Archiv für Mikrobiologie 42, 322–332 (1962)

From the University Botany Research Laboratory, Madras, India

Euglena Studies from Madras *

By
M. O. P. Iyengar

With 31 Figures in the Text

(Received October 16, 1961)

Professor Dr. E. G. Pringsheim's papers on the *Euglenaceae* have given the author a great impetus to a study of the *Euglena* flora of Madras and its neighbourhood. As a result of these studies, the author was able to complete the following two small studies on this interesting genus.

I. On a new species of Euglena with inner pyrenoids from Madras

Pringsheim (1956, p. 17) has shown that there are three kinds of pyrenoids in the Euglenaceae, viz., 1. naked pyrenoids, 2. double pyrenoids and 3. inner pyrenoids.

Naked pyrenoids are the denser portions in the centre of the chromatophores not visibly engaged in the deposition of paramylon. Though they are not always readily seen, they stain with haematoxylin. These naked pyrenoids are found in *E. deses* and *E. mutabilis*. Double pyrenoids are thickened middle portions of the chromatophores as in the previous case, but are covered on both sides of the thickened central portion with two thin watchglass-shaped sheaths of paramylon. These pyrenoids are found in the *Catilliferae* section of *Euglena*. Inner pyrenoids are found in the majority of the species of *Trachelomonas* and in *Colacium* (Pringsheim 1953). They have been observed only once in *Euglena*, viz., in *E. mucifera* by Mainx (1926, p. 157). In *Trachelomonas* and *Colacium*, the inner pyrenoids protrude from the centre of the concave surface of the chromatophores towards the middle of the cell. The paramylon covering them is a cap- or thimble-shaped structure consisting of one piece. It is far different from the inner pyrenoid described by Mainx in his *E. mucifera*. The chromatophores in *E. mucifera* are short ribbons arranged spirally beneath the surface of the cell. And each chromatophore has a spherical pyrenoid which is situated on the inner face of the chromatophore on a neck-like stalk directed towards the centre of the cell. The pyrenoid is covered with a layer of paramylon composed of two hemispherical halves. Thus the pyrenoids of *E. mucifera*, though they are in a way inner pyrenoids, are quite different in structure from those of *Trachelomonas* and *Colacium*, where the paramylon is a cap- or thimble-shaped

* The author has very great pleasure in dedicating this paper in honour of the 80th birthday of Professor Dr. E. G. Pringsheim, the great doyen algologist, who has contributed so vastly to our knowledge of Algae and allied subjects. The author drays that Professor Dr. Pringsheim may be spared many many more years of happy active life to continue his most valuable researches.

structure which is made up of a single piece and is not a double structure made up of two hemispherical pieces. PRINGSHEIM states that the whole chromatophore system in *E. mucifera* is different from anything that he has seen.

The author came across a new species of *Euglena* showing inner pyrenoids in a temporary rain water pool at Madras on 30th July, 1957. A brief account of it is given here below:

The alga is 22—26 μ broad and 58—90 μ long. It is broadly fusiform while swimming and often elongate-cylindrical. It is slightly narrowed and broadly rounded towards the anterior end, and gradually narrowed towards the posterior end to a point. It is also often broadened towards the posterior end. The periplast is striated. The flagellum is $1^1/_4$—$1^1/_2$ times as long as the body. The eye-spot is bright red, roundish-oval and 4.5 × 6 μ in size. Neutral-red bodies are very small and fusiform and are arranged in a steep spiral between the chromatophore bands. The nucleus is round and about 15 μ in diameter, and is slightly posterior or a little towards the middle. The alga is slightly reddish owing to the presence of a small amount of haematochrome granules. The paramylon grains measure 6 × 8 μ and are oval to oblong and solid with a depression in the middle and are seen especially crowded in the front portion of the cell. The chromatophores are band-shaped and run spirally left over right near the surface of the cell (Figs. 1, 27, 28, 31). The chromatophore bands often appear to unite with the adjacent chromatophores here and there. The space between the chromatophore bands is about 1.5 μ. Each band-shaped chromatophore has on its inner surface a pyrenoid which projects inside the cell. The pyrenoid is round to slightly ovoid in surface view (Figs. 1, 2, 8 and 31) and round to oblong-ellipsoid in side view (Figs. 3—7, 28 and 30). It is covered by a cap-like or thimble-like thin sheath of paramylon as in *Colacium* and most species of *Trachelomonas*.

The pyrenoids are more crowded in the posterior portion of the cell than in the anterior portion. The number of pyrenoids in the cell generally varies from 30—60. This *Euglena* resembles *E. mucifera* (MAINX 1926, p. 157) in having numerous spirally running band-shaped chromatophores near the surface of the cell and also in possessing inner pyrenoids. But the inner pyrenoids of the present *Euglena* differ from those of *E. mucifera* in having a single cap-like or thimble-shaped paramylon sheath on its inner side as in *Colacium* and many species of *Trachelomonas*, unlike in *E. mucifera*, where the pyrenoid is attached to the chromatophore by a neck-like stalk and its paramylon is a double-sheathed structure and consists of two pieces.

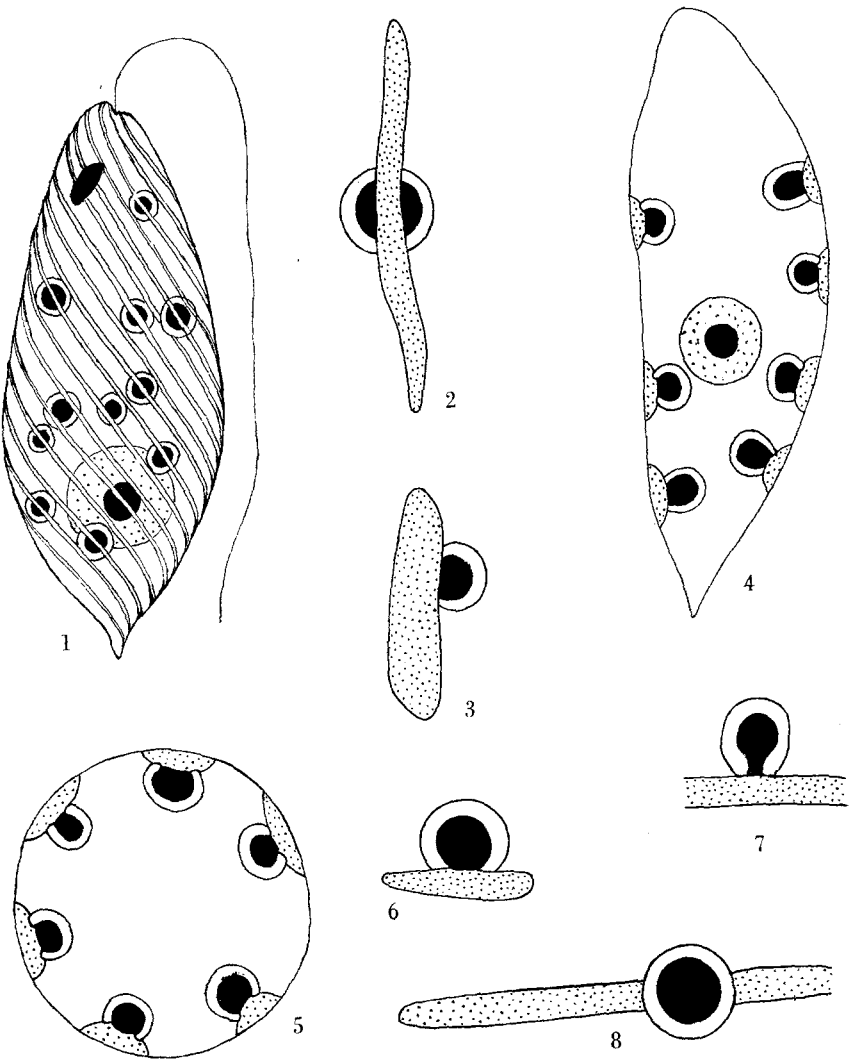
The inner pyrenoids of the present *Euglena* is therefore quite different from those of *E. mucifera* and, in fact, from those of any other species of *Euglena*. The present *Euglena* is clearly a new species. I have very great pleasure in naming this new species after Professor Dr. E. G. PRINGSHEIM and calling it *Euglena pringsheimii* sp. nov.

Description

Euglena pringsheimii sp. nov.

Body slightly metabolic, fusiform while swimming, broadly ellipsoid to cylindrical or pyriform. Anterior end attenuated and broadly rounded; posterior end tapering to a point. Cells 22—26 μ broad and 58—90 μ long. Pellicle finely striated spirally. Eye-spot bright red, oval; 4.5 × 6 μ in size. Colour of the alga green; often very slightly reddish through the

presence of a small quantity of haematochrome granules. Neutral red bodies numerous, spindle-shaped, and arranged in spiral rows between the chromatophore bands. Chromatophores band-shaped, numerous and arranged spirally. Chromatophore bands often connected laterally with the adjacent ones here and there. Each chromatophore having an



Figs. 1–8. *Euglena pringsheimii* sp. nov. Fig. 1: A motile individual. Fig. 2: Pyrenoid on a chromatophore band (surface view from above). Figs. 3, 6 and 7: Pyrenoids on chromatophore bands (side view). Fig. 4: Median optical section of an individual showing the pyrenoids attached to the chromatophore bands (side view). Fig. 5: Cross section of an individual showing the pyrenoids attached to the chromatophores (side view). Fig. 8: Pyrenoid on a chromatophore band (view from below). Figs. 1, 4 and 5 ×1000. Figs. 2, 3, 6 and 7 ×1500. Fig. 8 ×2000

inner pyrenoid with a cap-like or thimble-like paramylon sheath consisting of a single piece as in *Colacium* and many species of *Trachelomonas*. Pyrenoids about 3.5—5 μ in diameter and round to slightly ovoid in surface view and round to oblong-ellipsoid in side view. Pyrenoids numerous, about 30—60 in number and generally more crowded in the posterior portion of the cell. Nucleus round, about 15 μ in diameter, posterior or a little below the middle. Flagellum $1^1/_4$—$1^1/_2$ times as long as the body. Paramylon about 6×8 μ in size, oval to rounded oblong and solid with a slight depression in the middle. Cells becoming rounded and secreting plenty of mucilage; rounded cells 32—35 μ in diameter. Cells dividing in encysted condition.

Habitat: In a temporary rain water pool in Nungambakkam, at Madras, India, dated 30.7.1957. Type deposited in the author's herbarium.

Euglena pringsheimii spec. nov.

Corpus paulisper metabolicum, fusiforme cum natans, late ellipsoideum vel cylindricum vel pyriforme, apice anteriore attenuato et late rotundato, posteriore vero fastigato in punctum. Cellulae 22—26 μ latae, 58—90 μ longae. Pellicula pulchre striata spiraliter. Macula ocularis nitenter rubra, ovalis, 4.5×6 μ. Color algae viridis; saepe rubens ob praesentiam quantitatis parvae granulorum haematochromaticorum. Corpora neutralia rubra plurima, fusiformia, et disposita in ordines spirales inter zonas chromatophori. Chromatophori zonales, plurimi, spiraliter dispositi; chromatophori zonae saepe lateraliter aliae aliis conjunctae. Singuli chromatophori pyrenoideo interiore ornati vagina pilei simili paramyli constante ex unica particula ut in *Colacio* et in pluribus speciebus *Trachelomonae*. Pyrenoidea ca. 3.5—5 μ diam., rotunda vel tenuiter ovoidea aspectu superficiali, et rotunda vel oblongo-ellipsoidea aspectu laterali, plurima, numero ca. 30—60 et vulgo arctius aggregata in parte posteriore cellulae. Nucleus rotundus et ca. 15 μ diam., posterior vel paulum infra medium. Flagellum $1^1/_4$—$1^1/_2$ -plo. longius corpore. Paramylum 6×8 μ, ovale vel rotundo-oblongum et solidum, depressione tenui in medio. Cellulae evadentes rotundae et emittentes mucilaginem abundantem, cellulae 32—35 μ diam., dividentes in conditione encystica.

Habitat: in cisterna aquae pluvialis ad Nungambakkam, prope Madras, in India, 30. 7. 1957. Typus positus in auctoris collectione.

Summary

Three kinds of pyrenoids are known in the Euglenaceae, viz., (1) naked pyrenoids, (2) double pyrenoids, and (3) inner pyrenoids. Only naked pyrenoids and double pyrenoids are known in *Euglena*. Inner pyrenoids are known in *Colacium* and in most species of *Trachelomonas*, but have not been so far recorded in *Euglena*.

In 1926, a new kind of pyrenoid was described by MAINX in his *Euglena mucifera*. This pyrenoid, though it is in a way an inner pyrenoid, is quite different in structure from the inner pyrenoids of *Colacium* and *Trachelomonas*, and so, cannot be considered as a true inner pyrenoid.

The author came across a new species of *Euglena* in Madras, which possesses true inner pyrenoids quite similar to those of *Colacium* and *Trachelomonas*. A full account of this new species and its inner pyrenoids is given in the paper. This is the first record of true inner pyrenoids in the genus *Euglena*. This new species has been named *Euglena pringsheimii* sp. nov. in honour of Professor Dr. E. G. PRINGSHEIM.

II. Euglena oblonga Schmitz, a long misunderstood alga

There is a good deal of confusion regarding the structure of *E. oblonga* Schmitz. The author was not able to see SCHMITZ's original paper where he has described and figured his *E. oblonga*. But GOJDICS (1953, p. 65) has given SCHMITZ's idea of the chloroplast-pyrenoid pattern in *E. oblonga* as follows: "SCHMITZ (1884): 15—25 elongate slender bands, arranged spirally running with the striae, each with a small disc-shaped pyrenoid in the centre." This description of *E. oblonga* is not quite clear. It is not easy to understand small disc-shaped pyrenoids being in elongate slender chromatophore bands. Even in SCHMITZ's figure of *E. oblonga* which is reproduced by LEMMERMANN (1913, Fig. 184), no pyrenoids are seen in any of the slender bands of the alga. A number of ellipsoid pyrenoids are no doubt shown in this figure, below the chromatophore layer, but without any connection whatever with the chromatophore bands. They are lying loose below the chromatophore layer.

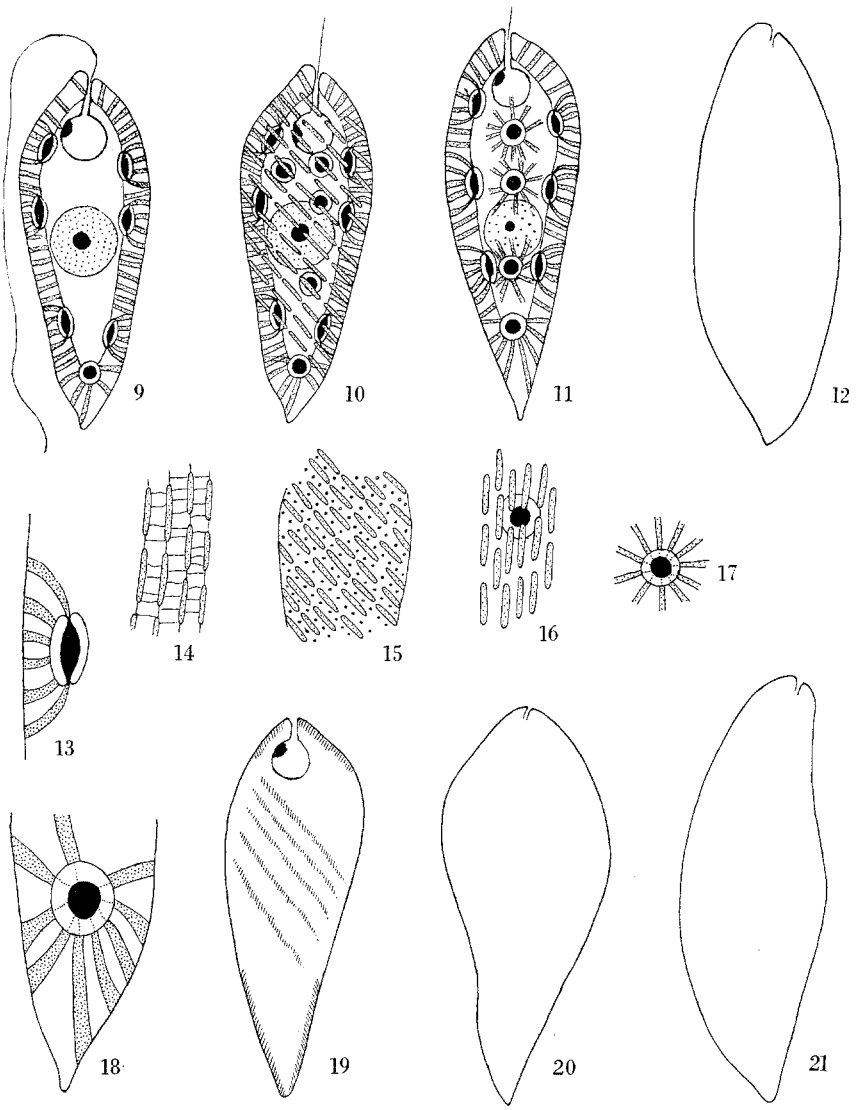
LEMMERMANN (1913, p. 127) describes the chromatophores of *E. oblonga* as "Chromatophoren zahlreich sternförmig. Pyrenoide beschalt". But in SCHMITZ's figure which he reproduces to illustrate his description of *E. oblonga*, the chromatophores are not stellate but band-shaped; and the pyrenoids are not "beschalt", but are merely homogeneous structures without any paramylon sheaths. And he shows these pyrenoids as lying loose below the chromatophore layer without any connection whatever with the chromatophore bands.

SKUJA (1948, p. 186, Pl. 21, Figs. 16—19) does not describe the chromatophores as stellate as LEMMERMANN has done, but describes the chromatophores as being numerous, and short and band-shaped and as lying in a peripheral layer of about 7 μ in thickness. And he describes these chromatophore bands as being oriented in two directions, 1. radially from the centre of the cell and 2. spirally under the surface of the cell. He also says that there are 10—20 double sheathed pyrenoids below the chromatophore layer, and states that each of these pyrenoids is very probably the real starting point of many chromatophore bands. He also states that the pyrenoids, however, are not always well developed and are not easily observable. Often you miss the paramylon shell, and the cell interior is so full of numerous paramylon granules that the pyrenoids are not at all distinguished.

CHU (1947, p. 104) states that *E. oblonga* SCHMITZ is nothing but *E. sanguinea* Ehrenb.

GOJDICS (1953, pp. 64 and 65) follows SKUJA's account of *E. oblonga* (1948). She states "Chromatophores; numerous short bands running in two directions, 1. parallel with the pellicular striae, and 2. radially on the long axis, streaming from the centre of the cell. These are in a parietal layer 7 μ thick. Pyrenoids 10—25, doubly sheathed, under the chromatophore layer, probably each a point of radiation for the chromatophores". She reproduces SKUJA's figure of *E. oblonga* in her book.

PRINGSHEIM (1956) was not able to find *E. oblonga* and so did not give a detailed treatment of *E. oblonga* in his account of the *E. sanguinea* group. He, however, thinks that *E. oblonga* is a species of the *E. sanguinea* group (PRINGSHEIM 1956, p. 136).



Figs. 9–21. *Euglena oblonga* Schmitz em. Iyengar. Fig. 9: Median optical longitudinal section showing the radially running chromatophore bands at the sides, the nucleus, the reservoir, the eye-spot and the flagellum. Fig. 10: The same specimen showing both the radially running chromatophore bands seen at median optical section and the spirally running chromatophore bands seen near the upper surface of the cell. In this figure, in addition to the pyrenoids seen at the sides of the cell, the pyrenoids seen near the upper surface of the cell are also shown. Fig. 11: Specimen showing in addition to the chromatophores seen at the two sides of the cell, some stellate chromatophores near the upper surface of the cell also. Figs. 12, 20 and 21: Specimens showing variations in shape of the cell. Fig. 13: A single stellate chromatophore in side view. Fig. 14: Longitudinally running chromatophore bands connected laterally by delicate strands of cytoplasm. Fig. 15: Neutral red bodies in surface view seen as rows of round dots between the spirally running chromatophore bands. Fig. 16: A pyrenoid seen just below the spirally running chromatophore bands. Fig. 17: A stellate chromatophore seen in surface view. Fig. 18: A stellate chromatophore at the posterior end of a cell much enlarged. Fig. 19: A cell showing spiral rows of spindle-shaped neutral red bodies. Figs. 9–12, 15 and 19–21 ×1000, Figs. 13 and 18 ×2000. Figs. 14, 16 and 17 ×1500

The author came across an *Euglena* in a temporary rain water pool in the sands of the Madras Beach.

The chromatophores of this *Euglena* appeared to be band-shaped and at first sight running in two directions, 1. radially and 2. spirally as described by SKUJA (1948). The author also found double pyrenoids lying immediately below the chromatophore layer. On account of these two main features, he identified the alga as *E. oblonga* Schmitz. Since there is so much uncertainty about this *Euglena*, the author made an intensive study of it to understand clearly its structure in full detail.

Not much detail could be observed regarding the chromatophores and the pyrenoids of this alga in the living specimens and in the living specimens starved in the laboratory for a few days, and also in material killed in dilute iodine and preserved in 4% formalin. The alga was therefore fixed in Schaudinn's fluid, stained in iron-alum haematoxylin and mounted in Canada balsam. These stained preparations proved very satisfactory and showed very clearly all the inner structures of the alga. In these stained preparations, the interfering effect of the paramylon grains is completely eliminated and the chromatophores, the pyrenoids, the nucleus and the other inner structures are very clearly seen. From these stained preparations the following points were observed in the present alga.

The chromatophores were really stellate with a double sheathed pyrenoid in the centre and a number of distinct arms radiating from it. These stellate chromatophores were parietal in position and were somewhat evenly distributed peripherally around a central space of the cell. The number of radiating arms were about 10—12, and the number of chromatophores were 16—24. Pyrenoids in surface view were round and 3—3.5 μ in diameter and in side view elliptic and about 2 μ thick (Figs. 9—11, 13 and 18). Each pyrenoid is covered by a double paramylon sheath. The stellate chromatophores are saucer-shaped with the concave side directed outward towards the surface of the cell (Figs. 9—11, 13 and 29). The saucer-shaped chromatophore in side view with the double pyrenoid in the centre and the radiating arms round it appears like the arched legs of a spider with its body raised in the centre, the body of the spider representing the double pyrenoid in the centre and the arched legs, the arms of the chromatophore radiating from it. The paramylon grains are very short, oblong-ellipsoid and $3—4 \times 4.5—6$ μ in size. The nucleus is round and about 13.5—15 μ in diameter and is situated near the centre or a little below the centre (Figs. 22—24 and 29). Neutral red bodies are found in plenty. They are spindle-shaped and 0.3—0.4 μ thick and 3 μ long. They are arranged spirally near the periphery between the chromatophore bands (Fig. 19). In surface view they look like small round bodies between the chromatophore bands (Fig. 15). The spirally running chromatophore bands are connected by delicate protoplasmic strands between them (Fig. 14). The alga generally becomes rounded and secretes a thin membrane round itself. It undergoes division into two in this rounded condition. The alga produces a large quantity of mucilage and lies embedded in it during a greater portion of the day.

Thus the alga shows a close resemblance to *E. sanguinea* Ehrenberg in the structure and arrangement of its chromatophores and pyrenoids as described by CHU (1947), but it differs from it in being smaller in dimensions and in being completely green and not at all red. The chromatophore arms of *E. oblonga* appear to be much shorter than those of *E. sanguinea*. It shows a certain amount of resemblance to *E. magnifica* Pringsheim (1956, p. 97) also in being completely green, but it is much

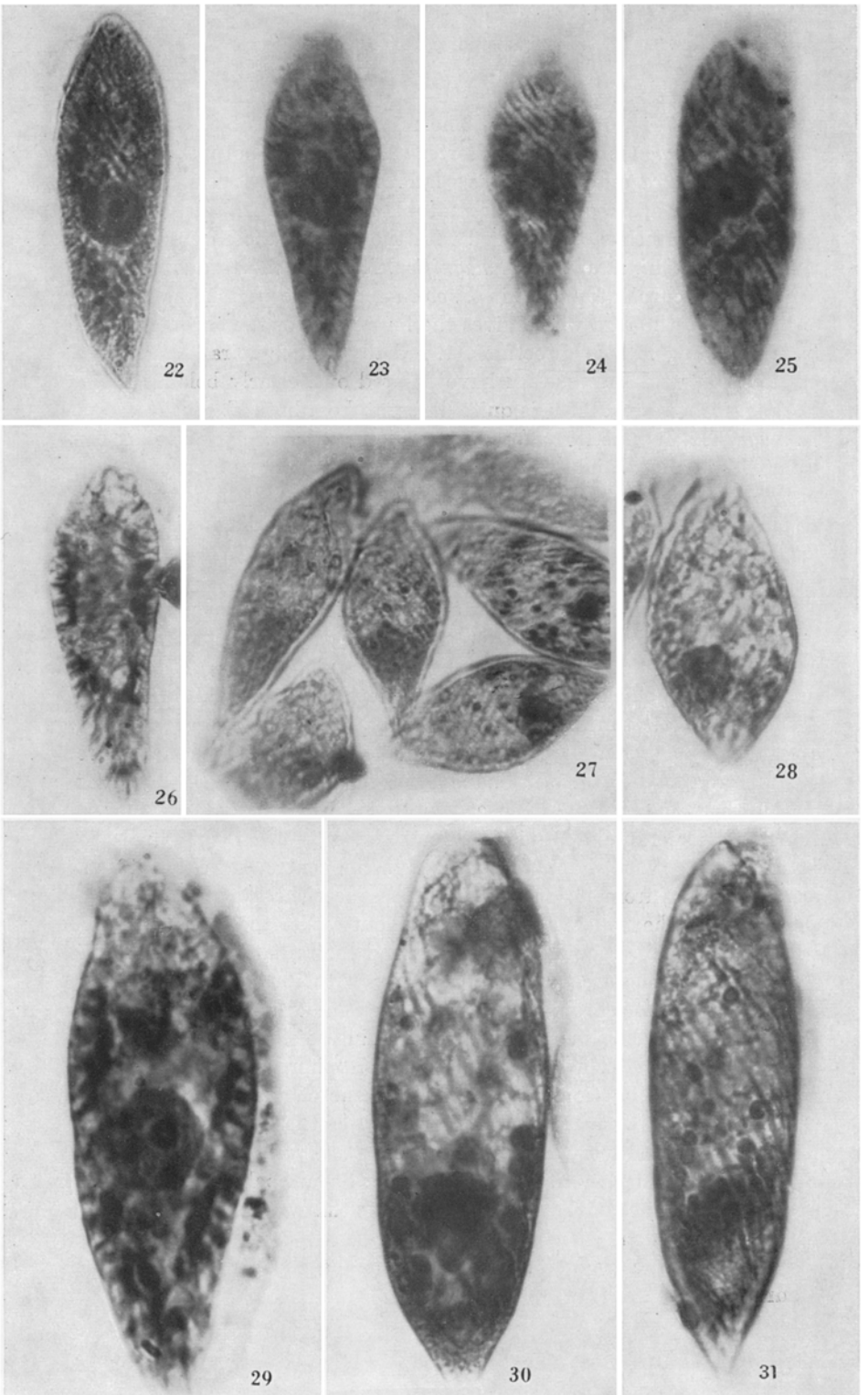
smaller in size. *E. magnifica* is 90—120×25—35 μ in size, whereas *E. oblonga* is 70—80×16—32 μ. The radiating arms of the chromatophores of *E. oblonga* are much shorter than those of both *E. sanguinea* and *E. magnifica* and, so, the two lateral peripheral layers containing the radiating arms of the chromatophores are much narrower and appear to be much more crowded with the arms of the chromatophores than in *E. sanguinea* and in *E. magnifica*. It is this shorter length of the arms of the chromatophores in *E. oblonga* and the peripheral layer on either side of the alga which gives the impression of the chromatophore bands running in two directions, 1. radially and 2. spirally. The alga, both as CHU and PRINGSHEIM have pointed out, clearly belongs to the *E. sanguinea* group. But it is quite different from both *E. sanguinea* and *E. magnifica*. It must therefore be considered as a species quite distinct from *E. sanguinea* and *E. magnifica*. The new points observed in the present alga necessitates a complete revision of the existing diagnosis of *E. oblonga*. The author therefore gives an emended diagnosis of *E. oblonga* here below:

Description

Euglena oblonga Schmitz, emend. M. O. P. Iyengar

Cells metabolic, 16—32 μ broad, 70—85 μ long, fusiform, front end narrowed and broadly rounded; posterior end drawn out to a narrow point. Pellicle strongly spirally striated. Stigma oval, bright red. Flagellum 1—$1^1/_2$ times as long as the body. Nucleus more or less round, about 13.5—15 μ in diameter, central or a little below the centre. Neutral red bodies, spindle-shaped, 0.3—0.4 μ thick and 3 μ long, spirally arranged between the chromatophore bands. Paramylon very short, oblong ellipsoid, 3—4.5 μ broad and 4.5—6 μ long. Chromatophores stellate with a double pyrenoid in the centre and about 10—12 arms radiating from it; chromatophores saucer-shaped or deeply cup-shaped with the concave side directed outwards, the chromatophore with the double pyrenoid in the centre and the radiating arms round it appearing like the arched legs of a spider with its body raised in the centre. Number of chromatophores 18—25. The arms of the chromatophores after reaching the periphery continuing as elongated bands along the surface of the cell, so that the chromatophore bands appear as if running in two directions, 1. radially from the centre of the cell to the periphery and 2. spirally along the surface of the cell. The chromatophores resembling very closely those of *E. sanguinea* Ehrenberg and *E. magnifica* Pringsheim. Alga quite green; haematochrome completely absent; appearance of the cell streaky. Cysts thin walled; cell division in encysted condition.

Habitat: In a rain water pool in the beach sand at Triplicane, Madras, India.



Figs. 22—31

Euglena oblonga Schmitz, emend. M. O. P. Iyengar

Cellulae metabolicae, 16—32 μ latae, 70—85 μ longae, fusiformes, angustatae et late rotundatae ad anteriorem apicem, fastigatae in punctum angustum ad posteriorem. Pellicula fortiter spiraliter striata; stigma ovale nitenter rubrum; flagellum aeque longum ac corpus vel sesquilongum. Nucleus plus minusve rotundus, ca. 13.5—15 μ diam., in medio vel paulisper infra medium. Corpora neutralia rubra, fusiformia, 0.3—0.4 μ crassa, et 3 μ longa, spiraliter disposita inter zonas chromatophori. Paramylum brevissimum, oblongum, ellipsoideum, 3—4.5 μ latum, et 4.5—6 μ longum. Chromatophori stellati, pyrenoideo duplici in medio et brachiis 10—12 radiantibus ex eo; chromatophori tenuiter vel alte cymbiformes, latere concavo extus directo. Chromatophori cum duplici pyrenoideo in medio et brachiis radiantibus apparent ut crura arcuata araneae suffulcientia corpus elevatum in medio. Chromatophori numero 18—25. Brachia chromatophororum peripheriam attingunt et procedunt ut zonae elongatae praeter superficiem cellulae et apparent quasi in duas directiones decurrerint, 1. radialiter ex medio ad peripheriam cellulae et 2. spiraliter praeter cellulae superficiem. Chromatophori simillimi eis *E. sanguineae* Ehrenb. et *E. magnificae* Pringsh. Alga penitus viridis; haematochroma nullum; aspectus cellulae striatus. Cysta tenuibus parietibus praedita; cellularum divisio in conditione encystica.

Habitat: in cisterna aquae pluvialis in littore arenoso ad Triplicane, Madras, in India.

Summary

Euglena oblonga was described by SCHMITZ in 1884. Because many of the later authors differed very much in their descriptions of its chromatophores and pyrenoids, there has been a good deal of confusion regarding the exact nature of these structures. LEMMERMANN (1913) described the chromatophores as stellate and as having a double pyrenoid in the centre. But in the figure that he gives of the alga, the chromatophores are not stellate but band-shaped, and the pyrenoids are not double, but homogeneous and without any paramylon shells. And these pyrenoids are shown as lying loose below the chromatophore-layer without any connection whatsoever with the chromatophores. CHU (1947) states that the chromatophores of *E. oblonga* are exactly as in *Euglena sanguinea* and that *E. oblonga* is nothing but *E. sanguinea*. SKUJA (1948) describes the chromatophores as bands running in two directions, (1) radially from the centre of the cell, and (2) spirally under the surface of the cell. He also

Figs. 22—31. Figs. 22—24, 26 and 29: *Euglena oblonga* Schmitz em. Iyengar. Figs. 22 and 24. Cells showing the chromatophore bands running spirally near the surface. Figs. 23, 26 and 29: Median optical section of the cells showing radial chromatophore bands at the two sides of the cell. Figs. 23 and 24 are photographs of the same individual. Fig. 23: Focussed at the optical median section to show the radial chromatophores and Fig. 24: Focussed to the surface of the cell to show the spirally running chromatophore bands, respectively. Fig. 29: Photograph of a specimen focussed at the optical median longitudinal section showing the radially running chromatophore bands at the two sides. Figs. 25, 27, 28, 30 and 31: *Euglena pringsheimii* sp. nov. Fig. 25: Surface view to show the chromatophore bands. Fig. 27: Specimens showing chromatophore bands near the surface and the pyrenoids attached to them. Fig. 28: Median optical longitudinal section of a specimen showing the inner pyrenoids projecting into the cell. Fig. 30: Optical median longitudinal section of another specimen showing three inner pyrenoids on the right side and three inner pyrenoids on the left side. Fig. 31: Surface view of a specimen showing the spiral bands of the chromatophores and the pyrenoids attached to them

states that the pyrenoids are double and situated below the chromatophore-layer. GOJDICS (1953) follows SKUJA's description and states that the chromatophores are band-shaped and run in two directions, (1) radially, and (2) spirally. PRINGSHEIM (1956) considered the alga as belonging to the *E. sanguinea* group. He does not say, however, that it is the same as *E. sanguinea*.

The present author came across some living material of *E. oblonga* at Madras. He made a careful study of the alga, and found that the chromatophores of the alga are stellate, with a double pyrenoid in the centre, as described and figured by CHU in *E. sanguinea*. He states, however, that it is not the same as *E. sanguinea*. He further states that it comes very close to Pringsheim's *E. magnifica*, but is quite different from it, and has a status of its own as an independent species. An emended diagnosis of *E. oblonga* SCHMITZ is given by the author.

Acknowledgment. The author is greatly indebted to the Council of Scientific and Industrial Research, New Delhi, for a grant for carrying out his Algological Researches. The author's sincere thanks are due to Rev. Father Dr. H. SANTAPAU for rendering into Latin the diagnoses of the two species of *Euglena* dealt with in the paper.

References

CHU, S. P.: Contributions to our knowledge of the genus *Euglena*. Sinensia **17**, 75—134 (1947).

GOJDICS, M.: The Genus *Euglena*. Madison 1953.

LEMMERMANN, E.: Eugleninae, in PASCHERS Süßwasserfl. Deutsch. Oesterr. u. Schweiz., Heft 2, Flagellatae II, 115—192 (1913).

MAINX, F.: Einige neue Vertreter der Gattung *Euglena* Ehrenberg. Arch. Protistenk. **54**, 150—162 (1926).

PRINGSHEIM, E. G.: Taxonomic problems in the Eugleninae. Biol. Rev. **23**, 46—61 (1948).

PRINGSHEIM, E. G.: Observations on some species of *Trachelomonas* grown in culture. New Phytol. **52**, 93—113, 238—266 (1953).

PRINGSHEIM, E. G.: Contributions towards a Monograph of the Genus *Euglena*. Nova Acta Leopoldina. Abh. deutsch. Akad. Naturf. (Leopoldina), N.F. Nr. 125, **18**, 1—168 (1956).

SCHMITZ, F.: Beiträge zur Kenntnis der Chromatophoren. Jb. wiss. Bot. **15**, 1—175 (1884).

SKUJA, H.: Taxonomie des Phytoplanktons einiger Seen in Uppland, Schweden. Symbolae bot. Upsalienses **9**, 1—399 (1949).

Professor M. O. P. IYENGAR, M. A., Ph. D., F. L. S., F. N. I., F. A. Sc., F. B. I.
100 V.R. Pillai Street, Triplicane, Madras, India