

Some chlorococcal algae (*Chlorophyceae*) from China

Niektoré chlorokokálne riasy (*Chlorophyceae*) z Číny

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Morphological variation of 13 representatives belonging to 6 genera of chlorococcal algae (*Chlorophyceae*), namely *Keratococcus*, *Monoraphidium*, *Crucigeniopsis*, *Botryococcus*, *Neodesmus* and *Scenedesmus*, were studied on the material from the territory of China. Majority of them have not been probably recorded till now from this country. A new species, *Scenedesmus kantonensis* Hindák, and a new combination, *S. subspicatus* Chodat var. *crassicaudatus* (Hortob.) Hindák, are proposed.

Introduction

During our short study stay in China, October 1986, we had an opportunity to collect some phycological material from different parts of the country, namely in Beijing (Peking), Wuhan (Prov. Hubei, C China), Guangzhou (Kanton, Prov. Guandong, SE China) and Xi'an (NC China) and their surroundings. Only a paper on morphological variation of trichomes in *Raphidiopsis curvata* Fritsch et Rich (Cyanophyta), sampled from fishponds at Wuhan, has been published so far from this collection, and a manuscript dealing with a rare species of the genus *Coelastrum* Näg. was prepared (Hindák, in preparation).

In this contribution, the results of studying morphological diagnostical features of selected chlorococcal algae are presented. The main attention was paid to the genus *Scenedesmus* Meyen, in which a new species, *S. kantonensis* Hindák, and a new combination, *S. subspicatus* Chodat var. *crassicaudatus* (Hortob.) Hindák, are suggested. However, owing to a limited time of the visit only some samples were taken and studied in fresh state and/or under laboratory conditions.

Results and discussion

1. *Keratococcus saxatilis* (Komárková-Legnerová) Hindák 1977

Fig. 1:1

Syn.: *Monoraphidium saxatile* Komárková-Legnerová 1969 - basion., *Chlorolobion saxatile* (Komárková-Legnerová) Komárek 1979

The species was originally described as *Monoraphidium saxatile* (Komárková-Legnerová 1969) but due to the presence of a pyrenoid with the starch envelope it was transferred into the genus *Keratococcus* (Hindák 1977, 1980). Komárek (1979) and Komárek et Fott (1983) considered this species as a member of the genus *Chlorolobion* Koršíkov 1953. The species has been recorded in Bohemia on wet rocky walls near

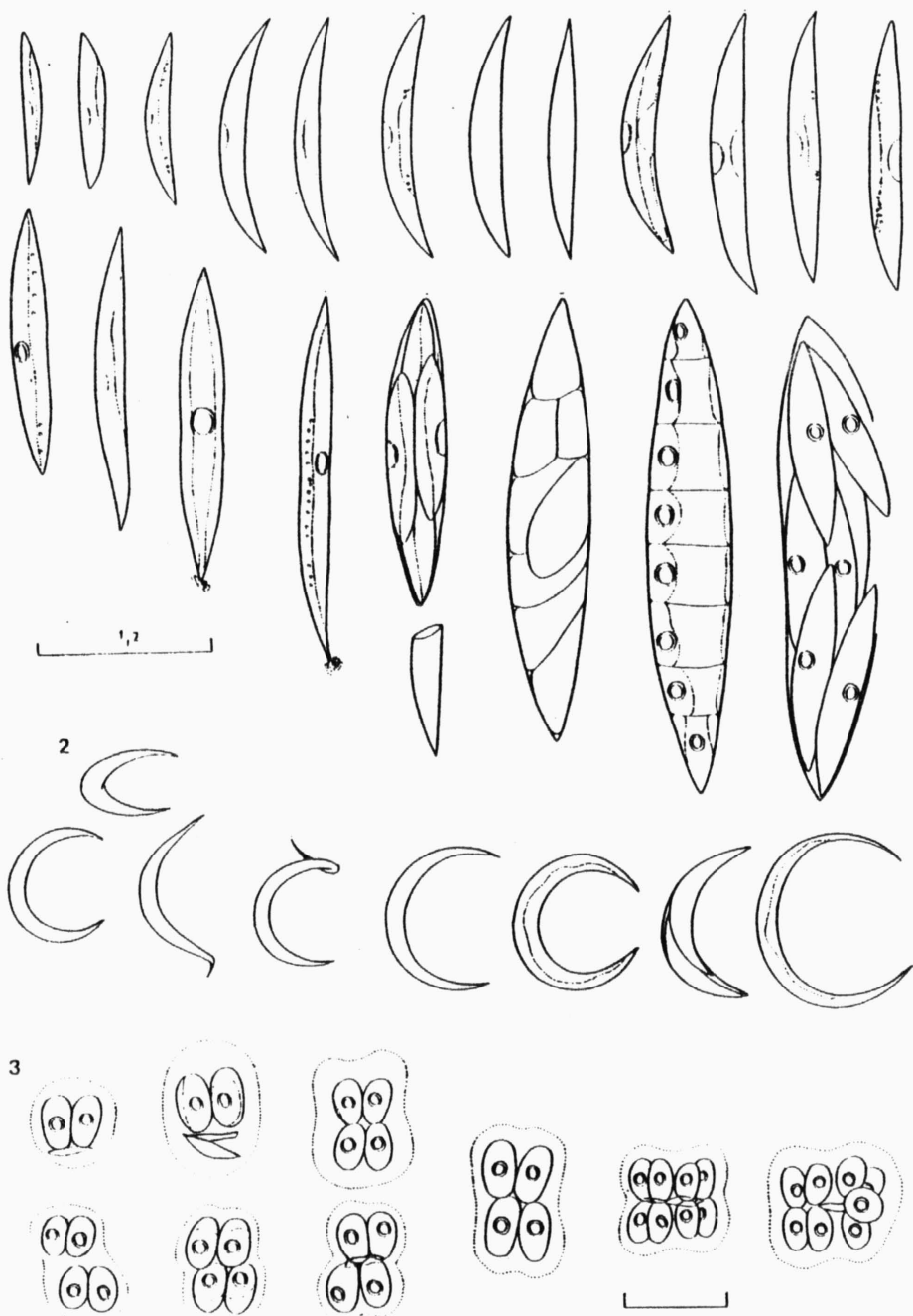


Fig. 1. - 1. *Keratococcus saxatilis* (Komárková-Legnerová) Hindák, cultured strain Hindák 1986/85, isolated from a pool at Hauqing Hot Springs near Xi'an; 2. *Monoraphidium circinale* (Nyg.) Nyg., natural material collected from the same locality; 3. *Crucigeniopsis divergens* (G. M. Smith) Hindák, specimens from a fishpond at Wuhan. Scale: 10 μ m.

Štěchovice (Komárková-Legnerová 1969) and at the territory of Slovakia on stones in a mineral spring at Kostolná near Trenčín (Hindák in Komárková-Legnerová 1969, Hindák 1977) and in littoral of an arm of the Danube River in Bratislava-Petržalka (Hindák 1980).

In China, it was collected in a pool with hot springs at Hauqing near Xi'an (NC China). In this pool, filled with mineral water, the cells were free or directly attached by one cell end on different substrates, mostly on detritus or on filamentous green alga *Rhizoclonium*. Cells were fusiform, straight or slightly bent or asymmetrical, gradually tapered towards ends, sharply pointed but not attenuated, without a mucilage layer. Dimensions of cells: 9-35 x 2.5-4.5 µm, those of autosporangia up to 45 x 9 µm. The chloroplast was parietal, large, with one big central pyrenoid, mostly situated on the dorsal part of slightly lunately bent cells. Starch envelopes were well developed around pyrenoids but in some cells the grains of starch were rather tiny. Number of autospores was 4-8; autospores are being released by the crosswise division of the mother cell wall into two equal parts.

Morphology of cells in the investigated culture (strain Hindák 1986/85), is in a good agreement with the original diagnosis and with our findings from Slovakia; only small differences were found. Young cells were less curved than those from the original material (Komárková-Legnerová 1969: Pl. 15), being bent only slightly and becoming straight prior to reproduction. The cells from Danube backwater were generally longer than those from China and the pyrenoid was also smaller.

2. *Monoraphidium circinale* (Nygaard) Nygaard 1977

Fig. 1:2

Syn.: *Monoraphidium capricornutum* var. *circinale* Nygaard 1979

The species is close to *Monoraphidium contortum* (Thur.) Komárková-Legnerová, but differs in having smaller and broader, arcuated to circinated cells. It has been recorded in the eutrophic lakes in Denmark (Nygaard 1977, 1979), gravel pit lakes and fishponds in Slovakia (Hindák et Holod 1983, Hindák 1988a) and oligotrophic Carinthian lakes in Austria (Hindák 1988b). It seems to be widespread in plankton and metaphyton of stagnant as well as of running waters but it has been overlooked or misinterpreted as *M. contortum*.

The cells from a pool at Hauqing Hot Spring near Xi'an (NC China), collected in the same site as the previous species, were markedly arcuated, torsional, from the centre towards the ends gradually attenuated and pointed, curved up to four fifth of a circle, with cell ends never overlapped, 7-10 µm in diameter, in the median part 1.2-2 µm, wide, along the axis to 22 µm long. The chloroplast was parietal, without a pyrenoid. Autospores 2-4, released by crosswise division of the mother cell wall in two parts. No mucilage was formed.

3. *Crucigeniopsis divergens* (G. M. Smith) Hindák 1984

Fig. 1:3

Syn.: *Crucigenia divergens* G. M. Smith - basion., *Crucigeniella divergens* (G. M. Smith) Fott 1981

The genus *Crucigeniopsis* Hindák 1984 with the only species *C. divergens* (G. M. Smith) Hindák was distinguished from the genus *Crucigeniella* Lemm. by X-shaped coenobia and by the mode of releasing daughter autospores from the mother cell wall. The species has been observed so far only in USA (Smith 1926) and in the Danube River and its backwaters near Bratislava, W Slovakia (Hindák 1984).

The investigated specimens from the experimental fishpond no. 3, situated near the Institute of Hydrobiology, Academia Sinica, Wuhan, did not differ essentially from those found in Slovakia. Coenobia were 4-celled or, after disintegration of coenobia, 2-celled, or after releasing of daughter coenobia they temporarily formed syncoenobia. The divergent long axes of cells were not so conspicuous as in the American population (Smith 1926) but coenobia were still X-shaped in general appearance and cells were not regularly radiately arranged but slightly shifted. The central opening of the coenobium was small and mostly irregular. The mucilage envelope was hyaline, thin, 1-1.5 μm wide. Dimensions of coenobia were somewhat smaller than those indicated in the Danube specimens, reaching 5-7 x 3.5-4 μm in the outline. Cells were elongated, ovoid to trapezoidal and slightly asymmetrical, 3-3.8 x 1.8-2.2 μm . The chloroplast was robust, parietal, with one big central pyrenoid. The number of autospores was 4; these were released from the mother cell wall in the same way as in the genus *Dictyosphaerium* Näg. or *Pseudotetrastrum* Hindák (Hindák 1977). Remnants of mother cell walls were irregular, visible for some time in the center of coenobia, i.e. on the "basal" end of autospores. Old coenobia before cell division were easily disintegrated into cell pairs or solitary cells.

4. *Botryococcus braunii* Kützinger 1849

Fig. 2:2

The species commonly occurs in plankton and metaphyton of oligotrophic to eutrophic waters, as the only representative of the chlorococcal algae forming water bloom. According to Komárek et Fott (1983) it is highly variable in some important diagnostical features.

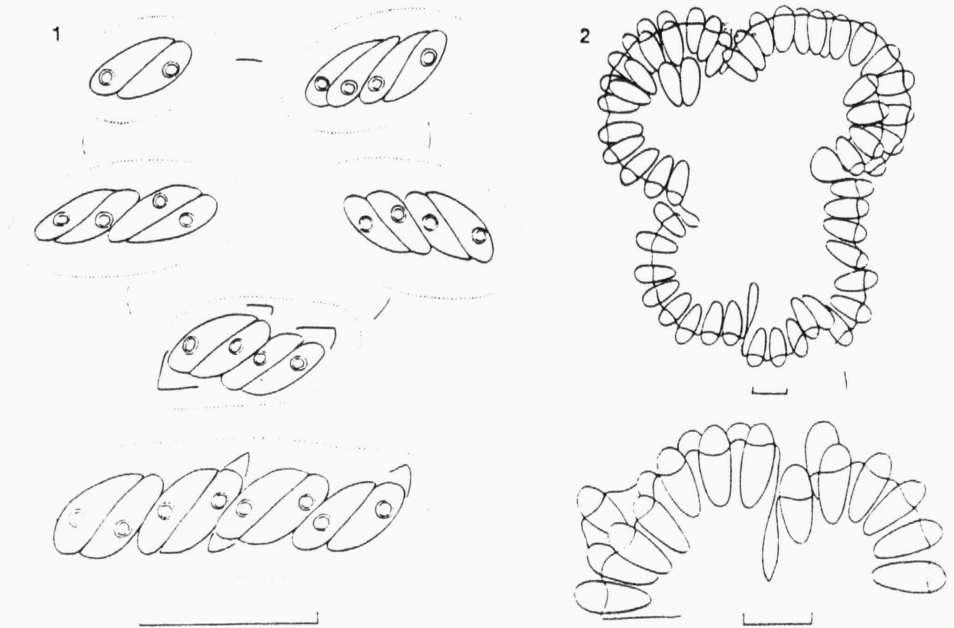


Fig. 2. - 1. *Neodesmus danubialis* Hindák, specimens from a pool in the zoo, Beijing; 2. *Botryococcus braunii* Kütz., colonies from a pool at Guangzhou. Scale: 10 μm .

The illustrated colonies (Fig. 2) were sampled from a small pool in the garden of the Hotel Dong-Fang at Guangzhou (Kanton). The shape and size of colonies did not differ from those found in the plankton of large water bodies (Komárek et Fott 1983, Hindák 1991). Colonies were large and composed of subcolonies with cells densely heaped and readily arranged at the periphery of stratified masses of mucilage. Cells were longitudinally obovoid, $10-12 \times 4.5-5.5 \mu\text{m}$, immersed up to two thirds or four fifths into mucilaginous matrix. The chloroplast was parietal, cup-shaped, with many oil droplets, therefore the pyrenoid was not distinct. Mucilage envelopes around colonies were tough, thick, to $10 \mu\text{m}$ wide or more (not depicted in Fig. 2:2).

5. *Neodesmus danubialis* Hindák 1976

Fig. 2:1

The monospecific genus *Neodesmus* Hindák is characteristic by the constant formation of two autospores from the mother protoplast and by the formation of linear syncoenobia embedded in delicate mucilage (Hindák 1976).

Studied specimens coming from a eutrophic pool in the zoo in Beijing (Peking) belonged to the dominant phytoplankton species. Coenobia were solitary or formed 4-8-celled, rarely more-celled syncoenobia; coenobia in syncoenobia were shifted from one another (to 45°) and connected by the median part of their outer cells. The shape of coenobia was oval, their dimensions being $5-7 \times 3-5 \mu\text{m}$, with mucilage layer $1-2 \mu\text{m}$ wide, thus resembling coenobia of *Didymocystis/Pseudodidymocystis* (Hindák 1990). Cells were drop-like, joined in a coenobium by their longer side but their cell ends were in the opposite direction, i.e. one end of the coenobium was composed of two morphologically different cell ends; one of them broadly rounded and the other one bluntly pointed. Cells were drop-like, $5-7 \times 2-3 \mu\text{m}$, with smooth cell walls. The chloroplast was parietal, with one markedly subapical pyrenoid. Autospores were 2, released by the division of mother cell walls into two parts; their remnants were visible as caps next to both cells ends of autospores but mostly gelatinized quickly (see also Hindák 1984).

The species occurs currently in the plankton of eutrophic waters in C Europe and seems to be common also in China and other countries. It is obviously being overlooked or misinterpreted as a representative of the genus *Didymocystis/Pseudodidymocystis*.

6. *Scenedesmus grahneisii* (Heynig) Fott 1973

Fig. 3:1-3

Syn. (selected): *Didymocystis grahneisii* Heynig 1962 - basion., *Scenedesmus berczikii* Hortobágyi 1975, *Didymocystis comasii* Komárek 1983

This species has been recorded several times from C Europe (Heynig 1962, Fott 1973, Hindák et Klasová 1974, Hegewald 1978, Hindák et Deisinger 1989, Hindák unpubl.). As it is evident from our findings in China, the species seems to be also commonly widespread there and probably all over the world; it is, however, being overlooked or misinterpreted. In nature 2-celled coenobia or solitary cells prevailed (Fig. 3:1,2) but 4-(8)-celled coenobia were also formed in cultures (Fig. 1:3). All our records from China are in good agreement with those from C Europe and no essential differences between both were found.

In the plankton of a highly eutrophicated pool in the zoo of Beijing (Peking), solitary cells dominated over 2-celled coenobia (Fig. 3:1). Solitary cells were conspicuously broader than cells in coenobia and also their ribs were thicker (to $4 \mu\text{m}$

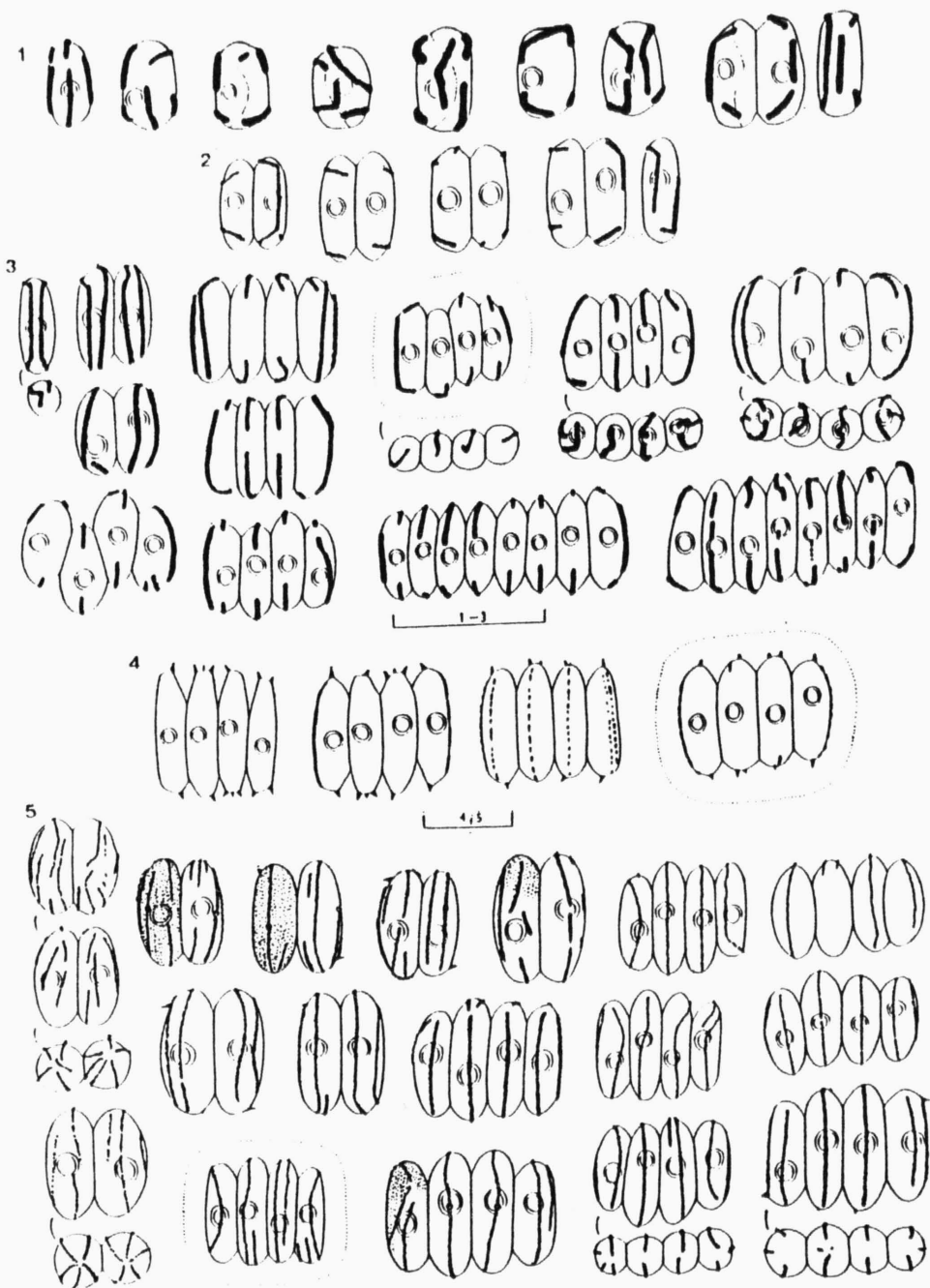


Fig. 3. - 1-3. *Scenedesmus grahneisii* (Heynig) Fott (1. from a pool in the zoo, Beijing; 2. from a pool at the Hotel Dong-Fang, Guangzhou; 3. cultured strain Hindák 1986/82 isolated from a pool in the Memory Park, Guangzhou); 4. *S. aculeolatus* Reinsch, 4-celled coenobia from a pool at Hauqing Hot Springs near Xi'an; 5. *S. brasiliensis* Bohl., cultured strain Hindák 1986/71 isolated from a pool at the Hotel Dong-Fang, Guangzhou. Scale: 10 μm.

wide) and rather irregular in their shape, number and distribution on cell walls. The rib shape in the form of long or slightly irregularly modified letter C is unique among the species of the genus *Scenedesmus*. Ribs in 2-celled coenobia were usually two in number, placed on the free side of cells, laying with their ends subapically, as it is clearly seen namely in specimens collected from a pool in the garden of the Hotel Dong-Fang at Guangzhou (Kanton) (Fig. 3:2). 4-8-celled coenobia were found in the cultured strain Hindák 1986/82, isolated from a pool in the Memory Park at Guangzhou; these were linear, with cells only rarely slightly alternating (Fig. 3:3). Ribs on outer cells were 2, rarely 3-4, thus not different from 2-celled coenobia; on inner cells they were short and only on subapical part of cells, i.e. interrupted on the median part of cells, well developed only on one side of coenobia; on the other side of cells they were strongly reduced or missing. The mucilaginous layer up to 2 µm wide was always present around coenobia. Cells were longitudinally oval to cylindrical, 5.8-8 x 2-3(-4) µm, with ends rounded. One pyrenoid, big, mostly in central part of cells. No spines formed.

7. *Scenedesmus aculeolatus* Reinsch 1877

Fig. 3:4

Syn. (selected): *Scenedesmus arthrodesmiformis* Schröder 1920, *Scenedesmus pulloideus* Hegewald 1980

This species is also of a cosmopolitan distribution (Komárek et Fott 1983, Hindák 1990) but in the LM it is hardly distinguishable from *Scenedesmus denticulatus* var. *linearis* Hansg. (Hegewald et al. 1990).

Coenobia from the plankton of a pool at Hauquing Hot Springs near Xi'an were mostly 4-celled, linear, with cells not alternated, embedded in a hyaline mucilage, 2-3 µm wide. Cells were cylindrically oval, straight, 10-12 x 2.5-4.5 µm in size, with ends rounded to truncate, at poles with 1-3 short teeth, sometimes forming a low apical crown. Ribs were longitudinal, on outer cells 1-2, rarely more or invisible in the LM; on inner cells one, well developed on one side, on the other side missing or strongly reduced into short apical dash-like pieces. One pyrenoid, central.

Hegewald et al. (1990) used for this alga the name *S. arthrodesmiformis* Schröder 1920, established several years later than *S. aculeolatus* and hence synonymous.

8. *Scenedesmus brasiliensis* Bohlin 1897

Fig. 3:5

Syn. (selected): *Scenedesmus praetervisus* Chodat 1926, *Scenedesmus blatensis* Fott 1973

This is another commonly occurring species both in the plankton and metaphyton of mesotrophic to polytrophic waters all over the world (Komárek et Fott 1983, Hindák 1990). The cultured strain Hindák 1986/71 isolated from a pool in the garden of the Hotel Dong-Fang at Guangzhou (Kanton) did not differ from those studied in C Europe (Hindák 1990). It is clearly distinguishable from the previous species namely by ribs with rosettes placed on both sides of cells.

In the Chinese culture 2-4-celled coenobia strongly dominated. The mucilage layer was 2-3 µm wide. Coenobia were linear, straight to slightly arcuated, with cells not alternated. Outer cells longitudinally oval to cylindrically oval, inner cells cylindrical, 10-14 x 3-5.5 µm in size, ends broadly rounded. One pole of outer cells bore usually one short subapical tooth, so that the teeth were diagonally displayed on coenobia. Ribs were longitudinal, on both side of coenobia; in 2-celled coenobia and sometimes also in outer cells of 4-celled coenobia they were 3-6 in number, from which usually 3 were longitudinal, going from one pole to another, other ribs were shorter or interrupted; on

inner cells there was mostly one rib, rarely two, but then short and apical. Rosettes were distinct in the LM, mostly on median parts of ribs, in the shape of small circles. The granulation (network in the EM) on all cells of coenobia was regular and dense. One pyrenoid, central. No long spines were formed.

9. *Scenedesmus abundans* (Kirchner) Chodat 1913

Fig. 4:1

Syn. (selected): *Scenedesmus caudatus* Corda f. *abundans* Kirchner 1879, *Scenedesmus spinosus* Chodat 1913

The morphological variation of the cultured strain Hindák 1986/73, isolated from the plankton of the experimental fishpond no. 5 at the Institute of Hydrobiology, Wuhan, corresponds to previous observation from W Slovakia (Hindák 1990) and S India (Hegewald et al. 1990). However, under the LM it is hardly distinguishable from *S. sempervirens* Chodat, in which the ribs are stronger and sometimes visible also in the LM. Since ribs in the Chinese culture were not observed during our investigations, we consider the species as *S. abundans*.

Coenobia were 2-4-8-celled but 4-celled coenobia dominated in soil-water media; no mucilage was found. Main caudate spines were as long as cells or shorter, missing only in abnormalities, located slightly subapically; bicaudate or brevicaudate coenobia were not observed. Additional long apical spines or short tooth-like spines in outer cells of coenobia were rarely formed. Spines at poles of inner cells varied considerably both in position and length, being developed at one or both poles, of the same length as the main caudate spines or in form of small teeth. Lateral spines were single, on the median part of outer cells but mostly missing. Coenobia were linear, with cells in one row or slightly alternating or *S. dispar*-like. No ribs, granules or rosettes were observed in the LM. Cells were cylindrical to cylindrically oval or nearly fusiform (inner cells), 6-8 x 2-2.5 µm in size, with ends broadly rounded to broadly conical. One pyrenoid, central.

Quadricaudate coenobia without additional apical and lateral spines resemble in general shape those of *S. communis* Hegew. [= *S. quadricaudata* (Turp.) Bréb. sensu auct.], in which, however, cells are bigger and rosettes as well as outer cell wall layer mostly strongly developed (Komárek et Fott 1983, Hindák 1990, Hegewald et al. 1990).

10. *Scenedesmus subspicatus* Chodat 1926 var. *crassicaudatus* (Hortobágyi) Hindák, comb. nova

Fig. 4: 2

Basion.: *Scenedesmus spinosus* Chodat var. *bicaudatus* Hortobágyi 1960 f. *crassicaudatus* Hortobágyi, Bot. Közlem. 54: 18, Fig. 15-38, 1967.

Syn.: *Scenedesmus spinosus* Chodat var. *bicaudatus* Hortobágyi 1960 sensu Hortobágyi 1967 (Ibid., Fig. 12-14), *Scenedesmus spinosus* Chodat var. *crassispinosus* Hortobágyi 1960 sensu Hortobágyi 1967 (Ibid., Fig. 4-7), *Scenedesmus spinosus* Chodat var. *crassispinosus* Hortobágyi 1967 f. *hanoiensis* Hortobágyi 1967 (Ibid., Fig. 39) - incl.

The infraspecific taxonomy of *Scenedesmus subspicatus* is not very well understood. According to relevant literature data, this species appears to be rich in infraspecific taxa. Hegewald et al. (1990) confirmed from India, besides the type variety *subspicatus*, also var. *longicauda* (G.M. Smith) Chodat 1926. However, some more varieties could be distinguished, e.g. var. *spicatiformis* Chodat 1926 (syn. *S. spinosus* Chodat or *S. gutwinski* Chodat (see also Uherkovich 1966)).

Hortobágyi (1967) established three new forms of *S. spinosus* Chodat from one (or more?) preserved sample of the plankton from highly eutrophic dead arm of the Red

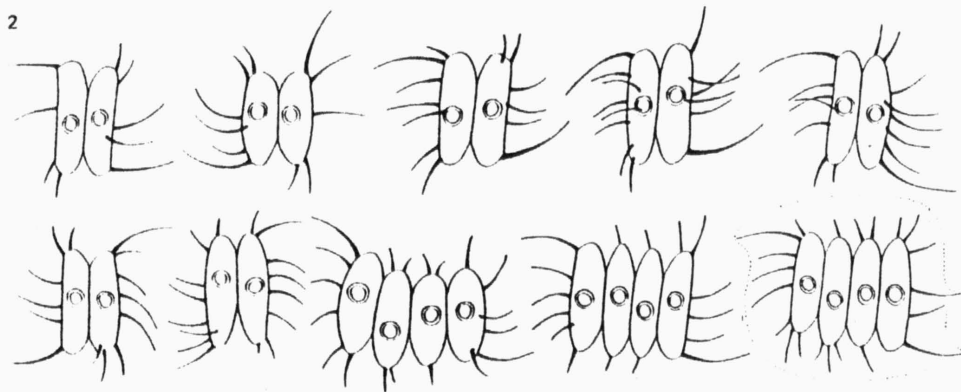
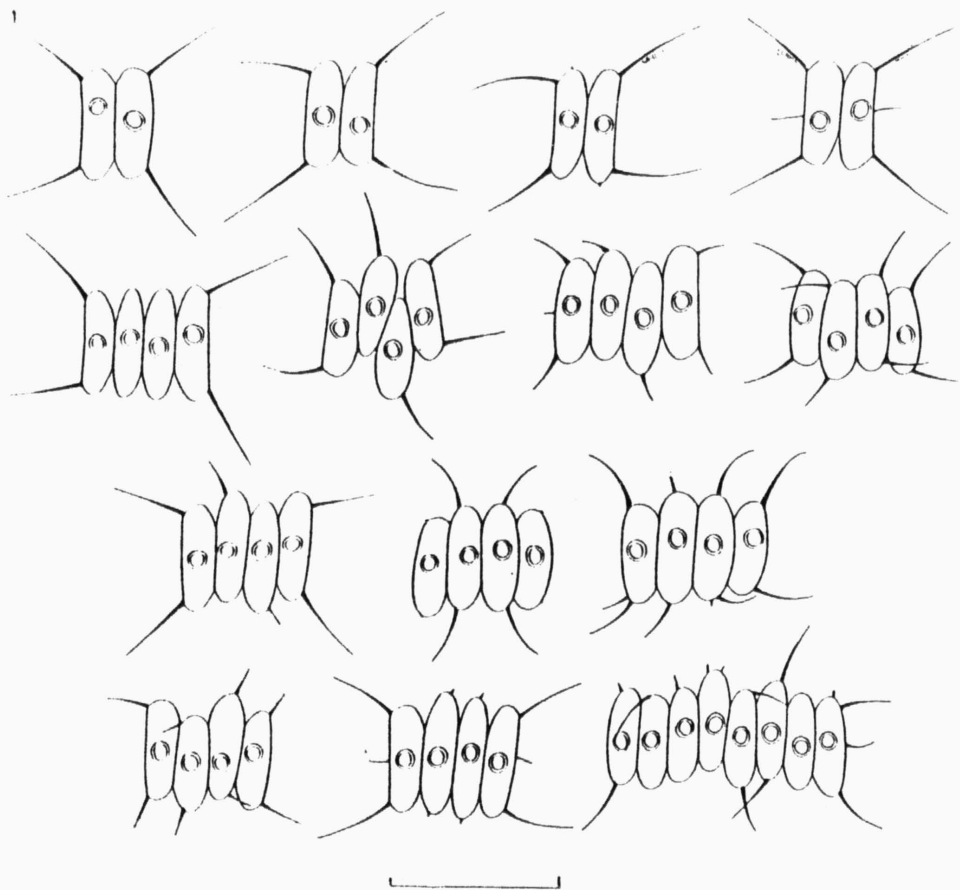


Fig. 4. - 1. *Scenedesmus abundans* (Kirchn.) Chodat, cultured strain Hindák 1986/73 isolated from a fishpond at Wuhan; 2. *S. subspicatus* Chodat var. *crassicaudatus* (Hortob.) Hindák, comb. nova, cultured strain Hindák 1986/72 isolated from a fishpond at Wuhan. Scale: 10 μ m.

River, Hanoi, Vietnam, i.e. *S. spinosus* f. *crassi-heterocaudatus*, *S. spinosus* var. *bicaudatus* f. *crassicaudatus*, and *S. spinosus* var. *crassispinosus* f. *hanoiensis*. In our opinion all these new forms belong to one taxon, and together with the specimens illustrated in Figs 4-7 (designated as var. *crassispinosus*) represent its phenotypic plasticity. Not only the variation of spines but also the presence of a mucilage layer around coenobia depicted in Figs. 5 and 36 support this opinion. The mucilage has not been mentioned in any other taxa of this group of *Scenedesmus* (Komárek et Fott 1983, Hindák 1990).

Our results concerning the variability of diagnostic features found in the Chinese culture fully confirm Hortobágyi's observations of this alga from Vietnam. Neither quadricaudate nor acaudate, but only bicaudate coenobia were found. Main caudate spines were shorter than the cell length, reaching mostly only a half of their length; they were robust, considerable thicker than additional spines, which were 2-7 in number, not in one row and oriented towards free lateral parts of outer cells. These lateral spines were of a different length (2-4 μm), thus always shorter than the main spines. On one cell they were bent in one direction and on another one in the opposite direction, being thus diagonally arranged in a coenobium. The cells were cylindrical to cylindrically oval, 5.5-7.5 x 1.8-2.5 μm , ends rounded. The chloroplast was parietal, with one central pyrenoid. The mucilage was hyaline, to 4 μm around coenobia, covering spines totally.

11. *Scenedesmus armatus* Chodat var. *spinosus* Fritsch et Rich 1929 Fig. 5:1,2

The morphological variation of two investigated cultures, strain Hindák 1986/87 isolated from a fishpond in the garden of the Institute of Botany, Wuhan (Fig. 5:1) and strain Hindák 1986/88 isolated from the fishpond no 3 in the experimental area of the Institute of Hydrobiology, Wuhan (Fig. 5:2), is very similar to that found in Indian cultures (Hegewald et al. 1990).

Quadricaudate coenobia generally dominated but bicaudate and brevicaudate (acaudate) coenobia were also formed commonly. Solitary cells and bicaudate coenobia occurred sporadically, they had two diagonally arranged long spines and two short additional spines. Coenobia were linear, with cells slightly to markedly alternated, rarely not alternated. The mucilage layer was conspicuous, hyaline, to 5 μm around coenobia, found in both cultures. Main caudate spines were as long as cells, rarely somewhat longer, but also shorter in some cases (brevicaudate-type coenobia), located subapically. On inner cells only similar short apical spines were formed, being thus diagonally arranged, or seldom occurring at each pole. Ribs were longitudinal, well developed only on outer cells, 1(-2) in number, mostly interrupted; in the 4-celled coenobia they were formed also on inner cells, mostly at apical parts, but only on one side of coenobia.

12. *Scenedesmus kantonensis* Hindák, spec. nova Fig. 6:7

Coenobia libere natantia, 2-4-8-cellularia (raro cellulae solitariae), longicaudata, quadricaudata, bicaudata vel acaudata; vel coenobia longicaudata, sine tegumento gelatinoso, 2-4-cellularia, raro 8-cellularia, cum cellulis alternatim dispositis, cum 1-3 costis vel costae nullae; vel coenobia acaudata, cum 1-3 costis, cum tegumento gelatinoso. Cellulae ovales usque cylindrice ovales vel cylindricae, 4,5-8 x 1,8-2,5(-3,5) μm , apicibus late rotundatis. Spinae in polis cellularibus (0-)1(-2), acutae, tenues, 3-8 μm longae, leniter inclinae, interdum in parte cum 1-3 longitudinalibus costis in una vel in utraque parte. Membrana cellularum hyalina. Chloroplastum unum, parietale, cum pyrenoide. Ex una cellula matricali unum coenobium 2-4-8-cellularum liberatur.

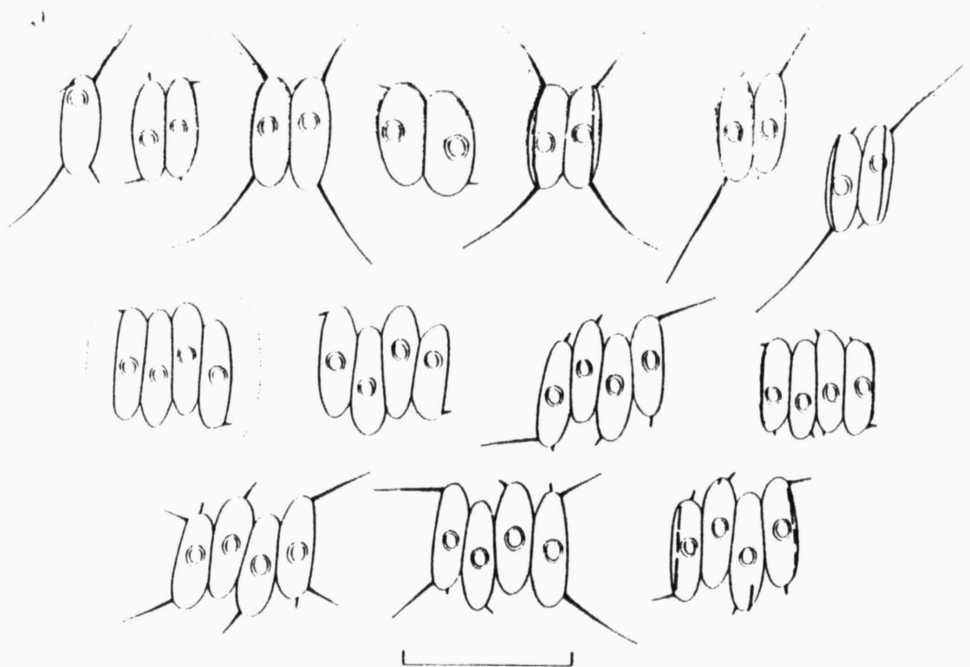


Fig. 5. - 1, 2. *Scenedesmus armatus* Chodat var. *spinosus* Fritsch et Rich (1, cultured strain Hindák 1986/87 isolated from a fishpond at Wuhan; 2, cultured strain Hindák 1986/88 isolated from a fishpond at Wuhan). Scale: 10 μ m.

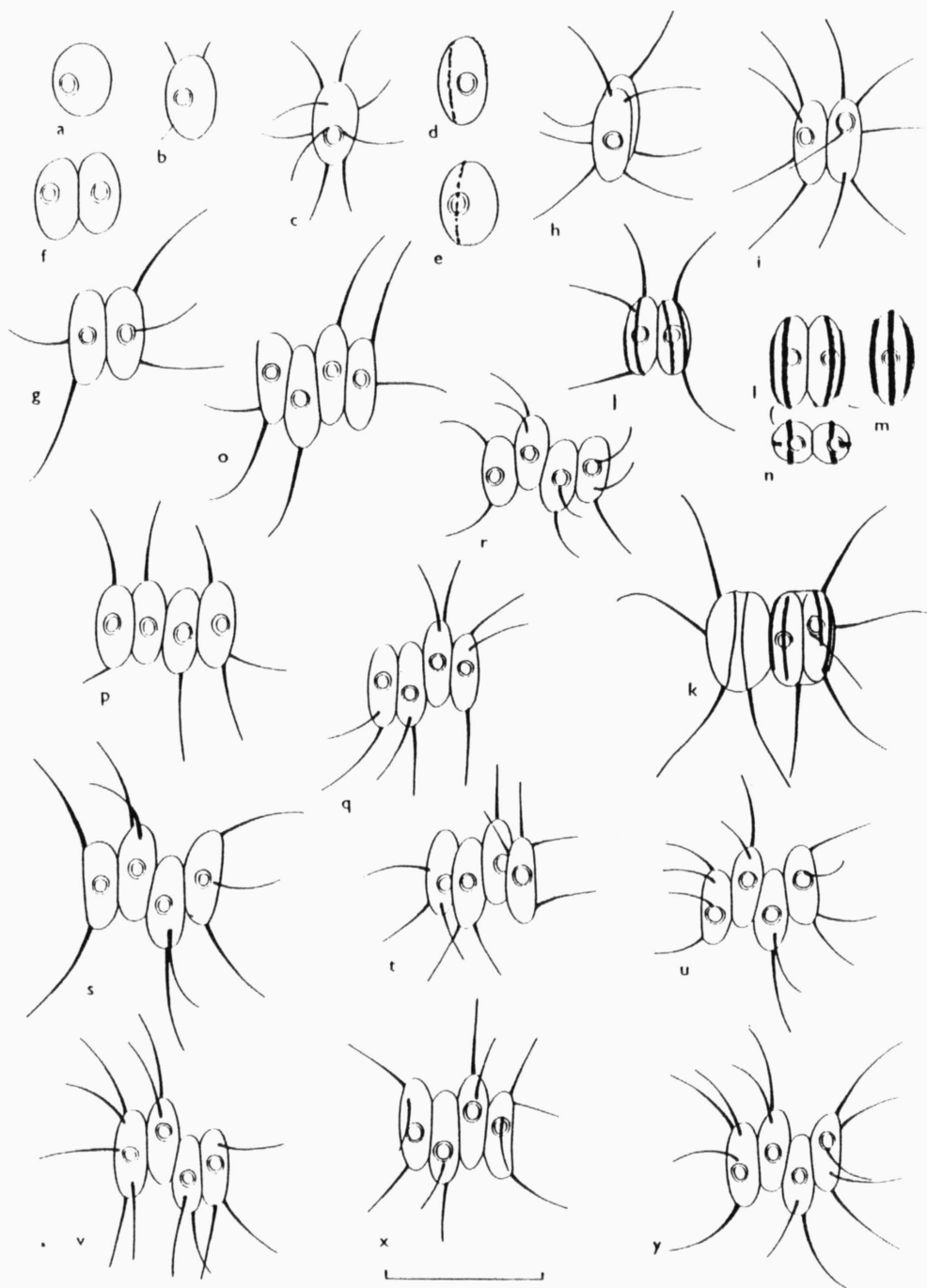


Fig. 6. - *Scenedesmus kantonensis* Hindák, spec. nova, morphological variation of cultured strain Hindák 1986/78. Scale: 10 μ m.

Habitatio: In plancto et metaphyto piscinae diversorii Dong-Fang in Guangzhou (Kanton), prov. Guandong, Sina australis.

Iconotypus: Figura nostra 6, 7.

Holotypus: In herbario Musei moravici in Brno (BRNM) depositus.

Cultura typica: Hindák 1986/76 designata, in collectione Instituti Botanici, in Třeboň deposita.

Coenobia free floating (rarely solitary cells), longicaudate, bicaudate, quadricaudate or acaudate; longicaudate coenobia 2-4-celled, rarely 8-celled, with cells alternated, ribs longitudinal, 1-3 in number or missing, without mucilage; acaudate coenobia 2-4-8-celled, with cells in one row, not alternated, ribs longitudinal, 1-3 in number on outer cells and one rib on inner cells, with mucilage to 2 μm wide. Cells cylindrically oval to cylindrical, 4.5-8 x 1.8-2.5-(3.5) μm , ends rounded. Main caudate spines 5-8 μm long, additional spines (0)-1-3 in number, on inner cells only one or missing. Cell walls hyaline, without granules. Chloroplast one, parietal, with one subapical to center pyrenoid. One 2-4-8-celled coenobium arising from the mother protoplast.

Occurrence: In the plankton and metaphyton of a basin in the garden of the Hotel Dong-Fang, Guangzhou (Kanton), Prov. Guandong, SE China.

Iconotype: Fig. 6, 7.

Holotype: Deposited in the Moravian Museum in Brno (BRNM).

Type culture: Strain Hindák 1986/76, deposited at the Culture Collection of the Institute of Botany ČSAV, Třeboň.

This new alga belongs to the group of highly variable species, containing e.g. *S. pleiomorphus* Hindák (Hindák 1988b, 1990), *S. multiformis* Hegew. et Hindák, *S. abundans* Chodat (Hegewald et al. 1990), *S. kissii* Hortob., and *S. komarekii* Hegew. (Hegewald 1989). It differs from all the species mentioned namely in generally bicaudate character of coenobia with alternating cells. However, the range of variation of spines and ribs is very similar to these species, varying from solitary cells resembling *Chlorella*, *Lagerheimia* or *Franceia*, through coenobia with only main spines, with additional spines, with ribs, without ribs etc. up to spineless coenobia with longitudinal ribs.

Unicells occurred namely in cultures, being broadly oval to longitudinally elliptical, without spines and ribs (*Chlorella*-type, Fig. 6:d,e), without spines and with one or two ribs (? *S. fuscus*-type, Fig. 6:d,e), without ribs but with spines (from *Lagerheimia*- to *Franceia*-type, Fig. 6:b,c). Four main types could be recognized with respect to the variation of 2-celled coenobia, i.e. spined coenobia without ribs (i) (Fig. 6:g-i) or with ribs (ii) (Fig. 6:j) and spineless coenobia without ribs (iii) (Fig. 6:f) and with strongly developed ribs (iv) (Fig. 6:l-n). The most simple but dominant type of spination both in 2-celled and 4-celled coenobia was a bicaudate one, i.e. with diagonally arranged spines. In 2-celled coenobia it was a coenobium with one apical spine and one subapical or lateral spines in median part (Fig. 6:g). Coenobia with 5-6 long spines of $\pm$ equal length on each cell also occurred (Fig. 6:h,i). These so-called generally quadricaudate coenobia were found also with longitudinal ribs (Fig. 6:j). Spineless coenobia without ribs were rare (Fig. 6:f), usually being of *Didymocystis/Pseudodidymocystis inconspicua*-type (Hindák 1990), having three strongly developed longitudinal ribs [Fig. 6:l-n, a coenobium from frontal (l), lateral (m) and apical (n) view].

Similar variation was found in 4-celled coenobia; the only exception was that coenobia lacking both spines and ribs were not observed. For a basal type of 4-celled

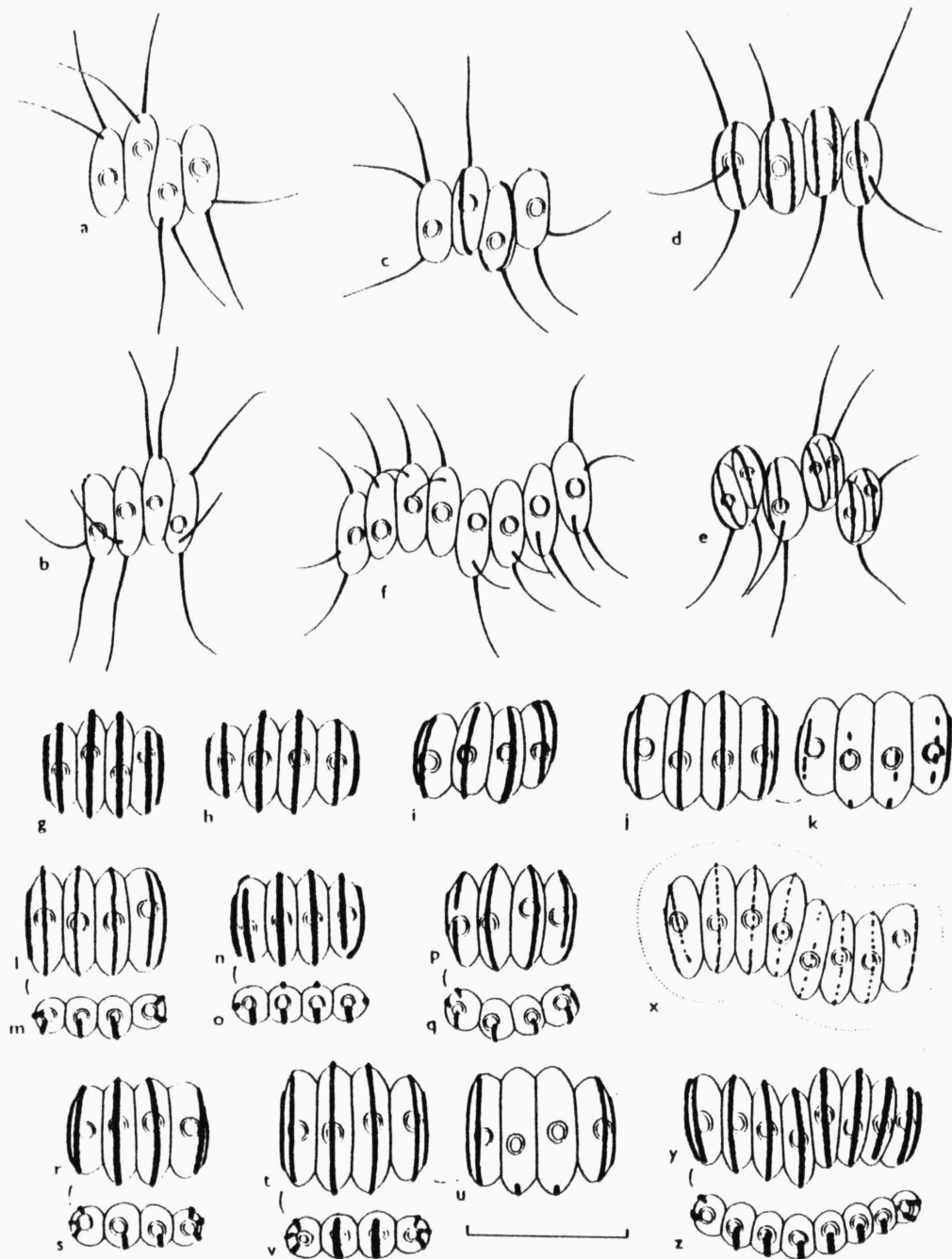


Fig. 7. - *Scenedesmus kantonensis* Hindák, spec. nova, morphological variation of cultured strain Hindák 1986/76. Scale: 10 μ m.

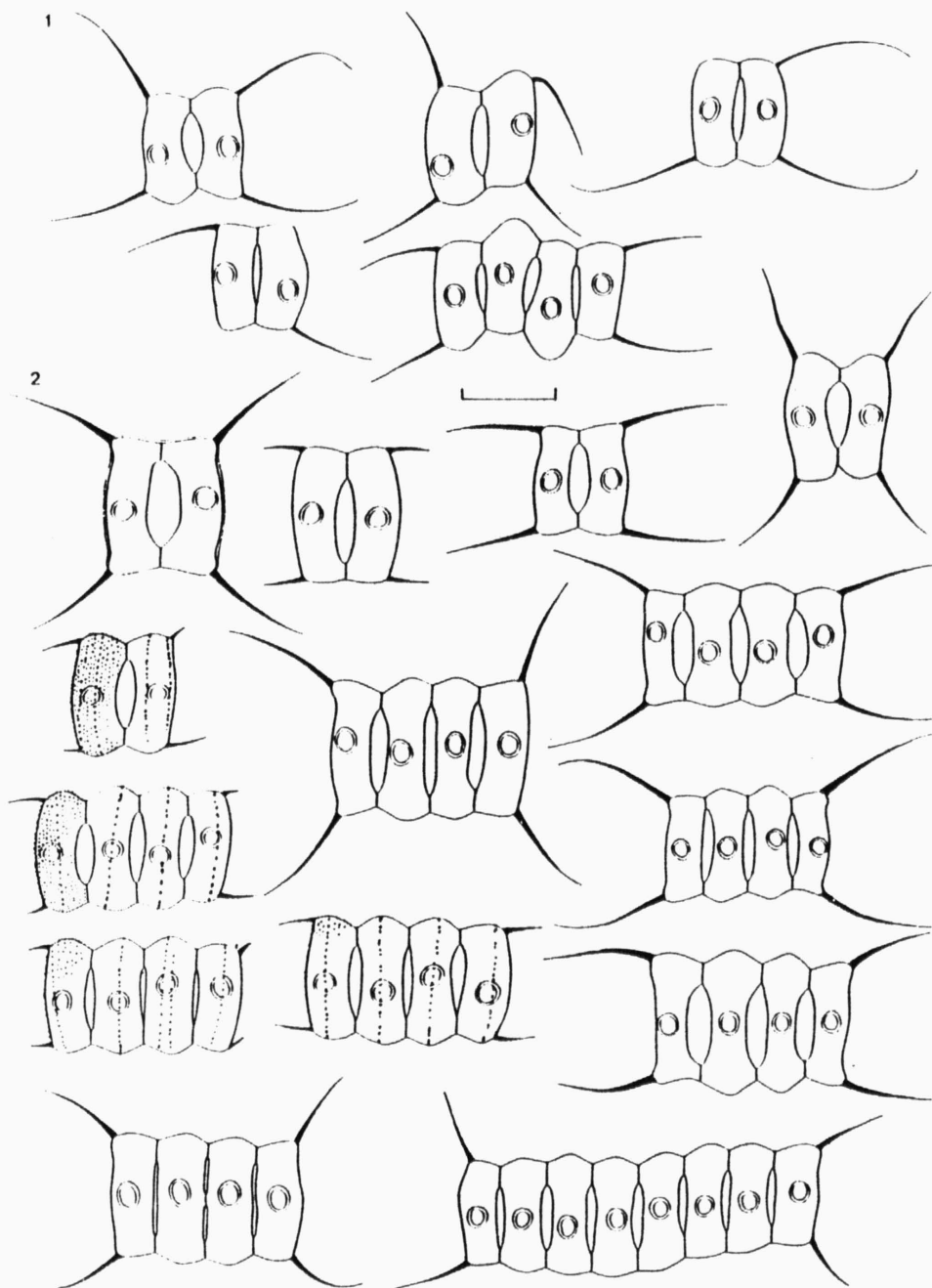


Fig. 8. - 1, 2, *Scenedesmus perforatus* Lemm. (1, natural material from a pool in the Memory Park, Guangzhou, 2, cultured strain Hindák 1986/76 isolated from a pool in the garden of the Hotel Dong-Fang, Guangzhou). Scale: 10 μ m.

coenobia could be considered a bicaudate coenobium with one apical and one subapical spine on one end of outer cells, and with one apical spine on one pole of inner cells (Fig. 6:o). All other types are derived from the combination of additional apical and lateral spines together with ribs (Fig. 6:p-y; all except g, x-z). However, the spination was not so rich, with regard to the number and position of spines, as in *S. pleiomorphus* (Hindák 1988b, 1990). The highest number of spines found on one cell of a coenobium was 5 (Fig. 6:v,y) but such a rich type of spination occurred relatively rarely; this was also the case with quadricaudate coenobia (Fig. 6:s,u,x,y; 7:d). In spineless coenobia with ribs the variation was rather poor: ribs were usually thick, strongly developed, 2-3 on outer cells and 1 on inner cells (Fig. 7:g-j,l,m,p-v), with ribs only rarely developed also on the other side of inner cells, but then strongly reduced, interrupted or merely at poles (Fig. 7:o). In contrast to 2-4-8-celled spine coenobia, the spineless coenobia were linear, with cells in one row, embedded in a mucilage layer.

Eight-celled coenobia were produced very rarely. In quadricaudate coenobia the spines were diagonally arranged and without ribs (Fig. 7:f), in spineless coenobia ribs on inner cells were generally developed only on one side; on outer cells there were 2-(3) ribs. However, cells in coenobia were in one row but two distinct groups of four cells were slightly alternated (Fig. 7:x, y).

13. *Scenedesmus perforatus* Lemmermann 1903

Fig. 8:1,2

This alga is considered a tropical species, occurring commonly in tropical and subtropical climatic zones all over the world (Komárek et Fott 1983, Komárek 1983, Hegewald et al. 1990). Having found it in two localities in SE China (a pool in the Memory Park and in a basin of the garden of the Hotel Dong-Fang at Guangzhou), we support this statement.

Natural material from the former locality (Fig. 8:1) did not differ from the cultured strain Hindák 1986/76 isolated from the latter one (Fig. 8:2). The 2-4-8-celled coenobia were linear; coenobia with alternated cells occurred sporadically. No mucilage was observed. The range of morphological variation was rather low, manifested namely in spination. Only caudate spines were formed. Neither additional nor lateral spines were observed. Quadricaudate coenobia with long spines dominated considerably, bicaudate coenobia occurred very seldom. Coenobia with 4 short spines (1-2.5 μm long) were only observed in a culture (Fig. 8:2). Main spines were robust, as long as cells or somewhat longer or shorter, up to 9 μm . The slits between cells were clearly visible, namely in natural material, up to 2 μm wide and 6 μm long. Cells were straight to slightly bent, cylindrical; outer cells were sometimes broadened or thickened in their median parts; dimensions of cells were 10-15 x 4-7 μm . Cell ends were flat to low truncate and due to slits capitate, but not so markedly as in *S. tropicus* Crew (Hegewald et al. 1990). Granulation on cell walls (network under the EM) was regular, dense; 1-2 longitudinal rows of granules (tubes under the EM) developed on some cells, resembling thus ribs; rosettes not visible in the LM. Pyrenoid one, big, $\pm$ central.

Investigated specimens from China correspond well to those found in India (Hegewald et al. 1990) and Cuba (Komárek 1983); no essential differences between both were observed.

Súhrn

V prírodnom materiáli a laboratórnych kultúrach sa študovala morfológická variabilita 13 zástupcov chlorokokálnych rias pochádzajúcich z rozličných zberov na území Číny. Opisuje sa nový druh *Scenedesmus kantonensis* Hindák, spec. nova a navrhuje sa nová kombinácia *S. subspicatus* Chodat var. *crassicaudatus* (Hortob.) Hindák, comb. nova. Výskyt väčšiny ostatných druhov [napr. *Keratococcus saxatilis* (Komárková-Legnerová) Hindák, *Monoraphidium circinale* (Nyg.) Nyg., *Crucigeniopsis divergens* (G. M. Smith) Hindák, *Neodesmus danubialis* (Heynig) Fott, *Scenedesmus aculeolatus* Reinsch] sa podľa dostupných literárnych zdrojov doteraz neudával z územia Číny.

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