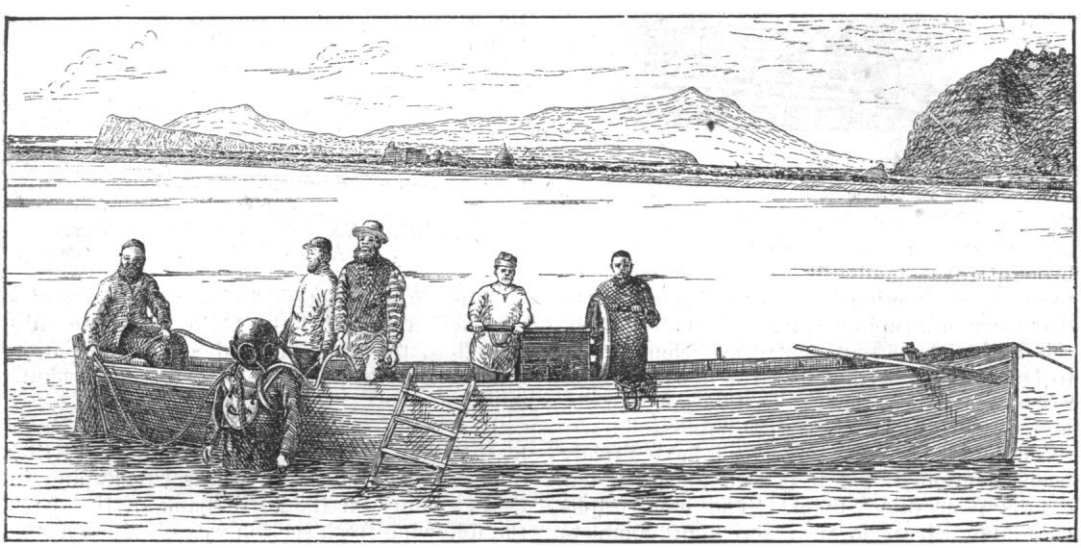
The smaller boats are used for shorter distances and for surface-netting, by which is obtained the heterogeneous collection of large and small pelagic animals known as *auftrieb*, and brought into the station every day in fair weather. A vessel full of the auftrieb is taken to the occupant of each table in order that he may search for free larvae, if he happens to be studying the embryology of animals which leave the egg at an early stage, or may study the many curious pelagic animals which cannot be kept in captivity, and only occur from time to time in the contents of the surface-nets. The larger pelagic animals — such as large medusae and ctenophores — are separated from the auftrieb for the use of those who happen to be specially engaged in their study. But among the many minute creatures which are to be found in it at various times may be mentioned the winged, free, swimming mollusks of the class Pteropoda, known to the Neapolitan fishermen as *farfalle di mare*, or sea-butterflies; the other class of free, swimming mollusks, Heteropods; the free, tailed ascidians, Appendicularia; innumerable species of small medusae, — some adult, some the young stages of the fixed Hydrozoa; and transparent crustaceans of various sizes of the class Copepoda, which are never wanting.

The greatest possible care and attention is given by the attendants, and by the gentlemen of the staff, to the requirements of each zoölogist in the station, with respect to material. If unfavorable weather prevents fishing-operations, or if the animals required are rare, whatever is at hand in the preserved state is placed at the disposal of the investigator; and advice as to methods of preservation and treatment, and information as to the breeding-times and seasons of frequency or rarity of the inhabitants of the gulf, are always offered with the greatest freedom and courtesy. By writing beforehand, a naturalist about to work at the station may insure having material — living and preserved, adult and in the young stages — ready for him on his arrival, so that he can commence his researches at once. But the zoölogist who occupies himself at the station is not merely a passive recipient of the benefits of its organization. Every opportunity is given to him to study its whole working, and to take an active part in the fishing and dredging operations. He is invited to accompany the members of the staff on the steamers on excursions in the bay and to various points on the coast or neighboring islands, — to the Bay of Salerno, to Capri, to Ischia, — in order to see how the different kinds of apparatus are worked, and, if he pleases, to descend, equipped in the diving-dress, and examine the bottom of the sea with his own eyes. The beauty of the scenery and climate, the congenial society, and the interest attaching to the operations, combine to render these excursions the most pleasant events in the course of a visit to the zoölogical station.

A zoölogist obtains the privilege of working at the station by application to some institution

in his own country which has the disposal of a table: in the majority of cases, the application has to be made to the government. The station lets its tables to scientific corporations or to governments at a yearly rental of four hundred dollars each. There are, at present, twenty tables taken, of which the greater number belong to Austria, Germany, Russia, and Italy. Holland and Belgium have one each, and England has two. There is room in the station for thirty. The rapid development of the institution is shown by the fact, that, when it was first opened (in January, 1874), only seven tables were taken. About two hundred and thirty biologists — among them, very many of the highest eminence — have worked in the laboratories of the station in the nine years of its existence; and the published works founded on the studies so carried out form a considerable proportion of the total addition to biological knowledge produced during that period. The brilliant researches of Francis Balfour on the development of elasmobranchs, which formed such a large step in the progress of vertebrate embryology, were carried out chiefly during the time he spent at the table of Cambridge university, in 1874, 1875, and 1877; and he always fully acknowledged the debt he owed to the zoölogical station and its staff. Professor Grenacher commenced his researches on the eyes of arthropods at the station in 1876, — researches which resulted in his classical work, which is, up to the present, the principal authority on the subject. The brothers Oscar and Richard Hertwig carried out their interesting work on the histology of the Actiniae at Naples. F. E. Schultze and Oscar Schmidt, two of the principal living spongiologists, have availed themselves of the resources of the station; and Professor Claus, Dr. Hubrecht, Dr. Spengel, and Dr. Chun are other names whose celebrity in zoölogy is connected with the institution. Last year an American zoölogist, Dr. Whitman, carried out some important researches in the Naples laboratory on the curious parasites, Dicyemidae.

The number of those belonging to the permanent scientific staff of the station is eight, including Mr. Petersen, the engineer, to whose skilful and successful management of the machinery the wonderful regularity and efficiency of all the mechanical arrangements is due. The other seven are biologists who are occupied in the preparation of monographs of various classes, for the series published by the station; while they divide among them the work connected with the issue of the two periodical publications, and the routine duties of the laboratories. Dr. Dohrn acts as director, and represents the station to the outside world; while the chief duties of management devolve on Dr. Eisig, to whose devotion and foresight the enterprise owes much of its success. The duties of librarian are discharged by Dr. Brandt, whose name is well known in connection with the recent discoveries that have been made, as to the existence and significance of symbrosis in animals, and who is engaged at present on the monograph of the radiolarians of the gulf. Dr. Lang, in the



THE DIVER'S BOAT.

course of his work on the turbellarians, has already produced some extremely important papers on their morphology, and the relations of plathelminths generally. The monograph of Dr. Mayer, on the curious crustacean family Caprellidae, has just appeared, and the 'Copepoda' of Dr. Giesbrecht is rapidly approaching completion. To the two zoölogists last named belongs the credit of most of the great improvements in technique which have been invented in the station. The value of these improved methods can scarcely be overestimated. Technical difficulties often stand in

THE STATION FISHERMAN.

the way of the solution of definite and important questions: before them the investigator is brought to a stand-still, and his advance in the desired direction hopelessly blocked. The discovery of a rapid and certain method of obtaining series of sections, which science owes to Dr. Giesbrecht, has given a new power to research, and enabled investigations to be undertaken which before were impossible.

The publications of the station have already been mentioned, but it is well to add a few details concerning them. The monographs are intended to form a series of complete studies of every group of animals existing in the gulf, and to contain a body of accurate information on the anatomy, histology, classification, and relations of marine forms, which shall serve as a sound basis for future investigations. The series includes Algae as well as animals. They may be written in either of the four generally known European languages. Six have already appeared, the first being the beautiful work of Dr. Chun on the Ctenophorae. One by Dr. Emery has already appeared in Italian; and the Actiniae of Dr. Andres will shortly be published in the same language. They are published by subscription, of which the annual amount is $12.50, and the number of subscribers, up to the present, is two hundred and sixty. The station also issues a journal for original memoirs of work done in its laboratories, called the 'Mittheilungen aus der zoologischen station,' which commenced in 1879, and whose three volumes contain already much important work; also a bibliography, called the 'Zoologische jahresbericht,' in which every paper on biological subjects is not only indexed, but summarized. The latter was commenced in 1880.

It will be allowed that the zoölogical station has already a many-sided activity; that it has done, and is doing, a great deal for biological science; nevertheless, it is about to take a still further expansion. A separate laboratory is in course of preparation for the study of comparative physiology, for which nowhere such favorable conditions could be found as will be provided by the resources of the existing station. Every one who is a friend to the progress of biology must wish the Neapolitan station success in its new enterprise, and a continuance of the successful development which has, up to the present, taken place in the original institution.

Emily A. Nunn.

EVIDENCES OF GLACIATION IN KENTUCKY.

The following notes of observations on glacial action south of the Ohio River are submitted to the fund of evidence of glaciation anterior to the period of the great terminal moraine.

1. At the crossing of the Kentucky River by the extension of the Kentucky Central R.R., opposite the mouth of Otter Creek, and in Clark County on the north bank of the river, the following fresh section was obtained at the mouth of the railway-tunnel.