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SCALED CHRYSOPHYTES FROM THE NETHERLANDS INCLUDING A DESCRIPTION OF A NEW VARIETY

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SUMMARY

Chrysophyceae from the northern region of the Netherlands have been examined by electron microscopy. Twenty-eight species, varieties and forms were found. Twenty-two of these have not previously been recorded for the Netherlands. In addition, one new variety is described.

1. INTRODUCTION

This paper deals with the Chrysophycean species occurring in selected pools and lakes situated near Groningen, The Netherlands. Although there have been a number of studies on Northern European scaled Chrysophytes, to date no examinations of Dutch freshwater phytoplankton have been made using electron microscopy. Thus, it was considered of value to publish the present electron micrographs to add to a better understanding of the distribution of the Chrysophyceae, as well as to point out to the limnological researchers in Holland some of the scaled Chrysophytes they may encounter in the plankton.

2. LOCALITIES

Four of the localities investigeted are in the province of Groningen, and one locality is in the province of Drenthe. The locality name and reference number of the Dutch Topographical Map are as follows: Siepelveen, near the village of Zeegse, Blade 12 East, coordinates (565, 240); Sassenhein ponds: northern pond, Blade 7, coordinates (575, 236) and southern pond, Blade 12 West, coordinates (574, 236); harbor at Zoutkamp, Blade 6 East, coordinates (195, 595); and Lauwers Meer, near Lauwersoog, Blade 2 East, coordinates (189, 603).

Siepelveen is a somewhat eutrophicated, but primarily dystrophic moorland-pool, which resulted from medieval and second world-war exploitation of peat from a small bog on top of an impervious layer of boulder clay. The small bog, in turn, developed when a wandering dune obstructed a rillet fed by infiltrated rainfall from higher levels of the landscape and streaming down the slope of the boulder clay under the cover sand.

Sassenhein northern pond is an old eutrophic peat pit. Transgressions of the sea into this area, in historic times, left some salt in the deeper layers of the peat. Recent lowering of the ground-water level causes this salt to be washed out, and to enter the surface water.

Sassenhein southern pond is a recently dug (1965) sand pit, 40 m. deep and with a bottom of post-glacial cover sands, boulder clay, and pre-moraineal sands which are rich in minerals. The shore and the surrounding area are covered by a thin layer of peat. The water is very clear.

Lauwers Meer is the deepest part of the former estuary of the rivers Lauwers and Reitdiep, separated from the sea by an enclosure dam with a sluice in 1969, but still slightly brackish due to saline seepage through the sandy subsoil. At periods of high discharge of the Lauwers and Reitdiep, the Lauwers Meer is flushed with fresh water, and the effectiveness of this is enhanced by the special construction of the sluice.

The harbor of Zoutkamp formerly was a small seaport at the mouth of the Reitdiep. It is now rendered inland.

3. METHODS

Phytoplankton was collected during the last week in March, 1975 either using a plankton net or pipetting a sample directly into a vial. Some species were first examined in live condition with a light microscope. For electron microscopy, a suspension of either live or preserved material was dried on Formvar-gold or -carbon coated 200 mesh grids. All of the plankton samples were preserved in 5% glutaraldehyde. All electron micrographs were made using a Philips EM 300 (University of Groningen; Central Michigan University) or a JEOL JEM-T7 (University of Copenhagen) electron microscope. All of the taxa reported with an asterisk are, to our knowledge, new published records for the Netherlands.

4. RESULTS

***Mallomonas acaroides** var. **striatula** Asmund (*fig. 1*).

Our specimens from the northern Sassenhein pond represent the third report of this taxon, it having been previously reported for Denmark (ASMUND 1959) and the United States (WUJEK & HAMILTON 1973). However, the species *M. acaroides* Perty has been recorded several times for the Netherlands.

***Mallomonas alpina** Pascher and Ruttner (*fig. 2*).

Recognized by many authors as a variety of *M. tonsurata*. ASMUND (personal communication) now believes it should be elevated back to the rank of species. It occurred in the northern Sassenhein pond and Siepelveen.

***Mallomonas annulata** Harris (*fig. 3*).

(Syn. *Mallomonas papillosa* var. *annulata* Bradley).

Evaluation of the differences and similarities of *Mallomonas papillosa* var. *annulata* Bradley with *M. papillosa* Harris and Bradley, already enumerated by its descriptor (1966), induced Harris to elevate the taxon to species level.

The characteristics are: base-plate punctate and papillose, posterior rim only punctate, anterior rim only papillose, not ribbed, and the bristle smooth. It has been reported previously from Great Britain (HARRIS & BRADLEY 1960, BRADLEY 1966) and from Japan (TAKAHASHI 1959). We observed it from the northern Sassenhein pond.

Mallomonas akrokomos Ruttner (*fig. 4*).

Electron micrographs of this species have been described by ASMUND (1956), HARRIS (1958), ASMUND & HILLIARD (1961) and WUJEK & HAMILTON (1972). Our specimens were observed in the Zoutkamp collections. The species has been recorded by DE GRAAF (1957) and other investigators for the Netherlands.

***Mallomonas calceolus** Bradley (*fig. 5*).

M. calceolus is small and insignificant in the light microscope, with the bristles of the living organism being barely observable. It has been reported from northern Iceland (BRADLEY 1964) and Great Britain (BRADLEY 1966, BELCHER 1969). The possibility that this species belongs to the genus *Allomonopsis* needs further verification since BELCHER (1969) has reported the presence of a second flagellum. Our specimens came from Siepelveen.

Mallomonas caudata Iwanoff.em. Krieger (*fig. 6*).

M. caudata is a very wide-spread and adaptive form. We observed it in samples from Siepelveen and both of the Sassenhein ponds. It has been reported by a number of investigators in Holland, as far back as REDEKE et al. (1922), and by numerous investigators both in Europe and North America.

***Mallonomas cratis** var. **asmundiae** *var. nov. (figs. 7–10)*.

Diagnosis: Cupola parva (et varia) sed prominens, costis quatuor ad octo rectis et parallelis (per longitudinem) or (per latitudinem) signata.

Dimensions: Cellula circa 23–35 × 15–22 μ, Squamae 6–7 × 3–3.5 μ. English diagnosis: Differs from the nomenclatural type of *M. cratis* (HARRIS & BRADLEY 1960) in having the dome variable in size, but marked with parallel ribs and not the U-shaped ribs of the type. Ribs may also be present at right angles to the longitudinal ribs. The variety was named *asmundiae* after Miss Berit Asmund (Snekkersten, Denmark), a prominent researcher of the scaled Chrysophyceae. Var. *asmundiae* was observed in large numbers from the collections at Zoutkamp.

***Mallomonas lychenensis** Conrad (*fig. 11*).

CONRAD (1938) described this species from Eastern Germany, and collected it from Belgium also (CONRAD 1941). Although the scales of this species are quite distinctive, they have been electron optically observed only in samples from Scandinavia (NYGAARD 1956) and England (HARRIS & BRADLEY 1957).

The organism appeared quite frequently in samples from Siepelveen, a similarly dystrophic habitat as the Belgian locality.

***Mallomonas multiunca** Asmund (*fig. 12*).

Its occurrence in Siepelveen fits well its holotype location from a peat bog in Denmark (ASMUND 1956).

***Mallomonas papillosa** Harris and Bradley (*fig. 13*).

This is a very small species which can be recognized only by means of EM. It has been observed throughout the world (see WUJEK & HAMILTON 1972).

Scales of this species were found in both Sassenhein ponds and Siepelveen.

***Mallomonas pediculus** Teiling (*fig. 15*).

The specimen from the northern Sassenhein pond agrees with the Danish specimens of ASMUND (1959).

***Mallomonas teilingii** Conrad (*fig. 14*).

The Dutch specimens from Zoutkamp agree with the previous micrographs of Danish material published by ASMUND (1956) and PETERFI's (1956) study of Rumanian Chrysophyceae. Both of these authors indicate very eutrophic conditions present where this species was collected. This species has been observed in the Netherlands, but not published (SALOMÉ 1967).

Mallomonas tonsurata Teiling em. Krieger (*fig. 16*).

This species has been found in several eutrophic ponds and lakes in Denmark (ASMUND 1959), Sweden (KRISTIANSEN 1969), Japan (TAKAHASHI 1959) and the United States (WHITFORD & SCHUMACHER 1969, WUJEK & HAMILTON 1973). It has also been reported by several investigators from selected locations in Holland, the first being MEYER & DE WIT (1955). Our specimens were collected from the northern Sassenhein pond.

***Mallomonopsis elliptica** var. **oviformis** (Nygaard) Harris (*fig. 17*).

This species has been reported form a number of European locations (HARRIS 1966, ASMUND 1959, HARRIS & BRADLEY 1960) as well as Japan (TAKAHASHI 1960). We observed it from the Zoutkamp samples.

***Mallomonopsis elliptica** var. **salina** Asmund and Hilliard (*fig. 18*).

Apparently, this variety is adaptable, it being described from a brackish, Alaskan habitat (ASMUND & HILLIARD 1965), but also observed from freshwater habitats (HARRIS 1966). Our scales, from Zoutkamp, fit well into this picture.

***Synura curtispina** (Petersen and Hansen) Asmund (*fig. 19*).

A species closely resembling *Synura spinosa* (*fig. 26*), but differing primarily in that the apical spines are shorter and less tapering, terminating in three or four minute teeth. It has been observed from Czechoslovakia (FOTT & LUDVIK 1957), Denmark (PETERSEN & HANSEN 1956), Japan (TAKAHASHI 1959, 1967), and the United States (WUJEK and HAMILTON 1972). We have observed scales of it from Zoutkamp and the northern Sassenhein pond.

***Synura echinulata** Korshikov. (*fig. 20*).

Synura echinulata has been thoroughly described by many investigators and many electron micrographs have been published. WUJEK & HAMILTON (1973) review the numerous North American localities and TAKAHASHI (1967) the European localities for it. The occurrence of this taxon in the Zoutkamp and Siepelveen samples is the basis for this first report for Holland.

***Synura glabra** Korshikov (*fig. 21*).

(syn. *Synura petersenii* var. *glabra* (Korsh.) Huber-Pest.)

Electron micrographs of material of this taxon have been published by TAKASHASHI (1959, 1967) from Japan, by PETERSEN & HANSEN (1956) from Denmark, and by BOURRELLY (1968) from France (see BOURRELLY 1957 for the locality). Representative scales were observed in the Zoutkamp collections.

***Synura petersenii** Korshikov (*figs. 22* and *23*).
(syn. *Synura caroliniana* Whitford)

The first *Synura* scales to be examined in an electron microscope (MANTON 1955), came from this species. Later many authors have carried on electron microscope examinations of scales of *S. petersenii* and it is now one of the best known and commonest *Synura* species. Scales of this species occurred in all the samples.

***Synura petersenii** f. **kufferathii** Petersen and Hansen (*fig. 25*).

Collections from Lauwers Meer and Zoutkamp contained scales of this form. PETERSEN & HANSEN (1958) described this form from the nomenclatural type.

***Synura petersenii** f. **praefracta** Asmund (*fig. 24*).

Our observation of this form from the northern Sassenhein pond represents the first report since its orginal description by ASMUND (1968) from Alaska.

***Synura spinosa** Korshikov (*fig. 26*).

The scales are of the same ultrastructure as previously reported by various authors. Representative scales were found in the collections from Siepelveen and Zoutkamp.

***Synura spinosa** f. **spinosa** Petersen and Hansen

A form with a wide distribution, it is one of five described by PETERSEN & HANSEN (1956). This form was present in all but the Lauwers Meer samples.

Synura uvella Ehrenberg (*fig. 28*).

This species was mentioned by BEIJERINCK (1927) for the province of Drenthe, and by several authors for other parts of the country thereafter. The scales of *S. uvella* are quite distinctive and have been illustrated by many authors (FOTT &LUDVIK 1957, PETERSEN & HANSEN 1956, HARRIS & BRADLEY 1956, WUJEK et al. 1975 review other localities). We observed it from Siepelveen and Zoutkamp.

***Spiniferomonas trioralis** Takahashi (*fig. 29*).

Presently, the only records of this recently established genus are from Japan (TAKAHASHI 1973) and the United States (WUJEK et al. 1975). Scales and spines of this species were observed in the plankton tows from Zoutkamp and the southern Sassenhein pond.

***Paraphysomonas butcheri** Pennick and Clarke (*fig. 30*).

This species is based on material observed as a contaminant of a marine coccolithophorid culture (PENNICK & CLARKE 1972) and has been subsequently observed in a number of other marine habitats (THOMSEN 1975). The occurrence of *P. butcheri* in the northern Sassenhein pond may reflect its indifference to salt in its environment. However, as indicated in section 2, the presence of some salt in the Sassenhein northern pond is not impossible.

***Paraphysomonas imperforata** Lucas (*fig. 31*).

This species was very rare in our samples, scales being observed infrequently in the Zoutkamp collections. It has been previously recorded from the English Channel (LUCAS 1967) and Denmark (MANTON & LEADBEATER 1974, THOMSEN 1975).

Paraphysomonas vestita (Stokes) De Saedeleer (*fig. 32*).

Scales of this taxon, the largest and most well known freshwater *Paraphysomonas* species, were observed in the Zoutkamp samples. It has been previously reported from Holland by HOUWINK (1952) who examined it in the electron microscope.

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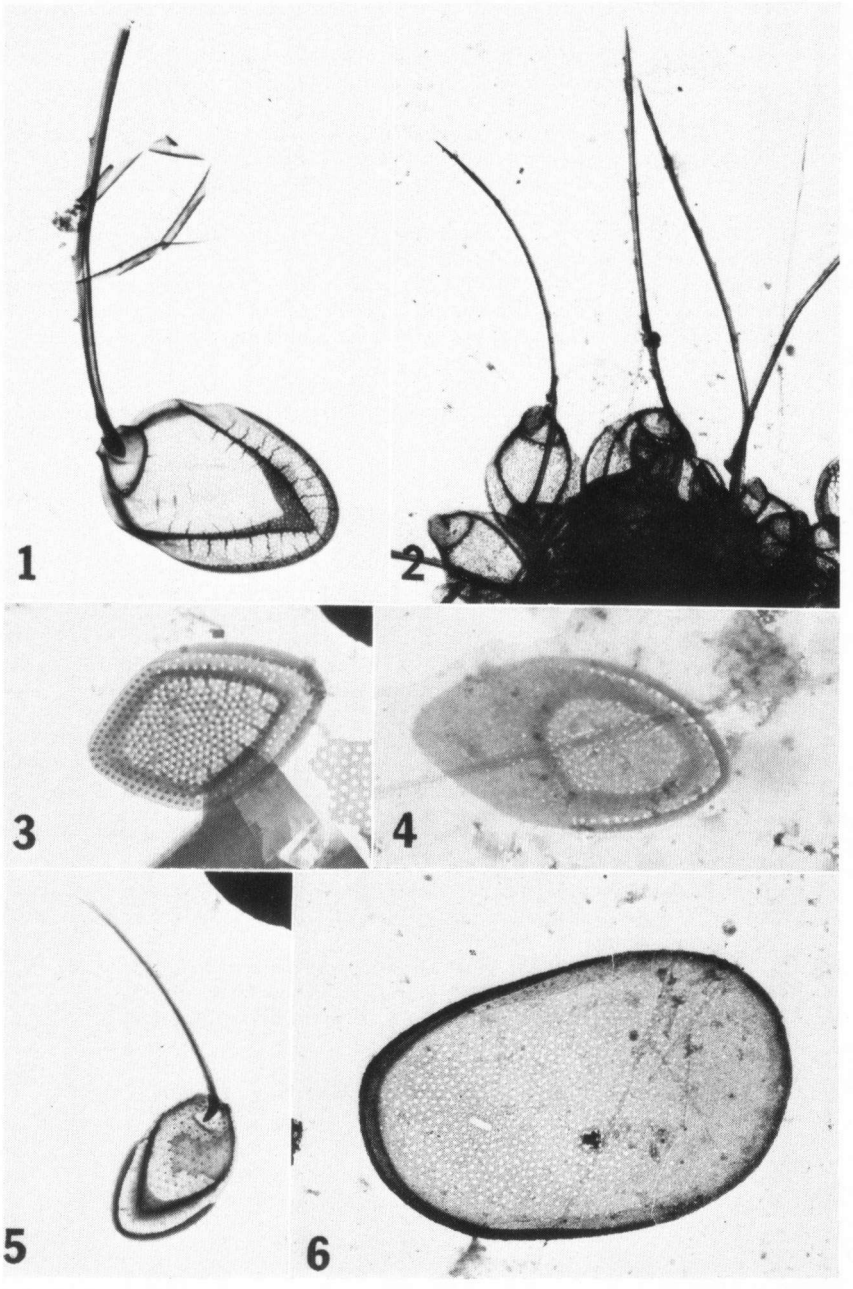
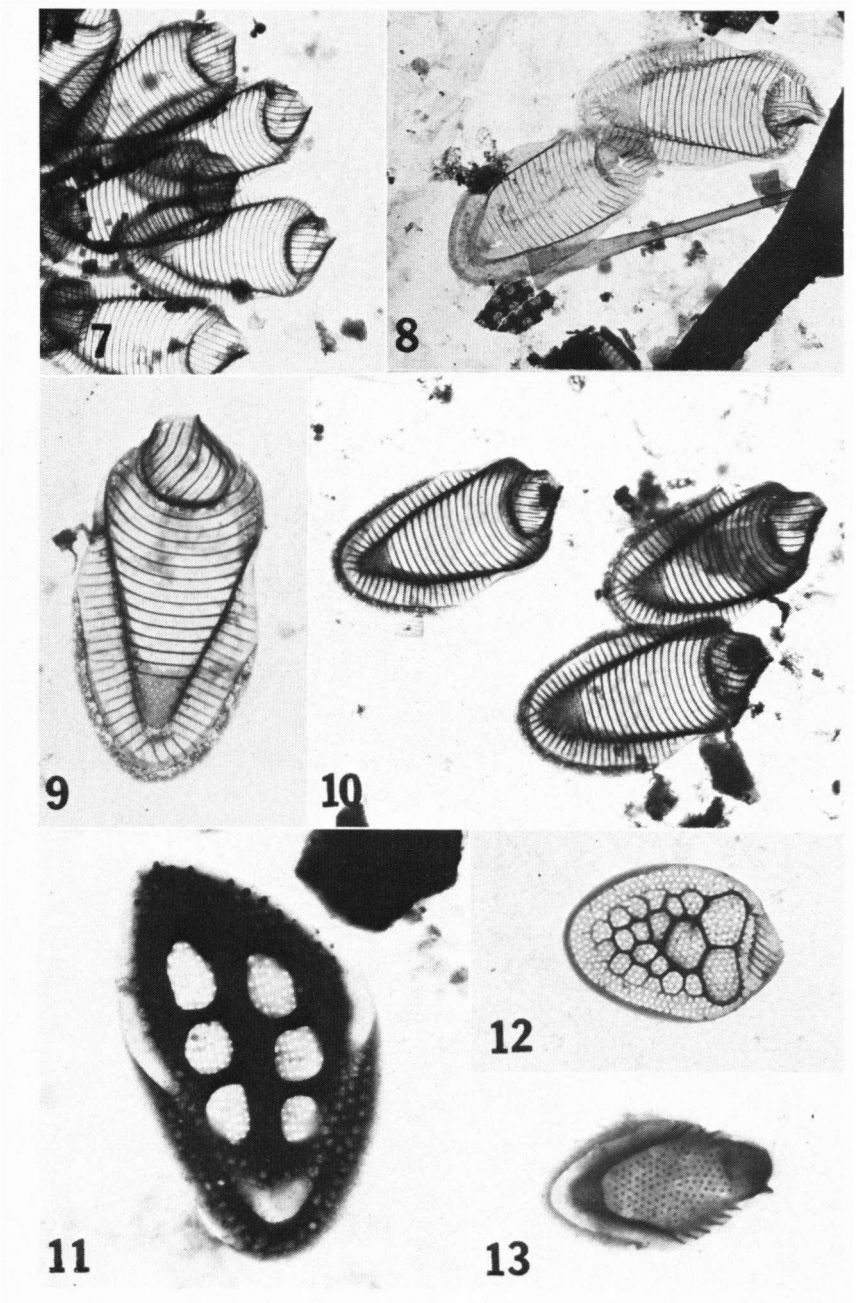
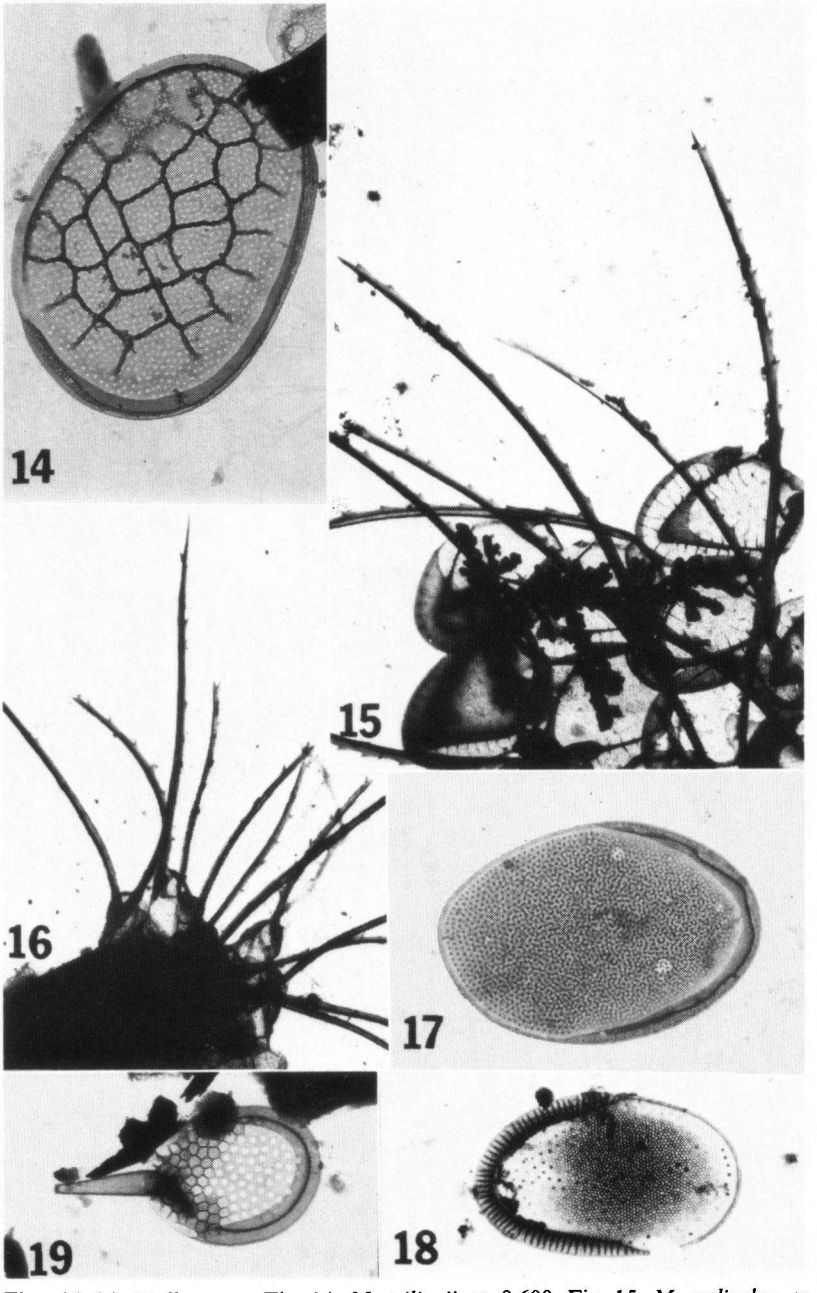


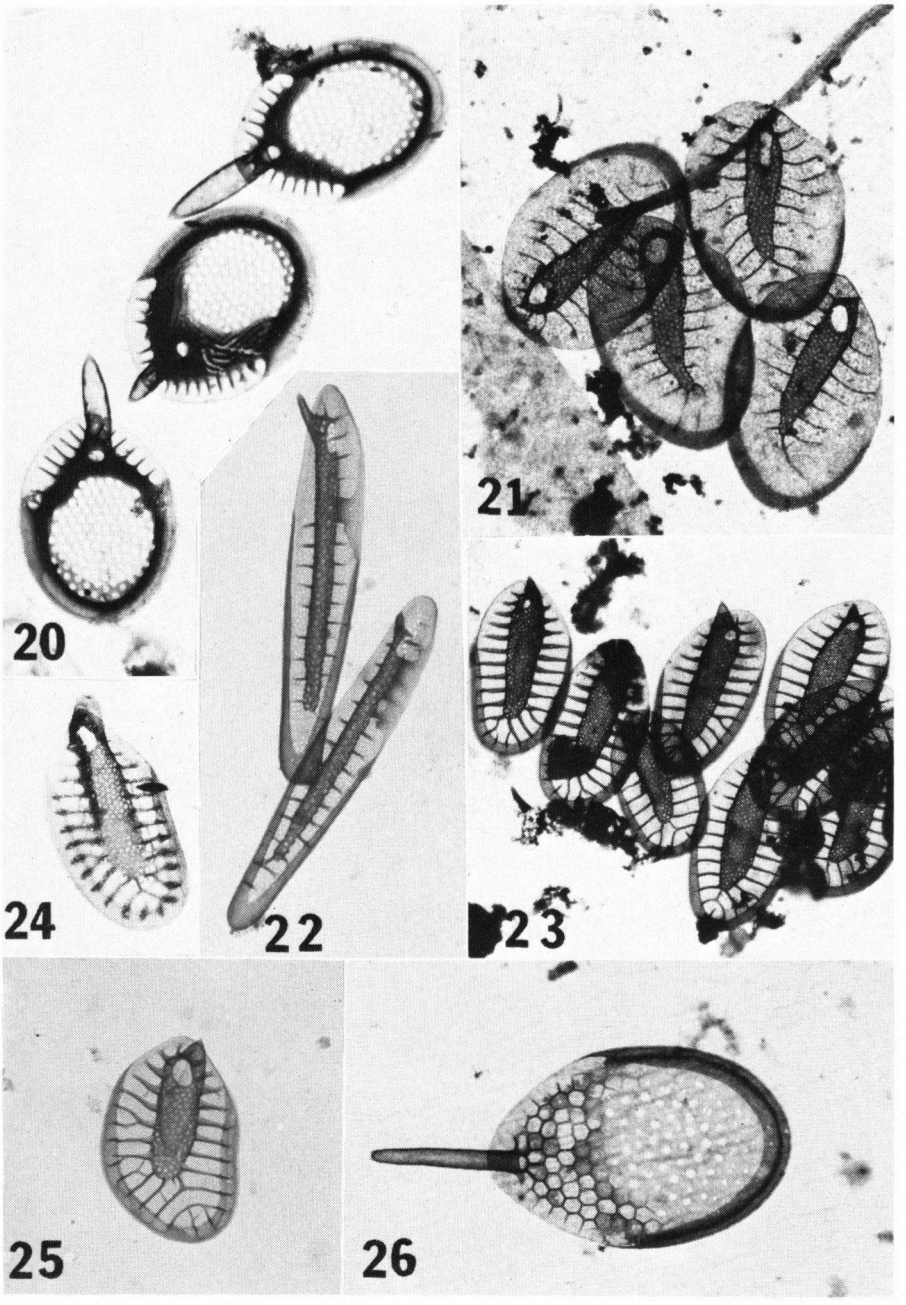
Figs. 1–6. *Mallomonas*. Fig. 1. *M. acaroides* var. *striatula*, × 21,100. Fig. 2. *M. alpina*, × 14,400. Fig. 3. *M. annulata*, × 10,800. Fig. 4. *M. akrokomos*, × 9,600. Fig. 5. *M. calceolus*, × 6,000. Fig. 6. *M. caudata*, × 8,900.



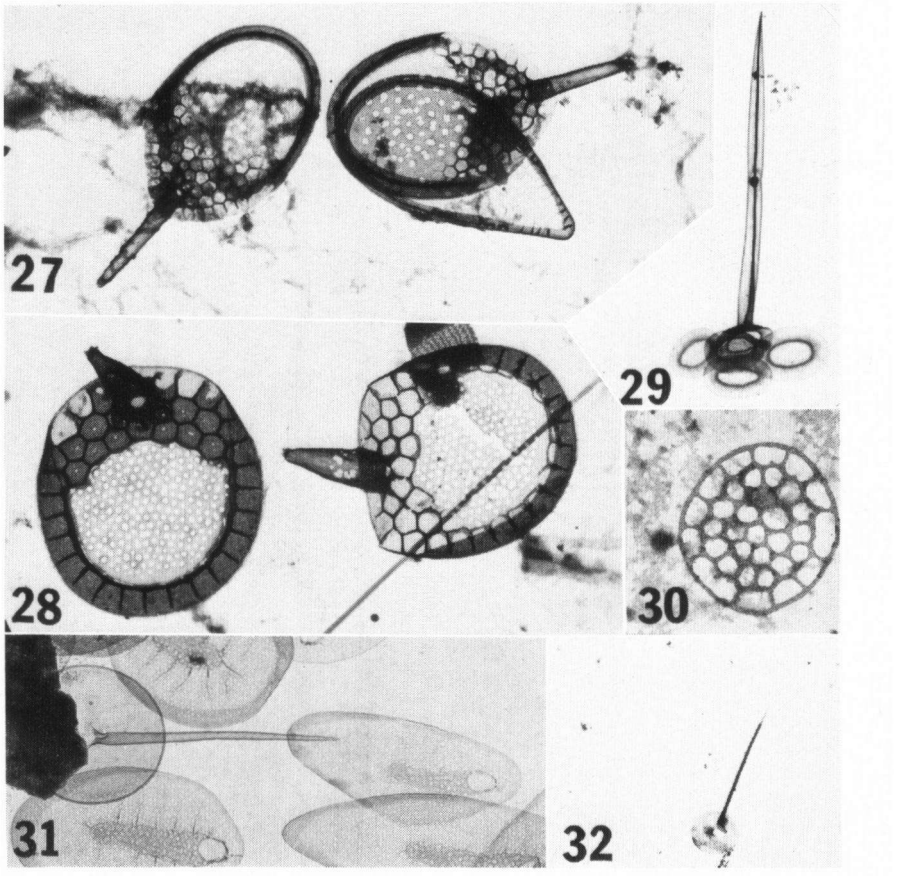
Figs. 7–13. *Mallomonas*. Figs. 7–10. *M. cratis* var. *asmundiae*, × 4,150; 4,150; 7,400; 4,900. Fig. 11. *M. lychenensis*, × 10,600. Fig. 12. *M. multiunca*, × 8,400. Fig. 13. *M. papillosa*, × 9,200.



Figs. 14–16. *Mallomonas*. Fig. 14. *M. teilingii*, × 8,600. Fig. 15. *M. pediculus*, × 13,300. Fig. 16. *M. tonsurata*, × 12,800. Figs. 17–18. *Mallomonopsis*. Fig. 17. *M. elliptica* var. *oviformis*, × 7,500. Fig. 18. *M. elliptica* var. *salina*, × 6,700. Fig. 19. *Synura curtispina*, × 7,250.



Figs. 20–26. *Synura*. Fig. 20. *S. echinulata*, × 8,800. Fig. 21. *S. glabra*, × 7,600. Figs. 22–23. *S. petersenii*, × 5,600; 8,100. Fig. 24. *S. petersenii* f. *praefracta*, × 6,800. Fig. 25. *S. petersenii* f. *kufferathii*, × 7,200. Fig. 26. *S. spinosa*, × 9,600.



Figs. 27–28. *Synura*. Fig. 27. *S. spinosa* f. *spinosa*, × 7,300. Fig. 28. *S. uvella*, × 7,500. Fig. 29. *Spiniferomonas trioralis*, × 4,600. Figs. 30–32. *Paraphysomonas*. Fig. 30. *P. butcheri*, × 27,000. Fig. 31. *P. imperforata*, × 4,140. Fig. 32. *P. vestita*, × 8,200.