in dispute. However, the establishment of breeding stock in warm bays and creeks is a practical application of these findings. The ability to forecast the time of spawning, which can be done with considerable accuracy, is of great value to the oystermen in determining the most propitious moment for planting out cultch.

The author describes briefly the process of setting, together with the necessary conditions. Much suitable oyster ground has been depopulated by pollution and overfishing, and this can be rehabilitated by the establishment of spawning beds, and the collection of seed. The overcrowding of spat constantly experienced in the best setting areas has been eliminated to a great extent by the development of artificial collectors. By the use of wire bags containing shells, partition collectors, brushwood, etc., the yield of seed oysters from a given area of bottom may be increased ten to fifteen times. Since it has long been recognized that intense setting occurs only in certain limited areas, the planting of these artificial collectors in such areas has become of considerable importance to the industry. Artificial collectors have been shown to be very satisfactory for use on soft mud where cultch would be quickly smothered. The extra labour entailed in separating the spat from the collectors, when a few months old, is stated to be well repaid by the superior growth and shape of such singled oysters. The transport of seed to the best growing grounds is also facilitated. On the Pacific coast, near Olympia, the oyster grounds have been much improved and extended by the construction of a system of dykes, dividing the foreshore in one-acre ponds. Such operations are expensive, but stated to be profitable.

Research has revealed that an oyster may filter as much as 15 gallons of water per day, and this fact should be borne in mind when considering the density of growing oysters per unit area of bottom.

The institution of sanitary standards for shellfish, and the possible good effects of purification are noted.

The process of shucking oysters is, at the moment, receiving the attention of scientific workers. Treatment with a very weak acid in fresh or salt water is stated to narcotize the oyster sufficiently to allow rapid opening, but it is very unlikely that such drastic treatment with chemicals will ever commend itself to the trade.

H. A. C.

A. W. H. Needler. "Rearing separate oyster spat on trays." Biol. Board Canada. Bull. No. XLVIII. Ottawa, 1935.

This paper contains a concise account of a method of rearing young oysters which has been successfully employed at the Prince Edward Island Biological Station, and which eliminates the heavy losses due to starfish which are experienced when oysters are reared entirely on the bottom. The losses due to starfish during the first and second years are generally estimated as exceeding 75 %. Losses due to this cause after the second year are almost negligible. This account is designed as an aid to the practical oyster-grower, and throughout details are given of the methods of construction of trays etc., and the cost of materials and labour. This method utilizes spat caught on concrete-coated cardboard collectors of the "egg-crate filler" pattern, and the first half of the paper deals with the collection of spat by this method. The advantages claimed for this method of rearing spat are as follows: (1) Freedom from attack by starfish. (2) Production of oysters of good shape by elimination of clustering and distortion. (3) Elimination of losses by smothering and overcrowding. (4) Advantageous

exploitation of spat set on cardboard collectors. (5) Ease of transfer from one ground to another.

The most satisfactory artificial collectors were ordinary egg-crate fillers coated with concrete. Directions for coating these fillers are given, together with estimates of cost. Several methods of exposing the collectors for the settlement of spat have been tried, the most satisfactory being the suspension from a float of bundles of coated fillers tied up in wire-netting. The methods of constructing floats etc., and the cost of materials and labour are given in detail. It is recommended that the collectors be exposed a few days after water temperatures of 68° F. or over are experienced. This is the temperature below which spawning is stated not to occur. In Malpeque Bay the settlement of spat averaged about 1000 per collector over a period of years. The spat are removed from the collectors during the late autumn, when the season's growth is complete. During removal the collectors are broken up piecemeal and the spat singled by hand. During the winter the spat is submerged on hard bottoms in shallow crates covered with wire cloth. If ice is avoided the losses are not estimated at more than 5 % during the winter months. During the second summer the spat is reared in floating trays holding seven to ten thousand spat, moored in protected bays. The optimum density of spat is stated to be about 1—1.5 per square inch. The trays are of wood, with a wooden cover, and with bottom and ends covered with galvanised wire cloth. Owing to the prevalence of shipworm all wood has to be primed with white paint and painted before use. A mortality of about 5 % only should experienced during the second summer. After the second summer's growth the young oysters should have reached a diameter of 1—3 inches, and 75 %—80 % can now be planted on firm bottoms without protection. The cost of rearing small oysters by this method is given as 1—1.5 dollars per 1000, while the collection of spat costs approximately 15 cents per 1000. These figures are, however, only provisional and further reduction is possible.

H. A. C.

(Various). "Annual Report Year 1934." Reps. Newfoundland Fish. Res. Lab., Div. of Fish. Res., Dep. Nat. Resources, Newfoundland. Vol. II, No. 3. St. John's, 1935.

Previous reports of this series have been reviewed in this journal, Vols. VIII, p. 274; IX, p. 124; and X, p. 216. The work which Dr. Harold Thompson directs is concerned both with the problems of supply and exploitation of the fisheries and the problems of handling and processing. This unity is rather attractive, all the problems of the industry being considered by one scientific body, but this review is only concerned with the first part of the work in Newfoundland, the fish supply and its capture.

For many years we have known vaguely, from the publications of Beaugé and of Huntsman, that the great cod fisheries of the region were affected by variations in hydrological conditions, which are on a large scale. The workers in Newfoundland are making remarkably fast progress in this enquiry. They express the changes rather simply, as variation in the strength of the cold Arctic Current. They have knowledge, as to the importance of the Arctic contribution, from temperature, salinity, drift bottles, and species in the plankton, which were mentioned in earlier reviews. They now add an interesting series of six species of *Ceratium* and even the eggs or fry of caplin, cod, and dab. The Arctic Current seems to act on cod through temperature, with remarkable effects in detail, both in the