ON THE OCCURRENCE OF PROTOZOA IN LAND-FILTERED SEWAGE EFFLUENT

It has been shown that certain ciliate protozoa, particularly Vorticellids, are of special significance in the Activated Sludge Process and other artificial systems of sewage purification, and that these protozoa in the sewage tanks are originally derived from soil.1-10 Further observations carried out during the last four years at
Madura (South India) have shown that these protozoa naturally develop in large numbers in the land-filtered sewage effluent and from an important link in the chain of life processes in the medium. The practice of land-filtration of sewage and the soil conditions at Madura, the mode of development of the protozoa in the effluent and related aspects are briefly described below.

Madura has now a population of about three and a half lakhs, and the sewage from more than half the population is discharged into the municipal sewers. The daily discharge of sewage from this population is about three million gallons, including a comparatively small quantity of liquid waste from the textile mills. About two million gallons of this volume with irrigation water for agricultural purposes. The land filtering the raw sewage is also cultivated and the principal crop grown is guinea grass which yields very well (about 120 tons per acre per year).

On either side of the effluent channel, as also attached to certain green algae, may be seen large whitish fluffy masses of Vorticellids which are composed of a number of species of Carcheels and a few species of EpistyUs. The dominating forms are the species of Car
cchelum and one of the commoner species is 
Carcheels epistyUs Cl. & L. (Figs. 1 and 2). Species of the simple Vorticella and other
ciliates protozoa, such as Paramecium, also occur in the effluent. Along with the protozoa, worms, insect larvae, especially those of

**FIG. 1.** Photomicrograph of a Colony of Carcheels epistyUs Cl. and L. occurring in the land filtered sewage effluent at Madura. $\times 75$.

**FIG. 2.** An individual of C. epistyUs Cl. and L. enlarged $\times 350$.

Chironomus sp., prawns, crabs, gastropods, frogs, fish and other forms also flourish.

The protozoa and other fauna develop in large numbers in the effluent in all seasons of the year unless sewage irrigation is stopped for unduly long periods, as under the conditions of excessive and continual rains, when they slowly disappear; but when the sewage application is resumed, the fauna also gradually develop. Thus during October-December 1946, when sewage irrigation was stopped due to unusually heavy rains, from 30th October to 20th November and again from 30th November to 19th December, the protozoal growths and other fauna, particularly the fish, were largely absent from the effluent, but reappeared when sewage irrigation was continued.
We have made a similar observation in regard to the development of protozoa in the Activated Sludge tank, viz., if aeration of sewage is continued without any fresh supply of raw sewage, the protozoa cease to multiply and become inactive and eventually disappear, presumably because of the lack of nutrients from raw sewage. In this connection it is of special interest to observe that examination of activated sludge from the purification plant at Bangalore over a period of several years has not revealed the presence of any species of Carchesium, while there is always a preponderance of Carchesium sp. in the land-filtered sewage effluent at Madura. The significance of this observation is still under study.

The occurrence of Carchesium Iachmanni in oxidising filters was reported many years ago by Boyce. Fowler observed this protozoan in the effluents from the contact beds and percolating filters at Davyhulme, Withington and Gorton Sewage Works (Manchester). Recently Lloyd has drawn attention to the more important ciliate protozoa occurring in percolating filters and these forms include Carchesium, Vorticella, Epistylis, Opercularia, Aspidisca and Chilodon.

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