UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

SCANNING ELECTRON MICROGRAPHS OF MODERN AND HOLOCENE CHRYSOMONAD CYSTS FROM FISH LAKE, STEENS MOUNTAINS, OREGON

by

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INTRODUCTION

This report is one of a series illustrating siliceous cysts from various localities. Although these cysts have been known for many years, they are so small that they cannot be observed in detail with optical microscopes. The recent development of the scanning electron microscope (SEM) has made possible much more detailed observations of the external features of these cysts, but as yet relatively few forms have been recorded in this way.

A major difficulty is taxonomic confusion. Many and perhaps all of these cysts are the resting stages of various algae of the phylum Chrysophyta; they will be referred to in the rest of this report as chrysomonad cysts, although other groups in addition to the Chrysomonadinae may be represented. Modern forms are found primarily in fresh water, and numerous authors have reported chrysomonad cysts from Holocene sediments (for example, see Nygaard, 1956). Older fossils have been recovered mostly from marine deposits, and are known as archaeomonads; whether the two groups are as distinct as this terminology suggests is not clear.

For an introduction to the literature on chrysomonad cysts and siliceous algal scales, the reader is referred to Adam and Mahood (1979a), a preliminary annotated bibliography on the subject.

The fossil archaeomonads have been described and named entirely on the basis of their cysts. This is not advisable with modern forms, because the cysts are the remains of one stage of the life cycle of algae that presumably already have legitimate taxonomic names. Proper cyst nomenclature therefore depends on establishing which cysts are produced by which algae. At the moment, we have only a very limited knowledge of the forms that exist, and almost no knowledge of the phycological pedigrees of the various forms.

The present work is directed towards expanding our knowledge of the various cyst forms and their geographic and environmental distributions. Taxonomic problems are ignored, and the various cyst forms are simply given numbers, which have been assigned arbitrarily. These numbers are consistent throughout all reports in this series, and are being used to tabulate where the various forms occur. (A list of the previous reports in this series is given in Appendix A). The approach used has been that of "splitting", as opposed to "lumping"; it may well be desirable to lump together many of the forms described here when more is known about them.

The SEM photographs are the most important part of this paper, and no attempt has been made to reduce them to words. Supporting data have been placed in the

captions. Sample preparation techniques are generally the same as those used for preparing diatom samples; details may be found in Mahood and Adam (1979b).

The purpose of these initial reports is to provide primary documentation of the occurrence of particular cyst forms at particular localities, and to provide a means by which the SEM photographs of the cysts may be placed in a permanent depository. Counts of the relative abundance of the various forms and interpretations of their significance have not yet been attempted, but must await a more complete understanding of the range of cyst morphologies.

We have illustrated all of the distinctive cyst forms found in the sample, using the best available photographs. In some instances we have included more than one photograph of a given form, but we have not included all of the photographs we have taken.

Negatives of the plates for this report are on deposit at the USGS Photo Library, and prints can be obtained (at your expense) by writing to:

U. S. Geological Survey Library
Photo Library
Stop 914
Box 25406, Denver Federal Center
Denver, Colorado 80225

SITE DESCRIPTION

Fish Lake occupies a glacially scoured basin at an elevation of 2270 m on Steens Mountain, Harney Co., southeastern Oregon. During the past 13,000 years or so nearly 9 m of sediment, averaging 20% dry weight loss after combustion at 600 C, have accumulated in the center of the 5 ha (12 acre) lake. The lake has a maximum depth of 9.5 m, an average depth of 7 m, and is fed by snowmelt and by a spring-fed brook that passes through a small grassy meadow adjacent to the lake. During most of the year the lake is either frozen, or has an inflowing and an outflowing stream. During the late summers of dry years, however, when evaporation exceeds inflow, the lake surface falls below the outlet.

Submerged rooted aquatic plants (*Myriophyllum spicatum*, *Potamogeton richardsonii*, and *Isoetes bolanderi*) are apparent in a few places on shallow shelves along the shore. Fish Lake is surrounded by a mosaic of sagebrush steppe and aspen groves, with the exception of a small sedge meadow at its upper end.

Two samples were studied for this report. The first sample was taken from the top of the core, and represents modern conditions; the cysts from the modern sample are shown in Plates A-D. The other sample was taken from a depth of 589-590 cm, just beneath the

lowest Mazama Ash layer, and has an age of about 6600-7000 radiocarbon years. Several cyst types were found in both samples, but many other types are found only in one sample or the other, suggesting that the two samples represent somewhat different environmental conditions. A list of the various cyst types encountered in the two samples is given in Table 1.

Cyst_type	Modern	Pre-Mazama	Cyst_type	Modern	Pre-Mazama
26		?	184	X	X
45	X		185	X	
46	X	X	186	X	
49	X		190		X
54	X	X	240		X
58	X		242		?
84	X		287		X
98	X	X	298	X	
114		X	316	X	X
137	X		317	X	X
170	X	X	318	X	
171	X	X	319		X
172	X	X	320		X
173	X		321		X
174	X		322		X
175	X	X	323		?
176	X		324		X
177	X	X	325		X
178	X		326		X
179	X		327	X	
180	X	?	328		X
181	X		329		X
182	X		330		X
183	X				

Table 1.--List of occurrences of the various cyst types encountered in the two samples.

REFERENCES CITED

Adam, David P., and Mahood, Albert M., 1979b, A preliminary working bibliography on siliceous algal cysts and scales. U. S. Geological Survey Open-File Report No. 79-1215, 34 p.

Nygaard, Gunnar, 1956, Ancient and Recent flora of diatoms and Chrysophyceae in Lake Gribsø, in Berg, Kaj, and Petersen, I. C., eds., Studies on the Humic acid Lake Gribsø: Folia Limnologia Scandinavica, No. 8, p. 32-94, 12 plates.

Fish Lake, Plate A
Sample 32, taken from top of core
scale bar = 3 micrometers

1 - Type 170
(aperture visible)

2 - Type 170
(with adhering debris; aperture not visible)

3 - Type 170
(with adhering debris; aperture not visible)

4 - Type 172
(with adhering debris; aperture not visible)

5 - Type 171
(strongly protruding aperture)

6 - Type 172
(with adhering debris; aperture visible at top right)

7 - Type 173
(with adhering debris; aperture not visible)

8 - Type 173
(aperture visible at top right)

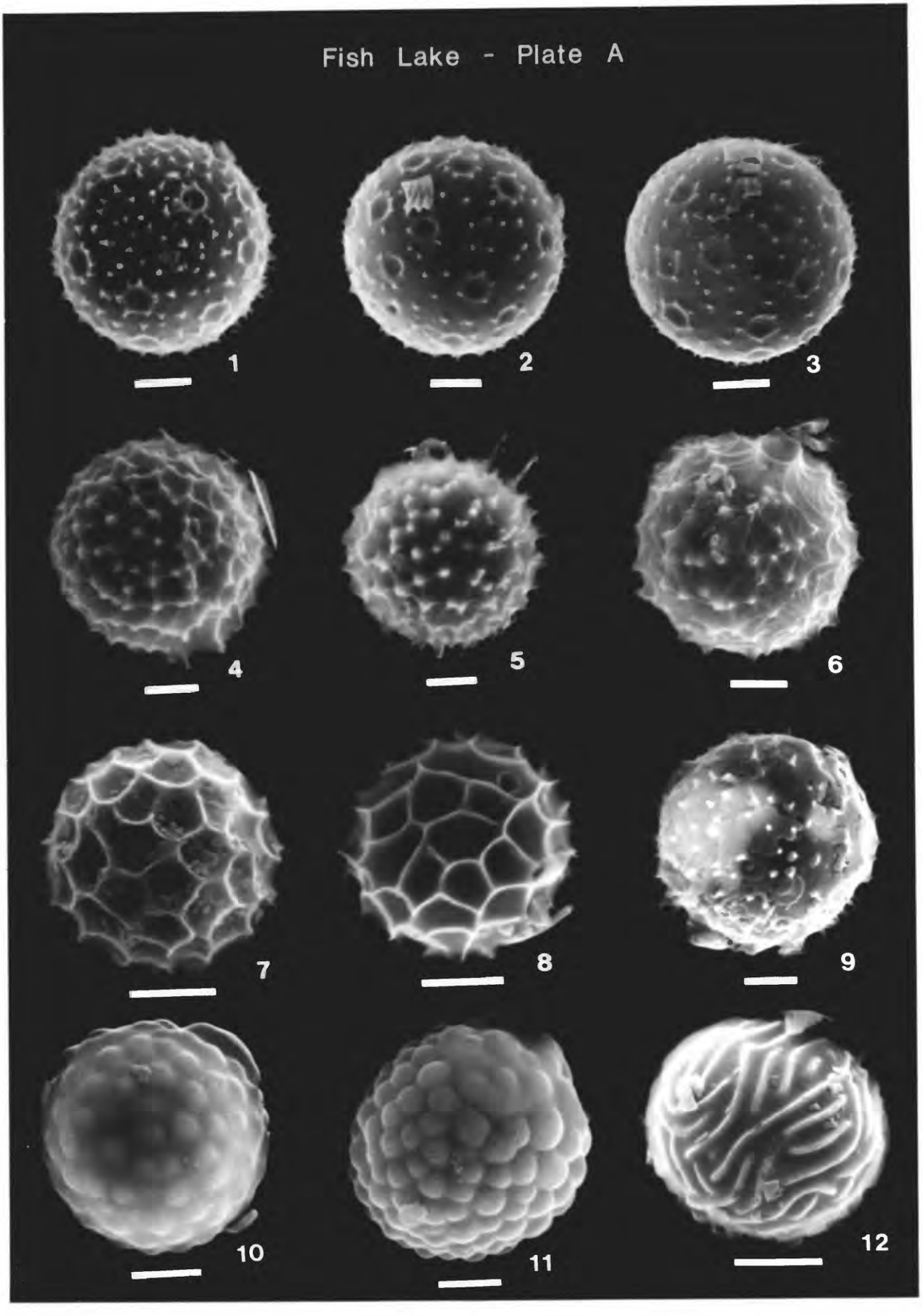
9 - Type 174
(variable shading is an artifact)

10 - Type 175
(aperture visible at top right)

11 - Type 175
(aperture visible at top right)

12 - Type 176
(aperture visible at top right)

Fish Lake - Plate A



Fish Lake, Plate B
Sample 32, taken from top of core
scale bar = 3 micrometers

1 - Type 98
(with adhering debris; good view of aperture)

2 - Type 98
(aperture not visible)

3 - Type 98?
(with adhering debris; many spines have been knocked off or corroded, revealing hollow spaces beneath them)

4 - Type 54

5 - Type 54

6 - Type 298
(with adhering debris, including a girdle band of a diatom; spine towards bottom of plate is part of cyst)

7 - Type 177
(with adhering debris)

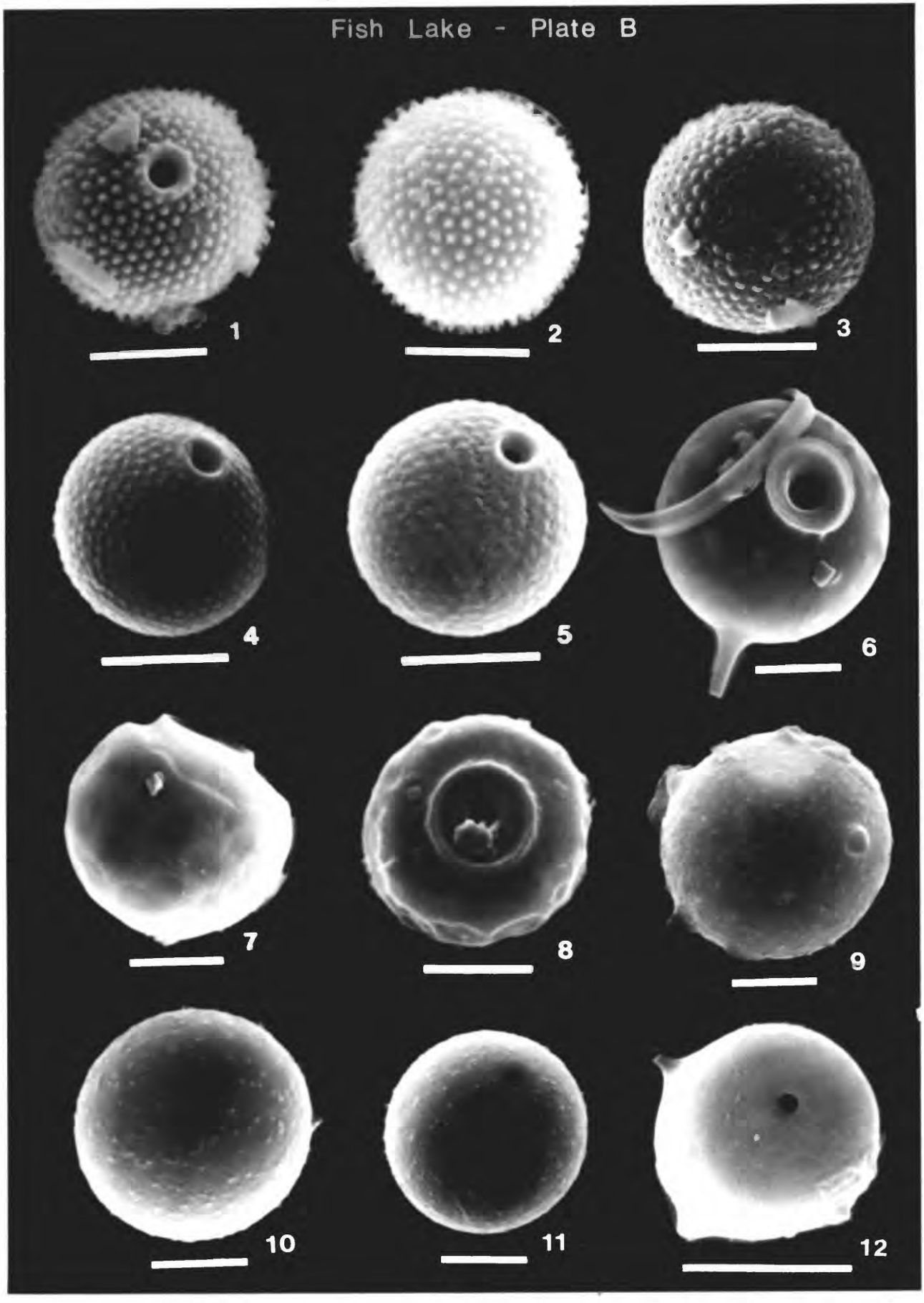
8 - Type 177
(with adhering debris)

9 - Type 178
(aperture not visible)

10 - Type 179

11 - Type 49

12 - Type 317
(with adhering debris)


Fish Lake - Plate B
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Fish Lake, Plate C
Sample 32, taken from top of core
scale bar = 3 micrometers

1 - Type 46(?)
(with adhering debris; aperture not visible)

2 - Type 180

3 - Type 181
(aperture visible at top right)

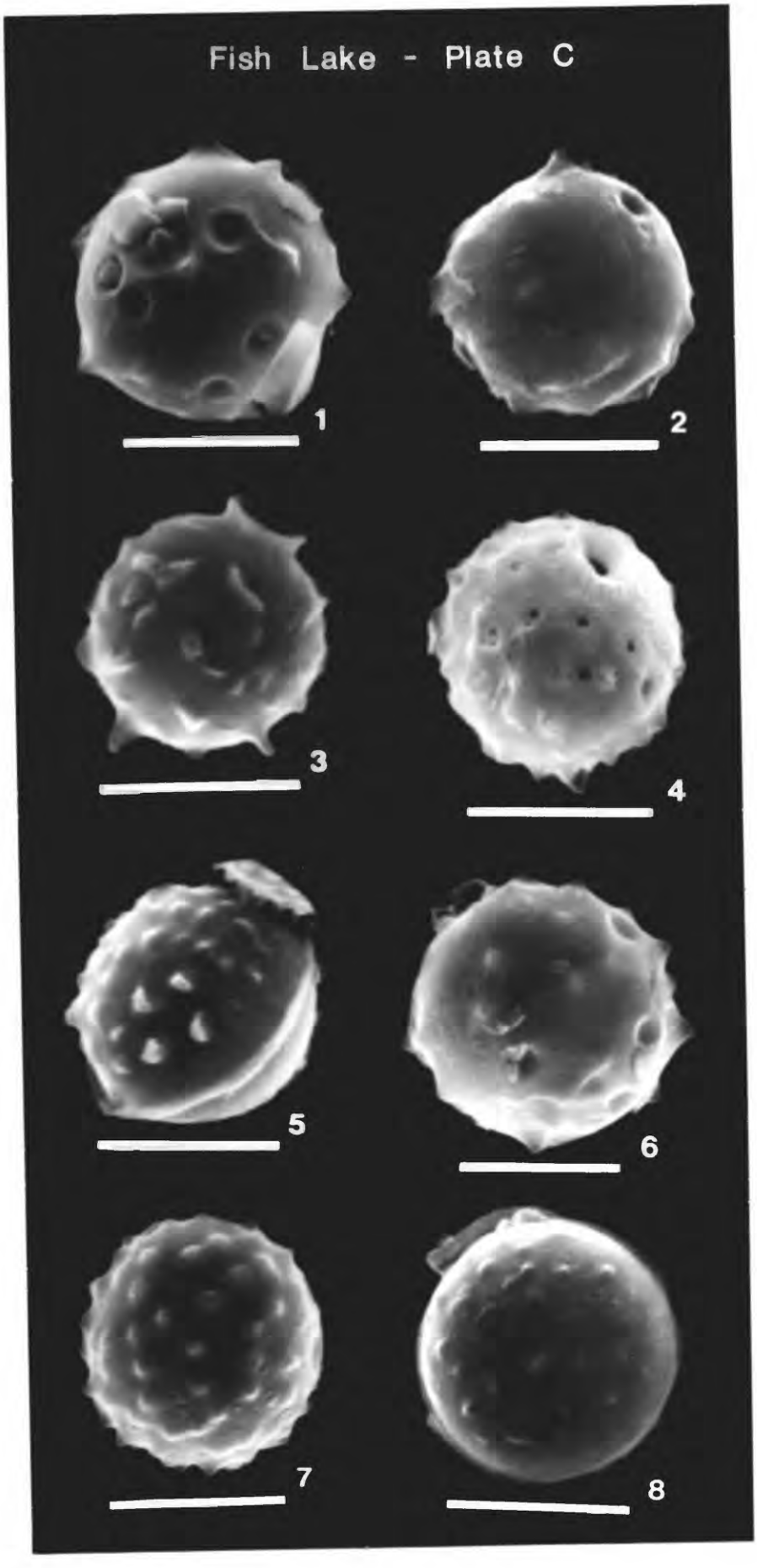
4 - Type 316
(note fine radial crenulations around aperture and spines, and also the holes in the pits)

5 - Type 182
(debris at top right)

6 - Type 46
(aperture not visible)

7 - Type 46(?)

8 - Type 182(?)
(debris at top left)


Fish Lake - Plate C
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Fish Lake, Plate D
Sample 32, taken from top of core
scale bar = 3 micrometers

1 - Type 183

2 - Type 184

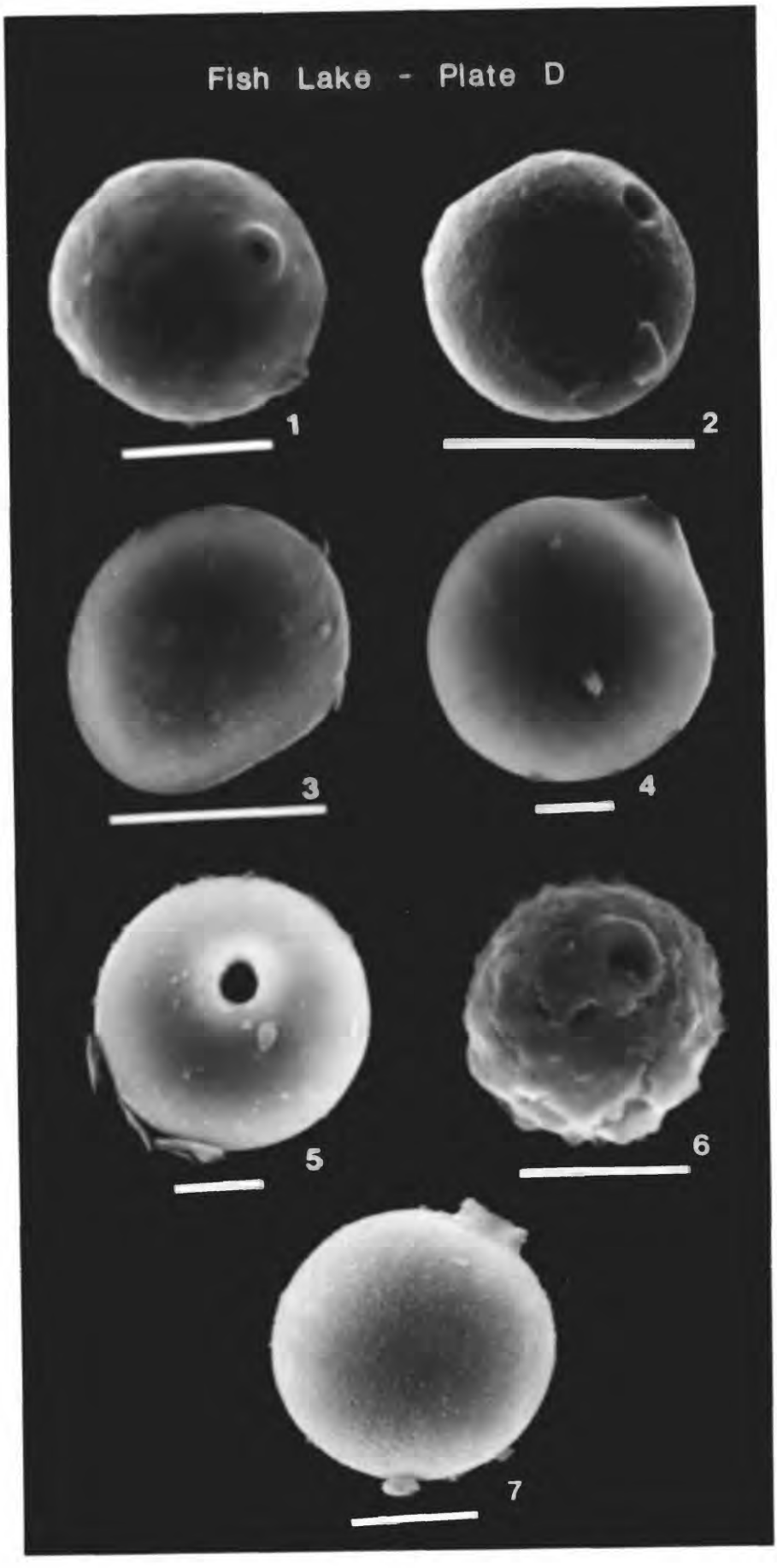
3 - Type 185
(aperture barely showing at top right)

4 - Type 186
(aperture visible at top right)

5 - Type 137
(with adhering debris; aperture is protruding)

6 - Type 327
(with adhering debris)

7 - Type 318
(note fine grainy surface sculpturing; aperture visible at top right)


Fish Lake - Plate D
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Fish Lake, Plate E
Sample 105, taken from just beneath Mazama Ash
scale bar = 3 micrometers

1 - Type 319
(with attached debris)

2 - Type 320
(with attached debris)

3 - Type 321
(with attached debris)

4 - Type 322
(with attached debris)

5 - Type 323(?)
(with attached debris)

6 - Type 321

7 - Type 287

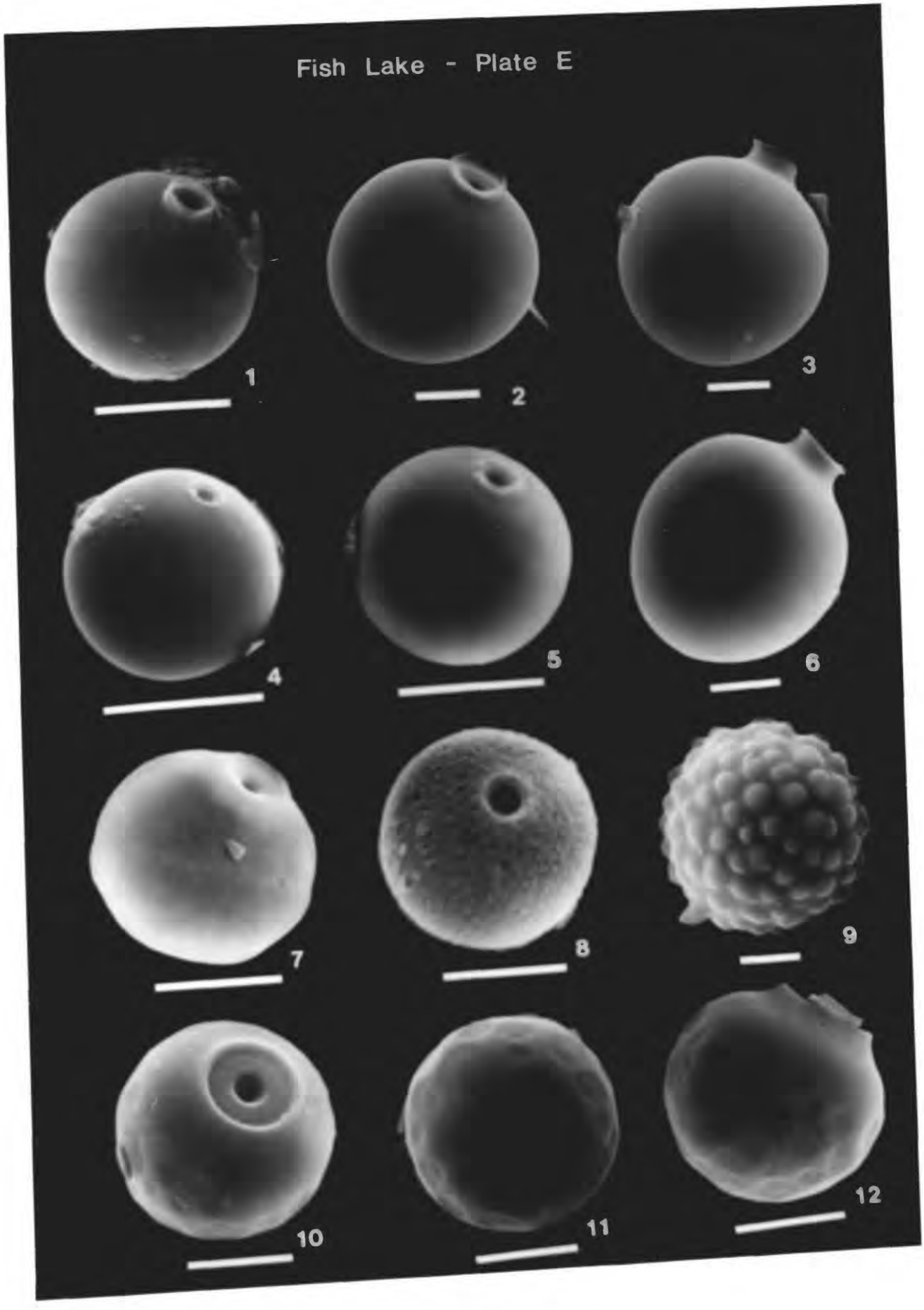
8 - Type 184

9 - Type 175
(aperture not visible)

10 - Type 177

11 - Type 177
(aperture not visible)

12 - Type 177
(aperture at top right; with attached debris)


Fish Lake - Plate E
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Fish Lake, Plate F
Sample 105, taken from just beneath Mazama Ash
scale bar = 3 micrometers

1 - Type 114
(with attached debris)

2 - Type 114
(with attached debris)

3 - Type 316

4 - Type 170
(aperture not visible)

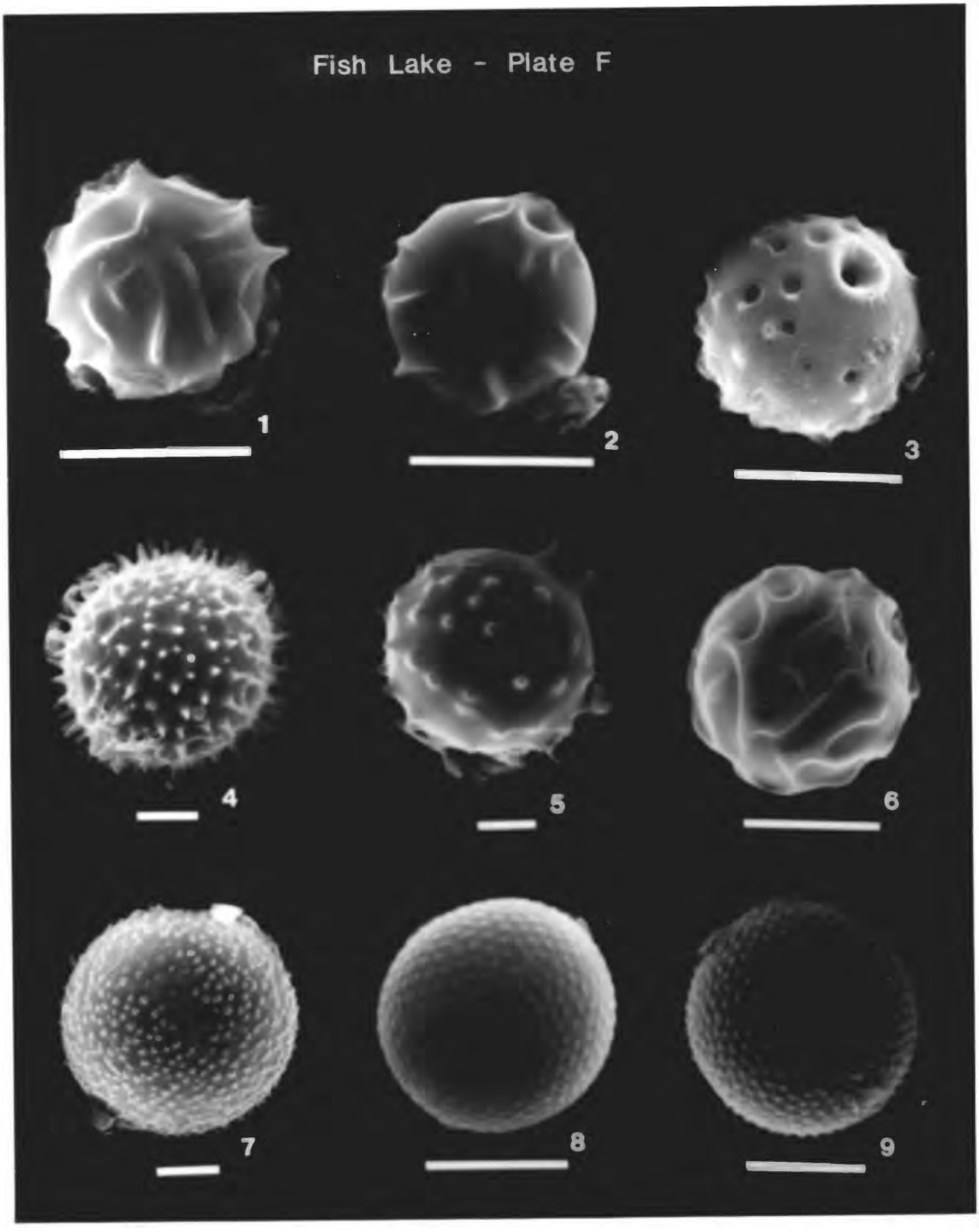
5 - Type 324

6 - Type 242(?)
(aperture at top right)

7 - Type 26(?)
(aperture not visible; with attached debris)

8 - Type 54
(aperture not visible)

9 - Type 54
(aperture at top right)


Fish Lake - Plate F
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Fish Lake, Plate G
Sample 105, taken from just beneath Mazama Ash
scale bar = 3 micrometers

1 - Type 171

2 - Type 172
(with attached debris)

3 - Type 172
(with attached debris)

4 - Type 325

5 - Type 98
(with attached debris)

6 - Type 98
(with attached debris)

7 - Type 45

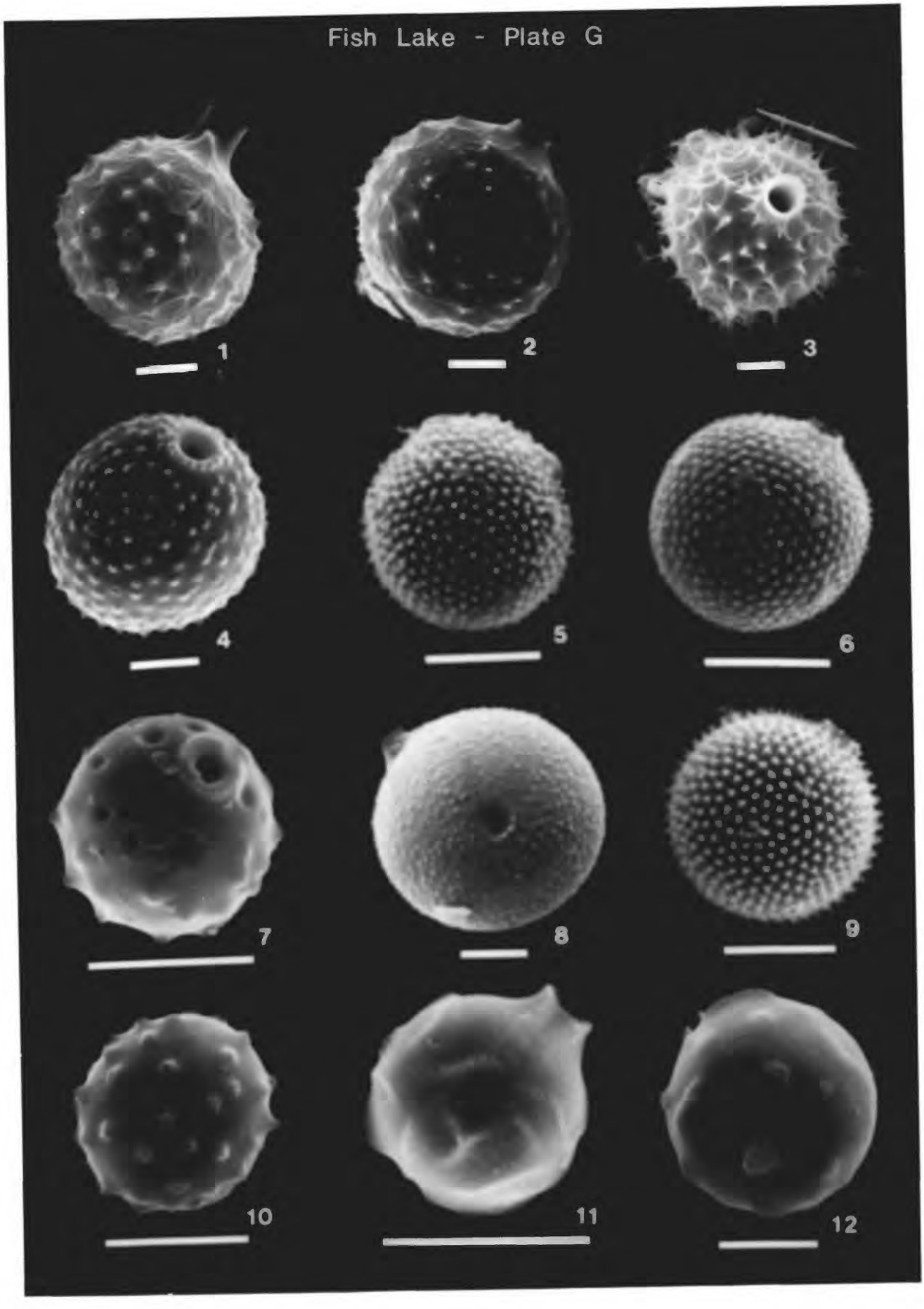
8 - Type 326

9 - Type 98
(aperture at top right)

10 - Type 327(?)
(aperture not visible)

11 - Type 46(?)

12 - Type 180(?)
(aperture not visible)


Fish Lake - Plate G
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Fish Lake, Plate H
Sample 105, taken from just beneath Mazama Ash
scale bar = 3 micrometers

1 - Type 317

2 - Type 317

3 - Type 328

4 - Type 240

5 - Type 84

6 - Type 58
(with attached debris)

7 - Type 190

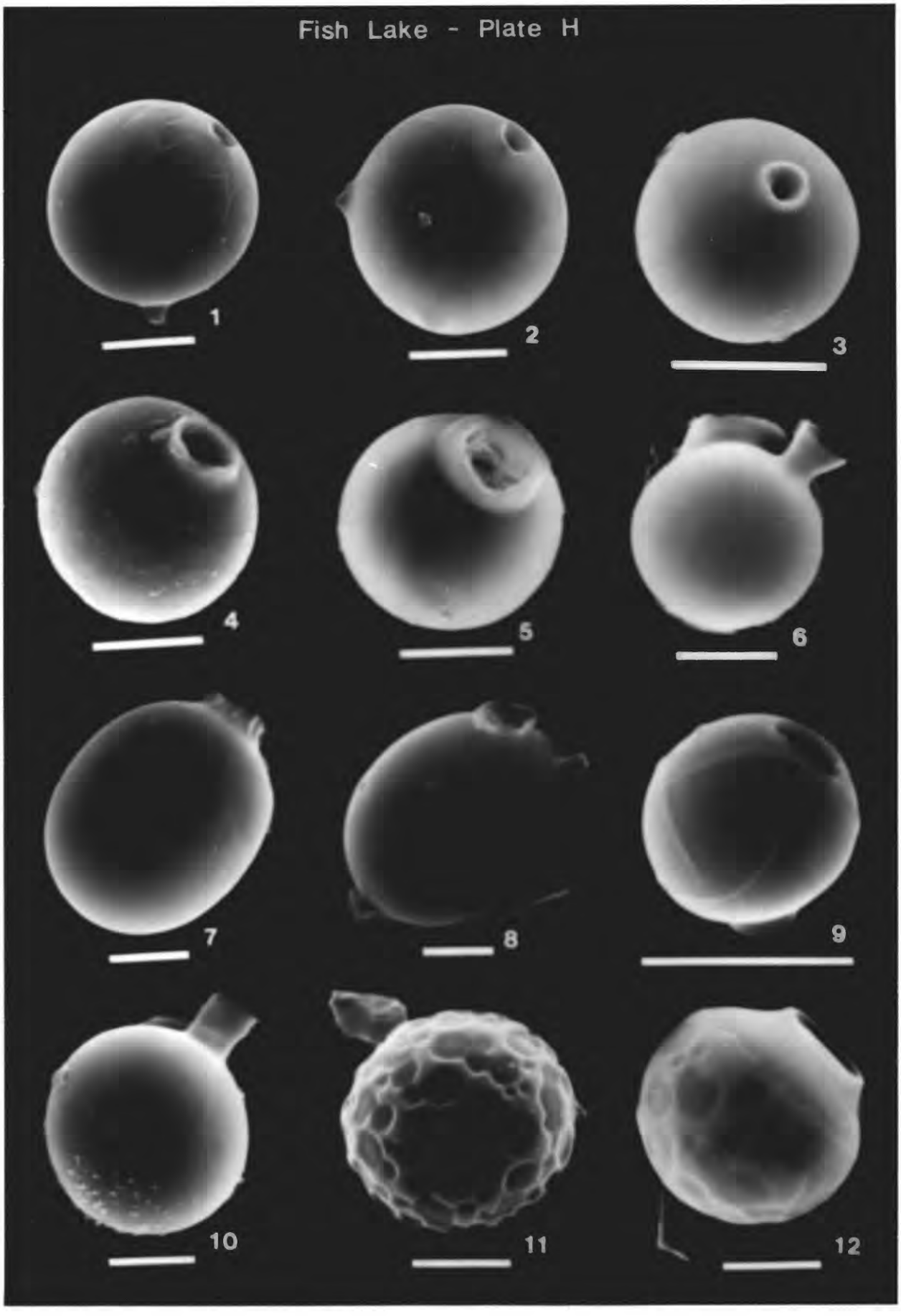
8 - Type 320
(aperture at top right; with attached debris)

9 - Type 329
(aperture at bottom)

10 - Type 330

11 - Type 177
(with attached debris; aperture not visible)

12 - Type 177
(with attached debris)


Fish Lake - Plate H
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APPENDIX A

PREVIOUS REPORTS IN THIS SERIES

Mahood, Albert D., and Adam, David P., 1979a, Late Pleistocene chrysomonad cysts from core 7, Clear Lake, Lake County, California: U. S. Geological Survey Open-file Report Number 79-971, 11 p., 4 plates. Defines types 1 through 44.

Adam, David P., and Mahood, Albert D., 1979a, A preliminary annotated bibliography on siliceous algal cysts and scales: U. S. Geological Survey Open-file Report Number 79-1215, 34 p.

Mahood, Albert D., and Adam, David P., 1979b, Techniques used for the cleaning, concentration, and observation of chrysomonad cysts from sediments: U. S. Geological Survey Open-file Report Number 79-1431, 5 p.

Adam, David P., and Mahood, Albert D., 1979b, Chrysomonad cysts from Upper Echo Lake, Eldorado County, California: U. S. Geological Survey Open-file Report Number 79-1461, 21 p. + 12 plates.

Adam, David P., and Mehringer, Peter J., Jr., 1980, Modern and Holocene chrysomonad cysts from Lost Trail Pass Bog, Montana: U. S. Geological Survey Open-file Report Number 80-797, 13 p. + 5 plates.

Adam, David P., and Mahood, Albert D., 1980, Modern chrysomonad cysts from Fallen Leaf Lake, Eldorado County, California: U. S. Geological Survey Open-file Report Number 80-798, 9 p. + 2 plates.

Adam, David P., and Mahood, Albert D., 1980, Modern chrysomonad cysts from Alta Morris Lake, Eldorado County, California: U. S. Geological Survey Open-file Report Number 80-822, 11 p. + 4 plates.

Adam, David P., and Mehringer, Peter J., Jr., 1980, Scanning electron micrographs of modern chrysomonad cysts from Castor Pond, Jemez Mountains, New Mexico: U. S. Geological Survey Open-File Report Number 80-1231, 18 p., including 5 plates.

Adam, David P., 1980, Scanning electron micrographs of modern chrysomonad cysts from Haypress Meadows, El Dorado County, California: U. S. Geological Survey Open-File Report Number 80-1235, 15 p., including 3 plates.

Adam, David P., 1980, Scanning electron micrographs of Upper Pleistocene chrysomonad cysts from Flagpole Peak, El Dorado County, California: U. S. Geological Survey Open-File Report Number 80-1239, 13 p., including 2 plates.