NEW AND INTERESTING PLANKTON ALGÆ FROM LAKE ERIE.

LEWIS H. TIFFANY,
Ohio State University,
AND
ELBERT H. AHLSTROM,
Northwestern University.

For the last five summers a rather intensive study has been made of the plankton algæ* of Lake Erie along the Ohio shore and in the region of Gilbraltar Island, upon which is located the Franz Theodore Stone Laboratory of Ohio State University. During the past summer particular emphasis has been given to the plankton algæ of Put-in-Bay Harbor of South Bass Island and of ponds on Middle Bass and North Bass Islands.

The three Bass Islands lie near the Ohio shore in Lake Erie, some few miles north of Catawba Peninsula. Gibraltar Island lies in Put-in-Bay Harbor off the north shore of South Bass Island, thus giving considerable protection to the harbor from wind and wave action. In the harbor are located three separate bays having "semi-pond" characteristics and known as Squaw Harbor, Terwilliger Pond, and Hatchery Bay.

Some of the following species and varieties collected in this region are apparently undescribed to date. Others because of their varied characteristics or rare occurrence in North America deserve special mention.

Chroococcus limneticus Lemmermann.

(Pl. I, Figs. 2–10.)

Bot. Centralb. 76: 153, 1898; Kryptogamenfl. d. Mark Brandenburg 3: 57, Fig. 8, 1907; G. M. Smith, Phytopl. In Lakes Wis. Pt. I: 29, Pl. 1, Fig. 4, 1920. *Chroococcus limneticus* Lemm. var. *distans* G. M. Smith, Bull. Torr. Bot. Cl. 43: 481, Pl. 26, Fig. 26, 1916; *Chr. limneticus* Lemm. var. *carneus* (Chod.) Lemm. Arkiv f. Bot. 2 (2): 101, 1904; Smith, Phyopl. In L. Wis. Pt. I: 30, Pl. 1, Fig. 6, 1920.

Chroococcus limneticus has been observed as a common plankton alga of Lake Erie for a number of years and was particularly abundant this past summer. It is quite variable

*A more comprehensive report of the plankton algae of the Put-in-Bay region of Lake Erie is in an advanced state of preparation.

in size, color, and arrangement of cells within the colony. The diameter of the cells varies from 3.5 to 26μ. The color may be light bluegreen, pale bluegreen, olive green, gray, grayish purple, or even brown. In some colonies the cells are very close together; in others cellular arrangement can be found that is typical of the various recognized varieties of the species. In fact, it is possible to find a complete intermediate series between the species proper and its so-called varieties. In spite of this marked intergrading, it seems desirable to recognize var. *purpureus* (Snow) nov. comb. and var. *subsalsus* Lemm. (see below). In the measurements of a great number of individuals of these algæ three definite means of sizes are noted, corresponding to the species itself and the two above-named varieties. The usual cell size of the species is 6.5 to 9μ.

Var. *distans* G. M. Smith and var. *carneus* (Chodat) Lemm. are merely growth variations of the species. In fact, every gradation in size, shape, color, and arrangement of cells was observed in the Lake Erie material between the species and these two varieties.

Var. **purpureus** (Snow) nov. comb.

(Pl. I, Figs. 11–15.)

Chroococcus purpureus Snow, Bull. U. S. Fish Comm. 22: 383, Pl. 4, Fig. 18, (1902) 1903; *Chr. limneticus* var. *elegans* G. M. Smith, Trans. Wis. Acad. Sci. Arts & Let. 19: 619, 1918; Phytopl. In. Lakes Wis. Pt. I: 30, Pl. 1, Fig. 8, 1920.

Colonies circular to semicircular in front view, somewhat flattened in side view, inclosed by a spherical or oval, hyaline, homogeneous envelop. Individual sheaths of cells may or may not be conspicuous. Cell contents homogeneous. Color blue-green to grayish-purple, or even brown—grayish purple being the usual color.

Diameter cells (without sheath) 13–26μ, usual diameter 16–19μ.

This large variety of *Chroococcus limneticus* is undoubtedly the form Snow described from the Lake Erie region under the name of *Chr. purpureus*. It is often grayish-purple in color, markedly more so than is usual for the species proper. The color is, however, variable. The specimens from East Harbor are predominantly grayish-purple, while those of the Put-in-Bay region are bluegreen or grayish-green. This variety is also identical with var. *elegans* G. M. Smith. Though the latter name is more appropriate, Snow's *purpureus* has priority. It differs from the species proper in its larger size. Due to marked changes in color at different seasons of the year in members of the Chroococcaceæ, names based on color characteristics are not particularly significant.

Var. **subsalsus** Lemmermann.

(Pl. I, Fig. 1.)

Forschungsbr. a. d. Biol. Stat. Zu Plon 8: 84, 1901; Arkiv f. Botanik 2 (2): 101, Pl. 1, Fig. 9, 1904; G. M. Smith, Phytopl. In. Lakes. Wis. Pt. 1: 29, Pl. 1, Fig. 5, 1920.

Diameter cells (without sheath) 3.5–4.5μ.

This variety establishes a range below the usual size of the species as does var. *purpureus* above the usual size.

Merismopedia convoluta Brebisson.

(Pl. II, Fig. 19.)

Kuetzing Spec. Algar. 472, 1849; Hansgirg, Prodromus der Algenfl. v. Bohmen, Pt. 3: 142, Fig. 52, 1893.

Diameter cells, 3.5μ; length of cells, 4.5μ.

The most common Merismopedia in the lake seems referable to this species. The colonies are usually large, seldom having less than 64 cells and frequently numbering thousands. The cells are definitely longer than wide. The colony is flat when the number of cells is small, but when composed of a large number of cells it has a tendency to roll under or overlap itself. The cell color is pale bluegreen, much lighter in the center than around the edges.

Var. **minor** (Wille) nov. comb.

(Pl. II, Fig. 20.)

Merismopedia convoluta Brèb. f. *minor* Wille *in* Geitler, Cyanophyceae *in* Pascher, Süsswasserflora, Deutsch. Öster. u. d. Schweiz 12: 106, 1925.

Diameter cells, 2.75μ; length, 3.5μ.

This variety is definitely smaller than the species proper. In addition the cells are more closely packed together. All colonies observed were large—several hundred to over a thousand cells. Its abundance and regular occurrence with the species seem to warrant varietal rank.

Gomphosphaeria lacustris Chodat.

(Pl. II, Fig. 22.)

Bull. Herb. Boiss 6: 180, Figs. 1A–1G, 1898; *Coelosphaerium roseum* Snow, Bull. U. S. Fish Comm. 22: 387, Pl. 55, Fig. 17, (1902) 1903; *Gomphosphaeria rosea* (Snow) Lemm. Kryptogamenfl. d. Mark Brandenburg 3: 80, 1907.

This alga is a very common, often abundant, form in the lake. The color, though usually pale bluegreen, may be rose

or brown. It is undoubtedly the alga that Snow described under the name of *Coelosphaerium roseum* and which later Lemmermann assigned to the genus Gomphosphaeria. Many specimens were found that suited the description as given by Snow in every detail. She realized the resemblance to *Gomphosphaeria lacustris*, but she placed too much emphasis upon the color of the alga under her observation.

Marssoniella elegans Lemmermann.

(Pl. II, Fig. 21.)

Ber. d. deutsch. bot. Ges. 1900: 275; Kryptog. d. Mark Brand. 3: 93, Fig. 9, 1910; Geitler, Cyanophyceae *in* Pascher, Süsswasserflora Deutsch., Öster u. d. Schweiz 12: 120, Fig. 155, 1925. ? *Coelosphaerium radiatum* G. M. Smith, Roosevelt Wild Life Bull. 2 (2): 136, Pl. 3, Figs. 9–10, 1924.

Diameter cells, (1–) 2–3μ; length cells, 5–6μ.

This alga appears rarely in the lake proper. It agrees with *Coelosphaerium radiatum* Smith, which Geitler refers to *Marssoniella elegans*, except in the absence of any observable sheath. The Lake Erie specimens usually have 32 to 64 cells in a colony (never less than 16) and have two to four axes of radiation.

The genus Marssoniella must be placed with the Chroococcaceae. There is no justification for its assignment to the Chamaesiphonaceæ by Lemmermann. The relationship to Coelosphaerium is evident, but it seems best to regard it as distinct.

Dictyosphaerium planctonicum nov. sp.

(Pl. II, Fig. 17.)

Colonies usually ovoid and relatively small, containing less than 40 cells. Cells bluntly rounded, ovoid, or markedly ellipsoid. Chloroplasts one or two, parietal, laminate, each with a single pyrenoid. Two (sometimes four) cells often contained in separate envelopes within the colony. Sheath of colony (?) absent.

Cells 8–9μ broad, 12–16μ long.

This species differs from *D. ehrenbergianum* Naegeli (Gatt. einz. Algen 73, Pl. II, Figs. Ea–E1, 1849) in the larger size, in the apparent absence of a sheath around the colony, and in the curious arrangement of cells in multiples of two, which often have a separate envelope surrounding them. Were it not that some colonies lack this latter feature, the assignment of this species to the genus Dictyosphaerium is open to question. Abundant in Put-in-Bay Harbor.

Oocystis eremosphaeria G. M. Smith.

(Pl. II, Fig. 18.)

Trans. Wis. Acad. Sci. Arts & Let. 19: 630, Pl. 14, Figs. 8–9, 1918.

Cells ovoid, up to twice as long as broad. Solitary or in families of two or four. Chloroplasts numerous (40–60), parietal, lenticular, each with a single pyrenoid. Cell wall thick, with a conspicuous polar nodule.

Cells 17–31μ broad, 21–45μ long.

This species is present in the plankton of Lake Erie, though apparently never very common. It is frequently smaller than the dimensions given by Smith, and the original description has been modified accordingly.

Treubaria varia nov. sp.

(Pl. II, Fig. 16.)

Treubaria triappendiculata G. M. Smith (non Bernard), Trans. Amer. Micros. Soc. 45 (3): 177, Pl. 9, Figs. 19–23, 1926.

Cells three- or more angled (up to eight-), usually four-, pyramidulate to quadrate in shape (usually pyramidulate), sides of cells concave or straight. Angles broadly rounded, each bearing a single hyaline spine that gradually tapers to near the end, where it terminates abruptly in a sharp point. Chloroplast massive, completely or nearly filling the cell, with one or four pyrenoids (usually four).

Diameter cells (with spines), 48–89μ, (without spines), 8–19μ; spines (20–) 25–38μ long, 3–6μ broad at base.

This species appears to be quite distinct from *T. triappendiculata* Bernard.* The latter according to Bernard's description has three spines usually 15–20μ long, seldom up to 30μ. The spines, moveover, are distinctly punctate. The chromatophore is supposedly flat with a single pyrenoid. *T. varia*, on the other hand, seldom has less than four spines. A few specimens with a single pyrenoid, which show them to be young plants, have spines only 20μ long. An interesting note here is that the spines during June-July averaged about 30μ long, while during August the average length was about 25μ, indicating a definite seasonal variation. The spines are somewhat variable in shape. The usual type seems intermediate between those of *T. triappendiculata* and *T. crassispina* Smith (*loc. cit.*, p. 178, Pl. 10, Figs. 2–5). A few taper to an acute point, while others have subparallel sides that taper abruptly to a sharp point.

*Dept. de l'Agr. Indes Neerland. 1908: 170, figs. 544–548.

The cell itself ranges in size from 8–19μ, the usual size being about 13μ. These dimensions are larger than those recorded by Smith and much larger than those of the original *T. triappendiculata*. Smith notes the absence of cavities between the base of the spines and the cell wall. The presence or absence of cavities is a variable feature, many cells having distinct cavities, while others lack them. The chromatophore in mature cells always has four pyrenoids, and not single, as Bernard noted for *T. triappendiculata*. It seems desirable, on the basis of the above data, to establish a new species for the American specimens as being distinct from the original *T. triappendiculata*.

This species is very close to *Borgea planctonica* G. M. Smith (Ark. f. Botanik 17: 2, 1922). It differs in having the cells pyramidulate to quadrate in shape, while the latter species has spherical cells. Perhaps the differences are too slight to warrant generic separation.

Micractinium pusillum Fresenius var. **longisetum** nov. var.

(Pl. III, Fig. 34.)

Colonies of four to eight cells. Cells spherical, with 5–8 delicately tapering very long setae on the faces not adjacent to other cells. Chloroplasts single, parietal, cup-shaped, with one pyrenoid.

Diameter cells (without setae), 6–8μ; setae up to 65μ long.

This variety with unusually long setæ was collected at the mouth of the Maumee River.

Micractinium eriense nov. sp.

(Pl. III, Figs. 32 and 33.)

Colonies of 2, 4, or 8 cells (usually 4 or 8, the latter more common). Cells spherical with 8–13 delicately tapering setae on the faces not adjacent to the other cells. Cells usually in a pyramidulate arrangement. Chloroplast single, parietal, cup-shaped, with a pyrenoid.

Diameter cells (without setae), 7–10μ; length of setae, 20–35μ.

This species differs from *M. pusillum* in its larger size and more numerous setæ. The usual number of setæ for each cell is 11 or 12, and the colonies do not contain more than 8 cells. Colonies of *M. pusillum* are normally larger than 8 cells, although colonies of var. *elegans* G. M. Smith (Trans. Wis. Acad. S. A. & L. 19:631, Pl. XII, Fig. 4, 1918) are quite similar to those of *M. eriense*. Collected from Wehrle Pond and

Haunck Pond on Middle Bass Island and from Smith Pond on North Bass during August.

Golenkinia radiata Chodat var. **brevispina** nov. var.

(Pl. III, Fig. 31.)

Cells spherical, solitary, containing numerous, delicate, short setae. Chloroplast single, cup-shaped, with a pyrenoid.

Diameter cells (without setae), 8–19μ; length setae, 8–15μ.

This variety differs from *G. radiata* Chodat (Jour. de Bot. 8:305, Pl. III, Figs. 1–24, 1894) in the much shorter setæ. It differs from *G. paucispina* W. & G. S. West (Trans. Roy. Acad. 32 (Sec. B):68, Pl. I, Fig. 18, 1902) into whose cell size range it runs, in the more numerous, light, and more delicate setæ, and in the cup-shaped chloroplast. Found in Haunck Pond on Middle Bass Island throughout the summer.

Golenkinia maxima nov. sp.

(Pl. III, Fig. 30.)

Cells spherical, solitary, with fairly long, delicately tapering setae, which are often bent after a short distance from the cell. Chloroplast single, apparently filling the cell, with a large pyrenoid.

Diameter cells (13–) 17–22μ; length setae, 35–45μ.

The setæ of this species are markedly heavier than those of *G. radiata*, and much darker, though comparable in length. The cell diameter is larger than that of *G. radiata*. *G. maxima* is near *G. paucispina* in size of cell, but differs in the much longer setæ. Found in Terwilliger Pond and Squaw Harbor throughout the summer.

Lagerheimia citriformis (Snow) Smith.

(Pl. III, Figs. 27 and 28.)

Phytopl. In. Lakes Wis. Pt. I: 130, Pl. 30, Figs. 1–2, 1920.

Diameter cells (without setae), 8–20μ; length cells, 13–26μ; length setae, 25–60μ.

More variable in Lake Erie than the original description would indicate. Although the chloroplast is usually single, individuals with two parietal chloroplasts are not uncommon. The length of the setæ varies greatly. Specimens from the mouth of the Maumee River have setæ up to 60μ long.

Lagerheimia citriformis var. **paucispina** nov. nom.

(Pl. III, Fig. 26.)

Chodatella subsala var. *citriformis* Woloszynska, Hedwigia 55: 201, Pl. 7, Figs. 15–19, 1914.

Cells ovoid to ellipsoid with a small obtuse projection at each pole. Poles with 2–3 (4) long, hyaline, delicately tapering setae at the base of the polar projections. Chloroplast single, parietal, with one pyrenoid.

Diameter cells, 8–9μ; length, 10–14μ.

Because of its very pronouncedly citriform shape, this alga should be regarded a variety of *L. citriformis* (Snow) Smith and not of *L. subsalsa* Lemm. (Forschungsbr. a. d. Biol. Stat. Plön 6: 193, Pl. 5, Figs. 2–6, 1898). It resembles the latter only in its small size, and differs from the former in its smaller dimensions and its fewer setæ.

Lagerheimia longiseta (Lemm.) Printz var. **major** G. M. Smith.

(Pl. III, Fig. 25.)

Phytopl. inland Lakes Wis. Pt. I: 130, Pl. 30, Figs. 10–12, 1920. *Chodatella longispina* Walton, Ohio Biol. Survey Bull. 24: 64, Fig. 37, (1930), 1931.

Diameter cells, 12–25μ; length, 15–37μ; length setae, 40–60μ.

This alga is quite common in the plankton of the lake region. Its size range is greater than that given by Smith. *Chodatella longispina* is apparently only a large form of this variety. It would appear from Walton's discussion of his species that he is not entirely familiar with the literature on this group of algæ, particularly the thorough American work of G. M. Smith.

Lagerheimia wratislawiensis Schröder.

(Pl. III, Fig. 29.)

Ber. d. bot. Ges. 15: 373, Pl. 17, Fig. 7, 1897; Smith, Trans. Amer. Micros. Soc. 45 (3): 180, Pl. 12, Figs. 10–14, 1926.

Diameter cells (without spines), 3–7μ; length cells (without spines), 10–14μ; length of spines, 14–26μ.

Collected from Haunck Pond, Middle Bass Island. Previously reported for this country only from Iowa.

Franceia tuberculata G. M. Smith.

(Pl. III, Fig. 37.)

Trans. Amer. Micros. Soc. 45 (3): 182, Pl. 12, Figs. 27–30, 1926.

Diameter cells (without setae), 5–12μ; length cells (without setae), 8.5–21μ; length of setae, 7–32μ.

This alga is quite common in the ponds of Bass Islands, though it is seldom found in the lake proper. Colonies consist of 2-4-6-8 (usually 4) closely appressed and parallel cells. No evidence of a gelatinous sheath. Tubercles always distinct, being at times raised as much as 3μ above the cells.

Franceia tuberculata var. **irregularis** nov. var.

(Pl. III, Figs. 35 and 36.)

Cells large, joined in colonies of 4 to 6 or 8 cells; half of the cells in the colony usually arranged at right angles to the other cells, though the arrangement may become somewhat irregular. Cells broadly ovoid with rounded poles; cells where not in contact with other cells clothed with rather long delicate, non-tapering setae with a distinct tubercle at the base of each.

Dimensions as in the species (above).

The variety is characterized by the irregular arrangement of the cells in the colony, instead of having the long axes of the cell always parallel.

Selenastrum bibraianum Reinsch var. **gracile** (Reinsch) nov. comb.

(Pl. II, Fig. 23.)

Selenastrum gracile Reinsch, D. Algenfl. d. Mitt. Th. v. Franken, 1867: 65, Pl. 4, Figs. 3 a–b, 1867.

This alga should not be given more than varietal rank, if it is to be recognized at all. It may be merely a growth form of *S. bibraianum* (Pl. 2, Fig. 24). The two algæ were always found growing together, and occasional colonies had cells typical of both. Autospores have frequently been observed in *S. bibraianum* but never in var. *gracile*. Young colonies of typical *S. bibraianum* are apparently identical with the variety.

Crucigenia apiculata (Lemmermann) Schmidle var. **eriensis** nov. var.

(Pl. III, Fig. 41.)

Coenobe four-celled with a relatively large open space in the center; coenobia frequently multiple. Cells quadrately arranged with base and median part of inner sides in mutual contact, but with the apices and outer faces free. Cells elongate, somewhat lunate, with free ends truncate, and provided on the inner apex with a short conical projection; usually a second projection at the side of the base away from the center of the coenobe. Cells with one to four parietal, disciform chloroplasts, with one pyrenoid.

Diameter cells, 3–5μ; length cells, 6–10μ.

The free apices of this variety have a superficial resemblance to *Crucigenia truncata* G. M. Smith (Phytopl. In. Lakes Wis.

Pt. I: 146, Pl. XXXVI, Figs. 7–9, 1920). On close examination, however, the definite conical projection on the inner side of the apex of the cell shows it to be closer to *C. apiculata* (Lemm.) Schmidle (Allg. Bot. Zeitschr. 6: 234, 1900; Smith, *loc. cit.* Pl. XXXVII, Fig. 1). The variety is found along with the species in Lake Erie. During the past summer it was the dominant Crucigenia in Buckeye Lake, near Columbus, Ohio.

Tetrastrum heterocanthum (Nordstedt) Chodat.

(Pl. III, Figs. 38–40.)

Bull. Herb. Boiss 3: 113, 1895; Smith, Trans. Amer. Mic. Soc. 45 (3): 187, Pl. 15, Figs. 16–20, 1926.

This alga occurs quite generally throughout the region. It is particularly common at the mouth of the Maumee River and in a small pond on North Bass Island. The spines are variable. Many are as delicate as those noted by Smith in Iowa, while others are as pronounced as Nordstedt's original illustration.

Scenedesmus bijuga (Turpin) Lagerheim var. **major** nov. var.

(Pl. III, Figs. 42 and 43.)

Colonies curved with 2–8 cells arranged in an irregularly alternating row. Cells ovoid, with smooth walls.

Diameter cells, up to 13μ; length cells, up to 21μ.

The cells of this variety vary greatly in their arrangement. The colonies are always curved. The alga resembles var. *irregularis* (Wille) G. M. Smith (Trans. Wis. Acad. Sci. Arts & Lett. 18 (2): 448, Pl. XXVIII, Figs. 59–62, 1916), but differs in its much larger size.

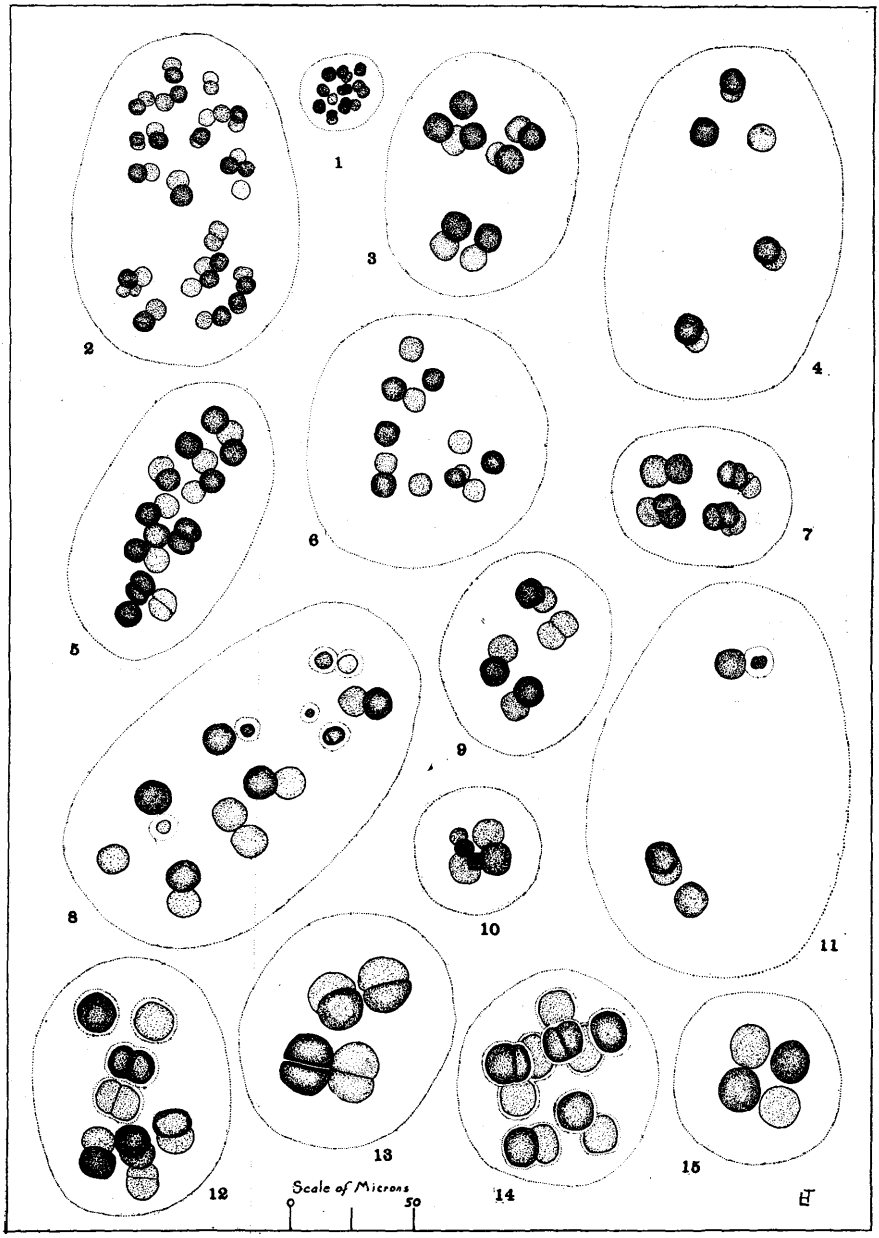

Fig. 1. *Chroococcus limneticus* Lemm. var. *subsalsus* Lemm.
Figs. 2–10. *Chroococcus limneticus* Lemm.
Figs. 11–15. *Chroococcus limneticus* Lemm. var. *purpureus* (Snow) nov. comb. Fig. 11 (=*Chroococcus purpureus* Snow) redrawn from Snow. Fig. 14 (=*Chroococcus limneticus* Lemm. var. *elegans* G. M. Smith) redrawn from G. M. Smith.

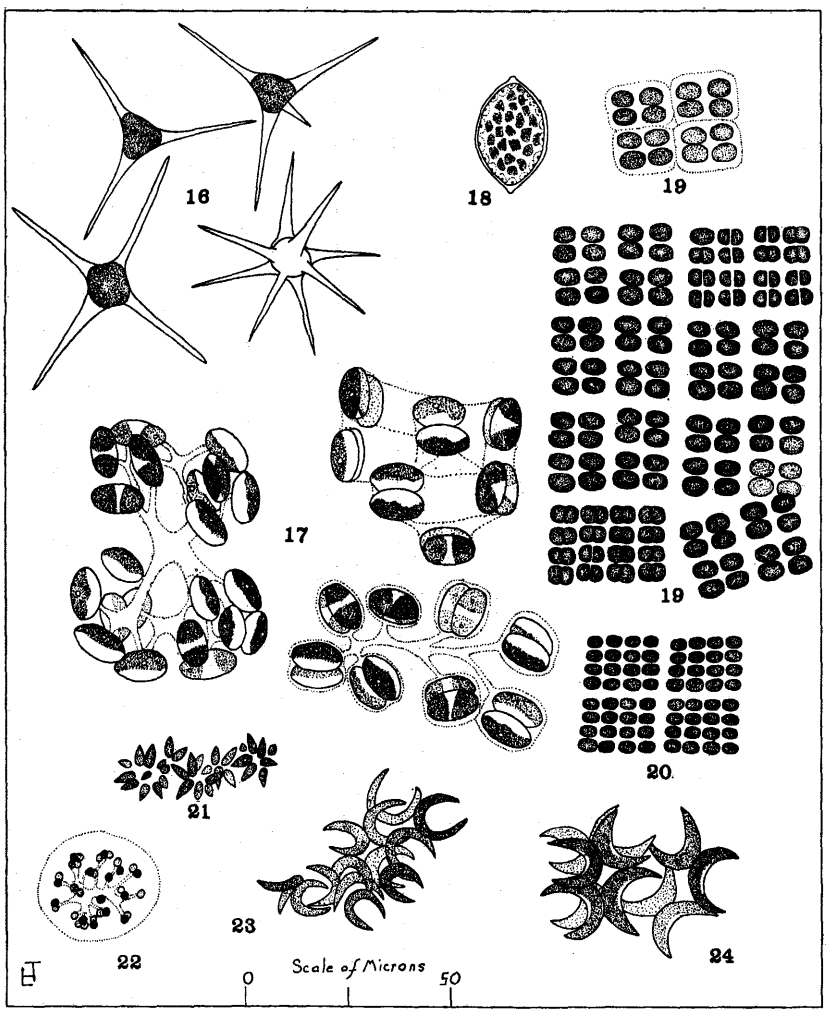

Fig. 16. *Treubaria varia* nov. sp.
Fig. 17. *Dictyosphaerium planctonicum* nov. sp.
Fig. 18. *Oocystis eremosphaeria* G. M. Smith.
Fig. 19. *Merismopedia convoluta* Brebisson.
Fig. 20. *Merismopedia convoluta* Breb. var. *minor* (Wille) nov. comb.
Fig. 21. *Marssoniella elegans* Lemm.
Fig. 22. *Gomphosphaeria lacustris* Chodat. (Redrawn from G. M. Smith.)
Fig. 23. *Selenastrum bibraianum* Reinsch var. *gracile* (Reinsch) nov. comb.
Fig. 24. *Selenastrum bibraianum* Reinsch. (Redrawn from G. M. Smith.)

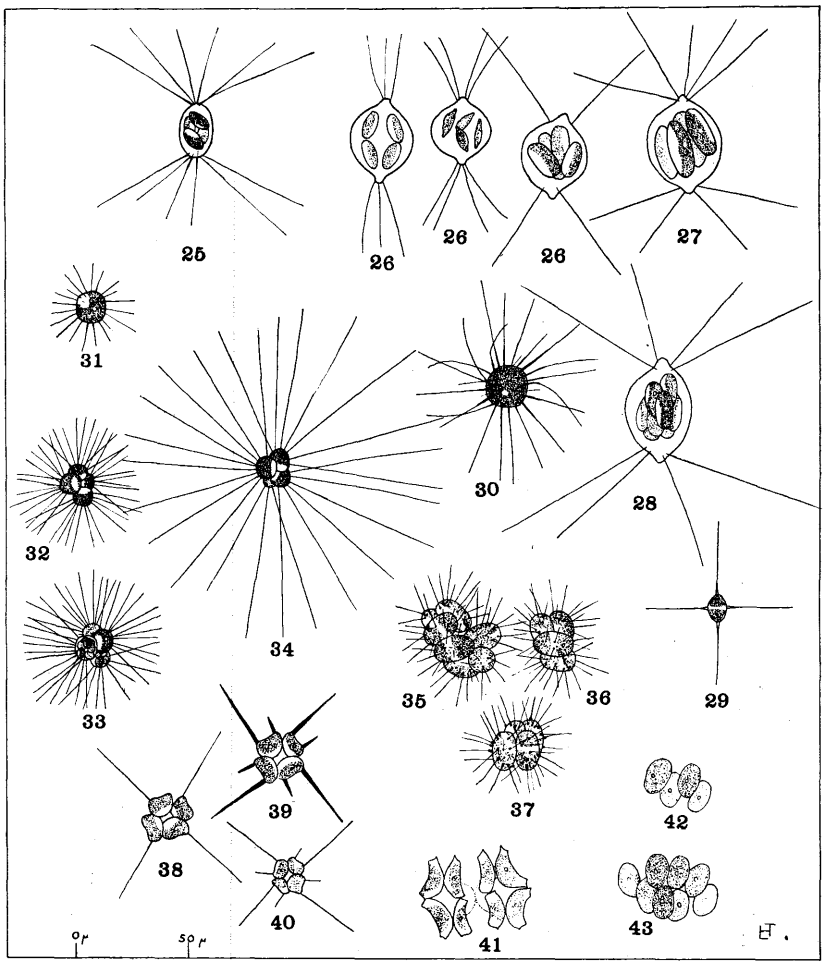

Fig. 25. *Lagerheimia longiseta* (Lemm.) Printz var. *major* G. M. Smith.
Fig. 26. *Lagerheimia citriformis* (Snow) Smith var. *paucispina* nov. nom. (Middle Figure redrawn from Woloszynska.)
Figs. 27 and 28. *Lagerheimia citriformis* (Snow) G. M. Smith.
Fig. 29. *Lagerheimia wratislawiensis* Schroder.
Fig. 30. *Golenkinia maxima* nov. sp.
Fig. 31. *Golenkinia radiata* Chodat var. *brevispina* nov. var.
Figs. 32 and 33. *Micractinium eriense* nov. sp.
Fig. 34. *Micractinium pusillum* Fres. var. *longisetum* nov. var.
Figs. 35 and 36. *Franceia tuberculata* G. M. Smith var. *irregularis* nov. var.
Fig. 37. *Franceia tuberculata* G. M. Smith, showing large tubercles.
Figs. 38–40. *Tetrastrum heterocanthum* (Nordst.) Chodat.
Fig. 41. *Crucigenia apiculata* (Lemm.) Schmidle var. *eriensis* nov. var.
Figs. 42 and 43. *Scenedesmus bijuga* (Turp.) Lager. var. *major* nov. var.