

Contributions to our knowledge of South Indian Algae—VIII*

M. O. P. IYENGAR, † F.A.Sc.

Chaetochloris indica Iyengar sp. nov.

CELLS aggregated, long oval with a narrow and tapering papilla; chloroplast cup-shaped, with a basal pyrenoid; eyespot not seen in vegetative cells; contractile vacuoles single, anterior; cells with two pseudocilia, pseudocilia up to three times as long as the body; cells 4.5–10.0 μm broad and 9–16 μm long; multiplication by cell division, first division longitudinal, forming up to 4 swarmers; swarmers biflagellate, flagella slightly longer than the body, obovate, eyespot anterior, of varying sizes, 4.0–7.0 μm long and 2.9–3.0 μm broad.

Habitat : On *Salvinia* roots, Lalbhag, Bangalore (29 March 1952).

Type : Text-figure 1 A–D.

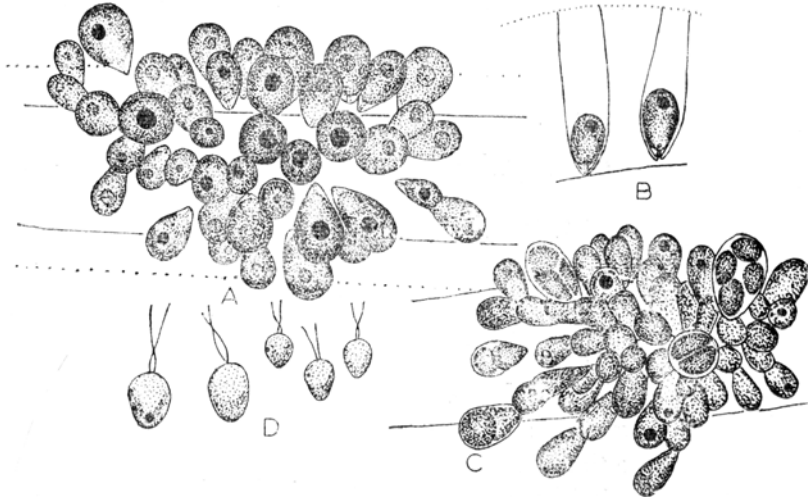
This alga comes near *Chaetochloris scherffeliana* (Pascher, 1940) but differs from it in having broader cells and in the papilla being more pointed and not broader.

Cellulae aggregatae, longae, ovaes, unusquaeque papilla angusta decrescenti instructa. Chloroplastus cupulatus, pyrenoide basali. Stigma in cellulis vegetativis non visum. Vacuola contractilis singula, antica. Cellula duobus pseudociliis, corpore usque 3 plo longioribus, instructa. Cellulae 4.5–10.0 μm latae, 9–16 μm longae. Multiplicatio per divisionem cellularum, primitivam longitudinalem, usque 4 zoosporas formantem. Zoosporae biflagellatae, flagella corpus paullo longiora, obovatae, stigmatem antico, amplitudine variabiles, 4.0–7.0 μm longae, 2.9–3.0 μm latae.

Habitat : In radicibus *Salviniae*, Lalbhag, Bangalore (29 March 1952).

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† The late Prof. M. O. P. Iyengar left behind a large amount of unpublished material. As desired by him these are now being published in a series. I am grateful to Mr. R. Ross, Keeper of Botany, British Museum of Natural History, London, for his generous help in translating the diagnoses into Latin.—T. V. Desikachary.



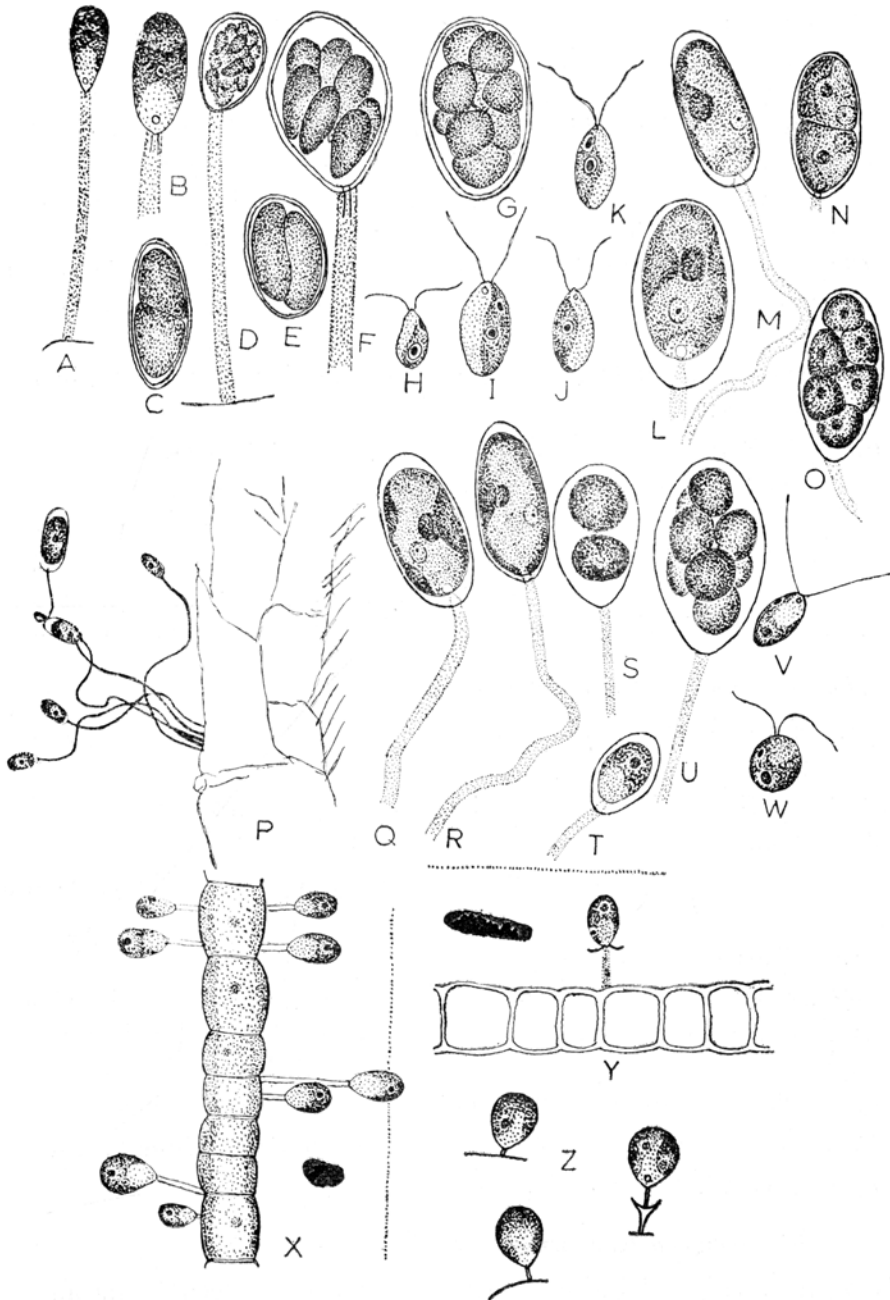
Text-figure 1. *Chaetochloris indica* sp. nov. D. Swarmers. (all after Iyengar; A-C, $\times 625$; D, $\times 1,000$).

***Chlorangiochloris epizootica* Kors.** (Text-figure 2 L-W)

Cells long oval; chloroplast cup-shaped or lateral with a single lateral pyrenoid; stalked, stalk up to about 5-6 times as long as the cells; contractile vacuoles single, anterior near the place of the origin of the stalk; zoospores formed up to 8 in each cell, biflagellate, eyespot anterior, flagella longer than the body; cells $5-13.4 \times 13.4-25.1 \mu\text{m}$, protoplast up to $18.4 \mu\text{m}$ long; zoospores $4.4-6.5 \times 7-8.5 \mu\text{m}$.

Habitat : Epiphytic on aquatic animals, paddy field, Madras (21 March 1941, leg. K. R. Ramanathan).

[A certain amount of confusion has crept into the applicability of certain generic terms and their typification. The genus *Chlorangiopsis* Kors. (1932) was based on *C. anomala* Kors. This species differs from similar other forms in the zoospores settling down by their posterior ends. Korschikov, later in 1953, has enlarged the genus to include another species of his *Chlorangiochloris*. This latter genus was typified by *C. piriformis* Kors. Finally, eight species became included at last in a third genus, *Chlorangiopsis* Kors. Ettl (1958; see also Fott 1972) recognizes three genera, *Characiocchloris* Pascher with many contractile vacuoles, monotypic *Chlorangiopsis* Kors., and *Chlorangium* Stein. In the last genus he merges *Chlorangiocchloris* Kors., *Chlorangiogloea* Kors., and *Chlorangiella* De Toni (1889). *Chlorangiella* De Toni (1889) is the valid name for *Chlorangium* Stein 1878 non Link 1849 (see Silva 1959). Ettl obviously does not attach significance to the peculiar nature of the attachment in *Chlorangiopsis anomala*.



Text-figure 2. A-K. *Characiochloris anophelesii* Iyengar sp. nov. D-G. Swarmer formation; H-K. Swimmers. (all after Iyengar). L-W. *Chlorangiellochlois epizootica* Kors. (all after Ramanathan). V, W. Swimmers. P. Habit, on mosquito larvae; N, O, S, U. Swarmer formation; V, W. Swimmers. X-Y. *Chlorangiella mucigena* Ramanathan sp. nov. on *Ulothrix* filaments. (all after Ramanathan). Z. *Chlorangiella consociata* (Kors.) Fott (after Ramanathan).

Bourrelly (1966, p. 112) seeks to give significance to this feature. He recognizes *Chlorangiella* De Toni, and *Chlorangiopsis* Kors. and a third one, *Pseudochlorangium* Bourr. This last genus (see also Fott 1972) is created by Bourrelly for taking *Chlorangiopsis anomala* and the residue of these epizootic forms are left behind in his revised *Chlorangiopsis*. Bourrelly's *Pseudochlorangium* is congeneric with *Chlorangiopsis* Kors. If one is to attach significance to the mode of attachment of the developing zoospore then *Chlorangiopsis* Kors. will have to be restricted to *C. anomala* and the other species will have to be segregated into a new genus. Fortunately one of these species is *Chlorangiochloris piriformis*, type of that genus, and therefore this genus is available. The correct distribution of species will have to be as follows:

- Characiochloris* Pascher with Type: *C. characioides* (Kors.) Pascher.
Chlorangiella De Toni, Type: *C. pygmaea* (Ehr.) Silva 1959
 [= *Chlorangium* Stein Type: *C. stentorium* (Ehr.) Stein.
Chlorangiopsis Kors. Type: *C. anomala* Kors.
 (= *Pseudochlorangium* Bourr. Type: *P. anomala* (Kors.) Bourr).
Chlorangiochloris Kors. Type: *C. piriformis* Kors. —T. V. D.]

***Characiochloris anophelesii* Iyengar sp. nov.**

Cells 4.4–6.3 × 10.5–13.8 μm, stalk 30–45 μm long; chloroplast cup-shaped with a lateral pyrenoid; swarmers 8–16 per cell, 2.9–5.4 × 7.1–10.4 μm, with a single lateral chloroplast and a single lateral pyrenoid, flagella as long as or shorter than the body.

Habitat : On mosquito larvae, muddy water pools, Guindy, Madras. (13 January 1951).

Type : Text-figure 2 A–K.

Cellulae 4.4–6.3 μm × 10.5–13.8 μm, stipites 30–45 μm longi. Chloroplastus cupulatus, pyrenoide laterali. Zoosporae 8–16 per cellulam, 2.9–5.4 μm, × 7.1–10.4 μm, chloroplasto laterali uno et pyrenoide laterali uno instructae, flagellis corpus aequantibus vel corpore brevioribus.

Habitat : In larvis *Anophelesii* in lacunis limosis, Guindy, Madras.

Typus : Text-figure 2 A–K.

***Chlorangiella mucigena* Ramanathan, K. R. sp. nov.**

Cells ovate or ellipsoidal with both ends rounded, attached by the anterior end; protoplast filling the cells, papilla absent; chloroplast cup-shaped, not perforated; pyrenoid single, median, posterior; eyespot anterior; contractile vacuole single, anterior; cells attached by a mucilaginous stalk.

stalk simple and not branched; cells $3.8-5.0\ \mu\text{m}$ broad and $5-6.7\ \mu\text{m}$ long, stalk about up to $10\ \mu\text{m}$ long.

Habitat : On *Ulothrix* filaments, paddy field, Adyar, Madras (7 March 1940).

Type : Text-figure 2 X-Y.

This alga resembles *Chlorangiella pygmaea* but differs in the presence of a pyrenoid, contractile vacuole and an eyespot and also in the dimensions of the cell.

Cellulae ovatae vel elliposoideae extremis ambobus rotundatis, per extremum anticum affixae. Protoplastus cellulam complens. Papilla carens. Chloroplastus cupulatus, non perforatus. Pyrenoides singula, postica, mediana. Stigma anticum. Vacuola contractilis singula, antica. Stipes mucilaginosus, simplex non ramosus. Cellulae $3.8-5.0\ \mu\text{m}$ latae, $5-6.7\ \mu\text{m}$ longae, stipes usque $10\ \mu\text{m}$ longus.

Habitat : In filamentis *Ulthricis*, in arvo *Oryzae*, Adyar, Madras.

Typus.—Text-figure 2 X-Y.

***Chlorangiella consociata* (Kors.) Fott** (Text-figure 2 Z).

A few specimens have been recorded by Sri. K. R. Ramanathan, from paddy fields, Madras.

***Chlamydocystis indica* Iyengar gen. et sp. nov.**

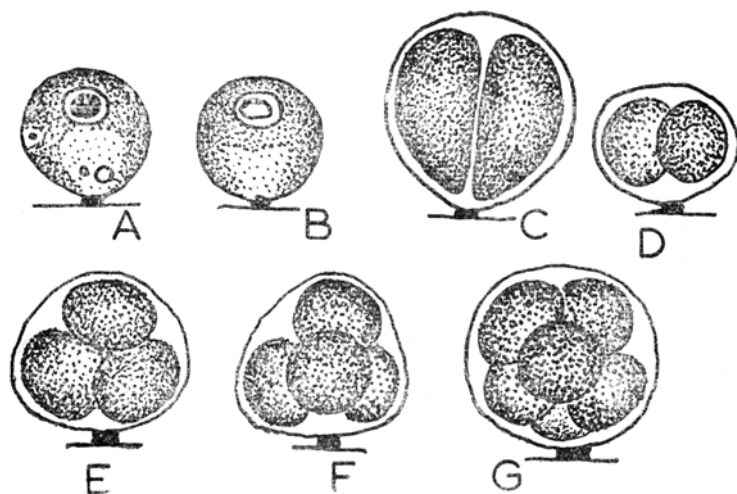
Cells spherical, attached by a distinct mucilaginous disc or pad, protoplast completely occupying the cell; contractile vacuoles 2, anterior and near the region of attachment; cells $9-14$ (-17.1) μm diam., pad $4.5 \times 0.8\ \mu\text{m}$; first division of the cell longitudinal, forming 4 to 8 cells, liberation and behaviour of the daughter cells not observed.

Habitat : On green sand grains, inside water in a beach pool, opposite to Springhaven road, Madras (22 February 1960).

Type : Text-figure 3.

This genus differs from all the known allied genera especially *Chlamydomonadopsis* and *Chlorangiella* in a number of respects. It differs particularly in the absence of a distinct stalk and in exhibiting a clear longitudinal division, whereas in the others it is either diagonal or nearly transverse. In this it resembles *Chlorophysema* spp., and *Malleochloris* but differs in the mode of attachment.

Cellulae sphaericae, per discum manifestum mucilaginum affixae. Protoplastus cellulam complens. Chloroplastus cupulatus, pyrenoides basali,



Text-figure 3. *Chlamydocystis indica* Iyengar gen. et sp. nov. C-G, Swarmer formation. (after Iyengar) (all $\times 1,500$),

Stigma anticum. Vacuolae contractiles duae, anticae, prope discum affingentuem positae. Cellulae 9-14 (-17.1) μm diam., discus affingens 4.5×0.8 μm . Divisio prima cellulae longitudinalis; cellulae filiales 4-8, liberationis et activitatis quarum non visae.

Habitat : In grains arenae viridibus, in stagno ad littus, "Springhaven road, Madras" oppositum.

Typus : Text-figure 3.

***Stylosphaeridiella crucigeniae* Iyengar gen. et sp. nov.**

Cells epiphytic, ovate or obovate; chloroplast with a single pyrenoid; eyespot present, anterior; contractile vacuoles not observed; zoospores biflagellated, flagella as long as or slightly shorter than the body, 8 zoospores per cell; first division of cell transverse; cells $6 \times 9-11$ μm ; zoospores 3×5 μm .

Habitat : Epiphytic on cells of *Crucigenia* sp., roadside rainwater pool, Guindy, Madras (28 December, 1959).

Type : Text-figure 4 A-F.

This genus differs from all the known species of the genus *Stylosphaeridium* in the absence of contractile vacuoles, in the shape of the cell and in the lateral chloroplast. It resembles *S. epiphytica* (Kors.) Kors. in the vegetative cells having an eyespot.

Cellulae epiphyticae, ovatae obovataeve. Chloroplastus lateralis, pyrenoido uno. Stigma praesens, anticum. Vacuolae contractiles non visae. Zoospores biflagellatae, flagella corpus aequantes vel corpore paullo breviora, 8 per cellulam. Divisio prima cellulae transversalis. Cellulae $6 \times 9-11 \mu\text{m}$; zoosporae $3 \times 5 \mu\text{m}$.

Habitat : Epiphytica in cellulis *Crucigeniae* sp., in lacuna aquae pluvialis ad latus viae, Guindy, Madras.

Type : Text-figure 4 A-F.

***Cecidochloris tetrasporidiae* Iyengar sp. nov.**

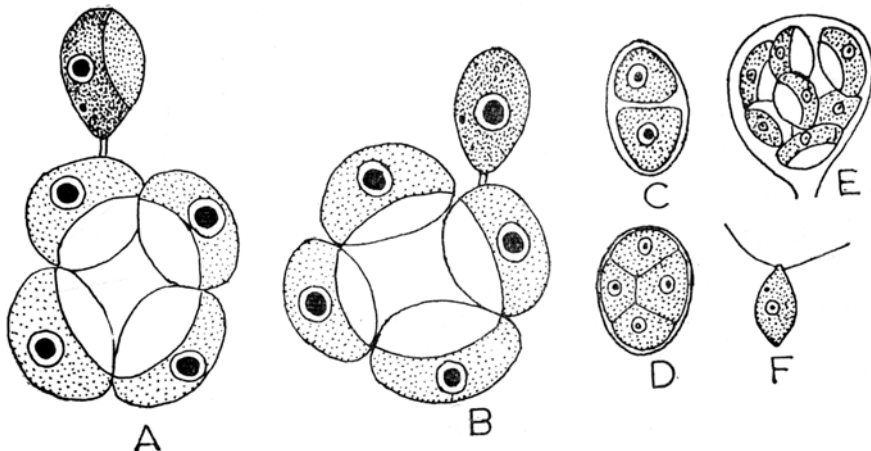
Cells nearly spherical, single with a distinct wall, protoplast slightly removed away from the wall; chloroplast single, occupying nearly all the protoplast, cup-shaped; pyrenoid single, axial; eyespot single; flagella and contractile vacuoles not seen; cells $10.5-12.5 \mu\text{m}$ diam.

Habitat : On *Tetrasporidium javanicum* Mobius, Madras.

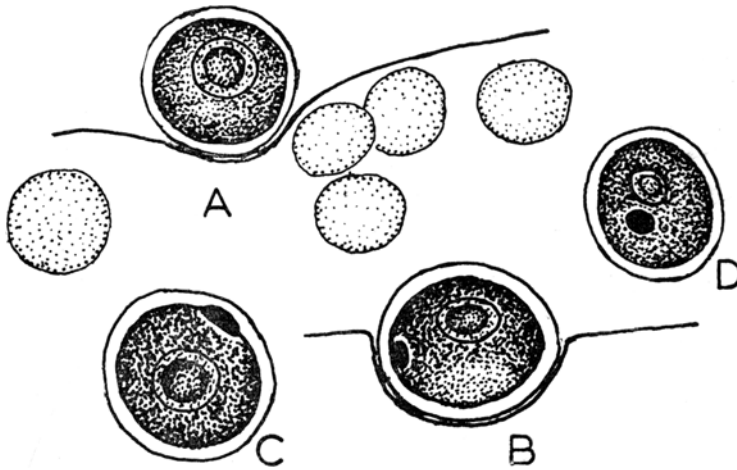
Type : Text-figure 5 A-D.

The alga lies always outside the layers of cells of the host. This species differs from the two others in the larger cells. [Iyengar (in lit.) considered it possible it may represent a new genus, *Hypnococcum*. It is placed here under *Cecidochloris* as it resembles it closely in spite of a lack of knowledge on the contractile vacuoles and the nature of cell division. The alga is incompletely known.—T. V. D.]

Cellula paene sphaericae, solitariae, pariete manifesto. Protoplastus a pariete parum distans. Chloroplastus singulus, totum fere protoplastum



Text-figure 4. *Stylosphaeridiella crucigeniae* Iyengar gen. et sp. nov. C-E. Swarmer formation; F, Swarmer.. (all after Iyengar) (all, $\times 1,600$).



Text-figure 5. *Cecidochloris tetrasporidiae* Iyengar sp. nov. (all after Iyengar, $\times 2,000$).

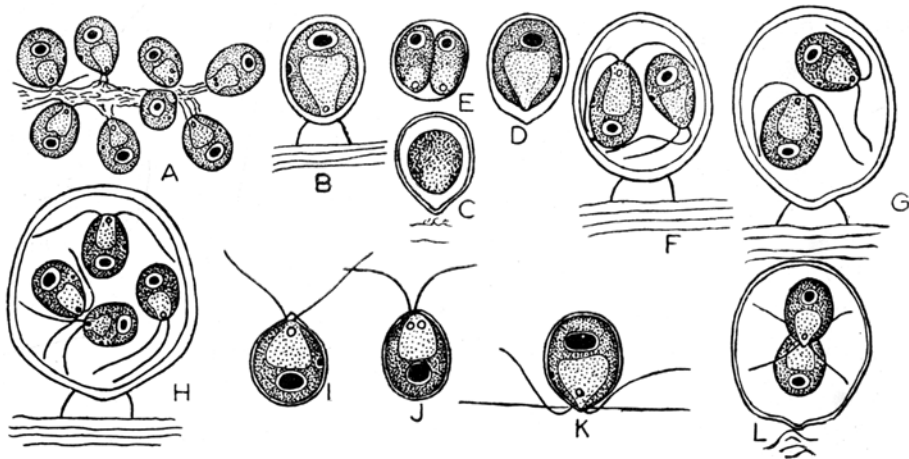
complens, cupulatus, Pyrenoides una, axialis. Stigma unum. Flagella et vacuolae contractiles non visae. Cellulae $10.5-12.5 \mu\text{m}$ diam.

Habitat : In *Tetrasporidio javanico* Moebius, Madras.

Typus : Text-figure 5 A-D.

***Chlorophysema madrasensis* Iyengar sq. nov.**

Cells nearly spherical or ellipsoidal, papillate; chloroplast cup-shaped, pyrenoid single and basal; biflagellate, flagella slightly longer than the body;



Text-figure 6. *Chlorophysema madrasensis* Iyengar sp. nov. A-C. Habit; D-H, L. Swarmer formation; I, J. Swarmer; K. Settling down of the swarmer on a host. (all after Iyengar, $\times 720$).

eyespot anterior to median; contractile vacuoles 2 or 1, anterior; first cell division longitudinal, each cell forming 2 or 4 zoospores; cells 13–14 × 16–18 μm, at dividing stage up to 33 × 44 μm.

Habitat : Roadside rainwater pool, Triplicane, Madras (19 August 1955).

Type : Text-figure 6.

The alga generally resembles *C. apiocystiformis* but differs in cell size, in the presence of an eyespot and in the nature of attachment through a ciliary stalk and not directly by the cell wall. It differs from *Chlorangiella* and *Chlorangiochloris* in the absence of a distinct mucilaginous pad or stalk serving as a means of attachment.

Cellulae aut paene sphaericae aut ellipsoideae, biflagellatae, flagellis corpore paullo longioribus. Chloroplastus cupulatus, pyrenoide una basali. Stigma anticum mediumve. Vacuola contractilis aut una aut duae, antica. Divisio prima cellularum longitudinalis; zoosporae 2–8 omni cellula formatae. Cellulae 13–14 μm × 16–18 μm, ad temporem divisionis usque 33 × 44 μm.

Habitat : In lacuna aquae pluvialis ad latus viae, Triplicane, Madras.

Typus : Text-figure 6.

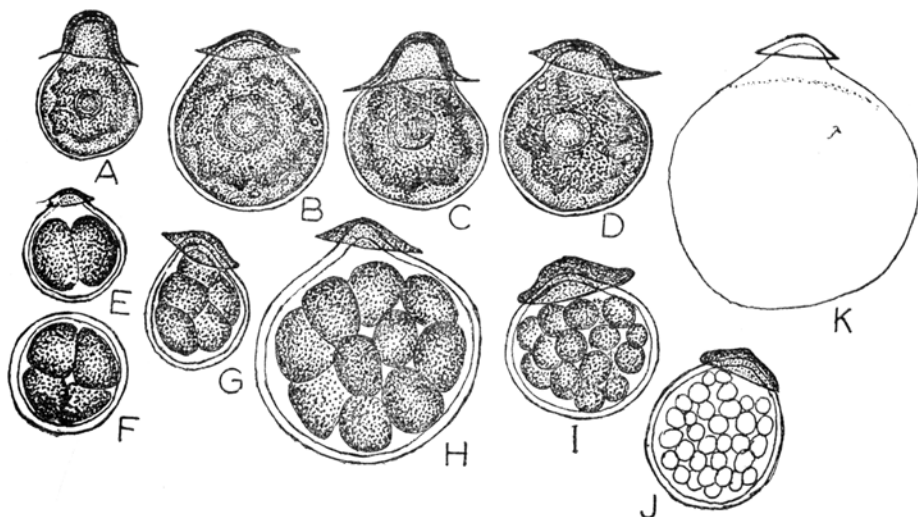
***Nautococcus madrasensis* Iyengar sp. nov.**

Cells forming a floating layer as it were, with some gelatinous material secreted between the cells and the rims appearing in side view somewhat interlocking; cells in sectional view truncated in the upper face and rounded in the lower face, in surface view appearing rounded and becoming angular by mutual compression; caps absent; chloroplast massive and located in the basal portion with a central pyrenoid; contractile vacuole single, anterior and upper portion, often to one side; cells dividing to form eight zoospores; zoospores with a caudate narrow posterior and the contents somewhat retracted; cells 9–11 μm broad and 6·3–10 μm high; swimmers 6–6·5 μm × 7·5–9 μm.

Habitat : Floating as a green scum, muddy water pond, Madras (21 July 1955).

Type : Text-figure 8.

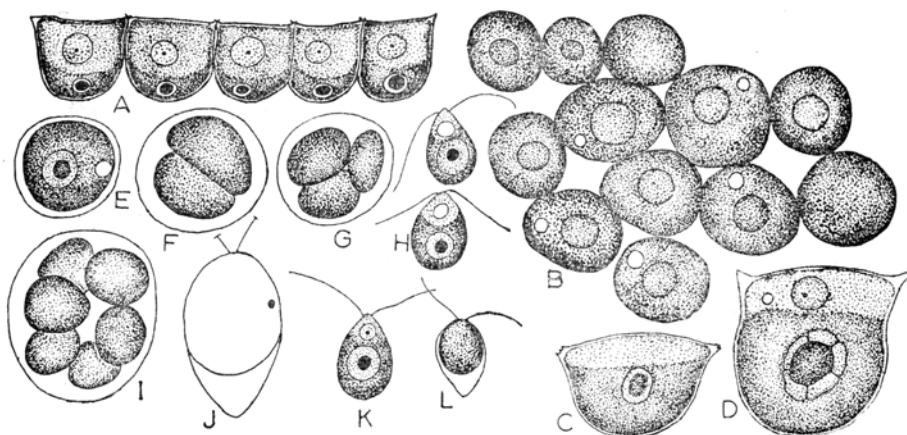
N. madrasensis is placed in this genus as it has a neustonic habit. It resembles the genus in the shape and other aspects of the cells. However, it differs in the absence of a clear neustonic habit with a cap. It may be



Text-figure 7. *Nautococcus caudatus* Kors. (all after Iyengar, $\times 1,050$). E-J. Swarmer formation. K. a large sporangium, contents not shown.

mentioned that the alga was collected at the end of the period when water was drying up and the alga was continuing to grow also on the bottom mud. The author (M. O. P. I.) considers it a *Nautococcus* species.

Cellulae stratum fluitans formantes; inter se aliqua materia gelatinosa secernita; margines cellularum e latere visae aliquantum interordinatae, ut videtur. Cellulae in sectione visae superne truncatae, infime rotundatae, a superficie visae rotundatae vel unius contra alia pressione angulatae factae;



Text-figure 8. *Nautococcus madrasensis* Iyengar sp. nov. (all after Iyengar) F-G, I. Swarmer formation; H, K, L. Swarmers. (A, B, E-H, K, $\times 1,400$; C, D, J, $\times 2,250$; I, L., $\times 1,380$).

galera carentia. Chloroplastus robustus, in portione basali cellulae positus, pyrenoide centrali instructus. Vacuola contractilis singula, antica, et saepe latus unum versus posita. Cellulae octo zoosporas divisione formantes; zoosporae postice anguste caudatae, contento aliquantum retracto. Cellulae 9–11 μm latae, 6.3–10 μm altae; zoosporae 6–6.5 \times 7.5–9 μm .

Habitat : Fluitans, strati viridis ad instar, in lacuna aquae limosae, Madras.

Typus : Text-figure 8.

***Nautococcus caudatus* Kors.** (Text-figure 7)

Cells somewhat spherical, nearly like a bulb, with a membrane cap at one end; chloroplast central, somewhat lobed, with a central pyrenoid; contractile vacuoles many, irregularly distributed; cells dividing to form 16 (or 32) daughter protoplasts, first division longitudinal; other stages not seen; cells 16–33 μm high and 12–32 μm broad; cysts 13.5 \times 15 μm .

Habitat : In a pond in Triplicane, Madras (10 October, 1950); roadside rain ditch, Madras (22 July 1955).

var. *minor* Iyengar var. nov.

Cells 16–22.5 $\mu\text{m} \times$ 23–26 μm ; cysts formed singly in each cell with a spinose wall, 13 \times 15 μm diam., spines 2–2.5 μm long.

Habitat : Roadside rainwater ditch, Madras (22 July, 1955).

Type : Text-figure 9.

Cellulae 16–22.5 $\mu\text{m} \times$ 23–26 μm . Cysta una in unaquaque cellula formata, pariete spinoso, 13–15 μm diam., spinae 2–2.5 μm longae.

Habitat : In aqua pluviali in fossa ad laus viae, Madras.

Typus : Text-figure 9.

***Nautococcus mammillatus* Kors.**

This alga was observed in a collection sent to the author (M. O. P.I.) from Dacca (Bangla Desh) by the late Prof. P. Maheswari.

***Nautococcus indicus* Iyengar sp. nov.**

Cells nearly pyriform, without a cap; chloroplast single, massive and central, with a single axial pyrenoid; cells dividing to form up to 32 biflagellate swimmers or gametes, swimmers liberated by a rupture of the parent cell at

the apex or broad end; quadriflagellate planozygotes (?) observed; cells $14.9-20 \mu\text{m} \times 22-29 \mu\text{m}$; swarmers $6-8 \times 8-14 \mu\text{m}$.

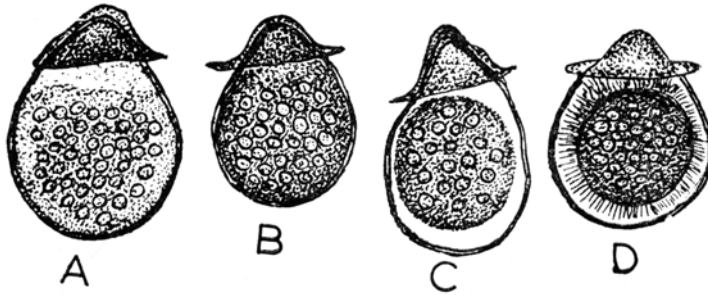
Habitat : Muddy water pools, Guindy, Madras (3 December 1950).

Type : Text-figure 10.

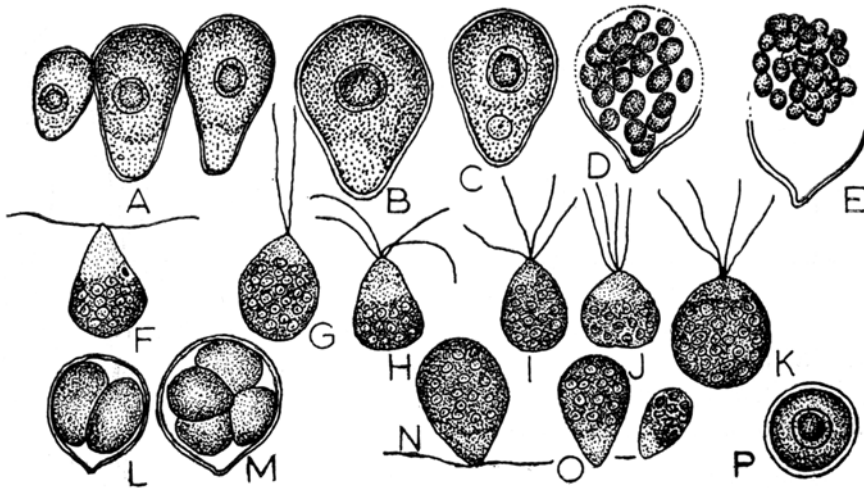
Cellulae paene pyriformes, sine galero. Chloroplastus singulus, robustus, centralis, pyrenoide uno axiali instructus. Zoosporae gametaeve biflagellatae usque 32 per divisionem cellulae formatae, per rupturam cellulae parentalis ad apicem latam liberatae. Planozygotae quadriflagellatae visae. Cellulae $14.9-20 \mu\text{m} \times 22-29 \mu\text{m}$; zoosporae $6-8 \mu\text{m} \times 8-14 \mu\text{m}$.

Habitat : In lacunis aquae limosae, Guindy, Madras.

Typus : Text-figure 10.



Text-figure 9. *Nautococcus caudatus* v. *minor* Iyengar var. nov. (after Iyengar) (all, $\times 1,180$).



Text-figure 10. *Nautococcus indicus* Iyengar sp. nov. D, E, L, M. Swarmer formation: F, G. Swarmers; H-K. Quadriflagellate zygotes; P. Rounded zygotes. (all after Iyengar; A, D, E, P, $\times 790$; B, C, O, $\times 1,120$; rest $\times 1,725$).

Nautococcus triplicanensis Iyengar sp. nov.

Cells broadly ovate or pyriform or spherical, cap absent; chloroplast massive, central with an axial pyrenoid; dividing to form up to 32 biflagellate swimmers from each parent cell, swimmers with an anterior eyespot, settling down by their anterior end; other developmental stages unknown; cells (8.3-) $12.5-24\ \mu\text{m} \times 12.5-29.0\ \mu\text{m}$; swimmers $6-9.5 \times 7.5-12\ \mu\text{m}$.

Habitat : Parthasarathy koil tank, Triplicane, Madras (14 October, 1951; also 18 October 1951).

Type : Text-figure 11.

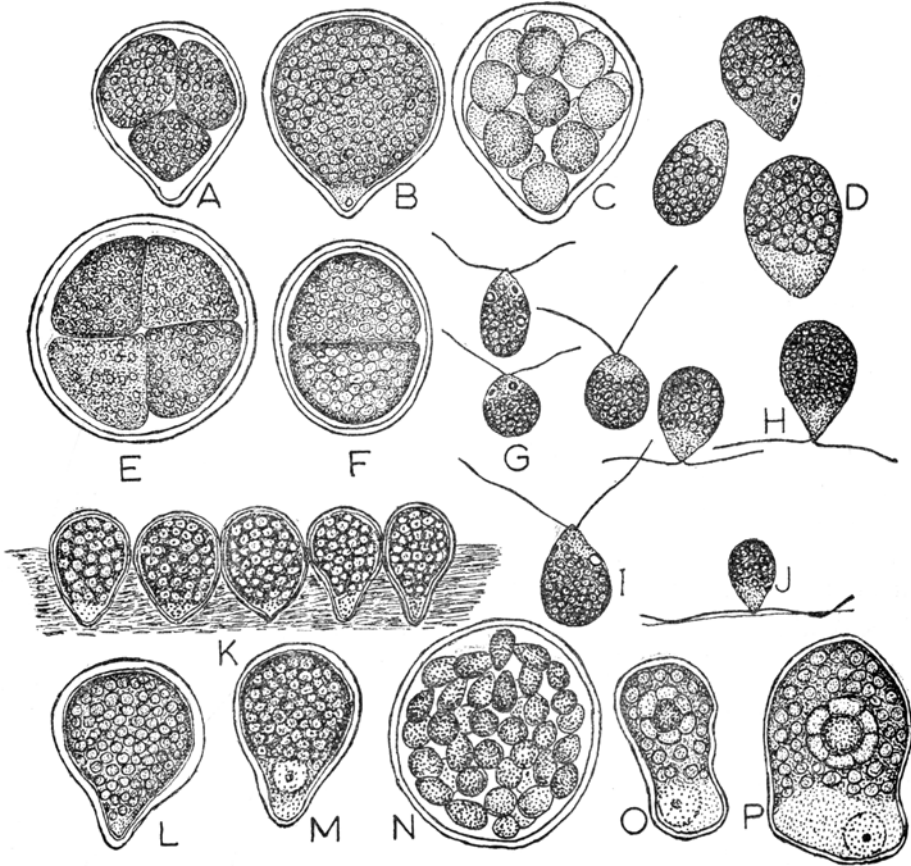
This alga was growing densely on silt recently exposed in the tank bed of the Parthasarathy temple tank. The alga formed a bright green extensive stratum on the moist soil surface of the silt. The cells were broadly ovate or broadly pyriform with a beak-like apical portion. The nature of the single chloroplast could not be ascertained or made out because of dense contents but appeared to be disc-shaped. The cell was full of starch grains. The beak-like portion was free of the chloroplast.

The material was brought to the laboratory and examined. From 9 p.m. onwards the contents began to divide first into two by longitudinal division and then at right angles to it so that four daughter protoplasts were formed. Further divisions took place forming usually 16 daughter cells. In smaller cells only 8, 4, or even 2 cells were formed. Rarely 32 cells were formed. The anterior portion of swimmers was hyaline and somewhat opaque and refractive in appearance. The eyespot was plate-like and situated at the upper portion of the chloroplast. There was a tiny papilla. One (or two) contractile vacuole was seen in the anterior hyaline portion. The swimmers settled down by their anterior end and were observed to move a certain distance creeping as it were with the aid of the flagella.

Cellulae late ovatae vel pyriformes vel sphaericae, sine galero. Chloroplastus robustus, centralis, pyrenoide axiali. Zoosporae usque 32 per divisionem uniusquaque cellulae parentalis formatae, unaquaeque stigmatem antico instructa, in apice antico sedens. Status alii evolutionis ignoti. Cellulae (8.3-) $12.5-24\ \mu\text{m} \times 12.5-29.0\ \mu\text{m}$; zoosporae $6-9.5\ \mu\text{m} \times 7.5-12\ \mu\text{m}$.

Habitat : 'Parthasarathy koil tank,' Madras.

Typus : Text-figure 11.



Text-figure 11. *Nautococcus triplicanensis* Iyengar sp. nov. A-F, N. Swarmer formation; G, I. Swarmers; H, J. Swarmers settling down. (A-C, E, F, J, L-N, $\times 730$; D, H, I, O, P, $\times 1,170$; G, $\times 880$; K. Diagrammatic representation of the habit).

***Gloeochaete wittrockiana* Lagerheim (Text-figure 12 A, B)**

This species was collected growing on *Pithophora*, at Mahabalipuram (26 September, 1952). Dr. M. S. Balakrishnan reported that he has also observed this alga in his collections from Poona.

***Characiellopsis* Iyengar, M.O.P. gen. nov.**

Iyengar and Iyengar (1932) described an alga growing on mosquito larvae [*Anopheles (Myzomyia) subpictus grossi*] growing in some ponds of some villages near Sonarpur in Lower Bengal. They placed the alga under *Characium*. At that time the alga was studied from alcohol preserved material. The contents were badly preserved and so the structure of the alga was not clear. Only the pyrenoid could be recognized with some certainty.

The present author (M. O. P. I.) collected some anophelean larvae from muddy water pools at Nekkundram (text-figure 13). The algae with the larvae were carefully fixed in Bouin's preservative (PFA₃). The alga could be studied again both in the living condition and in well made preparations. This study of the alga especially the chloroplast showed that the alga was not a *Charactum* but quite different and has to be placed in a new genus.

The cells of the alga was clavate elongate, broadly rounded at the top and narrowing gradually in the lower portion into a rounded base. The cells were attached to the larvae by a tiny pad of mucilage. They had a central nucleus. Cells had 1 or more (up to 4) chloroplasts each with a single pyrenoid in its centre. Young cells had a single chloroplast and the supernumerary chloroplasts were derived by the division of the single chloroplast. Mature cells had more chloroplasts. Ultimately the contents divided into a number of protoplasts each becoming a swarmer (text-figure 13 S-V). The swarmers were pyriform or obovate or somewhat spindle-shaped and biflagellate with a single chloroplast and an anterior eyespot (text-figure 13 W). The chloroplasts of the swarmers did not exhibit a stellate condition and were parietal, sometimes even nearly cup-shaped. These swarmers swam for sometime inside the mother cell wall. They became free finally by escaping through a rupture of the parent wall at the apex. The zoospores settle down on larvae. No sexual fusion was observed.

In a study of the alga collected on 9 July 1940 swarmer formation was observed. The entire contents divided themselves into a number of protoplasts and escaped *en masse*, through a very small circumscissal rupture of the cell enclosed in a thin cytoplasmic membrane (text-figure 13 X). The individual swarmers then began to move and escaped by disentangling from the mass.

The alga in possessing a stellate chloroplast is not a *Characium*. *Characiella* Schmidle, a planktonic genus, has a single stellate chloroplast but the present alga has many stellate chloroplasts. Further one does not know the manner of attachment, if any, in Schmidle's alga nor details of reproduction. A new genus is created here to include this single species, *C. anophelesii* Iyengar et Iyengar.

Characiellopsis Iyengar gen. nov.

Cells clavate elongate, broadly rounded at the apex, narrowing gradually to a rounded base; cells attached by a pad of mucilage. Nucleus single, central. Chloroplasts one in young cells, more up to 4 per cell in mature cells, each with a single pyrenoid. Reproduction by biflagellate swarmers,

swarmers liberated *en masse* enclosed in a thin cytoplasmic membrane, liberation through a small circumscissal rupture at the apex.

Monotypic : *Characiellopsis anophelesii* (Iyengar M.O.P. et M.O.T.)
Iyengar, M. O. P. comb. nov.

(= *Characium anophelesii* Iyengar, M.O.P. et M.O.T., On a *Characium* growing on *Anopheles* larvae, *New Phytol.* 31: 66-69, Fig. 1, 1932).

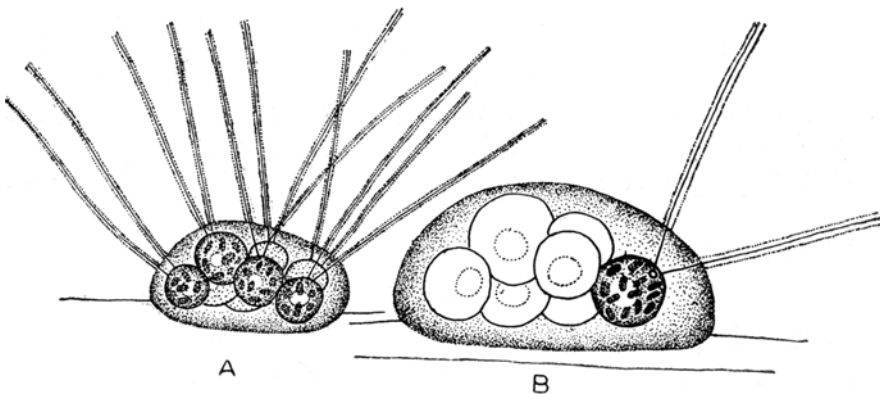
Cellulae clavatae, elongatae, in apice late rotundatae, in basim gradatim decrescentes, per pulvinum mucosum affixae. Nucleus singulus, centralis. Chloroplasti in cellulis juvenibus singuli, in cellulis maturis plures usque quatuor, unusquisque prenoide una instructus. Reproductio zoosporis biflagellatis effecta; zoosporae in membrana cytoplasmica tenui inclusae per foramen circumscissum parvum in apice cellulae liberatae.

Monotypic : *Characiellopsis anophelesii* (Iyengar, M.O.P. et M.O.T.)
comb. nov.

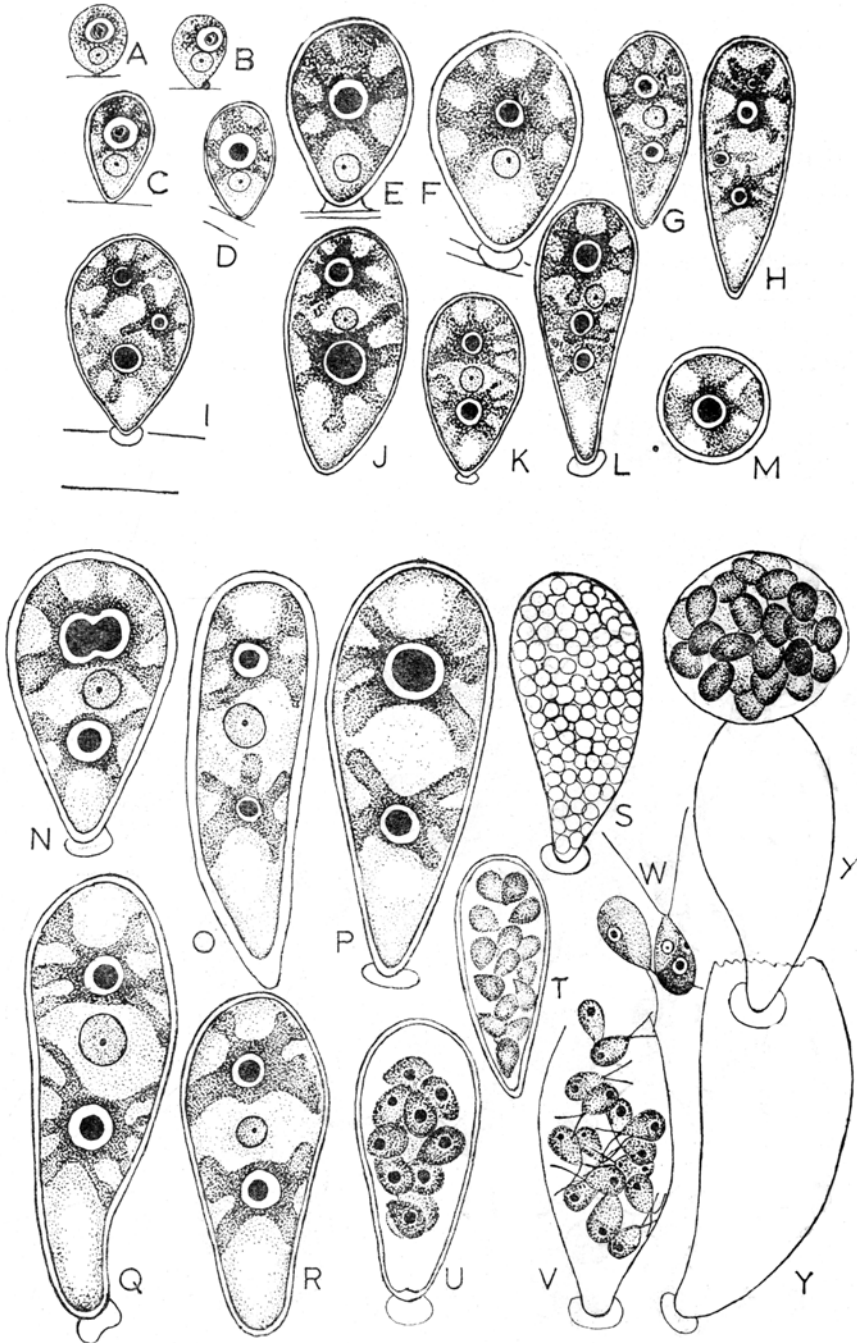
[= *Characium anophelesii* (Iyengar, M.O.P. et M.O.T.), *New Phytol.* 31: 66-69, Fig. 1, Plate III, 1932].

***Gilbertsmithia grandis* gen. et sp. nov.**

This alga was found growing in large numbers in muddy rainwater pools at Nekkundrum, Guindy, and other suburbs of Madras. These pools are formed in pits from which clay was dug out for making bricks. The water in these pools is brown, extremely muddy and soup-like and does not appear to contain any plankton at all, but microscopic examination of plankton net collections showed this alga in large numbers along with other interesting algae.

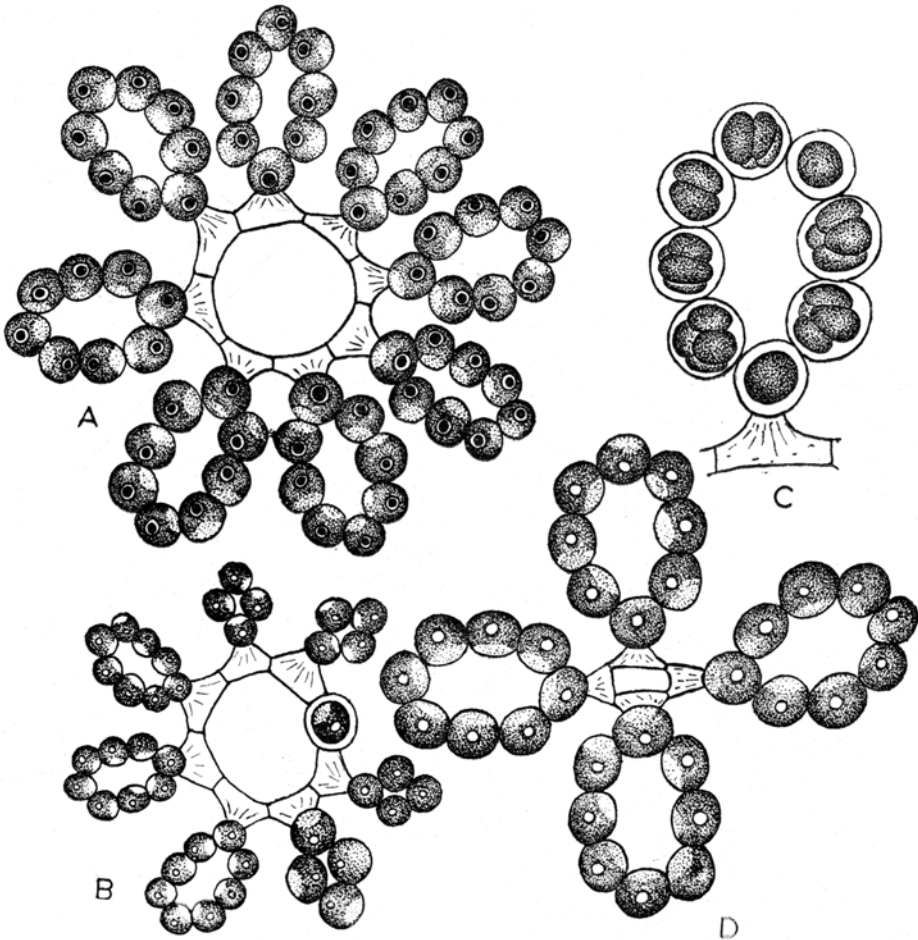


Text-figure 12. *Gloeochaete wittrockiana* Lagerh. (after Iyengar) (A, $\times 540$; B, $\times 750$),



Text-figure 13. *Characiellopsis anophelesii* (Iyengar et Iyengar) Iyengar, M. O. P. comb. nov. A-L, N-R. Different stages of development of the alga and the formation of a number of chloroplasts; M. Cross sectional view of the cell; S-U. Swarmer formation; V, X. Methods of liberation of swarmer cells; W, Swarmer; Y. An empty cell after the liberation of the swarmer. (all after Iyengar, M. O. P. Orig.) (all, $\times 900$).

The present alga forms a colony (coenobium) of 4 or 8 cells attached laterally to one another to form a circular or oval or ellipsoid rosary-like colonies. The cells of the alga have a firm wall. Each cell is round and has a chlorococcoid structure, with a single chloroplast in which is embedded a single pyrenoid at the thicker portion of the chloroplast and a single small nucleus. Individual cells of the colony do not show a particularly noticeable envelope, but when mounted in India ink the colonies are seen embedded in a mucilaginous matrix. This mucilage is evidently helpful in the flotation of the alga in the water. Reproduction takes place in the alga by the contents of each cell dividing to form 4 or 8 daughter protoplasts, inside the mother wall and the daughter protoplasts surrounding themselves each with a



Text-figure 14. *Gilbertsmithia grandis* Iyengar gen. et sp. nov. (all after Iyengar) (all, $\times 830$).

membrane of its own inside the mother wall (text-figure 14 C). The tiny cluster of young daughter cells emerge outside through a small slit-like rupture formed in the mother wall. The cluster of young daughter cells when inside the mother wall become attached to one another in the form of a circular ring.

The empty mother walls lose their old round shape and become angular. They do not become gelatinized but become larger and prominent and remain attached to each other very firmly. Very soon the second and third generation of daughter colonies are formed and thus compound colonies of several generations of cells are formed in this alga. The tiny rosary-like daughter colonies after emerging from the mother walls remain attached at the outside of the ruptured slit (text-figure 14 B-D).

The alga comes near *Westella botryoides* in cells being chlorococcoid in the colony being arranged in one plane. In *W. botryoides* the daughter cells remain grouped together in fours or eights and the mother is ruptured irregularly into thread-like structures which held the daughter cells together. In the present alga the daughter colonies are formed inside the mother cell wall and emerge outside through a slit-like rupture formed in it and remain attached to the mother cell walls of the parent colony at the ruptured opening. The old mother cell walls of the parent colony remain attached firmly to one another laterally to form a ring-like structure. The rosary-like condition of the colony is not seen in *Westella*. In the latter colony the cells merely remain grouped together into 4, 8 or 2 and are held together by the irregularly ruptured mother cell wall. They are not firmly attached to one another. The new genus is being named *Gilbertsmithia* in honor of the great algologist, the late Prof. Gilbert Morgan Smith.

Gilbertsmithia grandis Iyengar gen. et sp. nov.

Coenobia circular or oval rosary, mostly 8 celled, or frequently 4 celled, planktonic, solitary or in compound colonies, enclosed in a loose gelatinous matrix; 8 celled colonies up to $30 \times 22 \mu\text{m}$, 4 celled colonies up to $18 \times 12 \mu\text{m}$. Cells firmly attached, attachment lateral, globose; each cell with a nucleus, a single chlorococcoid chloroplast with a single pyrenoid; mature cells $7-10 \mu\text{m}$ in diam., when young $4-5 \mu\text{m}$ in diam. Reproduction by the formation of a daughter coenobium in each cell; daughter colonies 8 or 4 celled; cells of the daughter colonies remaining in a ring, cells laterally attached with each other; old empty mother walls appearing thick, firmly attached in the form of a ring, wall of each cell finally appearing rectangular with a ruptured conical side.

Habitat : In muddy water pools at Nekkundrum, Madras (22 September, 1953); also at Guindy (17, 19 September, 1951), near Madras.

Type : Text-figure 14.

Coenobia circularia vel ovalia, plerumque 8-cellularia, saepe 4-cellularia, planctonica, solitaria vel in colonias compositas intra matricem gelatinosam laxam inclusas aggregata. *Coenobia* 8-cellularia usque $30 \times 22 \mu\text{m}$, 4-cellularia usque $18 \times 12 \mu\text{m}$. Cellulae firme adhaerentes, juncturis lateralibus, globosae, unusquaque uno nucleo et uno chloroplasto chlorococcoidal pyrenoide singula munito instructa. Cellulae maturae $7-10 \mu\text{m}$ diam, juvenes $4-5 \mu\text{m}$ diam. Reproductio per formationem coenobii filialis in omni cellula effecta; coenobia filialia 8-vel 4-cellularia. Cellulae coenobiorum filialium in annulo manentes, lateraliter affixae. *Coenobia* filialia evacuatorum pariete cellulae rupto liberata. Parietes senes cellularum matronalium evacuatorum apparenter crassi, firme affixi ad instar annuli, omnis paries postremo rectangularis cum latere conico rupto.

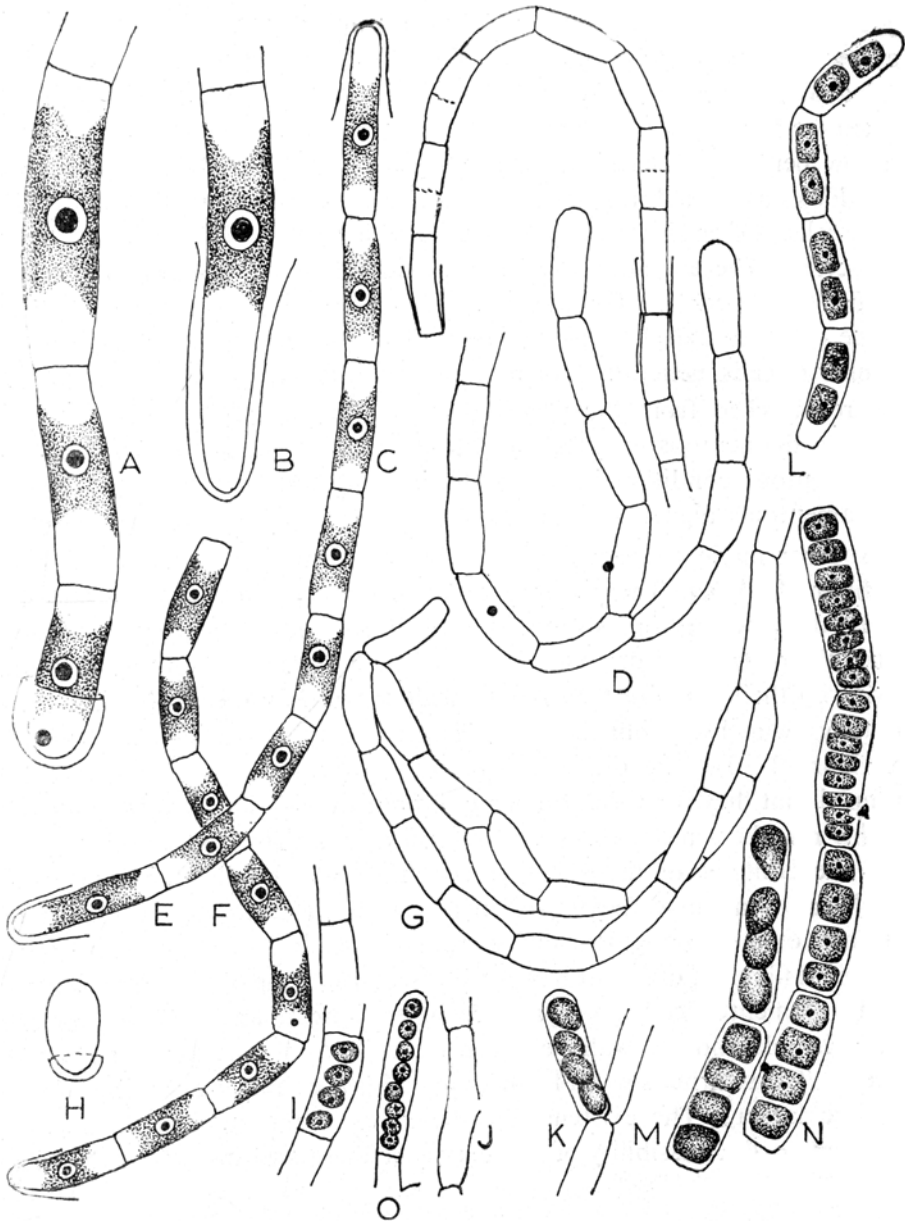
Habitat : In stagnis limosis ad Nekkundrum, Madras (22 September 1953). vel ad Guindy, Madras (17, 19 September 1951).

Typus : Text-figure 14.

***Ulotrichella fenestrata* Iyengar gen. et sp. nov.**

This alga was found in the plankton of some muddy rain water puddles of 1 to 2 feet depth at Nekkundrum, near Madras.

This alga was collected as small lengths of an apparently filamentous alga floating loosely in the water. The cells of the alga were fairly long up to about 2-5 times as long as the body. Each length of the filaments contained generally up to about 4 to 20 or more cells, and the filaments often have small loops of 4, 8 or 16 or more cells, often branched once or so. The cells were cylindrical elongate and attached end to end forming filaments. The cells are $5.3-8.8 \mu\text{m}$ broad and 2-4 or more times as long ($15.9-26.5$ and up to $39 \mu\text{m}$ long). It has a parietal chloroplast with a pyrenoid in the centre of the cell with a vacuole at either end of the cell. The chloroplast is fairly bright green. The end of the filament is narrowed. The way in which the filament grows is as follows. A protoplast divides into daughter protoplasts in the middle and then it elongates and a row of cells with 2 daughter cells in each is formed, and then finally each of these protoplasts divides in the same manner so that a row of 2, 4 or 8 cells are formed inside the mother cell. The protoplasts grow still further and each of these protoplasts surrounds itself with a membrane and a row of 2, 4 or 8 cells is formed



Text-figure 15. *Ulotrichella fenestrata* Iyengar gen. et sp. nov. I, J, K, O. Swarmer formation. (all after Iyengar). (A, B, $\times 1,500$; C-L, Q, $\times 700$; M, N, $\times 940$).

inside the old mother wall (text-figure 15 L-M). When these daughter cells grow further the original mother wall or membrane becomes gelatinized and disappears completely excepting at the end portion, where the vestiges

of the old mother membrane could be seen as enclosing the terminal cells in a row of cells (text-figure 15 E). When we examine a small collection of the alga we find filaments formed of 2, 4 or 8 cells and in a fairly long filament we find rows of 2, 4 or 8 cells. We could distinguish 2, 4, or 8 cells in a row bent at the terminal portion by the vestiges of the membranes so that it looks as though a length of a filament is made up of the products of a single cell. Often single filaments are found in water and one could recognize 8 or 4 cells. There is no case of cell division as in the ordinary filamentous alga like an *Ulothrix*. The alga grows by the division of the contents of a single cell into daughter protoplasts. The contents of a cell divides into a number of cells, generally 2 or multiples of 2, as also 4 or 8 and then these cells are attached from the very beginning, their arrangement end to end forming a filamentous growth. So the mode of formation of this alga and the filamentous condition is its peculiarity and quite different from any of the filamentous algae.

Another mode of reproduction is by the formation of motile swimmers (text-figure 15 I-K). The protoplast of the mother cell divides into 2, 4 or 8 round daughter protoplasts and each of these do not develop the membrane around themselves but develop 4 flagella and a single eyespot and then after growing to their full size they move inside the membrane of the mother cell and they swim away outside the cell after escaping through a small hole (text-figure 15 J). The exact fate of these swimmers is not known. It is presumed that they form the starting point of new individuals. It is suspected that this may be a mode of asexual reproduction. These swimmers swarmed inside the confines of their mother cell and after slightly swimming inside the cell cavity arrange themselves in a row in contact with each other and then each of these daughter cells surrounds itself with a delicate membrane and a small filament of 2, 4 or 8 cells is formed inside the old mother membrane and this filament of cells grows and becomes elongate and distend the mother wall. The old mother wall gelatinizes except at the terminal ends of the filaments. The swimmers when formed in eights are smaller and when formed fewer are larger. The existence of differences in the sizes of the swimmers points out to the possibility of anisogamy if these swimmers were to behave as gametes.

Ulotrichella fenestrata gen. et sp. nov.

Pseudofilamentous, in groups of 2, 4 or commonly eight cells arranged in a single row, cells end to end; cells cylindrical with a parietal chloroplast and a pyrenoid, uninucleate; multiplication by division of a cell to form 8, or 2 or 4 cells, these enlarging and elongating attached in uniseriate condi-

tion and getting freed from the parent wall by rupture and/or dissolution except at the end portions, end portions of parent wall continuing as two caps; swarmer formation with 2, 4 or 8 swarmers per cell, often of varying sizes, remaining attached inside the parent cell and growing into a pseudofilament.

Habitat: Muddy water pools, Madras (11 October 1949; also 12 October 1949).

Type: Text-figure 15.

Pseudofilamentosa. Cellulae binae, quaternae vel plerumque octonae aggregatae, seriatim dispositae. Cellulae cylindricae, unaquaeque chloroplasto parietale pyrenoide uno munito et nucleo uno instructa. Multiplicatio per divisione cellulae in 8, vel 2, 4 ve, cellulas, quae accrescunt et elongant, uniseriatim manentes, et pariete parentali rupto vel, praeter in extremitatibus, dissoluto, liberatae sunt; partes extremae parietis parentalis ad instar galerrum duorum manentes. 2, 4 vel 8 zoosporae, saepe amplitudine dissimiles, in cellula unaquaeque factae, intra cellulam parentalem remanentes et in pseudofilamentum crescentes.

Habitat: In stagnis limosis, Madras (11 October 1949; also 12 October 1949).

Typus: Text-figure 15.

***Ecballocystella planctonica* Iyengar gen. et sp. nov.**

The alga was found in a green scum formed on the surface of a laboratory growth of a collection of *Volvox* after *Volvox* has disappeared. It is found in colonies of 2, 4 or 8 cells, or even as single cells. The cells are somewhat obliquely elliptic pyriform with one end slightly broader and either broadly rounded or broadly pointed (or even somewhat acute). Each cell has a somewhat laminate plate like chloroplast with a single large pyrenoid. There are vacuolar spaces at either end of the cell. The cell wall is thin and firm. There does not appear to be any mucilage around the cells.

The contents of the cell divides into two, four or eight daughter protoplasts each of which surrounds itself with a wall of its own inside the mother wall (text-figure 16 J, Q, U, V). When the daughter cells grow in size, the mother wall ruptures circumcissally across the middle. The daughter cells are attached to each other in an oblique manner in an irregular row, though two daughter cells may frequently remain side by side. The two halves of the empty mother wall remains attached as closely fitting or a somewhat loose cap one at the end of each terminal cell of the row (text-figure 16 D, E,

G, H, I, J). If there are only two cells in the colony each of the two cells has the old mother wall half at each end. In a colony of four cells, the first and the fourth cells have the mother wall halves, and in a colony of eight daughter cells the first and the eighth cell have a cap each. When the cells of the colonies divide and form daughter cells in their turn compound colonies are formed, the number of daughter cells formed by the daughter cells may be two, four or eight irrespective of the number of cells present in the parent colony. These colonies of the second generation may separate or they may remain attached to form compound colonies. Very large compound colonies made up of several generations are often met with. In each of these compound colonies the limits of the colony formed by each parent cell can be clearly made out by the two persistent halves of the mother wall at the distal ends of the two end cells of the colony. The limits of colonies of each generation may be fairly made out through the presence of these remnants of the old mother walls of the previous generation.

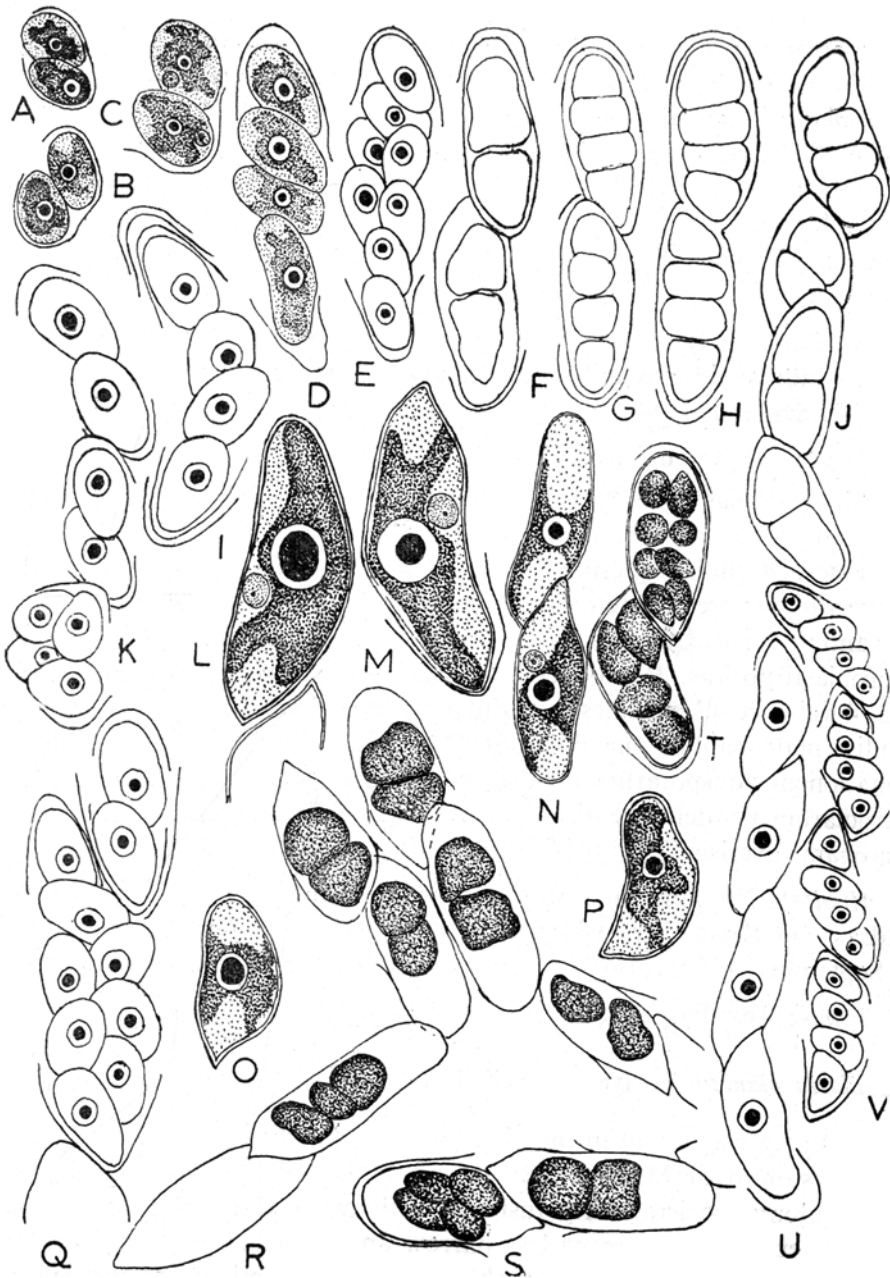
In some cases the terminal end of the mother cell rejuvenates more than once so that at the end of the end cells, a number of rejuvenated cell wall layers are found as is seen in the case of *Ecballocystis* as the latter appears to belong to the Oocystaceae.

This alga does not appear to show any attachment to a substratum but merely remains in the plankton in the muddy water.

Mr. K. R. Ramanathan collected this alga in one of the muddy water pools at Nekkundrum. He observed swarmer formation (text-figure 17; see also 16 M-O). The contents of each cell divided into two protoplasts which became rounded as swarmers (text-figure 17 E). These were quadri-flagellated with a single anterior eyespot (text-figure 17 F). These escaped out by a rupture of the mother cell wall, settled down by their anterior and began forming a new colony. In some cases the cells divided into 2, 4 or 8 swarmers. In all the swarmers a pyrenoid could not be made out. In the case of a cell forming 8 protoplasts these were smaller and ovate suggesting that there may be two types of swarmers, large rounded ones and small ovate ones. The liberation of these smaller ones was not observed and one could not confirm their gametic nature but the probability of a heterogamous condition cannot be ruled out.

Ecballocystella planctonica Iyengar gen. et sp. nov.

Alga forming loose colonies of 2, 4, or 8 cells, the colonies themselves being compound and attached to form smaller groups of cells and breaking



Text-figure 16. *Ecbalocystella planctonica* Iyengar gen. et sp. nov. (all after Iyengar). (F-I, $\times 910$; K, L, $\times 1,525$; U, $\times 740$; rest, $\times 975$).

into smaller units; cells generally elongate, rounded at one end and narrower at the other end and pointed sometimes; chloroplast parietal laminate somewhat lobed, single, with a single pyrenoid; nucleus single on one side of the chloroplast; vegetative reproduction by the division of a single cell into 2, 4, or 8 and the daughter cells remaining attached along their length after the rupture of the mother cell in the middle; reproduction by the formation of quadriflagellated zoospores; zoospores rounded with a single anterior eyespot; escaping by the rupture of the mother cell wall; heterogamous reproduction probably present.

Habitat : In laboratory cultures of muddy water algae from Nekkundrum, Madras (18 September 1949; also 18 September 1949; 9 October 1949; 21 September 1949; also 28 November, 1939, leg. K. R. Ramanathan).

Type : Text-figure 16.

Alga colonias laxas 2, 4 vel 8 cellularum compositas formans; coloniae ipsae compositae, ad catervas minores cellularum affixae, et in partes minores frangentes. Cellulae plerumque elongatae, in extremo uno rotundatae, in altero angustiores, interdum acutae. Chloroplastus parietalis, laminatus, aliquantum lobatus, singulus, pyrenoide uno. Nucleus singulus ad latus chloroplasti positus. Reproductio vegetativa per divisionem cellulae unius in 2, 4 vel 8 cellulas filiales quae inter se secus longitudinem earum affixae, cellulis matronalibus medio ruptis, manent. Reproductio asexualis per formationem zoosporarum quadriflagellatarum rotundatarum, stigmatate uno instructarum, per dehiscientiam cellulae matronalis liberatarum. Reproductio heterogama verisimiliter praesens.

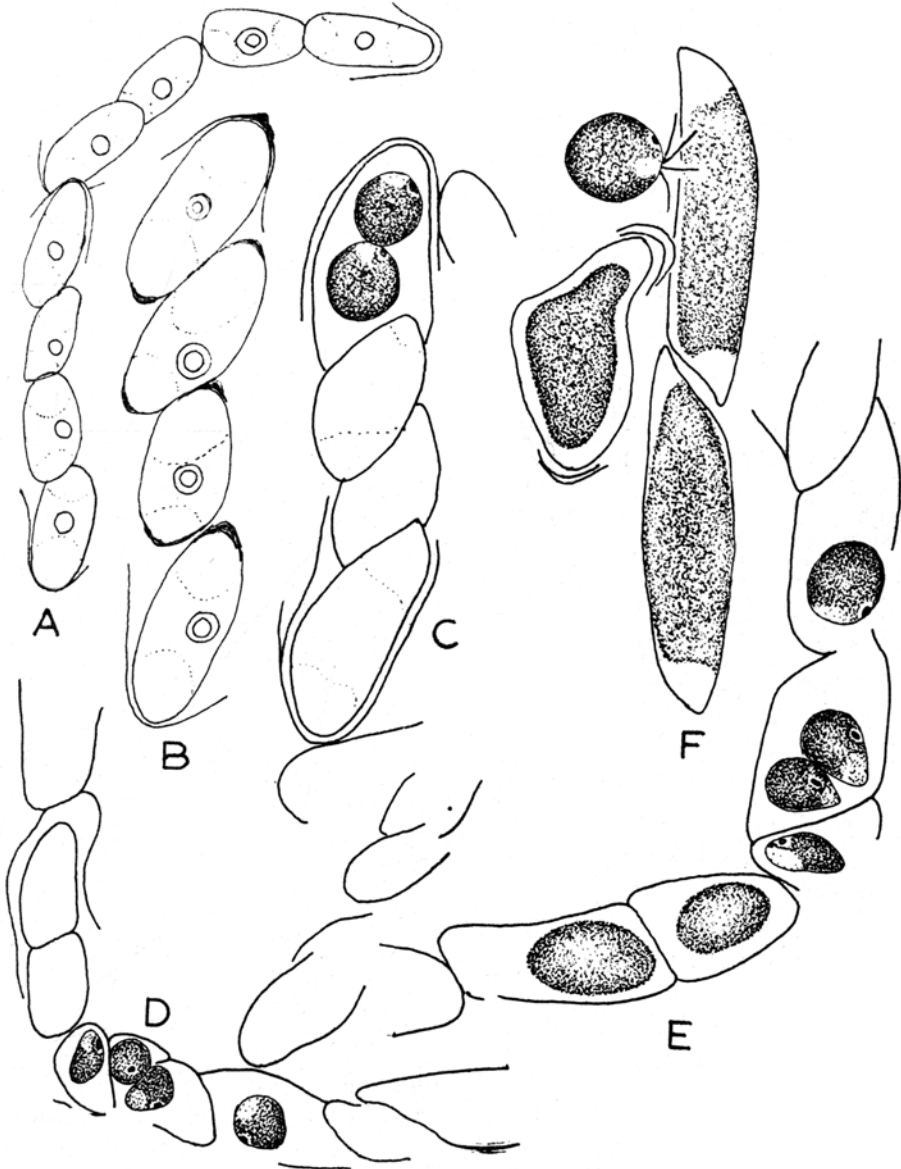
Habitat : In cultis laboratorii algarum ex aquis limosis ad Nekkundrum, Madras (18 September 1949; also 18 September 1949; 9 October 1949; 21 September 1949; also 28 November 1939, leg. K. R. Ramanathan).

Typus : Text-figure 16.

***Reticularia planctonica* Iyengar gen. et sp. nov.**

This alga was found in the plankton of a muddy water pool at Nekkundrum, a suburb of Madras. It forms colonies of 4 or 8 cells. The cells of the colony are irregularly fusiform with one end broadly rounded and the other end being more or less narrow and pointed. The cell contained a parietal laminate band-shaped chloroplast in the middle of the cell with a single pyrenoid in it. Each cell contained a single nucleus in the middle. Cells are 41–43 μm long and 11–12 μm broad. The cells were elongate fusiform with two ends narrowed and slightly bent on one side, the bend

being slightly in opposite directions. If the colony consists of 4 cells, 2 cells are placed side by side along their length in the middle and the other two are formed at each end (text-figure 18 C-D). The cells are arranged in a net-like manner (Text-Fig. 18 A), with two sets of 3 cells each arranged in a



Text-figure 17. *Ecballocystella planctonica* Iyengar. C, D, E. Swarmer formation; F. Quadriflagellate swarmer settling down and developing, (all after K. R. Ramanathan) (B, C, $\times 1,500$; rest, $\times 1,100$).

triangular manner and one cell at the end of each triangular (text-figure 18 E). It has the appearance of a tiny net. The author could not follow how the cells of the alga get arranged in this irregularly yet regular reticulate manner since he could not find any dividing stages of the cells at the time of his collection. It looks as though the contents of each cell divides into 4 or 8 protoplasts and the protoplasts surround themselves with a wall and then arrange themselves in the manner described above. The remnant of the ruptured wall of the mother cell could be seen clearly on one or both the end cells of the four-celled and the 8-celled colonies. It looks as though the contents of the cell divides into 4 or 8 protoplasts and each of the protoplasts surrounds itself with a wall of its own and the cells as they grow larger grow attached to one another in the pattern described already, *i.e.*, in one case one cell at each end of the colony and the remaining two cells in the middle of the colony attached along their length and at one end of the four-celled colony the remnant of the old mother cell could be still seen. In the case of the eight-celled colony the contents of the mother cell appears to divide into eight protoplasts, each protoplast surrounds itself with a wall of its own and the eight daughter cells grow in contact with each other in a geometrical fashion as in text-figure 18 E. The daughter cells remain attached by their end in the characteristic manner and form colonies. No vegetative division was observed in this alga nor any zoospore formation observed, nor structures observed suggesting that zoospore formation may take place in the alga.

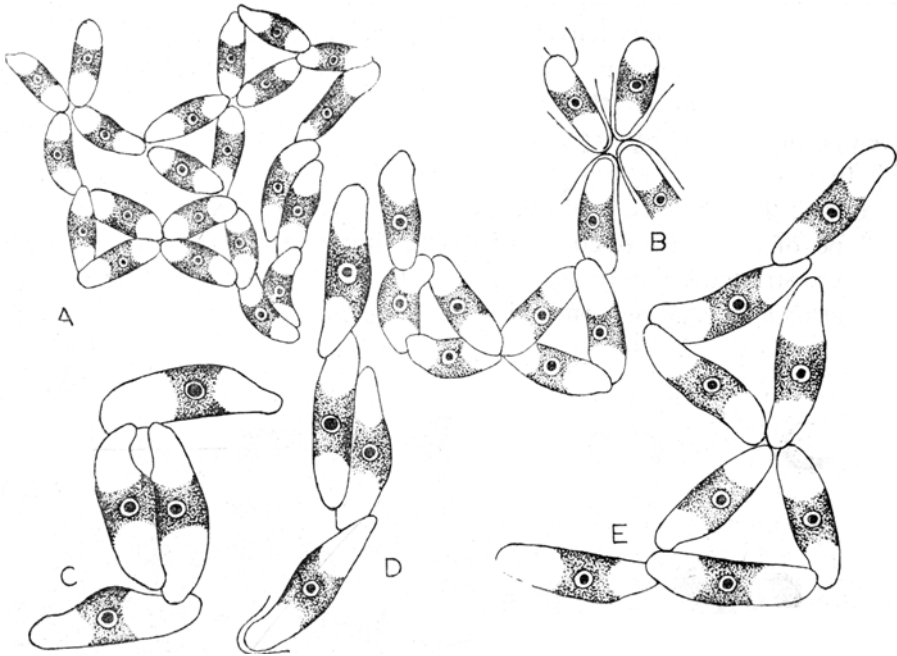
The laminated chloroplast with the pyrenoid forming a sort of median girdle suggests a relationship to the Chlorococcales. The contents of a cell dividing into eight parts and each of the protoplasts surrounding itself with a wall of its own and the cells growing attached inside the mother wall to form a net-like structure suggest a remote resemblance to a *Hydrodictyon*. The resemblance does not go further as no zoospore formation was observed nor their arrangement to form a net. At first the author thought of a reference of the alga to *Hydrodictyon* as a form in which zoospore formation was suppressed. But later he thought that the resemblance is superficial and that the alga must be placed in a new genus.

Reticularia planctonica gen. et sp. nov.

Colonies four or eight celled forming a primitive net-like structure; sometimes forming a large colony with up to 32 cells; each cell with a laminate parietal chloroplast, a single pyrenoid; each cell forming inside 4 or 8 cells which remain united to form a daughter colony; other stages not known, mature cells 11–12 μm broad and 41–43 μm long.

Habitat: Muddy water pool, Nekkundrum, Madras (10 October 1949; also 11 October 1949).

Type: Text-figure 18.



Text-figure 18. *Reticularia planctonica* Iyengar gen. et sp. nov. (after Iyengar, Orig.) (all $\times 570$).

Colonia ex 4 vel 8 cellulis constata; cellulae compagem primitivum ad instar reticuli formantes; aliquando ex usque 32 cellulis constata. Omnis cellula chloroplast parietali laminato et pyrenoide una instructa. Reproductio vegetativa per formationem intra omnem cellulam 4 vel 8 cellularum quae affixae, coloniam filialem formantes, manent; stati alii ignoti. Cellulae maturae 11–12 μm latae, 41–43 μm longae.

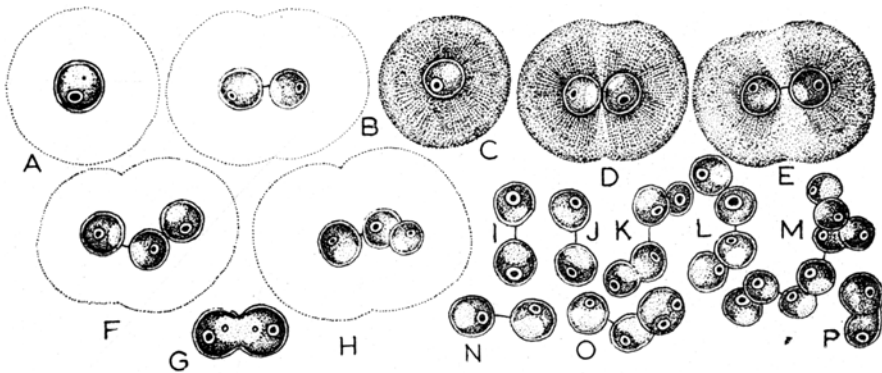
Habitat: In lacuna limosa, Nekkundrum, Madras (10 October 1949; also 11 October 1949).

Typus: Text-Fig. 18.

***Interfilum paradoxum* Chodat et Topali** (Text-figures 19–20)

An alga which resembled *Interfilum* came up in a culture in the laboratory cultures of material from an artificial tank, in Madras. The alga looked

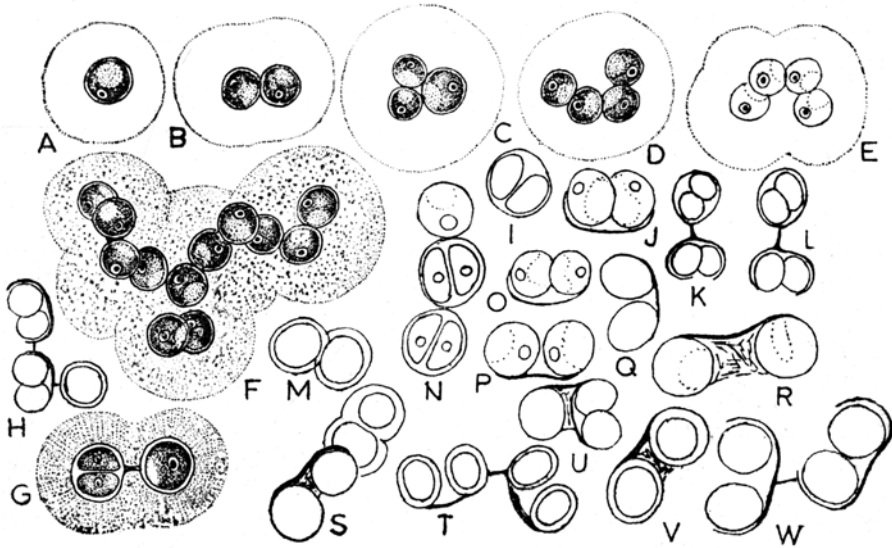
like some green mucilaginous matter and when mounted in India ink showed some extremely small colonies and round cells embedded in mucilage. The colonies consisted of one or two or four cells, sometimes larger with up to 16 cells. The cells were round and chlorococcoid with a thin laminate chloroplast in which is embedded a single pyrenoid. The cells were $4.8-7.8\ \mu\text{m}$ in diam. The mucilage envelope was lobed and followed the contour of the single cells of the colony as in text-figure 19 B F. The cells were connected by a delicate thread-like structure as in text-figure 19 E, F, H. The mucilage envelope in the case of single cells were quite round; in the case of colonies with two cells or more the mucilage envelope was lobed and followed the contour of the single cells of the colony as in text-figure 20 F. The mucilage envelope of each cell when stained with dilute carbol fuschin showed that they were striated strongly (text-figure 19 C-E). The alga showed resemblance to *Interfilum paradoxum* and also to *Radiofilum*.



Text-figure 19. *Interfilum paradoxum* Chodat et Topali. (after Iyengar, Orig., $\times 830$).

A more careful study of the living material showed that the alga was really an extremely reduced filamentous alga belonging to the Ulotrichaceae distinctly related to *Geminella*. The method of division appears to be as follows. Starting with a single cell the protoplast divides transversely across into two. The protoplast divides into two hemispherical daughter protoplasts and then surround themselves each with a wall of its own inside the mother envelope. The hemispherical daughter protoplasts grow larger and become rounded. As the two daughter protoplasts become larger and round the wall of the mother cell becomes ruptured on one side as in text-figure 20 G. The two daughter cells are held together by the ruptured mother wall on one side as in text-figure 20 J, O, P. The two daughter cells are firmly held together and as the old mother wall looks a small narrow strip of membrane to the ends of which the two daughter cells are attached. In

the young condition this small strip looks flat and strap-shaped. This ruptured tiny strap-shaped membrane contracts into a small thread-like structure so that the two celled alga appears like as if connected by a tiny thread-like structure. Each of the two daughter cells may divide again in the same way and a tiny four celled colony is formed as in text-figure 20 H, K, L. The alga at first appears as a unicellular alga embedded in a mucilaginous matrix but a careful examination of its development shows that it is a highly reduced filamentous alga, a filamentous alga reduced to 2 to 12 cells surrounded by mucilage.



Text-figure 20. *Interfilum paradoxum* (after Iyengar, Orig.) (A-G, H, K, L, $\times 750$; rest, $\times 1,200$).

Chodat and Topali say that they have not yet worked out a satisfactory theory to explain the formation of the thread which joins the different cell but a careful study shows that the threads are really tiny flat strap-shaped portions of the original mother wall of the dividing cell.

An alga closely resembling the above alga was also collected in cultures of material from a tank, Lalbhag, Bangalore (7 April 1952) (text-figure 20 R-W). This alga showed various stages in cell division, rupturing of the parent cell wall and formation of colonies in which the daughter cells are connected by portions of the parent wall.

[Fritsch and John (1942) have reported two forms of *Interfilum paradoxum* and the present alga of Iyengar bears a strong resemblance to the stages figured by them. Bourrelly (1966) has given original figures based on fresh

observations made on the type material which became available to him in cultures. The stages seen in the Lalbhag material closely resemble those drawn by Bourrelly. Iyengar's figures of the Lalbhag material shows clearly coccoid affinities and resemble the figures given by Bourrelly (1966). Fritsch and John (1942; see also Ramanathan) expressed a doubt whether *Interfilum* is a true filamentous alga and feel that its correct place may be among the Chlorococcales. Printz (1964) includes the alga under *Radiofilum*. *Interfilum* differs from *Radiofilum* in the mode of filament formation being quite different in the two (see also Fott 1971)—T. V. D.]

Cells in the Lalbhag material were 6–7 μm in diameter and cell division took place in the night.

REFERENCES

- Bourrelly, P., *Les Algues d'eau douce. Initiation à la Systematique* Tome I, Les Algues Vertes, Boubie et cie, Paris, 511 pp. (1966).
- Chodat, R. and Topali, C., Histoire des Algues de la Suisse. *Bull. Soc. Geneve.* 13 (9) 66 et seq. (1922).
- De Toni, J., *Sylloge Algarum omnium hucusque cognitarum. Vol. 1, Syllogé Chlorophycearum Patavii*, 1315 pp. (1889).
- Ettl, H., Einige Bemerkungen zur Systematik der Ordnung Chlorangiales Pascher, in Komarek, & H. Ettl, Algologischen Studien, *Tschech. Akad. Wiss. Prag.* pp. 291–356 (1958).
- Fott, B., *Algenkunde*, 2nd ed. Gustav Fischer Verlag, Jena, 581 pp. (1971).
- Fott, B., Chlorophyceae (Grünalgen), Ordnung: Tetrasporales, in G. Huber-Pestalozzi, *Die Phytoplankton des Süßwassers, Systematik und Biologie*, Teil 6 1–116 (1972) Schweizerbart'sche VerlagsBuchhandlung, Stuttgart.
- Fritsch, F. E. and John, R. P., An ecological and taxonomic study of the Algae of British Soils. II. Consideration of the species observed. *Ann. Bot. (London)* n.s. 6 371–395 (1942).
- Iyengar, M. O. P. and M. O. T., On a *Characium* growing on *Anopheles* larvae. *New Phytol.* 31 66–69 (1932).
- Korschikov, A. A., Studies in the Vacuolatae—I. *Arch. Protistenk.* 78 557–612 (1932).
- Korschikov, A. A., Vyznacnik prishnovodnik vodoroslei ukrainasikoi SSR, Pidkas Protokokovi (Protococcineae). *Ukr. Akad. Nauk, Kiev.* 437 pp. (1953).
- Pascher, A., Zur Kenntnis der Süßwassertetrasporalen I. *Beih. Bot. Central. Abt.* 60 135–156 (1940).
- Printz, H., Die Chaetophorales der Binnengewässer. *Hydrobiologia* 24 1–376 (1964).
- Ramanathan, K. R., *Ulotrichales*. Indian Council of Agricultural Research, New Delhi, (1964).
- Schmidle, W., Algen, insbesondere solche des Plankton aus dem Nyassa-See und seiner Umgebung in Berichte über die botanischen Ergebnisse der Nyassa-See und Kinga-Gebirgs-Expedition der Hermann-und Elise-geb: Heckmann-Wentzel Stiftung. *Bot. Jahrb.* 32 56–88 (1903).
- Silva, P. C. Remarks on algal nomenclature—II. *Taxon* 8 60–64 (1959).
- Stein, F., Der Organismus der Infusionsthierchen—III. Flagellaten. 1 Hälfte, Leipzig,, 154 pp. (1878).