

and relate to adult and Stage V *Calanus*. Only the latter were present in sufficient quantity to enable estimations to be made at all regularly. The data for males are for two months only, whilst the eight sets of determinations in the case of females cover four months.

The dry weight of all classes showed considerable seasonal variation, individuals in Stage V, for instance, being three times as heavy in December as in May. On this account the author has expressed the fat and protein contents as percentages of the dry weight.

Figures for fat and protein content are based in most cases on duplicate measurements, two for each sample of plankton. The results of the parallel estimations should presumably differ from each other by only small amounts due to the experimental errors inherent in the method. On two occasions, however, the differences between pairs of protein estimations in Stage V *Calanus* were fairly considerable, e.g. 32% and 44% on 17.XI.31 and 30% and 44% on 30.X.32. That such large discrepancies may occur raises the important question as to the validity of the method in the determination of seasonal variation in protein content.

In order to test this point the variance of the observations given in Table III, p. 629, has been analysed. There are only eight pairs of estimations, scarcely enough on which to base any very definite conclusion, but there exist a further twenty pairs of protein estimations for Stage V *Calanus* in the paper by Miss Marshall, Dr. Nicholls and Mr. Orr, J.M.B.A., XIX, 2, Table V, p. 826. The variance of these data has accordingly been subjected to analysis by the same method, namely that of Fisher (*Statistical Methods for Research Workers*, London, 1930, p. 216).

It would appear, in the latter case, that the seasonal variations in protein content are probably, but not certainly, significant. Such variation as is shown would occur in something between 1% and 20% of random samples from a population in which there was no seasonal variation, but nearer 20% than 1%. In the case of the eight pairs of estimations, taken from the paper under review, the higher values recorded have no significance.

It should be pointed out that Mr. Orr does not claim to have demonstrated seasonal variation in protein content; at the same time it should be made clear that the variations disclosed by Fig. 3, p. 622, are as yet to be interpreted with caution.

A section on the food value of *Calanus* in Loch Fyne is included. The weights of fat and protein have been calculated from Nicholls's data on the seasonal numerical variations in the area (J.M.B.A., XIX, 1, 1933).

A. C. G.

M. W. Smith. "Physical and Biological Conditions in Heavily Fertilized Water." Journ. Biol. Board Canada. Vol. 1, No. 1, pp. 67—93. Toronto, 1934.

The material for this paper is derived from the study of conditions in a small concrete pond to which 1000 pounds of cow manure had been added. In so far as one is entitled to compare such a specialized environment with more natural ones, the results are very much what one would expect to find, except that the fluctuations in chemical and physical factors are considerably wider. The recorded rise in dissolved oxygen content and in the pH value coincident upon times of great phytoplankton production,

effects of decomposition, pH and temperature gradients, and periodic "over-turnings" call for no special comment.

The object of manuring a pond is presumably to increase the amount of plankton and, as the author points out, "the ideal is that the good effects should more than counterbalance the bad effects ..." With only one experimental pond under observation it is hard to see how this particular aspect of the problem has been tackled. There was, of course, a considerable production both of zoo- and phytoplankton, but in the absence of any control it is impossible to decide whether 1000 pounds of cow manure produces the best results.

The author states that this was in the nature of preliminary work and that "more restricted and controlled experiments" were contemplated. From the point of view of the fish culturist, work of this kind is desirable, and it is to be hoped that future experiments will provide data on the optimum quantity of manure which should be added to produce the maximum amount of crustacean fish food.

A. C. G.

R. Southern. "Reports from the Limnological Laboratory. III. — The Food and Growth of Brown Trout from Lough Derg and the River Shannon." Proc. Roy. Irish Acad. Vol. XLII, Sect. B, No. 6. Dublin, 1935.

In spite of the importance of the brown trout (*Salmo trutta* L.) as an edible and sporting fish we know far less of its biology than we do of its relatives the sea trout and salmon. In this paper Mr. Southern sets out the results of his studies on the brown trout in the R. Shannon basin, made over a period of fifteen years, mainly as a side line to other work.

In all, 293 fish were examined for age determination; of these 121 were taken at various points in the R. Shannon, 96 in Lough Derg, and 53 in Lough Atorick; the remainder were taken from tributaries of the Shannon. The data recorded include the age, sex, growth-rate, reproductive history (so far as this can be deduced from the appearance of the gonads and the scales) and the condition factor. The author points out the difficulties of reading and interpretation of the scales of brown trout which make them less reliable guides to the life history than they are in the case of the salmon. For example, no trout from L. Atorick bore a spawning mark on its scales, even though it could be recognised from the condition of the gonads as a spent fish. The scales of trout from L. Derg and the R. Shannon, on the other hand, showed erosion after spawning.

Trout from L. Derg and the R. Shannon show very similar life histories; growth is rapid and the fish comparatively long lived, so that large trout are common. The greatest increase in length occurs in the 2nd, 3rd, and 4th years, whilst the greatest increase in weight is made in the 4th, 5th, and 6th years. Fish in these waters usually spawn for the first time when they are 4 years old and thereafter spawn annually. The ripening of the gonads reduces the growth-rate and hence it is found that the exceptionally large trout are those which have matured at a relatively advanced age.

Trout from L. Atorick grow very much more slowly than those discussed above and are much shorter lived. Hence the fish are small, none over 6 oz. in weight having been captured. Incidentally the heaviest trout recorded from L. Derg weighed 30 lb. The disparity in the rate of growth increases