Preslia, Praha, 57 : 97—110, 1985

The genus *Steinedesmus* KOFOID *(Scenedesmaceae, Chlorellales)*

Rod *Steinedesmus* KOFOID *(Scenedesmaceae, Chlorellales)*

Augusto Comas and Jiří Komárek

COMAS A.[1]) et KOMÁREK J.[2]) (1985): The genus *Steinedesmus* KOFOID (Scenedesmaceae, Chlorellales). — Preslia, Praha, 57 : 97—110.

The generic name *Steinedesmus* was established by KOFOID (1911) instead of *Steiniella* BERN. 1908, which is the latter homonymum of *Steiniella* SCHÜTT 1895 (Gonyaulacaceae, Dinophyceae). The genus *Steiniella* BERNARD 1908 (Scenedesmaceae, Chlorellales) was described as a monotypical taxon with the type species *Steiniella graevenitzii*. It is similar to the genus *Scenedesmus* by the form of the coenobia, but differs from it by the occasional formation of syncoenobia (coenobia are connected by the remnants of mother cell walls). Because the facultative formation of syncoenobia was also found in several other *Scenedesmus*-species, the genus *Steiniella* (= *Steinedesmus*) was considered as superfluous. However, the tendency to form syncoenobia is connected with another important feature in *Steinedesmus*, i.e., the daughter coenobia are released through the apical openings from the mother cells, not through lateral fissures as is the case of *Scenedesmus*. The genus *Steinedesmus* is therefore acceptable and characterised by the following features: (i) linear coenobia with clearly alternating cells, (ii) apical openings of the mother cells, (iii) tendency to form syncoenobia, and (iv) smooth cell walls without sculptures. A similar genus is *Rayssiella* EDELST. et PRESC. 1964, in which the cells are connected by the processi on the proximal cell ends. With reference to the above mentioned diacritical features the genus *Steinedesmus* KOFOID contains 6 species: *St. ovalternus* (CHOD.) comb. nova, *St. arcuatus* (LEMM.) comb. nova, *St. ralfsii* (PLAYF.) comb. nova, *St. graevenitzii* (BERN.) KOFOID (type-species), *St. indicus* (HORTOB.) comb. nova, and *St. capitatus* (G. M. SMITH) comb. nova.

[1]) *Cuban Academy of Sciences, Institute of Botany, Botanical Garden, Pepito Tey, Cienfuegos, Cuba*; [2]) *Czechoslovak Academy of Sciences, Botanical Institute, Department of Hydrobotany, Dukelská 145, 37982 Třeboň, Czechoslovakia.*

INTRODUCTION

BERNARD (1908) described from Indonesia (Java) the genus *Steiniella* with the type species *Steiniella graevenitzii* (Fig. 1a). The alga forms flat 4—8-celled coenobia with serially arranged and alternating cells like *Scenedesmus*, but the coenobia are connected spatially in syncoenobia by the remnants of the mother cell walls. The name *Steiniella* is incorrect because it was already used by SCHÜTT (1895) for one genus of Gonyaulacaceae (Dinophyceae); KOFOID (1911), therefore, changed the generic name *Steiniella* BERN. 1908 into *Steinedesmus* (cited according to FARR & al. 1979). It was found later that the daughter coenobia sometimes remained attached to the remnants of the mother cell walls also in several other species of *Scenedesmus*; the genus *Steiniella* (= *Steinedesmus*) was therefore considered as superfluous (CHODAT 1926, LUND 1960, UHERKOVICH 1966, etc.).

The type species, *Steinedesmus graevenitzii*, is characterised by yet another feature that supports the formation of syncoenobia. It is the release of the

daughter coenobia from the mother cells through the apical or subapical opening, not through lateral fissure as known in *Scenedesmus* (Figs. 2, 3). Because this feature is stable according to our investigation, and reflects a certain polarity of cells, we consider it to be important from the biological and evolutionary points of view and accept the genus *Steinedesmus*.

The genus *Scenedesmus* comprises several other taxa the morphology of which is similar to that of *Steinedesmus graevenitzii*. The following review discusses the generic features of the taxa in question, and the conspectus of the revised genus *Steinedesmus* is given.

RESULTS AND DISCUSSION

1. *Steinedesmus graevenitzii*

The type species of the genus *Steinedesmus* KOFOID 1911 (syn.: *Steiniella* BERN. 1908) is *St. graevenitzii* (BERN.) KOFOID (Fig. 1). The genus is characterised by ± ellipsoidal or slightly ovoid symmetrical cells connected alternately in linear coenobia. The coenobia possess the tendency to become joined together in colonies (syncoenobia) by the remnants of the mother cell walls. The daughter coenobia liberate from the mother cells through the apical openings of the cell walls (Figs. 1a, 2, 3). This feature is not described accurately in the diagnosis, but it is in coincidence with both the iconotype and our material from Cuba, which corresponds with the original description in all the other features (Figs. 1a, 4b).

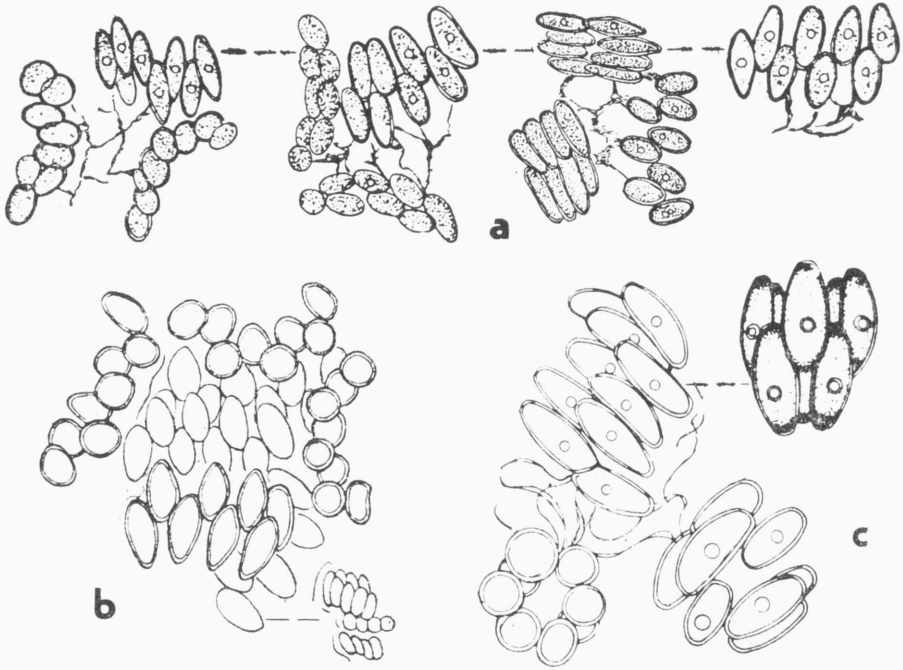

Fig. 1. — *Steinedesmus graevenitzii* (CHOD.) KOFOID; **a** iconotype from BERNARD 1908 from Indonesia, **b** after MARGALEF 1956 from Spain, **c** after UHERKOVICH 1981 from Brasil.

St. graevenitzii was later synonymised with *Scenedesmus* (mostly with *Sc. ovalternus*) but its features (syncoenobia, apical openings of mother cells) can be used as diacritical characters of the separate genus and species.

2. *Scenedesmus obtusus, Sc. alternans, Sc. platydiscus* and *Sc. ovalternus*

MEYEN (1829) described *Scenedesmus obtusus* documented by two drawings (his figs. 30, 31) which probably represent two different species (comp.

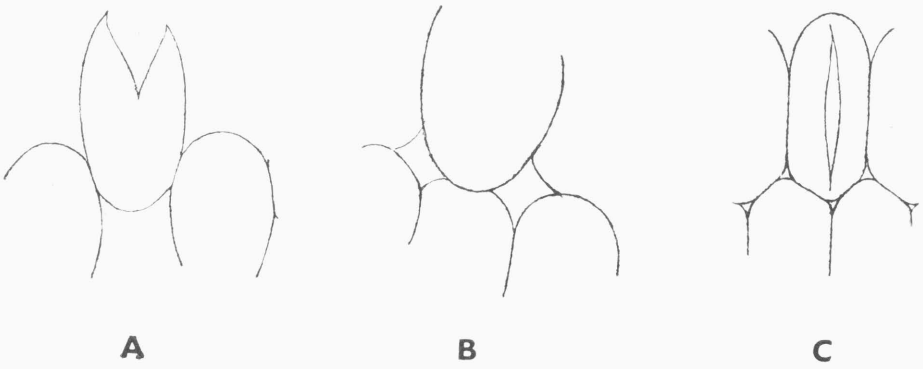

Fig. 2. — Disintegration patterns of the mother cell walls in *Steinedesmus* — **A**, *Rayssiella* — **B**, and *Scenedesmus* (subg. *Scenedesmus*) — **C**. (Orig.)

Figs. 5a and 6a). The name *Sc. obtusus* was used mainly in the sense of MEYEN's fig. 30 (our Fig. 5a; e.g., in G. M. SMITH 1916, COMPÈRE 1976, KOMÁREK & FOTT 1983), but the other usage (i.e., the identification with MEYEN's fig. 31, our Fig. 6a) also occurs (HEGEWALD & SCHNEPF 1979, our Fig. 6e).

We studied several natural populations of the alga in question and several similar species, with the following results:

(a) The first type (Fig. 5a) corresponding with MEYEN's fig. 30, has 4—8-celled coenobia with oval, slightly irregularly arranged cells. The cells of the 8-celled coenobia are situated in two rows. The neighbouring cells either touch each other with their side walls or there are narrow spaces between them. Both cell ends are broadly rounded with the cell walls not thickened. The outer cells have mostly convex sides. Between the rounded proximal ends ("bases") of the cells there occur small, ± triangular and irregular spaces. The daughter coenobia liberate through the apical opening. Because the name "*Sc. obtusus*" is in this concept nomen confusum and nomen ambiguum, it must be rejected according to Code, Art. 69, and a new correct name has to be selected.

Because CHODAT's (1926) iconotype of *Sc. ovalternus* (Fig. 5b) corresponds well to this alga, this name can serve as basionym for our alga within *S einedesmus*. The correct name of this alga is, therefore, *Steinedesmus ovalternus* (CHOD.) comb. nova. At least, this alga is similar to *Steinedesmus graevenitzii* and the variation limits between these two species must be

revised in the future. Similar alga was pictured as *Sc. bijugatus* var. *irregularis* sensu PHILIPOSE 1967 from India (Fig. 5c).

(b) MEYEN's other alga (his fig. 31) has a cell morphology similar to *Steinedesmus graevenitzii* (Fig. 6a) but the syncoenobia have never been found. Other morphologically similar algae are published under the names *Sc. alter-*

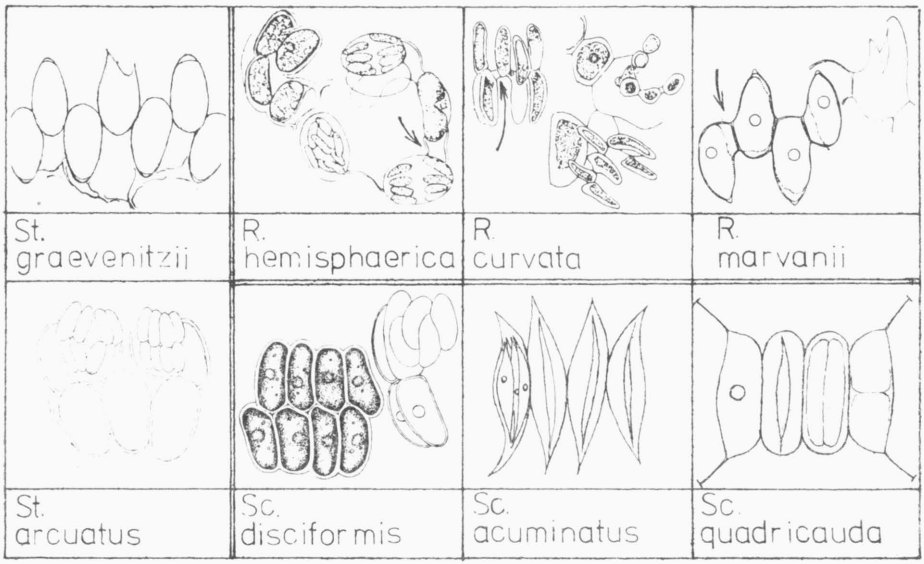

Fig. 3. — Comparison of the reproduction stages in *Steinedesmus* (2 species), *Rayssiella* (3 species), and *Scenedesmus* (3 species). (From different authors.)

nans REINSCH 1867 p.p. (Fig. 6b, second picture), *Sc. bijugatus* sensu SKUJA 1956 from Sweden (Fig. 6d), *Sc. bijugatus* var. *graevenitzii* sensu PHILIPOSE 1967 from India (Fig. 6g), and *Sc. obtusus* sensu HEGEWALD & SCHNEPF 1979 from Hungary (Fig. 6e). In Cuba (Fig. 6h) a morphologically similar population was found, in which the daughter coenobia liberate exclusively by the apical openings (COMAS in litt.). Because in this alga the daughter coenobia liberate through the apical openings in the mother cells they must be classified as one separate species of *Steinedesmus*.

The question of correct name of this alga remains. REINSCH's "*Scenedesmus alternans*" is in the same situation as with MEYEN's *Sc. obtusus*. The iconotype consists of two pictures belonging to two different types (the first one possibly to *Dimorphococcus*; our Fig. 6b). The name "*Sc. alternans*" is therefore nomen confusum, in spite of its being used later only for different *Scenedesmus* species. The very similar alga is also *Sc. ralfsii* PLAYF. 1923 (Fig. 6c) which can be used for the typification of the species in question. The correct name in this case is *Steinedesmus ralfsii* (PLAYF.) comb. nova.

The relations of *St. ralfsii* to *St. graevenitzii* and *St. ovalternus* are yet unclear. If the wider variation will be proved in these types and the taxonomic identity of all three taxa discussed, the correct name must be "*St. obtusus*

(MEYEN)" because both of MEYEN's algae belong in this case to one and the same species.

(c) Habitually similar alga is *Scenedesmus platydiscus* (G. M. SMITH) CHOD.

Fig. 4. — *Steinedesmus graevenitzii* (CHOD.) KOFOID, Cuban populations: **a** detail of a 4-celled coenobium, **b**—**d** colonies, **e**—**h** free coenobia, **i** solitary cell, **j**—**k** reproduction stages. (Orig. COMAS.)

1926 (Fig. 7). The coenobia are composed mainly of 2 rows of oval cells touching one another at their sides, without apical thickenings, broadly rounded at both ends. The outer cells have mostly slightly concave external sides. The daughter coenobia liberate through the lateral fissure, but syncoenobia were never observed. We studied the different populations of this alga from Czechoslovakia. It belongs to the genus *Scenedesmus* and the correct name is *Sc. platydiscus*.

3. *Scenedesmus arcuatus*, *Sc. disciformis* and *Rayssiella hemisphaerica*

Scenedesmus arcuatus (LEMM.) LEMM. 1899 (Fig. 8) has coenobia similar to *Sc. platydiscus*, but it differs from it by the longer and slightly narrowed cell ends, commonly arcuated coenobia and, mainly, by the apical openings of the mother cells during the reproduction. The ability to form small syncoenobia was also observed. In our opinion, this species must be transferred to the genus *Steinedesmus* as a separate species, *Steinedesmus arcuatus* (LEMM.) comb. nova.

Another similar species, *Scenedesmus disciformis* (CHOD.) FOTT et KOM. 1960, has the neighbouring cells completely attached to each other, no spaces (or with very small and regular triangular openings) between their proximal "bases" and walls, and with slightly concave sides of the outer cells (Fig. 3). The daughter coenobia are released through the lateral fissure in the mother cell walls (comp. KOMÁREK 1983). In our opinion, this species is well defined and belongs to the genus *Scenedesmus*.

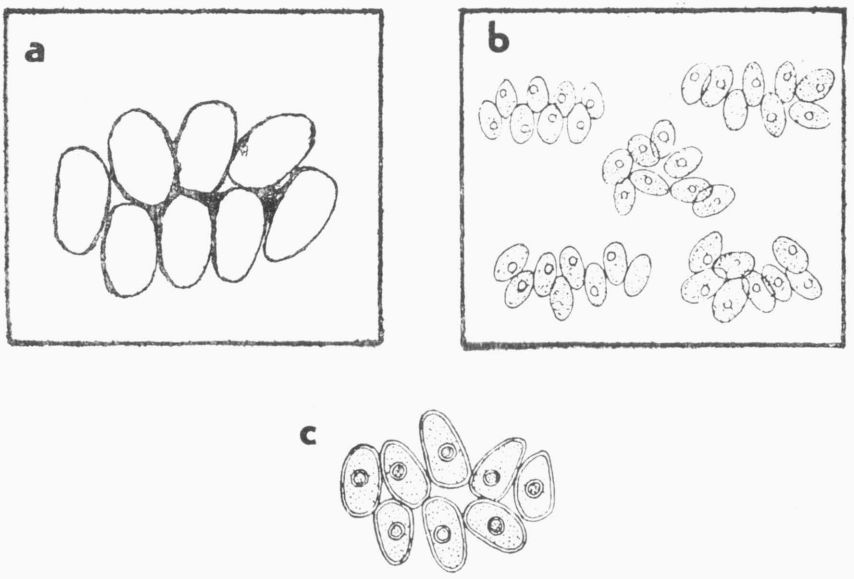

Fig. 5. — *Steinedesmus ovalternus* (CHOD.) comb. nova: **a** iconotype of *Sc. obtusus* MEYEN 1829 p.p. (fig. 30), **b** iconotype of *Sc. ovalternus* CHOD. 1926, **c** *Sc. bijugatus* (TURP.) KÜTZ. var. *irregularis* WILLE sensu PHILIPOSE 1967 from India.

Similar to *Steinedesmus arcuatus* is *Rayssiella hemisphaerica* EDELST. et PRESC. 1964. It follows from the iconotype of this alga (reproduction stages) that the proximal parts of the cells are connected by processi, which can define the separate genus (Fig. 3, arrows).

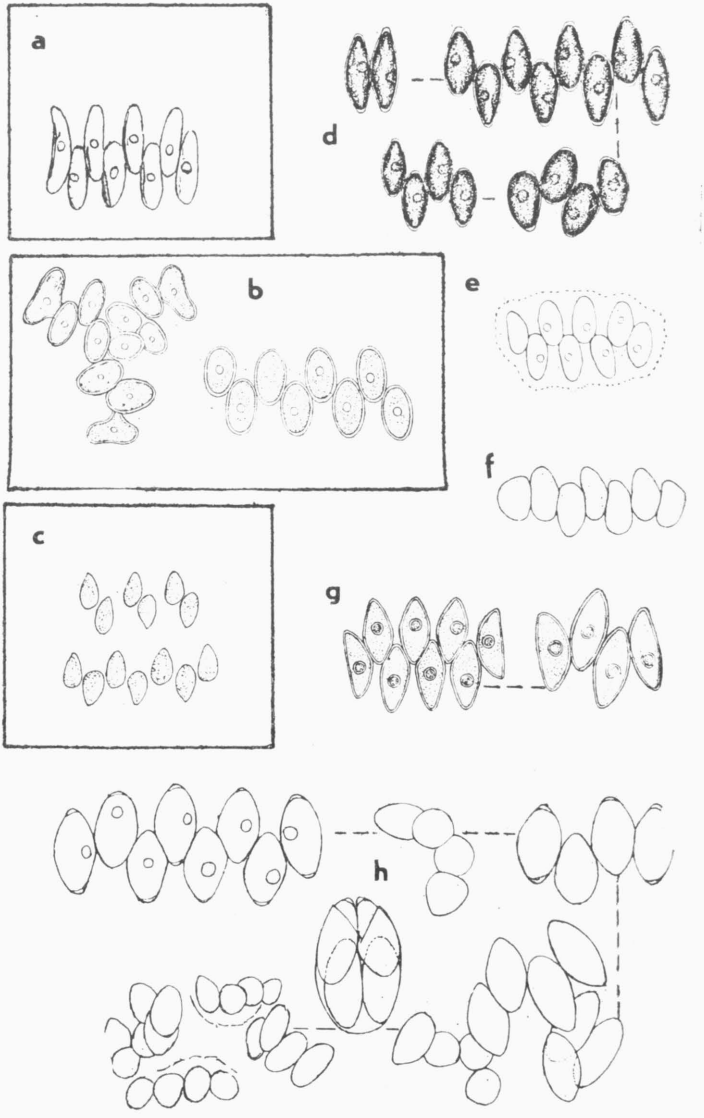

Fig. 6. — **a** Iconotype of *Sc. obtusus* MEYEN 1829 p.p. (fig. 31); **b** iconotype of *Sc. alternans* REINSCH 1866. — *Steinedesmus ralfsii* (PLAYF.) comb. nova: **c** iconotype of *Sc. ralfsii* PLAYF. 1923, **d** *Sc. bijugatus* (TURP.) KÜTZ. after SKUJA 1956 from Sweden, **e** *Sc. obtusus* MEYEN after HEGEWALD et SCHNEPF 1979 from Hungary, **f** *Sc. ovalternus* CHOD. after KISS 1939 from Hungary, **g** *Sc. bijugatus* (TURP.) KÜTZ. var. *graevenitzii* (BERN.) PHILIP. after PHILIPOSE 1967 from India, **h** Orig. COMAS from Cuba.

Scenedesmus arcuatus var. *capitatus* G. M. SMITH 1918 (Fig. 9) is a well described taxon, also with apical openings of the mother cell walls. We classify it, therefore, as a special species of the genus *Steinedesmus*, namely *St. capitatus* (G. M. SMITH) comb. nova.

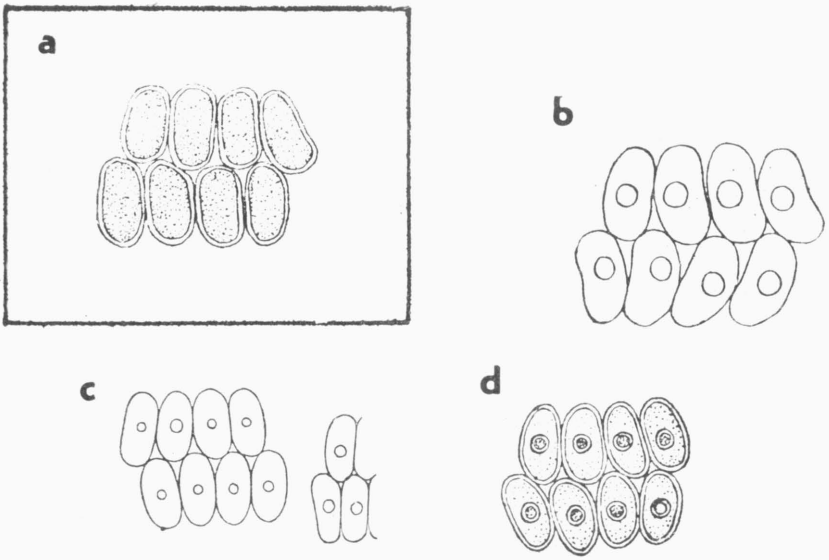

Fig. 7. — *Scenedesmus platydiscus* (G. M. SMITH) CHOD.: **a** iconotype of G. M. SMITH 1916, **b** *Sc arcuatus* (LEMM.) LEMM. sensu UHERKOVICH 1961 sec. 1966 from Hungary, **c** *Sc. alternans* REINSCH var. *platydiscus* G. M. SMITH sensu FOTT et KOM. 1960 from Czechoslovakia, **d** *Sc. arcuatus* (LEMM.) LEMM. sensu PHILIPOSE 1967 from India.

4. *Scenedesmus apiculatus* and *Sc. apiculatus* var. *indicus*

Another similar alga is *Scenedesmus apiculatus* W. et G. S. WEST forma in UHERKOVICH 1959 (see UHERKOVICH 1966, fig. 253), and *Sc. apiculatus* var. *indicus* HORTOB. 1969 (Figs. 10b, c). The features of these algae are as follows: 4—8-celled coenobia with strongly alternating cells, and spaces occurring between the cells. Cells elongated, irregularly spindle-like or elongated oviform, sometimes slightly asymmetrical and curved, with wart-like thickenings at the distal ends. Reproduction (according to our material from Cuba) through the apical openings.

This alga evidently represents a separate taxon similar to *St. ralfsii*, from which it differs mainly by the more elongated cells and by the dentiform thickenings of the cell wall. As the reproduction process is similar to that in *Steinedesmus graevenitzii*, this alga must be re-classified in the genus *Steinedesmus*.

This taxon was described from the tropical region, but its findings from the temperate zone are not rare (Hungarian localities). The epitheton can not be "*apiculatus*" because in WEST's iconotype of *Sc. apiculatus* (Fig. 10a) the cells are clearly oval with distinct terminal teeth, while they are irregularly oviform in the described material and the apical wart-like thickenings of the

cell walls (not teeth) are present. The correct name for this alga within *Steinedesmus* should be *St. indicus* (HORTOB.) comb. nova.

5. *Rayssiella curvata* and *R. marvanii*

Rayssiella curvata (originally *Scenedesmus curvatus* BOHL. 1897) and *R. marvanii* (Fig. 3) were reclassified into the genus *Rayssiella* by KOMÁREK (1974) because of the alternating cells in coenobia, lateral connections of the distinct processi at the proximal ends of the cells, slightly arcuated coenobia, and liberation of daughter coenobia from the mother cells through the apical or subapical openings (corresponding with the iconotype of *Rayssiella hemisphaerica*).

The genus *Rayssiella* is surely very close to *Steinedesmus*; the morphology of cell connections can, however, distinguish the two genera. The morphology of the connecting processi is documented by the iconotypes of *R. curvata* and *R. marvanii*; in the type species, *R. hemisphaerica*, it follows from the pictured reproduction stages (see also the iconotype).

6. Review of the genus *Steinedesmus* KOFOID 1911 and similar *Scenedesmus* species

Steinedesmus KOFOID Univ. Calif. Publ. Zool. 8 : 199, 1911.

Syn.: *Steiniella* BERN. Protoc. Desm. d'eau douce à Java, p. 189—190, 1908; non *Steiniella* SCHÜTT 1895.

Coenobia linear with 2 rows of clearly alternating cells, touching only at their bases, with (2)—4—8 cells; spaces occur between the cells in one row. Coenobia connected occasionally in syncoenobia by the remnants of mother cell walls. Cells oval, ellipsoidal or ovoid, sometimes slightly asymmetrical (particularly the marginal ones), sometimes narrowed at the distal ends, and with thickened walls. Cell walls smooth, without sculptures. Chloroplast parietal, with one pyrenoid having a starch sheath. Reproduction by daughter coenobia, liberating through the terminal opening from the mother cell. — Type species: *Steiniella graevenitzii* BERN. 1908 = *Steinedesmus graevenitzii* (BERN.) KOFOID 1911.

Key to the determination of the species:

1a Cells clearly ovoid (widest in 1/5 or 1/3, rarely in 1/2 of the cell length), without thickened cell walls 2
1b Cells ellipsoidal oš irregular ovoid (widest in 1/3 or 1/2 of the cell length) and elongated, obligatory or facultatively with polar cell wall thickenings (sometimes indistinct) or with wart-like thickenings 3
2a Cells shortly ovoid to oval, mainly 10—14 × 4—8 μm, speces between the cells lack or narrow (rarely wider than the width of cells); coenobia sometimes with irregularly arranged cells... ..... 1. *St. ovalternus*
2b Cells elongated, ovoid, mainly 8—20 × 4—9 μm, spaces between the cells narrow and regular (less than 1/2 width of cells); coenobia regular, mainly arcuated ..... 2. *St. arcuatus*
3a Cells ± ellipsoidal or ellipsoidal-ovoid (especially the inner ones), facultatively with cell wall thickenings at one or both poles 4
3b Cells in outline ± ellipsoidal (sometimes with slightly elongated distal ends), obligatory with apical wart-like thickenings 5
4a Coenobia regular, mainly solitary, without forming syncoenobia ..... 3. *St. ralfsii*
4b Coenobia often irregular, sometimes arcuated, with the tendency to form syncoenobia ..... 4. *St. graevenitzii*

5a Inner cells narrow, ovoid, $10-17 \times 3-8$ µm, outer cells ± ellipsoidal, sometimes slightly asymmetrical ..... 5. *St. indicus*

5b All cells widely ovoid to almost oval, $9-23 \times 3-11$ µm, symmetrical ..... 6. *St. capitatus*

1. *Steinedesmus ovalternus* (Chod.) comb. nova

Syn.: *Scenedesmus obtusus* Meyen Nova Acta Phys. Med. Acad. Caes. Leop. Carol. Nat. Curr. 14(2) : 775, 1829, p.p. (fig. 30); nomen ambiguum.
Scenedesmus ovalternus Chod. Scenedesmus, p. 164, fig. 51, 1926; basionym.
Scenedesmus bijugatus (Turp.) Kütz. var. *irregularis* Wille sensu Philipose Chlorococcales, New Delhi, p. 253, 1967.

Coenobia (4)—8-celled, sometimes irregular, easily disintegrating; cells oval or widely ovoid, widely rounded at the ends, without thickened cell walls; the spaces between the cells lacking or narrow, rarely ± as wide as is the cell width. Coenobia mainly solitary, rarely joined together. Cells $(?4)-8-18 \times 3-12$ µm. — Probably more frequent in tropical and rare in temperate regions. — Fig. 5.

Notes: The variation range of this alga probably also comprises other described taxa such as *Sc. ovalternus* var. *radiatus* (Reinsch) Hansg., *Sc. bijuga* var. *alternans* forma sensu Borge, *Sc. bijuga* var. *alternans* f. *parvus* G. M. Smith, *Sc. bijuga* f. *minutissimus* Kuffer., *Sc. alternans* var. *irregularis* (Kiss) Kirj., and others.

2. *Steinedesmus arcuatus* (Lemm.) comb. nova

Syn.: *Scenedesmus bijugatus* (Turp.) Kütz. var. *arcuatus* Lemm. Bot. Zentralbl. 76 : 159, 1898, basionym.

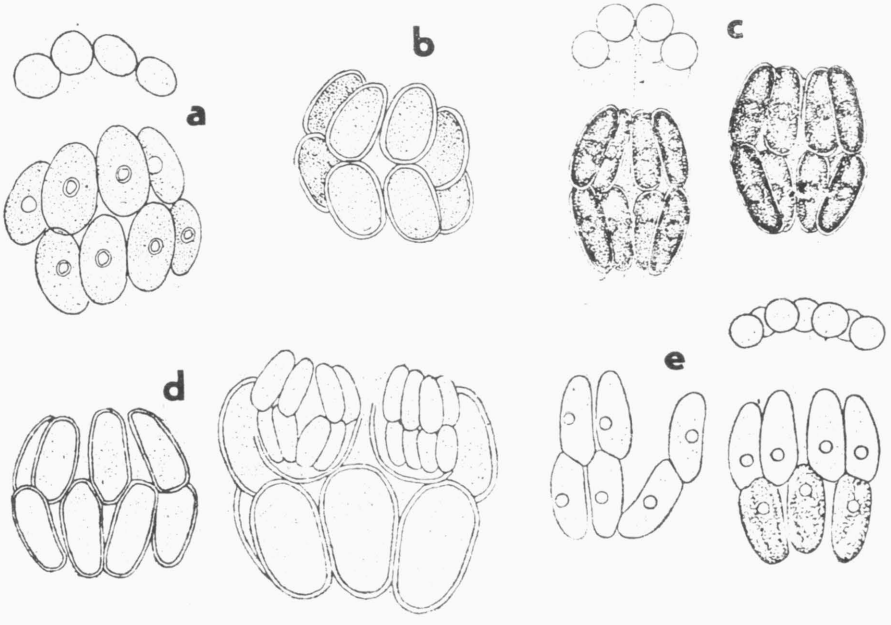

Fig. 8. *Steinedesmus arcuatus* (Lemm.) comb. nova: **a** iconotype of *Sc. arcuatus* (Lemm.) Lemm. after Lemmermann 1899, **b** *Sc. arcuatus* (Lemm.) Lemm. after G. M. Smith 1916, **c** *Sc. arcuatus* (Lemm.) Lemm. after Skuja 1956 from Sweden, **d** *Sc. arcuatus* (Lemm.) Lemm. after G. M. Smith 1920 from USA, **e** *Sc. alternans* Reinsch var. *prescottii* Fott et Kom. after Fott et Kom. 1960 from Czechoslovakia.

Scenedesmus arcuatus (LEMM.) LEMM Forschungsber. Biol. Stat. Plön 7 : 112 fig. 1, : 2–4, 1899.
Scenedesmus bijuga var. *alternans* sensu G. M. SMITH 1920 and PRESCOTT 1951.
Scenedesmus curvatus BOHL. sensu auct. post.
Scenedesmus alternans REINSCH var. *arcuatus* (LEMM.) FOTT et KOM. Preslia 32 : 126–127 fig. 8 : 10, 1960.
Scenedesmus alternans REINSCH var. *prescottii* FOTT et KOM. Preslia 32 : 127, fig. 8 : 5, 1960.

Coenobia (2)–4–8-celled, regular, mainly arcuated; cells elongated-ovoid, slightly narrowed at the ends and widely rounded, without thickened cell

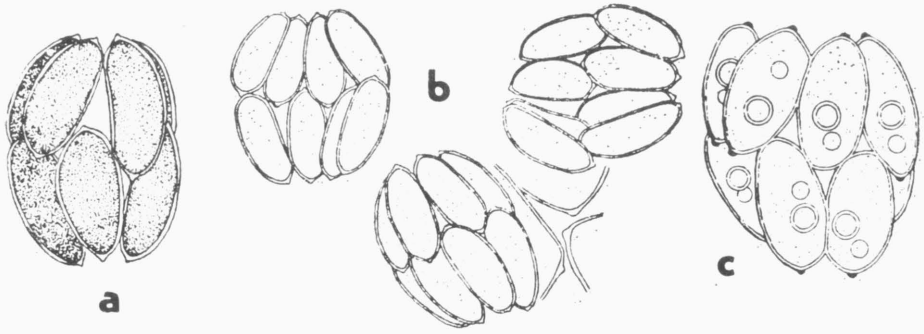

Fig. 9. – *Steinedesmus capitatus* (G. M. SMITH) comb. nova: **a** iconotype of *Sc. arcuatus* var. *capitatus* G. M. SMITH 1918 from USA, **b** after G. M. SMITH 1920, **c** after HORTOBÁGYI 1969 from India.

walls; the spaces between cells narrow, up to 1/2 of the cell width. Coenobia mainly solitary, rarely (young stages) are the daughter coenobia joined facultatively by the remnants of mother cell walls. Cells 8–20 × 4–9 µm. – In slightly eutrophic waters, mainly in the temperate zone. – Fig. 8.

3. *Steinedesmus ralfsii* (PLAYF.) comb. nova

Syn.: *Scenedesmus ralfsii* PLAYF. Proc. Linn. Soc. N.S.W. 48 : 22, 1923; basionym.
? *Scenedesmus obtusus* MEYEN Nova Acta Phys. Med. Acad. Caes. Leop. Carol. Nat. Curr. 14(2) : 775, 1829, p.p. (fig. 31); nomen ambiguum.
? *Scenedesmus alternans* REINSCH Abh. Senck. Naturf. Ges. 6 : 135, fig. 20 : D5, 1867, p.p.; nomen ambiguum.
? *Scenedesmus platydiscus* (G. M. SMITH) CHOD. var. *alternans* (REINSCH) CHOD. Scenedesmus, p. 176, 1926.
? *Scenedesmus obtusus* MEYEN f. *alternans* (REINSCH) COMP. Bull. Jard. bot. nat. Belg. 46 : 231, 1976.
Scenedesmus obtusus MEYEN sensu HEGEW. et SCHNEPF Schw. Z. Hydrobiol. 40 : 326, fig. 6d, 1979.
Scenedesmus bijugatus (TURP.) KÜTZ. sensu SKUJA Nova Acta Reg. Soc. Sci. Upsal. 4, 16(3) : 179, figs. 28 : 29–32, 1956.
Scenedesmus bijugatus (TURP.) KÜTZ. var. *graevenitzii* (BERN.) PHILIPOSE Chlorococcales, New Delhi, p. 254, 1967; sine typo.

Coenobia (2)–4–8-celled, mainly regularly situated in two rows; cells ± oval-ovoid to elongated ovoid or ellipsoidal-ovoid, to the distal end ± slightly narrowed, rounded and (sometimes?) with slightly thickened cell wall; the spaces between the cells of the width of ± 1/2 of cells or as broad

as the cell width. Cells 13.2—17×3—10 μm. — Probably with cosmopolitan occurrence, but not common. — Fig. 6.

4. *Steinedesmus graevenitzii* (BERN.) KOFOID Univ. Calif. Publ. Zool. 8 : 199, 1911.

Syn.: *Steiniella graevenitzii* BERN. Protoc. Desm. d'eau douce Java, p. 190, fig. 463—466, 1908.
Scenedesmus ovalternus CHOD. var. *graevenitzii* (BERN.) CHOD. Scenedesmus, p. 165, fig. 52, 1926.

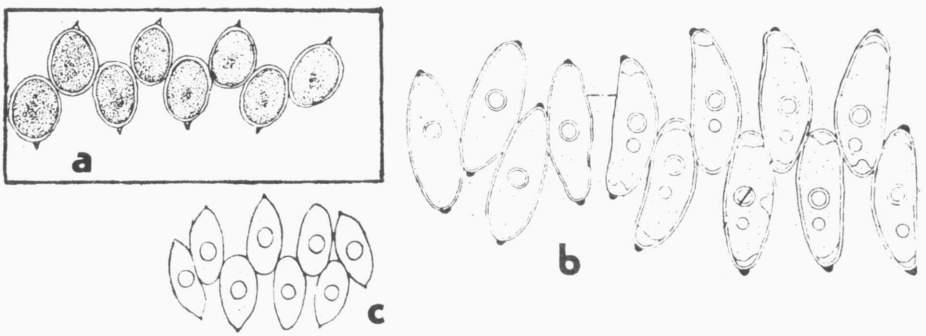

Fig. 10. — **a** Iconotype of *Sc. apiculatus* (W. et G. S. WEST) CHOD. after W. et G. S. WEST 1984. — *Steinedesmus indicus* (HORTOB.) comb. nova: **b** iconotype of *Sc. apiculatus* var. *indicus* HORTOB. 1969 from India, **c** *Sc. apiculatus* forma sensu UHERKOVICH 1959 sec. 1966 from Hungary.

Scenedesmus graevenitzii (BERN.) MARG. Publ. Inst. Biol. apl. 22 : 91, fig. 14d, i, 1956.
Scenedesmus bijugatus (TURP.) KÜTZ. var. *graevenitzii* (BERN.) PHILIPOSE Chlorococcales, New Delhi, p. 254, 1967; pro typo.
Scenedesmus alternans REINSCH var. *graevenitzii* (BERN.) KIRJ. Rod Scenedesmus, Avtoref., Plovdiv, p. 18, 1977.
Schroederiella africana WOLOSZ. sensu UHERK. Amazoniana 7(2) : 214, fig. 2 : 3, 1981.

Coenobia 4—8-celled, mainly slightly irregular, often joined in syncoenobia; cells in outline ± ellipsoid-ovoid, slightly narrowed and rounded towards both ends, mostly with slightly thickened cell walls at the poles; the spaces between cells as wide as the cell width or narrower (up to ± 1/2 of the cell width). Cells 10—16,5×3—8.5 μm. — Cited from localities all over the world, but probably distributed mainly in tropical regions. — Figs. 1, 4.

5. *Steinedesmus indicus* (HORTOB.) comb. nova

Syn.: *Scenedesmus apiculatus* W. et G. S. WEST sensu auct. post. sine typo (incl. fa. in UHERKOVICH 1959, sec. 1966).
Scenedesmus apiculatus W. et G. S. WEST var. *indicus* HORTOB. Stud. biol. Hung. 8 : 49, fig. 307, 1969; iconotype, basionym.
Scenedesmus ovalternus CHOD. var. *indicus* HORTOB. Microfl. Budapest waterworks, p. 103, fig. 488, 1973.
Scenedesmus alternans REINSCH var. *indicus* (HORTOB.) KIRJ. Rod Scenedesmus, Avtoref., Plovdiv, p. 19, 1977.

Coenobia 4—8—(16)-celled; cells narrow, ovoid, sometimes slightly arcuated and asymmetrical, narrowed toward the ends, rounded and with wart-like thickenings at the poles, marginal cells irregularly spindle-shaped,

sometimes slightly arcuated, with thickenings at both ends; spaces between cells ± 1/2 as wide as the cell width, or wider. Coenobia solitary. Cells 10—17 × 3—8 μm. — In tropical regions, rarely in warmer countries of the temperate zone. — Fig. 10.

Notes: The solitary coenobia are more similar to those of other *Scenedesmus* species (e.g., *S. tibiscensis*); the reproduction process and variation range must be revised.

6. *Steinedesmus capitatus* (C. M. Smith) comb. nova

Syn.: *Scenedesmus arcuatus* (Lemm.) Lemm. var. *capitatus* G. M. Smith Trans. Wis. Acad. Sci. Arts Lett. 19(1) : 637, pl. 11 : 4—5, 1918; basionym.

Coenobia 4—8—(16)-celled, arcuated, solitary or joined (when young) facultatively in small syncoenobia; cells ± widely ellipsoidal or oval, rarely slightly ovoid, rounded and with small, wart-like apical thickenings of the cell walls; the spaces between the cells are narrow, and neighbouring cells are sometimes in contact. Cells 9—23 × 3—11.3 μm. — Several localities from different countries, which need revision. — Fig. 9.

The morphologically similar species with the typical *Scenedesmus*-like reproduction (lateral fissure), discussed in this paper, are as follows:

Scenedesmus platydiscus (G. M. Smith) Chod. 1926 [Syn.: *Scenedesmus obtusus* Meyen 1829 p.p. (fig. 30), nomen ambiguum; *Sc. arcuatus* var. *platydiscus* G. M. Smith 1916; *Sc. reniformis* Kisel. 1931; *Sc. alternans* var. *platydiscus* (G. M. Smith) Fott et Kom. 1960].

Scenedesmus disciformis (Chod.) Fott et Kom. 1960 [Syn.: *Scenedesmus bijugatus* var. *disciformis* Chod. 1902; *Sc. ecornis* var. *disciformis* Chod. 1926; *Sc. bijugatus* sensu auct. post. (Behre 1939, etc.); *Tetrachlorella nephrocellularis* Kom. 1975].

ACKNOWLEDGEMENT

We are thankful to Dr. P. Marvan (Brno) for valuable comments.

SOUHRN

Bernard (1908) popsal z Indonesie (Java) rod zelené cenobiální řasy *Steiniella* (Scenedesmaceae, Chlorellales) s jediným druhem *Steiniella graevenitzii*. Jeho rodové jméno však bylo neplatné (pozdní homonymum ke *Steiniella* Schütt 1895, Gonyaulacaceae, Dinophyceae), bylo proto nahrazeno novým jménem *Steinedesmus* Kofoid 1911.

Tato řasa je podobná strukturou buněk a stavbou cenobií rodu *Scenedesmus*, od něhož se liší podle původní diagnosy příležitostnou tvorbou syncenobií (cenobia jsou spojena zbytky mateřských stěn). Protože fakultativní vznik syncenobií byl pozorován i u jiných druhů r. *Scenedesmus*, byl r. *Steinedesmus* (*Steiniella* Bern.) pokládán za neoprávněný. Na základě bohatého přírodního materiálu této řasy z Kuby však bylo zjištěno, že tvorba syncenobií u r. *Steinedesmus* je závislá ještě na dalším znaku: deeřinná cenobia se neuvolňují z mateřské buňky boční praskliny jako je tomu u *Scenedesmus*, ale apikálním otvorem a zůstávají pak často přisedlé na zbytcích zeslizovatělé stěny. Tento znak nebyl zdůrazněn v původní rodové diagnose, ale vyplývá z ikonotypu, je stabilní a vyjadřuje odlišnou polaritu buněk od r. *Scenedesmus*. Pokládáme jej za důležitý z biologického i vývojového hlediska a považujeme proto i rod *Steinedesmus* za oprávněný.

Rod *Steinedesmus* lze tedy definovat následujícími diakritickými znaky: (i) Lineární, dvouřadá cenobia typu *Scenedesmus* s výrazně alternujícími buňkami, (ii) uvolňování deeřinných cenobií apikálním otvorem, (iii) tendence tvořit syncenobia, (iv) hladká buněčná stěna bez skulptur na sporopoleninové vrstvě. Podobným rodem je *Rayssiella* Edelst. et Presc. 1964 s obdobnou stavbou cenobií a rovněž s apikálním uvolňováním deeřinných cenobií. Buňky jsou však u tohoto rodu spojeny na svých proximálních koncích bočními výrůstky, které zcela chybí v r. *Steinedesmus*.

Podle uvedených znaků byla provedena revise rodu, do kterého bylo zařazeno 6 druhů: *Steinedesmus ovalternus* (Chod.) comb. nova, *St. arcuatus* (Lemm.) comb. nova, *St. ralfsii* (Playf.) comb. nova, *St. graevenitzii* (Bern.) Kofoid (typ rodu), *St. indicus* (Hortob.) comb. nova a *St. capitatus* (G. M. Smith) comb. nova. Tři druhy (*St. ralfsii, St. graevenitzii* a *St. indicus*) byly nalezeny na Kubě, *St. arcuatus* je znám z mírného pásma a také z Československa. *St. capitatus* patří do r. *Steinedesmus* podle originálního popisu a ikonotypu G. M. Smitha. *St. ovalternus*, který je morfologicky velice blízký *St. graevenitzii*, potřebuje další revisi.

REFERENCES

Bernard C. (1908): Protococcacées et Desmidiées d'eau douce récoltés à Java. — Batavia, 230 pp.

Chodat R. (1926): Scenedesmus. Etude génétique, de systématique experimentale et d'hydrobiologie. — Z. Hydrol. Aarau, 3 : 71—258.

Comas A. (1983): Übersicht der zönobialen Chlorokokkalalgen von Kuba. — Ms. [Dissert., Třeboň, 162 pp.].

Compère P. (1976): Algues de la région du lac Tchad V. Chlorophycophytes 1. — Cah. O.R.S.T.O.M., Bondy, ser. hydrobiol., 10(2) : 77—118.

Edelstein T. et Prescott G. W. (1964): Rayssiella, a new genus of Oocystaceae, Chlorophyta from Spring Lake, Michigan. — Phycologia, Berkeley, 4(2) : 121—125.

Farr E. R., Leussink J. A. et Stafleu F. A. ed. (1979): Index nominum genericorum (plantarum). 1—3. — Utrecht et Haag.

Fott B. et Komárek J. (1960): Das Phytoplankton der Teiche im Teschner Schlesien. — Preslia, Praha, 32 : 113—141.

Hegewald E. et Schnepf E. (1979): Geschichte und Stand der Systematik der Grünalgen-Gattung Scenedesmus. — Schw. Z. Hydrol., Basel, 40 : 320—342.

Hortobágyi T. (1969): Phytoplankton organisms from three reservoirs on the Jamuna river, India. — Budapest.

Komárek J. (1974): The morphology and taxonomy of crucigenioid algae (Scenedesmaceae, Chlorococcales). — Arch. Protistenk., Jena, 16 : 1—75.

— (1983): Contribution to the chlorococcal algae of Cuba. — Nova Hedwigia, Braunschweig, 37 : 65—180.

Komárek J. et Fott B. (1983): Chlorophyceae (Grünalgen), Ordnung Chlorococcales. — In: Huber-Pestalozzi [red.], Das Phytoplankton d. Süsswassers, Stuttgart, 16, 7/1 : 1044 pp.

Lund J. W. G. (1960): Some new British algae. — Naturalist, London, 1960/7-8: 89—96.

Margalef R. (1956): Algas de agua dulce del noroeste de España. — Publ. Inst. Biol. Apl., Barcelona, 22 : 43—152.

Meyen F. J. F. (1829): Beobachtungen über einige niedere Algenformen. — Nova Acta Phys.-Med. Acad. Caesar. Leop. Carol. 14 : 769—778.

Philipose M. T. (1967): Chlorococcales. — New Delhi.

Skuja H. (1956): Taxonomische und biologische Studien über das Phytoplankton schwedischer Binnengewässer. — Nova Acta Reg. Soc. Sci. Upsal. 4, 16/3 : 1—404.

Smith G. M. (1916): A monograph of the algal genus Scenedesmus based upon some cultures studied. — Trans. Wisc. Acad. Sci. Arts Lett., Madison, 18 : 422—530.

— (1918): A second list of algae found in Wisconsin lakes. — Trans. Wisc. Acad. Sci. Arts Lett., Madison, 19 : 614—654.

— (1920): Phytoplankton of the inland lakes of Wisconsin I. — Bull. Wisc. Geol. Nat. Hist. Surv., Madison, 57/1 : 243 pp.

Uherkovich G. (1966): Die Scenedesmus-Arten Ungarns. — Budapest.

— (1981): Algen aus einigen Gewässern Amazoniens. — Amazoniana, Kiel, 7/2 : 191—219.

Received 26 January, 1984