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Four new planktic species of the genus *Koliella (Ulotrichales, Chlorophyceae)*

Štyri nové planktónové druhy rodu *Koliella (Ulotrichales, Chlorophyceae)*

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HINDÁK F. (1984): Four new planktic species of the genus *Koliella* (*Ulotrichales, Chlorophyceae*). — Preslia, Praha, 56 : 1—11.

Four new species of the genus *Koliella* HIND. (*Ulotrichales, Chlorophyceae*) from fresh water plankton are described: *K. sigmoidea* HIND. and *K. spirulinoides* HIND., found in Cuba; *K. norvegica* HIND., found in oligotrophic lakes in northern Norway; and *K. crassa* HIND., found in a fishpond in Bratislava-Železná Studienka, Czechoslovakia. The systematic position of the genera *Koliella* HIND. and *Raphidonema* LAGERTH. among filamentous green algae is discussed.

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The genus *Koliella* HIND. (HINDÁK 1963) belongs to the simplest representatives of the order *Ulotrichales* (sensu RAMANATHAN 1964, BOURRELLY 1966, FOTT 1971, HINDÁK 1962a, HINDÁK et al. 1965, 1975, 1978, STARMACH 1972, van den HOEK 1978, MOŠKOVA 1979). Characteristic features of the genus are singular elongate cells without a mucilage, which are narrower at the ends than in the medium part and divide into two ± equal parts. On the basis of solitary cells, the genus *Koliella* has been separated from the genus *Raphidonema* LAGERH., in which only species forming short filaments have been retained, in agreement with the type species *R. nivale* LAGERH. (*R. sabaudum* KOL. and *R. brevirostre* SCHERFF., in addition to *R. nivale*). Both genera are undoubtedly related, as indicated by the formation of filaments in culture of the genus *Koliella* [type species: *K. spiculiformis* (VISCH.) HIND.] and the occurrence of one-celled *Koliella*-like stages in the genus *Raphidonema*. This fact led HOHAM (1973) to include the genus *Koliella* in the genus *Raphidonema*. The solution of some taxonomic problems is limited, to a considerable degree, by a conception chosen in classification. Some taxonomists conceive of the generic category relatively broadly, others prefer so-called "small genera". We believe that the use of the second alternative is more suitable within the system of the order *Ulotrichales* and also in the relation of the contemporary taxonomy of the order. As a matter of fact, if the use of the so-called "large genera" would be accepted, several of today's naturalized and applied genera would have to be reviewed. Two genera, *Stichococcus* NÄG. 1849 and *Gloeotila* KÜTZ. 1843, may be presented as examples: Species of the genus *Stichococcus* usually have solitary cells and they occasionally (especially in cultures) form filaments; species of the genus *Gloeotila*, in contrast, usually form filaments and occasionally (especially in cultures) the filaments disintegrate into individual cells. The trend of filaments to dis-

integrate into individual cells may not be encountered only in the genus *Raphidonema*, but in other genera of *Ulotrichales*, also, for example in *Geminella* Turp., *Catena* Chod., *Hortobagyiella* Hajdu, *Klebsormidium* Silva, Mattox et Blackwell.

In this connection it is a significant feature in the genus *Koliella* that the cells, as a rule, preserve the individuality and original cell shape even when combined into filaments or filamentous configurations (see *K. spirulinoides*, Fig. 2, 3). In the genus *Raphidonema*, in contrast, the end cells of the filament are morphologically different from the inner cylindrical cells: they are longer and have lengthily attenuated ends (see Hindák 1963, Kol 1968, Starmach 1972, Moškova 1979).

By fusiform cell shape the genus *Elakatothrix* Wille, in which cells have a mucous envelope, resembles the genus *Koliella*. Daughter cells that

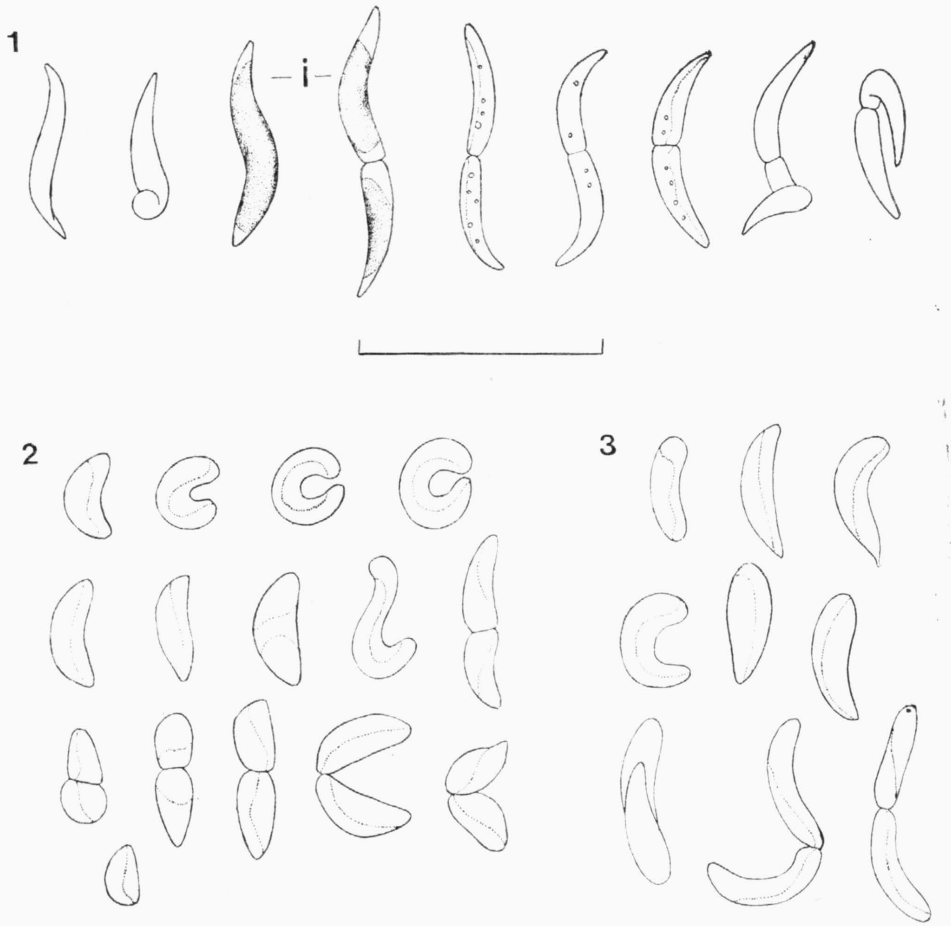


Fig. 1. — 1—3, *Koliella sigmoidea* Hind. (1, specimens from the lagoon at El Morillo, prov. Habana, Cuba, i = iconotype, 2, studied strain Hindák 1979/607, 3, studied strain Hindák 1979/592 isolated from the same locality). Scale: 10 μm.

originated from the division of the mother cell wall remain joined for a certain period of time and, just as in the genus *Koliella*, filament formation does not occur even in cultures (HINDÁK 1962b, MOŠKOVA 1979). Some algologists (BOURRELLY 1966, STARMACH 1972, BARTA et al. 1976) include the genus *Elakatothrix* in the order *Chlorococcales*. In representatives of the genus *Elakatothrix*, just as in the genera *Koliella*, *Geminella* etc., the mother cell wall, which obviously remains part of the cell wall of the daughter cells for a certain period of time, also divides together with the protoplast. Electron microscopic research of mitosis and cytokinesis will doubtlessly contribute to the definitive solution of the problem of the systematic classification of the genus *Elakatothrix*.

In the following, four new species of the genus *Koliella* are described. All are planktic species, three of them having been found in stagnant waters, and one in a river. Two species found in Cuba have sigmoid cells. A species occurring in Norwegian oligotrophic lakes in characterized by long thin cells whose ends often disunite in a fork-shaped manner. The fourth species comes from the plankton of a fertilized fishpond in Bratislava-Železná Studienka and is characterized by broad and asymmetrical cells having long attenuated robust ends.

Koliella ***sigmoidea*** HINDÁK, sp. nova Fig. 1

Cellulae libere natantes, singulae vel post divisionem binae conjunctae, fusiformes, curvatae usque sigmoidae, symmetricae, apicibus acutis, 4—10 × 1—1,4 μm. Membrana cellularum tenuis, hyalina, sine muco. Chromatophorum unum, parietale, sine pyrenoide. Propagatio cellularum divisione in partes duas.

Habitatio: In plancto lacus in El Morillo, provincia Habana, Cuba, 23. 12. 1979; cultura nostra HINDÁK 1979/607.

Iconotypus: Figura nostra 1 : i.

Cells free-floating, singular or after division joined in twos, fusiform, curved to sigmoid, symmetrical, gradually attenuated from centre to the ends and bluntly pointed, 4—10 × 1—1.4 μm. Cell wall thin, hyaline, without a mucilage. Chloroplast one, parietal, without a pyrenoid. Reproduction by cell division into two parts.

Occurrence: In the plankton of small lagoons at El Morillo, province of Habana, Cuba, December 23, 1979; studied strain HINDÁK 1979/607.

The characteristic feature of the species are relatively tiny sigmoid cells with narrowed but not attenuated ends. Curved to sigmoid cells are characteristic of some other species of the genus, too, for example in the following new species *K. spirulinoides* and *K. tatrae* (KOL) HIND. with several varieties, of which var. *bratislavensis* HIND. grows in plankton, the other four are cryophilous organisms (see HINDÁK 1963, KOL 1968, STARMACH 1972, MOŠKOVA 1979). *K. sigmoidea* differs from them mainly by smaller cell dimensions and by not having attenuated bluntly pointed cells.

The species was found in small eutrophic lagoons at El Morillo, approximately 50 km to the west of the capital, La Habana. The lagoons served as drinking basins for cattle and were one to three km from the sea. In one of the laggons the species occurred relatively more frequently and the laboratory cultures, strains HINDÁK 1979/607 and 1979/608, were obtained from this locality. As a contaminant *K. sigmoidea* was also found in strain 1979/592

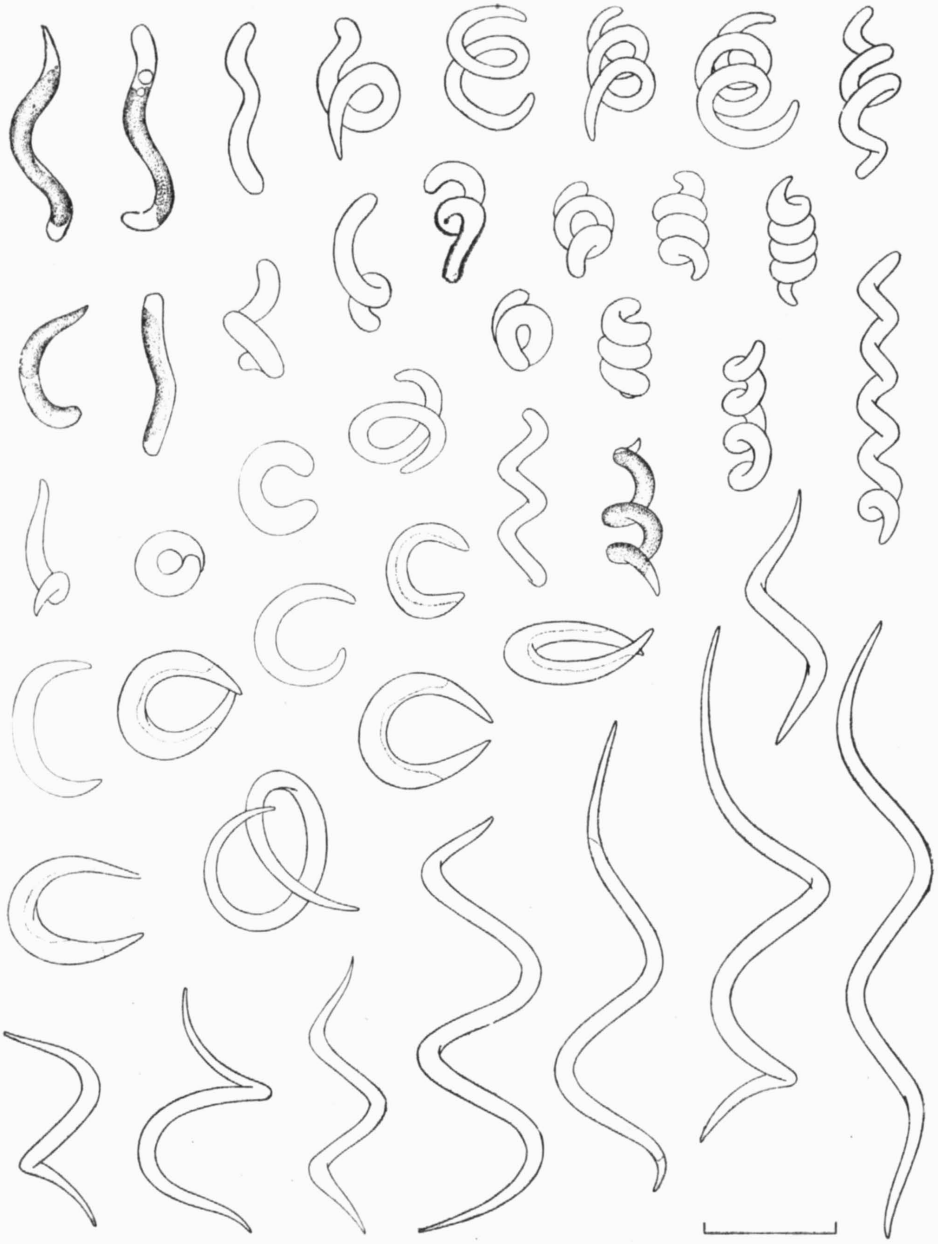


Fig. 2. — *Koliella spirulinoides* HIND. Studied strain HINDÁK 1979/235 isolated from the river Río Almendares in Habana, Cuba. Scale: 10 μm.

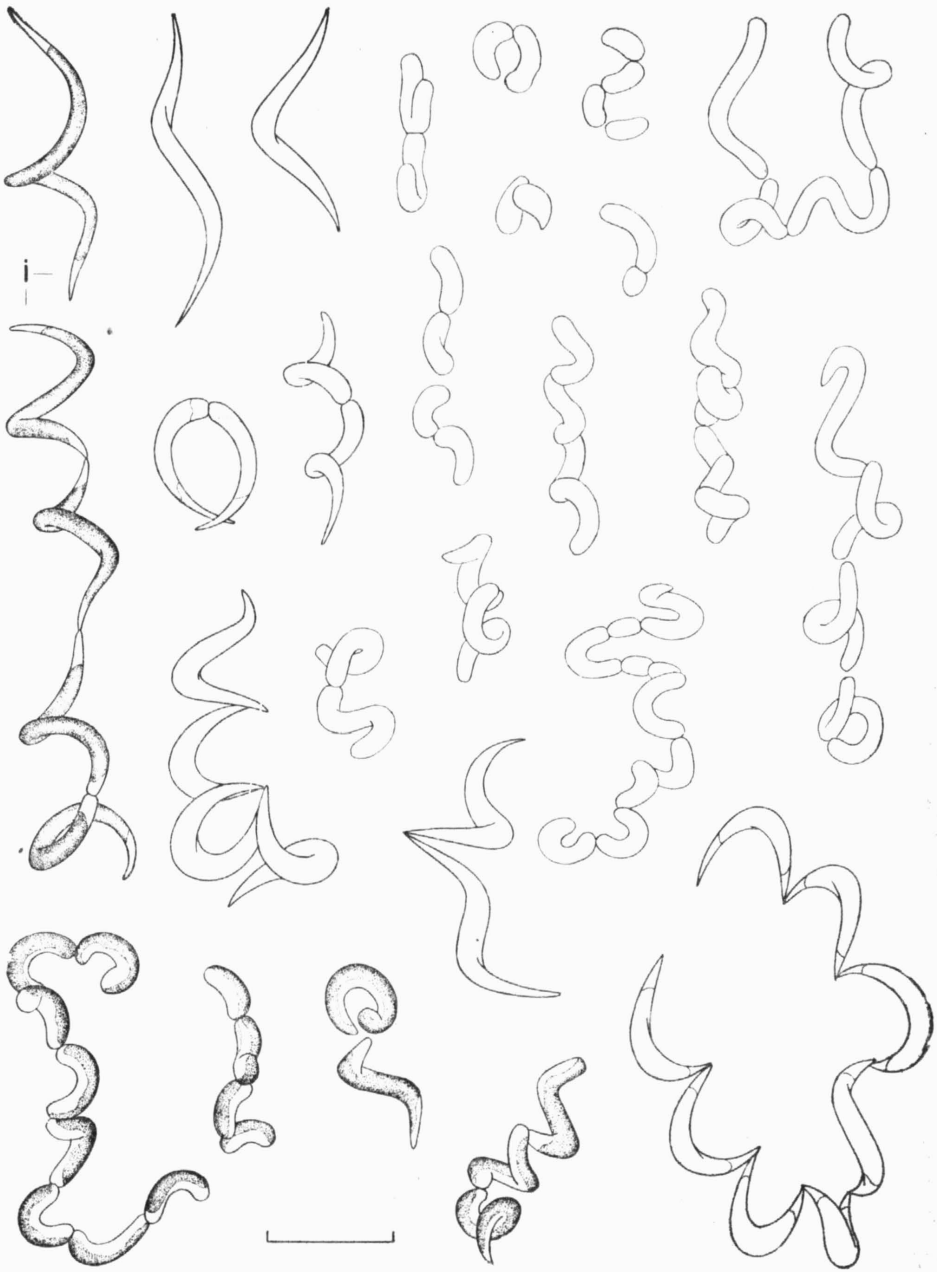


Fig. 3. — *Koliella spirulinoides* HIND. Studied strain HINDÁK 1979/235 isolated from the river Río Almendares in Habana, Cuba, i = iconotype. Scale: 10 μm.

coming from the same locality. The strains are stored in the collection of algal cultures of the Botanical Institute of the Cuban Academy of Sciences at Cienguegos. In the examined strains (Fig. 1 : 2, 3) the cells were shorter and less markedly torsional than in the wild material (Fig. 1 : 1). In the cultures there also occurred cells slightly to lunately curved or *Kirchneriella*-like, with one or both ends broadly rounded.

Koliella ***spirulinoides*** HINDÁK, sp. nova Fig. 2, 3

Cellulae libere natantes, singulae vel post divisionem conjunctae usque ad 10, sigmoidae usque cochleiformae, symmetricae, apicibus acutis, (4)—20—35—(50) × 1,5—2 μm. Membrana cellularum tenuis, hyalina, sine muco. Chromatophorum unum, parietale, sine pyrenoide. Propagatio cellularum divisione in partes duas.

Habitatio: In plancto fluminis Río Almendares, La Habana, Cuba, 29. 10. 1979; cultura nostra Hindák 1979/235.

Iconotypus: Fig. 3 : i.

Cells free-floating, singular, but after division joined in twos, and in cultured material by more cells (at most 10) by their ends; sigmoid to helically twisted (1—6 curves on the cells), symmetrical, narrowed at the ends and bluntly pointed, (4)—20—35—(50) × 1.5—2 μm. Cell wall thin, hyaline, without a mucilage. Chloroplast one parietal, without a pyrenoid. Reproduction by cell division into two parts.

Occurrence: In the plankton of the river Río Almendares, La Habana, Cuba, October 29, 1979; strain HINDÁK 1979/235.

The examination of the cultured material, strain HINDÁK 1979/235, isolated from the river Río Almendares, documents the unusually wide variability of cells in shape and size (Fig. 2, 3). The cells are singular, but after division linked by newly formed ends for a certain period of time. During the maturing process of these ends the daughter cells separate or continue to be linked up forming up to 10-celled filamentous strings that are helically twisted owing to the helical cell shape (Fig. 3). In some cases, when cell division is obviously relatively fast, the cell ends do not develop until the subsequent cell division and hence they are not attenuated and pointed, but broadly rounded. Sigmoid cell shape prevails, but there also occur, however, arcuately to horse-shoe-like curved cells with contiguous or helically twisted ends. In helically twisted cells the number of curves on the cells varies, so does the width and distance between the individual curves (Fig. 2). The maximal number of curves observed is six and in some cells the curves are densely pressed against each other. The specific name (the epithet) of this alga has been chosen with regard to the helically twisted cells (as well as filamentous strings), markedly reminiscent of representatives of the cyanophycean alga *Spirulina* TURP. (*Oscillatoriales*). Helically twisted cells have not been observed in any of the hitherto known species of the genus *Koliella* and among simple ulotrichal algae helically twisted cells and filaments are relatively rare [e.g. *Gloeotila spiralis* CHOD., *G. spiroides* (G. S. WEST) PRINTZ].

Just as cell shape and curve number varied considerably, cell length also varied. Specimens 20—35 μm in length occurred most commonly; the smallest cells were only 4 μm in length. The longest cells observed were 50 μm in length, their shape was sigmoid and the number of curves amounted to 2—2.5. Cell width, in contrast, varied only slightly within the range of 1.5—2 μm.

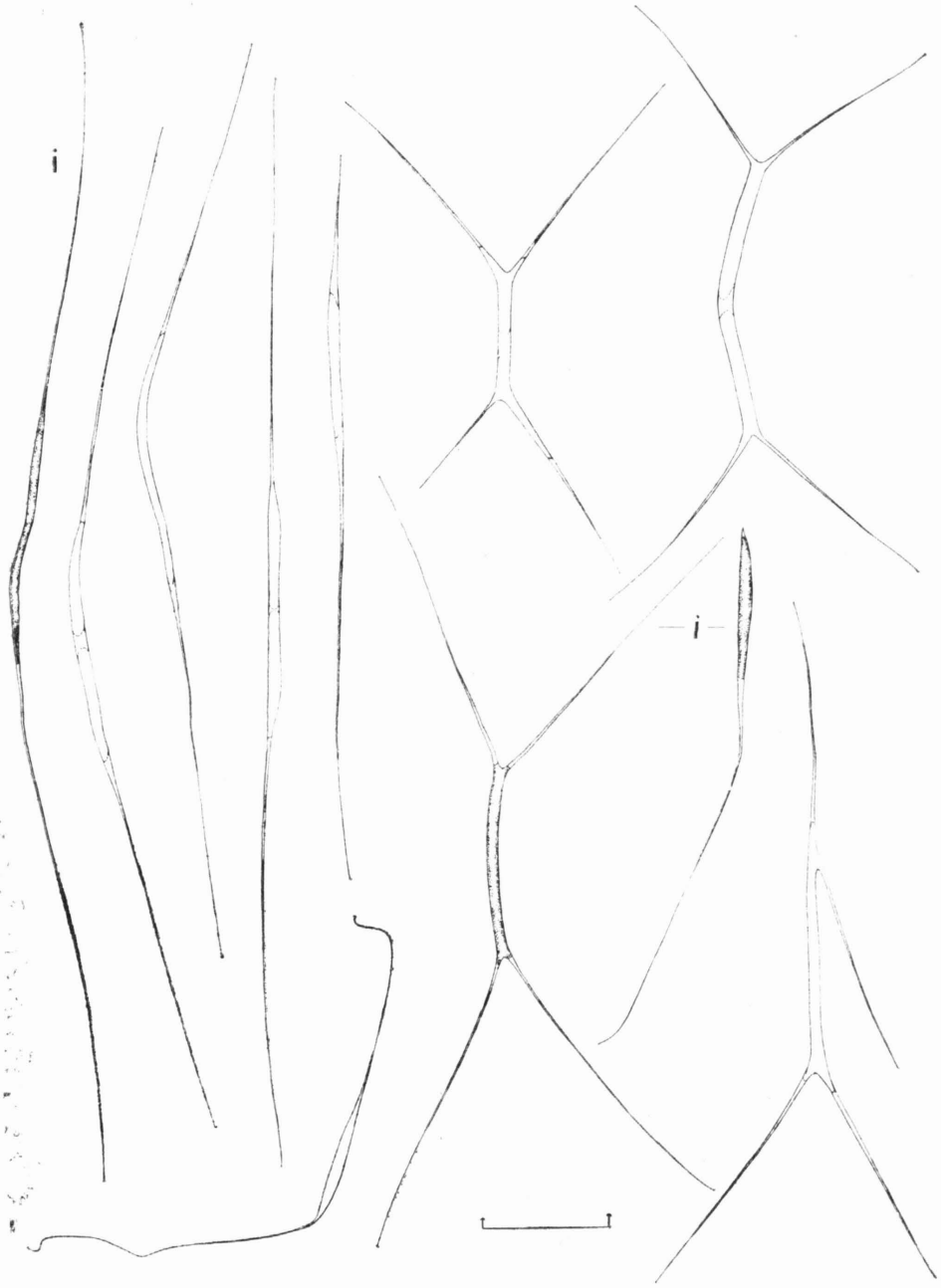


Fig. 4. — *Koliella norvegica* HIND. Specimens from mountain lakes in northern Norway, i = iconotype. Scale: 10 μm.

The studied strain HINDÁK 1979/235 is deposited in the collection of algal cultures of the Botanical Institute of the Cuban Academy of Sciences at Cienfuegos, Cuba.

Koliella ***norvegica*** HINDÁK, sp. nova Fig. 4

Cellulae libere natantes, singulae, ± fusiformes, rectae usque moderate curvatae, ± asymmetricae, ad apices ± succedane angustatae, cellulae adultae apicibus (1 – (2) longe extractis acutatisque, 42—96 × 0,8—1,5 μm. Membrana cellularum tenuis, hyalina, sine muco. Chromatophorum unum, parietale, sine pyrenoide. Propagatio cellularum divisione in partes duas.

Habitatio: In plancto lacuum oligotrophici, Norvegia septentrionalis, leg. Dr. Else-Øyvor Sahlquist, Oslo, aestate 1980.

Iconotypus: Fig. 4 : i.

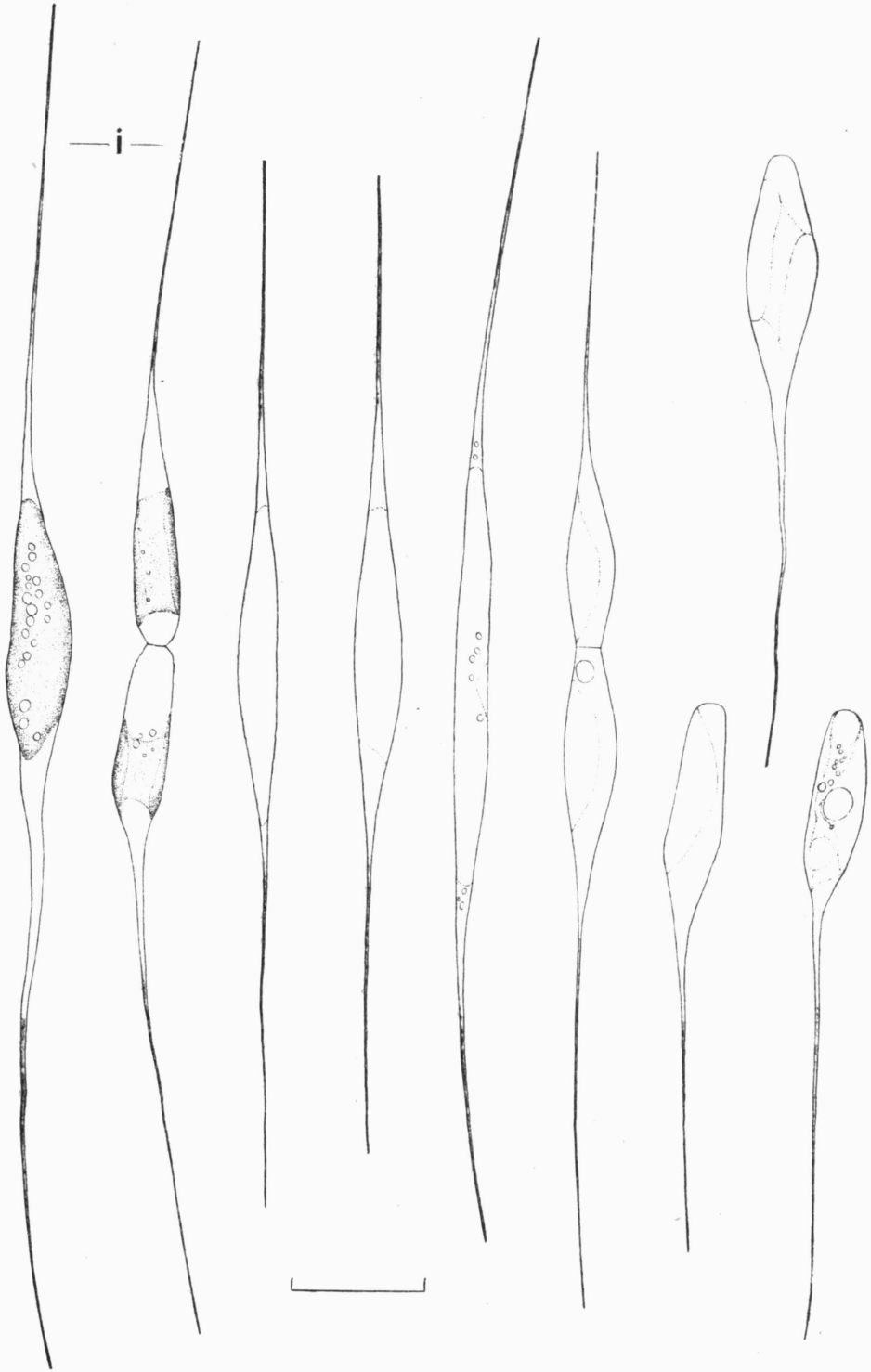
Cells free-floating, singular, ± fusiform, straight to slightly arcuately curved, ± asymmetrical, with suddenly attenuated slender and long, straight or slightly crenate setiferous ends in adult cells; one or two bifurcated ± equally long ends at each pole; cells 42—96 × 0.8—1.5 μm, the median part with chloroplast fusiforum to cylindrical, 10—20 μm long, the suddenly narroved terminus 17—40 μm. Cell wall thin, hyaline, without a mucilage. Chloroplast one, parietal, without a pyrenoid. Reproduction by cell division into two parts.

Occurrence: In the plankton of oligotrophic mountain lakes in northern Norway, leg. Dr. Else-Øyvor Sahlquist, Oslo, summer 1980.

The species is conspicuous by long and thin cells that are usually slightly asymmetrical, unequally broad in the median portion, straight up to slighty curved. Similarly, the attenuated ends are not entirely straight and regular, sometimes they are irregularly crenate up to curved as in the species *K. longiseta*. The median part of the cell where the chloroplast was placed, is irregularly fusiform to cylindrical, from it the long setiferous attenuated ends are tapered with a relative abruptness. In addition to cells with one attenuated end at each end, not rarely did there occur with bifurcated ends, so that the ends had the shape Y. Such bifurcated ends are rare in the genus *Koliella*, only in the cryophilous species *K. chodatii* (KOL) HIND. were cells with one bifurcated end (KOL 1931, HINDÁK 1963) rarely observed.

There was one chloroplast, two prior the cell division, which often filled the entire parietal cell perimeter except for the narrowed setiferous ends. Daughter cells that arose after the division of the mother cell, separated quickly from each other. As in the other species, young cells had one end long and the other (the maturing one), short. *K. norvegica* is similar to other species of the genus *Koliella* [namely to *K. elongata* (NYG.) NYG. and *K. longiseta* (VISCH.) HIND. f. *tenuis* NYG., described from the plankton of Danish lakes by Nygaard in 1977] by long and slender cells, gradually tapering toward the ends and the ends not bifurcated. Cells in *K. elongata* are up to 245 μm in length, cell dimensions in *K. longiseta* f. *tenuis*, in contrast, are as in *K. norvegica:* 51—86 × 0.6—1.1 μm.

Fig. 5. — *Koliella crassa* HIND. Specimens from fishponds in Bratislava-Železná Studienka, i = iconotype. Scale: 10 μm.


i

Koliella ***crassa*** HINDÁK, sp. nova Fig- 5

Cellulae libere natantes, singulae vel post divisionem binae conjunctae, ± fusiformes, ± rectae, moderate asymmetricae, ad apices ± subito angustatae, cellulae adultae apicibus longe extractis acutisque, 36—102 × 2,5—5 μm. Membrana cellularum tenuis, hyalina, sine muco. Chromatophorum unum, parietale, sine pyrenoide. Propagatio cellularum divisione in partes duas.

Habitatio: In plancto piscinae in Bratislava-Železná Studienka, Slovacia occidentalis, Martius 1980.

Iconotypus: Fig. 5 : i.

Cells free-floating, singular, after division linked up by two, ± fusiform, straight to slightly curved, slightly asymmetrical, in the median portion irregularly cylindrical and then toward the ends abruptly narrowed and setiferously attenuated, 36—102 × 2.5—5 μm; the medium portion irregularly fusiform; in young cells lanceolate, 15—35 μm long, attenuated ends up to 42 μm in length. Cell wall thin, hyaline, without a mucilage. Chloroplast one, parietal, without a pyrenoid. In the protoplast there are oily drops of various sizes. Reproduction by cell division into two parts; the daughter cells remain joined together for a certain period of time by their newly formed broadly rounded ends.

Occurrence: In the plankton of fertilized forest fishponds No. 3, 4 at Železná Studienka in Bratislava, March 1980.

The characteristic features of the species are slightly asymmetrical cells, the conspicuously broad medium part of cells and the relatively thick attenuated ends. Cells in the hitherto known planktic species are up to 3 μm in width and in the cryophilous species only *K. viretii* (CHOD.) HIND. has cells 3—5 μm in width (see HINDÁK 1963, KOL 1968, STARMACH 1972, MOŠKOVA 1979). Cells of the new species are relatively robust, not only owing to the broad median portion, appear to be hollow up to the tip, just as in the chlorococcal genus *Schroederia* LEMM.

Another significant feature was that daughter cells, after having been formed, remained joined together for a relatively long time by their broad ends, as for example in *K. helvetica* (KOL) HIND. Following the separation of daughter cells, the newly formed end remained broad during a cerain time of growth (see Fig. 5, cell on the right hand side above) and only later did the attenuated portion originate. Owing to this mode of growth of the new end, which differs from the type in *K. longiseta* (VISCH.) HIND., young cells are lance shaped, a feature that does not occur in any other species of the genus *Koliella*. These morphological features are responsible for the isolated position of the new species within the genus.

In young cells the trough-like chloroplast fills only a part of the inner perimeter of the median cell portion; in adult cells, to the contrary, it fills almost the entire parietal space of the median portion, except of the space for nucleus.

The species occurred in fishponds at Železná Studienka in Bratislava for only a relatively short time in the second half of March 1980 and has not been found since then.

SÚHRN

Opisujú sa štyri nové druhy rodu *Koliella* HIND. (*Ulotrichales, Chlorophyceae*) z planktóna sladkých vôd: *K. sigmoidea* HIND. a *K. spirulinoides* HIND. sa našli na Kube, *K. norvegica*

Hind. v oligotrofných horských jazerách v severnom Nórsku a *K. crassa* Hind. v rybníku na Železnej Studienke v Bratislave. Diskutuje sa systematické postavenie rodov *Koliella* Hind. a *Raphidonema* Lagerh. medzi vláknitými zelenými riasami.

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Poslední doba přináší syntetické snahy a nové kontakty mezi biologickými vědními odvětvími, přináší konvergenci tam, kde nové poznatky na začátku století vedly k hlubší specializaci a úplné divergenci. V polovině našeho století existovaly v botanice dva zcela odlišné diskontinuitní světy: laboratorní fyziologie, pracující na modelových rostlinách a směřující k molekulární interpretaci jevů na straně jedné a ekologie (ve střední a východní Evropě nazývaná geobotanika), pracující v terénu a směřující spíš k objasnění cenoz a areálů, na straně druhé. Styčné problémy byly výjimkou a jejich vyhledávání a řešení záleželo spíš na zálibě a individuálním zaměření některých odborníků. Šedesátá léta přinesla zlom: Mezinárodní biologický program vnesl kvantitativní fyziologické hledisko do studia přirozených cenoz a ekosystémů. Klíčovou otázkou se staly problémy: jak fungují přirozené ekosystémy, jakou úlohu zde mají

rostliny, jakými strategiemi se rostlinná složka prosazuje. Na celém světě bylo shromážděno mnoho údajů o porostech i druzích planě rostoucích a není ani divu, že se objevily i četné tituly o ekologii a ekofyziologii rostlin. Jedním z nich je i recenzovaná kniha o ekologické fyziologii rostlin.

Jde o originální učebnici, kde na rozdíl od předchozích podobných příruček (např. Larcher, Kreeb, Steubing) jsou podány pedagogicky názorně i vybrané obecné fyziologické principy; např. vtipně je vysvětlen vodní potenciál, kinetika příjmu iontů, teplotní koeficienty Q_{10} apod. Výběr je ovšem podřízen ekologickému hledisku, které objasňuje dvojaký vztah rostlin k prostředí: jednak rostliny využívají ekologické faktory ke svým základním životním funkcím a udržení své existence (světlo, voda, minerálie) — tyto faktory autoři probírají v oddíle „Využívání zdrojů" —, jednak se setkávají s faktory potenciálně škodlivými, jako jsou zátěže teplotní, toxiny a interakce mezi organismy — tyto faktory autoři řadí do oddílu „Reakce na zátěže". Nejnápadnější rozdíl proti dosavadním učebnicím fyziologie je v příkladech a číselných údajích, které byly většinou získány při studiu planě rostoucích rostlin, převážně travin a bylin. Není zde tedy příkladem fotosyntézy *Chlorella* a příkladem sorpce živin *Avena sativa*, ale hovoří se o *Dryas integrifolia*, *Deschampsia caespitosa* nebo o *Juncus squarrosus*.

Je možno diskutovat o tom, zda členění knihy do těchto základních dvou zorných úhlů je správné a do jaké míry vystihuje skutečnou množinu vztahů rostlin k prostředí. Toto nekonvenční členění vede k určitým nedůslednostem. Např. celou fyziologii klíčení včetně dormance semen autor vtěsnává jako oddíl III. kapitoly 4. Voda. Malá část klíčení zůstala pro samostatný odstavec B v kapitole 2. Světlo, oddílu II. Vliv kvality světla na rostliny. Tento odstavec B je zde souřadný s dalším odstavcem D, nazvaným Fotoperiodismus. Ten se však již zabývá délkou dne, tedy nikoliv kvalitou světla, a podle mého názoru je pro příručku ekologické fyziologie příliš stručný. Vždyť např. Mathon zveřejnil mnoho prací, zabývajících se soustavně květenou mírného pásma, kde dokazuje, že je fotoperiodismus určující pro rozšíření velké řady rostlin. Tohoto autora necitují. Nebo se celá problematika o rhizosferní mikroflóře a mykorrhize dostala ne do kap. 8 Interakce mezi organismy, ale jako pododdíl V. do kapitoly 3. Minerální živiny. Velmi originálně je zpracována kapitola 7. Toxicita plynů a její oddíl I. Anaerobiosa v půdách. Rozvádí se zde vliv anoxie na kořeny, dále jsou probrány adaptace rostlin k přežití v zaplavovaných půdách i s příslušnými metabolickými cestami ve schematech. Některé detaily by pro případné další vydání knihy měly být ještě přehlédnuty. Např. na str. 88 v tabulce o minerálním složení bylin je uvedeno, že hodnoty odpovídají průměrům z více než 1 vzorku. Na str. 107 se mluví o půdním ekosystému, ač se tím rozumí jen společenstvo rozkladačů apod.

Autoři čerpali velmi svědomitě z novějších původních prací a snesli mnoho originálního dokumentačního materiálu. I v této oblasti je však určitá jednostrannost. Jejich afinita k anglicky psaným pracem o řád převyšuje německy psané a o dva řády ostatní jazyky. Je zde totiž přes 700 citací anglicky psaných příspěvků, kolem 2 desítek německých a zcela ojedinělé práce francouzské a ruské.

Vcelku je kniha značně nekonvenčním průzorem do procesů, které určují distribuci rostlin na Zemi a umožňují jejich existenci v přirozených i civilizací změněných ekologických podmínkách. Přináší množství faktických údajů o planých i kulturních rostlinách všech pásem — v tom je její nepominutelná hodnota, pro kterou po ní sáhnou četní ekologové. Nejde však o soustavnou učebnici ekologické fyziologie rostlin jako spíš o jednotlivé eseje o významných ekologických faktorech, volně spojené autorským hlediskem využívání zdrojů a zátěží. Pro tyto nové aspekty, hlavně však pro bohatou faktologii, dobře dokumentovanou v rejstříku, bude kniha užitečná pro všechny botaniky, ať už ekology, fytogeografy nebo fyziology, a to zejména pro studenty, diplomanty, výzkumné i pedagogické pracovníky.

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