

E. Higgins

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the data for 1910-11, it is found that this is an increase of about 15 per cent for the New Jersey side and a decrease of about 50 per cent for Delaware. The planted bottom under lease from the States is 29,600 and 6,800 acres, respectively.

Effect of pulp-mill wastes on oysters in Shelton Bay.—In compliance with numerous requests made by the oystermen of Shelton Bay, Wash., a study of the effect of sulphite waste liquor discharged by the pulp mill has been undertaken. A temporary laboratory has been established in one of the floating "oyster houses" in Totten Inlet near Olympia. The work, which was begun in November, 1929, is being carried on by Dr. A. E. Hopkins and H. C. McMillin. A complete report of these investigations will appear at a later date.

CONTROL OF ENEMIES

Starfish.—An investigation for the control and elimination of starfish on oyster beds in Long Island Sound, N. Y., where it is the most serious natural enemy of the oyster, was carried out from June to September by Miss Louise Palmer. The life history and growth of the animal were studied, and a series of experiments was carried out to ascertain the susceptibility of starfish of different ages to various chemical substances. It has been found that starfish of Cold Spring Harbor, Long Island, spawn the first and second weeks of July and set on the grass and shells the first or second week of August. The spawning temperature varies from 23.5° to 26° C. (74° to 79° F.).

The minute stars are very destructive to the newly set oysters, and consequently are objects of special consideration for eradication. Unfortunately, starfish are not very sensitive to environmental changes or the presence of toxic substances. It has been found, however, that concentrations of copper sulphate from 20 to 150 parts per million, while not affecting young oysters are very effective in killing starfish. This effect is not dependent on temperature. The study of the methods of controlling starfish will be continued, and it is hoped that a practical solution of the problem will be found.

The oyster drill.—A study of the biology of the oyster drill, carried on at Beaufort, N. C., by Dr. Henry Federighi since 1926, has been completed, and the report was submitted for publication. The results of this investigation made possible the recommendation of certain measures to control this destructive species, some of which had already been mentioned in previous reports. A new method of catching drills has been developed and successfully tested at Beaufort. It consists in using small concrete pillars, which are placed on the infested oyster bottom. Because of the tendency of the drills to creep upward, the animals gather on the pillars and are then taken out and destroyed. Pillars of the size of 12 by 10 inches have collected as many as 500 drills in 3 days.

FRESH-WATER MUSSEL INVESTIGATIONS

Mussel culture.—The new system of mussel culture worked out for the bureau by Dr. M. M. Ellis at the Fairport station during the summer season, and at the University of Missouri under the supervision of the bureau during the college year, has made the advances

outlined for it in last year's annual report. It was then stated that particular attention would be given to developing individual mussel culture units to handle a greater number of glochidia at a time. The capacity of these units has been tripled in the course of the last six months, so that each unit will now handle one and one-half million at a time. Several such units have been operated to capacity several times producing some five or six million young mussels in the course of the summer and fall. These were held sufficiently long to determine that they were normal and healthy. Then at intervals portions of them were analyzed to determine proportions of essential chemicals at the various periods.

The young mussels actually produced in the few mussel culture units used were sufficiently great in number to warrant the assumption that the large-scale production of mussels is established as economically feasible. Two million of the young mussels produced at Fairport were removed to the University of Missouri by car, where they arrived in perfect condition. This made certain that young mussels may be transported safely to streams for planting. Further experiments at the university regarding this last problem have shown that transportation may be made with maximum success during the first three days after completion of metamorphosis from the glochidial stage, or after a period of three weeks from this date.

Mussel surveys.—During the summer of 1929 considerable attention was given to the problem of determining chemical requirements of waters suitable for the planting of mussels. A trip was made by Doctor Ellis and Mr. Chamberlain to mussel waters of Arkansas, Louisiana, Texas, and Mexico where many waters were examined ranging from some very decidedly alkaline to others distinctly acid. Notes were also made of the mussel fauna, if any, present in each. At the same time the mussel resources of the Rio Grande Valley, on both sides of the international boundary, were given a hurried survey.

Texas has not had a reputation in the past as a mussel-producing State, but as a result of the increased cost of commercial mussel shells during the past few years, it has proved economic to ship shells to the pearl button manufacturing centers in the Middle West and in the East. As a result the mussel resources of Florida and of Texas, but particularly of the latter, have been given increased attention during the past two years. The hundreds of miles of irrigation canals built in the citrus section of the lower Rio Grande Valley were found to contain an extensive supply of mussels of commercial value. In addition several rivers in Texas have produced many carloads of shells during the past year.

Depletion.—The evidence of further mussel depletion in most of the heavily worked mussel waters of the country during the past year has been striking. A survey during the past summer of the formerly productive Lake Pepin, between Minnesota and Wisconsin, has shown a pronounced decline in mussel population.

The same depletion has been evident in many mussel waters with the result that the price of raw material has most seriously mounted. How far the newly developed mussel territory in Texas and Florida will meet the deficiency is not yet known. Some effort to meet the

deficiency by importing fresh-water mussel shells is being made. A small number of tons of Chinese shells have been imported. Mexican resources are being looked into. Two companies are sending representatives to South America. Canada has mussels of commercial value but so far permits only the most limited and restricted shelling for domestic use only. Siamese shell resources are being examined by Dr. H. M. Smith, adviser in fisheries to the Siamese Government.

The most cordial cooperation in the bureau's mussel work has been extended by the various State departments. All are ready to assist to the utmost when the bureau's new mussel culture system is definitely started on large-scale production. This assistance will be both the closing of more mussel territory to protect the planting of young mussels and the furnishing of stock mussels for the actual propagation work.