deficiency. And two areas of the same mud flat 100 yards apart will show a marked difference in the species obtained from them.

The sand or mud washed out does not need to be under water, but may be anywhere from low water mark to nearly high water mark, and may have been left uncovered for several hours. When the tide goes out the copepods burrow into the sand or mud and wait for its return; so long as the material around them remains moist they can pass the entire intervals between tides without apparent trouble. Sometimes the sand or mud near high water mark gets quite hot in the sun before it is recovered with water, but if it is not dried as well as heated the copepods remain alive and appear unharmed.

Another result of the limited distribution is shown during reproduction; the eggs hatch in the sand or mud and the development stages are passed there. At all events nauplii, metanauplii, and copepodid stages are washed out along with the adults, and the proximity of the two makes identification much easier than among the free-swimmers.

The modifications of size, structure and habits to enable these benthonic copepods to cope successfully with such a changed environment are fully equal to those exhibited by the other 3 groups; and will be discussed in detail in the final report.

There is thus opened an entirely new field of research among the copepods, almost limitless in area when we remember the thousands of miles of mud flats and sand beaches which stretch along our American shores. The numbers of specimens obtained compare favorably with those of the free-swimmers, and the presence of both sexes and development stages bids fair to yield interesting and valuable data. From limited examinations accomplished between collecting trips during the summer there have been identified 68 species, 20 of which are new, and 5 of them become types of new genera.

9. EARLY LIFE HISTORIES OF GULF OF MAINE FISHES

By Marie Poland Fish, *Buffalo Museum of Science*

During the summer of 1930 the ichthyological work of the Cooperative Investigations consisted in the identification and description of all eggs and young fishes taken, a study of their seasonal occurrence, horizontal distribution, and other problems immediately concerned with the early life histories of local species.

The plankton nets which were used continuously from June 24 to August 29 were of rather fine silk mesh (no. 0 to no. 20 bolting cloth) and thus were capable of capturing only eggs and early pelagic stages. Many fishes seek the bottom waters a short time after hatching and are

sufficiently agile to escape the more slowly straining gear. For that reason apparatus specially designed for young fish, Helgoland nets, and Petersen trawls are necessary to rout them out from their near-bottom habitats and bring them captive to the surface. It is planned that such nets be employed next season, so that our catches will include postlarvae and young adult stages lacking in past collections.

Although the species taken by the group were limited because of this net handicap to those species which were spawning and hatching during the period of investigation, the 1930 hauls yielded eggs and larvae of fourteen different fishes and made possible some rather interesting observations.

Contrasted with areas south of Cape Cod, a striking difference was noted in the number of larvel forms occurring. During the normal spawning season of certain species, eggs were abundant but very few larvae appeared subsequently. For example, cunner (*Tautogolabrus adspersus*) eggs were taken commonly throughout the summer months, but not a single larval specimen was found. Similar conditions have been reported in adjacent regions to the eastward. Why are cunners unable to successfully breed along this region of the coast to the Bay of Fundy while the waters south about Cape Cod as well as the more northern St. Mary Bay, the outer coast of Nova Scotia, and the Gulf of St. Lawrence are excellent nurseries? In continuing the program special emphasis will be placed on the determination of the importance of such areas in the Gulf of Maine as Frenchman's Bay as production centers for young fish.

The collection of cod (*Gadus callarias*) eggs over an extended period in midsummer was a surprise. A difficulty arises in the identification of freshly spawned cod eggs, for they closely resemble those of the haddock and witch flounder, but the appearance of black chromatophores upon the embryo definitely eliminates the witch, and the pigment pattern of the later stages differentiates the other two. Embryos which could be definitely distinguished as cod were taken as late as August 26, an evidence of the so-called "after spawning" previously observed in European waters and to a less degree in this region by Dr. H. B. Bigelow.

Whiting (*Merluccius bilinearis*), and witch flounder (*Glyptocephalus cynoglossus*) eggs were taken on many occasions between June 30 and August 26, four-bearded rockling (*Enchelyopus cimbrius*) from July 6 to August 12, and those of the cusk (*Brosmius brosme*) on rare occasions in the middle of July, young of silverside (*Menidia menidia notata*), herring (*Clupea harengus*), haddock (*Melanogrammus aeglifinus*), rock eel (*Pholis gunnellus*), lumpfish (*Cyclopterus lumpus*), mummichog (*Fundulus heteroclitus*), and others were found between the end of June and the middle of August.

A second ichthyological program carried on at the Mt. Desert Island Laboratory during the summer months was continuation study of freshwater fishes, the results of which will be included in a monograph on the early life histories of the fishes of Lake Erie and its tributaries, which the writer is preparing for publication during the early winter. Mr. Vernon S. L. Pate assisted in this work. Over 15,000 larval and postlarval fishes were examined, identified, and described, and thirty-six camera lucida drawings of developmental stages completed.

10. ANTARCTIC COLLECTIONS

By R. F. Shropshire, *Buffalo Museum of Science*

During the summer of 1930, while working with the scientific staff of the Buffalo Museum of Science in their study of Frenchman's Bay and adjacent waters, work was started on material brought back from the Antarctic region.

This material was collected while on the Byrd Antarctic Expedition and can be divided into two groups. First, there is a series of sea water filtrations made between New Zealand and the Bay of Whales, from which it is hoped that some insight into geographic distribution may be obtained. These filtrations were made by passing water from the ship's pump through no. 20 bolting silk filters and preserving the residue.

The second group of material was obtained by melting pieces of ice broken from ice floes in the Antartic pack ice, and centrifuging the water. So rich is the phytoplankton community in the Antarctic Ocean that when the sea freezes, the ice is often discolored by the tremendous number of individuals frozen into its mass.

The identification of species and the preparation of a taxonomic list of diatoms found frozen in ice was started. In addition to diatoms, an interesting number of copepods were found.

11. THE OPALINID CILIATES OF THE GREEN FROG

By Robert Hegner, *The Johns Hopkins University*

All species of American frogs are infected with opalinid ciliates except the green frog and the bull frog. There is one report of an infection in a green frog (Kudo,1922). Green frogs, tree frogs and leopard frogs were studied during the summer of 1930 in an attempt to answer the following questions:

Do the adult green frogs on Mount Desert Island harbor opalinids? Ten specimens of various ages were examined. No opalinids were found