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Silica-scaled chrysophytes (Chrysophyceae and Synurophyceae) from the Kis-Balaton Reservoir, Hungary

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Abstract – Eight species of silica-scaled chrysophytes were identified by electron microscopy of phytoplankton samples from the newly opened Kis-Balaton Water Protecting Reservoir, Hungary. The composition of this flora of silica-scaled chrysophytes is characteristic for eutrophic to hypertrophic localities. Most of the species are common and widely distributed, even cosmopolitan. The record of *Chrysosphaerella annulata*, which was recently described from Austria and has been recorded from widely separated places in the world, is interesting. This and three further species (*Spiniferomonas trioralis*, *Synura petersenii* and *S. curtispina*) are new to Hungary, while the others (*Paraphysomonas vestita*, *Mallomonas acaroides*, *M. alpina*, *M. tonsurata*) were recorded before mainly on the basis of light microscopy. Electron micrographs of the above species are presented in the paper. A checklist of all the previous records of scaled chrysophytes in Hungary is added as an Appendix. With 10 figures.

The Hungarian flora of silica-scaled chrysophytes has so far only been known from light-microscopy (LM) investigations with the exception of an electron microscopical (EM) study of *Paraphysomonas vestita* (HAJDU 1975). Several species have been recorded, but most of these records are based on obsolete names (e. g. *Mallomonas horrida*, *Synura verrucosa*) which cannot be identified. Others have been identified with recognized species (e. g. *Synura uvella*, *Mallomonas acaroides*), but these identifications are questionable. Only a few LM identifications are reasonably trustworthy (e. g. *Mallomonas tonsurata*).

A checklist of all scaled chrysophytes previously recorded in Hungary is given in the Appendix.

However, it has long been established that electron microscopy of silica scales is necessary for reliable identifications. Thus it was decided to make a chrysophyte survey by means of EM of the samples from the Kis-Balaton, a newly constructed Water Protection Reservoir.

The reservoir was opened in June 1985 at the mouth of the Zala River, the largest and most polluted inflow of Lake Balaton, which is the largest shallow lake in central Europe. The reservoir has a surface area of 18 km^2 and an average depth of 1.2 m. It is a highly eutrophic body of water, in which summer phytoplankton biomass can exceed 150 mg l^{-1} (POMOGYI 1991). Many species of algae can be found in the reservoir. In 1988 the detailed floristic survey established the presence of 382 taxa of algae (VÍZKELETI 1991), most of which belong to Chlorococcales. Water blooms frequently occur mostly by heterocytic blue-green algae (*Anabaena* spp., *Aphanizomenon* spp., *Cylindrospermopsis raciborskii*), *Microcystis* spp., small unicellular centric diatoms and *Crypto-*

monas spp. However, apart from the previously cited report, very little information is available on the algal flora in the reservoir (SCHMIDT & al. in press).

When the samples of the present study were taken, surface water bloom was observed in the reservoir due to *Planktothrix agardhii* (GOM.) ANAGN. & KOM. and *Limnothrix redekei* (VAN GOOR) MEFFERT (identification by the participants of the 8th Workshop of the International Association of Phytoplankton Taxonomy and Ecology). Further details on the operational parameters, efficiency, etc. of the reservoir are available in POMOGYI (1991).

METHODS

Samples for EM chrysophyte studies were taken in the Kis-Balaton Reservoir on 9-10 July 1991 at 20 sampling stations (Fig. 10). Samples were fixed in Lugol's Iodine solution.

The preparation of the silica structures was made from the Lugol-fixed samples. Drops of the material were placed on formvar+carbon coated grids by means of a micropipette. After drying, the grids with material were rinsed with distilled water for iodine crystals. The grids were examined in a Jeol-100-SX electron microscope.

RESULTS AND DISCUSSION

Eight species of scaled chrysophytes (Figs 1-9) were found during the investigations.

Chrysophyceae

1. **Chrysosphaerella annulata** KRISTIANSEN & TONG (Fig. 1) – Described from eutrophic ponds in Austria and China; single scales also reported from various regions in the tropics (KRISTIANSEN & TONG 1989). New to Hungary. – Locality: No 15.

2. **Paraphysomonas vestita** (STOKES) DE SAEDELER (Fig. 3) – One of the most common and widely distributed chrysophytes. Cosmopolitan, found mainly in eutrophic localities where it may be the only chrysophyte occurring in any quantity (KRISTIANSEN 1985, 1988). Previously recorded from Hungary in EM (Hajdu 1975). – Localities: Nos 1, 2, 4, 6, 9, 10, 12, 13, 14, 15, 20.

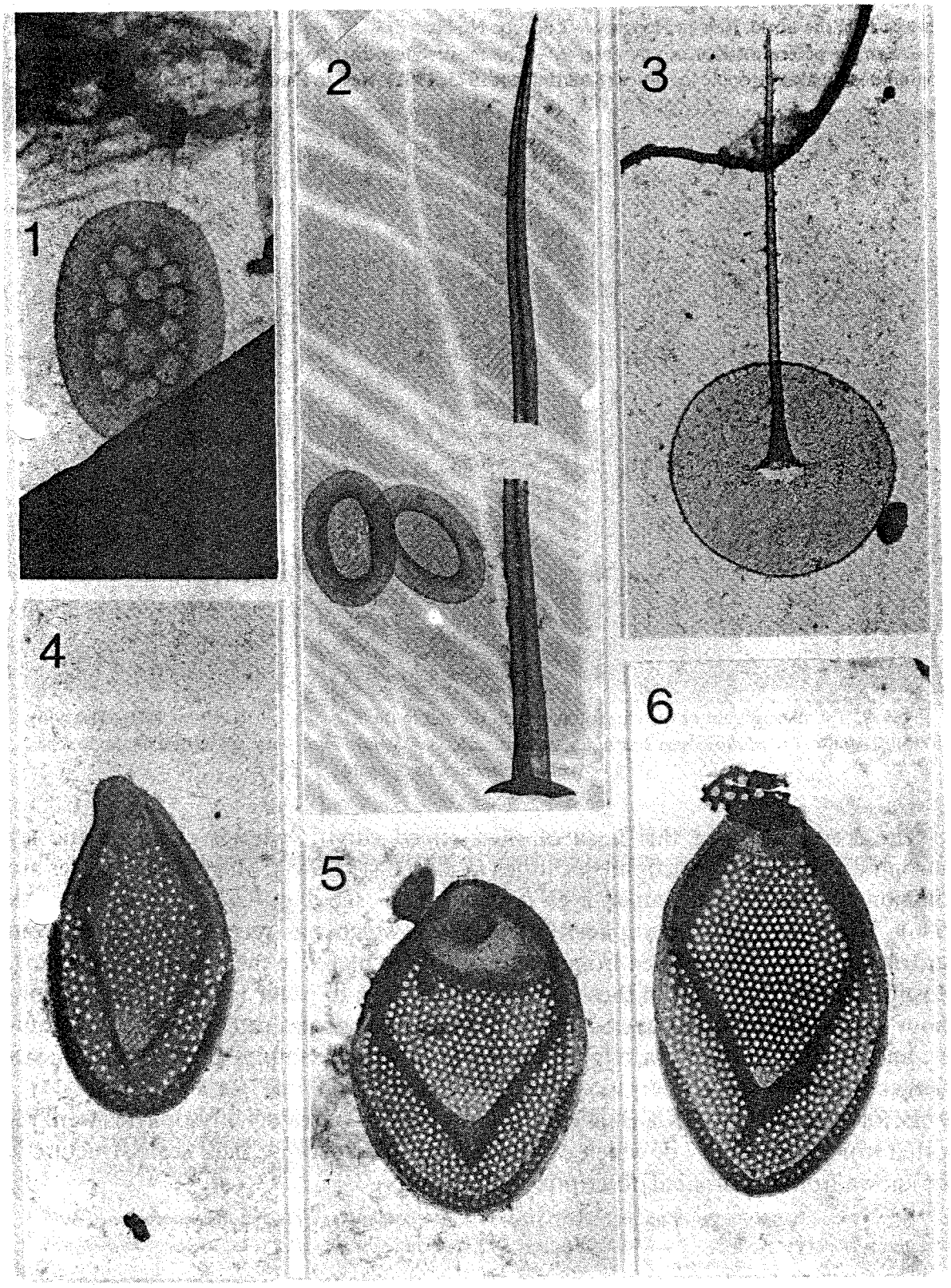
3. **Spiniferomonas trioralis** TAKAHASHI (Fig. 2) – A common species in many different types of water from oligotrophic to hypertrophic (ITO & TAKAHASHI 1982, KRISTIANSEN 1985, 1988, SIVER 1988). New to Hungary. – Locality: No 1.

Synurophyceae

4. **Mallomonas acaroides** PERTY em. IVANOV var. **acaroides** (Fig. 7) – Widely distributed, mainly in eutrophic localities (KRISTIANSEN 1986, 1988, SIVER 1991) in contrast to var. *muskokana* NICHOLLS, which is confined to oligotrophic conditions (NICHOLLS 1987). Reported from many LM investigations in Hungary, but not to be trusted without EM. – Localities: Nos 1, 13, 19.

5. **Mallomonas alpina** RUTTNER in PASCHER (Fig. 4) – This is also a widely distributed species, cosmopolitan and occurring in a wide range of localities. Mainly in eutrophic, but also in hypertrophic lakes and ponds (KRISTIANSEN 1985, 1988, SIVER 1991). Some LM records in Hungary but not to be trusted without EM. – Localities: Nos 3, 13.

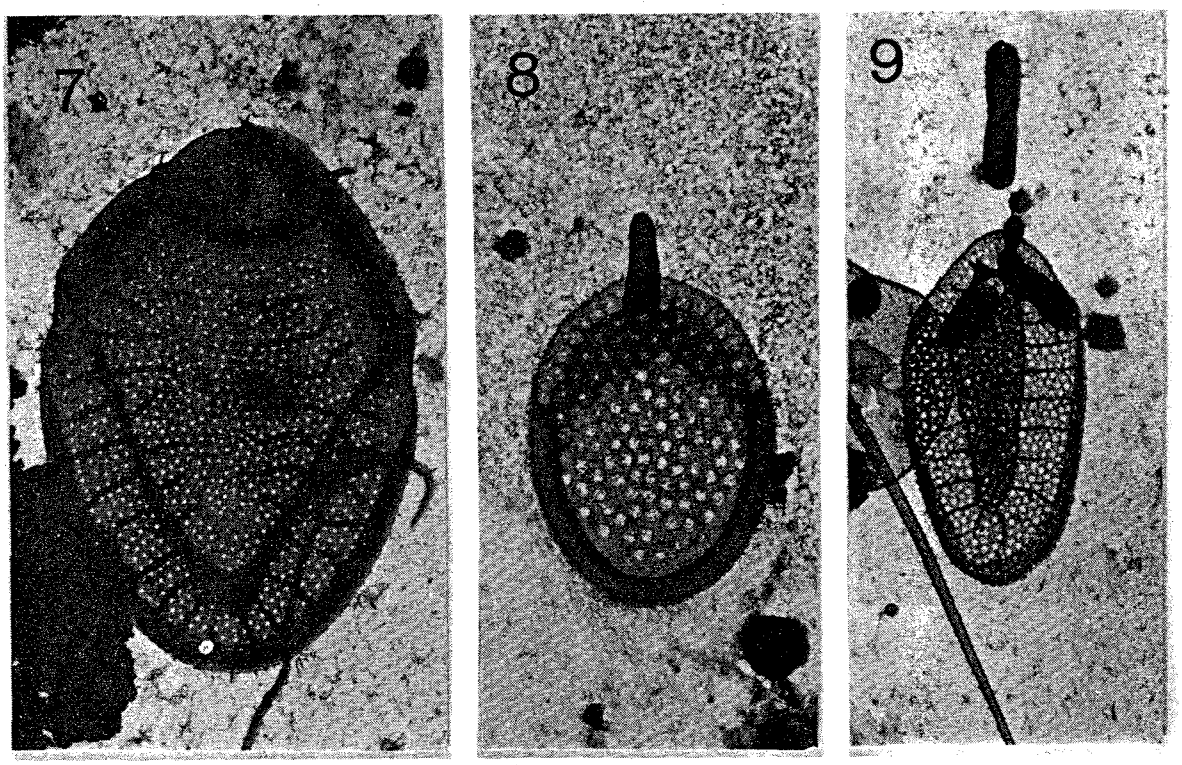
6. **Mallomonas tonsurata** TEILING em. KRIEGER (Figs 5-6) – One of the most widely distributed species, cosmopolitan. Found in many types of water, most characteristically in eutrophic lakes and ponds (KRISTIANSEN 1985, 1988, SIVER 1991). Several LM records from Hungary. – Localities: Nos 1, 3, 6, 12, 13, 14, 16, 19, 20.



Figs 1-6. EM micrographs of the chrysophyte scales found in the Kis-Balaton Reservoir. Magnification for all: 10,000x. 1 = *Chrysosphaerella annulata*, plate scale, 2 = *Spiniferomonas trioralis*, spine scale and plate scales, 3 = *Paraphysomonas vestita*, spine scale, 4 = *Mallomonas alpina*, domeless body scale, 5-6 = *Mallomonas tonsurata*, domed apical scale and domeless body scale

7. **Synura curtispina** (PETERSEN & HANSEN) ASMUND (Fig. 8) – Recorded from only a few places in different parts of the world. New to Hungary. – Locality: No 20.

8. **Synura petersenii** KORSHIKOV (Fig. 9) – The most widely distributed *Synura* species, cosmopolitan, also found in highly eutrophic localities (KRISTIANSEN 1975, 1981). New to Hungary. – Locality: No 13.



Figs 7-9. EM micrographs of the chrysophyte scales found in the Kis-Balaton Reservoir. Magnification for all: 10,000x. 7 = *Mallomonas acaroides*, domed scale, 8 = *Synura curtispina*, spine-bearing body scale, 9 = *Synura petersenii*, body scale

The composition of this flora of silica-scaled chrysophytes is characteristic for eutrophic to highly hypertrophic localities (KRISTIANSEN 1985). Most of the species are common and widely distributed, even cosmopolitan (see e. g. ASMUND & KRISTIANSEN 1986). The record of *Chrysosphaerella annulata*, which was recently described from Austria and has been recorded from widely separated places in the world, is interesting. Most of the species found in these samples are known to occur in other places throughout the year, even in summer. However, most chrysophytes prefer lower temperatures, and a much richer flora might be present in vernal samples (comp. KRISTIANSEN 1988).

Before this survey in Kis-Balaton reservoir 28 taxa of scaled chrysophytes were reported from Hungary, 17 of which cannot be identified because their scale structure is not known from the original descriptions (Appendix).

* * *

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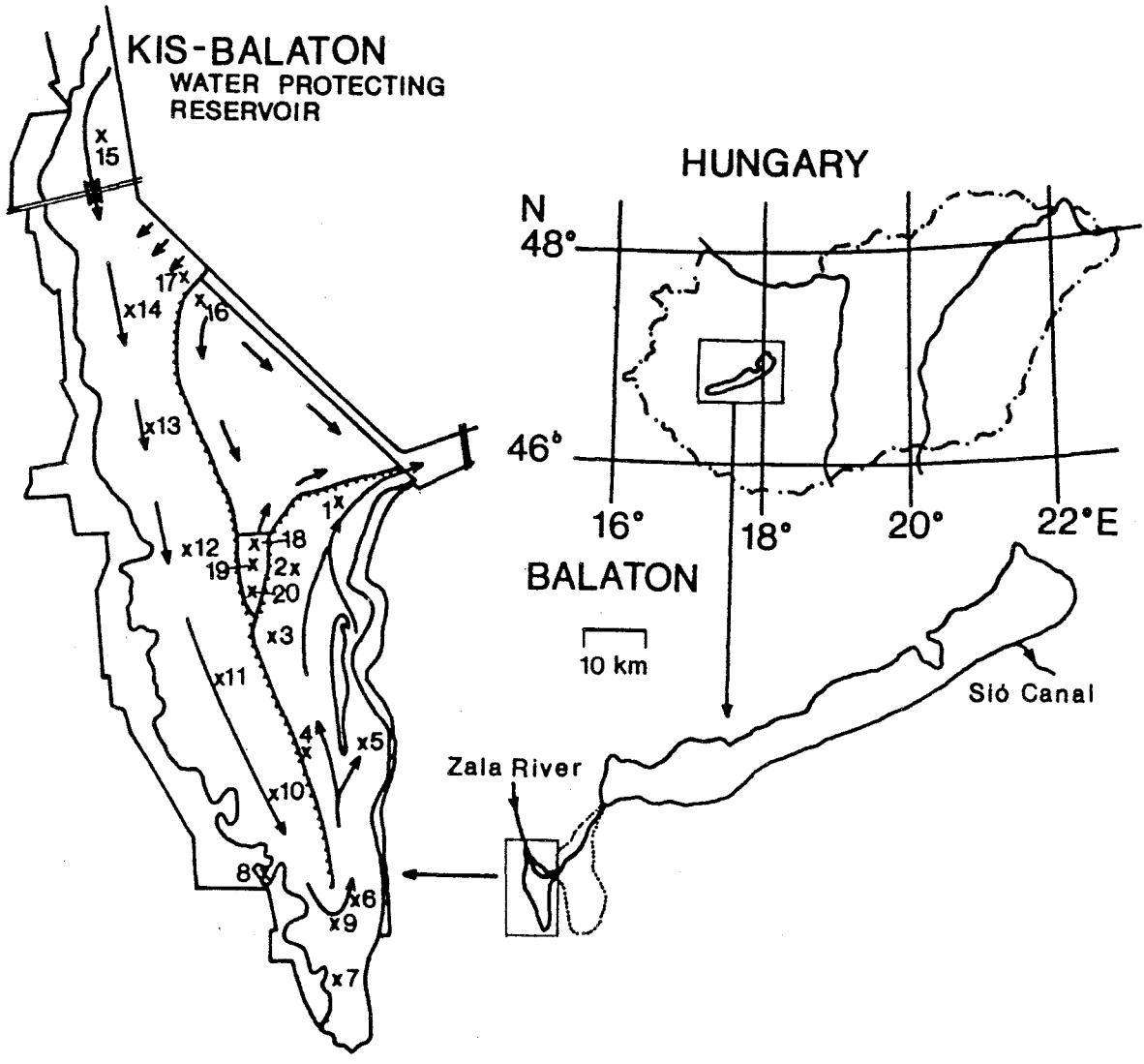

Fig. 10. Location of Kis-Balaton Reservoir and the sampling stations (x). Open arrows indicate the direction of the water flow

APPENDIX

A checklist of previous records of scaled chrysophytes in Hungary

Mallomonas acaroides PERTY – CLAUS (1962), ENTZ (1930), KISS, (1967), KREPUSKA (1917, 1930), KOL (1938), PONYI & al. (1974), SCHERFFEL (1904), SZEMES (1964, 1966a, b, 1967a, b, 1971), TAMÁS (1974), VÁNCSA (1976); identifications are dubious.

Mallomonas acaroides PERTY var. **lacustris** LEMM. – KOL (1966), SZABADOS (1939); cannot be identified.

Mallomonas acaroides PERTY var. **media** PALIK – PALIK (1938); cannot be identified.

Mallomonas acaroides PERTY var. **moskovensis** (WERMEL) KRIEGER – HORTOBÁGYI (1963); cannot be identified.

Mallomonas akrokomos RUTTNER–BERETZK & al. (1958), SCHMIDT (1976a), HAMAR (1976a); certainly correct.

Mallomonas allorgei (DEFL.) CONRAD – VÍZKELETY (1981); identification is dubious.

Mallomonas apochromatica CONRAD – UHERKOVICH (1958a); cannot be identified.

Mallomonas caudata IWANOFF – HAMAR (1976a), HORTOBÁGYI, T. (1977), KISS, I. (1978a), SCHMIDT (1976b), SZEMES (1964, 1966a, b, 1967a, b, 1971), UHERKOVICH (1958a, b, 1959a, b, 1960a, 1961a, b, c, 1962, 1963, 1964a, b, 1966a, b, 1967, 1971, 1972); probably correct.

Mallomonas cylindracea PASCH. – SCHMIDT (1976b); cannot be identified.

Mallomonas elegans LEMM. – SZABADOS (1954), SZEMES (1967a); cannot be identified.

Mallomonas elongata REVERDIN – PONYI & al. (1974), TAMÁS (1967a), UHERKOVICH (1964a, 1971) ; identifications are dubious.

Mallomonas fresenii KENT – HORTOBÁGYI (1943, 1957, 1973), SZEMES (1967a); cannot be identified.

Mallomonas globosa SCHILLER – SZEMES (1967a); perhaps a species of *Spiniferomonas*.

Mallomonas hirsuta CONRAD – KISS, I. (1978a); cannot be identified.

Mallomonas horrida SCHILLER – SZEMES (1967a), UHERKOVICH (1958c); cannot be identified.

Mallomonas longiseta LEMM. – HORTOBÁGYI (1957), UHERKOVICH (1966b); cannot be identified.

Mallomonas ovum SCHILLER – SZEMES (1967a), UHERKOVICH (1958a, 1959a); cannot be identified.

Mallomonas ploeslii PERTY – DADAY (1897), ENTZ (1920), FRANCÉ (1893, 1897); cannot be identified.

Mallomonas producta IWANOFF – ENTZ (1930), SZEMES (1967a); cannot be identified.

Mallomonas teilingii CONRAD – VÍZKELETY (1981); LM identification is possible.

Mallomonas tonsurata TEILING – HORTOBÁGYI (1942), PONYI & al. (1974), SZEMES (1964, 1966b, 1967a, 1971), TAMÁS (1974), UHERKOVICH (1961a, 1964a, b, 1965, 1966a, b, 1967, 1969a); LM identification is possible; at least some of the records are correct.

Mallomonas tonsurata TEILING var. **alpina** (PASCH. et RUTTNER) KRIEGER – HORTOBÁGYI (1942), SZEMES (1967a), UHERKOVICH (1967, 1968a,); identifications are dubious.

Paraphysomonas vestita (STOKES) DE SAEDELEER – HAJDU (1975); correct.

Synura globosa (SCHILLER) STARMACH – HAMAR (1976a); cannot be identified.

Synura uvella EHR. – DOBLER & KOVÁCS (1984), ENTZ (1880), ENTZ (1920, 1930), FÁZOLD & al. (1967), FRANCÉ (1893, 1897), HALÁSZ (1940, 1943), HAMAR (1971, 1976b), KISS (1978a), KOL & VARGA (1960), KOVÁCS (1986), KOVÁCS & DOBLER (1984), KREPUSKA (1917, 1930), MARGÓ (1865), SCHIEFNER & URBÁNYI (1970), SCHMIDT (1976b), SZEMES (1964, 1966a, b, 1967a, b, 1971), SZ. MUHITS (1955), TAKÁCS & al. (1969), TAMÁS (1959, 1965, 1967b, 1974), UHERKOVICH (1958c, 1960b, c, 1961a, c, 1962, 1964a, b, c, 1965, 1966a, 1967, 1969b, 1976, 1971, 1972), VÁNCSA (1972, 1976), VÍZKELETY (1981); identifications are dubious; the item may include several other species.

Synura uvella EHR. var. **punctata** AWERINZEW – ENTZ (1930); cannot be identified.

Synura uvella EHR. var. **tiszaensis** KISS – KISS (1978a, 1978b); perhaps a developmental stage.

Synura verrucosa PASCH. – UHERKOVICH (1958c, 1959c, 1971); cannot be identified.

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