jee[6] has also kept up the name. Unfortunately, however, this name, being a later homonym is invalid according to rules.[7] It is pre-occupied by a distinct and different plant from South Africa—*Plectranthus fruticosus* L'Herit.[8] I have been able to trace the correct name for the South Indian plant which is *Plectranthus deccanicus* Briq.,[9] and this name should be used to designate all the Indian herbaria sheets hitherto known as *Plectranthus fruticosus* (Benth.) Hook.f. *non* L'Herit. It appears that Briquet's new name, being published in a journal of comparatively less prominence has escaped the notice of botanists referred to above.

Bentham's reference[2] to *Wight Catalogue*, No. 2514, was misquoted by Hooker[1] as 2524. Neither of these numbers nor the name *Coleus fruticosus* could be found in Wight's Catalogue. Therefore, Wight's name should not be cited in connection with this plant.

Hooker's *Plectranthus urticifolius* (l.c. 6222) also requires a new name being pre-occupied by *Plectranthus urticifolius* (Lam.) Salisb.[10]; but as Mrs. M. Lewis is at present engaged in a revision of the genus (at Kew), I refrain from proposing a new name for this plant.

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*February* 11, 1948.

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## ON THE HABITS OF THE EXOTIC MOSQUITO-FISH *GAMBUSIA AFFINIS* (BAIRD AND GIRARD) IN THE WATERS OF MADRAS

THE introduction and acclimatisation of *Gambusia affinis* in North India have been described by Mulligan and Majid.[1] In Madras, the species was introduced on two occasions. Firstly, in 1929 a consignment of 600 was imported from Ceylon by the Fisheries Department for stocking two nurseries attached to the Krusadai Biological Station. Secondly, a consignment of 100 was brought to Madras City from Bangalore in 1930 through the efforts of the Malaria Officer. Since then *Gambusia* has attained a local stand in the Province, and now occurs in many brackish water canals and creeks and in freshwaters from the coastal area up to an elevation of about 7,000 feet.

The following are the observations made from the provincial waters of Madras, showing variations from those of Kuntz,[2] Hildebrand[3] and Seale[4] on the bionomics of *Gambusia* from the waters of the Americas and the Philippines.

*Maximum size* : 5·2 cms. in males and 6·8 cms. in females.

*Proportion of males and fema* : Equal.

*Food* : (1) *Insecta,* such as Diptera larvæ, Hemiptera adults and larvæ and Coleoptera adults and larvæ : 45 per cent.; (2) *Crustacea.*—Copepods, Daphnids and Cypris : 15 per cent.; (3) Desmids and diatoms.—*Closterium, Cosmarium, Eunotia, Fragilaria, Melosira, Navicula, Pinnularia, Staurastrum, Synedra* and *Tabellaria* : 25 per cent ; and (4) Algal filaments of *Cladophora, Œdogonium, Oscillatoria,* and *Spyrogyra* : 15 per cent.

*Maturity* : Attained when 3 months old and about 3 cms. in size.

*Breeding Season* : Throughout the year with a maximal from October to November.

*Eggs* : 120, 1·8 mm. in diameter, in each ovary.

*Parturition* : 23 to 35 larvæ liberated within 20 to 30 minutes. Post-natal recuperation of mother is by feeding on 5 to 8 young ones.

*Description of Larva* : 8 mm. in size. Transparent body with black eyes.

*Post-larval development* : Yolk-sac absorbed on sixth day. Pigmentation completed on 15th day. Adult characters assumed within eight weeks.

*Communal Association* : Its voracious habit has caused a striking diminution in the population of the indigenous form, *Aplocheilus blochii* (Jerdon).

*Larvicidal propensity* : Female consumes 260 mosquito larvæ in a day, whereas the male takes in only about 60 ; hardy fish adapting to all types of lentic environments. Russel and Jacob[5] and Bhasker and Ramoo[6] have found the species useful for mosquito control even in shallow casurina pits and wells. Those longer than 30 mm. stand transport well.

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*February* 3, 1948.

* Communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Mulligan, H. W., and Majid, S. A., *Rec. Mal. Sur. India.*, 1936, **6**, 537. 2. Kuntz, A., *Bull U.S Bur. Fish.*, 1915, **33**, 177-90. 3. Hildebrand, S. F., *Rep. U.S. Comm Fish.*, 1917, App. **6**, 1. 4. Seale, A., *Phil. J. Sci.* 1917, **12**, 177. 5. Russel, P. F., and Jacob, V. P., *J. Mal. Inst. India.*, 1939, **2**, (3), 273-91. 6. Bhasker, R. R., and Ramoo, H., *J. Mal. Inst. India.*, 1942 **4**, 633

## ROLE OF PROTOZOA IN THE CONCENTRATION OF NITROGEN IN THE SLUDGE DURING AEROBIC PURIFICATION OF SEWAGE

THE importance of micro-organisms in the nitrogen cycle has long been recognised and considerable amount of attention has been devoted to the study of nitrogen conservation in soil and sewage.[1] Certain forms of protozoa, such as the species of *Hartmanella, Heteromita, Colponema, Colpoda, Colpidium,* and *Oxytricha,* have been found to stimulate bacterial fixation

of nitrogen.[2-4] It has also been suggested that a large part of the nitrogen found in activated sludge is traceable to its protozoan content,[5] though it has been contended that the increased nitrogen content of activated sludge due to the growth of protozoa is not necessarily very high.[6]

Further to our earlier observations on the special significance of *Vorticellids* in the aerobic purification of sewage and sludge formation,[7,8] we have carried out studies on the role of *Epistylis* sp. and *Vorticella* sp. in the concentration of nitrogen in the sludges.

Homogeneous fæcal suspensions were treated as follows: (*i*) aerated as such (*ii*) inoculated with an active culture (16 ml.) of *Epistylis* sp. and then aerated; and (*iii*) inoculated with an inactive culture (16 ml. after heating to 60° C.) of *Epistylis* sp. and then aerated. The aerations were carried out for 120 hours and the sludges separating from representative samples analysed for their nitrogen contents. The results are given in Table I.

In another set of experiments, heat-sterilised suspensions of sewage, soil and compost were aerated with *Vorticella* sp. and 79 different strains of bacteria (characterised according to Bergey[9]) isolated from samples of water, sewage, soil, compost and fæces of animals. The influence of individual strains of bacteria from different sources on nitrogen concentration by *Vorticella* sp. in the sludges as obtained after aeration of the media for 96 hours was studied (Table II).

TABLE I

*Concentration of nitrogen in sludge as effected by protozoa*

| Medium | Total N (mg.) in fæcal suspension (800 c.c.) | N (mg.) added to suspension as protozoa (alive or dead) | After 24 hours' æration | | After 120 hours' æration | |
|---|---|---|---|---|---|---|
| | | | N (mg.) in sludge after deducting the N added as inoculum | % of fæcal N concentrated in sludge | N (mg.) in sludge after deducting the N added as inoculum | % of fæcal N concentrated in sludge |
| Fæcal suspension alone | 24·64 | .. | 1·2 | 4·9 | 6·3 | 25·6 |
| Fæcal suspension + *Epistylis* sp. (active) | 24·64 | 10·6 | 15·9 | 64·5 | 12·3 | 49·9 |
| Fæcal suspension + *Epistylis* sp. (dead) | 24·64 | 10·6 | 4·2 | 17·0 | 6·0 | 24·4 |

It will be seen from Table I that there is rapid concentration of nitrogen in the sludge when the *Epistylis* sp. is introduced. This nitrogen is, however, partly lost when the aeration is continued for 120 hours. In presence of dead protozoa the concentration of nitrogen at the end of 24 hours is more pronounced than when fæcal suspension alone is aerated. The effect may be due to either some mechanical action of the dead cells or some associated substance, active even after destruction of protozoa.

TABLE II

*Influence of different bacteria on nitrogen concentration by protozoa in sludges*

| Sources of bacteria | No. of bacterial strains isolated | Medium for sludge formation | No. of strains without effect on nitrogen concentration by *Vorticella* sp. | No. of strains affecting nitrogen concentration by *Vorticella* sp. | | | |
|---|---|---|---|---|---|---|---|
| | | | | No. of strains | % increase of N in sludge | No. of strains | % decrease of N in sludge |
| Water samples from bore-wells, tanks and river | 11 | Sterilised sewage | Nil | 4 | 0·53–2·01 | 7 | 0·96–15·77 |
| Garden soil .. | 6 | Sterilised soil suspension | Nil | Nil | .. | 6 | 0·29–17·00 |
| Compost heaps .. | 13 | Sterilised compost extract | 3 | 3 | 0·47–2·84 | 7 | 0·49–12·93 |
| Raw sewage .. | 2 | Sterilised sewage | Nil | 1 | 0·49 | 1 | 2·07 |
| Septic tank sludge .. | 2 | ,, | 2 | Nil | .. | Nil | .. |
| Activated sludge .. | 3 | ,, | Nil | Nil | .. | 3 | 0·64–0·75 |
| Cow dung .. | 7 | ,, | Nil | 2 | 0·04–0·60 | 5 | 0·26–1·76 |
| Horse dung .. | 8 | ,, | Nil | 4 | 0·55–1·70 | 4 | 2·83–11·04 |
| Fæces of other animals (rat, rabbit, dog and monkey) | 27 | ,, | 3 | 13 | 0·26–3·61 | 11 | 0·17–9·93 |

1 c.c. of active bacterial culture was used as inoculum in each case; the protozoan inoculum contained about 20,000 active cells of *Vorticella* sp.

As will be seen from Table II, very few of the isolated bacteria augment the action of protozoa. On the other hand, some of the bacteria seem to be fairly efficient in reducing the nitrogen content of the sludge.

The trend of evidence would suggest that

while the protozoa are efficient in concentrating the nitrogen in the sludge in the early stages, many of the associated bacteria produce a reverse effect when the aeration is prolonged. A small part of the nitrogen gets nitrified and passes into the effluent. The major part would still remain to be accounted for. The extent to which the latter passes into the effluent or is lost from the medium requires further study.

In actual practice, the total period of aeration in the Activated Sludge tank would be only a few hours. Raw sewage keeps on entering at one end, while the effluent continuously passes out at the other end. Under these conditions, there would be no scope for any secondary bacterial action leading to any loss of nitrogen from the sludge. If the aeration is prolonged, however, or during periods when little or no fresh sewage enters the tank, the secondary action may take place to some extent.

It is not clear whether any fixation of atmospheric nitrogen takes place through the direct or the indirect agency of either *Vorticella* sp. or *Epistylis* sp. This aspect would require careful study in view of the earlier observations[10-14] in regard to the fixation of atmospheric nitrogen in Activated Sludge. This important aspect is now under study and will be the subject of a later communication.

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*February* 21, 1948. V. SUBRAHMANYAN.

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## INDIAN RESEARCH COUNCIL

THE Governing Body of the Council of Industrial and Scientific Research met at Delhi in the first week of February 1948 to consider a number of schemes and projects of research and industry.

A Committee was set up to work out the details of a scheme for the manufacture of synthetic petrol from low-grade coal. The Council decided that intensified geological and geophysical exploration of possible areas of occurrence of petroleum in India should be carried out by the Government. It was also recommended to the Government that the possibility of buying crude petroleum from the Iranian and Burma oil-fields and refining it at two or three refineries at Indian ports should be explored.

On the recommendation of the Fuel Research Committee the establishment of three field survey stations for research in coal in the C.P., Raniganj and Bokhro-Raigarh coal-fields at a cost of Rs. 9 lakhs was approved. It was also recommended to the Government that a statutory cess of half anna per ton of coal despatched in India should be levied for aiding fuel research in the country.

It was also decided to have detailed plans for carrying underground gassification of coal which has brought about revolutionary changes in fuel technology in the world, particularly in Russia and the U.S.A.

To promote the development of dyestuffs both the educational and on the industrial research sides, the Council agreed to provide additional funds to the Bombay University for the creation of a professorship in Dyestuff Technology and for the institution of six research fellowships. The Council has been granting for some time to the Bombay University an annual recurring grant of Rs. 25,000 for the Department of Dyestuff Technology which will now be increased to Rs. 54,000. Fifty per cent. of the seats in the department will be reserved for students belonging to Provinces other than Bombay.

Two important schemes in the field of atomic research, *viz.*, theoretical studies in the properties of Meson Field and biological aspects of atomic research, were sanctioned at a cost of Rs. 50,000. The latter scheme will be investigated at the Tata Memorial Hospital in Bombay.

Revised plans of the Central Institute of Drug Research, the establishment of which was approved last year, were accepted by the Council at its meeting. The Institute will be established at a capital cost of Rs. 20 lakhs and will cover a very vide scope of activity.

The Indian Chemical Manufacturers' Association have also agreed to finance the Institute to a considerable extent. A Special Committee with Dr. Jivraj Mehta as Chairman has been set up to select a suitable place for the location of Institute.