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Freshwater Algae of Rae Lakes Basin, Kings Canyon National Park

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July 1979

FRESHWATER ALGAE OF RAE LAKES BASIN,

KINGS CANYON NATIONAL PARK

by

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U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
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FOREWORD

Protection of the environment requires effective regulatory actions that are based on sound technical and scientific information. This information must include the quantitative description and linking of pollutant sources, transport mechanisms, interactions, and resulting effects on man and his environment. Because of the complexities involved, assessment of specific pollutants in the environment requires a total systems approach that transcends the media of air, water, and land. The Environmental Monitoring and Support Laboratory-Las Vegas contributes to the formation and enhancement of a sound monitoring data base for exposure assessment through programs designed to:

- develop and optimize systems and strategies for monitoring pollutants and their impact on the environment
- demonstrate new monitoring systems and technologies by applying them to fulfill special monitoring needs of the Agency's operating programs

This report illustrates and characterizes algae found in the Kings Canyon National Park and describes their distribution among the Rae Lakes within. It is the first algal taxonomic study for the southern Sierra Nevada and the most comprehensive for the range. It serves as a reference manual for the identification of algae in alpine and subalpine regions and establishes baseline data for future investigations. This report was written for use by Federal, State, and local governmental agencies concerned with the application of biological data to water quality analysis and monitoring. Private industry and individuals similarly involved with the biological aspects of water quality will find the document useful. For further information contact the Water and Land Quality Branch, Monitoring Operations Division.

George B. Morgan
Director
Environmental Monitoring and Support Laboratory
Las Vegas

ABSTRACT

This report illustrates and characterizes algae (exclusive of diatoms) found in Kings Canyon National Park, California and describes their distribution among the Rae Lakes within. It is the first taxonomic study of the freshwater algae for the southern Sierra Nevada and the most comprehensive for the range. It serves as a reference manual for the identification of algae in alpine and subalpine regions and establishes baseline data for future investigations. More than half (113) of the 210 forms encountered were desmids (Chlorophyta). While 120 forms were thought to be new records for California, one variety was thought to be new to science. A table illustrating the distribution of taxa within the lakes and ponds is included and discussed.

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ACKNOWLEDGMENTS

Many of the data presented in this report were a portion of a thesis submitted to Humboldt State University in partial fulfillment of the requirements for the degree of Master of Arts, July 1974. I am greatly indebted to Dr. William C. Vinyard, my major professor, for direction and guidance on this study and for the collection of the samples upon which this report is based. Dr. Vinyard collected the samples as part of an intensive investigation he conducted into the possible eutrophication of the Rae Lakes through overuse of the region by hikers. I would also like to thank Dr. G. W. Prescott, University of Montana Biological Station, for his interest and response to inquiries during the completion of this project.

INTRODUCTION

Eutrophication, i.e., the process by which water bodies become nutrient-rich, is of great significance to water quality managers. One of the primary symptoms of eutrophication is the excessive growth of algae. This growth is used to monitor the trophic state or condition of lakes. In order to use algae as a biological water quality monitoring tool, it is necessary to be able to identify them and to have information on their distribution and habitat requirements.

The purpose of this study was to list and illustrate the freshwater algae (exclusive of diatoms) of the Rae Lakes Basin, a subalpine area of the Sierra Nevada. I am aware of only three reports dealing with the freshwater algal flora of the Sierra Nevada: Wolle 1887, Vinyard 1951 (unpublished master's thesis), and Thomasson 1962. The general lack of taxonomic publications covering this large geographic area emphasizes the need for further information.

DESCRIPTION OF THE RAE LAKES AREA

GEOGRAPHY

Kings Canyon National Park is located on the broad western slope of the Sierra Nevada, occupying 1833 square kilometers. The mountains in this region range in elevation from about 427 meters (m) in the western foothills to 4,418 m at Mount Whitney on the eastern crest. The region was glaciated several times in the Pleistocene epoch, resulting in an area of high relief and exposed granite which is representative of much of the Sierra Nevada.

The Rae Lakes (lat. 36°49' N., long. 118°24' W.) are in the eastern section of the park near the main crest at an altitude of 3,231 m (Figure 1). They are accessible only on foot or by horseback, requiring about two days travel time. The Dragon pluton, the principal rock type forming the lake basins, is a quartz monzonite-granodiorite that is poor in quartz (Moore 1963).

LAKES AND PONDS

The Rae Lake system consists of six interconnected alpine and subalpine lakes along a 4 kilometer (km) stretch of valley floor and two hanging-cirque lakes 150 to 180 meters above the general elevation of the other lakes (Figure 1). The basin runs north-south, with steep sides rising over 762 m to the surrounding peaks. Snowmelt is the primary source of water for these lakes. The water flows from south to north throughout the system and forms headwaters for the Kings River watershed.

Dr. W. C. Vinyard, of Humboldt State University, who took samples in the area August 16-25, 1972, noted that the two southernmost lakes were the largest. Lake 1, a cirque lake, was bordered by rock and barren of any conspicuous vegetation. Lake 2 had a maximum depth of 16 m. Coleman (1925) reported a maximum depth of 16.5 m in the Rae Lakes but failed to specify the lake to which the measurement applied. Aquatic vegetation in Lake 2 was limited to a well-developed marsh in the shallow northeast bay. Lake 3 was shallow; Lake 4 was essentially a *Carex* marsh; and Lakes 5 and 6 were larger, apparently with more depth than Lakes 3 and 4. Time constraints prevented sampling visits to the two hanging-cirque lakes, Dragon Lake and the unnamed lake located on the western wall of the canyon.

Two small ponds were included in the study. Pond A was between and to the east of Lakes 2 and 3. It was about 15 centimeters (cm) deep. Pond B was located between Lakes 5 and 6 and its depth was unknown.

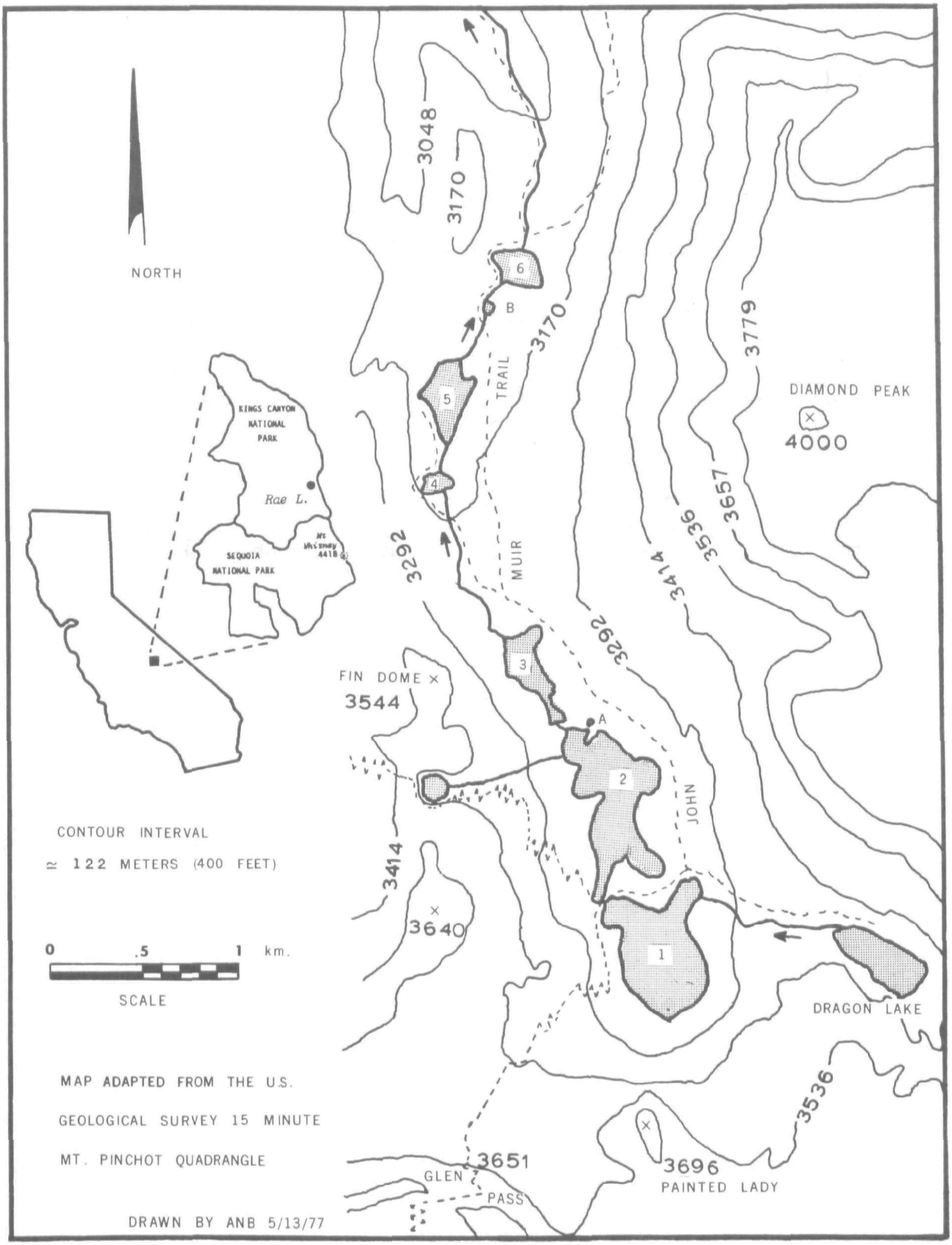

Figure 1. Rae Lakes, Kings Canyon National Park, California.

A descriptive summary of the study lakes and ponds is given in Table 1. At the time of collection the lakes and ponds were slightly acid, ranging in pH from 5.8 to 6.6; water temperatures ranged from 14.4 to 18.9 degrees Celsius.

The benthic vegetation was dominated by *Elodea nuttalii* forming dense beds at depths greater than 1 m. *Elodea nuttalii* was present in Lakes 2 and 6 and extended into the outlet streams. *Nitella* sp., a macroscopic chlorophyte, grew in dense beds fringing *E. nuttalii* in water less than one m deep. Neither plant was found in Lake 1. A sparse population of *Ranunculus aquatilia* was observed at the margin and in the outlet stream of Lake 6 and within the *E. nuttalii* beds in the stream between Lakes 5 and 6. *Isoetes bolanderi* was occasionally found in Lakes 2 and 3; *Sparganium* sp. and *Callitriche* sp. covered half of pond A.

The observed emergent vegetation was restricted to *Carex* sp. dominating a small marsh in a cove at the northeast corner of Lake 2 and nearly surrounding Lake 4. Otherwise, the plant was scattered.

The terrestrial vegetation included several species of *Salix* growing along streams and near lake shores. *Pinus contorta* and *P. balfouriana* were found intermixed, scattered, or in small clumps throughout the basin.

TABLE 1. DESCRIPTIVE SUMMARY OF THE RAE LAKES AND PONDS DURING AUGUST 16 - 25, 1972, AND SAMPLES COLLECTED

	Lakes						Ponds	
	1	2	3	4	5	6	A	B
Total number of taxa	23	131	91	39	72	62	65	43
Sample type:								
Plankton	3	5	4	1	4	3	1	2
Tychoplankton	--	1	1	2	--	3	--	1
Sludge	--	3	3	--	1	1	--	--
Benthic flocculum	1	5	--	1	4	--	1	--
Seepage	--	2	--	--	--	--	--	--
Epilithic	2	1	6	--	--	1	--	--
Total number of samples	6	17	14	4	9	8	2	3
pH	6.0	6.4-6.6	6.6	6.0-6.3	5.8-6.4	5.8	6.0	6.1
Air temperature (°C)	13.3-23.3	10-12.8	20	13.9-16.7	12.2-18.3	18.9	13.3-23.3	--
Water temperature (°C)	14.4-16.7	15.5-16.7	18.9	16.7	15.5-20	15.5	14.4-16.7	--
Aquatic plants mentioned in fieldnotes		*Elodea* *Nitella* *Isotetes* *Carex*	*Elodea* *Moss* *Isotetes*	*Elodea* *Carex*	*Elodea* *Carex*	*Elodea* *Ranunculus*	*Sparganium* *Callitriche*	*Elodea*
Depth	--	16 m	--	--	--	--	15 cm	--

MATERIALS AND METHODS

COLLECTION

The 63 samples (Table 1) used in this study were collected by Dr. Vinyard during a 9-day helicopter expedition to the Rae Lakes (August 16 - August 25, 1972). Samples were taken from various shoreline positions at each lake, the outlets, some of the connecting creeks, and seepage areas. Open water samples were not collected due to the impracticality of transporting a boat into the area. The number of samples collected from each lake was determined by the variety of habitats encountered. Samples were preserved in 5% formalin solution and returned to the laboratory for examination. A pinch of copper sulfate was added to each liter of preservative to maintain the original colors of the algae.

Each sample was labeled according to the lake and habitat from which it was collected. Habitats sampled included:

1. Planktonic (collected with a #25 plankton net).
2. Tychoplanktonic (squeezing of mosses, *Elodea*, *Nitella*, and floating mats of *Oedogonium* and *Rhizoclonium*).
3. Sludge.
4. Benthic flocculum.*
5. Seepage.
6. Epilithic.

---

*Vinyard coined this phrase to describe the thin layer of debris often found suspended just off the lake bed in the littoral zone.

PREPARATION AND EXAMINATION

Three permanent slides of each sample were prepared using Karo® syrup with phenol as the mounting medium. Cover slips were sealed with clear fingernail polish. The preserved samples and permanent slides are on file at California State University-Humboldt's cryptogamic herbarium. Each slide was examined and each form, when first encountered, was drawn with the aid of a camera lucida. Wet mounts of most samples were also examined for forms not encountered on the permanent slides and to clarify details overlooked on previously observed plants. Cell dimensions were measured from camera lucida drawings with the aid of a stage micrometer.

An iconographic record was established during preliminary examination of the permanent slides. The illustrations were organized by genus as they were drawn. In this way, accurate records were kept on the occurrence of each plant on a sample-by-sample basis without the immedate need of a species name. Distributions within habitats were easily derived from these records. The systematics presented here follow Prescott (1970) wherever possible. The following occurrence categories were established to indicate species abundance but they are of a subjective nature and should be interpreted in conjunction with the habitat and distribution records; Very rare - seen once or twice, usually in the same sample; Rare - seen several times in one or more samples; Common - low population density, but occurring in many samples; Very common - high population density in one or more samples, or occurring in most samples.

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RESULTS AND DISCUSSION

Descriptions of species, varieties and forms identified from Rae Lakes and Ponds as well as occurrence and habitat information are given in Appendix A. Species illustrations are presented in Appendix B, while a genus and species index can be found on page 106.

The algal flora of the Rae Lakes were dominated by Chlorophyta (82 percent), most of the remaining taxa were members of Cyanophyta (13 percent). Other divisions were poorly represented except Pyrrhophyta where a single species, Peridinium Willei, occurred quite commonly in large numbers (Table 2). These findings agree with Thomasson's (1962) list of 74 taxa from the Lake Tahoe region, where 85 percent of the taxa were chlorophytes and about 10 percent cyanophytes, and Vinyard's (1951) list of 161 taxa from eight alpine and subalpine regions of the Western United States, where 86 percent were chlorophytes and 13 percent cyanophytes (neither report addressed the diatoms).

Desmids, reflecting the soft water character of the Rae Lakes, were the dominating group within Chlorophyta (65 percent). This relationship also agreed with data collected by Vinyard (1951) and Thomasson (1962) where desmid taxa accounted for 67 and 65 percent of the chlorophytes respectively. Numerous papers have appeared in recent years dealing with algae, especially the desmids, of the North American arctic and subarctic (Whelden 1947, Croasdale 1955, 1956, 1957, 1958, and others). Croasdale (1965) noted that Cosmarium species usually made up more than 50 percent of the arctic desmid flora while some genera (e.g., Micrasterias and Triploceras) were absent. In comparison, 40 percent of the Rae Lakes desmids were Cosmarium, while Micrasterias was represented by eight species. Triploceras was not found in the Rae Lakes.

Non-desmid chlorophytes included 39 chlorococcaleans primarily in the genera Pediastrum, Oocystis, Scenedesmus and Coelastrum. This is apparently the first report of P. taylori since Sieminska described it in 1965 although, as she pointed out, it may have been placed in P. tricornutum var. alpinum by various workers in North America (Taylor 1922, 1924; and Vinyard 1951). Oocystis arctica Prescott is reported here probably for the first time since its description (Prescott and Vinyard 1965).

The seven members of the Euglenophyta reported here were found only in Lake 3. All were in the same sample (sludge near the outlet of Lake 3) except Lepocinclis fusiformis var. major which was in an epilithic sample of Tetraspora lamellosa.

TABLE 2. SUMMARY OF THE TAXA ENCOUNTERED

Divisions	Orders	Families	Genera	Species	Varieties	Forms	Total*
Chlorophyta	9	20	49	119	42	12	173
Euglenophyta	1	1	4	5	2	--	7
Pyrrhophyta	1	1	1	1	--	--	1
Chrysophyta	2	2	2	2	--	--	2
Cyanophyta	3	4	18	24	3	--	27
Total	16	28	74	151	47	12	210

*Total of species, varieties and forms.

Cosmarium askenasyii was considered an Australian and South Asian species until Carter (1935) found and named a variety in British Columbia. The variety was rare in the Rae Lakes material and found only on wet soil. *C. subtumidum* var. *minutum* was considered by Krieger and Gerloff (1965) to be a tropical species. It too had a unique microhabitat in a submersed epilithic sample of *Tetraspora lamellosa*.

Although the study lakes were located in the same small canyon with water from one feeding the next, there were interesting differences in the algal compositions (Table 3). Lake 1, the cirque lake, had the lowest diversity of the study lakes, due primarily to the lack of diverse habitats (e.g., little or no sediment and the absence of vascular aquatic vegetation). Lake 4 also had relatively few taxa compared to the other lakes. It was the smallest of the lakes, very shallow, and nearly overgrown by a *Carex* marsh. This emergent plant may have acted as a light shield hampering algal growth.

The composition of the major algal groups changed consistently from one end of the chain to the other. There was an increase in blue-green species from 9 percent in Lake 1 to 19 percent in Lake 6 with a corresponding decrease in desmids from 57 percent in Lake 2 to 35 percent in Lake 6. These changes suggested a slight increase in nutrient load down the chain of lakes. Lake 1 did not fit the pattern as desmids comprised 22 percent of the species present.

Although there were numerous desmids present in the Rae Lakes, relatively few were common to all of the lakes and ponds; to the contrary, most were limited to one or two lakes. By comparison, 18 of the 60 non-desmid chlorophytans (30 percent) were found in five or more of the lakes and ponds, whereas only 12 of the 113 desmids (11 percent) were found in five or more of the lakes and ponds. In addition, 16 taxa (mostly desmids) were limited to pond A with the exception of one Micrasterias also found in pond B. It should be noted that pond A was very shallow and had accumulated sediments, and probably provided a very different habitat from the other lakes and pond B.

The distributions noted in Table 3 may be misleading as the samples were collected during a very short period of time, and it is possible that many of the rarer species become increasingly abundant at different times during the year.

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
CHLOROPHYTA									
Chlamydomonadaceae									
Chlamydomonas angulosa					x				VR*
Volvocaceae									
Eudorina elegans	x	x	x		x	x		x	C*
Pandorina morum	x	x			x				R*
Tetrasporaceae									
Tetraspora lamellosa		x	x		x				VC*
Gloeocystaceae									
Asterococcus limneticus		x	x		x	x	x		C
Gloeocystis ampla		x		x	x	x	x		C
G. gigas	x	x	x	x	x	x	x	x	C
G. vesiculosa		x	x		x	x	x	x	C
Chlorococcaceae									
Tetraëdron gracile					x				VR
Palmellaceae									
Sphaerocystis schroeteri	x	x		x	x	x	x	x	C
Oocystaceae									
Ankistrodesmus falcatus		x	x		x		x		C
A. gelifactum		x			x				VR
Eremosphaera viridis				x	x				C
Kirchneriella lunaris var. *irregularis*		x	x						VR
Oocystis arctica								x	VR
O. borgei							x		R
O. elliptica?					x				R
O. parva	x	x	x	x	x	x	x	x	C
O. pusilla						x			VR

*VR = Very Rare, R = Rare, C = Common, VC = Very Common

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Oocystaceae (continued)									
O. sp.						x			C
Quadrigula lacustris		x	x	x	x	x	x	x	VC
Zoochlorella spp.		x			x		x		-
Micractiniaceae									
Golenkinia paucispina							x		VR
Dictyosphaeriaceae									
Botryococcus braunii		x	x	x	x	x	x	x	VC
Dictyosphaerium pulchellum	x		x			x			VC
Scenedesmaceae									
Coelastrum cambricum var. *intermedium*		x							R
C. microporum		x	x		x	x		x	C
C. printzii		x							VR
C. proboscideum			x						VR
Crucigenia rectangularis	x	x	x		x	x	x	x	VC
C. quadrata						x			VR
Enallax alpina		x							VR
Scenedesmus bijuga							x		VR
S. bijuga var. *alternans*		x							VR
S. dimorphus							x		VR
S. quadricauda	x	x	x		x		x	x	VC
Tetrademus sp.		x							VR
Hydrodictyaceae									
Pediastrum angulosum				x			x		C
P. boryanum		x	x	x	x	x	x	x	VC
P. boryanum var. *undulatum*		x				x			R
P. braunii			x						VR
P. integrum		x	x						VR
P. muticum		x						x	VR
P. taylori		x					x		R
P. tetras forma		x							R
P. tetras var. *tetraodon*		x			x	x			C
Sorastrum spinulosum							x		VR

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Ulotrichaceae									
Ulothrix variabilis		x	x	x	x				C
Chaetophoraceae									
Microthamnion strictissimum	x	x	x	x	x	x		x	C
Protoderma viride								x	C
Coleochaetaceae									
Coleochaete orbicularis				x	x			x	C
Oedogoniaceae									
Bulbochaete sp.	x	x	x	x	x	x	x	x	VC
Oedogonium spp.	x	x	x	x	x	x		x	VC
Cladophoraceae									
Rhizoclonium crassipellitum		x	x	x		x			C
Zygnemataceae									
Mougeotia spp.?	x	x	x		x	x	x	x	C
Spirogyra gracilis	x	x	x		x	x		x	C
Zygnema sp.						x			C
Mesotaeniaceae									
Cylindrocystis brebissonii		x							R
Gonatozygon aculeatum	x		x			x			C
G. brebissonii		x	x		x	x		x	VR
Netrium digitus		x	x		x	x		x	VC
N. digitus var. *naegelii*			x		x				VR
N. interruptum		x	x		x				VR
Desmidiaceae									
Closterium dianae?		x	x					x	R
C. dianae var. *minor*?		x	x						R

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Desmidiaceae (continued)									
C. gracile							x		R
C. intermedium		x	x						C
C. jenneri							x		R
C. libellula			x						VR
C. lunula forma *gracilis*		x	x	x		x		x	VC
C. macilentum var. *japonicum* forma					x	x			C
C. rostratum		x			x				R
C. striolatum		x	x		x		x		VC
Cosmarium abbreviatum forma *minor*			x						VR
C. amoenum		x	x						C
C. angulosum					x			x	R
C. askenasyii var. *americana*		x							R
C. bioculatum							x		C
C. bipunctatum		x	x	x			x		C
C. botrytis var. *tumidum*		x	x	x	x	x	x		VC
C. connatum		x			x				VR
C. contractum var. *ellipsoideum*		x			x				C
C. crenatum			x						C
C. cymatonotophorum var. *granulatum*		x							VR
C. difficile var. *dilatatum*		x							R
C. formulosum	x	x	x	x	x	x			C
C. globosum		x	x				x		C
C. hammeri		x							R
C. humile var. *striatum*				x				x	R
C. impressulum *α*		x							R
C. impressulum *β*		x						x	R
C. intermedium			x				x		R
C. laeve var. nov.?				x					R
C. margaritatum forma *subrotundata*		x							R
C. novae-semliae var. *granulatum*			x				x		R
C. ornatum var. *perornatum*			x		x				R

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Desmidiaceae (continued)									
C. portianum		x	x						C
C. pseudoarctoum					x				R
C. pseudoprotuberans forma *minus*	x						x		R
C. pseudopyramidatum var. *extensum*		x							C
C. *pseudoquadratulum*		x							R
C. pyramidatum		x							C
C. quadratum forma *willei*			x						C
C. quinarium		x							C
C. rectangulare var. *hexagonium*		x					x	x	C
C. reniform			x	x		x		x	C
C. sexangulare			x						R
C. sexnotatum var. *tristriatum*		x	x			x			C
C. subarctoum									
C. suberenatum		x							R
var. *isthmochondrum*		x	x	x	x	x		x	C
C. subspeciosum var. *validius* morpha		x					x		C
C. subtumidum var. *minutum*			x						VR
C. tenue var. *depressum*		x			x				VR
C. trachypleurum var. *fallax*				x					VR
C. undulatum var. *minutum*			x						R
C. ungerianum forma							x		VC
C. venustum var. *excavatum*		x							R
Desmidium grevillii								x	VR
Euastrum ansatum var. *pyxidatum*							x		R
E. ansatum var. *triporum*		x							R
E. bidentatum var. *speciosum*			x				x		C
E. denticulatum var. *angusticeps*		x					x		R
E. didelta		x							R
E. elegans					x	x	x		C
E. gemmatum forma *latior*		x	x						R
E. obesum		x							R
E. oblongum		x					x		C
E. verrucosum var. *perforatum*		x							R

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Demidiaceae (continued)									
E. verrucosum var. *rhomboideum*		x	x	x		x	x		C
E. verrucosum var. *vallesiacum*		x							R
Micrasterias americana		x							R
M. conferta		x							R
M. denticulata var. *angulosa*		x		x					R
M. muricata var. *tumida*							x		VR
M. pinnatifida		x							C
M. rotata							x	x	C
M. rotata forma *evoluta*		x			x			x	C
M. truncata var. *neodamensis*		x							R
Penium spirostriolatum			x			x			VR
Pleurotaenium ehrenbergii		x			x	x			VC
P. trabecula var. *elongatum*		x	x	x	x	x			R
P. trabecula var. *maximum*		x							VR
Spondylosium planum	x	x	x	x	x	x	x	x	R
S. pulchellum		x							VR
Staurastrum acarides		x							VR
S. alternans		x							C
S. anatinum		x	x		x	x	x	x	C
S. arctiscon	x	x	x	x	x	x		x	VC
S. brebissonii		x	x						R
S. breviaculeatum		x		x			x		VC
S. brevispinum					x			x	R
S. crenulatum						x			VR
S. cuspidatum							x		C
S. dickiei var. *circulare*		x						x	VR
S. grande var. *angulosum*		x							C
S. kurilense		x	x						R
S. kurilense forma *triquetra*							x		VR
S. margaritaceum		x							VR
S. orbiculare			x				x		R
S. pachyrhynchum		x							C
S. polonicum			x						C
S. polymorphum		x	x						R
S. punctulatum		x	x			x	x		C

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Desmidianceae (continued)									
S. punctulatum var. *kjellmani*		x							C
S. pyramidatum forma nov.?		x							R
S. sebaldii var. *ornatum*							x		C
S. spongiosum		x							VR
S. subavicula		x							VR
S. vestitum						x	x		C
Tetmemorus laevis		x	x						VR
Xanthidium subhastiferum	x	x	x	x	x	x	x	x	VC
Characeae									
Nitella sp.		x	x	x	x	x			VC
EUGLENOPHYTA									
Euglenaceae									
Euglena spirogyra var. *marchica*			x						VR
Lepocinclis fusiformis			x						R
L. fusiformis var. *major*			x						VR
Phacus sp.			x						VR
Trachelomonus bacillifera var. *minima*			x						R
T. lacustris			x						R
PYRRHOPHYTA									
Peridiniaceae									
Peridinium willei	x	x	x		x	x	x	x	VC
CHRYSOPHYTA									
Chlorobotrydaceae									
Ducellieria chodatii		x							VR

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Dinobryaceae									
Dinobryon cylindricum	x				x	x			R
CYANOPHYTA									
Chroococcaceae									
Aphanocapsa elachista var. *conferta*		x	x	x	x	x	x		C
A. pulchra		x							R
Aphanothece stagnina		x	x		x				C
Chroococcus prescottii			x		x	x			C
C. turgidus		x	x	x	x		x	x	C
Coelosphaerium kuetzingianum						x	x		R
C. pallidum?		x				x	x		C
Dactylococcopsis smithii					x				VR
Eucapsis alpina var. *minor*							x		R
Gloeothece rupestris?						x			VR
Merismopedia elegans		x			x		x		VC
Microcystis aeruginosa		x		x	x	x	x	x	C
Oscillatoriaceae									
Lyngbya aerugineo-caerulea	x	x			x				R
Oscillatoria agardhii		x	x		x	x			C
O. Limnetica			x						C
O. tenuis							x		C
O. tenuis var. *natans*		x							C
Phormidium corium			x						R
Nostocaceae									
Anabaena oscillarioides		x	x	x	x	x			VC
A. sphaerica		x			x				C
Cylindrospermum alatosporum					x				R
Nostoc parmelioides			x			x			C
N. paludosum	x	x	x	x	x	x	x	x	VC

(continued)

TABLE 3. DISTRIBUTION OF ALGAL SPECIES BY LAKE AND POND (Continued)

	LAKE						POND		OCCUR.
	1	2	3	4	5	6	A	B	
Scytonemataceae									
Scytonema mirabile		x		x					C
Tolypothrix distorta		x	x	x	x	x	x		C
Rivulariaceae									
Calothrix epiphytica		x							C
C. fusca			x			x			R
CHLOROPHYTA									
desmids	6	75	45	16	25	22	32	19	
non desmid	13	38	26	16	31	26	22	20	
EUGLENOPHYTA	-	-	7	-	-	-	-	-	
PYRRHOPHYTA	1	1	1	-	1	1	1	1	
CHRYSOPHYTA	1	1	-	-	1	1	-	-	
CYANOPHYTA	2	16	12	7	14	12	10	3	
TOTAL	23	131	91	39	72	62	65	43	

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APPENDIX A

SPECIES, VARIETY, AND FORM DESCRIPTIONS

The species descriptions are organized as follows:

1. Species, author and date. [An asterisk (*) before a species name denotes a species thought to be a new record for California while a question mark (?) immediately following a portion of the name denotes questionable identity of that part.]

2. Primary reference(s) used in making the identification.

3. Dimensions and descriptive information when it varies from the primary reference. All dimensions are given in micrometers (μm). Parentheses surrounding cell dimensions indicate the occurrence of extremely large or small cells in the sample material. Dimensions for desmids are given with the following abbreviations (applies to single cells):

   L. - length
   W. - maximum width
   Wa. - maximum width at apex
   Th. - maximum thickness
   Tha. - maximum thickness at apex
   Isth. - width of isthmus in face view

4. Occurrence. These data are of a subjective nature and should be interpreted in conjunction with the habitat and distribution records. Categories:

   Very rare - seen once or twice, usually in the same sample.

   Rare - seen several times in one or more samples.

   Common - low population density, but occurring in many samples.

   Very common - high population density in one or more samples, or occurring in most samples.

5. Habitat(s).

6. Appendix B plate and figure numbers with corresponding species illustrations.

SYSTEMATICS

CHLOROPHYTA

Volvocales

Chlamydomonadaceae

Chlamydomonas Ehrenberg

*Chlamydomonas angulosa Dill. 1895.
Prescott. 1962: 70, Pl. 1, Fig. 3.
Cells 20 μm long, 13 μm in diameter. This determination was based on two cells which had lost their flagella. In all other respects they closely followed Prescott's description.
Very rare.
Sludge.
Pl. 1, Fig. 2.

Volvocaceae

Eudorina Ehrenberg

Eudorina elegans Ehrenberg 1832.
Prescott. 1962: 76, Pl. 1, Figs. 24-26.
Cells 8-19 μm in diameter. Colonies were up to 165 μm in diameter.
Common in net tows.
Plankton, tychoplankton, benthic flocculum, and epilithic.
Pl. 1, Fig. 1.

Pandorina Bory

Pandorina morum (Müll.) Bory 1824.
Prescott. 1962: 75, Pl. 1, Fig. 23.
Cells 7.5-12 μm long, 5-8 μm in diameter. The colonies were 16-celled; the cells were smaller than Prescott's.
Rare.
Plankton, benthic flocculum, and sludge.
Pl. 1, Fig. 3.

Tetrasporales

Tetrasporaceae

Tetraspora Link

*Tetraspora lamellosa Prescott 1944.
Prescott. 1962: 88, Pl. 5, Fig. 6.

Cells 5-7.5 μm in diameter. The cells were smaller than Prescott's but the distinguishing characteristics were present: pseudocilia were greater than 20 times the cell diameter and possessed distinct lamellate cell sheaths. Shape of colony was unknown.

Very common.

Epilithic.

Pl. 1, Fig. 4.

Gloeocystaceae

Asterococcus Scherffel

*Asterococcus limneticus G.M. Smith 1918.

Prescott. 1962: 86, Pl. 4, Fig. 11.

Cells 6-9 μm in diameter, colonies 30-50 μm in diameter. Dimensions of cells and colonies were at the lower end of the range given by Prescott.

Common.

Plankton, tychoplankton, and benthic flocclulum.

Pl. 1, Fig. 5.

Gloeoystis Nägeli

Gloeocystis ampla (Kütz.) Lagerheim 1883.

Prescott. 1962: 84, Pl. 3, Fig. 17.

Cells 10-15 μm long, 7-10 μm in diameter.

Common.

Plankton, tychoplankton, benthic flocculum, and seepage.

Pl. 1, Fig. 11.

Gloeocystis gigas (Kütz.) Lagerheim 1883.

Smith. 1920: 101, Pl. 19, Fig. 2.

Cells 12-18-(20) μm in diameter. Lamellations were rarely obvious.

Common.

Plankton tychoplankton, wet soil, benthic flocculum, and sludge.

Pl. 1, Fig. 10.

Gloeocystis vesiculosa Nägeli 1849.

Prescott. 1962: 85, Pl. 3, Fig. 15.

Cells 3.5-11 μm in diameter.

Common.

Plankton, tychoplankton, benthic flocculum, sludge, and epilithic.

Pl. 1, Fig. 7.

Chlorococcales

Chlorococcaceae

Tetraedron Kützing

*Tetraëdron gracile (Reinsch) Hansgirg 1889 forma.

Prescott. 1962: 265, Pl. 60, Fig. 1.

Cells 11-15 μm in diameter without processes, 30-35 μm in diameter with processes. They did not have short spines tipping the processes. The illustration was identical to Skuja's (1949; Pl. 10, Figs. 19 and 20), which was named Isthmochloron gracile (Reinsch) Skuja.

Plankton.

Pl. 1, Fig. 6.

Palmellaceae

Sphaerocystis Chodat

Sphaerocystis Schroeteri Chodat 1897.

Prescott. 1962: 83, Pl. 3, Figs. 6 and 7.

Cells (4)-6-22 µm in diameter.

Common.

Plankton.

Pl. 1, Fig. 12.

Oocystaceae

Ankistrodesmus Corda

Ankistrodesmus falcatus (Corda) Ralfs 1848.

Prescott. 1962: 253, Pl. 56, Figs. 5 and 6.

Cells 40-68 µm long, 2.5 µm in diameter.

Common.

Net tow in 15 centimeters of water, benthic flocculum, seepage, and tychoplankton.

Pl. 1, Fig. 9.

*Ankistrodesmus gelifactum (Chod.) Bourrelly 1951.

Croasdale. 1973: 60, Pl. 9, Figs. 32 and 33.

Cells 35 µm long, 6 µm in diameter, single or in pairs.

Very rare.

Wet soil (seepage into Lake 2), and plankton.

Pl. 1, Fig. 8.

Eremosphaera de Bary

*Eremosphaera viridis de Bary 1858.

Prescott. 1962: 240, Pl. 53, Fig. 22.

Cells about 135 µm in diameter.

Common.

Sludge and benthic flocculum.

Pl. 2, Fig. 1.

Kirchneriella Schmidle

Kirchneriella lunaris var. irregularis G. M. Smith 1920.

Cells 8-11 µm long, 4 µm in diameter.

Very rare.

Sludge.

Pl. 2, Fig. 10.

Oocystis Nägeli

The accurate cytoplasmic data needed to make determinations in this genus were not always available leaving several species unidentified. Living material would have been particularly valuable for this genus.

*Oocystis arctica Prescott 1965.
Prescott and Vinyard. 1965: 455, Pl. 8, Figs. 13 and 14.
Cells 11.5-18 µm long, 8-10 µm in diameter. They were smaller than Prescott and Vinyard's which were 19-20 µm by 14-15 µm.
Very rare.
Squeezings of Elodea.
Pl. 2, Fig. 2.

*Oocystis borgei Snow 1903.
Prescott. 1962: 243, Pl. 51, Fig. 10.
Cells 11.5-14 µm long, 10 µm in diameter.
Rare.
Benthic flocculum.
Pl. 2, Fig. 4.

*Oocystis elliptica? W. West 1892.
Prescott. 1962: 244, Pl. 51, Fig. 11.
Cells 27-28 µm long, 13-14 µm in diameter. They were slightly longer than Prescott's and each chloroplast had a pyrenoid. Prescott wrote, "apparently without pyrenoids."
Rare.
Plankton.
Pl. 2, Figs. 5 and 6.

*Oocystis parva West and West 1898.
Prescott. 1962: 246, Pl. 54, Fig. 3.
Cells 9-15-(17) µm long, 4-8-(9) µm in diameter.
Common.
Plankton, tychoplankton, epilithic, and benthic flocculum.
Pl. 2, Fig. 3.

*Oocystis pusilla? Hansgirg 1890.
Prescott. 1962: 246, Pl. 51, Fig. 15; Pl. 54, Figs. 4 and 5.
Cells 8-9 µm long, 4-5 µm in diameter. The single chloroplast was a parietal plate with one pyrenoid. They differed from Prescott's description in the extension of the mother cell wall to form two bluntly rounded poles. Polar nodules were lacking.
Very rare.
Plankton.
Pl. 2, Fig. 7.

Oocystis sp.
Cells 37-40 µm long, 19-25 µm in diameter. Chloroplasts, 14-20 parietal disks, usually with one pyrenoid apiece. Cells were solitary or in groups of

4-8 enclosed in the old mother cell wall. Poles of cells had nodular thickenings.
Common.
Tychoplankton.
Pl. 2, Fig. 8.

Quadrigula Printz

Quadrigula lacustris (Chod.) G. M. Smith 1920.
Prescott. 1962: 260, Pl. 59, Figs. 4 and 5.
Cells 21-23 μm long, 2-3 μm in diameter.
Very common.
Plankton and tychoplankton.
Pl. 2, Fig. 12.

Zoochlorella spp. Zoochlorella Brand
Prescott. 1962: 235.
Zoochlorella was found inhabiting 2 protozoans: Paramecium bursaria, (Jahn. 1949: 187, Fig. 298-D) and Acanthocystis turfacea Leidy, (Jahn. 1949: 104, Fig. 164).

Micractiniaceae

Golenkinia Chodat

*Golenkinia paucispina West and West 1902.
Prescott. 1962: 213, Pl. 45, Fig. 2.
Cells 20 μm in diameter (- spines), spines 10-12 μm long.
Very rare.
Benthic flocculum and sludge.
Pl. 2, Fig. 9.

Dictyosphaeriaceae

Botryococcus Kützing

Botryococcus braunii Kützing 1849.
Prescott. 1962: 232, Pl. 52, Figs. 1,2, and 11.
Cells 6-8 μm long, 3.2-4 μm in diameter. Colonies were up to 200 μm in diameter.
Very common.
Plankton, benthic floccculum, tychoplankton, epilithic, and sludge.
Pl 2, Fig. 13.

Dictyosphaerium Nägeli

Dictyosphaerium pulchellum Wood 1874.
Prescott. 1962: 238, Pl. 51, Figs. 5-7.
Cells 4-9 μm in diameter.

Very common.
Plankton.
Pl. 2, Fig. 11.

Scenedesmaceae

Coelastrum Nägeli

Coelastrum cambricum var. intermedium (Bohlin) G. S. West.
G. W. Prescott (personal correspondence).
Cells 7-9 μm in diameter. Coenobia was about 25 μm in diameter.
Rare.
Benthic flocculum on gravel.
Pl. 3, Fig. 1.

*Coelastrum microporum Näegeli 1855.
Prescott. 1962: 230, Pl. 53, Fig. 3.
Cells 6-13 μm in diameter. Coenobia were occasionally adhering to one another forming compound colonies. The intercellular spaces characteristic of the species were often lacking.
Common.
Plankton, tychoplankton, benthic flocculum, and sludge.
Pl. 3, Figs. 2 and 3.

*Coelastrum printzii Rayss 1915.
Croasdale. 1973: 56, Pl. 8, Figs. 10-12.
Cells 12-14 μm in diameter. They had small triangular intercellular spaces (not shown on Croasdale's illustrations).
Very rare.
Sludge.
Pl. 3, Fig. 4.

*Coelastrum proboscideum Bohlin 1897.
Prescott. 1962: 230, Pl. 53, Figs. 4, 5, and 8.
Cells 10 μm in length, 12 μm in diameter. Coenobium 25 μm in diameter.
Very rare.
Sludge.
Pl. 3, Fig. 7.

Crucigenia Morren

Crucigenia rectangularis (Braun) Gay 1891.
Prescott. 1962: 285, Pl. 65, Figs. 7 and 8.
Cells 6-8 μm long, 3.5-4 μm in diameter.
Very common.
Plankton, tychoplankton, benthic flocculum, sludge, and epilithic.
Pl. 3, Fig. 6.

Crucigenia quadrata Morren 1830 forma.

Prescott. 1962: 285, Pl. 65, Fig. 10.

Cells 8-10 µm long, 8-9 µm in diameter. Differed from type in larger dimensions, about twice the size of other records.

Very rare.

Tychoplankton.

Pl. 3, Fig. 5.

Enallax Pascher

*Enallax alpina Pascher 1943.

Bourrelly. 1966: 220, Pl. 36, Fig. 19

Cells 19-20 µm long, 10-11 µm in diameter, with 4 longitudinal ribs. Coenobium was a cluster of 4 staggered cells.

Very rare.

Sludge.

Pl. 3, Fig. 8.

Scenedesmus Meyen

Scenedesmus bijuga (Turp.) Lagerheim 1893.

Prescott. 1962: 276, Pl. 63, Figs. 2 and 7.

Cells 11-14 µm long, 3-5 µm in diameter.

Very rare.

Benthic flocculum.

Pl. 3, Fig. 22.

Scenedesmus bijuga var. alternans (Reinsch) Hansgirg 1888.

Prescott. 1962: 277, Pl. 63, Figs. 3 and 4.

Cells 10 µm long, 7 µm in diameter.

Very rare.

Sludge.

Pl. 3, Fig. 9.

Scenedesmus dimorphus (Turp.) Kützing 1833.

Prescott. 1962: 277, Pl. 63, Figs. 8 and 9.

Cells 10-16 µm long, 3 µm in diameter.

Very rare.

Benthic flocculum.

Pl. 3, Fig. 11.

Scenedesmus quadricauda (Turp.) Brébisson 1835.

Prescott. 1962: 280, Pl. 64, Fig. 2.

Cells 14-19 µm long, 4-7 µm in diameter. Colonies were 4 and 8-celled.

Very common.

Plankton, tychoplankton, benthic flocculum, and sludge.

Pl. 3, Fig. 10.

Tetradesmus Smith

Tetradesmus sp.
Prescott. 1962: 283, Pl. 64, Figs. 12-14.
Bowman. 1964: 43, Pl. 7, Fig. 1.
Cells 11 μm long, 3-4 μm in diameter. They differed from T. Wisconsinense by the cell ends being extended into sharp spines. This feature was mentioned by Bowman (1964).
Very rare.
Benthic flocculum.
Pl. 3, Fig. 21.

Hydrodictyaceae

Pediastrum Meyen

*Pediastrum angulosum (Ehrenb.) Meneghini.
Prescott and Vinyard. 1965: 449, Pl. 5, Figs. 9-18.
Cells (8)-12-23 μm long, (7)-10-18 μm wide. Eight and 16-celled coenobia had smooth cell walls, while 32-celled coenobia had granulated cell walls.
Common.
Benthic flocculum and tychoplankton.
Pl. 3, Fig. 15, and Pl. 4, Fig. 2.

Pediastrum boryanum (Turp.) Meneghini 1840.
Prescott. 1962: 222, Pl. 47, Fig. 9, and Pl. 48, Figs. 1 and 3.
Cells (10)-13-20-(25) μm long, (7)-10-16 μm wide. Coenobia were 8, 16, 32, and 64-celled. Processes were variable in length and shape.
Very common.
Tychoplankton, sludge, and benthic flocculum.
Pl. 3, Figs. 18, 19, and 23.

*Pediastrum boryanum var. undulatum Wille 1879.
Prescott. 1962: 223, Pl. 48, Fig 2.
Cells 12-28 μm long, 15-20 μm wide.
Rare.
Tychoplankton and benthic flocculum.
Pl. 4, Figs. 1 and 3.

*Pediastrum braunii Wartmann 1862.
Prescott. 1962: 223, Pl. 48, Fig. 5.
Calls 8-12 μm in diameter, smooth walls.
Very rare.
Sludge.
Pl. 3, Fig. 12.

*Pediastrum integrum Nägeli 1849.
Carter. 1973: 55, Pl. 8, Fig. 4.
Prescott. 1962: 225, Pl. 48, Figs. 9 and 10.
Cells 15-25 μm in diameter.
Very rare.

Sludge.
Pl. 3, Fig. 16.

Pediastrum muticum Kützing 1849.
Prescott. 1962: 225, Pl. 49, Fig. 8.
Cells 13-14 µm in diameter. The cells were smaller than Prescott's which were 20 µm in diameter.
Very rare.
Plankton.
Pl. 3, Fig. 13.

*Pediastrum taylori Sieminska 1965.
Sieminska. 1965: 100, Pl. 2, Figs. 8-14.
Cells 11-15 µm long, 12-14 µm in diameter. The entire cell wall was punctate. Colonies were 4, 8, and 16-celled.
Rare.
Tychoplankton, benthic flocculum, and sludge.
Pl. 3, Fig. 17.

Pediastrum tetras (Ehrenb.) Ralfs 1844 forma.
Prescott. 1962: 227, Pl. 50, Figs. 3 and 6.
Smith. 1920: 173, Pl. 48, Figs. 9-12.
Cells 8-10 µm long, 9-10 µm in diameter. They differed from the type in shallower peripheral incision and the margins were straight or only slightly concave. Colonies 8-celled.
Rare.
Tychoplankton and benthic flocculum.
Pl. 3, Fig. 14.

Pediastrum tetras var. tetraodon (Corda) Rabenhorst 1868.
Prescott. 1962: 227, Pl. 50, Fig. 7.
Cells (4.5-6)-8.5-10 µm long, (4.8-5.5)-10-13 µm in diameter. The cells were much smaller than Prescott's.
Common.
Tychoplankton.
Pl. 3, Figs. 20 and 24.

Sorastrum Kützing

Sorastrum spinulosum Nägeli 1849.
Prescott. 1962: 228, Pl. 50, Fig. 9, and Pl. 53, Fig. 1.
Cells 6-7 µm long, 8 µm wide, and 5 µm thick, with short spines, 3 µm long.
Very rare.
Benthic flocculum.
Pl. 4, Fig. 12.

Ulotrichales

Ulotrichaceae

Ulothrix Kützing

**Ulothrix variabilis* Kützing 1849.
Prescott. 1962: 97, Pl. 6, Fig. 13.
Cells 11-14 μm long, 6-7 μm in diameter. They had 1, sometimes 2 pyrenoids in each chloroplast.
Common.
Plankton and tychoplankton (was not found attached to a substrate).
Pl. 4, Fig. 18.

Chaetophorales

Chaetophoraceae

Microthamnion *Nägeli*

**Microthamnion strictissimum* Rabenhorst 1859.
Prescott. 1962: 122, Pl. 11, Figs. 5 and 6.
Cells 7-18 μm long, 3-4 μm in diameter.
Common.
Plankton, tychoplankton, benthic flocculum, and sludge (this plant was not found attached in our samples).
Pl. 4, Fig. 7.

Protoderma Kützing

**Protoderma viride* Kützing 1843.
Prescott. 1962: 123, Pl. 9, Fig. 10, and Pl. 14, Fig. 10.
Cells 8-10 μm long, 4-5 μm in diameter.
Common.
Epiphytic on *Elodea*.
Pl. 4, Figs. 8 and 9.

Coleochaetaceae

Coleochaete Brébisson

**Coleochaete orbicularis* Pringsheim 1860.
Prescott. 1962: 129, Pl. 18, Figs. 3-5.
Cells about 20 μm long, 10 μm in diameter, and thallus up to 120 μm in diameter.
Common.
Epiphytic on *Elodea* and *Rhizoclonium crassipellitum*.
Pl. 4, Fig. 5.

Oedogoniales

Oedogoniaceae

Bulbochaete Agardh

Bulbochaete sp.

Plants were observed only in the vegetative condition.

Very common.

Fragments were found in every habitat.

Oedogonium Link

Oedogonium spp.?

The lack of adequate reproductive structures left species identification(s) in doubt.

Very common in most habitats.

Siphonocladales

Cladophoraceae

Rhizoclonium Kützing

*Rhizoclonium crassipellitum West and West 1897.

Prescott. 1962: 141, Pl. 23, Fig. 1.

Cells (80)-125-185 µm long, 40-50 µm in diameter. Cell walls 5-9 µm thick. The alga did not attain Prescott's larger dimensions and it was in soft water, whereas Prescott reported it in hard water lakes.

Common.

Tychoplankton and as a floating mat (6 x 8 meters).

Pl. 4, Fig. 13.

Zygnematales

Zygnemataceae

Mougeotia Agardh

Mougeotia spp.

Lack of mature reproductive structures made these plants impossible to identify to species.

Common.

Spirogyra Link

Spirogyra gracilis (Hass.) Kützing 1849.

Prescott. 1962: 315, (not illustrated).

Hylander. 1928: 109, Pl. 17, Figs. 12 and 13.

Cells 50-150 µm long, 28-30 µm in diameter. Zygospore 42-44 µm long, 23-25 µm in diameter. They closely followed Prescott's description except the cells had a greater diameter, and the zygospores had a slightly smaller

diameter. Reproductive structures were rare.
Common.
Plankton.
Pl. 5, Figs. 13 and 14.

Zygnema Agardh

Zygnema spp.
They lacked the reproductive structures necessary for species determination.
Common.
Within a floating mat of Oedogonium sp.

Mesotaeniaceae

Cylindrocystis Meneghini

Cylindrocystis brebissonii Meneghini 1838.
Prescott, Croasdale, and Vinyard. 1972: 20, Pl. 2, Figs. 1-5.
L. 32-43 µm, W. 14-15 µm.
Rare.
Sludge.
Pl. 18, Figs. 4 and 5.

Gonatozygon de Bary

*Gonatozygon aculeatum Hastings 1892.
Prescott, Croasdale, and Vinyard. 1972: 33, Pl. 8, Figs. 13-15.
L. 150-269 µm, W. 10-20 µm, Wa. 11-17 µm, Spines 6-6.5 µm.
Common.
Plankton, squeezings of Ranunculus, and sludge.
Pl. 5, Figs. 6 and 7.

*Gonatozygon brebissonii de Bary 1858.
Prescott, Croasdale, and Vinyard. 1972: 34, Pl. 8, Figs. 1-3 and 11.
L. 170-190 µm, W. 7.5-9 µm, Wa. 6 µm.
Very rare.
Benthic flocculum on gravel and tychoplankton (with Oedogonium).
Pl. 5, Fig. 5.

Netrium Nägeli

Netrium digitus (Ehrenb.) Itzigsohn and Roth 1856.
Prescott, Croasdale, and Vinyard. 1972: 24, Pl. 4, Figs. 14-16 and 21.
L. 142-312 µm, W. 42-82 µm.
Very common.
Sludge, seepage, and plankton.
Pl. 6, Fig. 15.

Netrium digitus var. naegelii (Bréb.) Krieger 1935.
Prescott, Croasdale, and Vinyard. 1972: 26, Pl. 5, Figs. 3 and 4.
L. 123 μm, W. 28 μm.
Very rare.
Sludge.
Pl. 6, Fig. 14.

*Netrium interruptum (Bréb.) Lütkemüller 1902.
Prescott, Croasdale, and Vinyard. 1972: 28, Pl. 5, Figs. 17 and 18.
L. 178 μm, W. 40 μm.
Very rare.
Sludge.
Pl. 6, Fig. 16.

Desmidiceae

Closterium Nitzsch

Closterium dianae? Ehrenberg 1838.
Prescott, Croasdale, and Vinyard. 1975: 46, Pl. 23, Figs. 16, 16a, and 17.
L. 192-2-214 μm, W. 20-21 μm, Wa. 3.5-5 μm.
Rare.
Tychoplankton.
Pl. 6, Fig. 11.

Closterium dianae var. minor? Hieronymus 1895.
Prescott, Croasdale, and Vinyard. 1975: 47, Pl. 23, Figs. 8 and 12.
L. 110-154 μm, W. 17.5-25 μm, Wa. 3-6 μm.
Rare.
Seepage and with Tetraspora lamellosa.
Pl. 6, Fig. 12.

Closterium gracile Brébisson 1839.
Prescott, Croasdale, and Vinyard. 1975: 52, Pl. 16, Figs. 2, 15, and 16.
L. 186-208 μm, W. 7-8 μm, Wa. 2.5-3 μm.
Benthic flocculum.
Rare.
Pl. 6, Figs. 3 and 4.

Closterium intermedium Ralfs 1848.
Prescott, Croasdale, and Vinyard. 1975: 54, Pl. 29, Figs. 10, 10a, and 11.
L. 245-275 μm, W. 15-16 μm, Wa. 6-7 μm.
Common.
Benthic flocculum and sludge.
Pl. 6, Fig. 10.

Closterium jenneri Ralfs 1848.
Prescott, Croasdale, and Vinyard. 1975: 55, Pl. 23, Figs. 4 and 10.
L. 69-100 µm, W. 10-15 µm, Wa. 2.5-3 µm.
Rare.
Benthic flocculum and sludge.
Pl. 6, Fig. 13.

Closterium libellula Focke 1847.
Prescott, Croasdale, and Vinyard. 1975: 60, Pl. 12, Fig. 12.
L. 242 µm, W. 38 µm, Wa. 16 µm.
Very rare.
Sludge.
Pl. 6, Fig. 1.

Closterium lunula forma *gracilis* Messikommer 1935.
Prescott, Croasdale, and Vinyard. 1975: 66, Pl. 14, Fig. 15.
L. 420-590 µm, W. 80-100 µm, Wa. 20-21.5 µm.
Very common.
Benthic flocculum, tychoplankton, and sludge.
Pl. 6, Fig. 9.

Closterium macilentum var. *japonicum* (Sur.) Grönblad 1926 forma.
Prescott, Croasdale, and Vinyard. 1975: 68, Pl. 22, Fig. 11.
L. 480-550 µm, W. 35-40 µm, Wa. 7-9 µm.
Common.
Plankton and sludge.
Pl. 6, Figs. 5 and 6.

Closterium rostratum Ehrenberg 1832.
Prescott, Croasdale, and Vinyard. 1975: 83, Pl, 31, Figs. 3 and 12.
L. 312 µm, W. 21 µm, Wa. 4 µm.
Rare.
Benthic flocculum on gravel shore.
Pl. 6, Figs. 7 and 8.

Closterium striolatum Ehrenberg 1832.
Prescott, Croasdale, and Vinyard. 1975: 87, Pl. 27, Figs. 1, 3, 10 (fa.), and 14, and Pl. 28, Fig. 4.
L. 247-320 µm, W. 30-55 µm, Wa. 10-22 µm. An unusual form of the species was also found in sludge sample 17.14 from Lake 2 containing numerous *Closterium* identical to *C. striolatum* except for the large numbers of axial pyrenoids, 9-25 per chloroplast.
Very common.
Sludge and benthic flocculum.
Pl. 6, Fig. 2.

Cosmarium Corda

Many species of *Cosmarium* were transferred to the genus *Actinotaenium* by Teiling (1954). Since his nomenclature has been accepted by many students of the desmids, both names, where applicable, are given in this text.

*Cosmarium abbreviatum Racib. forma minor West and West 1908.
West and West. 1908: 85, Pl. 72, Fig. 12.
L. 10 µm, W. 12 µm, Th. 5.5 µm, Isth. 4 µm. It was slightly larger than the Wests'. Krieger and Gerloff (1965), showed a name change to C. abbreviatum Racib. forma minus along with their illustration, but did not include a description (this is to follow in a forthcoming Part 3).
Very rare.
Sludge.
Pl. 7, Fig. 10.

Cosmarium amoenum Brébisson 1849.
West and West. 1912: 29, Pl. 102, Figs. 1-4, and Pl. 103, Fig. 9.
L. 57-58 µm, W. 31-33 µm, Th. 30 µm, Isth. 16-18 µm.
Common.
Moss squeezings and wet soil.
Pl. 10, Fig. 2.

*Cosmarium angulosum Brébisson 1856.
Krieger and Gerloff. 1965: 190, Pl. 37, Fig. 13.
L. 17 µm, W. 12.5 µm, Isth. 4 µm.
Rare.
Squeezings of Elodea and benthic flocculum.
Pl. 8, Fig. 14.

*Cosmarium askenasyii Schmidle var. americana Carter 1935.
Carter. 1935: 160, Figs. 43-45.
L. 82-92 µm, W. 66-74 µm, Th. 43 µm, Isth. 24-28 µm.
Rare.
Wet soil.
Pl. 9, Fig. 10.

Cosmarium bioculatum Brébisson 1835.
West and West. 1905: 165, Pl. 61, Figs. 3-7.
L. 24-25 µm, W. 18-20 µm, Th. 11-13 µm, Isth. 6.5-7 µm. They were slightly larger than the Wests'.
Common.
Net tow through 15 centimeters of water. Note: Most of the numerous desmids in this net tow sample had strands of mucilage extending out from their pores as illustrated on Pl. 8, Fig. 12.
Pl. 8, Figs. 7 and 12.

*Cosmarium bipunctatum Börge. 1890.
West and West. 1908: 213, Pl. 85, Fig. 6.
L. 22-24 µm, W. 19-22 µm, Th. 15-16 µm, Isth. 6-8 µm. Ours was longer than wide.
Common.
Benthic flocculum and epilithic with Tetraspora lamellosa.
Pl. 11, Fig. 8.

Cosmarium botrytis var. tumidum Wolle 1892. forma?
There are noteworthy variations in several reports of this plant

including my own. Wolle's plant, as originally described, apparently had a central swelling on the face of the semicell and larger granules in the central area. West and West (1912) noted, "often with one large granule adjacent to the isthmus", otherwise similar to Wolle's plant. Croasdale's (1956) plant lacked the central swelling but had a basal granule. Wade (1957) formed a new taxon, C. botrytis var. tumidum forma nudum, which was similar to Croasdale's plant and mine. Not having seen Wolle or Wade's descriptions I hesitate to assign this plant to a specific taxon. The following description will suffice until more information becomes available.

L. 70-77 µm, W. 55-62 µm, Th. 34-36 µm, Isth. 13-16-(19) µm. The semicells were semi-circular, with slightly flattened apices, were circular to broadly oval in side view, and were elliptic with sides parallel in end view. Granules were in more or less concentric series within the margin, becoming larger and scattered in the central area. The cell wall lacked granules on the apex and on both sides of the central area, and was punctate everywhere except smooth areas on the face of the semicell. The basal granule was always present.

Very common.
Found in most habitats.
Pl. 9, Fig. 3.

*Cosmarium connatum Brébisson 1848.
West and West. 1908: 25, Pl. 67, Figs. 15-17.
L. 73 µm, W. 51 µm, Isth. 38 µm.
Very rare.
Benthic flocculum.
Pl. 11, Fig. 11.

*Cosmarium contractum var. ellipsoideum (Elfv.) West and West 1905.
West and West. 1905: 172, Pl. 61, Figs. 28 and 35.
Prescott and Scott. 1952: 8, Fig. 3, No. 8.
L. 36-40 µm, W. 29-32 µm, Th. 21 µm, Isth. 9.5-11 µm. Wall was delicately punctate.
Common.
Net tow through 15 centimeters of water and sludge.
Pl. 8, Fig. 8.

Cosmarium crenatum Ralfs 1844.
West and West. 1912: 35, Pl. 98, Figs. 9-12.
L. 36 µm, W. 32 µm, Th. 23 µm, Isth. 7 µm.
Common.
Sludge.
Pl. 10, Fig. 5.

*Cosmarium cymatonotophorum W. West var. granulatum Grönblad.
G. W. Prescott (personal correspondence).
L. 15 µm, W. 14 µm, Th. 12 µm, Isth. 7.5 µm. The central protuberance was more pronounced than in the type. The granules were flat and difficult to see.
Very rare.
Sludge.

Pl. 11, Fig. 6.

*Cosmarium difficile Lütkem. var. dilatatum Börge forma nov.
G. W. Prescott (personal correspondence).
L. 25-29 μm, W. 16-18 μm, Th. 10-11 μm, Isth. 4.5 μm. They lacked the two transverse series of wall pits characteristic of the variety. Wall had minute, dense punctae.
Rare.
Sludge.
Pl. 8, Figs. 1 and 2.

Cosmarium formulosum Hoff 1888.
West and West. 1908: 240, Pl. 88, Figs. 1-3.
L. 40-43 μm, W. 35-39 μm, Th. 22 μm, Isth. 10-14 μm. Granulation was variable due to frequent fusion of granules. Central protuberance had 3-5 vertical rows of granules, subtended by a curved row of 5 granules. Punctae were sometimes present between the granules on the central protuberance.
Common.
Squeezings of Ranunculus, epilithic, and plankton.
Pl. 11, Figs. 9 and 10.

*Cosmarium globosum Bulnheimi 1861.
(Actinotaenium subglobosum (Nordst.) Teiling 1954.)
West and West. 1908: 29, Pl. 68, Figs. 1 and 2.
L. 32-37 μm, W. 20-21 μm, Isth. 17-17.5 μm.
Common.
Sludge and benthic flocculum.
Pl. 7, Fig. 1.

*Cosmarium hammeri Reinsch 1867.
West and West. 1905: 181, Pl. 62, Figs. 20 and 21.
L. 30-33 μm, W. 23-26 μm, Th. 14-15 μm, Isth. 7.5-8 μm. The form was smaller than the Wests' which measured 40-50 μm x 27-35 μm.
Rare.
Sludge.
Pl. 7, Fig. 12.

*Cosmarium humile? (Gay) Nordst. var. striatum (Boldt) Schmidle 1895.
Taylor. 1934: 254, Pl. 51, Figs. 27-29.
West and West. 1908: 223, Pl. 85, Figs. 21 and 22.
L. 14 μm, W. 13 μm, Isth. 4-5 μm. Assignment to this species was questionable due to the lack of an undulate apex, but Taylor (1934) noted a reduction of this feature on his smaller forms.
Rare.
Benthic flocculum and tychoplankton.
Pl. 8, Fig. 6.

Cosmarium impressulum Elfving 1881. ∝
Krieger and Gerloff. 1965: 133, Pl. 29, Fig. 4.
L. 31 μm, W. 20 μm, Th. 14 μm, Isth. 8 μm.
Rare.
Squeezings of moss.

Pl. 7, Fig. 5.

Cosmarium impressulum Elfving 1881. β
Krieger and Gerloff. 1965: 133, Pl. 29, Fig. 4.
L. 17-20 μm, W. 13-15 μm, Th. 10 μm, Isth. 5 μm. The dimensions of this form and ∞ above were within the limits of the type. These, however, based on cell dimensions, formed two distinct groups without intermediates.
Rare.
Seepage and squeezings of Elodea.
Pl. 7, Fig. 7.

Cosmarium intermedium Delponte 1877.
West and West. 1908: 138, Pl. 76, Fig. 10.
L. 58-63 μm, W. 50-58 μm, Isth. 15-17 μm.
Rare.
Epilithic with Tetraspora lamellosa.
Pl. 10, Figs. 3 and 4.

*Cosmarium laeve Rabenhorst var. nov.?
West and West. 1908: 99, Pl. 73, Figs. 8-19.
L. 22 μm, W. 18 μm, Th. 9 μm, Isth. 6 μm. Cells were about 1 1/4 times as long as broad; semicells were semi-oblong, the apex was narrowly truncated and retuse as in the type, and sparsely punctate. The side view of the semicell was sub-ovate, and the apex was narrower than the base. The vertical view was elliptic. They differed from the type by the presence of a central pore.
Rare.
Benthic flocculum.
Pl. 7, Fig. 8.

*Cosmarium margaritatum (Lund.) Roy and Biss. forma subrotundata West and West 1912.
West and West. 1912: 19, Pl. 100, Fig. 1.
L. 70 μm, W. 56 μm, Th. 38 μm, Isth. 22 μm.
Rare.
Wet soil.
Pl. 10, Fig. 1.

*Cosmarium novae-semliae var. granulatum Schmidle 1898.
Croasdale. 1956: 42, Pl. 8, Fig. 9.
L. 18-19 μm, W. 17-19.5 μm, Th. 12 μm, Isth. 8 μm.
Rare.
Sludge and squeezings of moss.
Pl. 11, Fig. 5.

*Cosmarium ornatum var. perornatum Grönblad 1948.
Croasdale and Grönblad. 1964: 183, Pl. 13, Figs. 26 α27.
L. 35-40 μm, W. 35-38.5 μm, Th. 23 μm, Isth. 12-13 μm.
Rare.
Benthic flocculum and sludge.
Pl. 9, Fig. 1.

Cosmarium portianum Archer 1860.
West and West. 1908: 165, Pl. 80, Figs. 4-7.
L. 35-38 µm, W. 26-28 µm, Th. 20 µm, Isth. 10-12 µm.
Common.
Benthic flocculum and sludge.
Pl. 9, Fig. 5.

*Cosmarium pseudoarctoum Nordstedt 1879.
[Actinotaenium cruciferm (de Bary) Teiling 1954.]
West and West. 1908: 32, Pl. 118, Figs. 12-14, and Pl. 122, Figs. 40 and 41.
L. 22-23 µm, W. 15-16 µm, Isth. 13.5-14 µm.
Rare.
Sludge in Carex marsh.
Pl. 7, Fig. 6.

*Cosmarium pseudoprotuberans forma minus Kossinskaja 1936.
Croasdale. 1956: 47, Pl. 10, Fig. 5.
Hirano. 1968: 27, Pl. 5, Figs. 10-13 and 16.
L. 20 µm, W. 20.5 µm, Th. 10 µm, Isth. 7 µm.
Rare.
Plankton.
Pl. 8, Fig. 10.

*Cosmarium pseudopyramidatum Lund. var extensum (Nordst.) Gerloff 1965.
Krieger and Gerloff. 1965: 127, Pl. 26, Fig. 8.
L. 69-74 µm, W. 37-42 µm, Th. 25 µm, Isth. 15-16 µm. Most specimens closely fit the published description but several cells had a depressed apex as in var. excavatum.
Common.
Sludge and wet soil.
Pl. 8, Figs. 4 and 5.

*Cosmarium pseudoquadratulum Prescott and Scott 1952.
Prescott and Scott. 1952: 11, Fig. 5, No. 12.
L. 15-17.5 µm, W. 13-13.2 µm, Th. 7-8 µm, Isth. 3 µm.
Rare.
Sludge.
Pl. 7, Fig. 11.

Cosmarium pyramidatum Brébisson 1848.
Krieger and Gerloff. 1965: 121, Pl. 25, Fig. 3.
L. 70-74 µm, W. 38-48 µm, Th. 28 µm, Isth. 15-17 µm.
Cells had 1-3 pyrenoids per semicell.
Common.
Sludge and seepage.
Pl. 7, Figs. 3 and 4.

*Cosmarium quadratum Ralfs forma willei West and West 1908.
West and West. 1908: 59, Pl. 87, Figs. 21 and 22.
L. 52-61 µm, W. 28-33 µm, Isth. 16-20 µm.
Common.

Moss squeezings.
Pl. 8, Fig. 9.

*Cosmarium quinarium Lundell 1871.
West and West. 1908: 216, Pl. 85, Figs. 9 and 10.
L. 47-50 μm, W. 36-40 μm, Isth. 9-12 μm. Ours differed from the Wests' by having numerous small punctations about the central granules.
Common.
Sludge.
Pl. 9, Fig. 4.

*Cosmarium rectangulare Grun. var. hexagonium (Elfv.) West and West 1908.
West and West. 1908: 56, Pl. 80, Fig. 4.
L. 26-30 μm, W. 21-24 μm, Th. 14 μm, Isth. 7-9 μm.
Common.
Net tow in 15 centimeters of water, sludge, and net tow in Elodea.
Pl. 7, Fig. 2.

Cosmarium reniforme (Ralfs) Archer 1874.
West and West. 1908: 157, Pl. 79, Figs. 1 and 2, and Pl. 82, Fig. 15.
L. 45-49 μm, W. 40-42.5 μm, Th. 24 μm, Isth. 12-14 μm.
Common.
Squeezings of Elodea, squeezings of Ranunculus, and epilithic.
Pl. 9, Fig. 6.

*Cosmarium sexangulare Lundell 1871.
West and West. 1908: 81, Pl. 72, Fig. 3.
Prescott and Vinyard. 1965: 467, Pl. 11, Fig. 26.
L. 33-34 μm, W. 25-27 μm, Isth. 8 μm.
Rare.
Sludge and epilithic with Tetraspora lamellosa.
Pl. 7, Fig. 13.

*Cosmarium sexnotatum Gutw. var. tristriatum (Lütkem.) Schmidle 1895.
West and West. 1908: 228, Pl. 86, Figs. 8 and 9.
L. 17-18 μm, W. 17-19 μm, Th. 11 μm, Isth. 5-6 μm.
Common.
Benthic flocculum on gravel, sludge, and tychoplankton.
Pl. 11, Figs. 3 and 4.

*Cosmarium subarctoum (Lagerh.) Raciborski 1892.
Kreiger and Gerloff. 1962: 69, Pl. 16, Fig. 8.
L. 15 μm, W. 11-11.5 μm, Th. 7.5 μm, Isth. 8 μm.
Rare.
Sludge.
Pl. 7, Fig. 9.

Cosmarium subcrenatum Hantz. var. isthmochondrum Messikommer 1938.
Croasdale. 1973: 105, Pl. 16, Figs. 18-20.
L. 27.5-33 μm, W. 25-28.5 μm, Th. 17 μm, Isth. 7.5-10 μm.
Apex was smooth except for a few small scattered granules.
Common.

Plankton, tychoplankton, sludge, and benthic flocculum.
Pl. 9, Fig. 2, and Pl. 11, Figs. 1 and 2.

Cosmarium subspeciosum var. validius Nordst. 1887.
Croasdale and Grönblad. 1964: 187, Pl. 15, Figs. 1-3.
L. 72-79 µm, W. 48-59 µm, Th. 35-38 µm, Isth. 18-20 µm. These were quite similar to Croasdale and Grönblad's form.
Common.
Benthic flocculum and sludge.
Pl. 10, Figs. 8-11.

There apparently was a second form, larger than the first, lacking apical granules, and with 9 vertical series of granules on the central tumor.
L. 84-92 µm, W. 53-69 µm, Th. 42 µm, Isth. 20-22 µm.
Common.
Benthic flocculum on gravel shore.
Pl. 10, Figs. 6 and 7.

*Cosmarium subtumidum Nordst. var. minutum (Krieger) Krieger and Gerloff 1965.
Krieger and Gerloff. 1965: 164, Pl. 34, Fig. 4.
L. 16.5 µm, W. 14 µm, Th. 7.5 µm, Isth. 4 µm. Differed from typical variety in smaller L/W ratio. Considered a tropical species by Krieger and Gerloff (1965), who previously reported it in Java, Sumatra, and Brazil.
Very rare.
Epilithic with Tetraspora lamellosa.
Pl. 8, Fig. 13.

*Cosmarium tenue Arch. var. depressum Irénée-Marie 1952.
Irénée-Marie. 1952: 134, Pl. 12, Fig. 11.
Croasdale. 1956: 56, Pl. 5, Fig. 13.
L. 8-10 µm, W. 8-9 µm, Isth. 2.5-3 µm.
Very rare (probably often overlooked).
Plankton and sludge.
Pl. 8, Fig. 11.

*Cosmarium trachypleurum var. fallax Lütkemüller.
G. W. Prescott (personal correspondence).
L. 34 µm, W. 32 µm, Th. 21 µm, Isth. 4.5 µm.
Very rare.
Benthic flocculum.
Pl. 11, Fig.7.

*Cosmarium undulatum Corda ex Ralfs var. minutum Wittrock 1869.
Krieger and Gerloff. 1962: 41, Pl. 11, Fig. 11.
L. 29-34 µm, W. 21-25 µm, Th. 15-17 µm, Isth. 8-10 µm.
Rare.
Sqeezings of moss.
Pl. 8, Fig. 15.

*Cosmarium ungerianum (Näg.) de Bary 1858 forma.
G. W. Prescott (personal correspondence).

Croasdale. 1956: 59, Pl. 12, Figs. 9-14.

L. 55-60 µm, W. 41-47 µm, Th. 30-33 µm, Isth. 13-14 µm. Large, often low granules usually formed 4, sometimes 3 or 5 horizontal rows, each granule ringed with 6 distinct scrobiculations. Scrobiculations were circular, sometimes triangular on the central cell wall. Apex was scattered with scrobiculations or possibly large pores.

Very common.

Benthic flocculum and net tow in 15 centimeters of water.

Pl. 9, Figs. 7-9.

*Cosmarium venustum (Bréb.) Arch. var. excavatum W. West.

Grönblad. 1962: 478, Pl. 102, Fig. 13e.

L. 33-36 µm, W. 24-26 µm, Th. 16 µm, Isth. 7-10 µm.

Rare.

Sludge and wet soil.

Pl. 8, Fig. 3.

Desmidium Agardh

*Desmidium grevillii (Kütz.) de Bary.

Taylor. 1935: 219, Pl. 34, Fig. 11, and Pl. 49, Figs. 4 and 5.

L. 18-19 µm, W. 40-41 µm.

Very rare.

Squeezings of Elodea.

Pl. 5, Fig. 11.

Euastrum Ehrenberg

*Euastrum ansatum Ehrenb. var. pyxidatum Delponte 1876.

Kreiger. 1937: 489, Pl. 58, Fig. 7.

L. 54 µm, W. 27 µm, Isth. 9 µm.

Rare.

Benthic flocculum.

Pl. 13, Fig. 5.

*Euastrum ansatum Ehreb. var. triporum Krieger 1937.

Krieger. 1937: 492, Pl. 59, Fig. 8.

L. 84-90 µm, W. 42-44 µm, Wa. 20 µm, Th. 28 µm, Isth. 13 µm.

Rare.

Sludge.

Pl. 12, Fig. 3.

Euastrum bidentatum Näg. var. speciosum (Boldt) Schmidle 1898.

Krieger. 1937: 603, Pl. 85, Figs. 3-6.

L. 60-70 µm, W. 42-47 µm, Wa. 25 µm, Isth. 9-12 µm.

Common.

Sludge and net tow in 15 centimeters of water.

Pl. 12, Fig. 2.

*Euastrum denticulatum var. angusticeps Grönblad 1921.

Krieger. 1937: 584, Pl. 80, Figs. 18 and 19.
Prescott and Scott. 1945: 236, Pl. 2, Fig. 13.
L. 21.5-23 µm, W. 15.5-18 µm, Wa. 13 µm, Th. 13 µm, Isth. 5 µm. Granulation best fit Prescott and Scott's species description, but the lateral view was of the variety.
Rare.
Sludge and benthic flocculum.
Pl. 12, Fig. 5.

*Euastrum didelta Ralfs 1844.
Krieger. 1937: 517, Pl. 67, Figs. 1-3.
L. 115-128 µm, W. 65-70 µm, Wa. 28-29 µm, Isth. 18 µm.
Rare.
Benthic flocculum on gravel shore.
Pl. 13, Fig. 6.

Euastrum elegans (Bréb.) Kützing 1845.
Krieger. 1937: 591, Pl. 81, Figs. 14-18.
L. 30-33 µm, W. 21-24 µm, Wa. 15 µm, Isth. 4-7 µm.
Common.
Benthic flocculum, squeezings of Ranunculus, and net tow in 15 centimeters of water.
Pl. 13, Fig. 4.

Euastrum gemmatum Bréb. var. taftii Prescott (1977).
Prescott, Croasdale and Vinyard. 1977: 62, Pl. 76, Fig. 22, and Pl. 82, Figs. 3, 5.
L. 48-57 µm, W. 37-40 µm, Isth. 10-11.5 µm.
Rare.
Sludge.
Pl. 13, Figs. 7 and 8.

*Euastrum obesum Joshua 1886.
Krieger. 1937: 495, Pl. 59, Figs. 9 and 10.
L. 51-58 µm, W. 30-34 µm, Wa. 17-18 µm, Th. 17 µm, Isth. 11-12 µm. They were densely and delicately punctate.
Rare.
Sludge.
Pl. 12, Fig. 4.

Euastrum oblongum (Grev.) Ralfs 1844.
Krieger. 1937: 526, Pl. 70, Figs. 3-6.
L. 136-186 µm, W. 68-92 µm, Wa. 40 µm, Th. 42 µm, Isth. 19-28 µm.
Common.
Benthic flocculum on gravel shore, sludge, and wet soil.
Pl. 12, Fig. 1.

*Euastrum verrucosum Ehrenb. var. perforatum Grönblad 1920.
Krieger. 1937: 649, Pl. 95, Fig. 6.
L. 118 µm, W. 106 µm, Wa. 36 µm, Isth. 25 µm. They lacked upper lateral lobes.
Rare.

Benthic flocculum on gravel shore.
Pl. 13, Fig. 1.

Euastrum verrocosum Ehrenb. var. rhomboideum Lundell 1871.
Krieger. 1937: 650, Pl. 96, Fig. 2.
L. 100-120 µm, W. 86-94 µm, Wa. 32 µm, Th. 51 µm, Isth. 20-22 µm . They had pores on the central protuberance.
Common.
Net tow in 15 centimeters of water and benthic flocculum on gravel shore.
Pl. 13, Fig. 2.

*Euastrum verrucosum Ehrenb. var. vallesiacum Viret 1909.
Krieger. 1937: 653, Pl. 96, Fig. 8.
L. 83-90 µm, W. 68-73 µm, Isth. 20-21 µm. Interlobular surfaces were smooth.
Rare.
Seepage.
Pl. 13, Fig. 3.
All three varieties of E. verrucosum were found in the same or similar habitats within Rae Lake 2. Perhaps the validity of these varieties should be re-examined.

Micrasterias Agardh

Micrasterias americana (Ehrenb.) Ralfs 1848.
West and West. 1905: 116, Pl. 53, Figs. 1-3.
L. 168-170 µm, W. 150-153 µm, Wa. 76-78 µm, Isth. 26-30 µm. They were larger than the Wests' in all dimensions.
Rare.
Benthic flocculum and benthic flocculum on gravel shore.
Pl. 12, Fig. 8.

*Micrasterias conferta Lundell 1871.
West and West. 1905: 88, Pl. 43, Figs. 4-8.
L. 96-110 µm, W. 77-85 µm, Isth. 21-25 µm. Some cells with apparent concretions of mucilage, affected both semicells.
Rare.
Sludge.
Pl. 14, Figs. 5 and 6.

*Micrasterias denticulata var. angulosa (Hantzs.) West and West 1902.
West and West. 1905: 107, Pl. 2, Figs. 3 and 4.
L. 262-277 µm, W. 200-214 µm, Th. 60 µm, Isth. 35-37.5 µm. Walls were smooth and non-punctate.
Rare.
Benthic flocculum and sludge.
Pl. 14, Figs. 1 and 8.

*Micrasterias muricata var. tumida West and West 1896.
Krieger. 1937: 75, Pl. 119, Fig. 7.

L. 172 µm, W. 120 µm, Wa. 80-90 µm, Th. 45 µm , Isth. 30 µm. Walls were punctate and the tips of each process had five points. The isthmus was almost twice the width of Krieger's.

Very rare.

Benthic flocculum.

Pl. 14, Fig. 7.

Micrasterias pinnatifida (Kütz.) Ralfs 1848.

West and West. 1905: 80, Pl. 41, Figs. 7-11 and 13.

L. 62-73 µm, W. 58-74 µm, Wa. 39-50 µm, Isth. 15 µm. Lobular attenuations were bluntly granular or sharply extended.

Common.

Seepage and sludge.

Pl. 14, Figs 2 and 3.

*Micrasterias rotata (Grev.) Ralfs 1844.

West and West. 1905: 102, Pl. 48, Figs. 1-6.

L. 250-300 µm, W. 225-273 µm, Isth. 37-40 µm.

Common.

Benthic flocculum and squeezings of Elodea.

Pl. 14, Fig. 4.

*Micrasterias rotata forma evoluta Turner 1893.

West and West. 1905: 104, (not illustrated).

L. 266-292 µm, W. 235-295 µm, Isth. 38-42 µm. They had a tooth on one side of the median emargination and a swelling on the other instead of a tooth on both sides. The tooth on the front side was opposite a swelling on the back side.

Common.

Benthic flocculum on gravel shore and squeezings of Elodea.

Pl. 12, Fig. 6.

Micrasterias truncata var. neodamensis (Braun) Dick 1926.

Prescott and Scott. 1952: 250, Pl. 7, Fig. 5.

L. 110 µm, W. 95 µm, Isth. 23 µm. They were punctate and almost twice the size of Prescott and Scott's (L. 66 µm, W. 65 µm, Isth. 16 µm).

Rare.

Seepage.

Pl. 12, Fig. 7.

Penium Brébisson

*Penium spirostriolatum Barker 1869.

West and West. 1904: 88, Pl. 9, Figs. 1-8.

L. 185 µm, W. (at constriction) 25 µm, Wa. 16 µm.

Very rare.

Sludge.

Pl. 5, Figs. 8 and 9.

Pleurotaenium Nägeli

Pleurotaenium ehrenbergii (Bréb.) de Bary 1858.
Kreiger. 1937: 410, Pl. 42, Figs. 4-8.
L. 515-650 µm, W. (at constriction) 26-47 µm, Wa. 22-27 µm.
Very common.
Benthic flocculum on gravel and squeezings of Ranunculus.
Pl. 5, Figs. 2 and 3.

*Pleurotaenium trabecula var. elongatum Cedergren 1913.
Krieger. 1937: 399, Pl. 40, Fig. 5.
L. 620-700 µm, W. (at constriction) 25-35 µm, Wa. 20-28 µm.
Rare.
Plankton, net tow in Elodea, and epilithic with Nostoc parmelioides.
Pl. 5, Fig. 4.

*Pleurotaenium trabecula (Ehrenb.) Naeg. var. maximum (Reinsch) Roll 1927.
Krieger. 1937: 400, Pl. 40, Fig. 8.
L. 670-800 µm, W. (at constriction) 50-52 µm, Wa. 38-45 µm. Margins were undulate with large basal inflation (70 µm in diameter). Two plants were found; one which may be abnormal had a swollen apex and large inflation (80 µm) above the basal inflation.
Very rare.
Benthic flocculum on gravel.
Pl. 5, Fig. 1.

Spondylosium Brébisson

*Spondylosium planum (Wolle) West and West 1912.
West, West and Carter. 1923: 222, Pl. 160, Figs. 23-25.
L. 8-10 µm, W. 10-13 µm, Th. 5 µm, Isth. 4-6 µm.
Rare.
Sludge in Carex marsh, squeezings of Ranunculus, and net tow in 15 centimeters of water.
Pl. 18, Fig. 7.

*Spondylosium pulchellum Archer 1858.
West, West and Carter. 1923: 227, Pl. 161, Figs. 1-3.
L. 11-13 µm, W. 9-11 µm, Wa. 7-7.5 µm, Isth. 3.5-4.5 µm.
Very rare.
Sludge.
Pl. 18, Fig. 6.

Staurastrum Meyen

Many species of Staurastrum were transferred to the genus Staurodesmus by Teiling (1967). Since his nomenclature has been accepted by many students of the desmids, both names, wherever applicable, are given in this text.

*Staurastrum acarides Nordstedt 1872.
West, West and Carter. 1923: 73, Pl. 140, Figs. 6 and 7.
L. 40 µm, W. 30 µm, Wa. 20 µm, Isth. 15 µm.

Very rare.
Wet soil.
Pl. 16, Fig. 4.

Staurastrum alternans Brébisson 1848.
West and West. 1912: 170, Pl. 126, Figs. 8 and 9.
L. 28-32 μm, W. 32-35 μm, Isth. 10-13 μm. Granules were sharp and distinct.
Common.
Sludge and benthic flocculum on gravel.
Pl. 17, Figs. 9 and 11.

*Staurastrum anatinum Cooke and Wills 1880.
West, West and Carter. 1923: 142, Pl. 147, Fig. 1.
L. 43-50 μm, W. 85-100 μm, Isth. 12 μm. They were similar to the smaller form described by the Wests and Carter.
Common.
Squeezings of Ranunculus, plankton, net tow in creek, and net tow in 15 centimeters of water.
Pl. 16, Figs. 1 and 2.

Staurastrum arctiscon (Ehrenb.) Lundell 1871.
West, West and Carter. 1923: 193, Pl. 157, Fig. 5.
L. (body) 63-66 μm, L. (+ processes) 122-124 μm, W. (body) 43-45 μm, W. (+ processes) 108-130 μm, Isth. 23 μm.
Very common.
Occurred in most habitats.
Pl. 18, Fig. 1.

Staurastrum brebissonii Archer 1861.
West, West and Carter. 1923: 61, Pl. 137, Figs. 4 and 5.
L. (body) 43 μm, W. (body) 47-56 μm, Spines 4-5 μm, Isth. 15 μm.
Rare.
Benthic flocculum on gravel.
Pl. 15, Fig. 13.

*Staurastrum breviaculeatum Smith 1924.
Smith. 1924: 78, Pl. 70, Figs. 10-18.
L. (body) 43-44 μm, W. (body) 38-40 μm, Spines 3-7 μm, Isth. 13-16 μm. Length and number of spines were variable in our material.
Very common.
Sludge and benthic flocculum.
Pl. 17, Figs. 1-3.

Staurastrum brevispinum Brébisson 1848.
(Staurodesmus brevispina (Bréb.) Croasdale 1957.)
Smith. 1924: 68, Fig. 7, A-E.
L. 43 μm, W. 42 μm, Isth. 13 μm.
Rare.
Squeezings of Elodea and plankton.
Pl. 18, Fig. 3.

*Staurastrum crenulatum (Näg.) Delponte 1887.

West, West and Carter. 1923: 110, Pl. 143, Figs. 9-13.
L. 23 µm, W. 37 µm, Isth. 5 µm.
Very rare.
Squeezings of Ranunculus.
Pl. 17, Fig. 10.

Staurastrum cuspidatum Brébisson 1840.
[Staurodesmus cuspidatus (Bréb.) Teiling 1967.]
Smith. 1924: 74, Pl. 68, Figs. 27-34.
L. 22 µm, W. (- spines) 19-20 µm, W. (+ spines) 38-40 µm, Isth. 5 µm, Spines 9-11 µm.
Common.
Benthic flocculum.
Pl. 17, Fig. 8.

Staurastrum dickiei Ralfe var. circulare Turner 1893.
[Staurodesmus convergens var. laportei Teiling 1967.]
West, West and Carter. 1923: 5, Pl. 124, Fig. 16.
L. 30 µm, W. 33 µm, Isth. 11 µm.
Very rare.
Seepage into Lake 2.
Pl. 15, Fig. 4.

*Staurastrum grande Bulnh. var. angulosum Grönblad 1920.
[Staurodesmus grandis (Bulnh.) Teiling 1967.]
Grönblad. 1920: 66, Pl. 3, Figs. 107 and 108.
L. 44-45 µm, W. 40-43 µm, Isth. 13-19 µm. They were smaller than Grönblad's and the cell wall was thickened at the basal angles.
Common.
Sludge.
Pl. 15, Fig. 6.

Staurastrum kurilense Okada 1924.
Vinyard. 1951: 44, Pl. 11, Figs. 3 and 4.
Carter. 1935: 171, Figs. 12 and 13.
L. 36 µm, W. 32 x 60 µm, Isth. 12 µm. They were sparsely punctate. Carter reported this plant as Staurastrum natator West var. rhomboideum. Vinyard noted that Okada's description had priority.
Rare.
Sludge and benthic flocculum.
Pl. 17, Figs. 6 and 7.

Staurastrum kurilense fa. triquetra Carter 1935.
Vinyard. 1951: 45, Pl. 11, Fig. 5.
Carter. 1935: 171, Figs. 33 and 34.
L. 46 µm, W. 43-46 µm, Isth. 14 µm. Vinyard (1951) noted that, "this is a 3-angled form of the species figured by Wailes (1930b), and described by Carter as a form of St. natator". See St. kurilense above. Mine differed in the number and position of the apical verrucose processes, with 9 instead of 6, 1 above each short lateral process and 2 above each long lateral process. Cell wall was sparsely punctate.
Very rare.

Benthic flocculum.
Pl. 17, Figs. 4 and 5.

Staurastrum margaritaceum (Ehrenb.) Meneghini 1840.
West, West and Carter. 1923: 131, Pl. 150, Figs. 5-9.
L. 33 µm, W. 29-34 µm, Isth. 10 µm.
Very rare.
Benthic flocculum on gravel shore.
Pl. 15, Fig. 14.

*Staurastrum orbiculare Ralfs 1845.
West and West. 1912: 155, Pl. 124, Figs. 10 and 11.
L. 45-48 µm, W. 28-37 µm, Isth. 11-12 µm.
Rare.
Sludge and benthic flocculum.
Pl. 15, Fig. 9.

*Staurastrum pachyrhynchum Nordstedt 1875.
[Staurodesmus pachyrhynchus (Nordst.) Teiling 1963.]
West and West. 1912: 151, Pl. 121, Figs. 8 and 9.
L. 33-35 µm, W. 27-30 µm, Isth. 10-11 µm.
Common.
Sludge.
Pl. 15, Fig. 7.

*Staurastrum polonicum Raciborski 1884.
G. W. Prescott (personal correspondence).
L. 40-43 µm, W. 28-32 µm, Isth. 18-20 µm. Plants were 7 or 8 angled.
Common.
Squeezings of moss and wet soil.
Pl. 15, Fig. 10.

*Staurastrum polymorphum Brébisson 1848.
West, West and Carter. 1923: 125, Pl. 142, Fig. 24, and Pl. 143, Figs. 1-3.
L. 20-22 µm, W. 27-28 µm, Isth. 7.5 µm.
Rare.
Sludge and epilithic.
Pl. 15, Fig. 12.

*Staurastrum punctulatum Brébisson 1848.
Prescott and Scott. 1951: 64, Fig. 14, No. 18.
West and West. 1912: 179, Pl. 127, Figs. 8-11, 13, and 14.
L. 30-34 µm, W. 32-40 µm, Isth. 10-12 µm. Granules were flattened.
Common.
Benthic flocculum on gravel shore and sludge in Elodea.
Pl. 15, Fig. 11.

*Staurastrum punctulatum Bréb. var. kjellmani Wille 1879.
West and West. 1912: 182, Pl. 127, Figs. 13, 17-19, 21, and 22.
L. 32.5-43 µm, W. 29-38 µm, Isth. 12-17.5 µm. The semicells were 3 and 4-angled and the 4-angled forms were larger.

Common.
Epilithic, benthic flocculum, and benthic flocculum on gravel shore.
Pl. 16, Figs. 3, 5, and 6.

*Staurastrum pyramidatum West and West forma nov.?
G. W. Prescott (personal correspondence).
L. 43-50 µm, W. 46-47 µm, Isth. 11-12 µm. Differed from the type in smaller dimensions; angles were more sharply rounded, slightly incurved, and smooth tipped. Granules were short and blunt at base and angles of semicell, becoming longer to form sharp conical spines towards the apex.
Rare.
Seepage and sludge.
Pl. 15, Fig. 8.

Staurastrum sebaldii var. ornatum Nordstedt 1873.
West, West and Carter. 1923: 167, Pl. 148, Fig. 7.
Sieminska. 1965: 117, Pl. 7, Figs. 18-20.
L. 80-90 µm, W. 105-150 µm, Isth. 23-24 µm. Three and 4-angled forms were present.
Common.
Net tow in 15 centimeters of water.
Pl. 16, Figs. 7, 8, and 10.

*Staurastrum spongiosum Brébisson 1848.
West, West and Carter. 1923: 76, Pl. 140, Fig. 14.
L. 52 µm, W. 45-48 µm, Isth. 13-16 µm.
Very rare.
Sludge and squeezings of moss.
Pl. 15, Figs. 1-3.

*Staurastrum subavicula W. and G. S. West 1894.
West, West and Carter. 1923: 181, Pl. 155, Fig. 10.
L. about 34 µm(- spines), L. about 42 µm(+ spines), W. 33 µm, Isth. 12 µm. Differed from the type in 4 series of granules on angles instead of 2, angles tipped with 3-4 spines instead of 2, and center of apex was punctate.
Very rare.
Sludge.
Pl. 15, Fig. 5.

Staurastrum vestitum Ralfs 1848.
West, West and Carter. 1923: 258, Pl. 151, Figs. 9-11, and Pl. 152, Figs. 5 and 6.
L. 35-42 µm, W. 56-60 µm, Isth. 11-13 µm.
Common.
Benthic flocculum.
Pl. 16, Fig. 9.

Tetmemorus Ralfs

*Tetmemorus Laevis (Kütz.) Ralfs 1848.
West and West. 1904: 222, Pl. 32, Figs. 11-16.

L. 83-84 μm, W. 26 μm, Isth. 23 μm.
Very rare.
Wet soil.
Pl. 6, Fig. 17.

Xanthidium Ehrenber

*Xanthidium subhastiferum West 1892.
West and West. 1912: 56, Pl. 106, Figs. 5-9.
L. (- spines) 50-56 μm, L. (+ spines) 60-66 μm, W. (- spines) 50-52 μm, W. (+ spines) 81-96 μm, Th. 28-30 μm, Isth. 11.5-14.5 μm. Cells with 3 pairs of spines per semicell reached a maximum length of 96 μm.
Very common.
Plankton, benthic flocculum, tychoplankton, and sludge.
Pl. 18, Fig. 2.

Charales

Characeae

Nitella Agardh

Nitella sp.
Mature reproductive structures were lacking. This plant was introduced in 1919 for the purpose of establishing a rainbow trout fishery (Coleman 1925).
Benthic, fringing beds of Elodea nuttalii at depths less than 1 meter.

EUGLENOPHYTA

Euglenales

Euglenaceae

Euglena Ehrenberg

Euglena spirogyra var. marchica Lemmerman.
Johnson. 1944: 112, Fig. 11-D.
Cells 150 μm long, 23 μm wide, spine 15 μm long. Determination based on external characteristics only.
Very rare.
Sludge.
Pl. 4, Fig. 4.

Lepocinclis Perty

Prescott. 1962: 406, Pl. 89, Figs. 7 and 15.

Cells 60 µm long, 39 µm in diameter. They had two large paramylon rings and unlike Prescott's, had typical spiral striations.

Very rare.

Epilithic with Tetraspora lamellosa.

Pl. 4, Fig. 6.

Lepocinclis fusiformis (Carter) Lemmermann 1901.

Prescott. 1962: 406, Pl. 89, Figs. 1-4.

Cells 31 µm long, 22 µm in diameter with 2 U-shaped paramylon bodies on opposite sides of the cell, broadly ovate, without a caudus. Flagellum extended through a truncated apical protrusion. Periplast had striations gently spiralling to the left.

Rare.

Sludge.

Pl. 4, Fig. 14.

*Lepocinclis fusiformis var. major Fritisch and Rich 1930.

Phacus Dujardin

Phacus sp.

Cells 26 µm long, 20 µm wide, broadly ovoid, with a short caudus angling slightly to the right (as seen in ventral view). Caudus 4 µm long. Periplast had very fine spiral striations. Paramylon was in the form of 10 rings. Flagellum was 1 1/2 times as long as the cell.

Very rare.

Sludge.

Pl. 4, Fig. 11.

Trachelomonas Ehrenberg

Trachelomonas bacillifera Playf. var. minima Playfair.

Huber-Pestalozzi. 1955: 303, Fig. 556.

Test about 23 µm long, 16-19 µm in diameter. Test broadly oval and brown. Flagellum aperture had a very short collar. Wall was densely covered with stout, blunt spines.

Rare.

*Trachelomonas horrida Palmer 1905.

Prescott. 1962: 415, Pl. 84, Fig. 1.

Test 40 µm long, 25 µm in diameter.

Very rare.

Sludge.

Pl. 4, Fig. 10.

*Trachelomonas lacustris Drezepolski 1925.

Prescott. 1962: 415, Pl. 83, Figs. 14 and 15, and Pl. 85, Fig. 15.

Test 27 µm long, 14 µm in diameter.

Very rare.

Sludge.

Pl. 4, Fig. 16.

Sludge.
Pl. 4, Fig. 17.

PYRROPHYTA

Dinokontae

Peridinium Ehrenberg

Peridinium willei Huitfeld-Kaas 1900.
Prescott. 1962: 434, Pl. 91, Figs. 22-25.
Cells 50-60 μm long, 52-60 μm wide, 40-45 μm thick.
Very common.
Plankton and tychoplankton.
Pl. 4, Fig. 15.

CHRYSOPHYTA

Mischococcales

Chlorobotrydaceae

Ducellieria Teiling

*Ducellieria chodatii (Ducell.) Teiling.
Bourrelly. 1968: 197, Pl. 39, Fig. 7, and Pl. 40, Fig. 1.
Cells 12-16 μm long (- spine), 11 μm in diameter, spine 5-6 μm long. Colonies of 9 and 16 cells were observed, 45 μm and 68 μm in diameter respectively.
Very rare.
Benthic flocculum.
Pl. 5, Figs. 10 and 15.

Ochromonadales

Dinobryaceae

Dinobryon Ehrenberg

*Dinobryon cylindricum Imhof 1883.
Prescott. 1962: 378, Pl. 107, Fig. 1.
Lorica 40-50 μm long, mouth 7-12 μm in diameter.

Rare.
Plankton and tychoplanton.
Pl. 5, Fig. 12.

CYANOPHYTA

Chroococcales

Chroococcaceae

<u>Aphanocapsa</u> Nägeli

*<u>Aphanocapsa</u> <u>elachista</u> var. <u>conferta</u> West and West 1912.
Prescott. 1962: 453, Pl. 101, Figs. 10 and 11.
Cells 1.5-2 µm in diameter. Colonies up to 110 µm in diameter.
Common.
Tychoplankton and benthic flocculum.
Pl. 19, Fig. 2.

*<u>Aphanocapsa</u> <u>pulchra</u> (Kütz.) Rabenhorst 1865.
Prescott. 1962: 454, Pl. 101, Fig. 14.
Cells 3-4 µm in diameter.
Rare.
Plankton in seepage.
Pl. 19, Fig. 3.

<u>Aphanothece</u> Nägeli

<u>Aphanothece</u> <u>stagnina</u> (Spreng.) Braun 1865.
Desikachary. 1959: 137, Pl. 21, Fig. 10.
Prescott. 1962: 469, Pl. 103, Figs. 14-16.
Cells 5-6.5 µm long, 3-3.5 µm in diameter. Colonies microscopic.
Common.
Benthic flocculum and sludge.
Pl. 19, Fig. 1.

<u>Chroococcus</u> Nägeli

*<u>Chroococcus</u> <u>prescottii</u> Drouet and Daily 1942.
Prescott. 1962: 450, Pl. 100, Fig. 13.
Cells 5-8 µm in diameter. Colonies were of 2, 4, 8, rarely 16 and 32 cells. Larger colonies were in loose groups of 8 cells.
Common.
Tychoplankton, sludge, and benthic flocculum.
Pl. 19, Fig. 4.

<u>Chroococcus</u> <u>turgidus</u> (Kütz.) Nägeli 1849.

Prescott. 1962: 450, Pl. 100, Fig. 19.
Cells hemispherical, 8-30 μm in diameter.
Common.
Plankton, tychoplankton, sludge, and benthic flocculum.
Pl. 19, Fig. 5.

Coelosphaerium Nägeli

Coelosphaerium kutzingianum Nägeli 1849.
Prescott. 1962: 470, Pl. 106, Fig. 2.
Cells 2-3.5 μm in diameter.
Rare.
Net tow in 15 centimeters of water.
Pl. 19, Fig. 7.

*Coelosphaerium pallidum? Lemmermann 1898.
Prescott. 1962: 471, Pl. 106, Fig. 3.
Cells 1.5-3 μm in diameter, 3.5-5 μm long. The cells were larger than Prescott's, within the range of C. naegelianum Unger but without pseudovacules and radiating fibrillar concretions. Colonies were spherical, ovate or lobed.
Common.
Benthic flocculum, plankton, and tychoplankton.
Pl. 19, Fig. 6.

Dactylococcopsis Hansgirg

*Dactylococcopsis smithii Chodat and Chodat 1925.
Prescott. 1962: 465, Pl. 105, Figs. 3 and 4.
Cells 8-10 μm long, 2-2.4 μm in diameter, smaller than the type but properly proportioned
Very rare.
Sludge.
Pl. 19, Fig. 10.

Eucapsis Clements and Shantz

*Eucapsis alpina Clements and Schantz var. minor Skuja.
Sieminska. 1965: 99, Pl. 1, Fig. 1.
Cells 2-3 μm in diameter, usually 32 cells in a distinct colony 8 μm x 12 μm x 15 μm, often with several colonies adjoined.
Rare.
Benthic flocculum.
Pl. 19, Fig. 13.

Gloeothece Nägeli

*Gloeothece rupestris ? (Lyngb.) Bornet 1880.

Prescott. 1962: 462, Pl. 103, Figs. 2 and 3.

Cells up to 8 µm long, 2.5-3 µm in diameter. The cells were about half the size of Prescott's, otherwise they followed his description closely.

Plankton.

Pl. 19, Fig. 9.

Merismopedia Meyen

Merismopedia elegans A. Braun 1849.

Prescott. 1962: 459, Pl. 101, Fig. 1.

Cells 7-8 µm long, 4-6 µm in diameter. Colonies seldom had more than 100 cells.

Very common.

Sludge and benthic flocculum.

Pl. 19, Fig. 11.

Microcystis Kützing

Microcystis aeruginosa Kützing 1846.

Prescott. 1962: 456, Pl. 102, Figs. 1-4.

Cells (2.5)-3-4 µm in diameter. Colonies were clathrate except when very small. They lacked pseudovacules, a character usually noted for the species when reported as a euplankter. The colonies were always collected in sludge and benthic flocculum with the exception of one net tow in moving water where the colonies may have been carried into the plankton.

Common.

Benthic flocculum, tychoplankton, squeezings of Elodea and Ranunculus, and sludge.

Pl. 19, Figs. 8 and 12.

Oscillatoriales

Oscillatoriaceae

Lyngbya Agardh

Lyngbya aerugineo-caerulea (Kütz.) Gomont 1892.

Prescott. 1962: 498, Pl. 111, Figs. 10 and 11.

Cells 5 µm in diameter, 2.5-3 µm long. Sheath 6 µm in diameter. Filaments were solitary.

Rare.

Benthic flocculum, plankton, and seepage.

Pl. 20, Fig. 4.

Oscillatoria Vaucher

*Oscillatoria agardhii Gomont 1892.

Desikachary. 1959: 235, (not illustrated).
Prescott. 1962: 484, Pl. 108, Figs. 15 and 16.
Cells 6.5-7 µm in diameter, 2.5-7 µm long. Apical cell was rounded, without a calyptra. Trichomes were scattered.
Common.
Plankton, tychoplankton, sludge, and benthic flocculum.
Pl. 20, Fig. 2.

*Oscillatoria limnetica Lemmermann 1900.
Prescott. 1962: 488, Pl. 109, Fig. 16.
Cells 1.5-2 µm in diameter, 3-5 µm long.
Common.
Tychoplankton.
Pl. 20, Fig. 3.

*Oscillatoria tenuis C. A. Agradh 1813,
Prescott. 1962: 491, Pl. 110, Figs. 8, 9, and 14.
Cells 4-4.5 µm in diameter, 2.5-3 µm long, slightly constricted at the crosswalls. Trichomes were loosely intermingled or scattered.
Common.
Tychoplankton.
Pl. 20, Fig. 5.

*Oscillatoria tenuis var. natans Gomont 1892.
Prescott. 1962: 491, Pl. 110, Figs. 10 and 11.
Cells 9-11 µm in diameter, 2.5-5 µm long, slightly constricted at crosswalls. Trichomes were scattered.
Common.
Tychoplankton and benthic flocculum.
Pl. 20, Fig. 1.

Phormidium Kützing

*Phormidium corium (Agardh) Gomont 1890.
Prescott. 1962: 494, (not illustrated).
Tilden. 1910: 101, Pl. 4, Figs. 71 and 72.
Cells 2.5-6 µm long, 4 µm in diameter. Filaments were parallel, forming compact bundles with ends free bending away from the bundle.
Rare.
Sludge.
Pl. 20, Fig. 6.

Nostocales

Nostocaceae

Anabaena Bory

*Anabaena oscillariodes Bory 1822.
Desikachary. 1959: 417, Pl. 71, Fig. 7.
Cells 4-5 µm long, 3.5-6 µm in diameter. Heterocysts spherical, 6.5-8

µm in diameter. Akinetes 20-37 µm long, 9 µm in diameter, mostly on just one side of the heterocyst.

Sometimes the filament had a watery sheath 14 µm in diameter.

Very common.

Sludge, wet soil, plankton, and benthic flocculum.

Pl. 20, Fig. 13.

*Anabaena sphaerica Bornet and Flahault 1888.

Desikachary. 1959: 393, (not illustrated).

Cells 6.5-8 µm in diameter, spherical, shorter, or longer than wide. Heterocysts spherical, 7.5-8.5 µm in diameter. Akinetes on one or both sides of heterocyst, 8.5-9 µm in diameter, 10 µm long. Filaments were scatterd.

Common.

Seepage and benthic flocculum.

Pl. 20, Fig. 9.

Cylindrospermum Kützing

*Cylindrospermum alatosporum Fritsch 1918.

Desikachary. 1959: 362, Pl. 64, Fig. 9.

Cells 3 µm in diameter, 3.5-7.5 µm long. Heterocysts 3.5-5.5 µm in diameter, 5.5-8 µm long. Akinetes 9-10 µm in diameter, 17-19 µm long, walls thick and punctate with age. Filaments were usually solitary. The cells, like the Indian form, were narrower than the type. Akinete lacked a thick yellowish inner wall.

Rare.

Sludge.

Pl. 20, Fig. 10.

Nostoc Vaucher

*Nostoc parmelioides Kützing 1843.

Desikachary. 1959: 389, Pl. 70, Fig. 3.

Cells 4-7 µm long, 3-5 µm in diameter. Heterocysts 7.5-8.5 µm long, 6.5-8.5 µm in diameter. Thallus lacked central radiating filaments. The arrangement of cells into trichomes varied within the same thallus; cells at periphery of thallus were adjacent to one another forming continuous trichomes with yellow sheaths, interior cells were 1-2 cell diameters apart, forming loose trichomes with very wide sheaths visible only after staining. Colonies were irregularly lobed, macroscopic, forming epilithic expanses.

Common.

Epilithic.

Pl. 20, Figs. 14-16 and 18.

*Nostoc paludosum Kützing 1850.

Desikachary. 1959: 375, Pl. 69, Fig. 2.

Cells 3-5 µm in diameter, 3.5-5 µm long. Heterocysts spherical to slightly ovate, 5-7 µm in diameter. Akinetes ovate 4-5 µm in diameter, 5.5-8 µm long.

Very common.

Plankton, tychoplankton, benthic flocculum, seepage, and sludge.
Pl. 20, Fig. 20.

Scytonemataceae

Scytonema Agardh

*Scytonema mirabile (Dillw.) Bornet 1889.
Prescott. 1962: 535, Pl. 124, Figs. 7 and 8.

Cells 5-16 µm long, 4-6 µm in diameter. Filaments 12-19 µm in diameter. Heterocysts 9-12 µm long, 6-10 µm in diameter. They seldom formed double false branches, diverging lamellations were found rarely and only in older sheaths.

Common.

Tychoplankton, sludge, and benthic flocculum.

Pl. 20, Fig. 19.

Tolypothrix Kützing

*Tolypothrix distorta Kützing 1843.
Prescott. 1962: 537, Pl. 125, Figs. 5 and 6.

Cells 2.5-7 µm long, 7-10 µm in diameter. Sheath sometimes lamellate, 10-17 µm in diameter, old sheaths were as wide as 25 µm in diameter. Heterocysts spherical, to ovate, 9-20 µm long, 9-11 µm in diameter. Presence of a lamellate sheath was inconsistent with the type, otherwise, they agreed.

Common.

Plankton, sludge, tychoplankton, and benthic flocculum.

Pl. 20, Figs. 7 and 8.

Rivulariaceae

Calothrix Agardh.

*Calothrix epiphytica West and West 1897.
Prescott. 1962: 553, Pl. 132, Figs. 2 and 3.
Desikachary. 1959: 543, (not illustrated).

Basal cells 3-5 µm in diameter, shorter than wide. Filaments 5-6.5-(9) µm in diameter. Sheath sometimes extended the entire length of the trichome. Heterocysts basal, 3-5 µm in diameter.

Common.

Epiphytic on Rhizoclonium crassipellitum.

Pl. 20, Figs. 11 and 12.

*<u>Calothrix fusca</u> (Kütz.) Bornet and Flahault 1886.
Prescott. 1962: 553, Pl. 132, Figs. 4 and 5.

Basal cells 9-10 µm in diameter, length 1 3 the width. Sheath 11-16 µm wide. Heterocyst basal, hemispherical, 7-7.5 µm in diameter, slightly smaller than Prescott's.

Rare.

Associated with the mucilage of <u>Nostoc parmelioides</u> and <u>Tetraspora lamellosa</u>.

Pl. 20, Fig. 17.

APPENDIX B

SPECIES ILLUSTRATIONS

The line drawn beside each illustration is equal to 10 micrometers.

PLATE 1

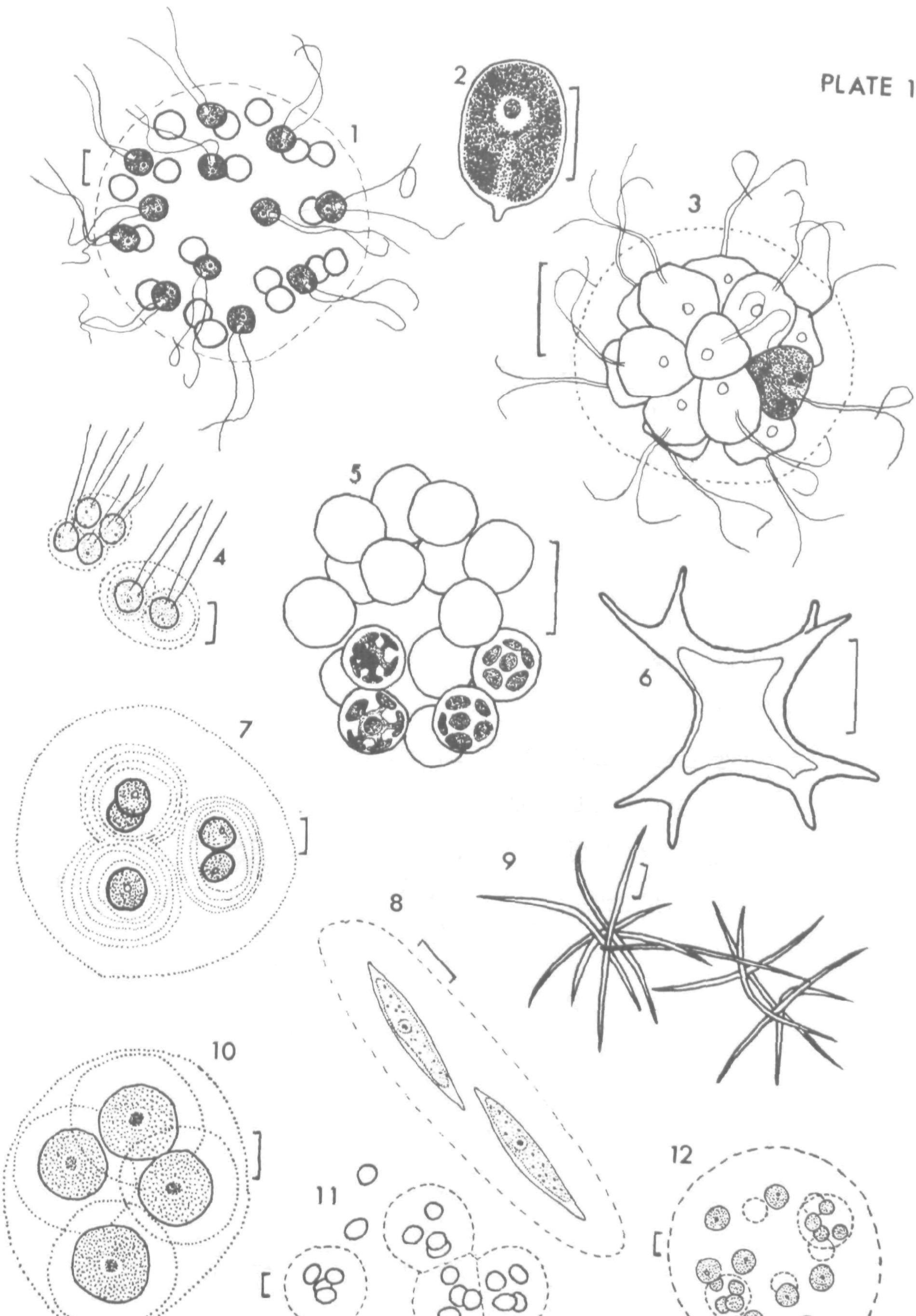
PLATE 1
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PLATE 2

PLATE 2

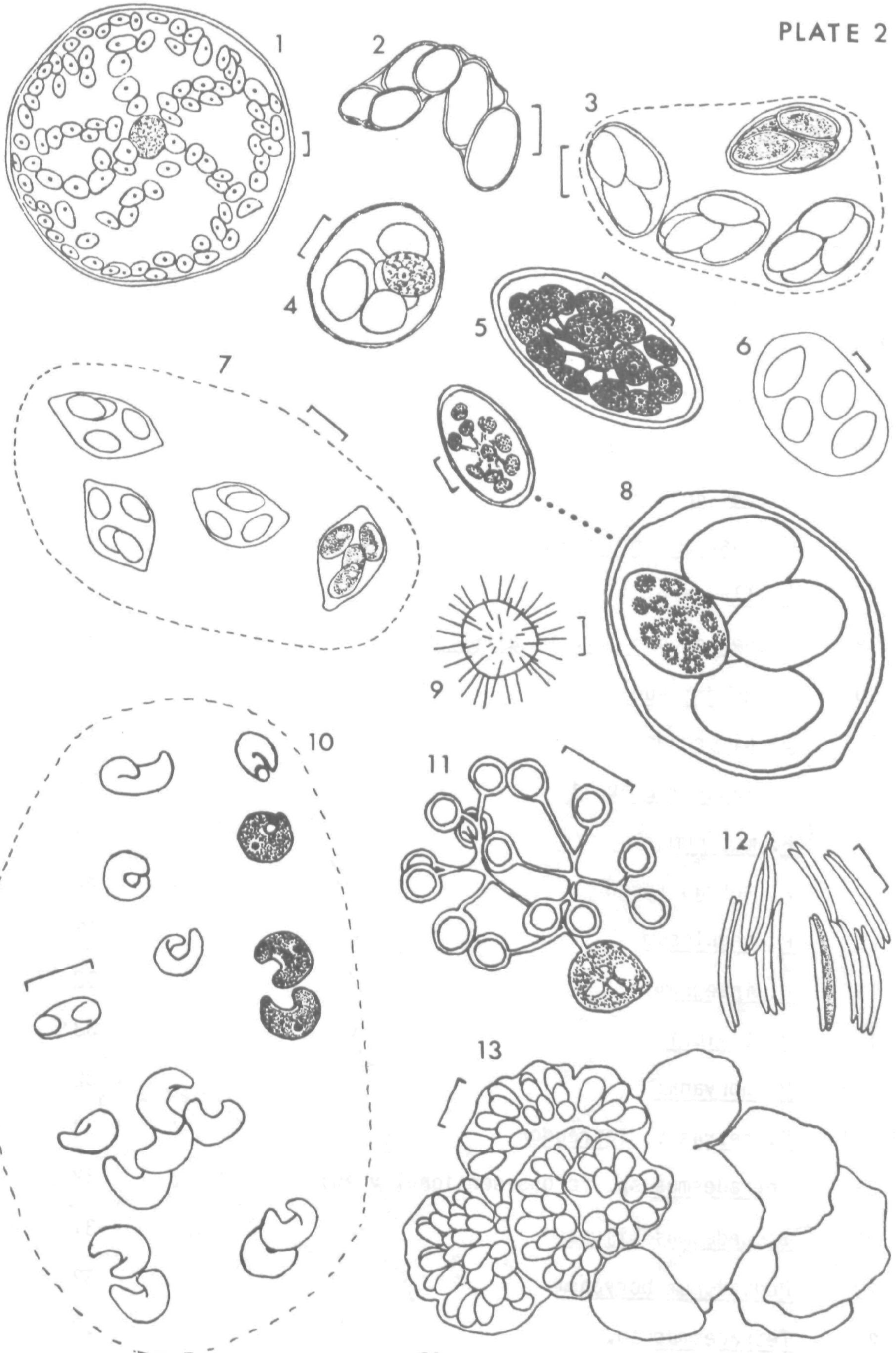

PLATE 3

Figure		Page
1	*Coelastrum cambricum* v. *intermedium*	30
2,3	*C. microporum*	30
4	*C. printzii*	30
5	*Crucigenia quadrata*	30
6	*C. rectangularis*	30
7	*Coelastrum proboscideum*	30
8	*Enallax alpina*	31
9	*Scenedesmus bijuga* v. *alternans*	31
10	*S. quadricauda*	31
11	*S. dimorphus*	31
12	*Pediastrum braunii*	32
13	*P. muticum*	33
14	*P. tetras* forma	33
15	*P. angulosum*	32
16	*P. integrum*	32
17	*P. taylori*	33
18,19	*P. boryanum*	32
20,24	*P. tetras* v. *tetraodon*	33
21	*Tetradesmus* sp. (cross-sectional view)	32
22	*Scenedesmus bijuga*	31
23	*Pediastrum boryanum*	32
25	*Tetradesmus* sp.	32

PLATE 3

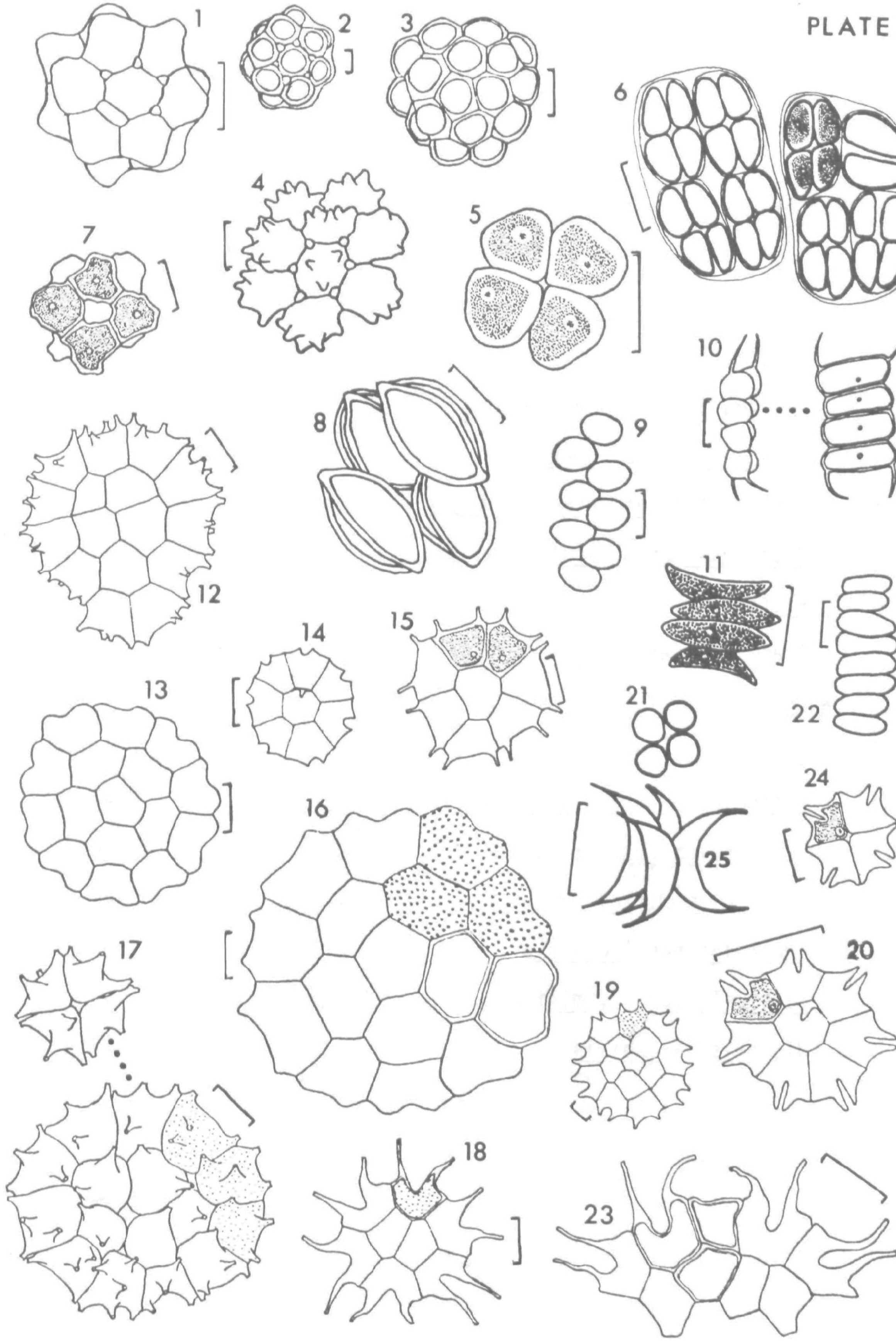

PLATE 4

Figure		Page
1,3	*Pediastrum boryanum* v. *undulatum*	32
2	*P. angulosum*	32
4	*Euglena spirogyra* v. *marchia*	55
5	*Coleochaete orbicularis*	34
6	*Lepocinclis fusiformis* v. *major*	56
7	*Microthamnion strictissimum*	34
8,9	*Protoderma viride*	34
10	*Trachelomonas horrida*	56
11	*Phacus* sp.	56
12	*Sorastrum spinulosum*	33
13	*Rhizoclonium crassipellitum*	35
14	*Lepocinclis fusiformis*	56
15	*Peridinium willei*	57
16	*Trachelomonas lacustris*	56
17	*T. bacillifera* v. *minima*	56
18	*Ulothris variabilis*	34

PLATE 4

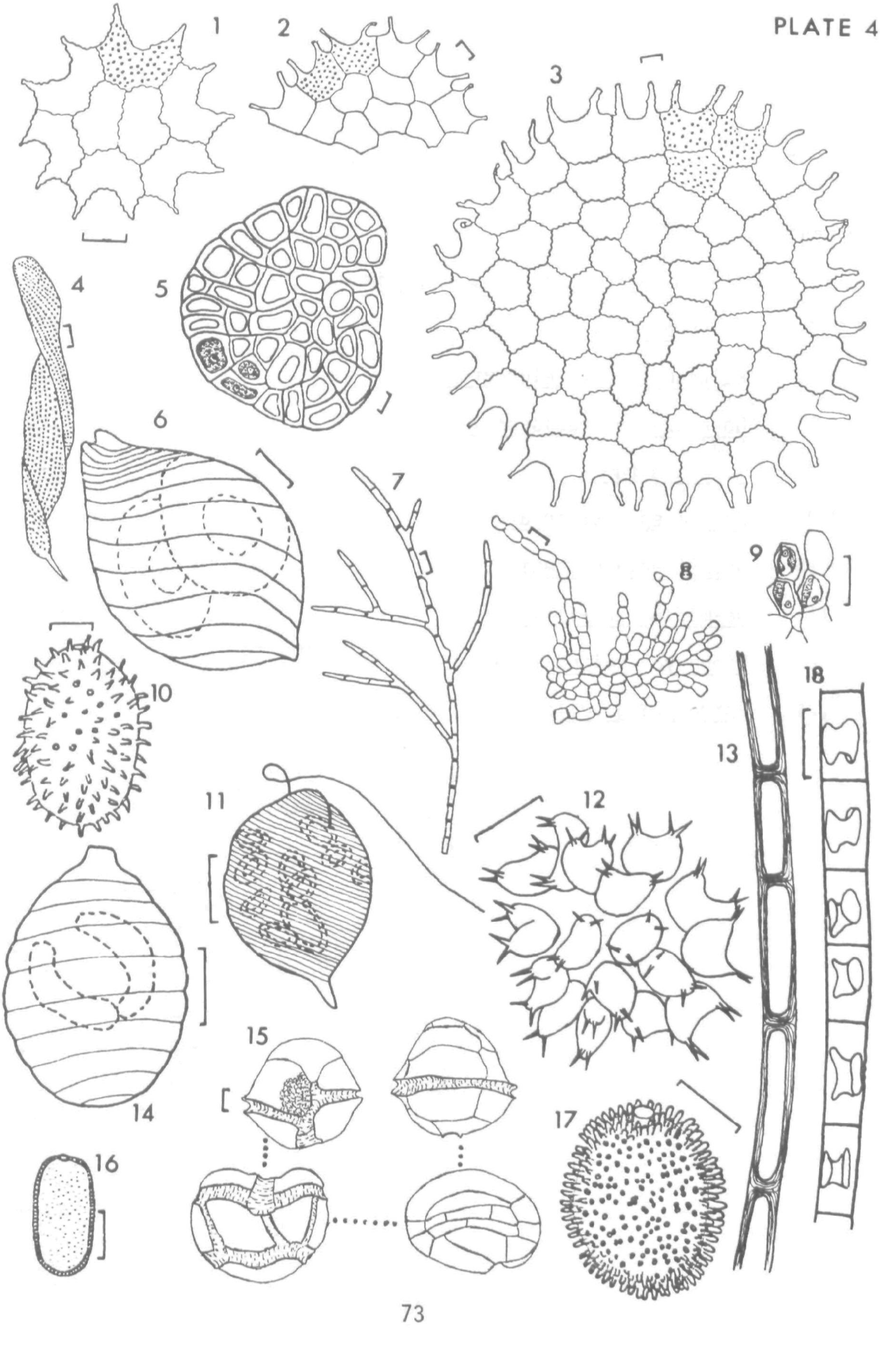

PLATE 5

Figure		Page
1	*Pleurotaenium trabecula* v. *maximum*	50
2,3	*P. ehrenbergii*	50
4	*P. trabecula* v. *elongatum*	50
5	*Gonatozygon brebissonii*	36
6,7	*G. aculeatum*	36
8,9	*Penium spirostriolatum*	49
10,15	*Ducellieria chodatii*	57
11	*Desmidium grevillii*	46
12	*Dinobryon cylindricum*	57
13,14	*Spirogyra gracilis*	35

PLATE 5

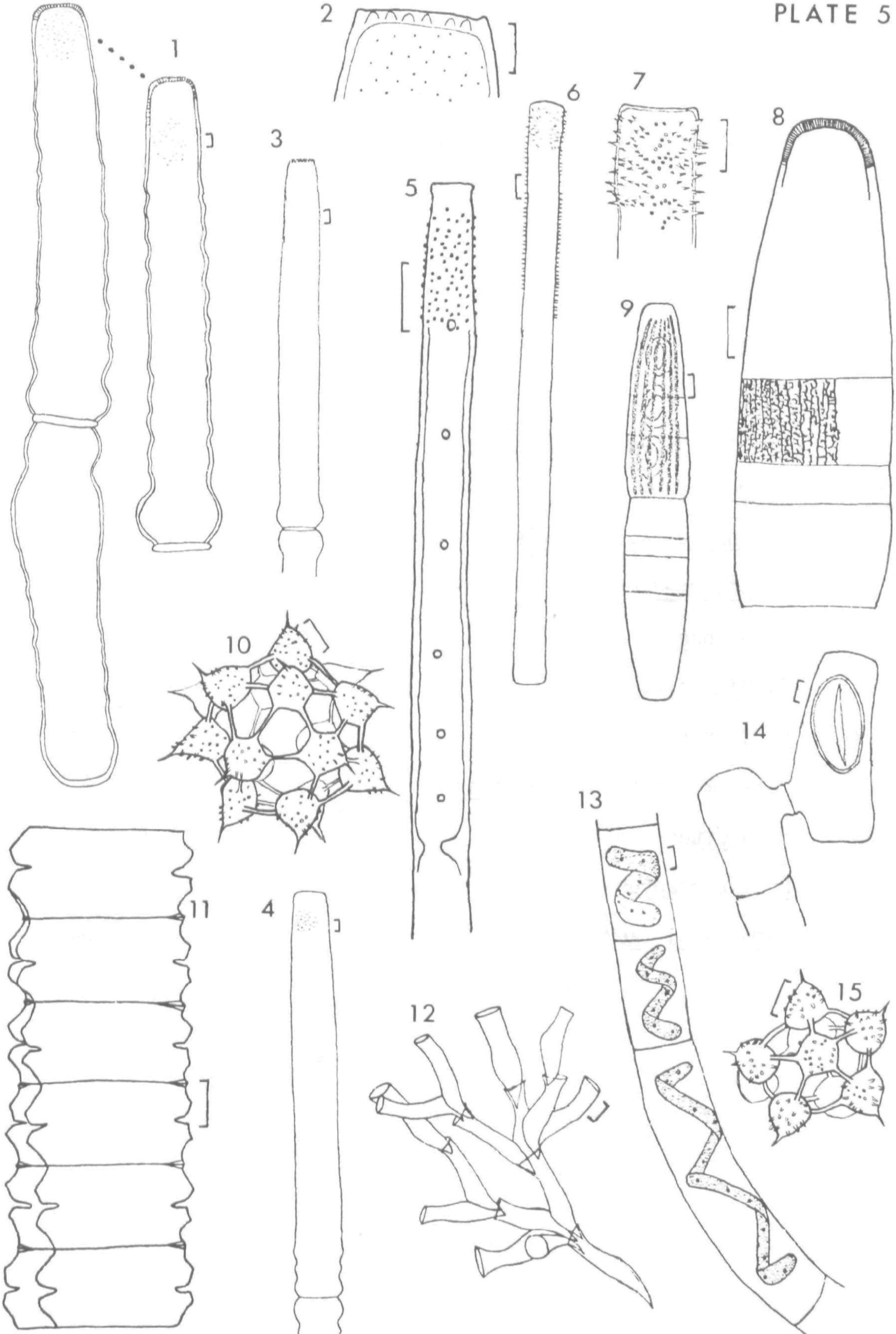

PLATE 6

Figure		Page
1	*Closterium libellula*	38
2	*C. striolatum*	38
3,4	*C. gracile*	37
5,6	*C. macilentum* v. *japonicum* forma	38
7,8	*C. rostratum*	38
9	*C. lunula* fa. *gracilis*	38
10	*C. intermedium*	37
11	*C. Dianae*?	37
12	*C. Dianae* v. *minor*?	37
13	*C. jenneri*	38
14	*Netrium digitus* v. *naegelii*	37
15	*N. digitus*	36
16	*N. interruptus*	37
17	*Tetmemorus laevis*	54

PLATE 6

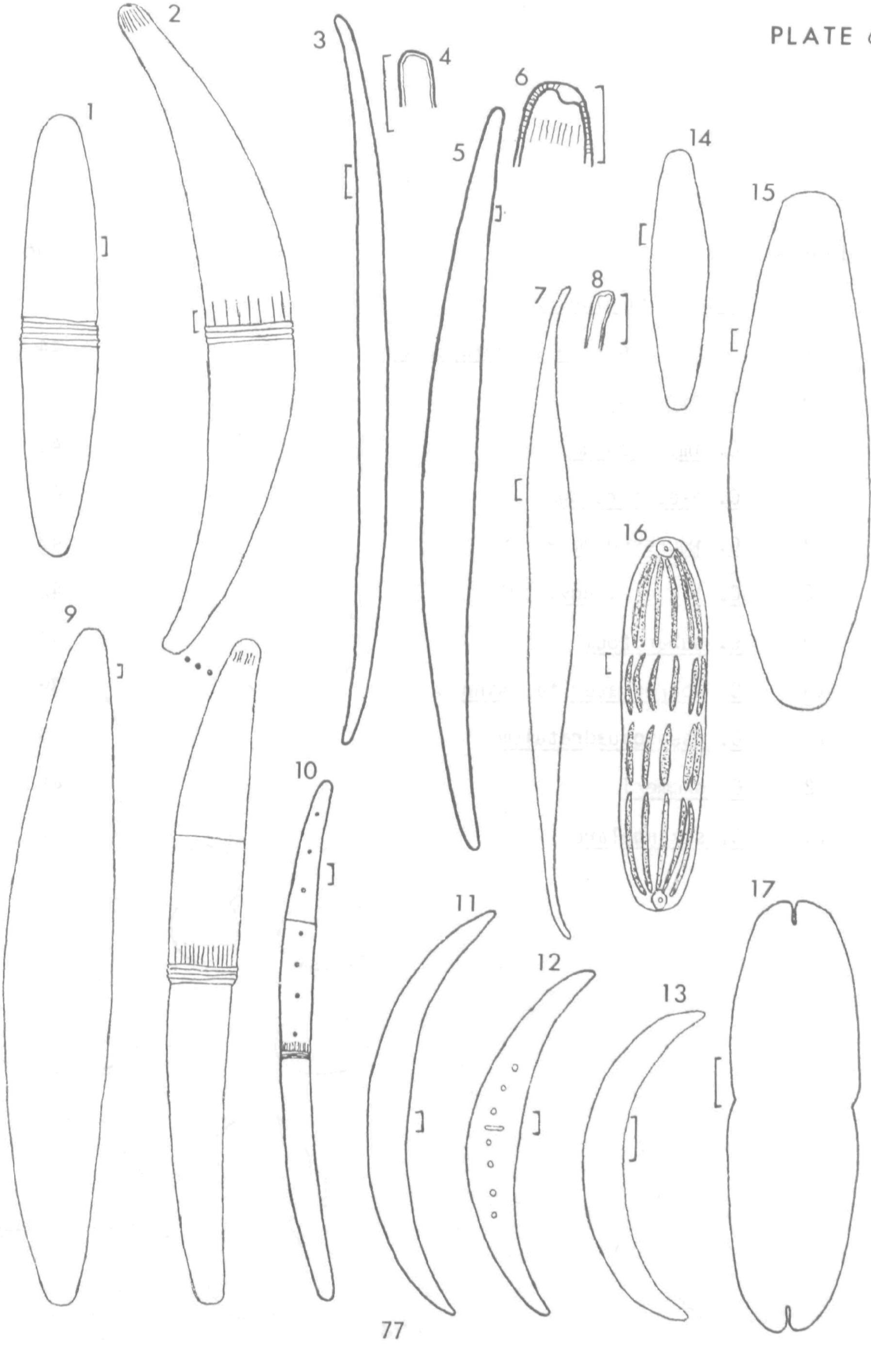

PLATE 7

Figure		Page
1	_Cosmarium_ _globosum_	41
2	_C_. _rectangulare_ v. _hexagonium_	44
3,4	_C_. _pyramidatum_	43
5	_C_. _impressulum_ α	41
6	_C_. _pseudoarctoum_	43
7	_C_. _impressulum_ β	42
8	_C_. _laeve_ v. _nov_. (?)	42
9	_C_. _subarctoum_	44
10	_C_. _abbreviatum_ fa. _minor_	39
11	_C_. _pseudoquadratulum_	43
12	_C_. _hammeri_	41
13	_C_. _sexangulare_	44

PLATE 7

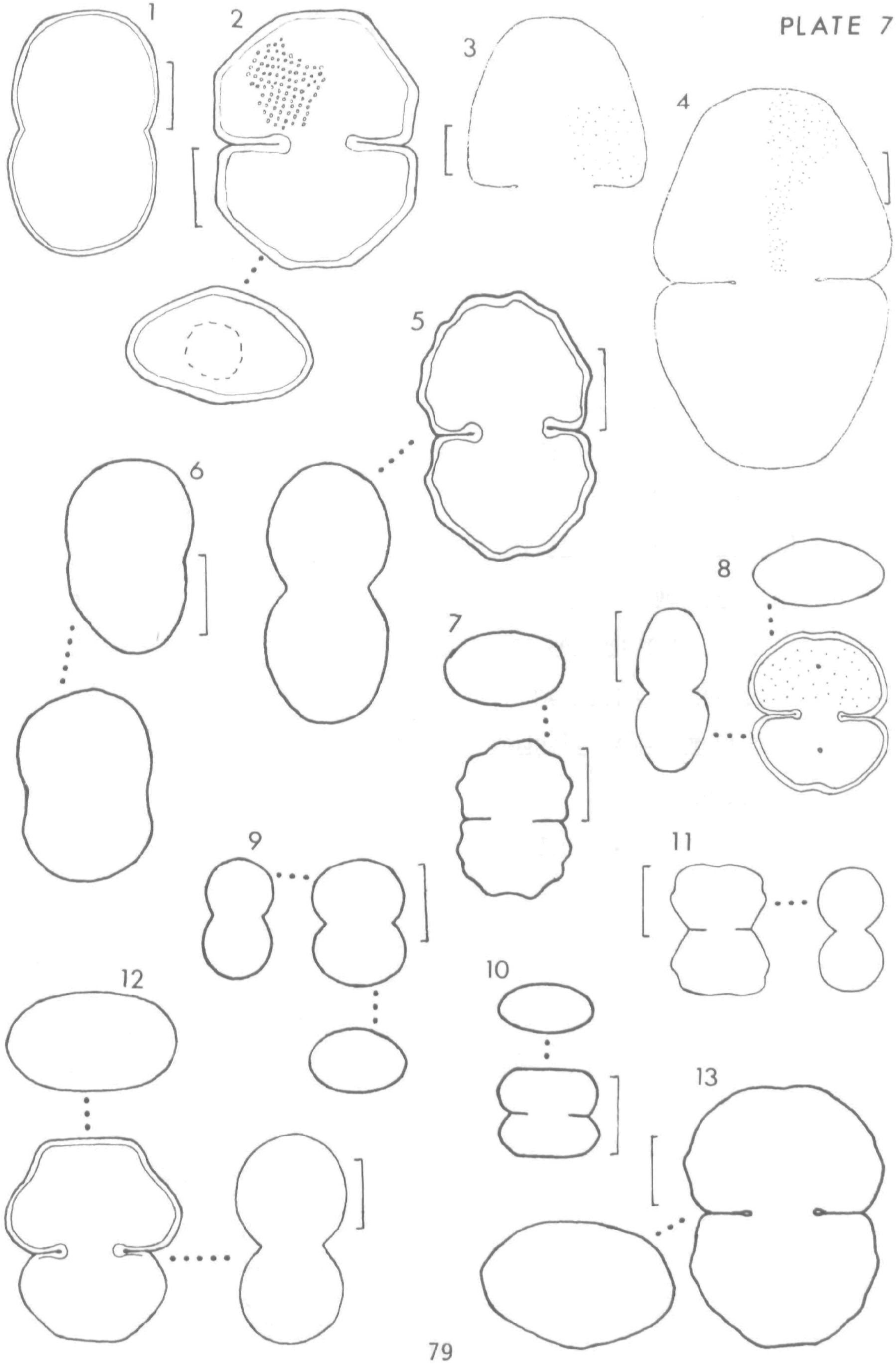

PLATE 8

Figure		Page
1,2	Cosmarium difficile v. dilatatum	41
3	C. venustum v. excavatum	46
4,5	C. pseudopyramidatum v. extensum	43
6	C. humile v. striatum	41
7,12	C. bioculatum	39
8	C. contractum v. ellipsoideum	40
9	C. quadratum fa. willei	43
10	C. pseudoprotuberans fa. minus	43
11	C. tenue v. depressum	45
13	C. subtumidum v. minutum	45
14	C. angulosum	39
15	C. undulatum v. minutum	45

PLATE 8

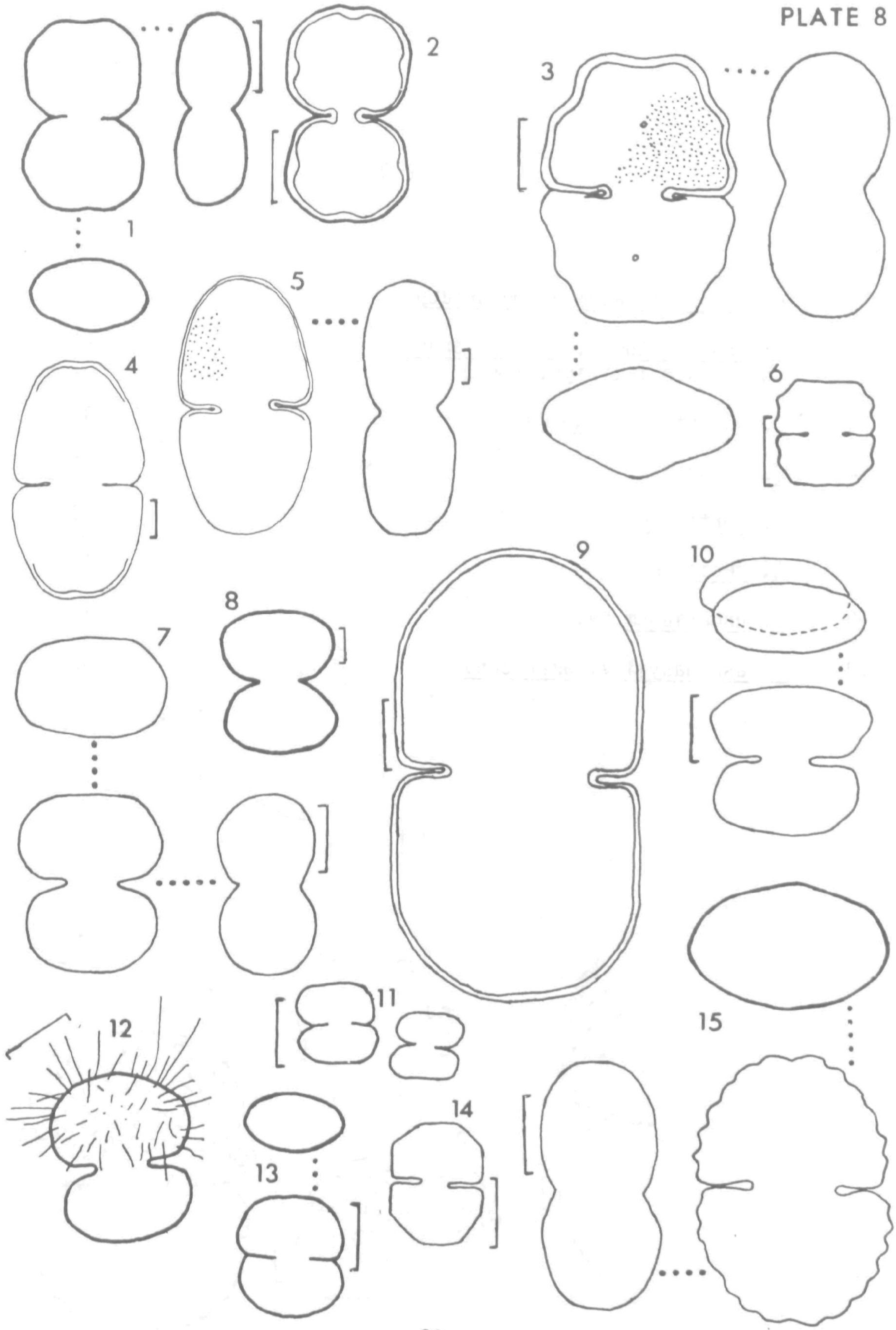

PLATE 9

Figure		Page
1	*Cosmarium ornatum* v. *perornatum*	42
2	*C. subcrenatum* v. *isthmochondrum* (See Plate 11, Figs. 1 & 2)	44
3	*C. botrytis* v. *tumidum*	39
4	*C. quinarium*	44
5	*C. portianum*	43
6	*C. reniform*	44
7-9	*C. ungerianum* fa.	45
10	*C. askenasyii* v. *americana*	39

PLATE 9

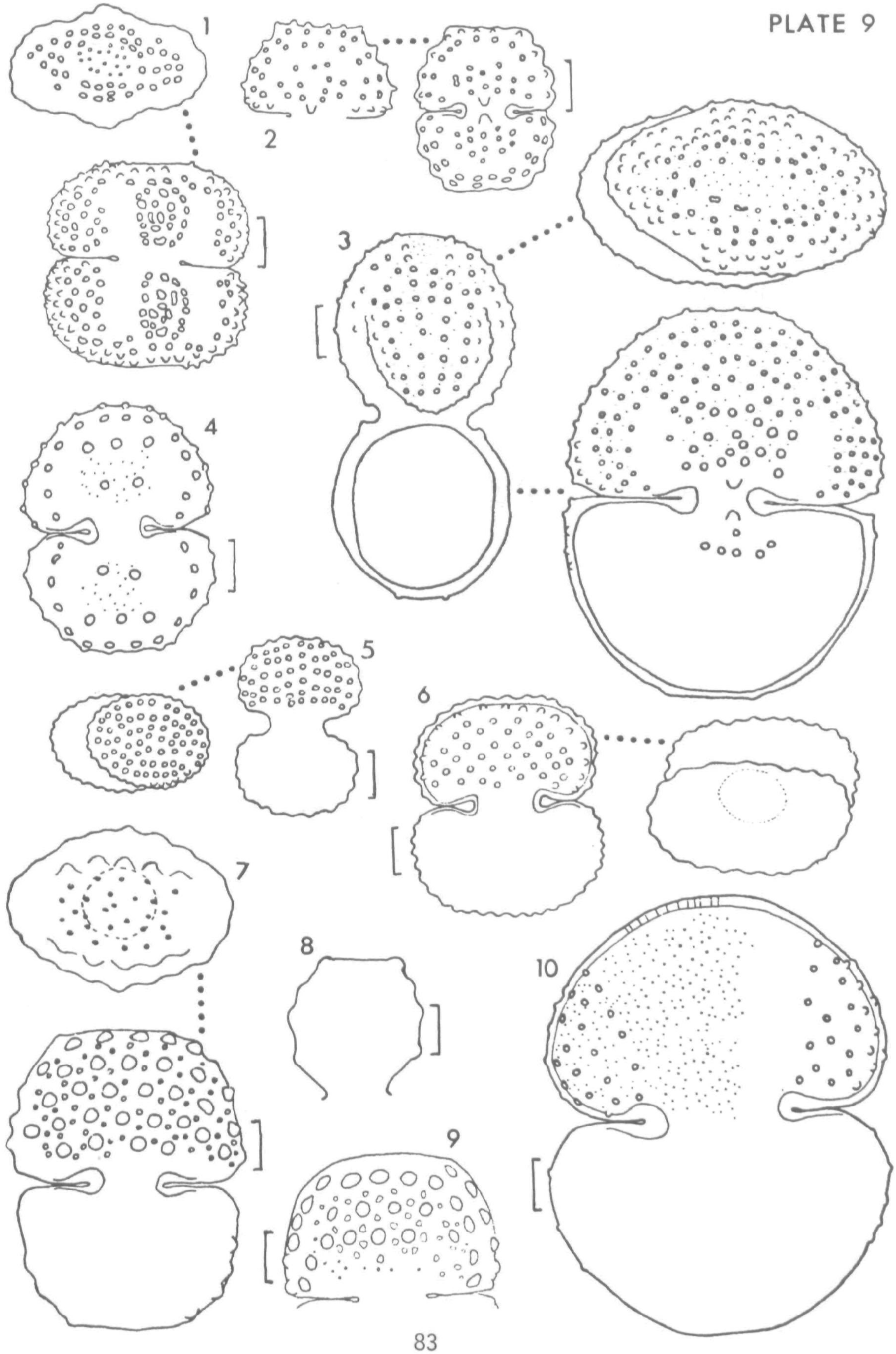

PLATE 10

PLATE 10

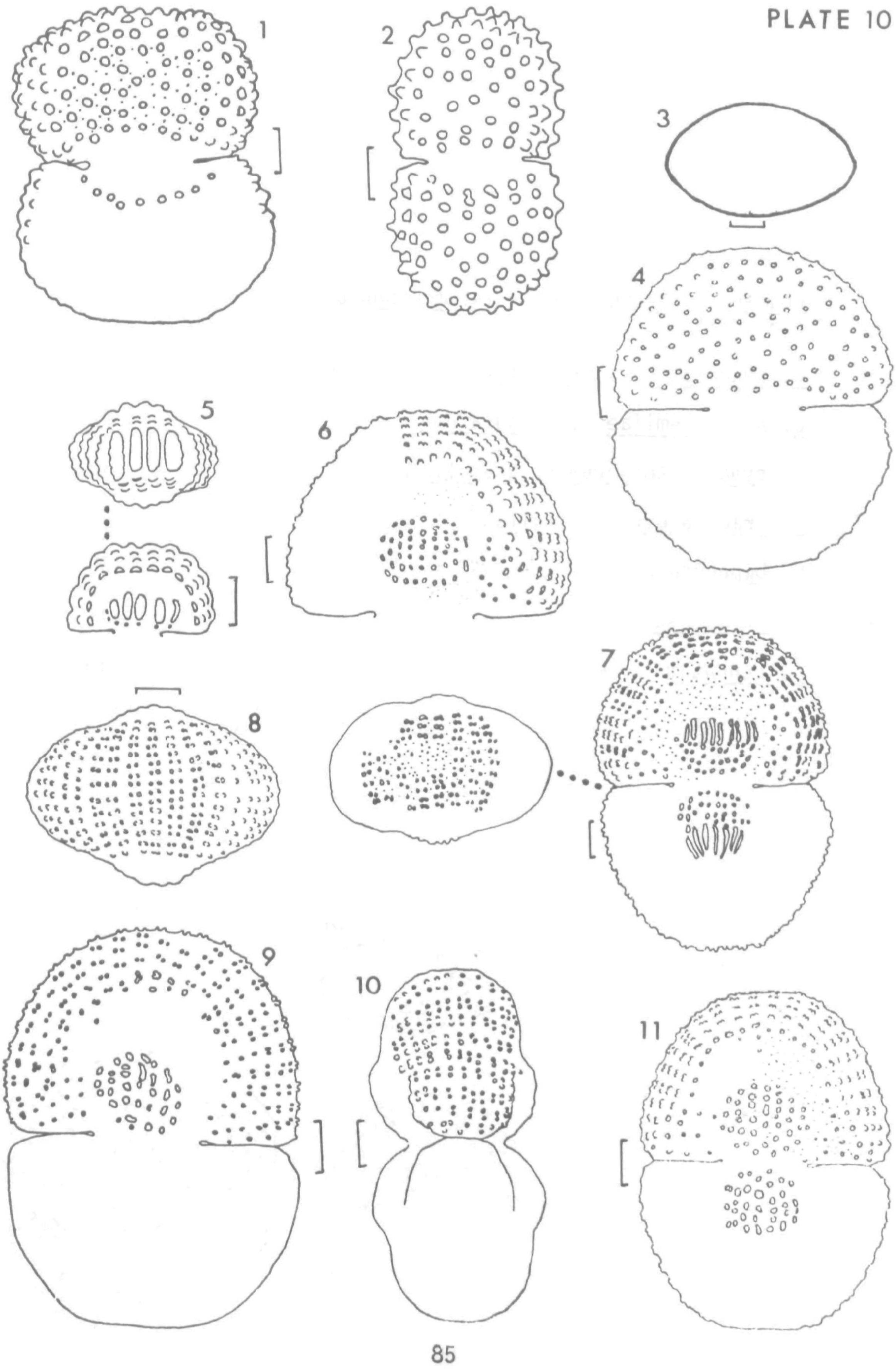

PLATE 11

Figure		Page
1,2	*Cosmarium subcrenatum* v. *isthmochondrum* (See Plate 9, Fig. 2.)	44
3,4	*C. sexnotatum* v. *tristriatum*	44
5	*C. novae-semliae* v. *granulatum*	42
6	*C. cymatonotophorum* v. *granulatum*	40
7	*C. trachypleurum* v. *fallax*	45
8	*C. bipunctatum*	39
9,10	*C. formulosum*	41
11	*C. connatum*	40

PLATE 11

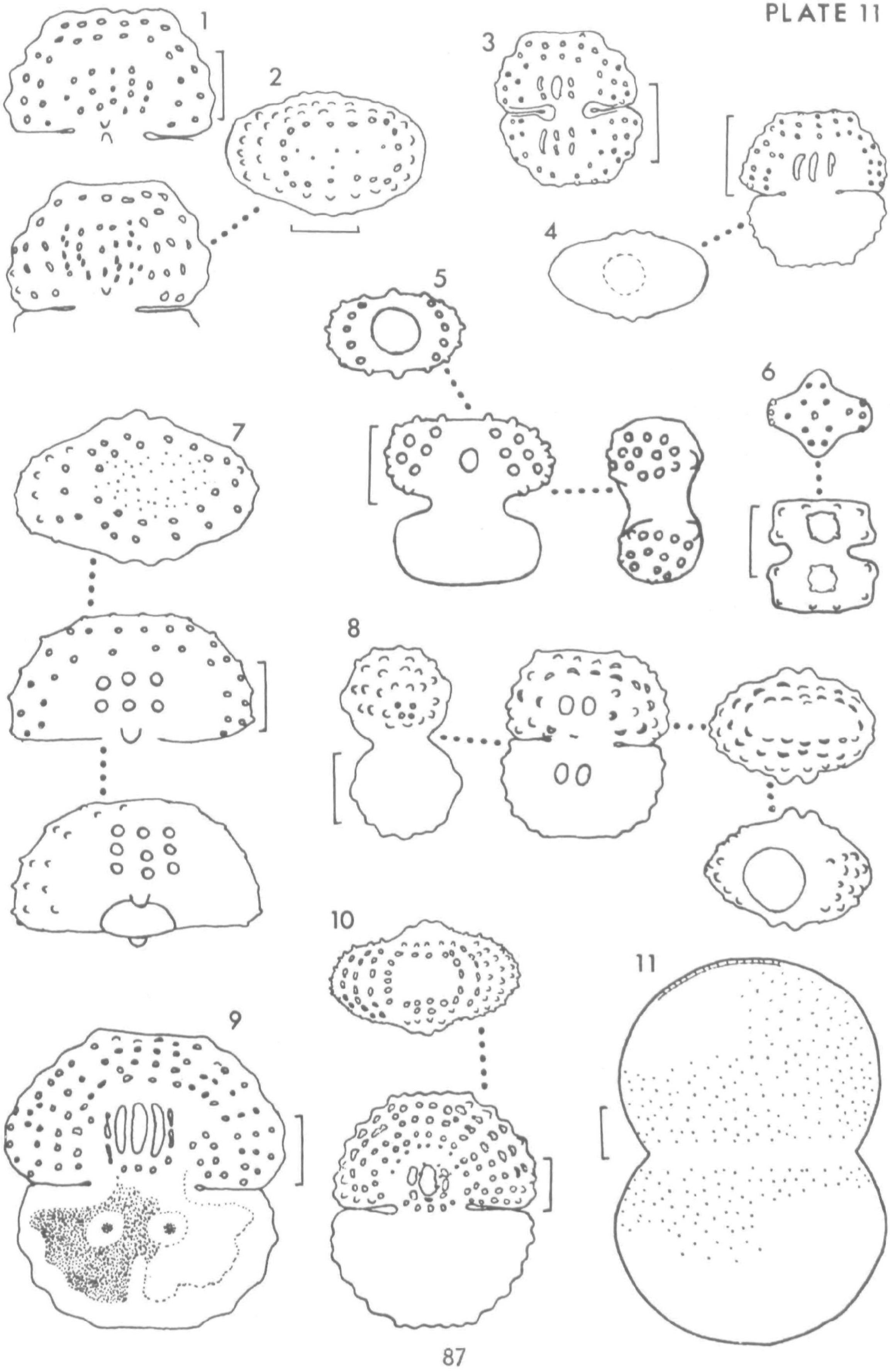

PLATE 12

Figure		Page
1	*Euastrum oblongum*	47
2	*E. bidentatum* v. *speciosum*	46
3	*E. ansatum* v. *triporum*	46
4	*E. obesum*	47
5	*E. denticulatum* v. *angusticeps*	46
6	*Micrasterias rotata* fa. *evoluta*	49
7	*M. truncata* v. *neodamensis*	49
8	*M. americana*	48

PLATE 12

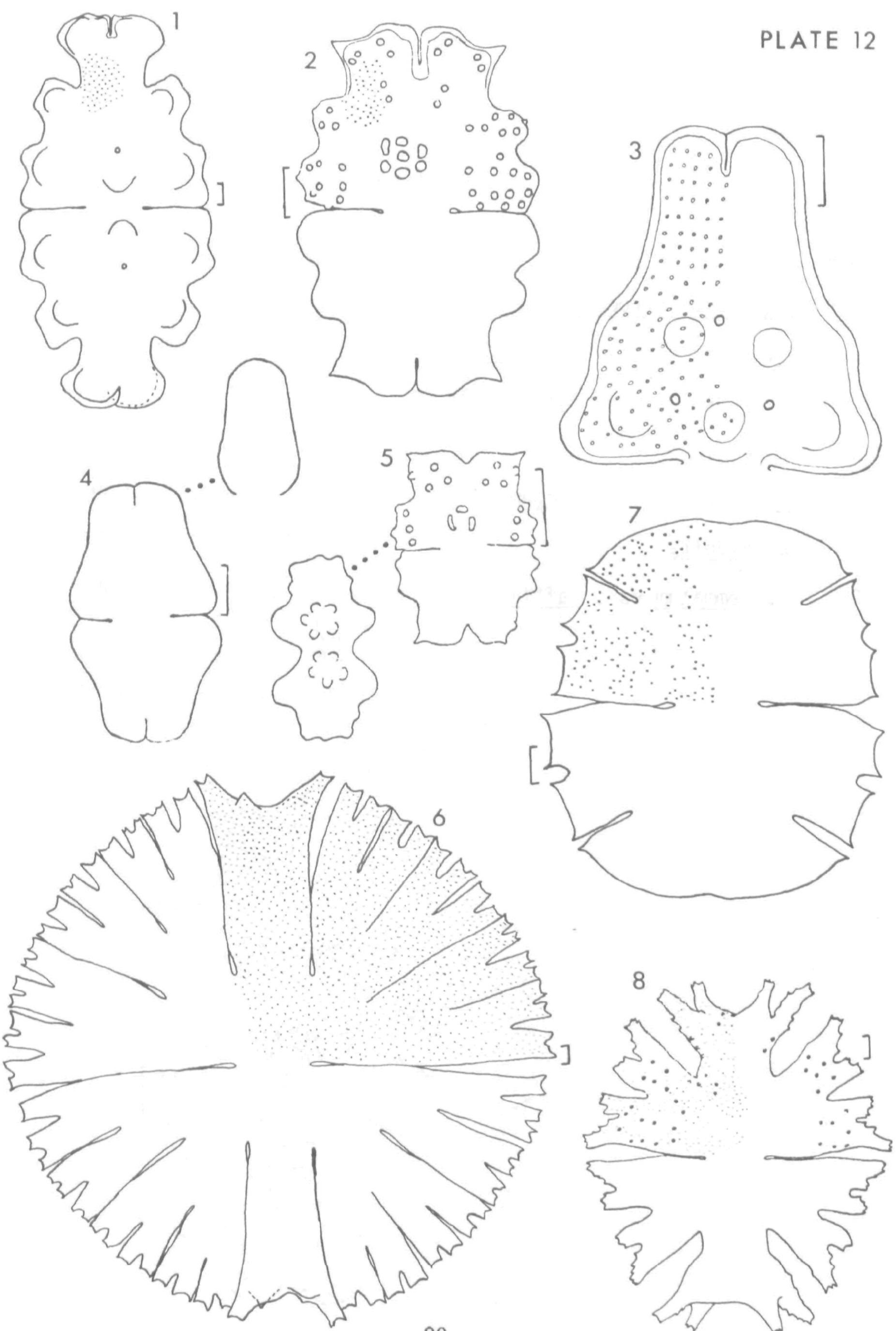

PLATE 13

PLATE 13

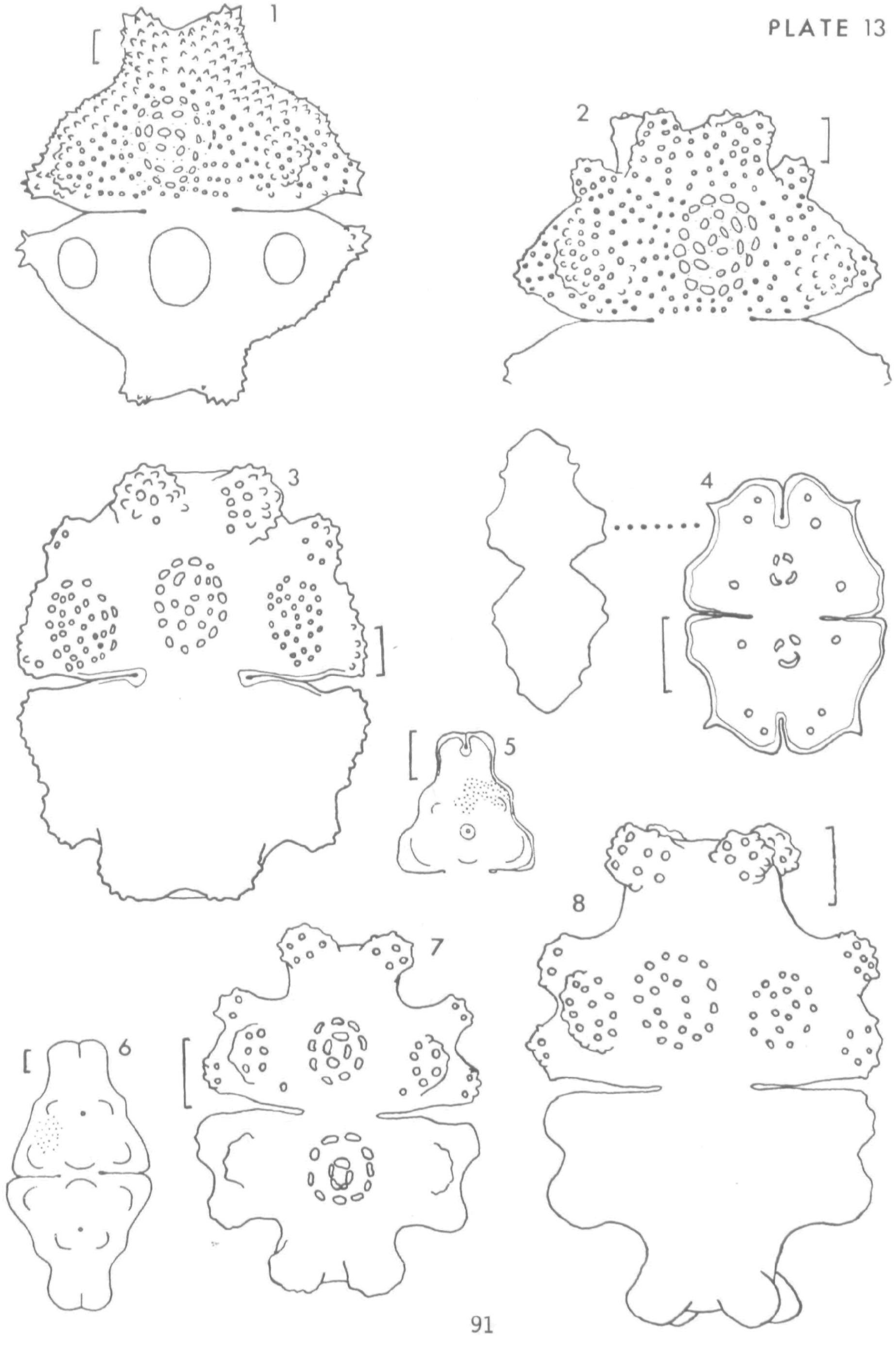

PLATE 14

Figure		Page
1,8	*Micrasterias denticulata* v. *angulosa*	48
2,3	*M. pinnatifida*	49
4	*M. rotata*	49
5,6	*M. conferta*	48
7	*M. muricata* v. *tumida*	48

PLATE 14

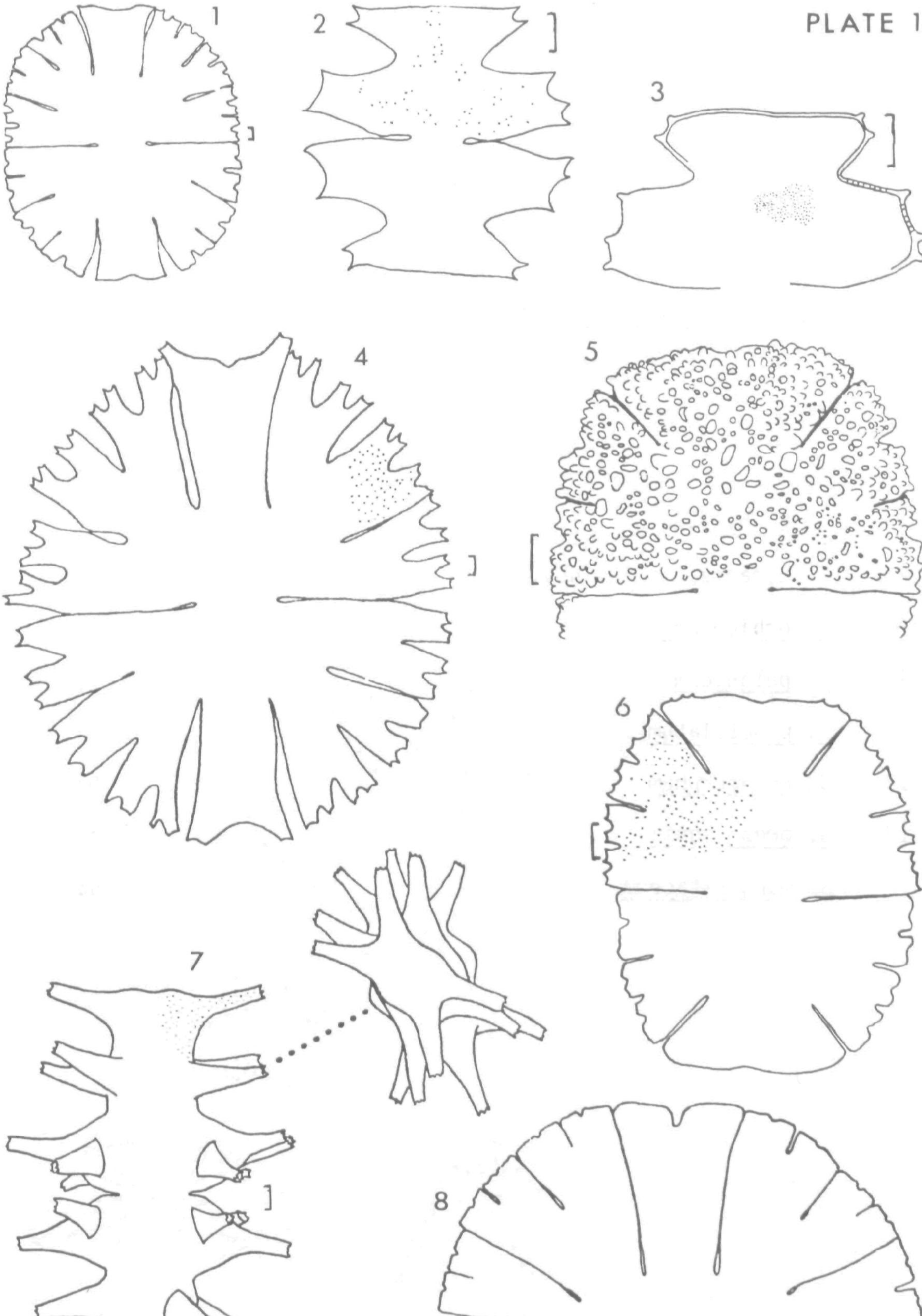

PLATE 15

Figure		Page
1-3	*Staurastrum spongiosum*	54
4	*S. dickei* v. *circulare*	52
5	*S. subavicula*	54
6	*S. grande* v. *angulosum*	52
7	*S. pachyrhynchum*	53
8	*S. pyramidatum* fa. nov. (?)	54
9	*S. orbiculare*	53
10	*S. polonicum*	53
11	*S. punctulatum*	53
12	*S. polymorphum*	53
13	*S. brebissonii*	51
14	*S. margaritaceum*	53

PLATE 15

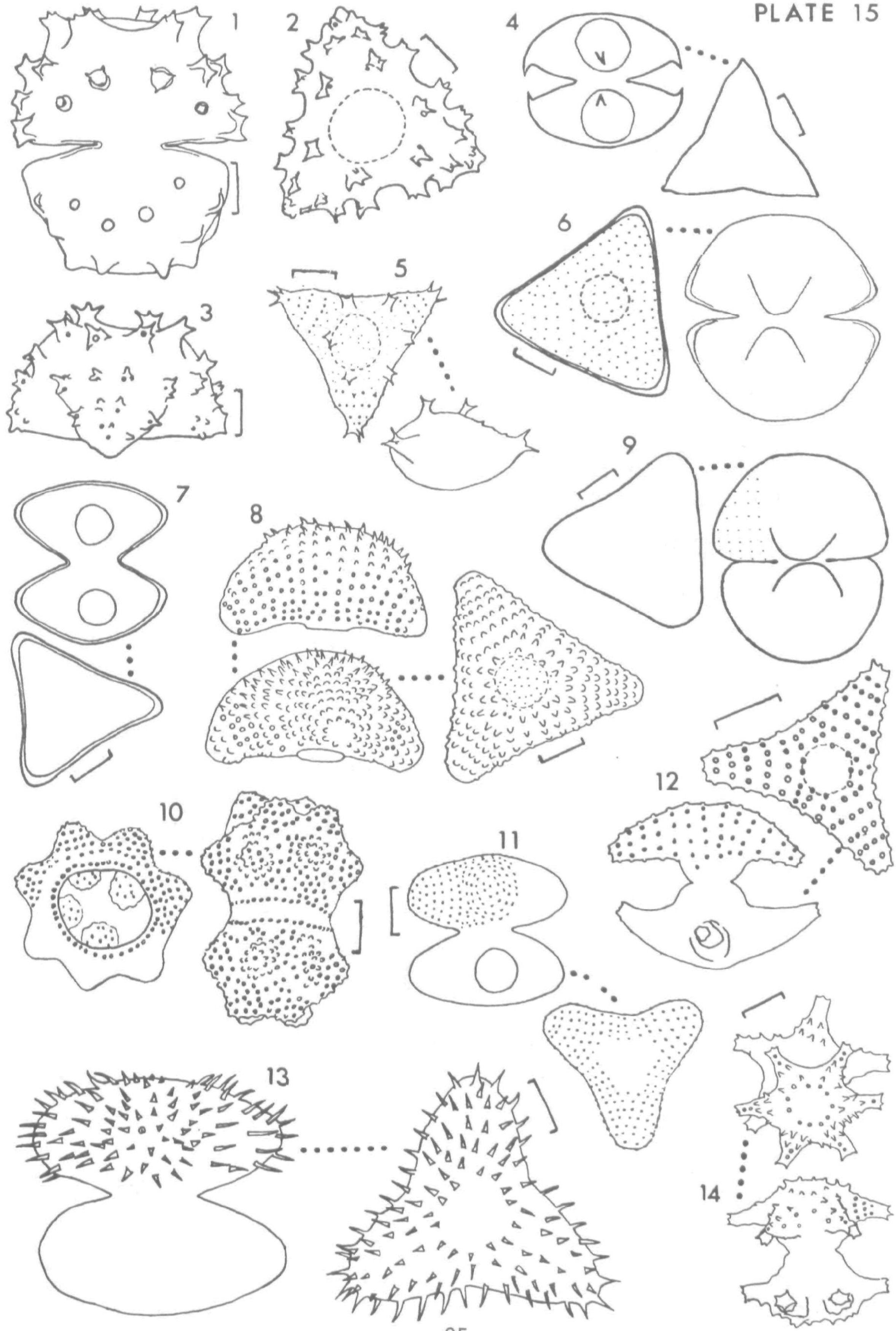

PLATE 16

PLATE 16

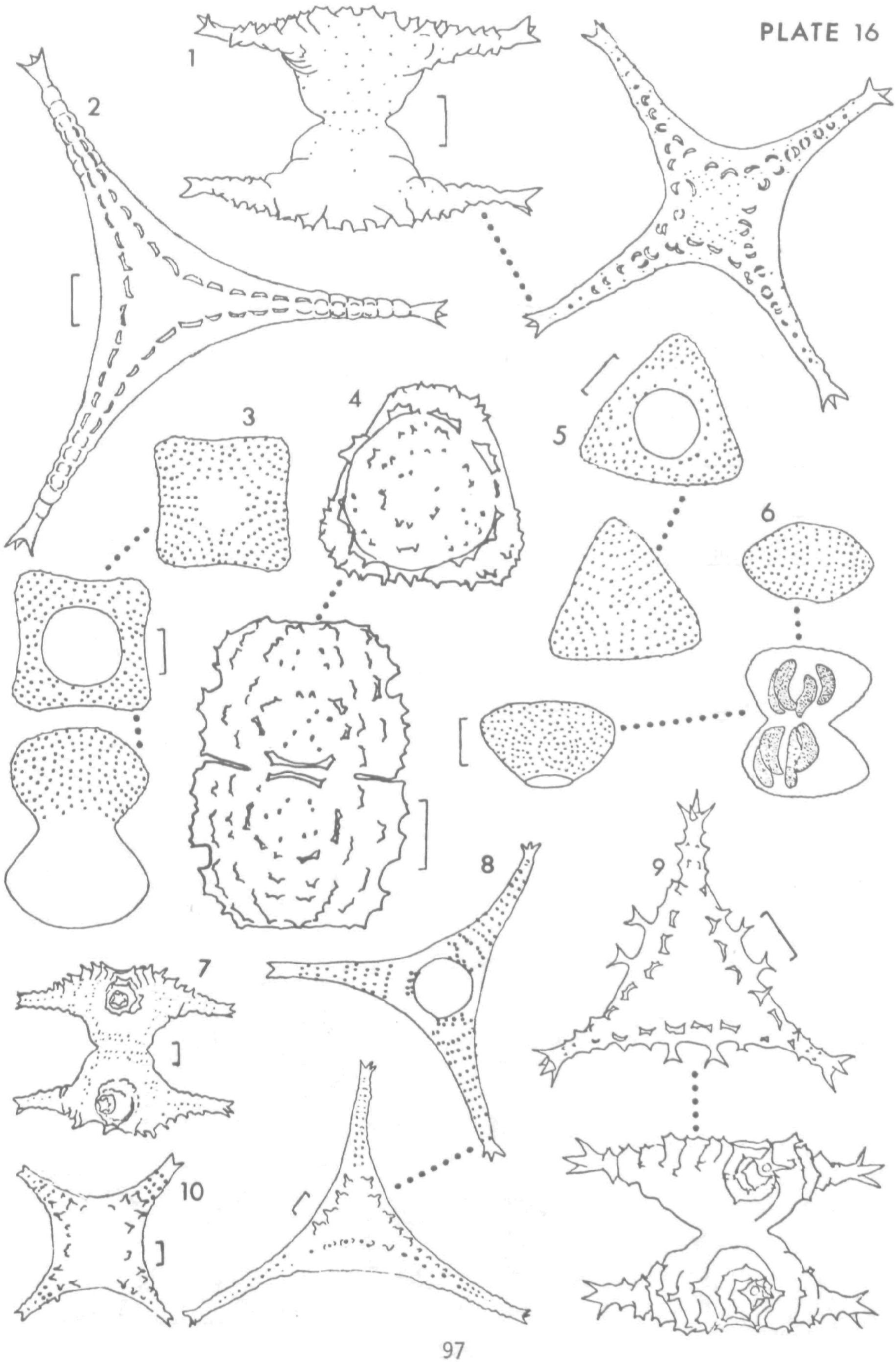

PLATE 17

Figure		Page
1-3	*Staurastrum breviaculeatum*	51
4,5	*S. kurilense* fa. *triquetra*	52
6,7	*S. kurilense*	52
8	*S. cuspidatum*	52
9,11	*S. alternans*	51
10	*S. crenulatum*	51

PLATE 17

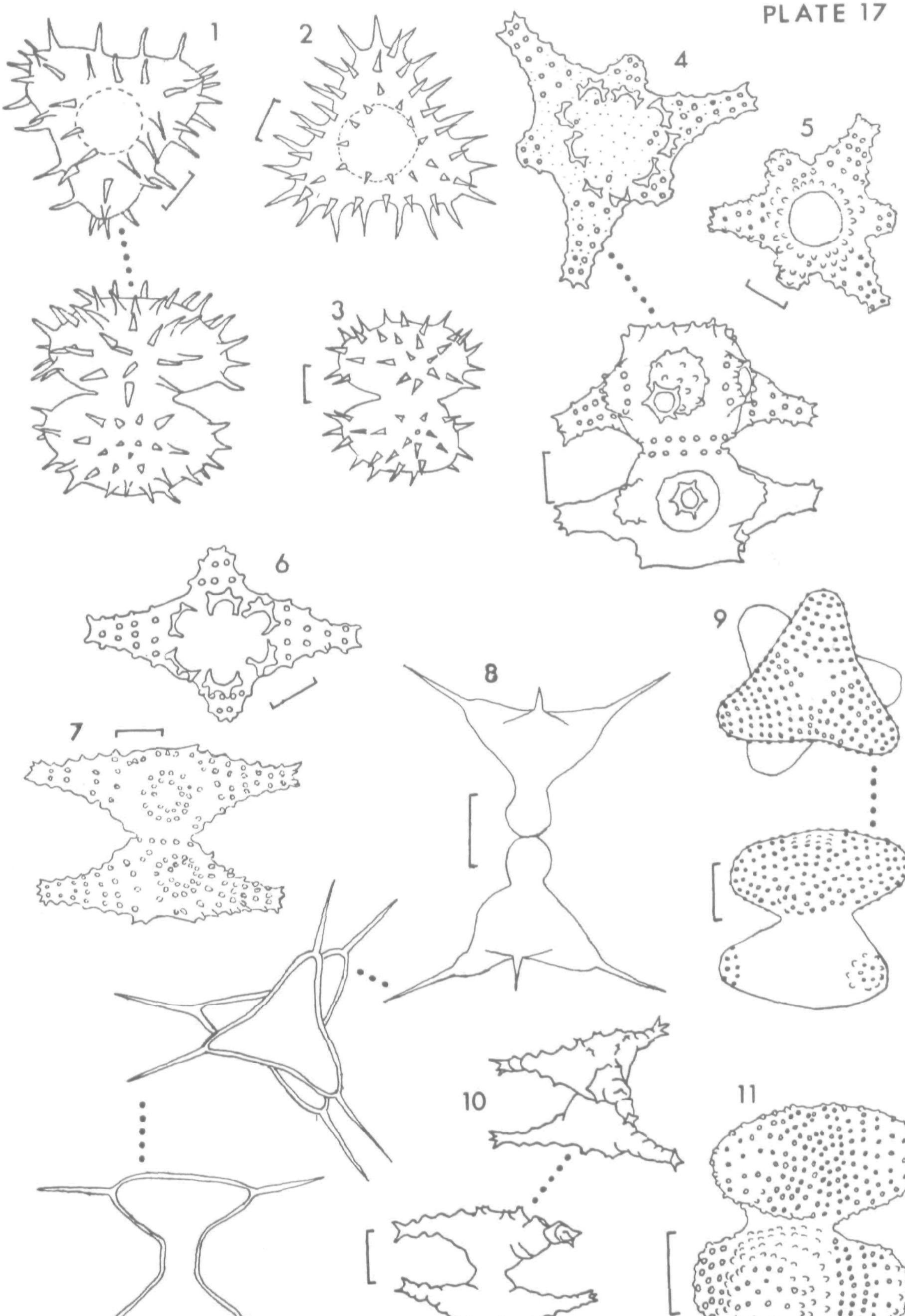

PLATE 18

Figure		Page
1	*Staurastrum arctiscon*	51
2	*Xanthidium subhastiferum*	55
3	*Staurastrum brevispinum*	51
4,5	*Cylindrocystis brebissonii*	36
6	*Spondylosium pulchellum*	50
7	*S. planum*	50

PLATE 18

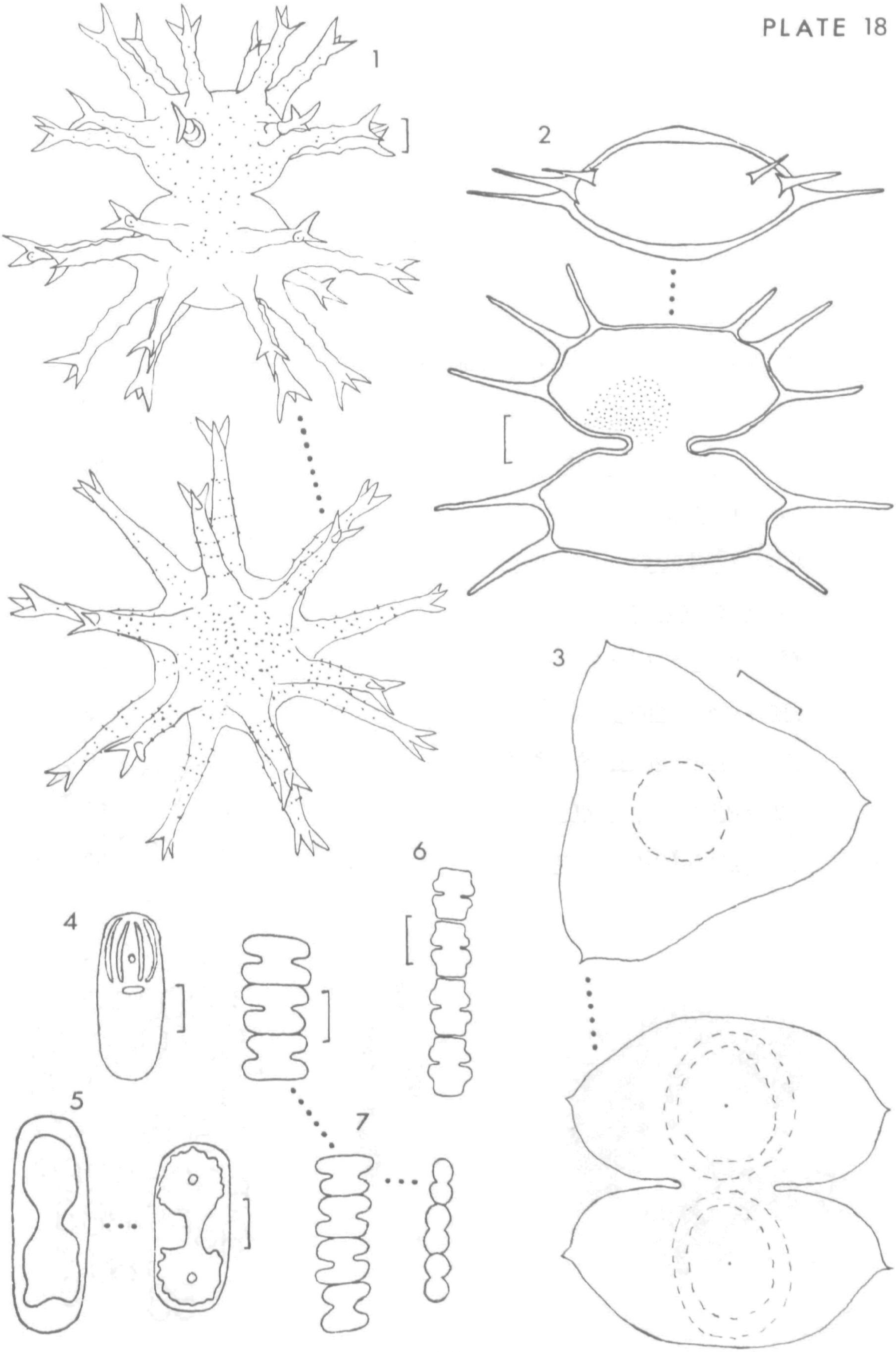

PLATE 19

Figure		Page
1	*Aphanothece stagnina*	58
2	*Aphanocapsa elachista* v. *conferta*	58
3	*A. pulchra*	58
4	*Chroococcus prescottii*	58
5	*C. turgidus*	58
6	*Coelosphaerium pallidum*?	59
7	*C. kuetzingianum*	59
8,12	*Microcystis aeruginosa*	60
9	*Gloeothece rupestris*?	59
10	*Dactylococcopsis smithii*	59
11	*Merismopedia elegans*	60
13	*Eucapsis alpina* v. *minor*	59

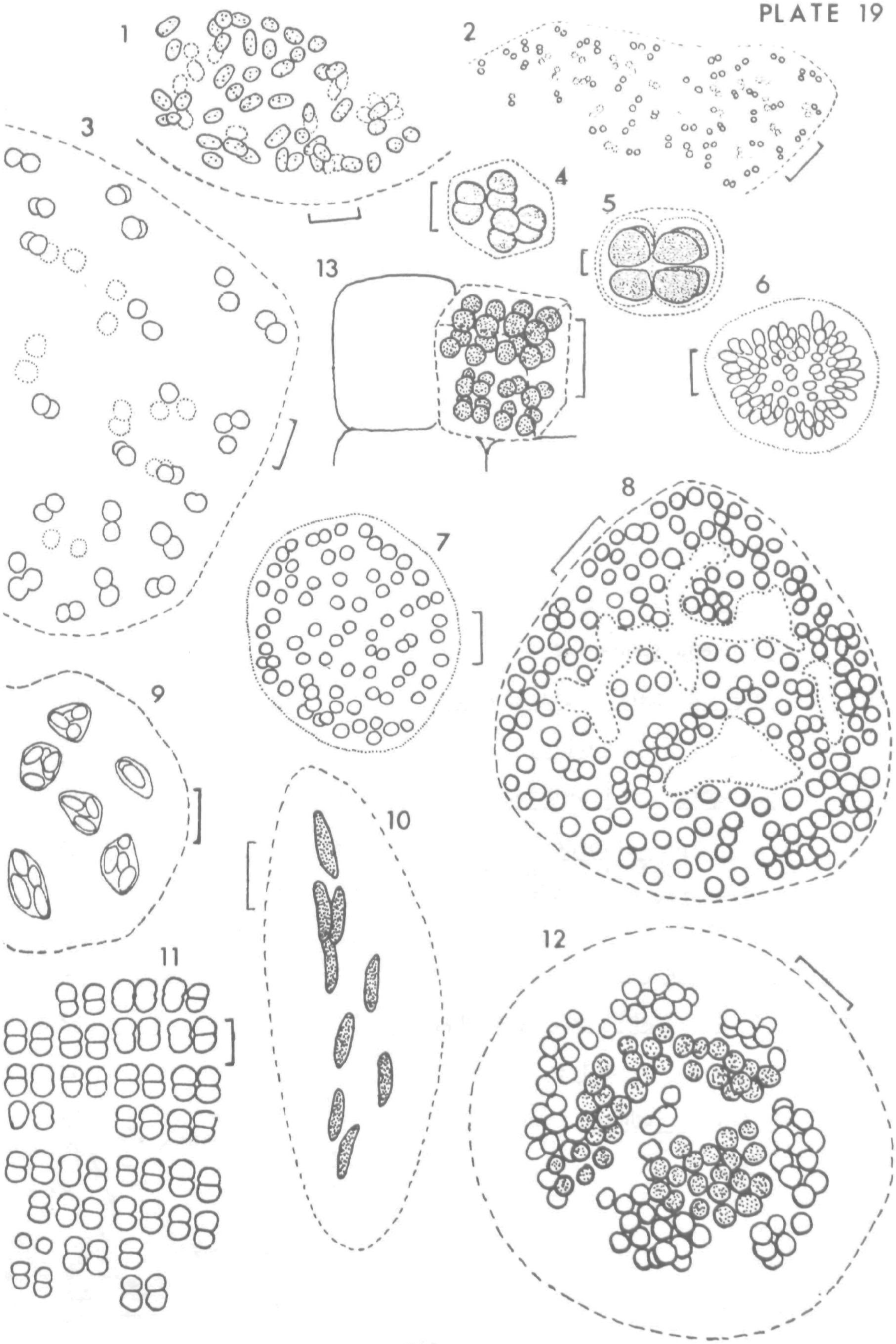
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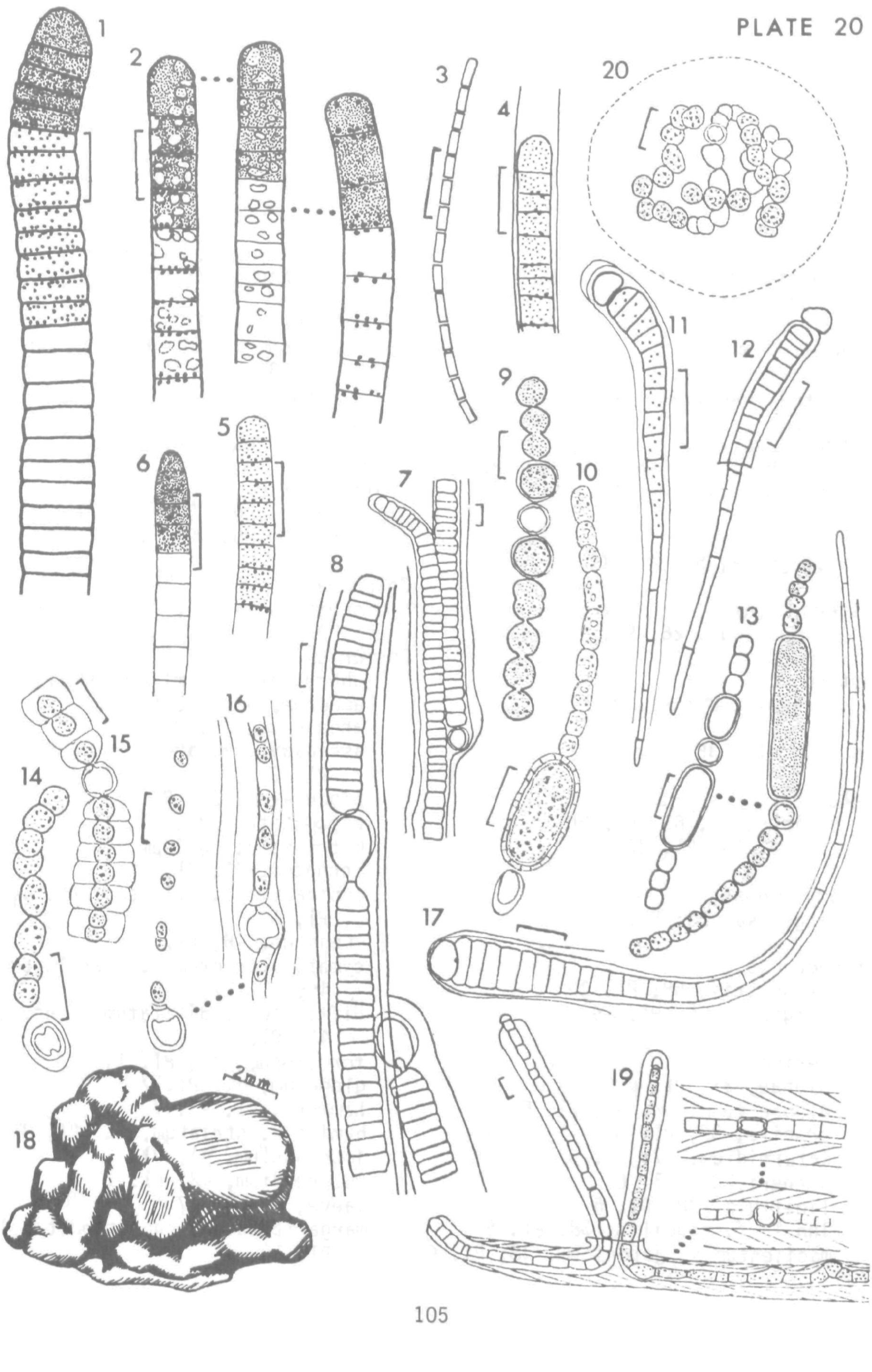
PLATE 20

PLATE 20



GENUS AND SPECIES INDEX

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-600/3-79-080	2.	3. RECIPIENT'S ACCESSION NO.
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16. ABSTRACT

This report illustrates and characterizes algae (exclusive of diatoms) found in Kings Canyon National Park, California and describes their distribution among the Rae Lakes within. It is the first taxonomic study of the freshwater algae for the southern Sierra Nevada and the most comprehensive for the range. It serves as a reference manual for the identification of algae in alpine and subalpine regions and establishes baseline data for future investigations. More than half (113) of the 210 forms encountered were desmids (Chlorophyta). While 120 forms were thought to be new records for California, one variety was thought to be new to science. A table illustrating the distribution of taxa within the lakes and ponds is included and discussed.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Algae Freshwater Taxonomy	alpine, subalpine habitat Sierra Nevada range algal survey	06 C 08 H

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