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Preliminary Note

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This alga was found growing in clusters on tiny stones and pebbles in the bed of a shallow stream, in three to four inches of water at Vaiyampatti near Trichinopoly in South India.* The alga is up to 1 cm. long and about 0·5-1 mm. broad. It is more or less cylindrical and long and, when fully grown, is somewhat club-shaped and broader at the upper end and gradually narrowed down to its base where it is attached to the substratum (pl. XXIII, 1, figs. 1, 2, 7). It is bright green in colour when living.

The alga at first sight looked like a large coenocyte with numerous disc-shaped parietal chloroplasts. But a careful examination of a large number of living specimens and also stained microtome preparations of the alga showed that what looked at first sight like separate chloroplasts were really discrete lumps of protoplasts each containing inside a large stellate chloroplast (figs. 5, 6) on the outer side and a small nucleus towards its inner side below the chloroplast. A single pyrenoid is imbedded in the chloroplast. The product of assimilation is starch. In the living alga two to five contractile vacuoles are found actively working in the cytoplasm of each protoplast. No eye-spot could be detected in any of the protoplasts. Thus each individual protoplast possessed all the characteristics of a single uninucleate green cell, only it did not possess a cell wall.

Though the several protoplasts formed discrete units and were quite separate from one another, careful examination showed that they were united with one another by means of delicate protoplasmic strands not unlike those of some species of

*I am indebted to Rev. Mr. A. Rapinat, S.J., Professor of Botany, St. Joseph's College, Trichinopoly, for kindly placing his formalin material of the alga at my disposal and for directing me to the locality where the alga was growing.

Volvox (fig. 4, pl. XXIII, 3, 4). The protoplasts in the young plants and the basal portions of the older plants are quite separate from one another, and are more or less round in surface view and somewhat elongated elliptic in edge view (figs. 5, 10). They are more numerous and placed closer together towards the upper part of the thallus, and, in the topmost portions, they are extremely crowded and become highly angular by mutual pressure and present a parenchymatous appearance (fig. 3). They are here pentagonal to hexagonal in surface view and somewhat rounded-quadrate to oblong in edge view (fig. 6). But even the most careful examination does not reveal the presence of a wall round any of the protoplasts. It is again very interesting to note that, though these protoplasts were pressed against one another very closely, their margins did not show any signs of fusing with those of the neighbouring protoplasts. The several protoplasts retained their individuality throughout and remained quite separate from one another.

The living material was brought from Vaiyampatti to Madras and kept growing in the Laboratory for some time. Several stages of the development of the alga were followed in some detail.

Both asexual and sexual reproduction were observed. During asexual reproduction the contents of the thallus become converted into a mass of biciliated zoospores, which escape by a rupture of the apical portion of the thallus. These, after swarming for some time, settle down and grow into new plants. Biciliated gametes also were observed. These resembled the zoospores and fused in pairs. The development of the zygotes could not be followed.

In the young plant in its unicellular condition are present a stellate chloroplast with one pyrenoid imbedded in it and many contractile vacuoles. At its basal end two thin thread-like structures traverse downwards from the protoplast through the thick wall. These are really the persisting old basal portions of the cilia of the zoospore when it settled down. Such persisting ciliary stalks are seen in *Characiochloris* Pascher [1]. Moreover, *Characiochloris* also possesses a stellate chloroplast with a pyrenoid imbedded in it and many contractile vacuoles. The present alga in its unicellular condition closely resembles the full grown individuals of *Characiochloris*.

The structure of the thallus of this alga is very extraordinary and is not known in any other alga. The thallus cannot be called a coenocyte, since we do not have a continuous multinucleate protoplast. On the other hand, the several individual unwalled protoplasts are quite distinct from one another and possess a single

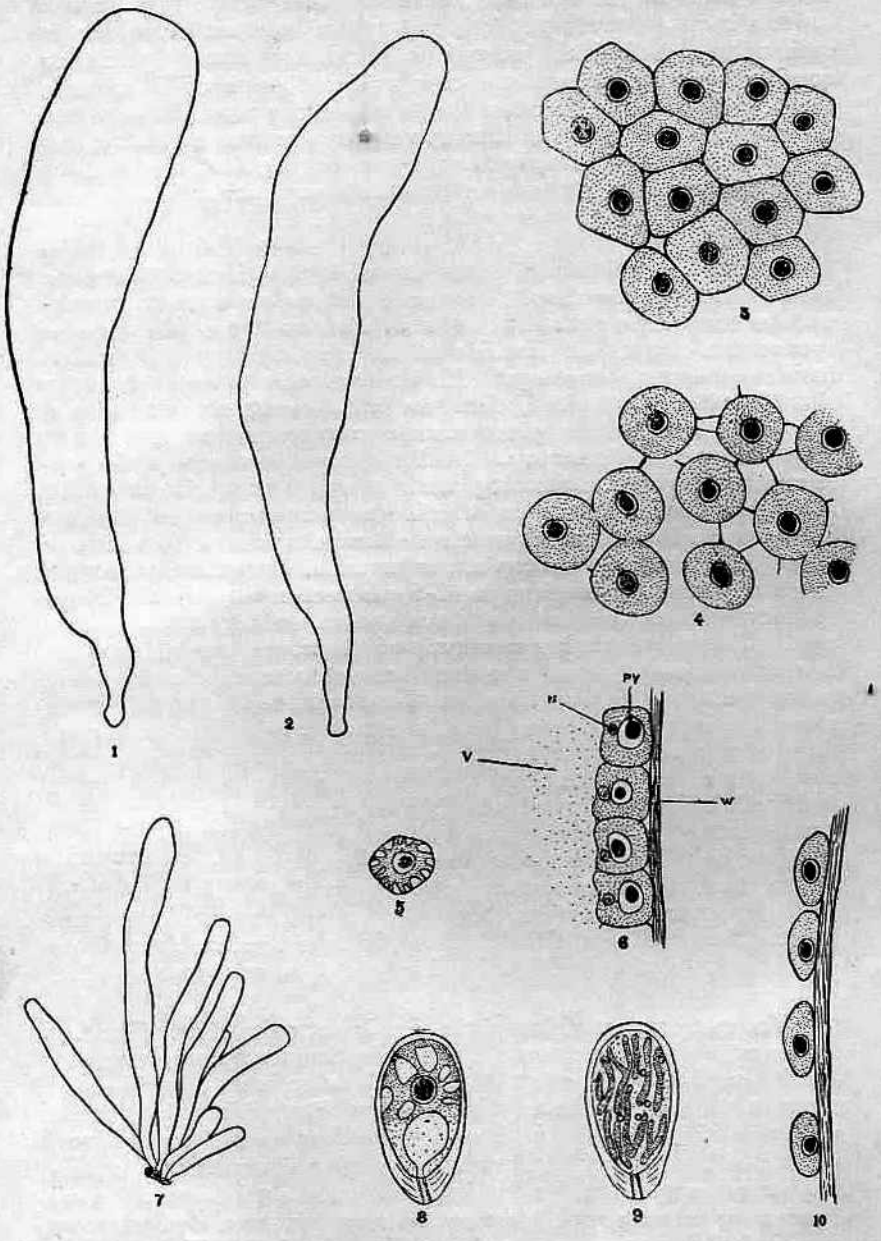
(1) Pascher, A. (1927). Süsswasserflora Deutschlands, etc., Heft 4. Volvocales-Phytomonadinae, pp. 485-7. Korshikov, A. A. (1932) Studies in Vacuolatae I. Archiv für Protistenkunde, Bd. 78, pp. 557-62.

nucleus each and so must be considered as separate cells though inside a common envelope. The presence of contractile vacuoles in each of the individual protoplasts is another strong point for considering them as separate cells and not parts of a common coenocytic structure. Again the fact that the protoplasts retain their individuality even in the uppermost portions of the thallus where they are placed very closely pressing against one another suggests again that we are dealing with separate cell-units and not merely parts of a coenocytic structure.

Now, if the delicate protoplasmic connections between the several protoplasts should be considered as equal to the intercellular connecting strands seen in *Volvox* then the separate protoplasts should be considered as separate unwalled cells inside a common envelope. If, on the other hand, this view should not be accepted, then we must consider the several protoplasts with their protoplasmic connections as parts of a huge coenocytic structure. If the latter view should be preferred, then we are dealing with a very extraordinary type of coenocytic structure in which the protoplast has become compacted into several discrete cell-like units connected with one another by delicate protoplasmic strands, each unit having a single chloroplast, a nucleus and 2-5 contractile vacuoles. Such a coenocytic structure has not been known so far in any other alga. This therefore is a new type of structure coming between a normal coenocyte and a multicellular structure. Since, owing to the presence of a common envelope and the absence of walls round the individual protoplasts, it stands nearer to a coenocytic than to a multicellular structure—though it must be admitted that there are sufficient grounds for considering it a multicellular structure of an extraordinary type—a new name, "protocoenocyte" may be given for this type of structure. It must however be pointed out that the difference between a coenocyte and a multicellular structure is only very slight. Fritsch[1] states that coenocytes "are best interpreted as multicellular structures lacking the usual septation". Here, in this alga, we have a concrete case to illustrate Fritsch's interpretation of a coenocyte.

The systematic position of the alga is not quite clear. The fact that contractile vacuoles are present in the protoplasts suggests that it must be a very primitive form. The alga in its general shape shows some resemblance to *Codiolum* and *Protosiphon,* but, in the structure of its protoplast, it entirely differs from them. Since, as pointed out already, the young unicellular plants show a certain amount of resemblance to the individual plants of *Characiochloris* Pascher, it is very probable that the alga has been derived from some unicellular ancestor resembling *Characiochloris.* The alga may

(1) West, G. S. and Fritsch, F. E., British Fresh Water Algae, 1927, p. 31.



Figs. 1-10. *Characiosiphon rivularis* sp. et gen. nov. Figs. 1, 2. Two full grown plants. Fig. 3. Protoplasts in the upper parts of the thallus angular through mutual pressure. Fig. 4. Protoplasts from lower part of

be placed in a new genus by name *Characiosiphon* in a separate family, Characiosiphonaceæ, close to the family, Characiae, and may be called *Characiosiphon rivularis* sp. nov.

Description

Characiosiphon gen. nov.

Thallus elongated, cylindrical and somewhat clavate when old, consisting of an outer firm common membrane closely investing a large number of separate naked cell-like protoplasts arranged in a single layer immediately below it and having a large hollow space filled with sap in the centre; the protoplasts connected with one another by protoplasmic processes; each protoplast having on the outer side a more or less stellate chloroplast with a large pyrenoid embedded in it and a single nucleus below the chloroplast close to the central hollow space; two or more contractile vacuoles regularly working in each protoplast in the living alga; eye-spot absent; asexual reproduction by means of biciliated zoospores which escape outside through the rupture of the thallus; sexual reproduction by means of biciliated gametes which fuse in pairs to form a zygote; development of the zygote not known.

Characiosiphon rivularis sp. nov.

General characters same as those of the genus. Thallus up to 1 cm. long and 0·5-1 mm. broad; apex of the thallus broadly rounded to obtusely conical; common cell-wall thick and lamellated; protoplasts in the lower part of the thallus placed somewhat separately from one another and more or less round to ellipsoid in surface view; protoplasts in the uppermost parts of the thallus placed more compactly and angular through mutual pressure and pentagonal or hexagonal in surface view; protoplasts 13—15μ in diameter.

Hab. Plants growing in clusters on small pebbles and stones in a shallow stream at Vaiyampatti, near Trichinopoly, South India. Collected by A. Rapinat.

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the thallus lying separate and showing protoplasmic connections. Fig. 5. A single protoplast showing stellate chloroplast and pyrenoid. Fig. 6. Portion of a microtome section of the thallus showing position of the nucleus and of the pyrenoid. Fig. 7. A cluster of young plants. Fig. 8. Young unicellular plant showing stellate chloroplast and the pyrenoid and basal ciliary strands. Fig. 9. The same in surface view showing five contractile vacuoles and the terminal ends of the stellate chloroplast. Fig. 10. Edge view of the cells near the lower portion of the thallus. *w*, wall of thallus; *py*, pyrenoid; *n*, nucleus; *v*, central vacuole of the thallus. Figs. 1, 2 and 7, X 15: the rest, X 700.

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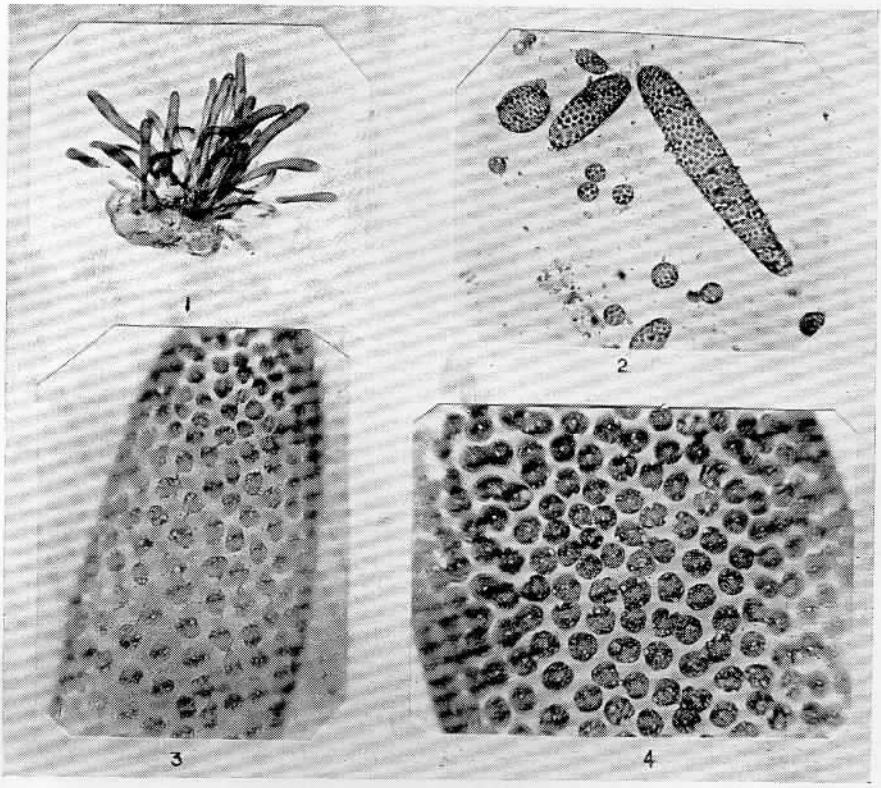
Explanation of Plate XXIII

Characiosiphon rivularis sp. nov.

1. A cluster of plants growing on a small stone. X 2.
2. Photomicrograph of young plants grown in cultures showing various stages of development. X 72.
3. Photomicrograph of a young plant showing the separate protoplasts in surface view. Protoplasmic connections are seen between many of the protoplasts. Contractile vacuoles can be seen in several protoplasts. X 270.
4. Photomicrograph of a portion of an older plant showing the protoplasts placed more compactly. X 270.



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