LETTERS TO THE EDITORS

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Hydrological and Biological Studies of Loch Sween

IT is now many years since I directed the attention of zoologists to the excellent facilities for marine biological research afforded by Loch Sween on the coast of Argyle. In the years before 1914 it provided a delightful centre for the activities of Glasgow students of zoology during their Easter vacation. During the early post-war years Government approval was actually obtained for the conversion of one of the hospital barges used on the rivers and canals of France and Flanders into a floating laboratory, to be used as tender to the Millport Marine Station and moored for periods in Loch Sween and other west coast lochs. These plans had, unhappily, to be cancelled when economic pressure brought about the curtailment of expenditure on scientific research during the lean post-war years.

It is accordingly of much interest to myself to read in an article by Dr. F. Gross[1] of his references to Loch Sween, and I think it well to indicate two lines of investigation which to my mind deserve special attention. The first of these is an intensive study of the hydrography of the Loch—more especially of the rise and fall in the level of its waters. During my early seasons there I naturally endeavoured to construct a time table, but found myself reduced to giving up this task in despair. Tidal behaviour in the Sound of Jura outside the Loch; the local distribution of barometric pressure; the direction of the prevalent wind: all these factors played their part, but it appeared to me there must be other unknown factors, and I found myself inclined to suspect something of the nature of a *seiche*. In this connexion I bore in mind the existence of the strongly flowing tidal currents of the Sound of Jura which form a kind of barrier across the mouths of the sea-lochs opening into it and which, in the case of Loch na Cil, widely open to the south-west, is so effective as to make that loch a useful anchorage even in a south-westerly gale.

The second line of investigation is that of the origin of the fine silt accumulating in the Loch and constituting a factor inimical to the oysters which in earlier days were so abundant. During my tenure of the chair of zoology in the University of Glasgow, I kept under observation a large aquarium tank in which grew the Canadian pondweed Elodea with a balanced animal population—pulmonate Gasteropods, fresh-water Oligochaetes, Protozoa, etc. My special interest in this tank lay in its gradual accumulation of a thick deposit of fine mud of organic origin—composed of fæcal and other debris from its animal and plant inhabitants—and the interesting problem suggests itself: Is any appreciable proportion of the fine mud of Loch Sween contributed by its rich planktonic and other fauna? Dr. Hilary Moore's important studies of the mud of the Firth of Clyde might find a profitable extension to the muddy deposits of Loch Sween and other similar highland sea-lochs.

JOHN GRAHAM KERR.

Tayvallich,
Loch Sween,
Argyll. Aug. 31.

[1] NATURE, **148**, 71 (1941).

Plankton as a Source of Food

THERE are several points which should be raised in connexion with the communication from Dr. Nicholas Polunin[1] in which the value of phytoplankton as plant manure is discussed. He suggests that the development of a rich growth of algæ in an open bucket or pan of water increases the value of this water as plant manure. It is, however, obvious that the only increase in total matter in the water is the carbon absorbed by the algæ. This carbon, incorporated in the algal cells, is of very doubtful value as plant manure. Growth of algæ in the water is dependent on the presence of dissolved nutrients, notably nitrogen and phosphorus salts, and the transformation of these into organic compounds does not increase their amount, or their value as plant manure, but rather the reverse, since the complex organic compounds must be decomposed by bacteria before the nutrients become available to the plants manured. For the purpose suggested, that is, the watering of vegetables, which are short-period crops, it would seem more important to add the nutrients in readily available form than to build up a reserve of organic matter in the soil. Furthermore, it is probable that there is a loss of nitrogen from the water during the development of the plankton, owing to the escape of gaseous nitrogen by denitrification or by the reaction between amino-nitrogen and nitrite. It is unlikely that any of the algæ capable of fixing nitrogen, (that is, members of the Cyanophyceæ) would grow in such tanks or buckets. It would therefore appear that the bucket of water constitutes a more valuable plant manure in its original state than it does after the development of a phytoplankton.

Figures which I obtained during experiments on the growth of algæ under conditions similar to those mentioned may be of interest. The vessels used were shallow tubs and glass tanks, open or with glass lids, heavily manured with the essential elements. Under summer conditions, a dense growth of Chlorococcales developed, but its dry weight was small in comparison with the amount of salts added. A tub of 100 litres capacity, to which 28 gm. of nutrient salts were added, produced a total dry weight of Chlorococcalean plankton of the order of 5 gm. in one month. No figures for the changes in total quantity of dissolved salts are available, but the following figures give an idea of the changes in nitrogen content. With ammonium nitrate, the decrease in ammonia and nitrate nitrogen was compensated by the increase in organic nitrogen, but in water manured with ammonium sulphate, a decrease of 15 per cent or more in total nitrogen was observed, while with potassium nitrate the decrease was 10 per cent.

It will be evident from this that the increase in humus content, which is in any event of problematical value as plant manure, is more than offset by the probable loss of nitrogen, and the certain decrease in availability of the nutrient salts.

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Freshwater Biological Association,
Wray Castle, Ambleside,
Westmorland. Aug. 14.

[1] NATURE, **148**, 143 (1941).