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ABSTRACT

This is the second paper of a floristic survey of the scaled Chrysophyceae of Arkansas and includes the following species: *Mallomonas crassisquama*, *M. cratis* var. *Asmundiae*, *M. papillosa*, *M. caudata*, *M. heterospina*, *M. insignis*, *Paraphysomonas vestita*, *P. imperforata* and *Spiniferomonas conica*.

INTRODUCTION

The morphology of the siliceous scales surrounding the cells continues to be the main distinguishing taxonomic feature for organisms placed in the family Synuraceae. This second paper continues the floristic survey of the scaled chrysophytes of Arkansas that has been previously initiated (Andersen and Meyer 1977).

METHODS

Samples were collected from several pools and ponds east of Fayetteville along Arkansas Highway 16 near Sequoyah Reservoir (Washington County), farm ponds along Arkansas Highway 170 north of Devil's Den State Park (Washington County), and De Gray Reservoir, an impoundment of the Caddo River (Clark County). Collections were made with a plankton net or Van Dorn water bottle and prepared for transmission electron microscopical study as described in the initial paper (Andersen and Meyer 1977).

RESULTS

Genus *Mallomonas* Perty 1851

The species assigned to this genus have been arranged into various groups based on the morphology of the scales (Conrad 1933; Huber-Pestalozzi 1941; Bourrelly 1957; Harris and Bradley 1960). The species discussed below are arranged according to Harris and Bradley's (1960) scheme which includes four series: Tripartiae, Planae, Quadratae and Torquatae. The series Tripartiae is further subdivided into three groups: acaroides, striata and papillosa. There is also an artificial cluster of species which do not fit into the four series.

Series Tripartiae

Group acaroides

Mallomonas crassisquama (Asmund 1959) Fott 1962, p. 79.
basonym: *M. acaroides* Perty 1851 emend Pascher 1910, Krieger 1930, Conrad 1933 var. *crassisquama* Asmund 1959, p. 32.

Plate III, Figure 19.

The validity of this taxon as a separate species has been questioned by Kristiansen (1975, 1976), and its relationship to *M. Bourrellyi* Teiling in Bourrelly 1957 is not clear. Thomasson (1963) published micrographs of scales from *M. Bourrellyi* which appear very similar to those of *M. crassisquama*. The cells of *M. Bourrellyi* are 22-38 μm by 12-14 μm (Bourrelly 1957) while the cells of *M. crassisquama* are smaller, 14-20 μm by 9-12 μm (Asmund 1959). The Arkansas material was collected from De Gray Reservoir, February 19, 1977. The cells and scales were very typical of *M. crassisquama*, and no "transitional" scales of the *M. acaroides* var. *striatula*-type were found.

Group striata

Mallomonas cratis Harris et Bradley 1960 var. *Asmundiae* Wujek et Van der Veer 1976, p. 181.

Plate I, Figures 1,6.

This variety was recently described by Wujek and Van der Veer (1976) from material collected in The Netherlands, and it is distinguished from the nomenclatural type by its parallel rib orientation on the dome rather than the u-shaped ribs of the type. It was collected on December 30, 1975, from an ephemeral pond located near Sequoyah Reservoir. The pond forms in an isolated woodland area following periods of extensive precipitation. It has trees throughout its confines; the water is dark brown in color and slightly acidic. The pond dried shortly after the collection and did not form again until February, 1978, but the species was not found again.

Group papillosa

Mallomonas papillosa Harris et Bradley 1957, p. 44 var. *papillosa*.

Plate I, Figures 5,7.

This species was found in a shallow pool near Sequoyah Reservoir during March, 1977. This pool also contained *Synura uvella* and *Mallomonas insignis*.

Series Planae

Mallomonas caudata Iwanoff 1899, p. 250 emend Krieger 1930, p. 294, Asmund 1955, p. 163.
synonyms: *M. fastigiata* Zacharias in Lemmermann 1899, p. 109.
M. fastigiata Zacharias 1903, p. 259.
M. fastigiata Zacharias 1903 var. *macrolepis* Conrad 1933, p. 65.
M. fastigiata Zacharias 1903 var. *Kriegeri* Bourrelly 1957, p. 187.

Plate II, Figures 8,9,10,13.

The taxonomy, and particularly the nomenclature, of this species is somewhat confusing (Fott and Ettl 1959; Asmund and Hilliard 1961). I agree with Asmund and Hilliard's (1961) retention of the name *M. caudata* because of the very incomplete description of *M. fastigiata* (Lemmermann 1899), the adequate description of *M. caudata* by Iwanoff in 1899 and the later descriptive but synonymous account by Zacharias (1903).

The armour of this species consists of numerous oval or circular scales, each with an attached bristle (Fig. 8,9,10). However, the connection between the scale and bristle is not siliceous but rather organic in nature, because the bristles are always separated from the scales during treatment with nitric acid. The acid treated bristle base, or "foot", is smooth and flattened (Fig. 13) with no evidence of an attachment point on the distal, unperforated end of the scale (Fig. 10).

This species has been found in two ponds near Devil's Den State Park during the fall of 1977, and was present in substantial numbers in both ponds. It has been reported from Arkansas on two previous occasions, once as *M. caudata* (Meyer 1969) and again as *M. fastigiata* (Meyer *et al.* 1970).

Mallomonas heterospina Lunc 1942, p. 274 emend Asmund 1956, p. 75.

Plate I, Figures 2,3,4.

Mallomonas heterospina is closely related to three other species: *M. multiunca* Asmund 1956, *M. pugio* Bradley 1964, and *M. Harrisae* Takahashi 1975. The scales of these four species can be distinguished by the shape of and ribbing pattern on the dome, the reticulate pat-

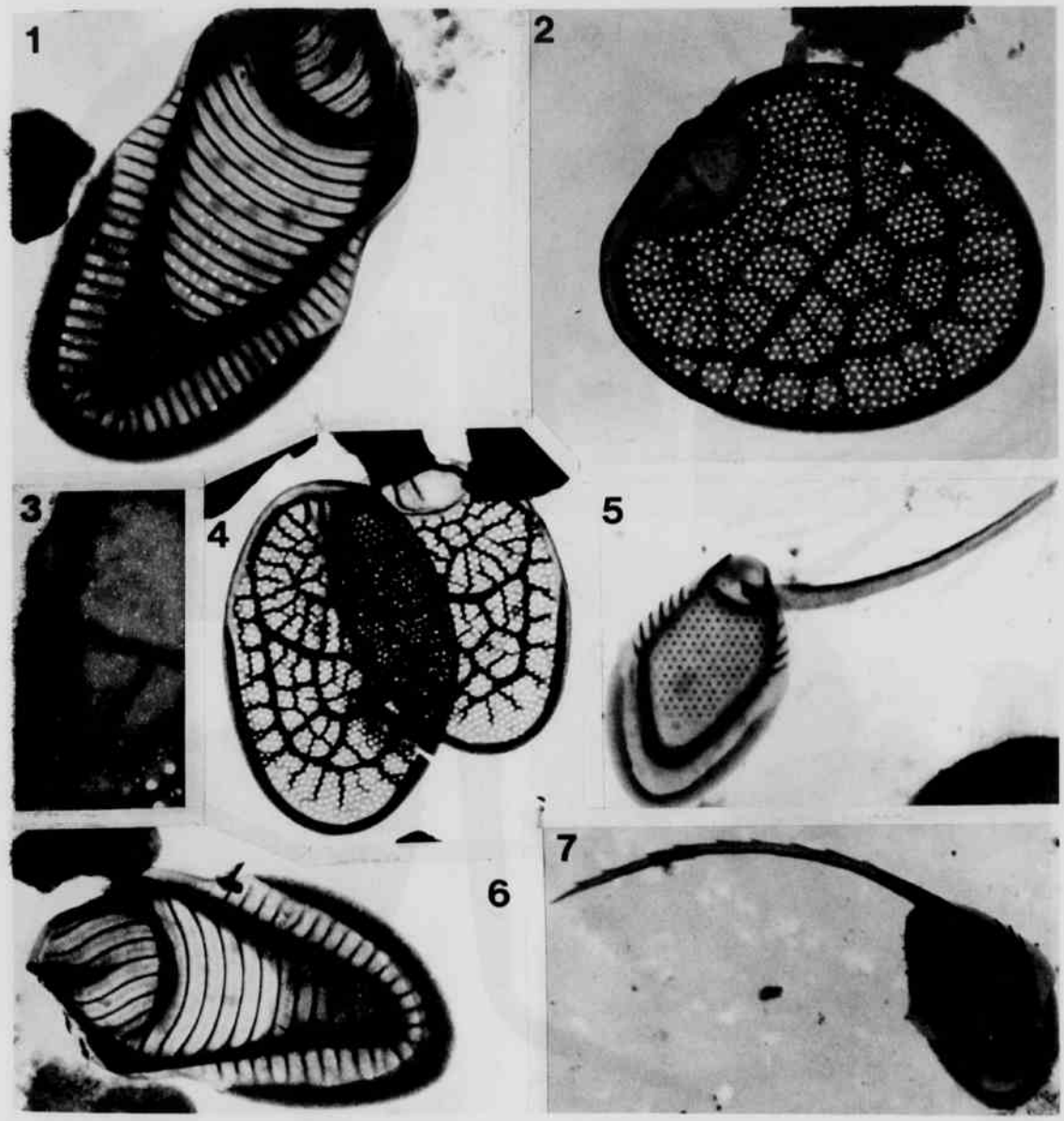


Plate I. Fig. 1. *Mallomonas cratis* var. *Asmundiae*. acid cleaned. 15,000 X. Fig. 2. *M. heterospina*. acid cleaned. 21,000 X. Fig. 3. *M. heterospina*. enlargement of dome area in figure 2. 42,000 X. Fig. 4. *M. heterospina*. acid cleaned. 15,000 X. Fig. 5. *M. papillosa*. 18,000 X. Fig. 6. *M. cratis* var. *Asmundiae*. acid cleaned. 15,000 X. Fig. 7. *M. papillosa*. 15,000 X.

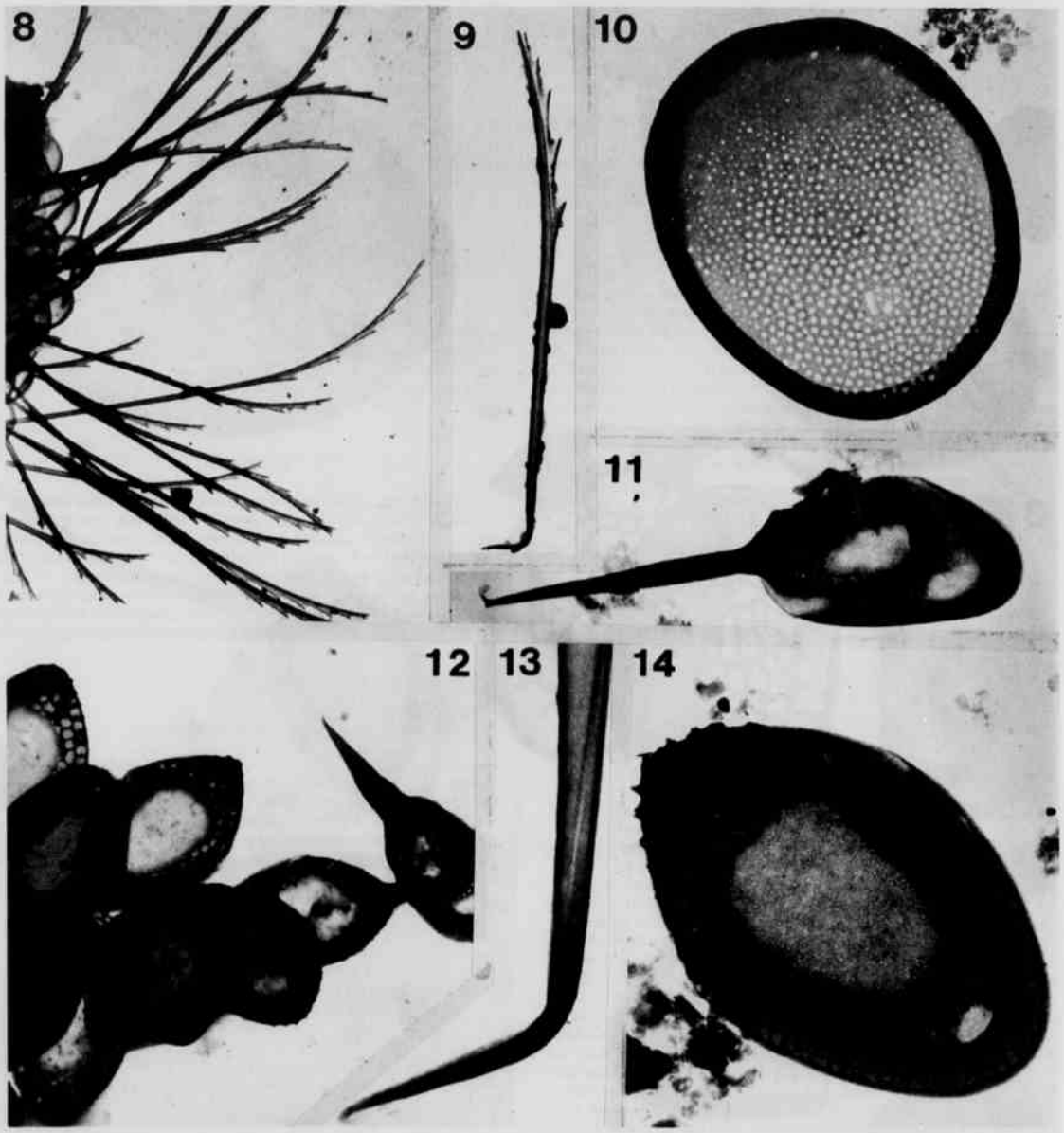
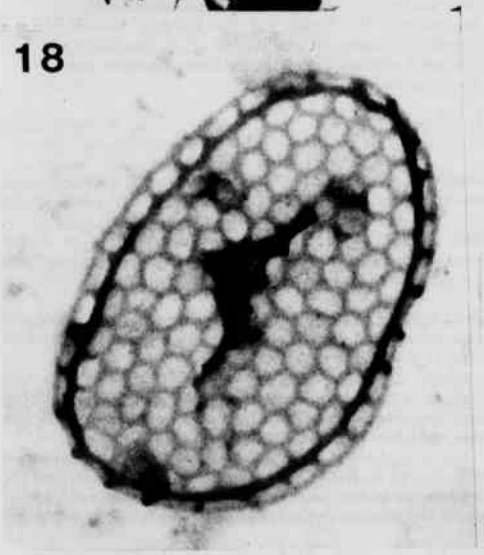


Plate II. Fig. 8. *Mallomonas caudata*. 1800 X. Fig. 9. *M. caudata*, bristle. 4500 X. Fig. 10. *M. caudata*, scale, acid cleaned. 12,000 X. Fig. 11. *M. insignis*, tailend scale, acid cleaned. 15,000 X. Fig. 12. *M. insignis*, apical and body scales. 4500 X. Fig. 13. *M. caudata*, acid cleaned bristle foot. 21,000 X. Fig. 14. *M. insignis*, body scale, acid cleaned. 12,000 X.



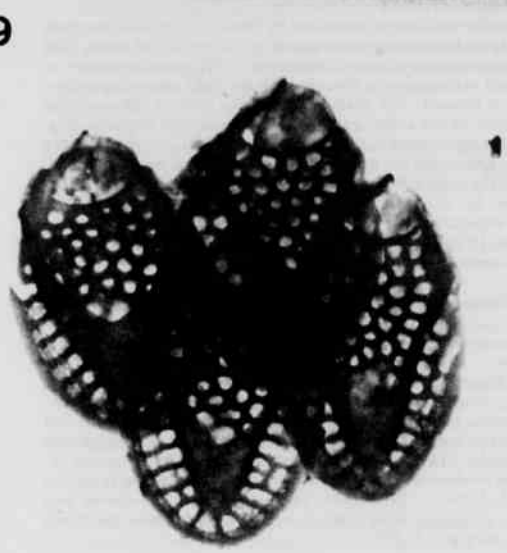


Plate III. Fig. 15. *Paraphysomonas vestita*. dried cell. 3300 X. Fig. 16. *P. imperforata*. 21,000 X. Fig. 17. *Spiniferomonas conica*. acid cleaned. 30,000 X. Fig. 18. *Paraphysomonas* sp. 30,000 X. Fig. 19. *Mallomonas crassisquama*. 9000 X.

terning and the type(s) of bristle(s) present. However, when this sample was digested with nitric acid, the bristles separated from the scales and no direct connections between the two were observed. Thus, the identification made here is based on the scale morphology only, but it should be mentioned that no hooked bristles were observed. The scales have some markings on the dome (Fig. 2,4), but these are not as heavy and distinct as those of *M. Harrisae*. And although the dome of *M. heterospina* has been described as smooth (Bradley 1964; Takahashi 1975), the micrographs of Asmund (1956, Fig. 3-5) and Wujek *et al.* (1975, Fig. 1) show similar light markings on the dome. Another character used to distinguish *M. heterospina* from *M. Harrisae* is the complete lack of hooked bristles on the latter (Takahashi 1975). However, Bradley (1964) reports juvenile cells of *M. heterospina* may lack hooked bristles, and Asmund (1956) found cells with an "almost total absence of hooked bristles." Thus, the differences between *M. heterospina* and *M. Harrisae* seem nebulous, and the difference used to distinguish these species in this case was the degree of thickness of the reticulate meshwork and dome striations. The meshwork and dome markings of *M. Harrisae* are thicker than those of *M. heterospina*. This species occurred in the same small woodland pond with *M. cratis* var. *Asmundiae*, and the temporary nature of this pond may have allowed only juvenile cells without bristles to form.

Species of Undesignated Series

Mallomonas insignis Penard 1919, p. 122.
synonyms: *M. torulosa* Kisselew 1931, p. 239.
M. mesolepis Skuja 1932, p. 28.
M. mesolepis Skuja 1932 var. *spinosa* Matvienko 1954, p. 90.
Plate II, Figures 11,12,14.

This species was clearly described by Penard (1919) and has more recently been thoroughly investigated by Harris (1958) using both light and electron microscopy. Organisms of this species are relatively large and rather easy to identify with the light microscope when their tail is present. The scales are likewise distinct. The cell has spined scales on the anterior (Fig. 12 - right side) and posterior (Fig. 11) ends and non-spined scales over the midbody region (Fig. 14, 12 - left side). The scales are described as hollow with a bent tip (Harris 1958), but the scale in Figure 11 appears to have a lateral tooth rather than a bent tip. The identification of this species has been verified by electron microscopy for collections from a woodland pond on December 30, 1975, and a small pool during March, 1977, both near Sequoyah Reservoir.

Genus *Paraphysomonas* de Saedeleer 1929, p. 177.

Paraphysomonas vestita (Stokes 1885) de Saedeleer 1929, p. 177.
basonym: *Physomonas vestita* Stokes 1885, p. 313.
Plate III, Figure 15.

Paraphysomonas vestita is a colorless, single-celled flagellate which, has numerous siliceous scales surrounding the protoplasm. It has been found in water of wide-ranging temperatures and hydrogen ion concentrations (Takahashi 1976), and in addition to numerous records from freshwater, this species recently has been found in marine samples (Leadbeater 1972, 1974; Thomsen 1975). This species was found in a collection from a small, temporary pool near Sequoyah Reservoir on March 9, 1977.

Paraphysomonas imperforata Lucas 1967, p. 330.
Plate III, Figure 16.

This species was described from a sample collected from the English Channel (Lucas 1967), but it has also been collected from freshwater in The Netherlands (Wujek and Van der Veer 1976). This appears to be the first record of the species in the western hemisphere. It was found in a sample collected from De Gray Reservoir on February 19, 1977.

Paraphysomonas sp.
Plate III, Figure 18.

Grids prepared from the De Gray Reservoir samples of February 19, 1977, contained scales which apparently belong to an undescribed species of *Paraphysomonas*. These scales are nearly identical to Takahashi's (1959) microplankton species number 13, and bear a superficial resemblance to *P. foraminifera* (Lucas 1967). The scales have a very regularly reticulated base which recurves up and in to produce a rim. There are solid triangular structures in the center of the scales, and these may represent either short or broken spines. Whole cells were not observed.

Genus *Spiniferomonas* Takahashi 1973, p. 76

Spiniferomonas conica Takahashi 1973, p. 79.
Plate III, Figure 17.

Scales belonging to this species were observed in a sample collected from a farm pond near Devil's Den State Park. There are two types of scales known for this species (Takahashi 1973). The elliptical scales have a hollow center and are about 1 μm in length. The two conical scales, partially hidden in the lower center of Figure 17, have a short spine with a capitate end projecting upward from the basal plate. The elliptical scales in Figure 17 agree with Takahashi's description (1973), but the spines of the conical scales are shorter. Takahashi describes the spine length to be 6.1 to 6.8 μm in length, and these are clearly several times longer than the elliptical scales in his Figures 21 and 22. Those collected from the farm pond have spines which are shorter than the elliptical scale length, and only about 0.6 μm in length. The type description is the only report of this species I have found. The slight difference in spine length reported here will probably be found to be within the limits of natural variation for the species.

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