

OBSERVATIONS ON CHRYSOPHYCEAE FROM A NORWEGIAN MOUNTAIN LAKE

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Chrysosphaerella coronacircumspina Wujek & Kristiansen and *Spiniferomonas bilacunosa* Takahashi have been shown by electron microscopy to be regular members of the phytoplankton society in an oligotrophic Norwegian mountain lake. This is the first published record of these species in Norway.

Chrysosphaerella coronacircumspina was described by Wujek et al. (1977) from Lake Geneserath, Michigan, USA. Single scales had previously been observed by Kristiansen in 1969 and 1975 and incorrectly referred to as *Chrysosphaerella brevispina* Korshikov and *Spiniferomonas trioralis* Takahashi respectively, and by Preisig & Takahashi who described it in 1978 as *Chrysosphaerella solitaria* Preisig & Takahashi.

Spiniferomonas bilacunosa Takahashi was described from Lake Otori-ike in Japan (Takahashi, 1973). *Chrysosphaerella parva* Asmund (Asmund, 1973) is identical with *Spiniferomonas bilacunosa*. Due to the extreme smallness of these species and the details of taxonomic interest, the employment of high-quality electron-optical equipment is obligatory. Documentation is therefore scarce. The known geographical distribution of these and related small species is still limited to a handful of observations.

MATERIALS AND METHODS

Samples for qualitative phytoplankton studies were taken during 1977 and 1978 with a 10 μm plankton net in the epilimnion (0-10 m). Some samples were preserved with the acetic-acid Lugol's solution, while others were preserved with 2% glutaraldehyde in 0.05 M cacodylate buffer, pH 7.4. Samples for scanning electron microscopy (SEM) were sedimented on a polylysine coated coverglass, dehydrated in alcohol, critical point dried in CO_2 , coated with gold/palladium and viewed under the microscope. Samples for study under the transmission electron microscope (TEM) were washed with distilled water, dried on a formvar/carbon coated grid and shadowcast with carbon/platina.

LOCALITY

Lake Savalen is situated 707.2 m above sea level in the central part of Norway with geographical position lat. 62°15'N, long. 0°15'E. The lake has a surface area of 15.4 km², max.

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depth 62 m, mean depth 17 m and is ice-covered from November to June. The surface water temperature reaches a max. of about 17°C in August, while the hypolimnion has a temperature of about 6°C. Lake water shows low nutrient levels, the pH is about 7.4 and the conductivity is about 45 $\mu\text{S cm}^{-1}$. Further information on water chemistry is given in Table I. Primary productivity was estimated at approximately 22 g C m⁻² year⁻¹, which clearly indicates the oligotrophic level of the lake (Nicholls, 1980).

TABLE I. Water chemistry of Lake Savalen (Nicholls, 1980)

	Ca	Mg	Na	K	HCO ₃	SO ₄	Cl	Al
m equiv. l ⁻¹	0.50	0.08	0.04	0.02	0.41	0.10	0.01	5 × 10 ⁻³
% equiv.	78.1	12.5	6.3	3.1	78.8	19.2	2.0	1.0

OBSERVATIONS

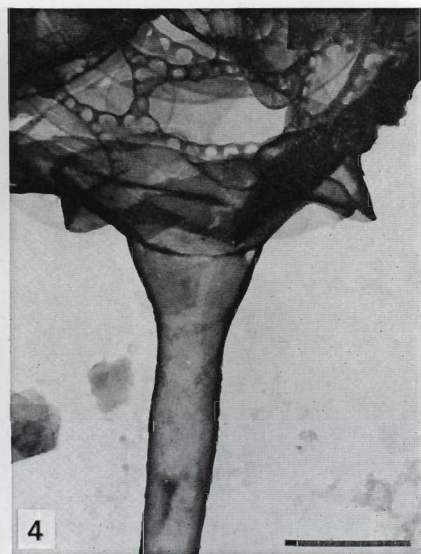
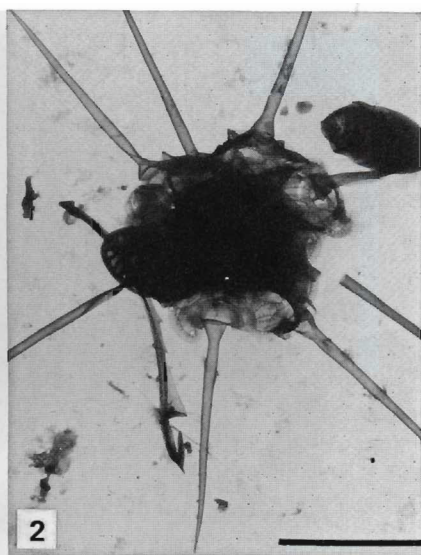
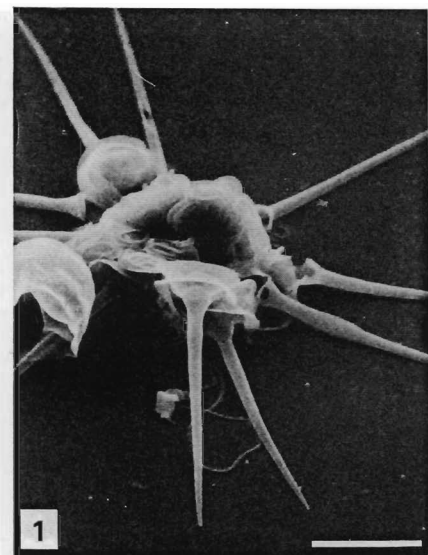
Chrysophaerella coronacircumspina Wujek & Kristiansen (Figs 1–6)

Chrysophaerella coronacircumspina was described from USA by Wujek et al. (1977) and recorded from Sweden and Canada (Kristiansen, 1969, 1975), Switzerland and Japan (Priesig & Takahashi, 1978) and from Greenland (Nygaard, 1978). Up to now three freshwater species of *Chrysophaerella* seem to be taxonomically legitimate (Asmund, 1973; Wujek et al., 1977; Takahashi, 1978). These are the colonial species *C. longispina* Lauterborn, *C. brevispina* Korshikov and the single-celled *C. coronacircumspina*. In addition to these Birch-Andersen (1973) described *C. salina* Birch-Andersen from salt marsh pools. The species identified as *C. brevispina* by Green (1979) is identical with *C. coronacircumspina*. In accordance with Kristiansen (1969), Wujek & Hamilton (1972) and Asmund (1973) it is supposed that *C. longispina* and *C. multispina* Bradley are the same species.

The species observed from Lake Savalen were somewhat smaller than the type, 8 μm and 9–12 μm respectively (Figs 1, 2). Other dimensions seem to fit well the data given by Wujek et al. (1977): scales varied between 1.1 and 1.5 μm width and 1.7 and 2.3 μm in length, with the rim being 0.4 μm broad. Even though some scales were almost circular, the overall shape was elliptical (Fig. 6). Viewed under the SEM the scales have an outer and inner surface of quite different ornamentation. The inner surface has the circular ornamentation on the inner edge of the rim (Fig. 5). The outer disc of the base (second basal plate) varied between 3 and 4 μm in diameter with the inner disc about 0.6 μm greater in diameter. The hole in the spine, located at the junction between spine and base, was 0.4 μm and the spine width at that portion was 1.1 μm (Figs 3, 4). These two latter dimensions seemed to be fairly constant. Eleven spines were observed with maximal length from 8 to 12 μm . In accordance with the dimensions given by Priesig & Takahashi (1978), the species found in Lake Savalen fits within the smaller morphological group.

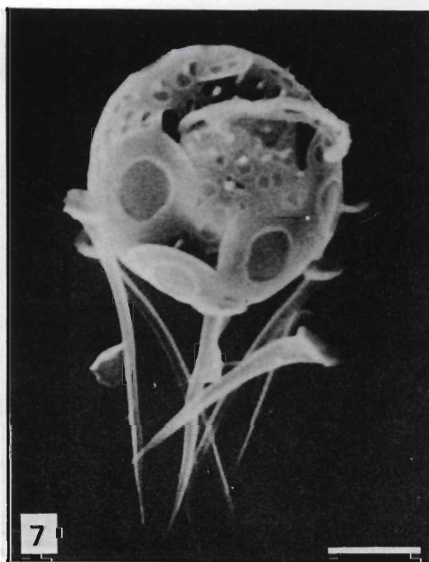
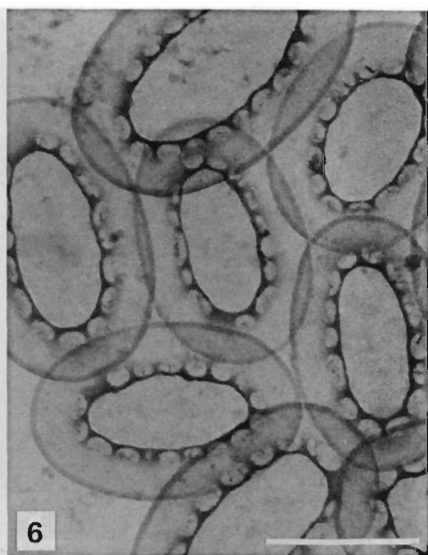
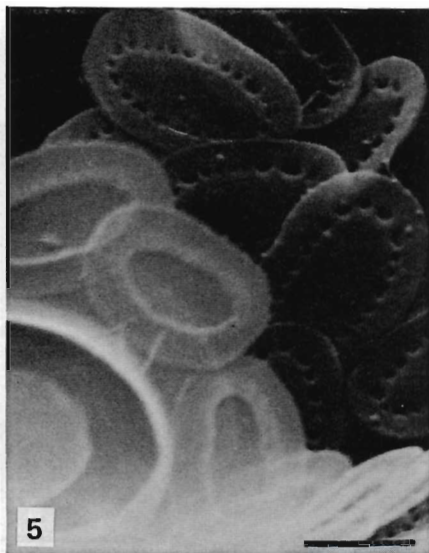
Spiniferomonas bilacunosa Takahashi (Figs 7–12)

Spiniferomonas bilacunosa was described from Japan by Takahashi (1973) and recorded from Denmark by Asmund (1973) and Kristiansen (1976) and from



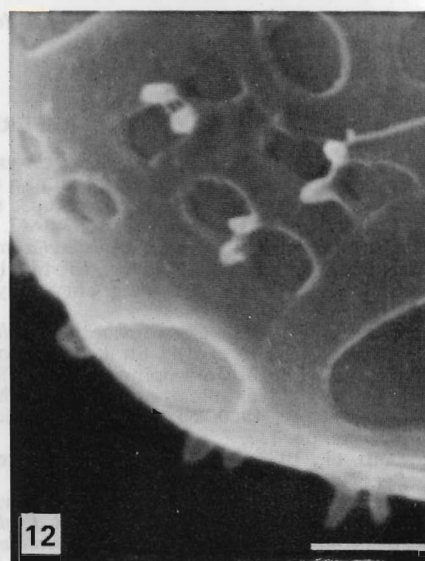
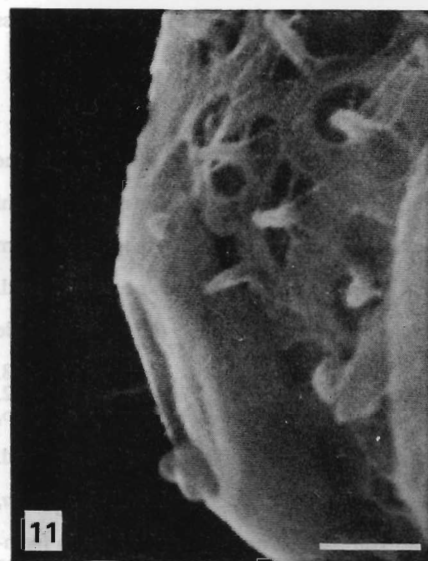
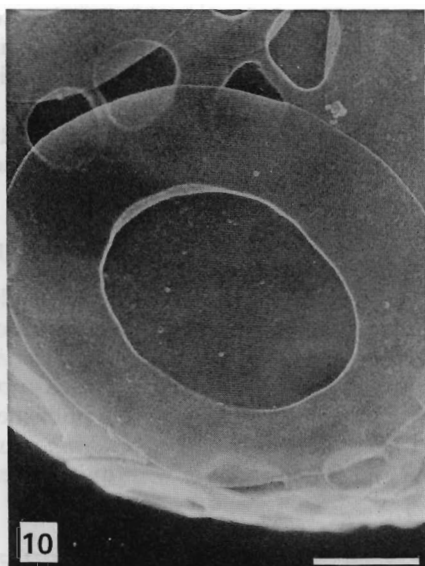
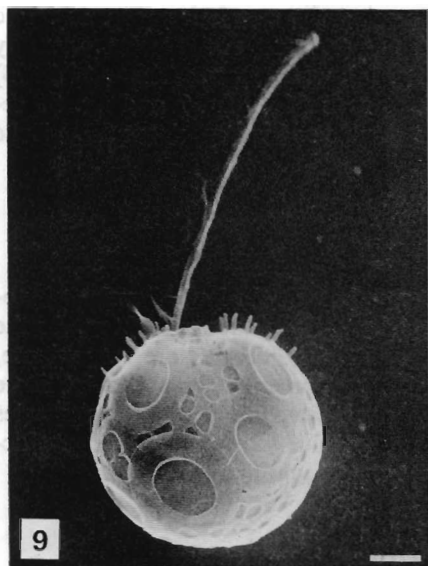
Figs 1-4. *Chryso-sphaerella coronacircumspina*. Fig. 1. Whole cell. Scale bar: 5 μm . (SEM, Jeol S.1). Fig. 2. Whole cell. Scale bar: 5 μm . (TEM, Siemens 1.A). Fig. 3. Shows base plates and the hole in the spine. Scale bar: 1 μm . (SEM, Jeol 35.C). Fig. 4. Same position on cell as Fig. 3. Scale bar: 1 μm . (TEM, Siemens 1.A).

Canada by Green (1979). The species found in Lake Savalen varied in cell size from 4 to 6 μm , with an observed maximum of 10 spines (Fig. 7). The spines varied in length between 4.5 and 5.0 μm (Fig. 8). Two basically different kinds



Figs 5–8. Figs 5, 6: *C. coronacircumspina*. Fig. 5. Shows the inner and outer surfaces of scales. Scale bar: $1\ \mu\text{m}$. (SEM, Jeol S.1). Fig. 6. Scales. Scale bar: $1\ \mu\text{m}$. (TEM, Siemens 1.A). Figs 7, 8: *Spiniferomonas bilacunosa*. Fig. 7. Whole cell with spines. Scale bar: $2\ \mu\text{m}$. (SEM, Jeol S.1). Fig. 8. Spine. Scale bar: $1\ \mu\text{m}$. (SEM, Jeol S.1).

of scales could be distinguished. These were the large, somewhat elliptic scales: $2.0\text{--}2.5\ \mu\text{m}$ long and $1.6\text{--}2.3\ \mu\text{m}$ broad, and the small elliptic ones with two holes: $1.0\text{--}1.2\ \mu\text{m}$ long and $0.6\text{--}0.9\ \mu\text{m}$ broad (Figs 9, 10). The broad margin on the larger scales was $0.4\text{--}0.5\ \mu\text{m}$ and that on the small scales about $0.2\ \mu\text{m}$. The



Figs 9–12. *Spiniferomonas bilacunosa*. Fig. 9. Whole cell with flagella. Scale bar: $1\ \mu\text{m}$. (SEM, Jeol 100 C). Fig. 10. Part of posterior cell surface. Scale bar: $0.5\ \mu\text{m}$. (SEM, Jeol 100 C). Fig. 11. Small scales with one rod. Scale bar: $0.5\ \mu\text{m}$. (SEM, Jeol 35.C). Fig. 12. Small scales with two rods. Scale bar: $0.5\ \mu\text{m}$. (SEM, Jeol 35.C).

smaller kind of scales could be divided into three varieties: without, with one and with two erect rod(s). The two latter forms were always located at the anterior part of cell surface. Some specimens had the rod scale type in which the rod was located between the two holes (Fig. 11), some had the two rods located

at each side of the bridging portion separating the two holes (Fig. 12). The length of the rods varied between 0.25 and 0.5 μm . Some of the scales shown by Takahashi (1973) have one erect rod (his fig. 14), while those of Asmund (1973) and Kristiansen (1976) possessed two erect rods (their fig. 7 and fig. 31 respectively). Balonov (1978) recorded the double-rodded specimen from Lake Golovca in URSS as *S. cornutus* Balonov.

DISCUSSION

The species discussed here were regular members of the Lake Savalen phytoplankton, at times making up a significant part of the nannoplankton. As the species within the genera *Chrysosphaerella* and *Spiniferomonas* are very minute, phytoplankton workers are urged to apply EM equipment when available. There are reasons to believe, from the published records cited above, that these species of *Chrysosphaerella* and *Spiniferomonas* may be widely distributed geographically, and found in lakes with quite different water qualities.

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