

mainly of sericite and dolomite. The 'pressure shadows' are occupied by calcite and quartz.

The size of the pyrite grains varies from 2.5 mm.  $\times$  1.5 mm. to 0.4 mm.  $\times$  0.3 mm. The 'pressure shadows' are generally 'V'-shaped with the blunt sides on the faces of pyrite and the apices pointing in the direction of weakly developed schistosity ( $S_2$ ). The size of the shadow zones ranges from 4.5 mm.  $\times$  1.5 mm. to 0.75 mm.  $\times$  0.40 mm., depending on the size of the pyrite face. Quartz in the 'pressure shadows' are feathery in nature with the length varying from 2.5 mm. to 0.60 mm. and gradually the grains become equant near the apices of the shadow zones. Quartz has a strong dimensional orientation in contrast to calcite, with the long axes perpendicular to the controlling pyrite face (Fig. 1). In cases where composite shadow

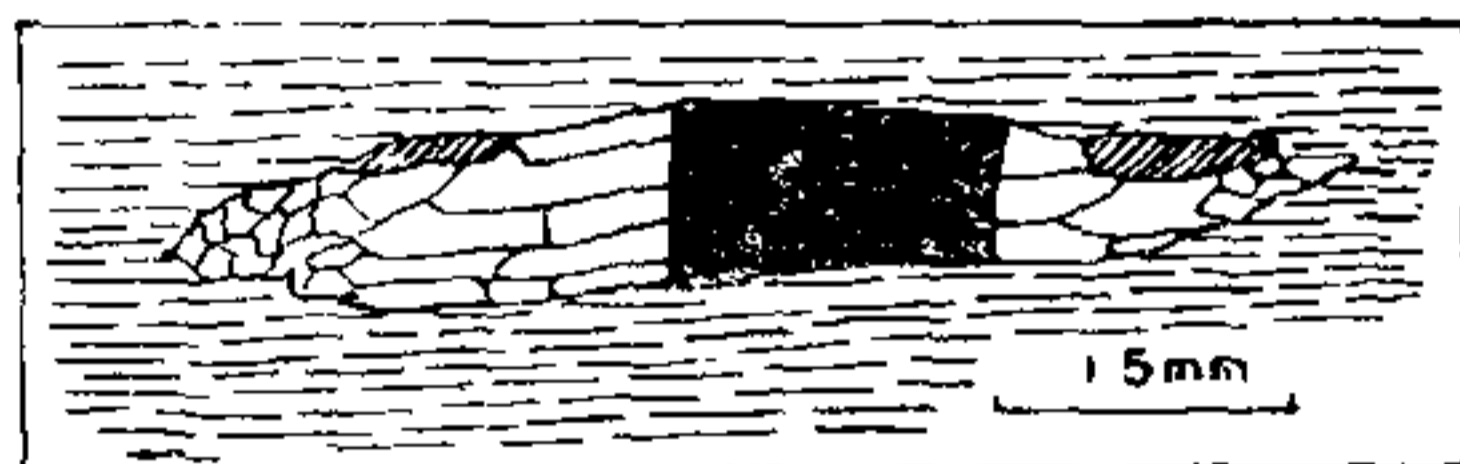


Fig. 1 'Pressure shadow' developed on the faces of pyrite crystal (black) Note the dimensional orientation of quartz (white) and its variation in grain size Calcite - ruled

zones are developed on two adjacent faces of pyrite crystal, the quartz grains show two preferred directions of dimensional orientation, viz., (i) parallel to the schistosity ( $S_2$ ) and (ii) perpendicular to the pyrite faces, which are athwart to  $S_2$  (Fig. 2).

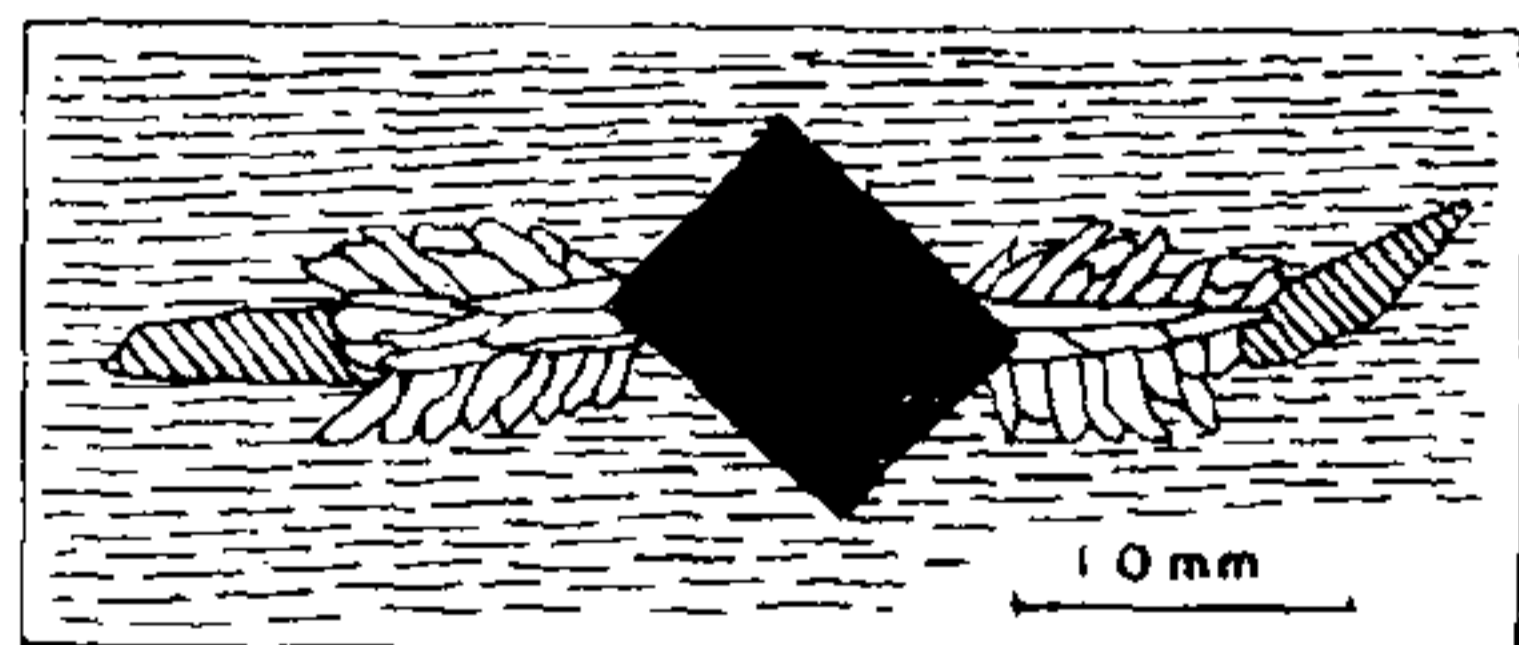


Fig. 2 'Pressure shadow' at the edges of pyrite crystal (black) Quartz - white, Calcite - ruled

Chlorite, which is scanty in the rock, becomes increasingly abundant as the fringes of the 'pressure shadows' are approached. The phyllite is coarser in grain size in the vicinity of the 'pressure shadows' than away from it. The fracture cleavage ( $S_3$ ) in the phyllite is manifested in the shadow zone by the elongation of minute quartz grains sub-parallel to it at the margins.

The origin of the 'pressure shadows' is yet to be clearly understood. Pabst (*loc. cit.*) considered them to be the result of extension in the host rock in the plane of schistosity which tended to pull the matrix from the sides of the porphyroblasts, the potential opening being filled continuously by quartz. This envisages some rotation of the porphyroblasts. The pyrite crystals in these phyllites apparently do not show any evidence of rotation. It is, therefore, suggested that after the growth of pyrite, the superincumbent pressure was responsible for creating stress-free zones at the fringes of the pyrite crystals in the direction of the schistosity, resulting in 'pressure shadows', where neo-crystallisation of calcite and quartz took place.

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### INTERRELATIONSHIP OF PHYTO- AND ZOOPLANKTON IN A FRESHWATER TANK

PLANKTONIC organisms show a variety of interrelationships between individuals of a species as well as between species. Of these, diurnal vertical migration of phyto- and zooplankton, in freshwater ponds, have been investigated by several workers. However, contributions from tropical regions are meagre and some of the recent investigations are those of Chacko *et al.* (1953, 1954),<sup>1</sup> Chakrabarty *et al.* (1958),<sup>2</sup> George (1961)<sup>3</sup> and Krishnamoorthy *et al.* (1963).<sup>4</sup>

This note deals with the interrelationship between phyto- and zooplankton populations in Mariamman Teppakulam, an artificial tank in Madurai. The tank is almost a perfect square, measuring 304.8 metres from North to South and 289.56 metres from East to West, having a maximum depth of 3.05 to 3.66 metres during the rainy season and 0.91 to 1.52 metres during summer. There is an artificial island in the centre, from which the study was made. A neat parapet wall is constructed around the tank and the central island. It is purely rainfed and the sewage of the town is let in occasionally.

Plankton collections were made at intervals of 3 hours for 24 hours, from 9 a.m. to 9 a.m. the following day. The samples were taken at the surface, 0.7 metres and 1.3 metres from the surface respectively, when the total depth of the water was only 1.5 metres. Temperature and

oxygen did not show any wide differences at the various depths, the maximum difference in the temperature being  $1.5^{\circ}\text{C}$  and in oxygen  $0.2\text{ ml./litre}$  at the time this observation was made. The pH of the water in the tank remained on the alkaline side (pH 9) with very little change during the period of observation.

Column 1, in Fig. 1, read from left to right, indicates the trend of total phytoplankton which shows an upward movement reaching maximum density at the surface at 3 p.m. This trend reverses between 6 p.m. and 12 midnight, after which once again the upward movement is repeated.

general pattern of total zooplankton but not so the population trend of *Microcystis*. The latter reaches its maximum at the surface by 9 a.m. and shows very rapid fluctuations in the mid-depth and bottom during the rest of the day. It is remarkable that in a matter of 3 hours (6 a.m. to 9 a.m., Column 4) the bulk of *Microcystis* population moves from the bottom and reaches the surface. Thus, there is evidence of clear vertical migration of plankton.

The total count of plankton at various depths shows further that they do not make up to the same total number at all times. Making allowances for mortality through predation or grazing

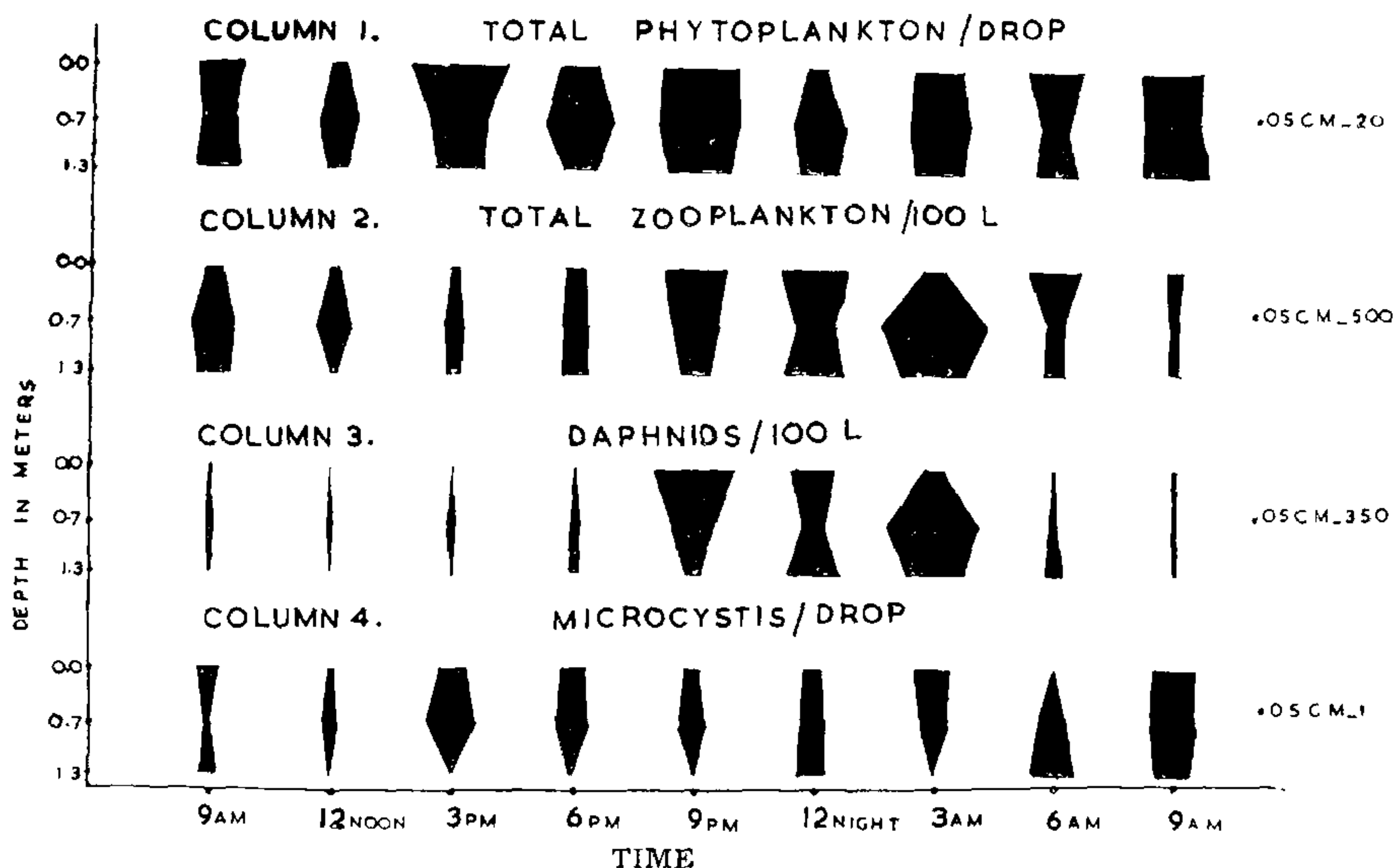


FIG. 1. Showing vertical migration of phyto- and zooplankton.

Column 2 represents the trend in total zooplankton population, showing a maximum between 9 p.m. and 12 midnight and by 3 a.m., the downward movement is well underway and the population thins out at all depths by 9 a.m.

As these two columns represent perhaps the mean trend of the entire phyto- and zooplankton population, they are at best the mean of vertical migration of the various species comprising the entire net plankton.

In order to elucidate the precise intrinsic relationship, the population of *Daphnia* (Column 3) and of *Microcystis* (Column 4) are displayed in Fig. 1. It is seen clearly in the presentation, that the *Daphnia* population follows the

and other causes, still the possibility of the plankton, particularly the zooplankton, taking shelter, in the bottom debris or at the water-soil interface at the bottom seems to be a natural means of escaping adverse conditions. *Daphnia* maximum (at all depths) at 9 p.m. is 9688/100 l but this dwindles to a mere 538/100 l or 118/100 l at 9 a.m. (Column 3). The discrepancy in number is very wide and obviously this is due to their moving to the bottom and behaving as benthic organisms. This is not true to the same extent in *Microcystis* and the time of maximum density also differs in the phytoplankton. The building up of *Microcystis* population between 6 a.m. and 9 a.m. (Column 4) bears

no relationship whatsoever to the total zooplankton maximum (9 a.m. to 3 a.m., Column 2) to indicate any grazing effect. Hence, the oscillations in the population of phyto- and zooplankton seem to be independent of each other.

I am indebted to Dr. S. V. Job, under whose supervision the present work was carried out. My thanks are due to Prof. S. Krishnaswamy and Dr. Theodore Srinivasagam for their valuable suggestions.

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#### ON A HITHERTO UNKNOWN METACERCARIA FROM A DRAGONFLY

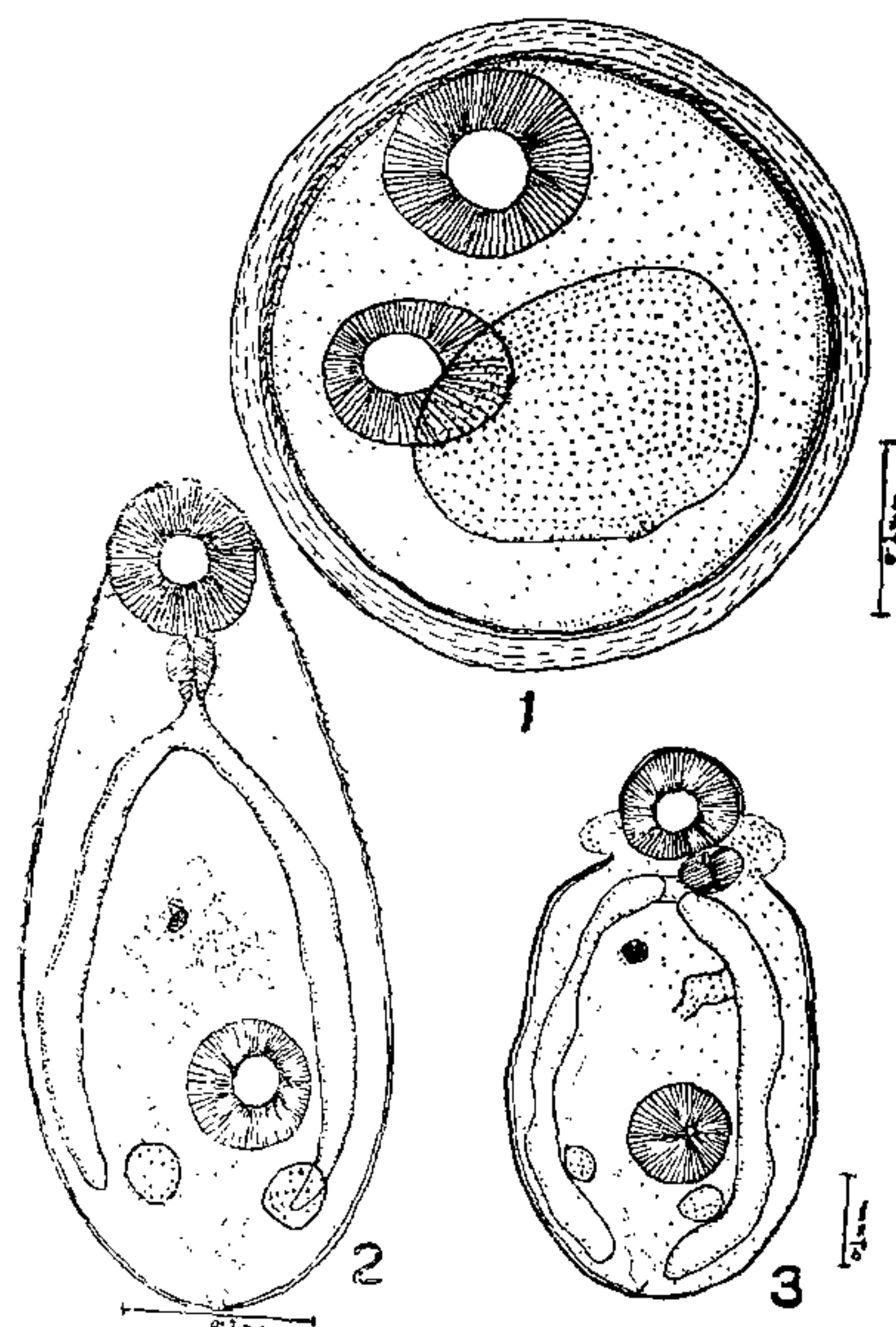
MISHRA and Pande (1967, 1967a) have recently reported, from *Sympetrum decoloratum*, the metacercaria of *Prosthogonimus putschkowskii* Skrjabin, 1912 and two other metacercarial forms with a lecithodendriid affinity. In an earlier report, Hanumantha Rao and Madhavi (1961) had recorded that the naiads of the dragonflies of the family Libellulidae harboured the metacercariae of *Eumegacetes* sp.

From amongst a total of 1212 specimens of dragonflies belonging to six species, two specimens of an interesting metacercarial form, described below under *Laterotrema*, were recovered from a female specimen of *Crocothemis servilia servilia*.

The greenish-yellow, spherical cysts, with a scarlet brown hue on the inner border, measured 0.399 mm. in diameter—the cyst wall being 0.02 mm. thick. One of the cysts was fixed in 10% formalin and preserved. A coverslip preparation of the second, examined under the microscope, exhibited the juvenile completely filling up the space surrounding it. It exhibited a spined cuticle, the two powerful suckers and an extensively developed but somewhat oval bladder. The bladder, full of black excretory granules, occupied the greater part of the cyst (Fig. 1).

The excysted juvenile carried spines mostly in the preacetabular region and measured 0.841 mm. in length and 0.380 mm. in maxi-

mum breadth in the region of acetabulum. The subterminal oral sucker was 0.150 mm. in diameter; the prominent pharynx 0.067 × 0.051 mm. in size; the short oesophagus of 0.015 mm. in length; the intestinal caeca extended to near the middle of the postacetabular region; and the acetabulum, situated at about 3/4th of the body length from the anterior extremity, measured 0.133 mm. in diameter. The excretory pore, at the posterior end, opened into an extensive Y-shaped excretory bladder which extended beyond the acetabulum. The rudiments of the two testes, rounded in form and lying just behind the acetabulum, lay near the tips of the intestinal caeca and measured 0.061–0.067 mm. in diameter. The preacetabular ovarian rudiment was present near the middle of the body (Fig. 2).



FIGS. 1-3. Fig. 1. A cyst; Fig. 2. Excysted juvenile (alive); Fig. 3. Excysted juvenile (stained mount).

After fixation, the excysted form was stained for a permanent mount which, in addition to the symmetrically placed postacetabular rudiments of the testes and the ovary lying laterally in front of the acetabulum revealed the rudiments of the cirrus sac on the side opposite to that of the ovarian rudiment. The cuticular spines were lost during processing. The following measurements were taken: length 0.568 mm.;