SOME ALGAE IN LAKES HUME AND MULWALA (1974)

VICTORIA

By

KANJANA VIYAKORNVILAS B.Sc. (Tas.)

A Thesis submitted in partial fulfilment of the requirements for the Degree of Bachelor of Science with Honours at the University of Tasmania.

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree in any university and that, to the best of my knowledge, the thesis contains no copy or paraphase of material previously published or written by another person, except when due reference is made in the text.

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K.Viyakornvilas,

Botany Dept.,

University of Tasmania,

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SUMMARY

Lakes Hume and Mulwala have very similar plankton communities in which *Melosira granulata* Ralfs is dominant. The species composition and the plankton quotients show the two lakes are mesotrophic. Most of the algae seen are well-known and widespread. *Micrasterias Hardyi* G.S.West has only been recorded from Australia.

INTRODUCTION

Lakes Hume and Mulwala, parts of the Murray River (fig.1) Victoria, are near the boarder of Victoria and N.S.W. The aims of this study are three-folded:

1) to identify most of the phytoplankton species in both lakes,

2) to determine the trophic status of both lakes from the species composition and the phytoplankton quotients,

3) to survey the geographical distribution of the desmids seen.

The algae will be identify solely from their morphology. Attempts will be made to put them into existing taxa. In recent years advances have been made on the identification of algae by the use of cultures and scanning electron microscope. The latter is particularly useful in the case of Cosmarium sp. or the diatoms,etc. where the wall structures are the taxonomic criterion (Lyon 1969). Culture experiments are useful when one wishes to delimit species.

MATERIALS AND METHOD

20 (1974) Hume and 7 (1974) Mulwala fixed samples as well as some live samples, all were collected by Mr.R.L.Croome with a 20 μ pore net at various stations shown in fig. 1, were examined on a Carl Zeiss RA microscope fitted with a prism drawing system with internally reflected image, allowing binocular viewing while drawing. 1 (1968) Hume and 6 (1968-9) Mulwala fixed samples were also examined.

The 1974 samples were denoted as date/month of collection. The numbers in brackets following the Hume samples indicated the station numbers. All the 1968, 1969 samples were denoted by year/month/date/number of the sample.

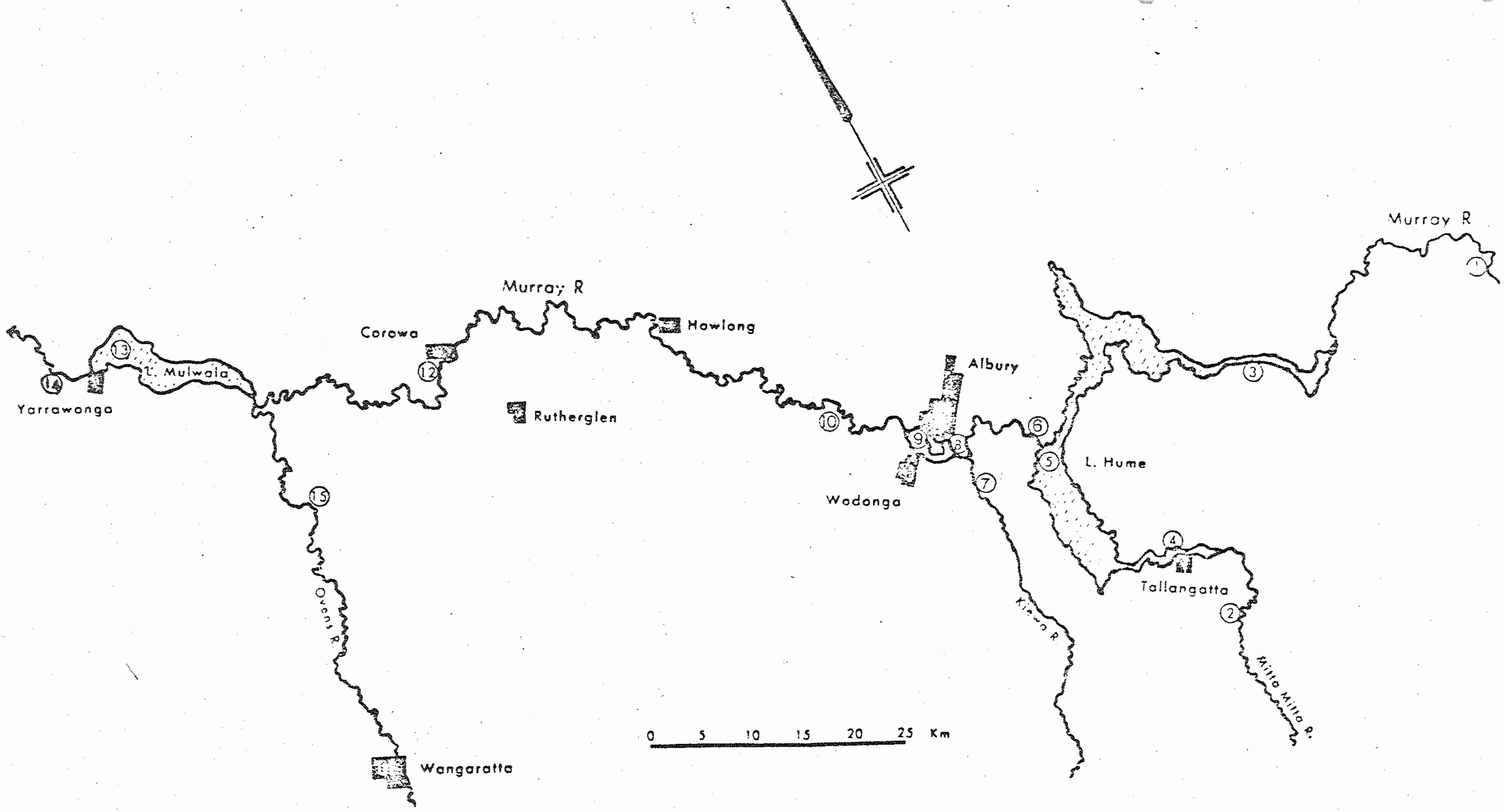


Figure 1. ECOLOGICAL STUDY — LOCATION OF SAMPLING STATIONS

RESULTS

TABLE 1: THE ALGAL COMPOSITION OF LAKES HUME AND MULWALA (1968, 1969 AND 1974)

+ = seen in 1974 samples

++ = seen in 1974, 1968, 1969 samples

- = not seen in 1974 samples

* = seen only in 1968/1969 samples

Species	Hume	Mulwala
Division Chlorophyta		
Class Chlorophyceae		
Order Volvocales		
Eudorina elegans Ehrenb.	+	+
Pandorina morum (Muller) Bory	+	++
Pleodorina californica Shaw	-	+
Sphaerocystis Schroeteri Chodat	++	++
Volvox cf. aureus Ehrenb.	+	*
" " Carteri Stein	*	*
" " globator Linnaeus	-	*
Order Ulotrichales		
Ulothrix subconstricta G.S.West	-	++
Order Oedogoniales		
Oedogonium sp.	++	-
Order Chlorococcales		
Actinastrum Hantzschii Lag.	+	+
Ankistrodesmus falcatus Corda	-	+
Botryococcus Braunii Kuetz.	++	++

Genus and species names are not underlined for simplicity of table.

Species	Hume	Mulwala
Coelastrum microporum Naeg.	+	-
" reticulatum (Dang.) Senn.	+	++
Dictyospaerium pulchellum Wood	+	+
Dimorphococcus lunatus A.Braun.	+	-
Kirchneriella lunaris(Kirchner) Moeb.	+	+
Micractinium pusillum Fres.	+	-
Nephrocytium Agardhianum Naegeli	+	+
Oocystis lacustris Chodat	+	-
" parva West & West	+	-
Pediastrum duplex Meyen forma	+	++
" " var. clathratum (A.Brun.) Lag.	+	*
" " var. gracillimum West & West	+	+
" " var. rugulosum Raciborski	+	*
" tetras (Ehrenb.) Ralfs	+	+
Scenedesmus denticulatus Lagerh. var. denticulatus May	-	+
" obliquus (Turp.)'Kuetz. var. dimorphus May	-	+
" opoliensis Richter	+	+
" quadricauda (Turp.) Breb.	+	+
" " " var. quadrispina (Chodat) G.M.Smith	-	+
Selenastrum westii G.M.Smith	+	+
Tetraedron gracile (Reinsch) Hansgirg	+	+
" hastatum(") "	+	-
" limneticum Borge var. gracile Prescott	+	-

Species	Hume	Mulwala
Tetraedron regulare Kuetz.	-	+
" victorieae Wolosz var. major Smith	+	-
Treubaria triappendiculatum Bernard	+	+
<u>Order Zygnematales</u>		
<u>Family Zygnemataceae</u>		
Cf. Mougeotia sp.	+	-
Spirogyra sp 1	-	+
" sp 2	+	*
<u>Family Desmidiaceae</u>		
Arthrodesmus constrictus G.M.Smith var. longispinus (Gronbl.)	+	+
" convergens Ehrenb.	-	*
Closterium aciculare T.West var. subpronum Wests	+	+
" ceratium Perty	-	+
" gracile Breb.	-	+
" Kutzingii Breb.	+	+
" moniliferum (Bory) Ehrenb.	+	+
" striolatum Corda	+	-
" Venus Kutz. var. inflatum Claassen 1961	+	-
Cosmarium bipunctatum Borgesen	+	-
" contractum Kirchn.	+	-
" granatum Breb. var. pyramidal Schmidle	+	-
" magnificum Nordst.	-	++
" cf. pseudonitidum Nordst.	-	+
" punctulatum Breb. var. subpunctulatum Borge	+	-
" quadrum Lund	-	++

Species	Hume	Mulwala
Euastrum anasatum (Ehrenb.) Ralfs	-	+
" cuspidatum var. goyazense Forster	+	+
" divergens Joshua	-	+
" elegans Kutz.	+	-
Gonatozygon kinahani (Archer.) Rabenh.	++	+
" monotaenium De Bory	+	-
Micrasterias Hardyi G.S.West	++	+
" decemdentata (Nag.) Archer.	-	+
" mahabuleswarensis Hobson	-	++
" thomassiana var. notata (Nordst.) Gronbl.	+	-
Pleurotaenium Ehrenbergii (Breb.) De Bory var. undulatum Schaarschmidt	+	-
Spondylosium planum (Wolle) West & West	+	*
Staurastrum anatoides Scott & Prescott	-	*
" arctiscon (Ehrenb.) Lund var. glabrum West & West	-	++
" asterias Nygaard	-	+
" dickiei Ralfs	+	++
" grande Bulhn. var. parvus West	-	*
" Freemanii West & West	+	-
" furcatum (Ehrenb.) Breb.	+	*
" leptocladum Nordst.	+	+
" nodulosum Prescott	+	+
" pachyrhynchum Nordst.	+	+
" patens Turner	-	*

Species	Hume	Mulwala
Staurastrum pingue Teiling	++	++
" " " (small form)	+	+
" cf. pinnatum Turner var. subpinnatum Schmidle	-	+
" Playfairi Scott & Prescott	+	++
" pseudosebaldi Wille var. planctonicum Teiling	-	++
" sebaldi Reinsch. var. ornatum Nordst.	-	*
" cf. subavicula West	+	-
" subgemmulatum West & West	+	+
" tetracerum Ralfs	+	++
" " " var. evolutum West & West	+	-
" tohopekaligense Wolle	+	*
" victoriense West	-	*
Staurodesmus cuspidatus (Breb.) Ralfs var. tricuspidatus (Breb.)	+	-
" triangularis (Lagerh.) Teiling	+	+
<u>Division Chrysophyta</u>		
<u>Class Chrysophyceae</u>		
Dinobryon divergens Imhof.	+	++
" sertularia Ehrenb.	+	-
Mallomonas akrokomos Ruttner	-	+
" splendens (G.S.West) Playfair	+	+
" sp.	+	+
Synura spinosa Korsh	++	++

Species	Hume	Mulwala
<u>Class Bacillariophyceae</u>		
<u>Centrales</u>		
Attheya Zachariasi J.Brun.	+	++
Cyclostella stelligera Cleve & Grun.	+	-
Melosira granulata Ralfs	++	++
" varians Agardh.	++	++
Rhizosolinia erensis H.L.Sm.	+	+
" " " " var. morsa West & West	+	+
<u>Pennales</u>		
Asterionella formosa Hass.	+	+
Cymbella cf. gastroides Kutz.	+	+
" lanceolata Ehrenb.	+	-
Epithemia sorex Kutz.	+	++
Fragilaria capucina Desm.	+	+
" sp.	+	-
Gomphonema Augur Ehr. var. Guatieri H.V.H.	-	+
" constrictum Ehrenb.	+	++
" " " var. capitatum Ehrenb.	+	+
Cf. Gyrosigma attenuatum	+	++
Cf. Navicula hennedyi	+	-
Nitzschia pelagica O.Mull.	+	+
Pinnularia abaujinsis (Pant.) Ross var. abaujinsis	-	+
Stauroneis fulmen var. capitata	-	*
Surirella Engleri O.Mull.	+	+
" spinifera Hust.	+	++

Species	Hume	Mulwala
Surirella tenera Greg.	+	+
Synedra acus Kutz.	+	++
" " var. radians (Kg.) Hust.	+	++
" ulna (Nitz.) Ehr. var. danica (Kg.) V.H.	+	-
Tabellaria flocculosa (Roth) Kutz. var. flocculosa Knudson	+	*
<u>Division Euglenophyta</u>		
<u>Class Euglenophyceae</u>		
<u>Order Euglenales</u>		
Euglena cf. gracilis Kleb.	-	+
" spirogyra Ehrenb.	+	+
Phacus tortus (Lem.) Skvortzow	+	-
" pleuronectes (Muell.) Dujardin	+	-
Trachelomonas armatus var. longispina (Playfair) Dêflandre	+	-
" " bacillifera Playf.	+	+
" " caudata Stein var. australica Playfair	+	-
" " hispida (Perty) Stein var coronata Lemm.	+	-
" " " " var. rectangularis Br. Schroder	+	-
" " scabra Playfair	-	+
" " superba Swirenko	+	+
" " volvocina Ehrenb. var. punctata Playfair.	+	+

Species	Hume	Mulwala
Division Pyrrhophyta		
Class Dinophyceae		
Order Peridiniales		
Ceratium hirundinella (O.Muell) Dujardin	+	+
Glenodinium sp.	+	-
Peridinium sp.	+	-
Division Cyanophyta		
Class Cyanophyceae		
Order Chroococcales		
Coelospharium Naegelianum Unger.	++	+
Microcystis aeruginosa Kutz.	+	+
" flos-aquae (Wittr.) Kirchner.	-	+
Order Nostocales		
Anabaena limnetica G.M.Smith	+	-
" spiroides Kleb.	+	+
Lyngbya palmarum Bruhl et Biswas	-	+
Oscillatoria curviceps Agardh ex Gomont	-	+
" lacustris (Kleb.) Geitler	-	+
" nigra Vaucher	-	+
" cf. subbrevis Schmidle	-	*
" waterbergensis Claassen 1961	-	*
Schizothrix rivulis (Wolle) Drouet	+	-

TABLE 2: <u>THE PHYTOPLANKTONQUOTIENTS OF LAKES HUME AND MULWALA</u>

	No of species	
	Hume	Mulwala
Myxophyceae	5	8
Chlorophyceae	29	24
Centrales	6	5
Euglenideae	10	6
Total	50	43
Desmidiaceae	34	30
Phytoplankton quotients	$\frac{50}{34} = 1.47$	$\frac{43}{30} = 1.43$

TAXONOMIC COMMENTS.

All dimensions are given in microns.

Abbreviations.

W = width	cpr = with processes
L = length	spr = without processes
Ist. = isthmus width	csp = with spines
dia. = diameter	ssp = without spines

Division Chlorophyta

Class Chlorophyceae

Volvocales

Eudorina elegans Ehrenberg. Pl 2 fig. 8

Smith 1920 Pl 19 fig. 1 p. 96

Prescott 1962 Pl 1 figs. 24-26

cell dia 8-10

colony dia 77-86

Eudorina is distinguished from *Pandorina* by its colony of distanced cells with one to several pyrenoids. (Prescott 1962). Playfair (1923) believed *P.morum* become regularly spherical and form *E.elegans*. Dr. P.Tyler (pers. comm.) thinks it probably does, too. When *P.morum* divides the mucilage expands and the colony then resembles (or equals) *E.elegans*.

E.elegans is widespread and has been recorded from Australia. (Hardy 1906, West 1909, Playfair 1916, 1923, Thomasson 1973). Bailey 1895 *P.morum* (pl. VIII fig. 8) is probably *E.elegans*.

Samples: Lake Hume 9/7(3), 11/9(5)

Lake Mulwala 10/2, 4/4, 680921/1.

Pandorina morum Bory Pl 2 figs 10,11

Smith 1920 Pl 19 figs 16,17 p. 95

Prescott Pl 1 fig 23 p. 75 (1962)

cell dia 8

colony dia 24-50

Playfair(1915)stated that the Australia plant differed from the European plant by having coenobia ovate. This is not correct because Smith (1920) and Prescott (1962) figured ovate P.morum from Wisconsin.

This alga is widespread. Previous Australian records- West (1909), Playfair (1915,1923).

Samples: Lake Hume 1/5(3), 30/5(5), 9/7(3), 10/7(3), 8/8(4),9/9(3), 11/9(5).

Lake Mulwala 4/4, 12/8, 681121/2, 680921/1.

Pleodorina californica Shaw Pl 2 fig. 9

Prescott 1962 Pl 2 fig. 1 p. 77

The colony (Pl 2 fig. 9) was viewed from the anterior pole where larger reproductive cells resided. (Prescott 1962).

Vegetative cells dia 4-5

Reproductive cells dia 8-9

Previous Australian record: none

Samples: Lake Mulwala 10/2.

Sphaerocystis Schroeteri Chodat Pl 4 figs. 10-12

Smith 1920 Pl 19 figs. 3-4

Prescott 1962 Pl 3 fig. 6 p. 83

Clusters of recently divided cells were somtimes within envelopes inside the colonial envolope.

cells dia 9-14

colony dia 40-126

Sphaerocystis Schroeteri and Planktosphaeria gelatinosa are so similar the only difference between them is the presence of several parietal, polygonal chloroplasts each with one pyrenoids in the latter. (Smith 1920). Pl 4 fig. 10 has one cell with three pyrenoids. It could be Planktosphaeria gelatinosa. Although it is possible the two species are forms of the same plant, West (1909) did not observed any life stages of Sphaerocystis Schroeteri(fig. 8, p. 76) that resemble Planktosphaeria gelatinosa.

Previous Australian record: West (1909).

Samples: Lake Hume 14/2(Dam), 7/3(3), 8/3(Tallangatta), 2/4(Tallan.) 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 30/5(3), 3/6(5), 8/7(5), 9/7(3), 10/7(3), 7/8(5), 9/9(3), 10/9(4), 11/9(5), 681122/3.

Lake Mulwala 10/2, 4/4 7/5, 4/6, 680921/1, 681121/2, 690206/1.

Volvox sp.

Three morphological forms of Volvox sp. were observed. (Pl 2 figs. 12-16). They could not be identified by Smith 1944 key because of the lack of all stages of asexual and sexual reproduction.

Volvox cf. aureus Ehrenberg. Pl 2 figs. 12-13

Smith 1920 Pl 18 fig. 20 p. 98

Smith 1944 fig. 3

The specimens may be Volvox aureus Ehrenberg. because of the presence of cytoplasmic connections. Volvox aureus is not the only species which possesses cytoplasmic connections. (Smith 1944).

cell dia 5-6

Samples: Lake Hume 14/2(Dam), 7/3(3), 8/3(Tallan.), 31/5.

Volvox cf. Carteri G.M. Smith Pl 2 figs. 15,16

Smith 1920 Pl 18 fig 1 p. 99

Smith 1944 fig. 37 as Volvox Carteri Stein.

The specimens have no cytoplasmic connections. Smith (1944) depicted Volvox Carteri Stein with undivided gonidia of equal size. The plant seen (Pl 2 fig. 15) may have some gonidia divided therefore some gonidia are bigger than others.

cell dia 4-5

colony dia 780

Samples: Lake Hume 681122/3

Lake Mulwala 680921/1, 681121/2.

Volvox cf. globator Linnaeus Pl 2 fig. 14

The pentagonal to hexagonal cells suggest Volvox globator L. (Smith 1920 Pl 18 fig. 3 p. 98, Smith 1944 fig. 7)

cell dia 5-6

Volvox globator Playfair (Playfair 1915, Pl 44 figs. 5-6, p. 341) and Volvox globator var. australis Playfair 1915, p. 342 are Volvox Merrilli Shaw according to Smith 1944.

Sample: Lake Mulwala 680921/1.

Ulotricales

Ulothrix subconstricta G.S.West Pl 5 fig. 5

The closest the Mulwala plants resemble is Ulothrix subconstricta G.S.West (Prescott 1962 Pl 6 fig. 11, p. 96, Ramanathan 1964 Pl 10 fig. 10G, p. 39). The plants differ from the above authers'in having chloroplasts extend throughout the entire length of cells but the length of chloroplasts compared with the cells'length is variable in Ulothrix sp. (Lokhorst & Uroman 1972).

The cell dimensions are comparable with those given by Ramanathan 1964. cell L 9, dia 6.

There is no previous Australian record. Smith (1920) was of the opinion that Ulothrix subconstricta is the only one of the order which has become established as a true member of the plankton.
Samples: Lake Mulwala 4/4, 680921/1.

Oedogoniales

Oedogonium sp. Pl 5 fig. 1

The Hume plants are Oedogonium sp.because cells possess scar rings. Also, they are unbranched filaments with cells showing a slight inflation toward one end. The chloroplasts are parietal, each containing several pyrenoids (Prescott 1962).

cell L 54-63
W 13-17

In differentiating the species of Oedogonium, size of vegetative cells, the shape and size of the oogonia, the form and decoration of the zygospore wall and the location of the antheridal cells are the most important differentiating and specific characters. (Prescott 1962). In the absence of these characters one cannot possibly do more than Oedogonium sp.
Samples: Lake Hume 3/5(Dam), 681122/3.

Chlorococcales.

Actinastrum Hantzschii Lag. Pl 3 figs. 1-5

There are two morphological forms of Actinastrum one of which is wider (Pl 3 figs. 1-3) than the other (Pl 3 figs. 4-5). Smith (1920) designated both forms as Actinastrum Hantzschii and Actinastrum gracillimum G.M.Smith respectively.

Playfair (1916), Haughey (1968 figs. 9,10) grouped Actinastrum with outer ends of cells acute and inner ends blunt of the same dimensions as both forms of the plants found in Actinastrum Hantzschii. Their grouping will be followed. Cell L 7-38, W 2-5..

Smith (1920) depicted a specimen (Pl 43 fig. 8) which resembled his *Actinastrum gracillimum* (Pl 43 fig. 4) and called it *Actinastrum Hantzschii var. elongatum* because of its larger size. It is possible that Smith s'*Actinastrum Hantzschii var. elongatum* are bigger cells of *Actinastrum gracillimum* and *Actinastrum gracillimum* and *Actinastrum Hantzschii* are forms of the same plant.

The multiple colony (Pl 3 fig. 5) is held together by lateral contact (Philipose 1967).

Previous Australian and New Zealand records: Playfair 1916, Scott & Prescott 1958, Haughey 1968.

Samples: Lake Hume 7/3(3), 1/5(3), 2/5(4), 3/5(Dam), 31/5(4),
3/6(5), 8/7(5), 9/8(5), 10/9(3), 11/9(5).

Lake Mulwala 4/4, 7/5, 4/6, 12/8.

Ankistrodesmus falcatus Corda Pl 3 fig. 6

Smith 1920 Pl 32 fig. 1

Prescott 1962 Pl 56 fig. 5

Philipose 1967 figs 121 a,c

Cell L 50

W 3

Ankistrodesmus falcatus Corda is widespread and has been recorded from Australia and New Zealand (Hardy 1906, West 1909, Playfair 1916, Scott & Prescott 1958, Thomasson 1973, and Maskell 1881, Haughey 1968).

Edward (1894) observed cells of *Ankistrodesmus falcatus* loosened in culture then curved like those of *Ankistrodesmus convolutus* (Philipose 1967 fig. 122 a-d) which are smaller. Haughey (1968) observed a gradation from curved, larger to straight, smaller cells in his samples.

Sample: Lake Mulwala 4/4.

<u>Botryococcus Braunii</u> Kuetz Pl 2 fig. 17

This alga is common and often abundant, especially in semi hard water lakes where it frequently is the dominant component of water bloom associations(Prescott 1962). It has been recorded from Australia. (Bailey 1893, Hardy 1906, West 1909, Scott & Prescott 1958, Thomasson 1973).

Samples: Lake Hume 2/5(4), 3/5(Dam), 681122/3.

Lake Mulwala 7/5, 681121/2.

<u>Coelastrum microporum</u> Naeg. Pl 3 fig. 16

Haughey (1969) fig. 4:1,1a

cell dia including shealth 14

Previous Australian and New Zealand records: West (1909),Scott & Prescott 1958, Thomasson (1973), Haughey 1969.

Samples: Lake Hume 3/5(Dam).

<u>Coelastrum reticulatum</u> (Dang.) Senn Pl 3 fig. 15

Smith (1920) Pl 42 fig. 4 p. 161

Bourrelly (1966) Pl 34 fig. 6

Prescott (1962) Pl 53 fig. 6 p. 230

The plants have cell dia with sheath of 5-6 which is in the range recorded by Smith (1920). Philipose (1967) figured <u>Coelastrum reticulatum</u> (Dang.) Senn. (fig. 142) which looked neither like the specimens nor the illustrations given by the above authôrs.

Previous Australian record: Playfair (1918).

Samples: Lake Hume 5/4(Dam), 3/5(Dam), 3/6(5).

Lake Mulwala 10/2, 690206/1.

<u>Dictyosphaerium pulchellum</u> Wood Pl 3 figs. 10,11

Smith 1920 Pl 20 fig. 13 p. 105

Prescott 1962 Pl 51 fig. 6

Dictyosphaerium pulchellum Wood observed (Pl3 figs. 10,11) do not have cells as round as those depicted by the mentioned workers but, according to Smith (1920) the cells are sphaerical when mature, sphaerical to ovoid when young. The Hume & Mulwala cells are not as ellipsoid as those of Dictyosphaerium ehrenbergianum Nag. (Haughey 1968 fig. 72). Dictyosphaerium pulchellum was given as a synonym of Dictyosphaerium ehrenbergianum (Bailey 1898).

Sometimes the colony envelope is not seen (Pl 3 fig. 11).

cell L 5-7

cell dia. 4-5

Dictyosphaerium pulchellum is widespread (Philipose 1967).

Previous Australian records: Schmidle 1896, Hardy 1906, West 1909, Croome & Tyler (1972), Thomasson (1973).

Samples: Lake Hume 8/3(Tallan.), 2/5(4), 3/5(Dam), 3/6(5), 8/7(5), 11/9(5).

Lake Mulwala 4/6.

Dimorphococcus lunatus A. Braun. Pl 3 fig. 14

Philipose 1967 fig. 115a p. 205

cell L 7

W 7-12

Previous Australian records: Scott & Prescott 1958, Thomasson 1973.

Samples: Lake Hume 3/5(Dam), 3/6(5).

Kirchneriella lunaris (Kirchner.) Moeb. Pl 3 fig. 14

Smith 1920 Pl 34 fig. 4

Philipose 1967 fig. 131

The following dimensions are within the range given by the above authors.

cell L 10-13

W 6-9

Kirchneriella lunaris is widespread (Smith 1920) and has been recorded from Australia (Bailey 1895, Schmidle 1896, Hardy 1906, West 1909, Playfair 1914, Thomasson 1973).

Bailey (1895) noted "------neither a gelatinous envelope nor a regular arrangement of groups into four appears remarkable-----" According to Philipose (1967) the gelatinous envelope is visible only after stainking. No gelatinous envelope was observed but cells were in groups of four. Pl3 fig. 14.

Samples: Lake Hume 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 3/6(5).

Lake Mulwala 10/2, 7/5.

Micractinium pusillum Fres Pl 2 fig. 18

Smith (1920) Pl 28 fig. 1-3

Haughey (1968) fig. 9:3a

cells dia. 4-5

setae L 10-14

Haughey (1968) recorded this form with rather short setae from NZ.

Previous Australian record: none

Samples: Lake Hume 2/5(4), 3/5(Dam), 3/6(5).

Nephrocytium Agardhianum Naegeli Pl 3 figs. 24-26

Smith (1920) differentiated genera Oocystis and Nephrocytium by their cell shape.

Cells ovoid to elleptic, never curved------------Oocystis

Cells ovoid to reniform, frequently curved-------Nephrocytium

Using the above key the plants (Pl 3 figs. 24-26) are Nephrocytium. They are Nephrocytium Agardhianum Naeg. (Philipose 1967, fig. 104b, p. 189). Cells L 12-21, W 5-11.

Previous Australian records: West 1909, Borge 1911, Playfair 1912, 1916, (varieties).

Samples: Lake Hume 2/5(4), 3/5(Dam), 31/5(4), 3/6(5), 10/7(3), 11/9(5).

Lake Mulwala 4/6, 7/5.

Oocystis lacustris Chodat And Oocystis parva West & West.

There are two morphological types of Oocystis in Lake Hume. One type has pointed ends which suggest polar thickenings (Pl 3 figs. 21-23). Their cells'shape and dimensions agree with those of Oocystis lacustris Chodat (Smith 1920 Pl 22 figs. 8-9 p. 112, Rehakova 1969 Tab. 1 fig. 6).

cell L 13-18

W 9-10

Another type (Pl 3 figs. 19-20) closely resembles Oocystis parva West & West (Smith 1920 Pl 22 fig. 6 p. 112). Although Smith (1920) stated this species had pointed ends, some of his cells (Pl 22 fig. 6) had rounded ends like the Hume plants. Rehakova 1969 figured Oocystis parva West & West of both round and pointed ends. The plants'dimensions agree with those of Oocystis parva given by Smith (1920).

cell L 14-15

W 7

West (1909) recorded both forms from Vic.

Playfair (1916) regarded both Oocystis lacustris & Oocystis parva as polymorphic forms of one organism. This is probably very correct. It is not known what initiates polar thickenings. One may culture Oocystis parva and find out if they form polar-thickenings in which case Oocystis parva and Oocystis lacustris are forms of one biological species.

Samples: Oocystis lacustris

Lake Hume 2/5, 31/5, 9/7.

Oocystis parva

Lake Hume 14/2(Dam), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 30/5(3), 9/7(3), 9/9(3).

<u>Pediastrum duplex</u> Meyen

The type form (Pl 4 fig. 4) and three varieties of <u>Pediastrum duplex</u> Meyen were found. Pl 4 fig. 4 is the type form (Smith 1920 Pl 46 fig 16). Cell dia. 10-22.

Samples: Lake Hume 8/3(Tallan.), 1/5(3), 2/5(4), 3/5(Dam),30/5(3), 3/6(5), 9/7(3).

Lake Mulwala 10/2, 4/4, 4/6, 680508/1, 680411/1, 690206/1.

<u>Pediastrum duplex var. clathratum</u> (Braun. A) Lagerheim Pl 4 figs. 1-2 (Smith 1920 Pl 47 fig. 3). Sulex (1969) in the recent European-monograph recorded this variety as <u>var. duplex</u> and stated it is synonymous with <u>P.duplex var. clathratum</u>. Cell dia. 7-11.

Samples: Lake Hume 5/7(2).

Lake Mulwala 681121/2.

<u>Pediastrum duplux var. gracillimum</u> W.& G.S West (Pl 4 fig. 3) (Smith 1920 Pl 47 figs. 8-11 p. 172, Haughey 1968 fig.6:3)

cell dia 8

Huber-Pestalozzi (1936) depicted <u>P.duplex var. gracillimum</u> with two cells in the middle as seen in one colony (Pl 4 fig. 6). Usually this <u>var. gracillimum</u> has no cells in the mid region as depicted in Pl 4 fig. 3.

Samples: Lake Hume 1/5(3), 3/5(Dam).

Lake Mulwala 12/8.

<u>Pediastrum duplex var. rugulosum</u> Raciborski Pl 4 fig. 7 Sulek 1969 Beil 4 fig. 4.

cell dia. 11-17

Bailey (1895) recorded this variety as <u>P.duplex</u> from Queenland (Pl VII fig. 9).

Samples: Lake Hume 8/3(Tallan.)

Lake Mulwala 681121/2, 690206/1.

The arrangement of big cells with two cells in the mid-region(Pl 4 fig. 5) is not recorded in the recent European monograph by Sulex 1969. Cell dia 15. Sample: Lake Hume 3/5(Dam).

Smith (1920) stated that in many cases the marginal cells of P.duplex and the variety clathratum have a tuft of long hyaline setae at the apex of the projection. Their function is to give buoyancy to the colonies when living under pelagic conditions. These hyaline setae are sometimes observed on P.duplex (type form) but not on the variety clathratum.

P.duplex and its varieties have been recorded from Australia and New Zealand (Bailey 1895, Hardy 1906, West 1909, Thomasson 1973, Haughey 1968).

Pediastrum tetras (Ehrenb) Ralfs Pl 4 figs. 8,9.

Prescott (1962) Pl 50 fig. 6

Sulex (1969) Taf 12 fig. 6

cell dia. 9-13

P.tetras has been recorded from Australia and New-Zealand (Bailey 1893, Hardy 1906, West 1909, Borge 1911, Scott & Prescott 1958, Spencer 1882, Nordstedt 1888).

Samples: Lake Hume 3/5(Dam), 10/9(4).

Lake Mulwala 10/2, 4/4, 681121/2.

Scenedesmus denticulatus Lagerh. var. denticulatus May 1973 Pl 5 fig 16 May 1973 p. 444.

= Scenedesmus denticulatus Lagerh. (Haughey 1969 fig. 5:3, Philipose 1967 fig. 176 a-c).

cell L 13-14

W 6-8

teeth L 2-4

Previous Australian and New Zealand records: May (1973, other varieties), Haughey 1969.

Trainor in 1966 regarded Sc. denticulatus as a stable species (May 1973).

Samples: Lake Mulwala 4/4, 7/5.

Scenedesmus obliquus (Turp.) Kuetz. var. dimorphus May 1973 p. 438.
= Scenedesmus dimorphus (Turp) Kuetz. (Philipose 1967 fig. 160a,
Haughey 1968 fig, 10:4).

cell L 18-29
W 3-6

According to Philipose (1967) 8-celled colonies are always in subalternating series.A linear 8-celled colony was observed(P15 fig. 6).

May (1973) gave a list of previous Australian records of the variety. Haughey (1968) recorded it as Sc. dimorphus from NZ.

Samples: Lake Mulwala 10/2, 4/4, 4/6.

Scenedesmus opoliensis Richter Pl 5 figs. 12-15.
Smith 1920 Pl 41 figs. 8-11
May 1973 p. 446

cell L 15-22
W 4-5
spine L 14-23

The navicular shape of the cells, their lateral contact in the median third only, together with the beak-like instead of rounded apex separate this species from Sc. quadricauda (Smith 1920). May (1973) distinguished Sc. opoliensis from Sc. quadricauda by having cells of coenobe join in median third of their length.

W.& G.S. West (1902 p. 197) stated Sc. opoliensis Richter is a synonym of Sc. quadricauda var. opoliensis (Richter) West & West.

The record of a tendency of Sc. opoliensis cells to assume a more cylindric form like those of Sc. quadricauda (Haughey 1968) indicates the two species may be forms of the same organism. Only culture experiments would prove the forgoing statement. May (1973) regards Sc. opoliensis as one of the 14 recognised species in Australia.

Previous Australia and New Zealand records: May (1973), Haughey (1968).

Pl 5 figs. 12,15 are 2-celled coenobia which may be obtained under high B.O.D. loadings (Haughey 1968).

Samples: Lake Hume 5/7(2).

Lake Mulwala 4/4, 7/5.

Scenedesmus quadricauda (Turp) Breb. Pl 5 figs. 8-10

= Scenedesmus quadricaudus (Turp.) Breb. (May 1973 p. 445).

Pl 5 fig. 8 is the type form of Sc. quadricauda . The dimensions are in the range of the type form s' and var. maximus s' as given by Smith (1920).

4-celled coenobia L 21-29

W 16-21

Spine L 15-23

A small form of Sc. quadricauda (Pl 5 fig. 10) could be either a daughter coenobium of Sc. quadricauda or Sc. quadricauda var. parvus West & West (Smith 1920 Pl 40 fig. 7). The dimensions are in the range given for var. parvus given by Smith (1920).

4-celled coenobia L 16

W 9

Spines L 11

An 8-celled coenobium (Pl 5 fig. 9) may be Sc. quadricauda var. Westii (Smith 1920 Pl 41 fig. 3). The dimensions are smaller than those given by Smith (1920).

8-celled coenobium L 12-14

W 4

Despite the various variety names recorded in the literature, all _Sc. quadricauda_- like plants (Pl 5 figs. 8-10) will be grouped in _Sc. quadriquada_. There are experimental-results and field observation that _Sc. quadricauda_ change number of cells in a coenobium(2, 4, 8) and the size of cells(Komarek & Ruzicka 1969, May 1973). With these variation in mind it is doutful if _Sc. quadricauda_ is a stable species in the sense that they do not vary greatly with conditions of culturing, an idea of Trainor s'in 1964, 1966 (from May 1973).

Sc. quadricauda have been recorded from Australia and New Zealand (May 1973, Haughey 1968, Maskell 1881).

Samples: Lake Hume 2/5(4), 8/8(4).

Lake Mulwala 10/2, 4/4, 7/5.

Scenedesmus quadricauda var. quadrispina (Chodat) G.M.Smith.

The plant depicted in Pl 5 fig. 11 may be _Sc. quadricauda var. quadrispina_ (chodat) G.M.Smith(Philipose 1967 fig.187d). The plant s'dimensions agree with those given by Philipose(1967) but its cells join at the median third of their length.

cells L 11

W 6

spines L 4

Sc. quadricauda var. quadrispina has been recorded from Australia as _Sc. quadricaudus var. quadrispina_ (May 1973 p. 446).

Sample: Lake Mulwala 4/4.

Selenastrum westii G.M.Smith Pl 3 figs. 7-8

The plants are identified as _Selenastrum westii_ because the strongly curved cells have their convex faces toward one another. (Smith 1920). Their dimensions are comparable with those given by Smith 1920 Pl 31 figs. 8-10 p. 132. Cells L 20, W 3.

Smith (1920) stated *Selenastrum westii* had no pyrenoids. Sometimes one pyrenoid per cell was observed in Lakes Hume and Mulwala plants. Prescott (1962, p. 257) was not sure if pyrenoids of this species were lacking.

Selenastrum species are distinguished from *Ankistrodesmus species* by both vegetative cells (and autospores when liberated) have the characteristic convex faces toward one another in a colony (Smith 1920). Species of *Selenastrum* should be compared with those of *Kirchneriella* which have scattered lunate cells within a gelatinous envelope(Prescott 1962 p. 256).

There is no previous Australian record of the species.

Samples: Lake Hume 31/5(4),

Lake Mulwala 10/2, 4/4.

Tetraedron gracile (Reinsch) Hansgirg Pl 4 figs. 13,14

Smith 1920 Pl 26 figs. 1-5, p. 122

Philipose 1967 figs. 69 a-c, p. 154

The plants'dimensions are in the range given by Philipose (1967). Wsp 34-36, Wsp 10-11.

There is no previous Australian record.

Samples: Lake Hume 1/5(3), 3/5(dam),

Lake Mulwala 12/8.

Tetraedron hastatum (Reinsch) Hansgirg Pl 4 figs. 15,16

Scott & Prescott 1958 fig. 24:16

The plants differ from Smith s'(1920 Pl 25 fig. 18) in having two terminal spines.

Lcp 36

W of base of process 7

The general shape of the cell is similar to that of *Tetraedron limneticum* Borge but there is no branching of the processes.

(Smith 1920). One specimen (Pl 4 fig. 16) had just branched suggesting Tetraedron hastatum and Tetraedron limneticum may be forms of the same biological species.

Previous Australian record: Scott & Prescott 1958. Playfair (1916) recorded T. hastatum var. elegans from NSW.

Sample: Lake Hume 1/5(3).

Tetraedron limneticum Borge var. gracile Prescott Pl 4 figs. 17,18

Philipose 1967 fig. 73

Lcp 37-38

dia. of base of process 7-8

There is no previous Australian record. This variety differs from the type in being smaller and having bases of the processes adjoining so there is scarcely a cell body (Prescott 1962).

Samples: Lake Hume 8/3(Tallan.), 3/5(Dam), 30/5(3).

The mentioned three Tetraedron species may be forms of the same biological species. As a rule in T. limneticum the processes are tetrahedral while in the majority of cases those in T. gracile are in the same plane (Thomasson 1965) but Thomasson (1965) found a plant which looks like T. gracile but has 6 processes which are directed from everywhere. (fig. 3:6) He called his plant T. limneticum.

Tetraedron regulare Kuetz. Pl 4 fig. 20

Prescott 1962 Pl 60 fig. 25 p. 269

Philipose 1967 fig. 60a p. 145

cell dia. 21

Previous Australian records: Schmidle 1896, Scott & Prescott 1958.

Sample: Lake Mulwala 10/2.

Tetraedron Victorieae Wolosz. _var. major_ G.M.Smith Pl 4 fig. 19

Smith 1920 Pl 24 figs. 21, 22

Philipose 1967 fig. 63d

Lcp 42

W 20

There is no previous Australian record.

Sample: Lake Hume 5/4(Dam), 2/5(4), 3/5(Dam).

Treubaria triappendiculatum Bernard Pl 3 fig. 17

Philipose 1967 fig. 32 p. 107

The spines were observed to vary from 3-4. The dimensions are comparable to those given by Philipose (1967).

cell csp 39-41 in dia.

spine 32-34 long and 2-3 broad at base.

Playfair (1918) recorded _Bernardia tetraedrica_ n. sp. (Pl VII fig. 12) from NSW. His plant was slightly smaller than _Treubaria triappendiculatum_. Playfair s'plant may be the same as the Hume and Mulwala plants.

Sample: Lake Hume 2/5(4),

Lake Mulwala 10/2.

An identified plant Pl 3 fig. 18

The filaments were arranged in a tetrahedron structure.

Samples: Lake Hume 8/3(Tallan.), 30/5(3), 10/7(3), 7/8(3), 8/8(4).

Lake Mulwala 12/8.

Order Zygnematales

Family Zygnemataceae

Cf. _Mougeotia sp._ Pl 5 fig. 4

The plants may be _Mougeotia sp._ because of the band-like chloroplasts. No drawings of any plants were found to match the plants.

cell L 18-36

W 3-4

To identify Mougeotia sp. one must know its mode of reproduction (by conjugation or by aplanospores or both), structure and position of the zygospore formed, and finally the size of the vegetative cells(Prescott 1962).

Samples: Lake Hume 2/5(4), 9/9(3).

Spirogyra sp. 1 Pl 5 fig. 3

The curvature of the cell tempts one to identify it as Spirotaenia condensata. Since a lot of workers (West & West 1904 Pl 2 figs. 7-8, Krieger 1937 Taf 2 fig. 1, Bourrelly 1966 Pl 84 fig. 9, Prescott 1966 Pl 11 fig. 8) depicted Spirotaenia condensata as having much more rounded ends and a thicker band of chloroplasts than the Mulwala plant, the plant(Pl 5 fig. 3) is a cell of Spirogyra species s'filament. Reproductive structures (conjugation tubes, zygospores) are needed to identify the species.

L 151

W 16

Sample: Lake Mulwala 10/2.

Spirogyra sp. 2 Pl 5 fig. 2

L 162

W 41

Samples: Lake Hume 10/7(3).

Lake Mulwala 681121/2.

Family Desmidiaceae

Arthrodesmus convergens Ehrenb. Pl 5 fig. 17

= Staurodesmus convergens (Ehrenb.) Teiling 1948 var. Laportei Teil.

West & West 1912 Pl CXVI figs. 7-12, p. 107

Smith 1924 Pl 84 fig. 6 p. 126

Frere-Irenee-Marie 1939 Pl 60 fig. 1

Teiling 1967 Pl 25 fig. 4 p. 588

Lsp 60, Wsp 55, spines L 10, Ist. 14

Previous Australia and New Zealand records: Borge 1896, Hardy 1906, Maskell 1883, 1889, Nordstedt 1888.

Sample: Lake Mulwala 680921/1.

Geographical distribution: widespread (West & West 1912).

Arthrodesmus constrictus G.M.Smith var. longispinus (Gronbl.)

Pl 7 figs. 14,15

Apart from having more incurved spines the Hume and Mulwala plants resemble Arthrodesmus constrictus var. longispinus (Scott & Prescott 1961 Pl 36 fig. 2).Their dimensions are comparable.

Lssp 29-33, Wcsp 39-62, Ist. 5-6, Spines L 7-22

Previous Australian record: none

Samples: Lake Hume 14/2(Dam), 2/5(4), 3/5(Dam), 8/3(Tallan.).

Lake Mulwala 4/4, 7/5.

Geographical distribution: The Amazon Basin, Brazil (Scott, Gronblad, & Prescott 1965) Wisconsin, Canada(Smith 1921 forma).

Closterium aciculare T. West var. subpronum West & West Pl 6 fig. 1

West & West 1904 Pl XXIII figs. 4,5 p. 175

L 371-577-766

W 5-7

Apex 2

In this variety cells commenly more elongate than in the type, very slightly sigmoid (West & West 1904).

Previous Australian records: West 1909, Scott & Prescott 1958 fig. 7:16, Thomasson 1973, Prescott & Scott 1952 forma).

Samples: Lake Hume 8/3(Tallan.), 1/5(3), 2/5(4), 3/5(Dam.),31/5(4), 3/6(5), 5/7(2), 8/7(5).

Lake Mulwala 4/4, 7/5, 4/6.

Geographical distribution : Germany, New Zealand (West & West 1904).

Closterium ceratium Perty Pl 3 fig. 3

The closest plant for Pl 6 fig. 3 is Closterium ceratium (Pl XXIII figs. 6,8 West & West 1904). The dimensions are in the range given by West & West (1904) who also stated that this species' apices are the sharpest ones met with in the whole genus.

cell L 210, W 5

There is no previous Australian record.

Sample: Lake Mulwala 4/4.

Geographical distribution: England, France, Germany, Switzerland, Austria & Galicia, Sweden (West & West 1904).

Closterium gracile Breb Pl 6 fig. 4

The morphology of Pl 6 fig. 4 resembles most to Closterium gracile Breb. (Pl XXI fig. 10 West & West 1904 p. 166, Krieger 1939 Taf. 30 figs 7-9). The dimensions are within the range given by West & West (1904).

cell L 188, W 5

Previous Australian records: Schmidle 1896, Bailey 1893, 1895 Pl X fig. 18, Hardy 1906, Borge 1911, Playfair 1914, 1915, Prescott & Scott 1952).

Sample : Lake Mulwala 4/4.

Geographical distribution: widespread (West & West 1904).

Playfair (1915) stated Brebisson s'plant had blunt ends. The shape of apices does vary. Frere-Irenee-Marie (1939) figured two Closterium gracile with very pointed apices. (Pl 3 figs. 15,16). Gronblad & Croasdale (1971) figured Cl. gracile with narrow apices than the Mulwala plant s'.

Closterium Kutzingii Breb Pl 6 fig. 2

West & West 1904 Pl XXV fig. 19 p. 186.

L 469, W 16, Apex 2

Previous Australia and New Zealand records: Möbius 1892, Schmidle 1896, Bailey 1898, Hardy 1906, West 1909, Prescott & Scott 1952, SCOTT + PRESCOTT 1958, Thomasson 1973, Norstedt 1888, and Haughey 1969 who noted that a few cells from a polluted farm pond were noticeably more curved towards the extremities.(figs. 5, 5a).

Samples: Lake Hume 2/5(4), 3/5(Dam), 3/6(5), 9/9(3).

Lake Mulwala 12/8.

Geographical distribution: widespread (West & West 1904).

Closterium moniliferum (Bory) Ehrenb. Pl 6 figs. 5,6

West & West 1904 Pl XVI figs. 15,16

Krieger 1937 Taf. 18 figs 6,7

Smith 1924 Pl 52 fig. 10

Bicudo 1969 Tab. 117 fig. 38

L 201-260, W 38-46

Although West & West (1904) stated Cl. moniliferum had broad and rounded ends and one central row of pyrenoids, the species with acute ends and ones that had many rows of pyrenoids had been reported (Frere-Irenee-Marie 1939 Pl 5 fig. 2,1 and Prescott 1966 Pl 2 fig. 6 respectively).

Since cell dimensions are variable and the Hume & Mulwala plants sometimes were seen to exhibit one character each of Cl.Leibleinii (acute apices) and Cl.Ehrenbergii (many rows of pyrenoids). The three taxa may be forms of one species as suggested by Playfair 1914. Playfair (1914) did not provide drawings and description of the zygospores of Cl.Ehrenbergii and Cl. moniliferum which he claimed to be identical (p. 100).

Previous Australian and New Zealand records: Playfair 1914, Maskell 1883, Spencer 1882, Norstedt 1888.

Samples: Lake Hume 30/5(3), 9/7(3), 10/7(3), 7/8(3), 8/8(4), 9/9(3).

Lake Mulwala 12/8.

Distribution: widespread (West & West 1904, Claassen 1961).

Closterium striolatum Corda Pl 6 fig. 7

The truncate ends, the dimensions and the number of striation on the wall of the Hume plant agree well with Cl. striolatum (Krieger 1937 Taf. 28 fig. 9, Thomasson 1967 fig. 4:5). The Hume plant,Pl 6 fig. 7,has wider cell than Krieger s'drawing. However judging from the dimensions given by Krieger,his plant may be wider than the Hume s'.

L 230-330, W 29-30, Apices 9, 14 striation across wall.

Although West & West (1904) stated it exhibited little variation as far as the cell s'shape was concerned Bailey (1898) figured Cl.striolatum with obtuse round ends (Pl VII figs. 1a,b) and Borge (1903) figured Cl. striolatum which curved more than Wests'plants(Tab. 1 fig. 12).

Cl.striolatum Corda have been recorded from Australia & New Zealand (Raciborski 1892, Bailey 1898, Hardy 1906, Harrop 1869, Spencer 1882, Maskell 1881, 1883, Prescott & Scott 1952).

Based on the dimensions and the morphology given by Rich (1932) Cl.Hutchinsonii sp. nov.(figs. 5 d-g) are Cl.striolatum. Rich (1932) was not justified in creating this new species on the basis of minor morphological variations. It was stated Cl. Hutchinsonii had straighter inner margin and narrower apices.

Samples: Lake Hume 7/8(3), 10!9(4).

Distribution: widespread (West & West 1904).

Closterium Venus Kutz. var. inflatum Claassen 1961 Pl 6 fig. 8

Pl 6 fig. 8 was an empty cell with a distinct inflation in the mid-cell region. Apart from being more curved this specimen resembles Cl.Venus var inflatum (Tab. 6 fig. 17 Claassen 1961).

L 54-153, W 9-13

They are longer than Claassen (1961) s'plants(L 68-70, W 9-10). Specimens which curved less than the drawing were also observed.

West (1909) and Maskell (1883) recorded Cl.Venus from Australia and New Zealand. The Hume plants also resemble Cl.dianae var. compressum (Krüger 1937 Taf. 19 fig. 14) but the latter are 2-3 times longer. Maskell (1883) noted Cl.Venus and Cl.dianae are similar and the former are smaller. It was proposed that sexual morphology be an essential feature in the identification of taxa within the Cl.Venus-Cl.diana complex(Cook 1963).

Sample: Lake Hume 8/8(4).

Geographical distribution: Cl. Venus are widespread(West & West 1904).

Cosmarium bipunctatum Borgesen Pl 5 figs 22-24

West & West 1908 Pl LXXXV fig. 6

Forster 1969 Taf. 16 fig. 12

The presence of the two mid granular structures suggests Cosmarium bipunctatum. The Hume plants differ from the above authors' in having apecies devoid of granules and being slightly bigger.

L 25-27, W 21-23, Ist. 7-8

Pl 5 figs. 22, 24 are probably Cos.bipunctatum because they are similar to fig. 23 which has been identified as Cos.bipunctatum. From the end view the plant (fig. 22) seems to possess central granular structures but the front view does not review them.

There is no previous Australian record.

Samples: Lake Hume 8/3(Tallan.), 2/5(Tallan.).

Geographical distribution: Brazil, England, (West & West 1908)

Sao Paulo (Borge 1918).

Cosmarium contractum Kirchn. Pl 7 fig. 6

West & West 1905 Pl LXI figs. 23-25 p. 170

Gronblad 1960 Pl XIV fig. 27

Scott & Prescott 1961 Pl 27 fig. 4

Another similar plant is Spondylosium monoliforme Lundell. Since the Hume plant consists of two cells and not a string of them, a character of Spondylosium sp.(West & Carter 1923), it may be Cosmarium contractum.

L 28-32, W 22-23, Ist. 10

Previous Australian records: Hardy 1906, West 1909.

Sample: Lake Hume 7/3(3).

Geographical distribution: widespread (West & West 1905).

cosmarium granatum Breb. f. pyramidal Schmidle Pl 5 fig. 19

Gronblad, Scott & Croasdale 1964 Pl IV figs. 76, 77

Forster 1965 Taf. 5 fig. 4, Taf 11 fig. 29

Prescott 1966 Pl VIII fig. 46

The plant s'dimensions are in the range as those given by Forster (1965).

L 43, W 27, Ist. 7, Apex 7.

Bailey (1898) recorded Cos.granatum var. gibbosum Schmidle 1896(Pl 2 figs. 8a, b) which also looks like the Hume plant. It is possible that Cos. granatum var. gibbosum and f. pyramidal are the same plant.

Gronblad (1960) stated Cos.granatum Breb. is a most variable species. In 1942 he gave various forms of Cos. granatum (Taf. II figs. 22-25). They differed in size, the shape of sinus, the extent of cell wall granulation. Bailey (1898) gave no description for Cos. supergranatum n. sp. (Pl III fig. 5). His new species looks so much like the Hume plant they may be the same biological species.

The Hume plant differs from the type in not having the sinus apical dilation as depicted in West & West 1904 Pl LXIII figs.1-4.

Previous Australian and New Zealand records: Borge 1896, Hardy 1906, West 1909, Borge 1911, Maskell 1881, Nordstedt 1888.

Sample: Lake Hume 30/5(3).

Geographical distribution: widespread (West & West 1905, Claassen 1961).

Cosmarium magnificum Norstedt Pl 5 fig. 20

The outline, the large and small pores in the mid region of each semicell and the size are similar to those of Cos. magnificum Norstedt (Norstedt 1888 Tab. 6 fig. 19 p. 62). The only difference is the shape and the width of the sinus. Nordstedt s'plant has narrow sinus with dilated ends.

L 118, W 91, Ist. 46

The apices of some Mulwala specimens are smooth like those of Nordstedt s'plant while others'are not. Skuja (1949) figured Cos.magnificum Nordst. var. subcirculare Skuja (Taf. XXXII fig. 8) with not smooth apecies.

Thomasson (1965) gave a photo of Cos.decoratum which is similar to Cos. magnificum in outline but is about 30 μ smaller in length and width. His photo was so dark any wall structure (if any) could not be seen(photo h fig. 9:8). Cos. magnificum seems closely related to Cos. multiordinatum West & West var. africanum Bourrelly (Bourrelly 1957 Pl 11 fig. 96) which,according to Lind (1967 Pl 6 fig. 4) have the big and small granules confined to the central area.

There is no previous record of Cos. magnificum in Australia. Nordstedt (1888) first reported it from New Zealand. Maskell (1889 p. 6) stated Cos. gemmiferum is Cos. magnificum. His 1883 drawing of Cos. gemmiferum (Pl XXIV fig. 4) showed neither the big and small central pores nor the characteristic outline of Cos. magnificum which is truncate. He stated Cos. gemmiferum was a big desmid but gave no dimensions.

Samples: Lake Mulwala 4/4, 680508/1

Geographical distribution: Australia & New Zealand and perhaps Africa (as Cos.multiordinatum West & West var. africanum Bourrelly).

Cosmarium pseudonitidum (cf.) Nordst. Pl 7 figs. 19-22

The closest plant that looks nearly like the Mulwala plants in all views is Cosmarium pseudonitidum Nordstedt(Nordstedt 1872 fig. 4 p. 46). The Mulwala plants are smaller than Nordstedt s' plant whose dimensions are in brackets.

L	26-32	(42)
W	24	(33)
Ist.	6	(10)

Mucilagenous strands were sometimes observed around the plants (Pl 7 fig. 22). Nordstedt (1872) did not mentioned any mucilagenous strands.

There is no previous record of the species.

Sample: Lake Mulwala 4/4.

Cosmarium punctulatum Breb. var. subpunctulatum (Nordst.) Borgesen Pl 5 fig. 21

West & West 1908 Pl LXXXIV figs. 15-20

Smith 1924 Pl 57 fig. 29

Forster 1965 Taf. 7 fig. 10

Smith (1924) described this variety as "semicells with granules of central area conspicuously larger than those near the margin. The arrangement of granules at centre generally not following a definite pattern".

L 49, W 37

Gronblad (1926 Taf. II figs. 75,76) Cos.multiundulatum n. sp.

resemble the Hume plants. His new species is probably Cos. punctulatum var. subpunctulatum. Norstedt (1888) raised this variety to a specific rank (Tab. 5 fig. 8).

Previous Australian and New Zealand records: Borge (1896, 1911, Scott & Prescott 1958 fig. 14:7, and Mobius 1892, Hardy 1906, West 1909, Bailey 1893 as Cos. subpunctulatum (Breb.) Nordstedt.

Samples: Lake Hume 8/3(Tallan.), 2/5(Tallan.).

Geographical distribution: widespread (West & West 1908).

Cosmarium quadrum Lund Pl 5 fig. 18

West & West 1912 Pl C figs. 3-6, p. 21

Thomasson 1965 fig. 9:5

L 65, W 64

The dimensions are in the range given by West & West 1912. From the end view the intermingle of large and small granules was observed only in the mid region.

Previous Australian and New Zealand records: Bailey 1898, West 1909, Flint 1966.

Samples: Lake Mulwala 4/4, 680411/1.

Geographical distribution: widespread (West & West 1912).

Euastrum anasatum (Ehrenb.) Ralfs Pl 7 fig. 8

Krieger 1937 Taf 58 fig. 1 p. 484

The Mulwala Plant dimensions are within the range given by Krieger (1937).

L 85, W 40, Its. 12

The facial swellings on each semicell were not observed. Their number and disposition along with the proportion of semicell base and apex do vary (Prescott & Scott 1966).

Previous Australian records: Harrop 1869, Mobius 1892, Bailey 1893, Borge 1896, 1911, Maskell 1883, Norstedt 1888).

Hardy (1906) doubted if Euastrum affine Ralfs could be Euastrum anasatum Ralfs. From Pl 35 figs. 11,12 West & West 1905 of E.affine the morphology of these two plants are quite different.

West & West (1905, Pl XXXVI fig. 10) and Frere-Irenee-Marie (1939 Taf. 40 fig.8) recorded with one lateral swelling on each side of a semicell and called E.anasatum. Sometimes such a plant is called E.obesum var. crassum (Pl 1 fig. 23 Prescott & Scott 1942). E.cuneatum (Bourrelly 1957 Pl 2 fig. 14) also resembles the Mulwala plant. Perhaps all these taxa refer to the same biological species.

Sample: Lake Mulwala 4/4.

Geographical distribution: widespread (West & Carter 1923, Claassen 1961).

Euastrum cuspidatum var. goyazense Forster 1969 Pl 7 figs. 9-11

The closest plant that looks nearly like the Hume and Mulwala s'is Euastrum cuspidatum var. goyazense Forster (Forster 1969 Taf. 9 fig. 20). Their sinus shape is the same. The Hume and Mulwala plants differ from Forster s'plants in having three pyrenoids per semicell instead of one, and they have less number of spines on polar lobes. Their dimensions are comparable.

Lcsp 22-26, Wcsp 23-29, Ist. 5

Forster (1969) stated its basinonym was Euastrum subtile Borge var. goyazense (Forster 1964 Taf. 40 fig. 19), its synonym was Euastrum cuspidatum Wolle var. subtile (Borge).

There is no previous Australian record but this plant has been seen in Lake Sorell, Tas. (Dr. P.A.Tyler pers. comm.).

Samples: Lake Hume 5/4(Dam), 1/5(3), 3/6(5), 8/7(5).

Lake Mulwala 4/4, 7/5, 4/6.

Geographical distribution: Brazil (Scott, Gronblad & Croasdale 1965) as Euastrum cuspidatum Wolle var. subtile, (Borge 1918) as E. subtile,

North Carolina (Schumacher et al 1966) as Euastrum cuspidatum Wolle.

Euastrum divergens Josh. Pl 7 fig. 12

The Mulwala plant resembles closely Euastrum divergens Josh. (fig. 5:2 Scott & Prescott 1958). The original plant of Joshua s'(1886 Pl 23 fig. 9) had more pointed spines on each lobe and its sinus is wider open.

L 51-60, Wcsp 48-56, Its. 7-12

There are many varieties of Euastrum divergens because of the variation in the pattern, length and the number of terminal spines on each lobe, the shape of the central protuberance.

Previous Australian records: Scott & Prescott (1958), Borge (1896) recorded Euastrum divergens var. australianum Borge (Tab II fig. 15) from Queenland. His plant had fewer spines which were more pointed and a more open sinus when compared with the Mulwala plant.

The Mulwala Euastrum divergens were seen to have spine ornamentation on each semicell lobe.

Sample: Lake Mulwala 10/2.

Geographical distribution: Burma (Joshua 1885), Africa (Lind 1967),

Australia.

Euastrum elegans (Breb.) Kutz. var. elegans forma Pl 7 fig. 7

West & Carter 1923 Pl 38 fig. 16

Gronblad, Scott & Croasdale 1964 Pl IX fig. 210 p. 13

L 31, W 19, Ist. 5

These dimensions are comparable with those given by the above authors.

Previous Australia and New Zealand records: Scott & Prescott 1958, Maskell 1881, Nordstedt 1888.

Geographical distribution: widespread (West & Carter 1923).

Sample: Lake Hume 3/5(Dam).

Gonatozygon kinahani (Archer) Rabenh Pl 7 figs. 2,3

Frere-Irenee-Marie 1939 Pl 66 fig. 25

Forster 1969 Taf. 1 fig. 9

West & West (1904) showed the chloroplast bands of Gonatozygon kinahani were not continuous as seen in those of the Hume and Mulwala and Forster s'plants.

L 185-198, W 9-13, pyrenoids 10-12 per chloroplasts band.

The dimensions are in the range given by the above authors.

West & Carter (1923) and Krieger (1937) figured Roya cambrica West var. limnetica West (Pl CLXVI fig. 14 p. 260 and Taf. 5 fig. 10 respectively) of the same morphology but of smaller size when compared with the Hume and Mulwala plants. The two taxa seem closely related.

Gonatozygon kinahani have been recorded from Australia and New Zealand(West 1909, Playfair 1912, 1914, Flint 1966).

Samples: Lake Hume 14/2(Dam), 2/5(4), 9/9(3), 681122/3.

Lake Mulwala 10/2.

Geographical distribution: Canada (Frere-Irenee-Marie 1939),
Central Africa (Forster 1969),
Italy, Siam(var.), U.S.A.(Wests 1904).

Gonatozygon monotaenium De Bory Pl 7 fig. 4

West & West 1904 Pl 1 figs. 1-7 p. 30

Forster 1965 Taf. 1 fig. 4

The dimensions fall into the range given by West & West 1904.

L 117, W 8, apex W 9.

Previous Australian and New Zealand records: Hardy 1906, West 1909, Flint 1966.

Sample: Lake Hume 14/2(Dam).

Geographical distribution: widespread (West & West 1904, Claassen 1961).

Micrasterias Hardyi G.S. West Pl 6 fig. 9

West 1909 Pl 5 fig. 1, p. 57

Lcp	202-242
Lsp	102-108
Wcp	213-248
Ist.	20-27

Polar lobe process length 0-7

The variations within the population were observed to be

1) The sinus shape. This may be wider open than that of the drawing (Pl 6 fig. 9).
2) The furcation along the length of each process may be longer or shorter than that of the drawing (Pl 6 fig. 9).
3) The polar lobe processes may not be present.

An empty cell was found and all the wall ornamentation was as shown in the drawing.

Previous Australian records: West 1909, Tyler 1970.

Dr. Tyler (pers. comm.) thinks this species may be an endemic form of Australia. I think may be it is an extreme form of the cosmopolitan Micrastrias mahabuleshwarensis Hobson because some reported drawings of M.mahabuleshwarensis could become those of M. Hardyi if the processes are longer or shorter, etc. Gronblad (1945) depicted M. mahabuleshwarensis with shorter processes-otherwise the plant becomes M.Hardyi. (Tab IV fig.80). Kreiger s'(1939) M.mahabuleshwarensis (Taf. 109 fig. 10) looks like M.Hardyi with shorter processes and long polar lobe processes. M.mahabuleshwarensis var.europaea Nordst.(Krieger 1939 Taf.110 fig. 5) may become M.Hardyi if the polar lobe processes are reduced and their processes become longer with deeper incision of lateral lobules.

A genetic link of M.Hardyi with M.tropica var. indivisa (Nordst.) Eichl et Racib via M.berganii Hauge had been suggested (Tyler 1970).

Samples: Lake Hume 14/2(Dam), 7/3(3), 8/3(Tallan.), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 31/5(4), 3/6(5), 8/7(5), 9/7(3), 7/8(3), 681122/3.

Lake Mulwala 4/4.

Geographical distribution: Tas.,Vic.,NSW,(Australia-Tyler 1970).

Micrasterias decemdentata (Nag.) Arch. Pl 6 fig. 12

Bailey 1898 Pl 2 fig. 18

Krieger 1939 Taf. 104 fig. 8 p. 34

Bourrelly 1957 Pl 4 fig. 38, Pl 5 figs. 39-40

Claassen 1961 Tab. 16 fig. 5 p. 585

Gronblad & Croasdale 1971 Pl IV fig. 47 p. 11

Tyler (1970) included the Mulwala plant in M.laticeps var. minor Nordst. I think the plant may be M.decemdentata because it differs from Nordstedt s'original plant (1869 Taf. 2 fig. 14 p.220). and Bicudo et al (1972) who studied polynorphism in M.laticeps did not record any form with lateral branched lobules like the Mulwala plant. The Mulwala plant agrees in shape and size with M.decemdentata (Bailey 1898 Pl 2 fig. 18). The other mentioned workers reported M.decemdentata of 30 μ smaller to about half the size of the Mulwala plant.

L 95, W 100

Playfair (1912) recorded M.truncata mixed form(Pl lvi fig. 3) with one semicell of M.decemdentata and another semicell

Previous Australian records: Mobius 1894, Bailey 1895, 1898, Schmidle 1896, Borge 1911, Tyler 1970 as M.laticeps var. minor

Sample: Lake Mulwala 10/2.

Geographical distribution: seem widespread.

Micrasterias mahabuleshwarensis Hobson typica-wallichii transition Pl 6 fig. 11

Tylor (1970) fig. 17 e

Lcp 167, Lsp 127, Wcp 146.

The wall ornamentation was not shown in the drawing because the ornamentation was hard to observe against the cell contents.

Previous Australian records: Mobius 1894, Tyler 1970.

West & West (1905) described the variation within M.mahabuleshwarensis which had resulted in the naming of numerous varieties.

Samples: Lake Mulwala 4/4, 690206/1.

Geographical distribution: This species is principally tropical and subtropical in its distribution (West & West 1905).

Micrasterias thomassiana var. notata (Nordst.) Gronblad Pl 6 fig. 10

West & West 1905 Pl 50 fig. 7 as M.denticulata var. notata Nordst.

Krieger 1939 Taf. 140 fig. 1 p. 111

Scott & Prescott 1961 Pl 17 fig. 6

Flensburg 1967 Pl IIIc

Tyler 1970 fig. 29a

L 251, W 210, Ist. 38.

The dimensions are comparable with those given by the above authors. The plant also closely resembles the South African plant M.denticulata Breb.var. subnotata West(Claassen 1961 Tab.12 fig. 2, Tab.13 fig. 1) which is synonymous with M.thomassiana var. notata (Krieger 1939). Krieger (1939) gave various synonyms of the taxon. The intergradation of <u>M.denticulata</u> and <u>M.thomassiana</u> has been mentioned (Tyler 1970).

Previous Australian record: Tyler (1970), Prescott & Scott-1952).

Sample: Lake Hume 7/8(3).

Geographical distribution: England, Germany, Sweden, Finland, NZ, (West & West 1905), Tasmania & Victoria (Tyler 1970), Indonesia (Scott & Prescott 1961), Canada (Stein & Garrath 1968).

<u>Pleurotaenium Ehrenbergei</u> Breb. De BQry <u>var. undulatum</u> Schaarschmidt.

Smith 1924 Pl 54 fig. 9 p. 15

L	444-523
W	31-42
Apex	24
Ist.	33

<u>Pleutaenium Ehrenbergei</u> have been recorded from Australia and New Zealand (Mobius 1894, Schmidle 1896, West 1909, Nordstedt 1888). This variety <u>undulatum</u> differs from the type in having the undulation more or less throughout the whole semicell s' length (Smith 1924). Prescott & Scott (1952) recorded the variety.

Sample: Lake Hume 30/5(3).

Geographical distribution: widespread (Claassen 1961).

<u>Spondylosium planum</u> West & West Pl 7 fig. 5

West & Carter 1923 Pl CIX figs. 23-24

Gronblad 1926 Taf. 3 fig. 123

Frere-IreneeMarie 1939 Pl 61 fig. 17

Prescott & Scott 1960 Pl 60 figs. 6-8

L 14, W 14, Ist. 7.

There is no previous Australian record. Flint (1966) recorded it from New Zealand.

Samples: Lake Hume 14/2(Dam),

Lake Mulwala 680411/1, 681121/2, 690202/1

Geographical distribution: New Zealand (Nordstedt 1888). Australia,

West & Carter (1923) : Norway, U.S.A.,

Canada.

Staurastrum anatoides Scott & Prescott Pl 10 fig. 1

The Mulwala plant is a form of Staurastrum anatoides This taxon was named by Scott and Prescott (1958). Scott & Prescott (1961) described St.anatoides var. javanicum (Pl 56 fig. 1) whose end view is almost identical to that of the Mulwala plant. The front view differs slightly. Scott & Prescott s'semicell has a row of granules above the isthmus while the Mulwala plant has two long isthmal spines per semicell. Their dimensions are comparable. I think St. quebecense Frere-Irenee-Marie (Frere-Irenee-Marie 1939, Pl 47 fig. 6 and Pl 54 fig. 5) may be the same biological species as St. anatoides Scott & Prescott. Their dimensions are comparable and on focusing up the curved lines in the middle and at the base of each process of the semicell from the end view as depicted by Frere-Irenee-Marie (1939 Pl 47 fig. 6) become bifurcate verrucae.

Previous australian record: Scott & Prescott 1958.

Sample: Lake Mulwala 690206/1. (L 44, Wcp 73, Ist. 11).

Geographical distribution: Australia

Indonesia (Scott & Prescott 1961)

Perhaps Canada as St.quebecense

(Frere-Irenee-Marie 1939).

St.arctiscon (Ehrenb.) Lund var. glabrum West & West Pl 10 figs. 7,8

Smith 1924 Pl 84 figs. 3-5, Pl 83 fig. 15, p. 125

Frere-Irenee-Marie 1939 Pl 57 fig. 3

St.arctiscon var. glabrum have smooth processes. There are two sizes (Pl 10 figs. 7,8). As a rule, there are six processes in the upper whorl and nine in the lower whorl (Thomasson 1973). The processes may be either bifurcate or trifurcate (Frere-Irenee-Marie 1939, Thomasson 1973).

Lsp	34-57
Lcp	62-102
Wsp	26-37
Wcp	57-95
Ist.	14-25

St.arctiscon var. glabrum and St.leptacanthum Nordstedt are similar plants (Frere-Irenee-Marie 1939 Pl 48 fig. 2, Pl 58 figs. 10,11). The latter have fewer processes, 4 in the upper whorl, 6 in the lower whorl (Frere-Irenee-Marie 1939). Forster (1969) St.leptacanthum var. Borgèi morpha minor is St.arctiscon var. glabrum. Gronblad (1947 fig. 37) St.tohopekaligense is also St.arctiscon var. glabrum judging from the end view.

St.arctiscon var. glabrum, St.leptacanthum, and St.tohopekaligense seem to be three well-defined morphological species to me.

Thomasson (1973) stated the number of arms of St.arctiscon var. glabrum varies. He reported the species with only three processes in the lowr whorl. This plant morphology of St.arctiscon var. glabrum seems odd.

Previous Australian and New Zealand records: Thomasson (1973, smalle form), Flint 1966.

Samples: Lake Mulwala 4/4, 680411/1, 680508/1, 690206/1.

Geographical distribution: seem widespread.

St.asterias Nygaard Pl 9 fig. 12

Nygaard (1926) Pl VI fig. 62 p. 232

The end view of the Mulwala plant agrees well with that of Nygaard s'original plant. As for the front view the Mulwala plant has more convex apecies. Their dimensions agree.

Lsp 31, Wcp 39, Ist. 11.

Previous Australian records: none

Sample: Lake Mulwala 4/4.

Geographical distribution: Australia, Japan (Hinode 1966 Pl 9 fig. 5), Malaya (Nygaard 1926).

Starastrum dickiei Ralfs Pl 9 figs. 1-5

= Staurodesmus dickiei (Ralfs) Lillier (Teiling 1967 fig. 29:3, p 598).

West & Carter 1923 Pl CXXIX fig. 14 p. 3-4

Frere-Irenee-Marie 1939 Pl 44 fig. 10 p. 275

L 33-38

Wcp 33-43

Ist. 8-11

According to Gronblad, Scott & Croasdale 1964 the plants (Pl 9 figs. 4,5) are St.dickiei var. maximus (Pl XII figs. 277,278). The spines of St.dickiei may be straight or slightly incurved (Claassen 1961).

Previous Australian records: Raciborske 1892, Hardy 1906, West 1909.

Samples: Lake Hume 8/3(Tallan.), 2/5(4), 3/5(Dam), 5/4(Dam), 7/8(3).

Lake Mulwala 12/8, 680508/1, 680921/1.

Geographical distribution: widespread (West & Carter 1923).

Staurastrum grande Bulnh. var. parvum West Pl 9 fig. 6

= Staurodesmus grande (Bulnh.) Teiling (Teiling 1967 Pl 23 fig. 5)

West & West 1912 Pl CXX figs. 2,3

Frere-Irenee-Marie 1939 Pl 45 fig. 4, 1951 Pl 2 fig. 5

L 64, W 61, Ist. 14

The dimensions agree with those given by West & West (1912). The chloroplast appears stellate from the end view.

Previous Australian record: West (1909)-St.grande Bulnh.

Sample: Lake Mulwala 680508/1.

Geographical distribution: Australia, Canada (Frere-Irenee-Marie 1939, 1951), Norway & Scotland (Wests 1912).

Staurastrum Freemanii West & West 1902 Pl 9 fig. 9

The Hume plant is a form of St.Freemanii West & West 1902 (West & West 1902 Pl 21 fig. 21 p. 177).which has two processes in the end view. The Hume plant s'end view has three processes the base of which has no accessory spines otherwise it is very similar to St.Freemanii var. triquetrum (West & West 1902 Pl 21 fig. 22). The Hume plant dimensions are slightly bigger than St.Freemanii var. triquetrum s' (West & West 1902).

Lssp 30

Wcsp 63-72

St.Freemanii and St.patens Turner (Pl 9 fig. 10) seem closely related. West & West 1902 stated St.Freemanii differs from St.patens in its smooth lateral margins, its much more produced angles, and in the characteristic pairs of spines at the apices.

Previous Australian records: Scott & Prescott (1958).

Sample: Lake Hume 7/3(3).

Geographical distribution: Australia, Ceylon (West & West 1902), Indonesia (Scott & Prescott 1961, variety).

The central highland of New Guinea as St.freemanii facies triquetrum (Brook & Hine 1966).

Sturastrum furcatum (Ehrenb.) Breb. Pl 9 figs. 13,14

West & Carter 1923 Pl CLV figs. 1-4 p. 173

Smith 1924 Pl 83 figs. 1-3 p. 118

Frere-Irenee-Marie 1939 Pl 48 fig. 7

The end view of the Hume and Mulwala plants'suggests St.furcatum. From the published figures of St.furcatum and St.tohopekaligense var. brevispinum G.M.Smith (Smith 1924 Pl 82 figs. 8-11, Thomasson & Tyler 1971 figs. 10 g,h) the main difference of these two taxa is: from the end view the shorter processes are closer to the longer ones in the former. Since the Hume and Mulwala plants'dimensions also are in the range between those of St.furcatum and St.tohopekaligense var. brevispinum, these two taxa may be synonymous.

Lcp	38-42
Lsp	28
Wcp	33
Wsp	19
Ist.	9-11

Judging from the almost identical end view morphology and the dimensions of St.furcatum and St.tohopekaligense Wolle given by West & Carter (1923) these two taxa may be varieties of the same biological species. One variety has longer processes than the other. That St.furcatum and St.tohopekaligense may be synonymous had been suggested by Chuah (1969).

Previous Australian records: West (1909), Chuah (1969).

Samples: Lake Hume 14/2(Dam), 7/3(3), 8/3(Tallan.), 9/7(3).

Lake Mulwala 680411/1.

Geographical distribution: widespread (West & Carter 1923, Claassen 1961).

Staurastrum leptocladum Nordst Pl 8 figs. 6-11

The plants resemble St.leptocladum (Smith 1924 Pl 78 figs. 6,7). They are smaller and have no subapical spines. Smith (1924) and Scott, Gronblad & Croasdale (1965) stated Nordstedt in his orginal plant did not mention the subapical spines because they may have been lost. Rows of granules at the subapical region were observed (Pl 8 fig. 11).

Lsp	23-32
Lcp	44-61
Wcp	67-92
Ist.	5

One plant with dichotypecal semicells (Pl 8 fig. 7) suggests a relationship with St.nodulosum Prescott (Pl 8 fig. 5). The smaller size and the presence of dichotypical specimens of St.leptocladum and St.nodulosum features suggest St.nodulosum is a small form of St.leptocladum. Perhaps Prescott (1936) should not have created the new species, St.nodulosum. The processes of St.leptocladum are not always parallel or nearly so. Thomasson (1960) recorded St.leptocladum var. elegans with upwardly curved processes (fig. 22) from New Zealand.

Scott & Gronblad (1957) recorded a variety of St.leptocladum which resembles the Hume and Mulwala plants..They did not give any dimensions.

Previous Australian and New Zealand records: West 1909, Thomasson (1960, variety).

Samples: Lake Hume 1/5(3), 2/5(4), 3/5(Dam), 31/5(4), 3/6(5), 8/7(5), 9/8(5), 11/9(5).

Lake Mulwala 4/6.

Geographical distribution: widespread.

Staurastrum nodulosum Prescott Pl 8 figs. 1-5, 12, 13, 15-17

Prescott 1936 Pl LXIV figs. 2,3

The plants fit the description of St.nodulosum (Prescott 1936 p. 506-507). Dichotypical specimens of St.nodulosum semicell and another semicell with upwardly curved processes were often encountered (Pl 8 fig. 3) therefore there are two morphological forms of St.nodulosum in both lakes, namely

Forms:		Processes upwardly curved	Processes divergent
		(Pl 8 figs. 1, 15, 16)	(Pl 8 figs. 2, 4, 5, 17)
	Lsp	16-19-24	15-30
	Lcp	36-53-68	39-60
	Wcp	38-53-67	44-79
	Ist.	3-5	4-6

The variations within the populations are the size, the degree of divergence of the processes and the shape of the sinus (Pl 8 figs. 1-4). There are more specimens of the divergent St.nodulosum in both lakes.

Thomasson (1965) recorded St.caledonense f. major Thomm. (fig. 11:8) with upwardly curved processes and better-developed terminal spines. He suggested his plant was very similar to St.nodulosum. Since some St.nodulosum in Lakes Hume and Mulwala had upwardly curved processes Thomasson s'plant may be grouped in St.nodulosum.

In 1974 Thomasson noted St.chaetopus Hinode from NZ (fig. 5:7,8). His plants especially fig.5:7 looks like St.nodulosum (Pl 8 fig. 15). The descriptions of St.chaetopus given by Smith (1924 Pl 76 figs. 21-24) and Brook (1960 Tab. 89 fig. 1) did not fit Thomasson s'St.chaetopus therefore his plants may be St.nodulosum.

The plant (Pl 8 fig. 12) is probably a form of St.nodulosum. Only one specimen was seen. The only clostest plant is St.volans West & West as depicted by Rich (1932 figs. 14 a-d) but St.volans is much smaller and the plant s'dimensions are within the range of St.nodulosum found. Since dimensions vary St.volans may be a form St.nodulosum and hence St.leptocladum.

St.volans-like plant		St.volans in Rich (1932)
Lsp	23	14-17
Lcp	46	not given
Wcp	54	32-44
Ist.	6	4-6

Judging from the shape and dimensions, the plant (Pl 8 fig. 13) with well-develope apical verrucae could be grouped in St.nodulosum.

Previous Australian records: Thomasson & Tyler 1970.

Samples: Lake Hume 14/2(Dam), 8/3(Tallan.), 2/4(Tallan.), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 3/6(5), 5/7(2), 8/7(5), 10/7(3).

Lake Mulwala 10/2, 4/4, 7/5, 4/6.

Geographical distribution: Australia (Thomasson & Tyler 1970), Panama Canal, Africa (Prescott 1936).

Staurastrum Playfairi Scott & Prescott Pl 8 fig. 14

The plants which are of the same size as the divergent form of St.nodulosum but have granules on their semicell wall and an isthmal row of granules (Pl 8 fig. 14) resemble St.Playfairi Scott & Prescott (Scott & Prescott 1961 Pl 52 fig. 4 p. 101).

I agree with Chuah (1969) that Scott & Prescott (1961) should not introduce a new taxon when they stated that St.Playfairi was synonymous with St.volans var. elegans (Playfair 1913).

Chuah (1969) had observed a janus form of St.Playfairi from Wood's lake, Tasmania.

Previous Australian record: Chuah (1969).

Samples: Lake Hume 2/5(4), 3/5(Dam), 5/4(Dam).

Lake Mulwala 4/4, 680508/1.

Geographical distribution: Australia, Indonesia (Scott & Prescott 1961).

Chuah (1969) suggested a relation between St.Playfairi-leptocladum-volans. The presence of dichotypical plants of St.nodulosum-leptocladum indicates culture experiments could provide an evidence for grouping St.Playfairi, St.nodulosum, St.volans and St.leptocladum into one biological species, where St.leptocladum may have many varieties.

Staurastrum pachyrhynchum Nordstedt Pl 9 figs. 7,8

= Staurodesmus pachyrhynchus (Nordstedt) Teiling (Teiling 1967)

West & West 1912 Pl CXXI fig. 8 p. 151

Teiling 1967 p. 499

The plants'dimensions are in the range given by the above authors.

L 30, W 24, Ist. 14.

Sometimes the plants had a spine on each corner.

There is no previous Australian record. Thomasson (1973) recorded Staurodesmus pachyrhynchus that does not look like the Hume and Mulwala plants. He recorded it from New Zealand (figs.4:14-16).

Samples: Lake Hume 14/2(Dam), 8/3(Tallan.), 5/4(Dam), 2/5(4),8/7(5).

Lake Mulwala 4/4, 7/5.

Geographical distribution: widespread (West & West 1912).

Staurastrum patens Turner Pl 9 fig. 10

The Mulwala plant is St.patens Turner (Turner 1892 Tab.14 fig.11 p.108). In the end view the accessory spine at the base of each process as depicted by Turner is not seen. The plant differs from West s'St.patens var.planctonicum in not having two small denticulations at the base of each process (West 1909 Pl 6 fig.14).

The Mulwala plant s'dimensions are smaller than Turner s' original St.patens (Turner 1892 Tab.14 fig.11) but are comparable to those of St.patens var.planctonicum given by West (1909).

Lssp	28
Lcsp	41
Wssp	28-30
Wcsp	47-53
Ist.	14

Previous Australian records: West (1909) recorded St.patens var.planctonicum from Vic. He stated Playfair in 1907 recorded the same variety under the name of "forma australica".

Sample: Lake Mulwala 680508/1

Geographical distribution: Australia, East India (Turner 1892).

Staurastrum pingue Teiling Pl 11 figs. 1-6

Staurastrum pingue Teiling (small form) Pl 11 figs. 7-13

Teiling 1942 Abb. 3

Brook 1959 Pls XVII & XVIII figs. 2,6,12

Forster 1967 Taf. 10 fig. 11

Chuah 1969 fig. 1 b

Thomasson & Tyler 1971 figs. 3 a-d, 7 a

From the literature survey most of the Australian plants (Chuah 1969, Thomasson & Tyler 1971) including those of the Hume s' and Mulwala s' have no apical ornamentation as depicted by Brook (1959) and Forster (1967). Teiling (1942) figured one out of three plants with had no apical ornamentation (Abb.3).

The variations within the two lakes populations are the size, the sinus shape, the degree of process furcation. St.pingue small form occur with the usual ones. Brook (1959) and Forster (1967) gave the detail of various sinus shape.

Pl 11 fig. 3 is a form of St.pingue which approaches St.planctonicum Teiling (Brook 1959 Pl XVIII fig. 12). It is St.pingue stout form according to Thomasson & Tyler (1971). The plants (Pl 11 figs. 1,2,4-6) are the slender form which have bulbous sinus (Chuah 1969).Pl 11 figs. 1,2 was described as St.gracile var. bulbosum by Thomasson & Tyler (1971 fig. 3f). Pl 11 figs. 7-13 are small form of St.pingue formerly known as St.paradoxum var. evolutum West & Carter 1923 (Brook 1959 Pl XVIII figs. 2,6,12). The angles of one semicell alternate with those of the other as seen from the end view (Pl 11 fig. 11). This is one characteristic of St.pingue (Brook 1959).

	small form	St.pingue
Lsp	22-23	30-34-40
Wcp	34-56	52-68-102
Ist.	5	6-12

Previous Australian and New Zealand records: Thomasson & Tyler 1971, Thomasson 1973, Thomasson 1960.

Samples: Lake Hume 14/2(dam), 7/3(3), 8/3(Tallan.), 1/5(3), 2/5(4), 3/5(dam), 30/5(3), 31/5(4), 10/7(3), 8/7(5), 9/8(5), 11/9(5), 681122/3.

Lake Mulwala 4/4, 4/6, 7/5, 680921/1, 681121/2, 690206/1.

Geographical distribution: widespread.

Samples: St. pingue (small form) Lake Hume 7/3(3), 8/8(4), Lake Mulwala 4/4.

Staurastrum cf.pinnatum var. subpinnatum Pl 9 fig. 17

West & West 1902 Pl 21 fig. 33

Skuja 1949 Taf.XXXIV fig. 7

Bourrelly 1957 Pl 17:149

Only one specimen was seen. The end view (pl 9 fig. 17) resembles closely that of St.pinnatum (Turner) var. subpinnatum (Schmidle) given by the above workers. Due to the presence of the cell contents it was not seen if the Mulwala plant had the apical spines as depicted by the mentioned workers. To positively identify the plant the front view is needed. Scott & Gronblad (1957) figured St.comptum Wolle var. pinnatiforme (Pl XXV fig.II) with bifurcate small processes otherwise the end view is similar to the Mulwala plant. Its front view and those of St.pinnatum var.subpinnatum as given by West (1902) and Skuja (1949) are quite different.

Previous Australian record: none. Schmidle (1896) recorded St.subpinnatum which resembles the Mulwala except the small sub-processes do not terminate in three spines. (Taf.IX fig. 20).

Samples: Lake Mulwala 4/4.

Geographical distribution: widespread.

Staurastrum pseudosebaldi Wille var. planctonicum Teiling Pl 10 fig.3

Forster 1969 Taf.41 fig.4

The plants' dimensions agree well with Forster s' (1969).

Lcp	51-77
Lsp	40
Wcp	79-96
Ist.	10-14

Thomasson (1974) provided photos of St.manfeldtii var. fluminense Schumacher some of which (figs. 5:1,3) are similar to the Mulwala plants, others are not (figs. 1:9-15). His plants have granules on the semicell wall while, due to the presence of chloroplasts, it was hard to see if the Mulwala plants had such granules. Forster (1969) did not depict any granules. Thomasson (1974) stated his plants may be related to St.pseudosebaldi var. planctonicum as depicted in Forster (1969 Taf.41 figs.4-6).

Playfair (1908) recorded this variety from Australia.

Samples: Lake Mulwala 4/4, 680921/1.

Geographical distribution: Australia,

Brazil (forster 1969),

Canada (Bourrelly 1966, forma).

Staurastrum sebaldi Reins.var. ornatum Nordst. Pl 10 figs. 2,4

The presence of apical verrucae in a trigular shape as seen from the end view indicates the plants are St.sebaldi Reinsch. var. ornatum Nordst.(Teiling 1947 fig.13). The plants (Pl 10 figs. 2,4) resembles St.sebaldi var. ornatum (Lind & Croasdales 1966 Pl 2 fig. 15, Pl 1 fig. 1 respectively). Lind & Croasdale (1966) who gave an account of the variation in St.sebaldi var. ornatum stated it was a variable desmid. The front and end view of St.sebaldi var. ornatum (Frere-Irenee-Marie 1939 Pl 54 fig. 7) did not look like the Mulwala plants. Rows of granules at the base of each process as seen in Pl 10 fig. 4 were also in Lind & Croasdale s'plant (1966 Pl 1 fig. 9). St.sebaldi var. ornatum = St.manfeldtii in West & Carter (1923) according to Teiling (1947).

Lsp 49

Wcp 66-94

Ist. 13

Previous Australian records: Hardy 1906, Scott & Prescott-1958.

Sample: Lake Mulwala 680921/1.

Geographical distribution: widespread (Lind & Croasdale 1966).

Staurastrum subavicula West Pl 9 fig. 11

The closest plant that looks like the Hume plant Pl 9 fig. 11 is St.subavicula as depicted by Lind (1967 Pl 8 fig. 5 p. 380).

Lssp 28, Wcp 47, Ist. 14.

These dimensions are comparable with those given by Lind (1967). The Hume plant, seen only once, may be this species.

Sample: Lake Hume 7/3(3).

Geographical distribution: Africa (Lind 1967)

Central Norway (Bergan 1946).

Staurastrum subgemmulatum West & West Pl 9 fig. 18

Claassen 1961 Taf. 31 figs. 1,2 p. 602

The plant is not St.sagittarium Nordst. because St.sagittarium have their processes curve downwards and have much shorter cell body.(Nordstedt 1888 Pl 4 fig. 6 p. 37, Thomasson & Tyler 1971 figs. 11 a,b p. 307). The plant s' dimensions agree with those given by Claassen (1961).

L 33, Wcp 50, Ist. 10.

There is no previous Australian record of the species.

Samples: Lake Hume 2/4(Dam), 2/5(4), 3/5(Dam), 8/3(Tallan.).

Lake Mulwala 10/2.

Geographical distribution: Transvaal Province, Africa(?) (Claassen 1961).

Staurastrum tetracerum Ralfs Pl 9 figs. 15,16

West & Carter 1923 Pl 149 fig. 2

Frere-Irenee-Marie 1939 Pl 49 fig. 19

Gronblad & Scott 1955 figs. 7,8,24 as St.bibrachiatum Reinsch Type II

Gronblad 1960 Pl VIII fig. 174

Lsp 8, Lcp 23, Wcp 31, Ist. 4.

The dimensions are comparable with the above authors'.

Gronblad & Scott (1955) stated St.tetracerum may be a form of the variable St.bibrachiatum Reinsch.

Previous Australian records: Borge 1896, Scott & Prescott 1958, Thomasson 1973. Maskell 1881 recorded St.tetracerum Kutzing (not Ralfs) from New Zealand.

Samples: Lake Hume 8/3(Tallan.)

Lake Mulwala 4/4, 680921/1.

Geographical distribution: widespread (West & Carter 1923).

Staurastrum tetracerum var. evolutum West & West Pl 9 figs. 19-21

Thomasson & Tyler 1970 fig. 8g p. 309-310

This species has been discussed and recorded from Australia (Thomasson & Tyler 1971).

Lsp 22, Wcp 32, Ist. 4.

Samples: Lake Hume 14/2(Dam), 1/5(3), 2/5(Tallan.), 2/5(4), 30/5(3), 8/7(5).

Staurastrum tohopekaligense Wolle Pl 10 fig. 9

West & Carter 1923 Pl CLV fig. 12 p. 178

The dimensions agree well with those given by West & Carter (1923).

Lcp 66-74

Lsp 31-33

Wsp 20-24

Wcp 65-72

Ist. 14-17

Processes length 24

Previous Australian and New Zealand records: Scott & Prescott (1958), Thomasson (1972, 1973), Flint (1966).

Samples: Lake Hume 14/2(Dam), 7/3(3).

Lake Mulwala 680411/1, 680508/1, 690206/1.

Geographical distribution: widespread (West & Carter 1923).

Staurastrum victoriense West Pl 10 figs. 5,6

West (1909) Pl 5 figs. 13,14 p.67

Thomasson & Tyler (1971) fig. 10d

Lsp	53
Wsp	43
Wcp	89-103
Ist.	36
Width of processes	5-7

The cell bodies are slighty bigger than West s'plant (1909) but are of the same size as Borge s'St.nudibrachiatum (Borge 1903 Taf.4 fig.20) therefore the Australian plants ~~only~~ differ from Borge s'Brazilian St.nudibrachiatum only in the narrower processes- with entire apices, and in the greater number of processes on each semicell (West 1909).

I agree with Thomasson & Tyler (1971) that St.nudibrachiatum as depicted by Gronblad (1945 Pl 11 fig. 239) s'and West s' (1909) plants are too similar to be described as different species. I doubt if West s'plants (1909) did differ significantly from Borge s'(1903). The number of terminal spines and that of the processes have, in natural populations, been shown to vary. For example: the variation in the number of processes of St.sagittarium Nordst.in Arthur s' lake, Tasmania (Thomasson & Tyler 1971).

Previous Australian records: West (1909), Thomasson & Tyler 1971.

Samples: Lake Mulwala 680508/1, 690206/1.

Geographical distribution: Australia.

St.victoriense may be closely related to St.nudibrachiatum Borge which had been recorded from Brazil (Borge 1903, Gronblad 1945).

Staurodesmus cuspidatus (Breb.) Ralfs subsp. tricuspidatus (Breb.) Pl 7 fig. 13

= Staurastrum cuspidatum(Frere-Irenee-Marie 1939 Pl 55 fig. 1 p. 280)

The Hume plants have shorter spines than Teiling s'plants. (Teiling 1948 fig. 61).

Lcp 27, Wcp 29, Ist. 5, spines length 5

Teiling (1948) stated Arthrodesmus constrictus G.M.Smith belong to Staurodesmus cuspidatus.

Previous Australian and New Zealand records: Hardy (1906), Borge 1896, West 1909, Scott & Prescott (1958), Maskell (1883), Nordstedt (1888), (all the authors recorded Staurastrum cuspidatum). Thomasson (1973) recorded Staurodesmus cuspidatus from Sydney.

Samples: Lake Hume 14/2(Dam), 5/4(Dam), 2/5(4), 3/6(5), 10/9.

Geographical distribution: widespread (West & Carter 1923 as Staurastrum cuspidatum).

Staurodesmus triangularis (Lagerh.) Teiling 1948 Pl 7 figs. 16-18

Teiling 1948 fig. 64 , 1967 p. 517

Lssp 16-20

Wssp 12-16

Ith. 3-4

spines length 19-24

Teiling (1948) stated this species is synonymous with Arthrodesmus quiriferus West & West and Arthrodesmus triangularis Lagerheim. Two features of Staurodesmus triangularis described by Teiling (1967) are observed in the Hume and Mulwala plants, these features are: the apex somewhat elevated above the bases of the spines, often retuse in the median part, isthmus mostly elongate.

The degree of divergency of the spines and their length were found to vary.

Previous Australian record: Thomasson (1973).

Samples: Lake Hume 3/5(Dam), 3/6(5), 11/9(5).

Lake Mulwala 4/4, 7/5, 4/6.

Geographical distribution: seem widespread.

Division Chrysophyta

Class Chrysophyceae

Dinobryon divergens Imholf Pl 12 fig. 8

Huber-Pestalozzi 1941 Abb. 289

The basal part of the species'loria is wavy in a characteristic manner. It occurs in oligotrophic waters(Huber-Pestalozzi 1941).

Loria L 35-47

W 7-9

The dimensions agree well with those given by the above author. The variation in the loria shape is observed in both lakes and is given in detail by Ahlstrom (1937 Pl 1 figs. 1-36).

Previous Australian records: Thomasson (1973).

Flint (1966) recorded this plant from New Zealand.

Samples: Lake Hume 2/5(4), 3/5(Dam), 5/7(2), 8/7(5), 10/7(3), 7/8(3).

Lake Mulwala 7/5, 680508/1, 680921/1, 681121/2.

Dinobryon sertularia Ehrenb. Pl 12 fig. 9

Huber-Pestalozzi 1941 Abb. 290

The loria dimensions agree well with Huber-Pestalozzi s'

L 29-41

W 9-11

There is loria shape variation in Lakes Hume and Mulwala. Huber-Pestalozzi (1941) and Ahlstrom (1937 Pl 2 figs. 1-16) provided detail of loria shape variations. The outline of Dinobryon sertularia may be slightly undulated.

Previous Australian records: Playfair (1912, 1915, 1921), Thomasson (1973).

According to Playfair (1912) Wesenberg-Lund & Kofoid regarded species of Dinobryon as forms of one biological species. No polytypical colonies of many species'loria were observed in the two lakes. I agree with Playfair (1912) that wherever colonies of different species lorea are observed the many species belong to the same biological species.

Samples: Lake Hume 3/5(Dam), 5/7(2), 8/7(5), 10/7(3), 8/8(4), 10/9(4).

Mallomonas akrokomos Ruttn. Pl 12 fig. 5

Huber-Pestalozzi 1941 Abb. 109 a p. 93

L 30, W 5

The spiral flagellum shown in Huber-Pestalozzi s'drawing may have been lost. Harris (1958) who gave the description of Mallomonas akrokomos as seen with the optical and the electron microscopes stated that the tail may be straight or bent as seen in the Mulwala plant. Only one plant was seen.

Previous Australian record: Croome & Tyler (1973).

Sample: Lake Mulwala 4/4.

Mallomonas splendens (G.S.West) Playfair Pl 12 fig. 6

Synonym: Lagerheimia splendens G.S.West

West 1909 Pl 6 figs. 4-8 p. 74

Playfair 1921 Pl 11 fig. 3 p. 108

The mentioned drawings show three setae while the Hume & Mulwala plants have four. Playfair (1921) stated there may be 2-4 setae before and behind.

L 24-41

W 9-10

Setae length 22-31

The spiral striation on the cell wall was observed clearly on one empty cell (Pl 12 fig. 6).

Previous Australian records: West (1909 as Lagerheimia splendens), Playfair (1912,1921), Thomasson (1973).

Samples: Lake Hume 1/5(3), 2/5(4), 3/5(Dam), 10/5(3), 10/9(4),11/9(5).

Lake Mulwala 4/4, 7/5, 4/6.

Mallomonas sp. Pl 12 figs. 10-12

Without the knowledge of the scale shape and morphology which are important taxonomic criteria (Harris 1960, 1970) I cannot positively identify the Mallomonas sp.(Pl 12 figs. 10-12). The lack of rear bristles suggests they may be a form of Mallomonas tonsurata Teiling (Huber-Pestalozzi 1941 Abb. 108, Harris 1970 fig. 1d) but the plants have only one instead of two chromatophores as shown in Huber-Pestalozzi s'drawing. The spiral flagellum as depicted in Huber-Pestalozzi s'drawing may have been lost.

Harris (1970) pointed out that the imperfect form of Mallomonas intermedia Kisselew (fig. 1e) resembles the perfect form of Mallomonas tonsurata Teiling (fig. 1d). There is a possibility that the Hume and Mulwala plants seen may be the imperfect form (i.e. the form that lack the features that have been included in the diagnosis-Harris 1970) of Mallomonas intermedia.

L 23-29

W 11-12

Samples: Lake Hume 5/4(Dam), 2/5(4), 3/5(Dam), 3/6(5), 11/9(5).

Lake Mulwala 4/6.

Synura spinosa Korch Pl 12 fig. 7

The plants were identified as Synura spinosa Korch because their scales were observed under the oil immersion to have thickened apical ends as shown in Huber-Pestalozzi (1941 Abb. 195 p. 139). Their scales'dimensions are comparable with those given by Huber-Pestalozzi (1941). L 4, W 3, Tail length 4.

No flagella were observed. To confirm the plants are Synura spinosa electron micrographs of the scales and the whole organism as given in Petersen & Hansen (1956) are needed.

Petersen & Hansen (1956) stated the shape of the cell is of no taxonomic valve. Within the same species, there are few-celled colonies with nearly sphaerical cells and large, many-celled colonies with long-stalked cells. These two cell shape and colony were observed in lakes Hume and Mulwala.

There is no previous Australian record of the species.

Samples: Lake Hume 30/5(3), 5/7(2), 8/7(5), 9/7(3, abundant), 10/7(3), 7/8(3), 8/8(4), 681122/3.

Lake Mulwala 4/4, 681122/3 (mostly long-stalked cells).

Class Bacillariophyceae

Centrales

Attheya Zachariasi J. Brun. Pl 13 figs. 1-6

Huber-Pestalozzi 1942 Abb. 518

There are two forms of Attheya Zachariasi in the two lakes. Form 1 (Pl 13 fig. 6) is relatively wider and shorter than Form 2 (Pl 13 fig. 1). More of the slender form 2 are present.

	Form 1	Form 2
Lssp	21-28	25-75
Lcsp	52-95	80-137
W	18-33	14-18

Intermediates of the two forms were present. Pl 13 figs. 2-5 show the vegetative cell division of Attheya Zachariasi. The frustules and chromatophores elongate, followed by the formation of two sets of daughter cells'spines. The daughter cells soon break apart.

Previous Australian record: Playfair (1912).

Samples: Lake Hume 2/4(Tallan.), 5/4(Dam), 8/3(Tallan.), 1/5(3), 2/5(4), 3/5(Dam), 31/5(4), 3/6(5), 8/7(5), 9/7(3), 10/7(3), 11/9(5).

Lake Mulwala 4/4, 4/6, 690206/1.

Cyclostella stelligera Cleve & Grun. Pl 13 fig. 7

Huber-Pestalozzi 1942 Abb, 484c p. 397

The diameter 16 μ is within the range given by Huber-Pestalozzi (1942). Only one plant was seen.

Previous Australian records: Playfair 1912 (Pl LVI fig.26) Croome & Tyler 1972, Thomasson 1973.

Sample: 3/5(Dam).

Melosira granulata Ralfs Pl 13 figs. 8 a,b

Huber-Pestalozzi 1942 Abb. 451,452

There are two major forms of Melosira granulata in the two lakes. Intermediate forms are present. The first form has wider but shorter frustules.(Pl 13 fig. 8a).

L 18-25

W 8-17

The spines of end frustules were observed to vary in length and in number from none to four.

The second form is much slender and each end frustule has one to two spines which also vary in length.

L 22-31

W 5-8

Previous Australian and New Zealand records: West (1909), Playfair (1912), Thomasson (1973), and Flint (1966).

Samples: All samples from both lakes.

<u>Melosira varians</u> Agardh. Pl 13 fig. 9

Huber-Pestalozzi 1942 Abb. 447

The plants may be wider than Huber-Pestalozzi s'plants whose dimensions are in brackets.

L	22-32	(8-35)
W	11-23	(9-13)

Previous Australian record: Playfair (1914 p. 123).

Samples: Lake Hume 1/5(3), 3/5(Dam), 30/5(3), 31/5(4), 5/7(2), 8/7(5), 10/7(3), 7/8(3), 8/8(4).

Lake Mulwala 4/4, 7/5, 4/6, 12/8, 680921/1, 681121/2.

<u>Rhizosolenia eriensis</u> H.L.Smith Pl 13 fig. 13

Huber-Pestalozzi 1942 Abb. 514

Lssp	50-54
Lcsp	97-103
W	3-5

Previous Australian and New Zealand records: Thomasson (1973), and Flint (1966).

Samples: Lake Hume 2/5(4), 11/9(5).

Lake Mulwala 4/4, 4/6.

<u>Rhizosolenia eriensis</u> H.L.Smith <u>var. morsa</u> G.S.West Pl 13 figs. 10-12

Huber-Pestalozzi 1942 Abb 515

Lssp	24-49
Lcsp	69-107
W	4-15

Previous Australian record: Playfair (1912).

Samples: Lake Hume 2/4(Tallan.), 3/5(Dam), 11/9(5).

Lake Mulwala 4/4, 4/6

Pennales

Asterionella formosa Hass. Pl 14 fig. 12

Huber-Pestalozzi 1942 Abb. 531a.

Patrick & Reimer 1966 Pl 9 figs. 1,3 p. 159.

L 28-57

Previous Australian and New Zealand records: Thomasson (1973), and Flint (1966), Wood (1960).

Samples: Lake Hume 2/5(4), 9/7(3), 10/7(3), 9/8(5), 11/9(5).

Lake Mulwala 12/8.

Cymbella cf. gastroides Kutz., Cymbella cf. gastroides var minor Pl 14 fig. 16

Heurck (1896) Pl 1 figs. 35,36 p. 146

No drawings were found to match the plants better than Cymbella gastroides Kutz. given by Heurck (1896). Their dimensions are within the range of the type form and var. minor given by Heurck (1896).

L 69-160

Striation in 10 μ = 7-10

Cymbella gastroides is common in fresh waters (Heurck 1896). There is no previous Australian record.

Samples: Lake Hume 5/4(Dam), 5/7(2), 8/7(5), 7/8(3), 8/8(4).

Lake Mulwala 4/4.

Cymbella lanceolata Ehr. Pl 14 fig. 17

Heurck 1896 Pl 1 fig. 37

The plants' dimensions are comparable with those given by the above author.

L 116

Striation in 10 μ = 8

Previous Australian record: Wood (1960). This species is very common in fresh waters (Heurck 1896).

Sample: Lake Hume 7/8(3).

Cymbella gastroides Kutz. and Cymbella lanceolata Ehr. may be forms of the same plant. Both have beaded striation, their dimensions and the number of striation in 10 μ are comparable. Their valves'view differs slightly (pl 14 figs. 16,17).

Epithemia sorex Kutz. Pl 14 fig. 5

Judging from the morphology and dimensions given by Heurck (1896 Pl 9 fig. 351 p. 295) the Hume and Mulwala plants (Pl 14 fig. 5) may be Epithemia sorex Kutz.

L 44

Striation in 10 μ = 15

Bourrelly (1968) gave photos of Epithemia sorex which showed the beaded striation very clearly (Pl 100 figs. 10-12).

Previous Australian + NZ records: West (1909), Wood (1960).

Samples: Lake Hume 5/4(Dam), 5/7(2), 10/7(3).

Lake Mulwala 4/4, 7/5, 4/6, 12/8, 680508/1, 680921/1, 681121/2.

Fragilaria capucina Desmazieres Pl 14 fig. 6

The closest plant that looks nearly like the Hume and Mulwala is Fragilaria capucina Desm. (Huber-Pestalozzi 1942 Abb. 527a p. 441). Bourrelly (1968) figured Fragilaria capucina Desm. (Pl 63 fig. 9) which seemed to have wider central area than the plants. He gave no dimensions. The plants'dimensions are comparable with those given by Huber-Pestalozzi (1942).

L 50

Striation in 10 μ = 13

Previous Australian record: Wood (1960).

Samples: Lake Hume 10/7(3)

Lake Mulwala 12/8.

Fragilaria sp. Pl 14 fig. 7

I could find any drawings to match the plants. They seem to be Fragilaria sp. which differs from Fragilaria capucina (Pl 14 fig. 6) in being longer and having coarser striation.

L 169

Striation in 10 μ = 8

Samples: Lake Hume 5/7(2), 8/7(5).

Gomphonema constrictum Ehrenb. Pl 14 fig. 14

Heurck 1896 Pl 7 fig. 296 p. 270

Bourrelly 1968 Pl 96 figs. 1,2

The plants' dimensions are within the range given by Heurck (1896). The costae on each striae were not observed.

L 36-46

Striation in 10 μ = 11-12

Common in fresh waters (Heurck 1896). West (1909) recorded this species from Australia. Wood (1960) recorded it from NZ.

Samples: Lake Hume 9/8(5).

Lake Mulwala 4/4, 4/6, 680411/1, 680921/1, 690206/1.

Gomphonema constrictum var. capitatum Ehr. Pl 14 fig. 15

Heurck 1896 Pl 7 fig. 297 p. 270 . Wood (1960) Pl 54 figs. 161 a,b.

The dimensions are within the range given by Heurck (1896).

L 43-55

W 13-14

Striation in 10 μ = 11-13

Hirano (1964) recorded Gomphonema constrictum Cleve (not Ehrenb.) var. capitata (Ehrenb.) Cleve (Pl 10 fig. 14) with stipulated striation. The Hume and Mulwala plants seem to have smooth striation.

This variety is common in fresh waters (Heurck 1896).

Previous Australian and New Zealand records: Wood (1960); Flint (1966).

Samples: Lake Hume 3/5(Dam), 8/7(5), 9/7(3), 10/7(3), 7/8(3), 10/9(4).

Lake Mulwala 7/5, 4/6, 12/8.

Cf. Gyrosigma attenuatum Ku tz. Pl 14 fig.9

Gyrosigma sp. have longitudinal and transverse striation on valve surface perpendicular to each other while in Pleurosigma sp. they are not at 90° angle to each other (Patrick & Reimer 1966). Only longitudinal striation was seen in the Hume and Mulwala plants therefore they may be Gyrosigma sp. The side view (Pl 14 fig. 9) resembles Gyrosigma attenuatum Kutz. (Bourrelly 1968 Pl 77 fig. 9).

L 98-110

W 11-15

Previous Australian records of the species: West (1909). Spencer (1882) recorded Gyrosigma attenuatum from New Zealand.

Samples: Lake Hume 7/3(2), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 5/7(2), 8/7(3), 9/7(3), 7/8(3), 8/8(4), 10/9(4).

Lake Mulwala 10/2, 4/4, 12/8, 4/6, 680508/1, 680921/1, 681121/2, 690206/1.

Nitzschia pelagica O Mull. Pl 13 fig. 15

Huber-Pestalozzi 1942 Abb. 571 p. 477

The dimensions slightly differ from those given by Huber-Pestalozzi (1942) which are in brackets.

L 31-41 (35-54)

W 3-4 (2)

Striation in 10 μ = 11 (18-20)

Colonies of 4-5 frustules were observed. There is no previous Australian record.

Samples: Lake Hume 3/5(Dam).

Lake Mulwala 10/2, 4/4.

<u>Pinnularia abaujensis</u> (Pant.) Ross <u>var. abaujensis</u> Pl 14 fig. 4
Patrick & Reimer 1966 Pl 58 fig. 2 p. 612

The plants'dimensions are in the range given by the above authors.

L 88-130

W 12

Striation in 10 μ= 9-11

The only difference from Patrick & Reimer s'plants is the Mulwala plants have shorter striae in the mid valve area.

There is no previous Australian record of the species.

Samples: Lake Mulwala 4/4, 12/8.

<u>Surirella Engleri</u> O Mull. Pl 14 fig. 2

The closest plant seems to be <u>Surirella Engleri fa. angustior</u> (Huber-Pestalozzi 1942 Abb. 594b p. 493). This fa. is narrower than the Hume and Mulwala plants. The other forms of the species have an inward curvature in the mid region of the valves. From the literature survey the Hume & Mulwala plants may be a form of <u>Surirella Engleri</u> possibly <u>fa. angustior</u> with wider valve which is possible since the other forma of the species are wider than fa. <u>angustior</u>.

	Mulwala	<u>Su.Engleri fa. angustior</u> (Huber-Pestalozzi 1942 s')
L	242	173-290
W	46	30-36
Striation (10μ)	2	2

There is no previous Australian record.

Samples: Lake Hume 8/7(5).

Lake Mulwala 12/8.

Surirella spinifera Hust. Pl 14 fig. 1

Huber-Pestalozzi 1942 Abb. 627

The plants are Surirella spinifera Hust. because of the presence of one thorn at one end of the frustules. Their dimensions are comparable with those given by Huber-Pestalozzi (1942).

L 116-197

W 46-67

Striation in 10 μ = 20

The drawing (Pl 14 fig. 1) has one end less pointed than Huber-Pestalozzi s'drawing (1942 Abb. 627).

There is no previous Australian record of the species.

Samples: Lake Hume 1/5(3), 30/5(3), 10/7(3),

Lake Mulwala 4/4, 680411/1, 681121/2, 690206/1.

Surirella tenera Greg. Pl 14 fig. 3

The plants are probably a form of Surirella tenera Greg. They differ from the type form (Huber-Pestalozzi 1942 Abb. 623a) in having two thorns in the mid region (raphe). One thorn seems bigger than the other. Huber-Pestalozzi (1942) figured Su.tenera var.nervasa (Abb. 623b,c) with one big mid region thorn and eleven small ones.

The plants'dimensions agree with those of the type form given by Huber-Pestalozzi (1942).

L 132

W 40

Striation in 100 μ = 19

Wood (1960) recorded Su. tenera var. splendidula (Pl 56 fig. 198) from Lake Dobson, Australia. No dimensions were given. The Hume and Mulwala plants differ from his plant in having one end more pointed and the straight in place of the undulate median line.

A plant from Lake Sorell, Tas. (negative 710424/1:7) seems wider across the middle of the valve otherwise it resembles the Hume and Mulwala plants.

Samples: Lake Hume 2/5(4),

Lake Mulwala 4/6.

Synedra acus Kutz. Pl 13 figs. 16, 20

Huber-Pestalozzi 1942 Abb. 536a p. 458

There is a slight variation from the dimensions given by Huber-Pestalozzi (1942, in brackets).

L 122-246 (100-300)

W 6-7 (5-6)

Striation in 10 μ =9-10 (12-14)

Pl 13 fig. 16 is probably a form of Synedra acus because of the lack of striation in the central area. The valve is slightly inflated in the mid region. Its dimensions are in the range of Synedra acus s'given by Huber-Pestalozzi (1942).

L 195

W 5

Striation in 10 μ = 11

Synedra acus Kutz. var. radians (Kutz.) Pl 13 figs. 18,19

The plant may be Synedra acus Kutz. var. radians (Kutz.) Hust. (Huber-Pestalozzi 1942 Abb. 536b) because of a pair of short striae in the central region (Pl 13 fig. 19). Huber-Pestalozzi (1942) stated this variety had the same dimensions as the type form.

L 235

W 5

Striation in 10 μ = 10

Wood(1960), West (1909) recorded Synedra acus Kutz. from Australia.

Samples: Synedra acus and its variety were found in

Lake Hume 5/7(2), 8/7(5), 7/8(3), 10/9(4).

Lake Mulwala 4/4, 680921/1, 681121/2.

Synedra ulna (Nitz.) Ehr. var. danica (Kutz.)V.H. Pl 13 fig. 17

Patrick & Reimer 1966 Pl 7 fig. 10 p. 151

The dimensions are comparable with those given by the above authors.

L 169-220

W 7

Striation in 10 μ = 8-10

West (1909) recorded Synedra ulna from Yan Yean Reservoir Vic. Flint (1966) recorded this variety from New Zealand.

Samples: Lake Hume 31/5(4), 5/7(2), 8/8(4), 10/9(4).

Tabellaria flocculosa (Roth) Kutz. var. flocculosa Knudson 1952 Pl 14 fig. 18

Knudson 1952 figs. 5 a-i

Patrick & Reimer 1966 Pl 1 fig. 5

L 19-23

Number of septa 4-5

Knudson (1952) should not have created a new species, Tabellaria quadriseptata whech is distinguished from T.flocculosa by having 4 septa per frustule and the valve view has the same extent of inflation in the mid and both end regions when she knew these two features of T.flocculosa were greatly variable (p.434-435). The new species, T.quadriseptata, were created on the basis of very variable features and no biological concept of species was taken into account. Patrick & Reimer (1966) accepted T.flocculosa and T.quadrisepta as two distinct species.

Huber-Pestalozzi (1942) figured a zig-zac colony of Tabellaria fenestrata (Lyngb.) Kg. (Abb. 519) which is very similar to the Hume and Mulwala plants (Pl 14 fig. 18) but according to Knudson (1952) and Patrick & Reimer (1966) the colony morphology of T.fenestrata is a straight line.

Previous Australian and New Zealand records: West (1909), Wood (1960), Flint (1966), thomasson (1973).

Samples: Lake Hume 30/5(3), 9/7(3), 8/7(5), 7/8(3).

Lake Mulwala 680921/1.

Cf.Navicula hennedyi Pl 14 fig. 13

A photo of an Australian diatom given by Wood (1960,fig.65b) resembles the Hume plant. Wood (1960) gave no dimensions. His references were not available. The Hume plant may belong to this taxon.

L 19, W 14, Striation 10 in 10 μ..

Sample: Lake Hume 10/9(4).

Stauroneis fulmen var. capitata Pl 13 fig. 14

The Mulwala plant resembles markedly Wood s'(1960) photo of Stauroneis fulmen var. capitata (Pl 53 fig. 105). He gave no dimensions.

L 132

Sample: Lake Mulwala 690206/1

Division Euglenophyta

Class Euglenophyceae

Order Euglenales

Euglena cf. gracilis Kleb. Pl 2 figs. 3,4

The closest taxon for the Mulwala plants is Euglena gracilis Kleb. (Prescott 1962 Pl 85 fig. 17 p. 393, Leedale 1967 fig. 11 p. 21). The plants resemble Euglena gracilis in having many chloroplasts and a somewhat pointed posterior end. The plants are slightly shorter than the above authors'plants and have a more pointed anterior end.

L 31-32

W 11-13

There is no previous Australian record. Haughey (1968) recorded it from New Zealand.

Samples: Lake Mulwala 10/2, 7/5.

Euglena spirogyra Ehrenb. Pl 2 figs. 1,2

Prescott 1962 Pl 86 fig. 15 p. 394

Plaufair 1912 Pl IV fig. 2 p. 119-120

L 136-149

W 11-21

The dimensions are in the range given by Prescott (1962). Claassen (1961) recorded Euglena spirogyra var. major from South Africa (152-196 x 22-26).

The plant (Pl 2 fig. 1) appeared twisted. Twisting occurs when it is irretated (Leedale, Meeuse, Pringheim 1965). Straight plants were also observed. It is said (Leedale et al 1965) a system of papillae or protuberances which are believed to be exudations emitted through pores arranged along the straie of the periplast are observed only in cultures with soil though not in all of them and in habitats rich in iron. The system of protuberances was sometimes observed (Pl 1 fig. 1). They may be lacking as seen in the plant (Pl 1 fig. 2).

The colour and ornamentation of the wall vary (Leedale et al 1965). Deformities of Euglena spirogyra as stated by Pringsheim (Leedale et al 1965) espectially in the tail end were not seen. Playfair (1912) stated that as a rule the granulate striae run obliquely from left to right but Pringsheim (Leedale et al 1965) observed the occurrence of right and left helices in the same clone and could afford no explation.

Physiologically the paramylon of Euglena spirogyra was established to have a β 1:3 glucan structure which is very similar to the laminarin of Phaeophyceae rather than the starch of Chlorophyceae (Leedale et al 1965).

Euglena spirogyra is widespread and has been recorded from Australia and New Zealand (Playfair 1912 and Haughey 1969).

Samples : Lake Hume 2/4 (Tallan.), 2/5(4), 8/8(4), 30/5(3).

Lake Mulwala 10/2, 4/4.

Phacus tortus (Lem.) Skvortzow Pl 2 figs. 5,6

Haughey (1968) stated that most specimens of Phacus tortus when swimming actively appear curved throughout most of their length while cells at rest appear flat. The curved or twisted plant (Pl 2 fig. 6) resembles the swimming form of Phacus tortus given by Haughey (1968 fig. 4:1e p. 734). The flat plant (Pl 2 fig. 5) resembles the curved one in having the longitudinal striation on the periplast and numerous chloroplasts. However the flat plant does not look exactly like Haughey s'figure of Phacus tortus resting form (Haughey 1968 fig. 4:1a,b). The former is narrower and has a longer tail. From the dimensions given by Haughey (1968) his Phacus tortus may be even narrower tha the Hume plant.

	Hume	Haughey (1968)
L with tail	112-134	80-108
W	43-57	30-44
tail length	37-52	32-50

Jahn (1949) recorded Phacus longicauda (fig. A) with body flattened but not twisted and Phacus tortus (fig. 81 B,C) as similar to Phacus longicauda except that the body is twisted. Haughey (1968) suggested specimens thought to be Phacus longicauda (Ehr.) may belong to this species. He suggested further on the taxonomy of Phacus.

There is no previous Australian record of *Phacus tortus*, Playfair (1921) recorded *Phacus longicauda*, which may be the same plant as *Phacus tortus* (resting form) according to Haughey in 1968). Haughey (1968) recorded *Phacus tortus* from New Zealand.

Samples: Lake Hume 2/5(4), 5/7(2).

Phacus pleuronectes (Muell.) Dujardin Pl 2 fig. 7

Playfair 1921 Pl V fig. 1 p. 123

Prescott 1962 Pl 88 fig. 16 p. 402

L 41

W 29-32

Previous Australian records: Mobius 1894, Playfair 1921, Bailey 1895, Scott & Prescott 1958.

Sample: Lake Hume 8/8(4).

Trachelomonas armatus var. longispina (Playfair) Deflandre Pl 12 fig. 24

Playfair 1915 Pl IV fig. 20

Prescott 1962 Pl 83 fig. 27 p. 411

The dimensions agree with those given by Prescott (1962).

Test dia. 30

L 40

Previous Australian record: Playfair 1915.

Sample: Lake Hume 2/5(4).

Trachelomonas bacillifera Playfair Pl 12 figs. 16-19

Playfair 1915 Pl 3 figs. 15,16

The plants' dimensions are in the range between those of the type form and those of the *var. minima* given by Playfair (1915).

Lssp 25-35

Wssp 22-30

Upon focusing up the spines on the wall (Pl 12 fig. 19) were seen as granular structures (Pl 12 figs. 16,17). The flagella pore could be seen when the plant was tilted. (Pl 12 fig. 17). In 1921 Playfair figured Trachelomonas bacillifera with longer and blunt spines (Pl VII figs. 2,3) and stated they were reddish yellow. The Hume and Mulwala plants were brick red.

Previous Australian records: Playfair (1915, 1921).

Samples: Lake Hume 8/3(Tallan.), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 30/5(3), 31/5(4), 3/6(5), 8/7(5), 9/7(3), 10/7(3).

Lake Mulwala 4/4, 7/5, 4/6.

Trachelomonas caudata Stein var. australica Playfair Pl 12 fig. 25

The closest plant that may be the plant, seen only once , is Trachelomonas caudata Stein var. australica Playfair (Playfair 1915 Pl V fig. 2). The dimensions are within the range given by Playfair (1915).

L		87
W		18
Collar	L	19
	W	5
Cauda	L	28
	W	5

Playfair (1915) recorded this species from NSW.

Sample: Lake Hume 7/8(3).

Trachelomonas hispida var. coronata Lemmermann Pl 12 fig. 22

Prescott 1955 Pl 1 fig. 23

1962 Pl 83 fig. 30

The Hume plants are slightly smaller than Prescott s'.

Test	dia	19
	L	24

Sample: Lake Hume 2/5(4).

Trachelomonas hispida (Perty) Stein var. rectangularis Br. Schroder Pl 12 figs. 20,21

The closest plant that resembles the Hume plants is Trachelomonas hispida var. rectangularis (Playfair 1915 Pl III fig. 10 p. 21). Their dimensions are comparable.

Lssp	30-41
Wssp	20-21

The colour was dark orangy red.

Samples: Lake Hume 2/5(4), 5/7(2), 7/8(3).

Trachelomonas scabra Playfair Pl 12 figs. 13-15

The curved neck of Pl 12 fig. 15 suggests Trachelomonas euchlora (Ehr.) Lemm. which may or may not be smooth-walled (Playfair 1915 Text figure 4 p. 16 and Pl 3 fig. 1). The Mulwala plant is slightly shorter than Playfair s'Tr.euchlora.

Ls collar		22-25
W		20-21
Collar L		4
	W	5

Since Prescott (1962) named a plant with a curved neck Tr.scabra var. longicallis Playf. (Pl 1 fig. 8) all the similar plants observed with ~~with~~ square but rounded corners cells and a collar will be grouped in Tr.scabra Playf. no matter if their necks are curved. It is not possible to observed the wall ornamentation (if any) because the cell contents were present. Playfair s'(1915) Tr.euchlora and Tr.scabra seem closely related.

Previous Australian record: Playfair (1915).

Sample: Lake Mulwala 7/5.

Trachelomonas superba Swirenko Pl 12 fig. 23

Messikommer 1927 Taf. VI fig. 7

Lcsp 36-42

Wcsp 27-30

Morphologically this species was observed to differ from *Tr. bacillifera* (Pl 12 figs. 16-19) in not having the "granules" or pore-like structures upon focusing up. Prescott (1962) showed the species had spines only at the anterior and posterior ends (Pl 84 fig. 10) . It was found that the plants seemed to possess spines at the anterior and the posterior ends when they were viewed in one plane only. Upon focusing they were seen to have spines all over the tests.

Samples: Lake Hume 5/4(Dam), 2/5(4), 3/5(Dam), 3/6(5), 5/7(2), 8/7(5).

Lake Mulwala 4/6.

Trachelomonas volvocina Ehr. *var. punctata* Pl 12 fig. 26

The Hume and Mulwala plants were identified as *Trachelomonas volvocina var. punctata* because its shape, punctate wall and colour agree with Playfair s'description although they were bigger. The colour was dark red.

Test dia. 19 (Playfair s'plants test dia. 13-14)

Prescott (1962) recorded *Tr. volvocina var. punctata* Playf. of even smaller tests (Pl 83 fig. 12 p. 419, test dia. 10, L 20). therefore the dimensions vary.

Previous Australian record of the variety: Playfair (1915). Schmidle (1896) and Haughey (1968) recorded the tpye form with no wall punctation from Australia and New Zealand.

Samples: Lake Hume 8/3(Tallan.), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 30/5(3), 31/5(4), 3/6(5), 5/7(2), 8/7(5), 9/7(3), 10/7(3), 11/9(5).

Lake Mulwala 10/2, 4/4, 7/5, 12/8.

Division Pyrrhophyta

Class Dinophyceae

Order Peridiniales

Ceratium hirundinella (O.Muell.) Dujardin Pl 12 fig. 2

Prescott 1962 Pl 92 fig. 5 p. 437

L 253-266

The length of the only one posterior horn was observed to vary. The thecal structure of Ceratium hirundinella as viewed under the scanning electron microscope was given by Dodge et al (1970).

Previous Australian and New Zealand records: Mobius (1892), Playfair (1912), Thomasson (1973) and Flint (1966).

Samples: Lake Hume 14/2(Dam), 7/3(3), 8/3(Tallan.), 5/4(Dam), 1/5(3), 2/5(4), 3/5(Dam), 31/5(4), 3/6(5).

Lake Mulwala 4/6.

Peridinium sp. Pl 12 fig. 4

The pattern of the wall plates is needed in identifying Peridinium sp.

Samples: Lake Hume 8/3(Tallan.), 2/5(4), 30/5(3), 7/3(3).

Glenodinium sp. Pl 12 fig. 3

The characteristics of the genus given in Prescott (1962) were observed in the Hume plants : cell wall thin, plates obscure with a transverse furrow that extends completely around the cell.

Sample: Lake Hume 8/3(Tallan.).

Division Cyanophyta

Class Myxophyceae

Order Chroococcales

Coelosphaerium Naegelianum Unger. Pl 3 figs. 12,13

The morphology and size of the plants suggest *Coelosphaerium Naegelianum* Unger. (Smith 1920 Pl 4 fig. 1 p. 35, Desikachary 1959 Pl 28 figs. 9, 16 p. 147) but no mucilagenous envelope was observed. Their dimensions agree well with those given by Desikachary (1959).

cell L 2-3

W 4-6

There is no previous Australian record.

Samples: Lake Hume 5/4(Dam), 1/5(3), 2/5(4), 3/6(5), 8/7(5), 10/7(3), 9/8(5), 11/9(5), 681122/3.

Lake Mulwala 4/4, 7/5, 4/6, 12/8.

Microcystis aeruginosa Kutzing Pl 1 figs. 6, 11

Smith 1920 Pl 5 figs. 1,2 p. 39

Prescott 1962 Pl 102 fig. 1 p. 456

cell dia. 3-4

There is no previous Australian record. Haughey (1968) recorded it from New Zealand.

This species is a frequent component of water blooms, especially in lakes with eutrophic characteristics (Prescott 1962).

Samples: Lake Hume 14/2(Dam), 1/5(3), 7/3(3), 2/5(4), 3/5(Dam), 30/5(3), 3/6(5), 10/7(3), 7/7(3), 9/8(5), 11/9(5).

Lake Mulwala 10/2, 7/5, 4/6.

Microcystis flos-aquae (Wittr.) Kirchner. Pl 1 fig. 7

Smith 1920 Pl 5 fig. 3

Desikachary 1959 Pl 17 fig. 11 p. 94

The Mulwala plants'cell dia. is comparable to that given by Desikachary (1959). Cell dia. 7-8.

Some workers put Microcystis flos-aquae (Wittr) Kirchner. as synonymous with Microcystis aeruginosa Kutzing (See Prescott 1962 for further discussion).

Previous Australian records: Scott & Prescott 1958, Thomasson 1973.

Sample: Lake Mulwala 4/6.

Anabaena limnetica G.M.Smith Pl 1 fig. 4

Using the key provided by Smith (1920) this slightly flexed Anabaena,seen only once, may be Anabaena limnetica G.M.Smith (Smith 1920 Pl 8 fig. 8 p. 57). The Hume dimensions agree with those given by Smith (1920).

cells	W	9-13
hetercyst	W	9
spore	W	18
	L	31

This species differs from Anabaena spiroides Kleb. in that the filament did not coil and the vegetative cells and the akinetes are bigger. Desikachary did not describe this species from India (1959).

There is no Australian record of the species.

Sample: Lake Hume 3/5(Dam).

Anabaena spiroides Klebahn Pl 1 figs. 1-3

Desikachary 1959 Pl 71 fig. 9 p. 395

cells	W	6-8
heterocysts	W	8-10
akinetes	W	10
	L	15-23

The dimensions are comparable with those given by Desikachary (1959). Sometimes the heterocysts are in the mucilagenous envelope (Pl 1 fig. 3).

There is no previous Australian record. Flint (1966) recorded Anabaena spiroides Kleb. from New Zealand.

Samples: Lake Hume 14/2(Dam), 7/3(3), 8/3(Tallan.), 1/5(3), 2/5(4), 3/5(Dam), 5/7(2), 11/9(5).

Lake Mulwala 10/2, 4/4.

Lyngbya palmarum Bruhl et Biswas Pl 1 fig. 8

Desikachary 1959 Pl 55 fig. 6 p. 301

The Mulwala plant is Lyngbya palmarum Bruhl et Biswas (using Desikachary 1959 s'key p. 198-199). The sheath is yellow and the plant is slightly shorter than the Indian plant.

cell L 2

W 7

Prescott (1962) recorded a similar plant Lyngbya aerugineo-caerulea (Kutz.) Gomont (Pl 111 fig. 11 p. 498) but his plant had colourless sheath.

There is no previous Australian record of the species.

Samples: Lake Mulwala 10/2, 7/5.

Oscillatoria curviceps Agardh. ex Gomont Pl 1 fig. 14

Using Desikachary s'key (1959 p. 198-199) the plant was identified as Os.curviceps Agardh. ex Gomont.(Pl 39 figs. 9,10) The Mulwala plant differs from Desikachary s'plant in having slightly bent apex. The dimensions agree well.

cell L 3

W 14

The cross walls of Os.curviceps may or may not be granulated (Prescott 1962 Pl 108 fig. 17 p. 487).

There is no previous Australian record.

Sample: Lake Mulwala 10/2.

Oscillatoria lacustris (Kleb.) Geitler Pl 1 fig. 10

Prescott 1962 Pl 109 fig. 15 p. 488

Bourrelly 1966 Pl 1 fig. 8

cell dia 5-6

L 3-5

Prescott (1962) noted it was possible that subsequent study will establish Os.lacustris (Kleb) Geitler as a new fresh water species of Trichodesmium. According to Desikachary (1959)Os. lacustris (Kleb) geitler is synonymous with the fresh water Trichodesmium lacustre Kleb. (Pl 42 fig. 22 p. 246).

Sample: Lake Mulwala: 7/5.

Oscillatoria nigra Vaucher Pl 1 fig. 5

Using Desikachary s'key (1959 p. 198-199) the plant is identified as Os.nigra Vaucher.

cell L 2-4

W 7

The plant has no granulated cross wall. Prescott (1962) stated the cross wall of Os.nigra may or may not be granulated while Desikachary (1959) stated it is. The drawings given by Prescott (1962, Pl 109 fig. 18) showed the end cells had rounded ends. The plant end cells have truncate ends like those of Desikachary (1959 p. 223).

This species has no previous Australian record. Spencer (1882) and Norstedst (1888) recorded it from New Zealand.

Sample: Lake Mulwala 10/2.

Oscillatoria subbrevis (cf.) Schmidle Pl 1 fig. 13

The plant resembles closest Os.subbrevis Schmidle (Desikachary 1959 Pl 40 fig. 1 p. 207). The dimensions are in the same order as Desikachary s'. Cell L 3, W 7.

Away from the apical cell of Oscillatoria subbrevis seen the cells seem to be divided into two by a cavity filled with granules.

Sample: Lake Mulwala 680921/1.

Oscillatoria waterbergensis Claassen 1961 Pl 1 fig. 12

The morphology and dimensions agree with those of the new species created by Claassen in 1961 (Pl 2 fig. 9 p. 565).

cell L 4-6

W 5

There is no previous Australian record.

Sample: Lake Mulwala 680921/1.

Schizothrix rivularis (Wolle) Drouet Pl 1 fig. 9

The closest plant that looks like the Hume plant (pl 1 fig. 9) is Schizothrix rivularis (Wolle) Droret (Prescott 1962 Pl 114 fig. 3). The filament observed had fluorescent property. Prescott (1962) recorded the cells are quadrate 5-11 μ in diameter.

Cell dia. 5

L 7-12

There is no previous Australian record. Prescott (1962) stated this species, left standing, would dissociate from the bundle sheath and give out pigments to fluoresce the water.

Samples: Lake Hume 3/5(Dam), 8/3(Tallan.).

Protozoa

Vorticella sp. Pl 12 fig. 1

The contracted stalk resembles that of Vorticella sp. (Jahn 1949 fig. 358 b). Jahn (1949) stated Vorticella s'stalk possessed internal myoneme which was capable of contracting. The sheath merely coiled like a spring.

Samples: Lake Hume 3/5(Dam), 11/9(5), 8/7(5).

More diatoms

Gomphonema Augur Ehr. var. Guatieri H.V.H. Pl 14 fig. 11

The Mulwala plants look identical with Gomphonema Augur Ehr, var. Guatieri H.V.H. as depicted by Heurck (1896 Pl VII fig. 302 p. 271). Their dimensions agree with those given by Heurck. (1896).

L 50

W 16

Striation 11 in 10 μ

Samples: Lake Mulwala 10/2, 4/6.

There is no previous Australian record.

Unidentified diatoms

1) Pl 14 fig. 10 (L 58, W 12, Striation 11 in 10 μ).

Samples: Lake Hume 5/7(2), 7/8(3), 10/9(4).

Lake Mulwala 680921/1.

2) Pl 14 fig. 18 (L 58, W 14, Striation 25 in 10 μ).

Samples: Lake Hume 1/5(3), 7/8(3), 10/9(4).

Lake Mulwala 4/6, 12/8.

DISCUSSION

Assuming that desmids are inhabitants of oligotrophic (nutrient-poor)waters and Euglenineae, Myxophyceae, and a great majority of Chloroccoccales and Centrales have an eutrophic tendency, Nygaard (1949) proposed the phytoplankton hypothesis whereby the numbers of oligotrophic and eutrophic species found in plankton samples are used to calculate the compound phytoplankton-quotient which is defined as:

$$\frac{\text{Myxophyceae + Chlorococcales + Centrales + Euglenineae}}{\text{Desmidieae}}$$

The quotient of less than 1.0 indicates oligotrophic lakes. Values of greater than 1.0 probably indicate eutrophic lakes (nutrient-rich) and those between 5-20 indicate a higher degree of eutrophy.

Brook (1959b, 1965) pointed out two major limitations to the use of the compound phytoplankton quotients to determine the trophic status of lakes:

1) Most of the desmids were found to be tychoplanktic,i.e. adventitous forms from other habitats, therefore the inclusion of all desmids collected into the denominator of the quotient gave a misleadingly-low value which indicated oligotrophy.

2) Taxonomists have different opinions on the delimitation of species hence one investigator s'determination may not be comparable to the other s'.

Nygaard (1949)& Brook (1959b, 1965) were of the same opinion that the aim of this biological means ~~of~~ for determining the trophic status of lakes must be the formulation of a quotient based on a limited number of planktonic species, whose status in the plankton and whose nutritional requirement have been adequately investigated.

Brook (1965) stated quotients can be applied with a fair degree of reliability if the limitations mentioned above are observed. The Hume and Mulwala compound phytoplankton quotients (Table 2) indicate both lakes are in the same lower range of eutrophy. The desmids and other algae, seen in 1968-1969 samples only, were not taken into account since the corresponding 1974 samples lack them. The 1968-1969 Mulwala samples had high numbers of some desmid species, in particular, Staurastrum arctiscon (Ehrenb.) Lund var. glabrum West & West, St.dickiei Ralfs, St.grande Bulhn var. parvus West, St.furcatum (Ehrenb.) Breb., St.tohopekaligense Wolle, and St.victoriense West. This observation shows that Mulwala 1968-1969 conditions differ from those at present. Perhaps the lake was more oligotrophic. Brook (1965) stated that an increase in pH may be responsible for the disappearance of desmids.

The other approach is to characterise waters in terms of their dominant plankton species and to classify them according to the community or associations they support. The plankton of an oligotrophic lake may be characterised by a large numbers of desmids species although it may be dominated numerically by one or two species of diatoms or Chrysophyceae, and a eutrophic may be characterised not by a large number of species of Myxophyceae but by very large numbers of filaments or colonies of only one or two species as during a water bloom (Brook 1965). Using this approach the two lakes are oligotrophic (Table 2).

To average the results of the determination of the determination of the trophic status of Lakes Hume and Mulwala by the two approaches, the two lakes may be said to be mesotrophic.

Geographical distribution of desmids seen.

The world distribution of algae in order to characterise them according to climatic regions has only a tentative value since algae from all parts of the world have not been critically examined. Also, the delimitation of species especislly in the desmids is very subjective. It depends on the judgement of the desmologists.

From the literature survey all desmids seen are cosmopolitan except:

1) *Micrasterias Hardyi* G.S.West has only been recorded from Australia.

2) *Cosmarium magnificum* Nordstedt, *Staurastrum asterias* Nygaard, and St.victoriense G.S.West have no European records.

3) The southern hemisphere *St.nodulosum* Prescott may be a form of the widespread *St. leptocladum* Nordstedt.

4) *St.anatoides* Scott & Prescott may be synonymous with *St.quebecense* Frere-Irenee-Marie in which case this alga has been recorded from both hemispheres.

EXPLANATION OF PLATES

Where there is no along-side scale, the bottom scale applies.

PLATE 1

Fig. 1-3	Anabaena spiroides Kleb.
4	" limnetica G.M.Smith
5	Oscillatoria nigra Vaucher
6	Microcystis aeruginosa Kutz.
7	" flos-aquae (Wittr.) Kirchner.
8	Lyngbya palmarum Bruhl et Biswas
9	Schizothrix rivulis (Wolle) Drouet
10	Oscillatoria lacustris (Kleb.) Geitler
11	Microcystis aureginosa Kutz.
12	Oscillatoria waterbergensis Claassen
13	" Cf. subbrevis
14	" curviceps Agard ex Gomont

PLATE 2

1,2	Euglena spirogyra Ehrenb.
3,4	" cf. gracilis Kleb.
5,6	Phacus tortus (Lem.) Skvortzow
7	" pleuronectes (Muell.) Dujardin
8	Eudorina elegans Ehrenb.
9	Pledorina californica Shaw
10,11	Pandorina morum (Muller) Bory
12,13	Volvox cf. aureus Ehrenb.
14	" cf. globator Linnaeus
15,16	" cf. Carteri G.M.Smith
17	Botryococcus Braunii Kuetz.
18.	Micractinium pusillum Fres.

All genus and species names have not been underlined.

PLATE 3

Fig. 1-5	Actinastrum Hantzschii Lag.
6	Ankistrodesmus falcatus Corda
7,8	Selenastrum westii G.M.Smith
9	Kirchneriella lunaris (Kirchner.) Moeb.
10,11	Dictyosphaerium pulchellum Wood
12,13	Coelospharium Naegelianum Unger.
14	Dimorphococcus lunatus A.Braun.
15	Coelastrum reticulatum (Dang.) Senn.
16	" microporum Naeg.
17	Treubaria triappendiculatum Bernard
18	Unidentified plant
19,20	Oocystis parva West & West
21-23	" lacustris Chodat
24-26	Nephrocytium Agardhianum Naegeli

PLATE 4

1,2	Pediastrum duplex Meyen var. clathratum (A.Brun.) Lag.
3	" " " var. gracillimum West & West
4	" " " type form
5,6	" " "
7	" " " var. rugulosum Raciborski
8,9	Pediastrum tetras (Ehrenb.) Ralfs
10-12	Spherocystis Schroeteri Chodat
13,14	Tetraedron gracile (Reinsch) Hansgirg
15,16	" hastatum " "
17,18	" limneticum Borge var. gracile Prescott
19	" victorieae Wolosz var. major Smith
20	" regulare Kuetz.

PLATE 5

Fig. 1	Oedogonium sp.	
2	Spirogyra sp. 2	
3	"	sp. 1
4	Cf. Mougeotia sp.	
5	Ulothrix subconstrict G.S.West	
6,7	Scenedesmus obliquus (Turp.) Kuetz. var. dimorphus May	
8-10	"	quadricauda (Turp.) Breb.
11	"	" " var. quadrispina Chodat
12-15	"	opoliensis Richter
16	"	denticulatus Lag. var. denticulatus May
17	Arthrodesmus convergens Ehrenb.	
18	Cosmarium quadrum Lund	
19	"	granatum Breb. var. pyramidal Schmidle
20	"	magnificum Nordst.
21	"	punctulatum Breb. var. subpunctulatum Borge
22-24	"	bipunctatum Borgesen

PLATE 6

1	Closterium aciculare T.West var. subpronum West & West	
2	"	Kutzingii Breb.
3	"	ceratium Perty
4	"	gracile Breb.
5,6	"	monoliferum (Bory) Ehrenb.
7	"	striolatum Corda
8	"	Venus Kutz. var. inflatum Claassen
9	Micrasterias Hardyi G.S.West	
10	"	thomassiana var. notata (Nordst.) Gronbl.
11	"	mahabuleswarensis Hobson
12	"	decemdentata (Nag.) Archer.

PLATE 7

Fig.	1	Pleurotaenium Ehrenbergii (Breb.) De Bory
	2,3	Gonatozygon kinahani (Arch.) Rabenh.
	4	" monotaenium De Bory
	5	Spondylosium planum (Wolle) West & West
	6	Cosmarium contractum Kirchn.
	7	Euastrum elegans Kutz.
	8	" anasatum (Ehrenb.) Ralfs
	9-11	" cuspidatum var. goyazense Forster
	12	" divergens Joshua
	13	Staurodesmus cuspidatus (Breb) Ralfs var. tricuspidatus
	14,15	Arthrodesmus constrictus G.M.Smith var. longispinus Gronb.
	16-18	Staurodesmus triangularis (Lag.) Teiling
	19-21	Cosmarium cf. pseudonitidum Nordst.

PLATE 8

11 Staurastrum Playfairi Scott & Prescott

All the other figures are of Staurastrum nodulosum Prescott

PLATE 9

Fig.	1-5	Staurastrum dickiei Ralfs	
	6	"	grande Bulhn. var. Parvus West
	7,8	"	pachyrhynchum Nordst.
	9	"	Freemanii West & West
	10	"	patens Turner
	11	"	sp.
	12	"	asterias Nygaard
	13,14	"	furcatum (Ehrenb.) Breb.
	15,16	"	tetracerum Ralfs
	17	"	cf. subpinnatum Turner var. subpinnatum Schmid.
	18	"	subgemmulatum West & West
	19-21	"	tetracerum Ralfs var. evolutum West & West

PLATE 10

Fig. 1	Staurastrum	anatoides Scott & Prescott
2,4	"	sebaldi Reinsch. var. ornatum Nordst.
3	"	pseudosebaldi Wille var. planctonicum Teil.
5,6	"	victorience West
7,8	"	arctiscon (Ehrenb.) Lund var. glabrum Wests
9	"	tohopekaligense Wolle

PLATE 11

1-6	Staurastrum pingue Teiling
7-13	" " " (small forms)

PLATE 12

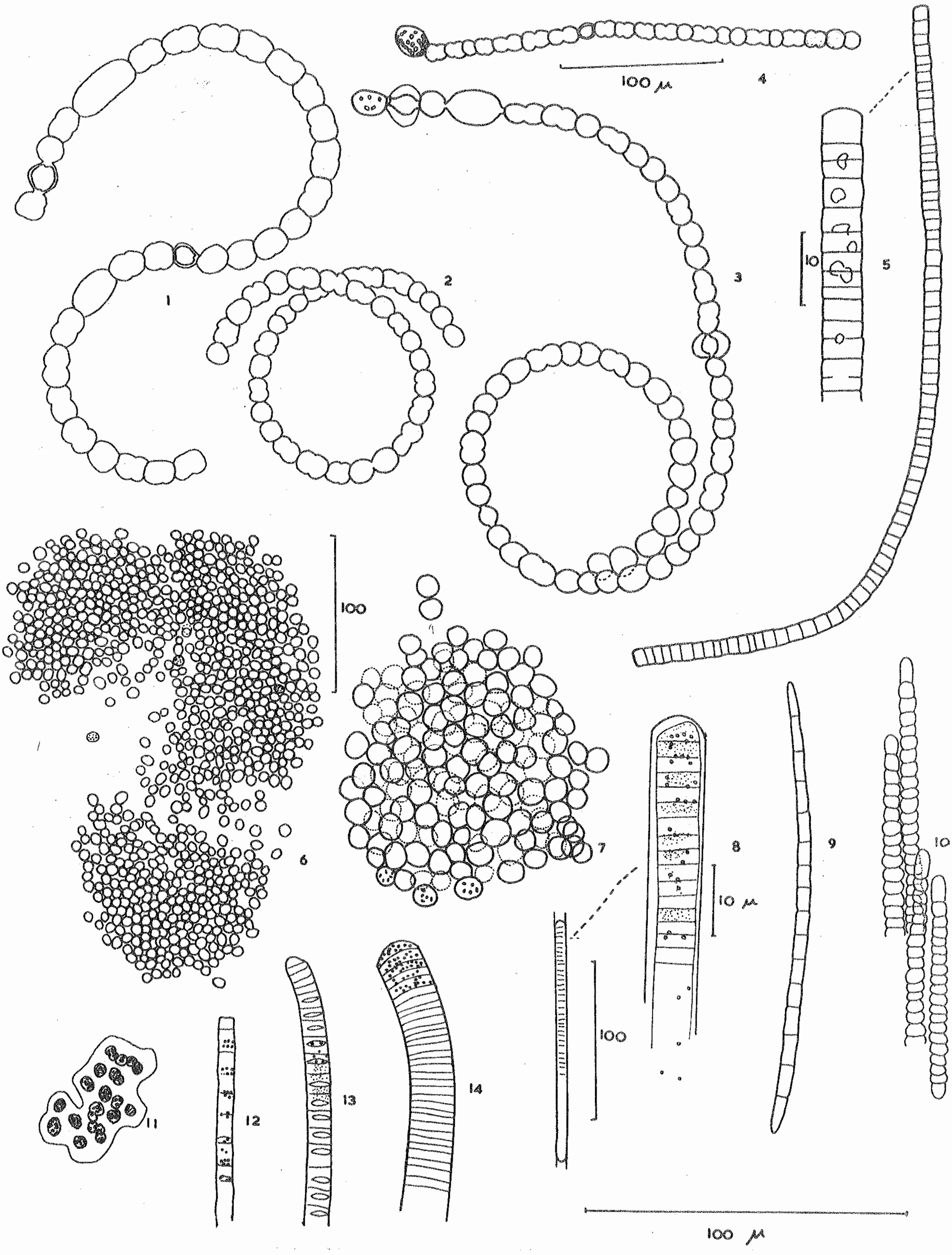
1	Vorticella sp.
2	Ceratium hirundinella (O.Muell) Dujardin
3	Glenodinium sp.
4	Peridinium sp.
5	Mallomonas akrokomos Ruttner
6	" splendens (G.S.West) Playfair
7	Synura spinosa Korsh.
8	Dinobryon divergens Imhof.
9	" sertularia Ehrenb.
10-12	Mallomonas sp.
13-15	Trachelomonas scraba Playfair
16-19	" bacillifera Playfair
20,21	" hispida (Perty) Stein var. rectangularis
22	" " " " var. coronata Lem m.
23	" superba Swirenko
24	" armatus var. longispina (Playfair) Deflandre
25	" caudata Stein var. australica Playf.
26	" volvocina Ehrenb. var. punctata Playf.

PLATE 13

Fig.	1-6	Attheya Zachariasi J.Brun.
	7	Cyclostella stelligera Cleve & Grun.
	8	Melosira granulata Ralfs
	9	" varians Agardh.
	10-12	Rhizosolinia erensis H.L.Sm var. morsa West & West
	13	Rhizosolinia erensis H.L.Sm
	14	Stauroneis fulmen var. capitata
	15	Nitzschia pelagica O.Mull.
	16	Synedra acus Kutz.
	17	" ulna (Nitz.) Ehr. var. danica (Kg.) V.H.
	18,19	" acus Kutz. var. radians (Kg.) Hust.
	20	" acus Kutz.

PLATE 14

1	Surirella spinifera Hust.
2	" Engleri O.Mull.
3	" tenera Greg.
4	Pinnularia abaujinsis (Pant.) Ross var. abaujinsis
5	Epithemia sorex Kutz.
6	Fragilaria capucina Desm.
7	Fragilaria sp.
8	Tabellaria flocculosa (Roth) Kutz. var. flocculosa Knudson
9	Cf. Gyrosigma attenuatum
10	Unidentified diatom
11	Gomphonema Augur Ehr. var. Guatieri H.V.H.
12	Asterionella formosa Hass.
13	Cf. Navicula hennedyi
14	Gomphonema constrictum Ehrenb.
15	" " " " var, capitatum Ehrenb.
16	Cymbella gastroides (cf.) Kutz.
17	Cymbella lanceolata Ehrenb
18	Unidentified diatom



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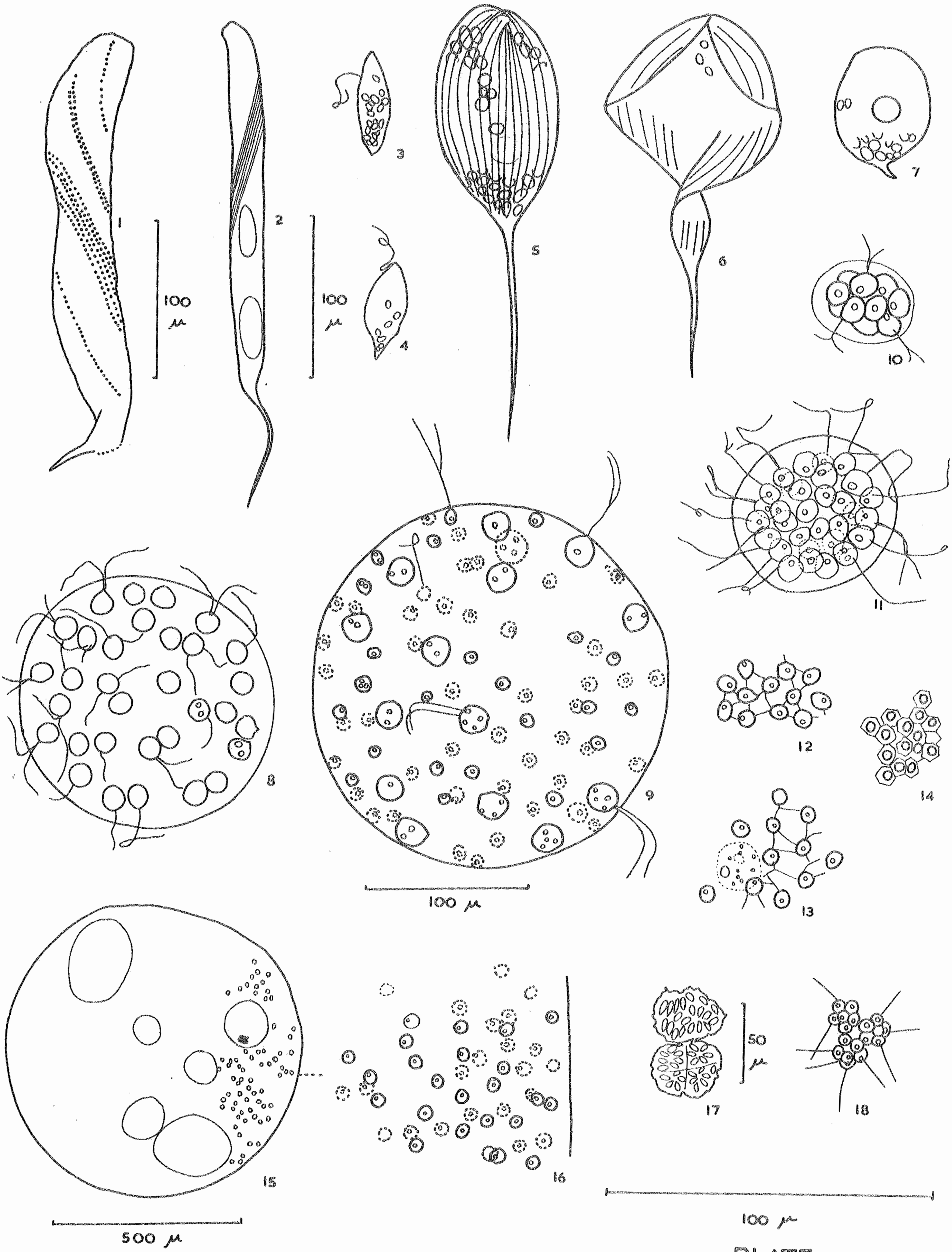
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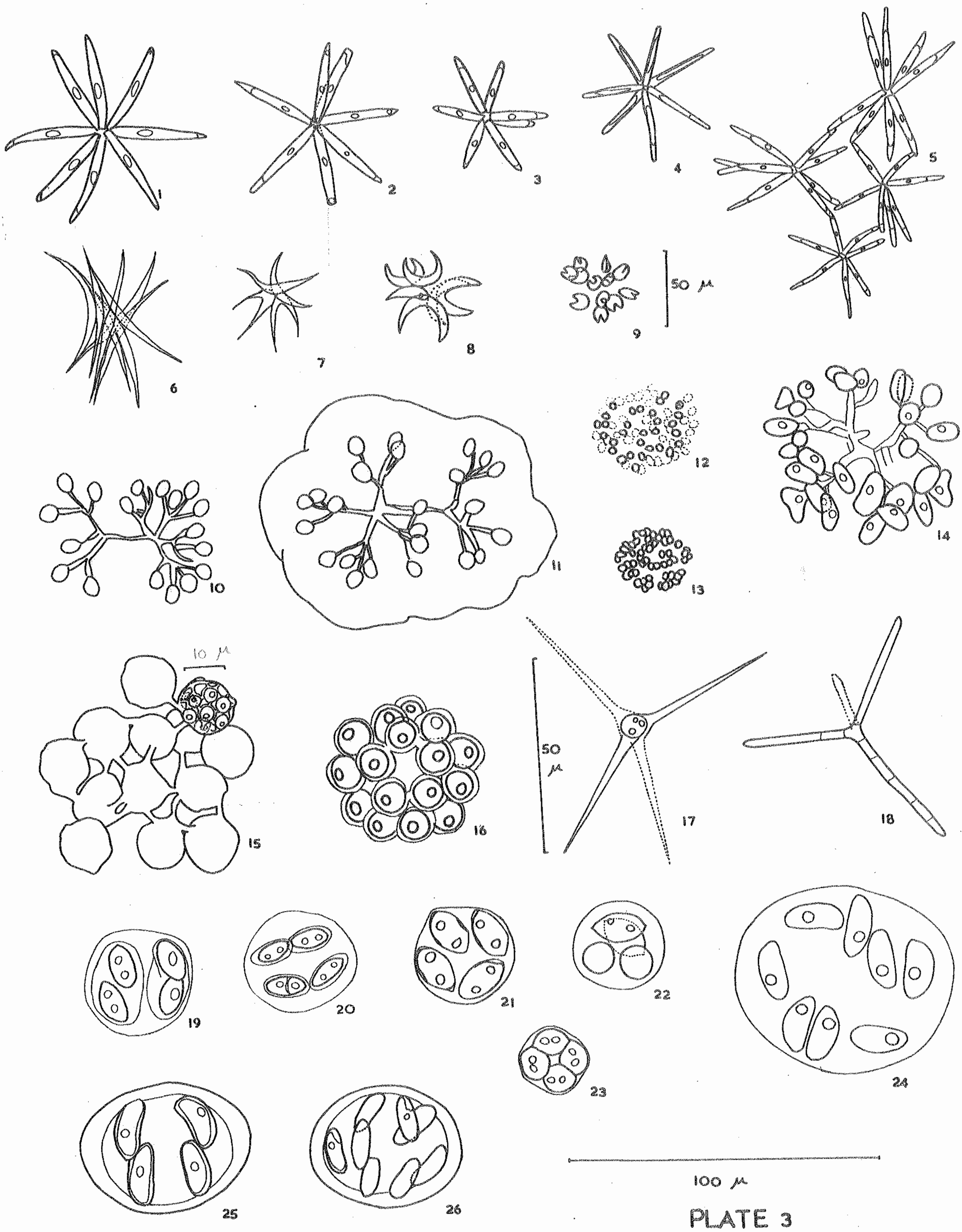

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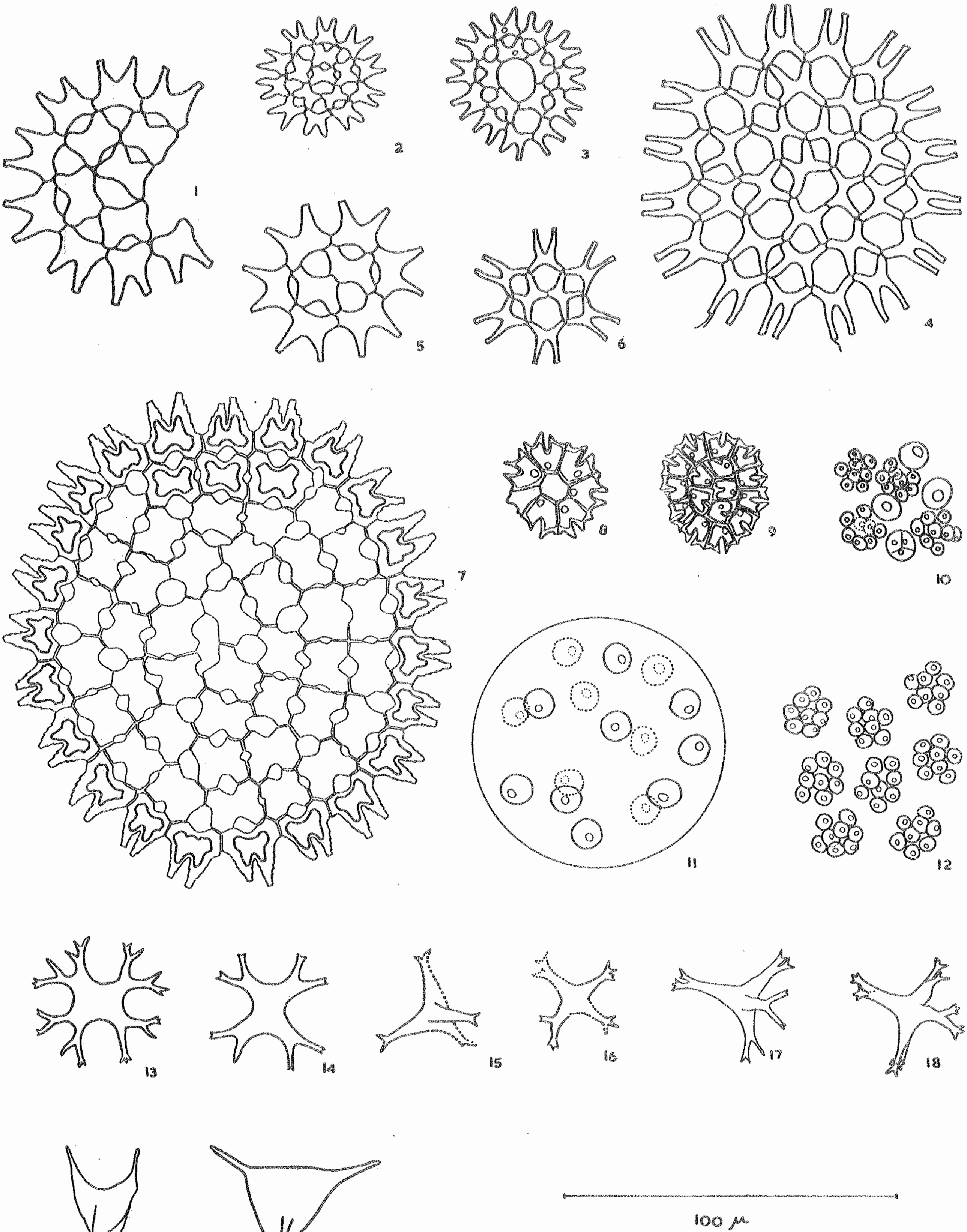

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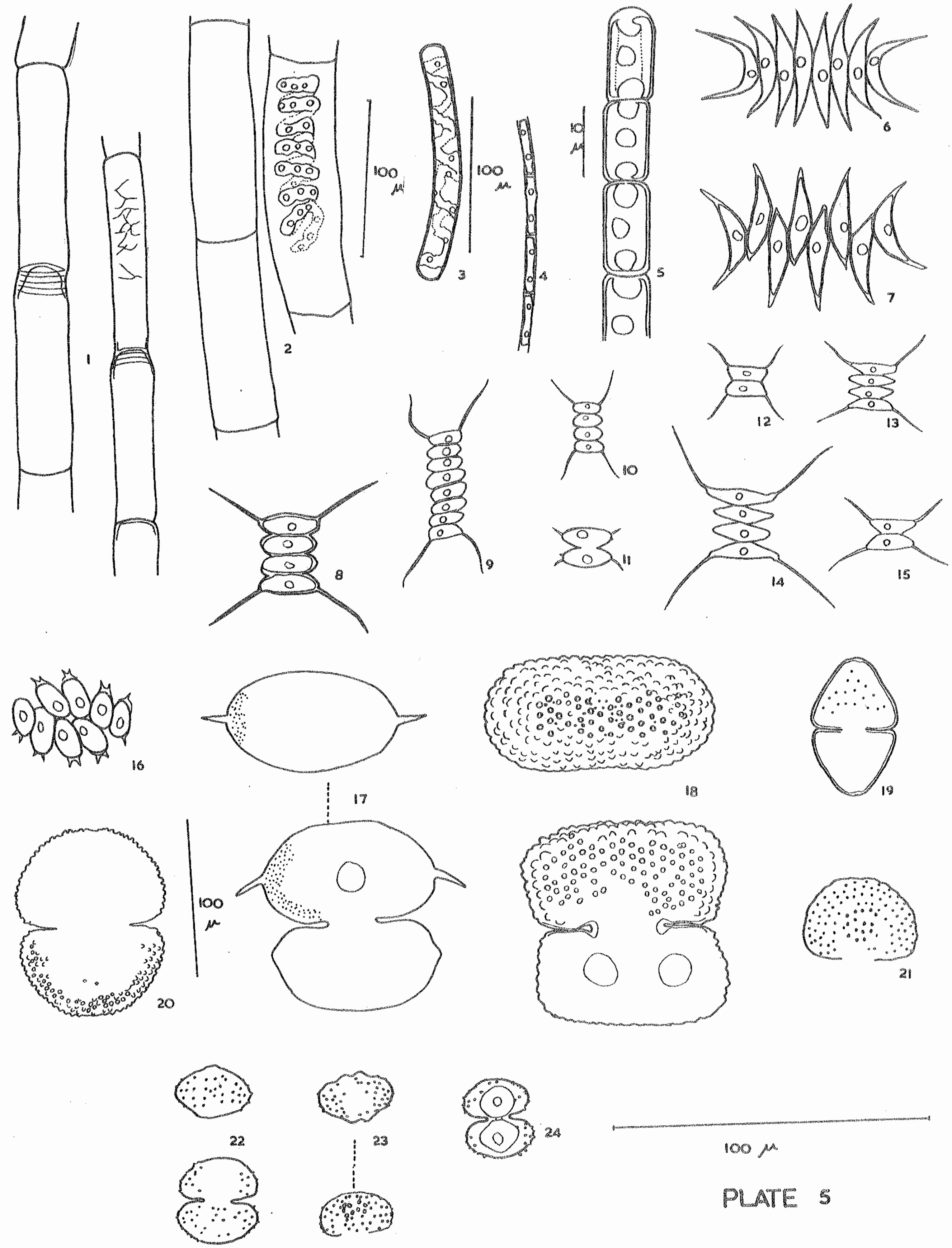
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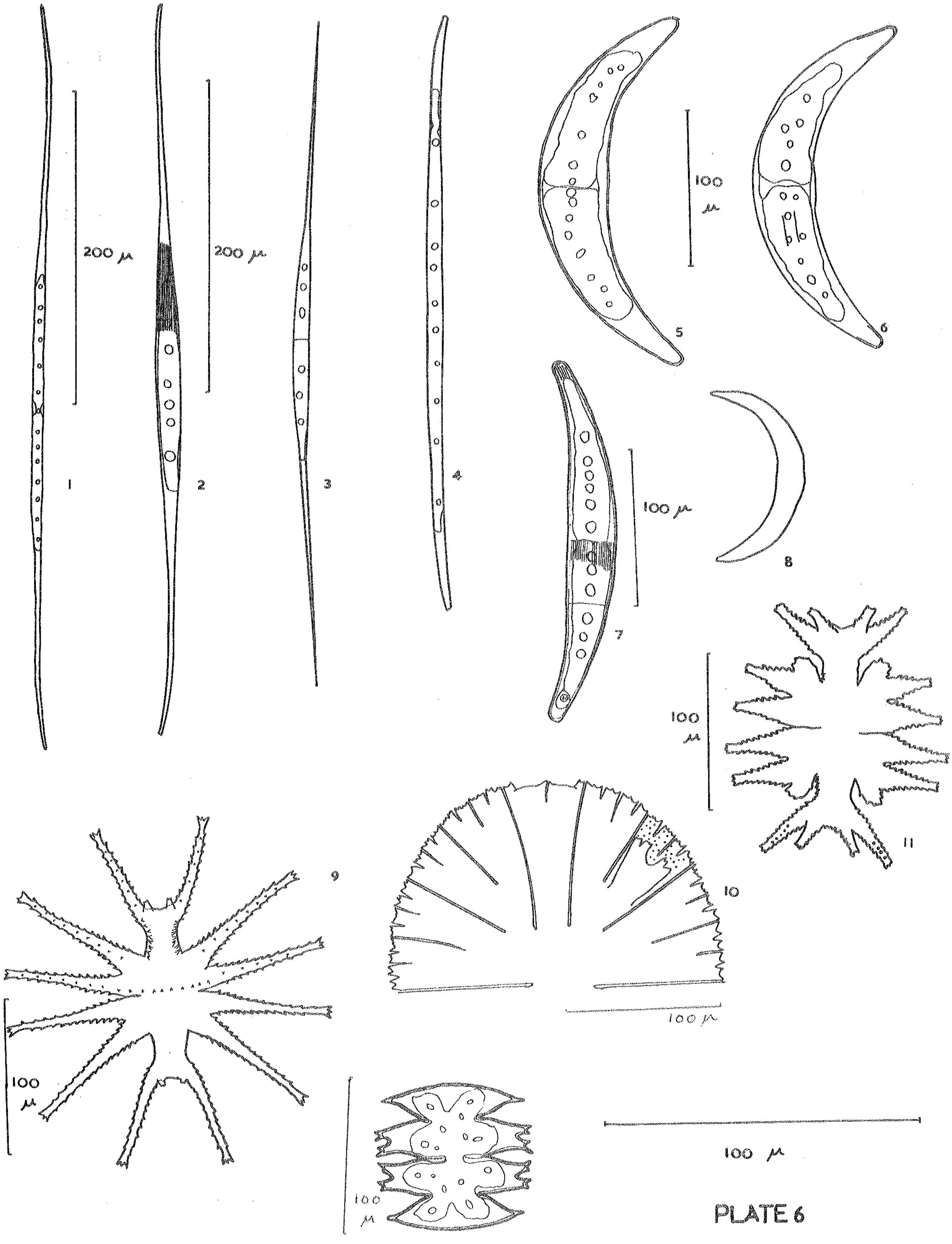
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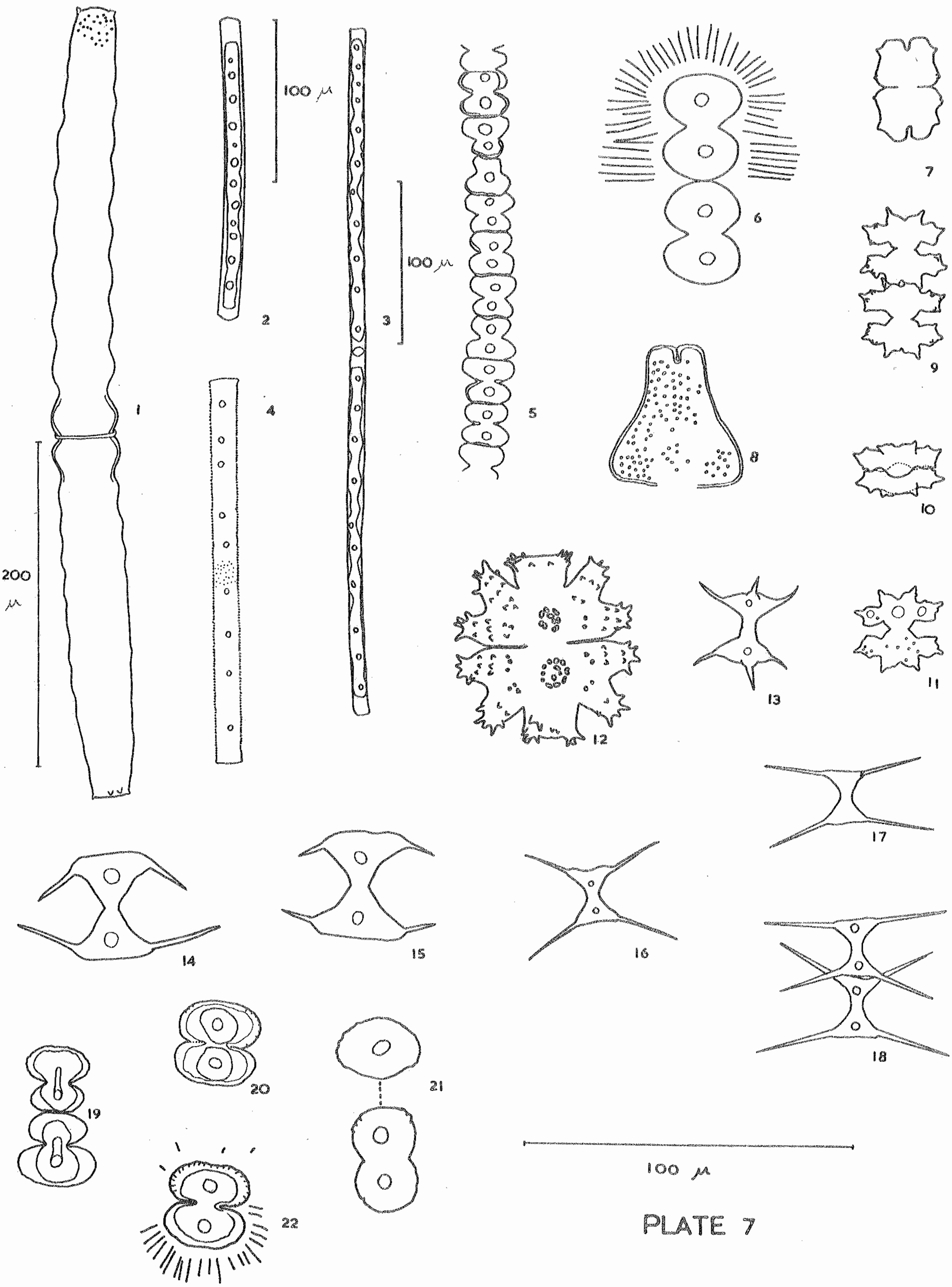
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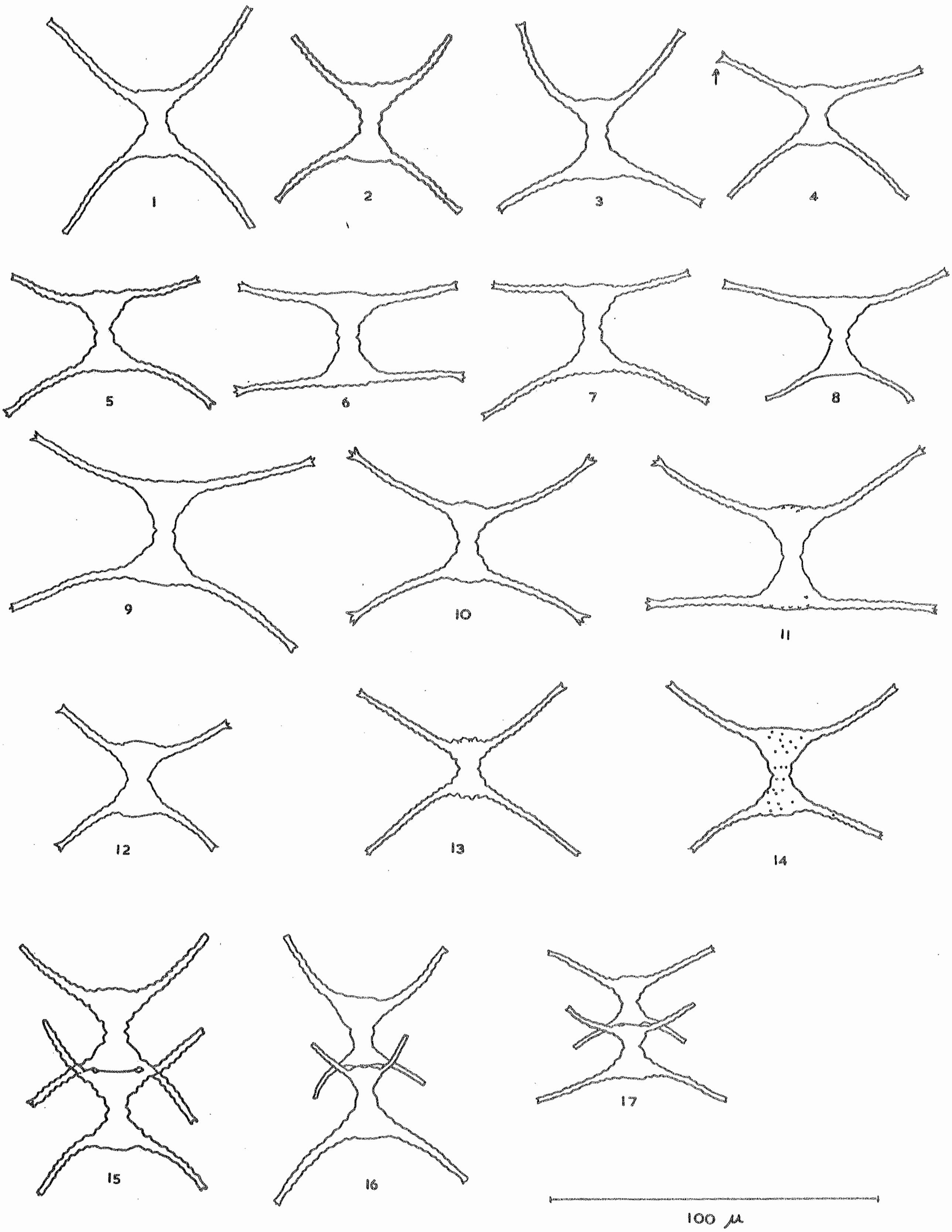
PLATE 7



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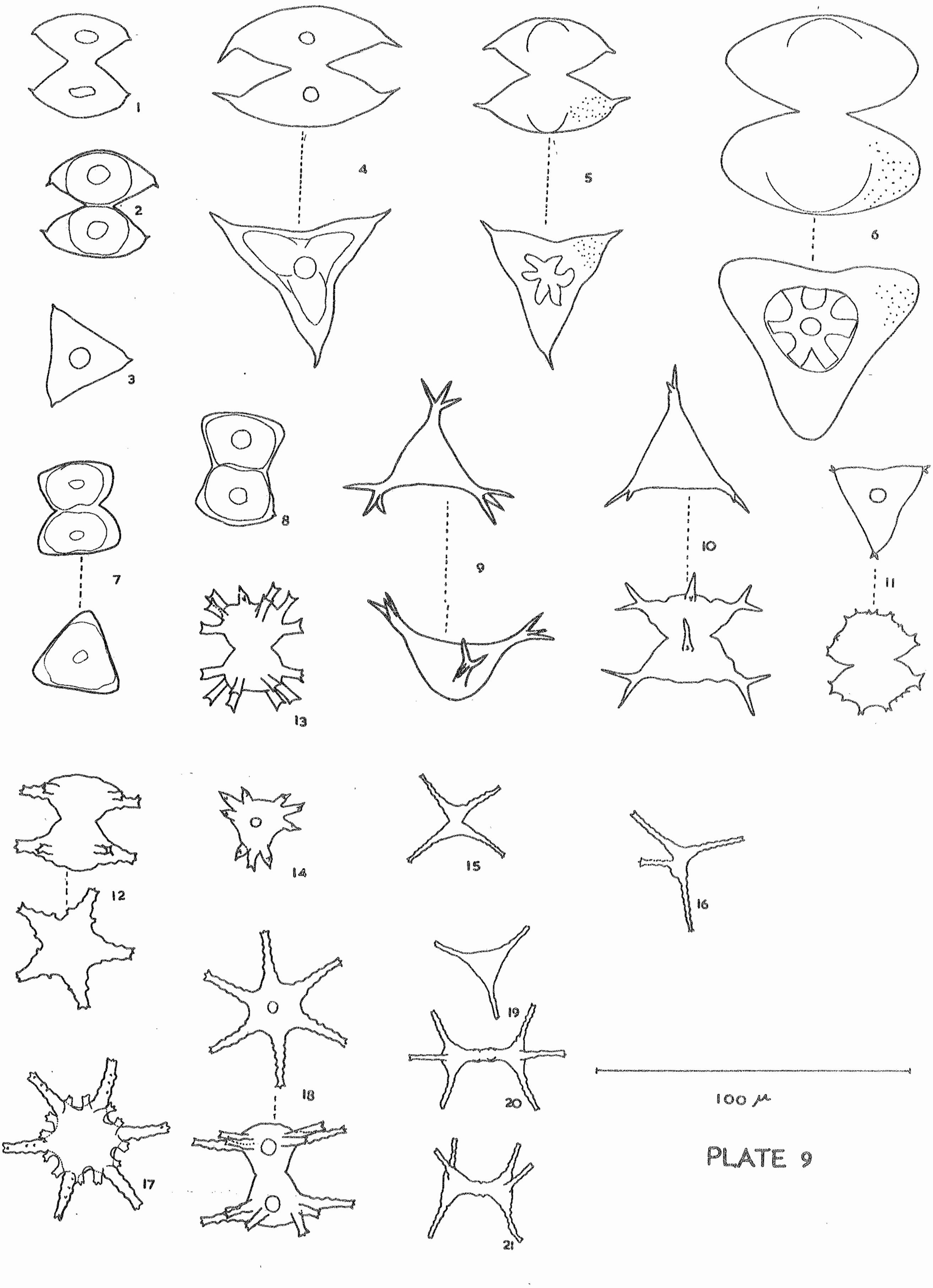

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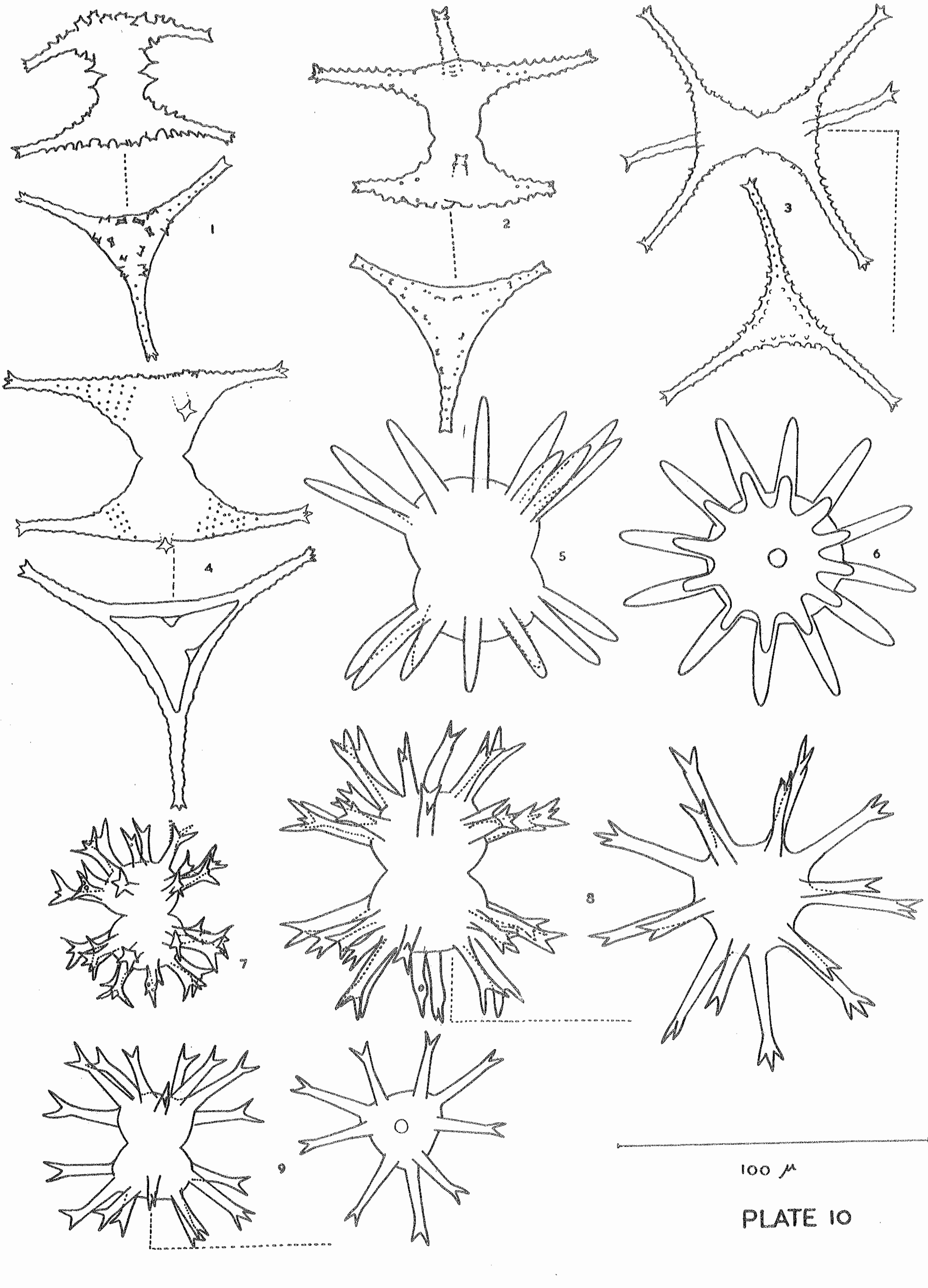

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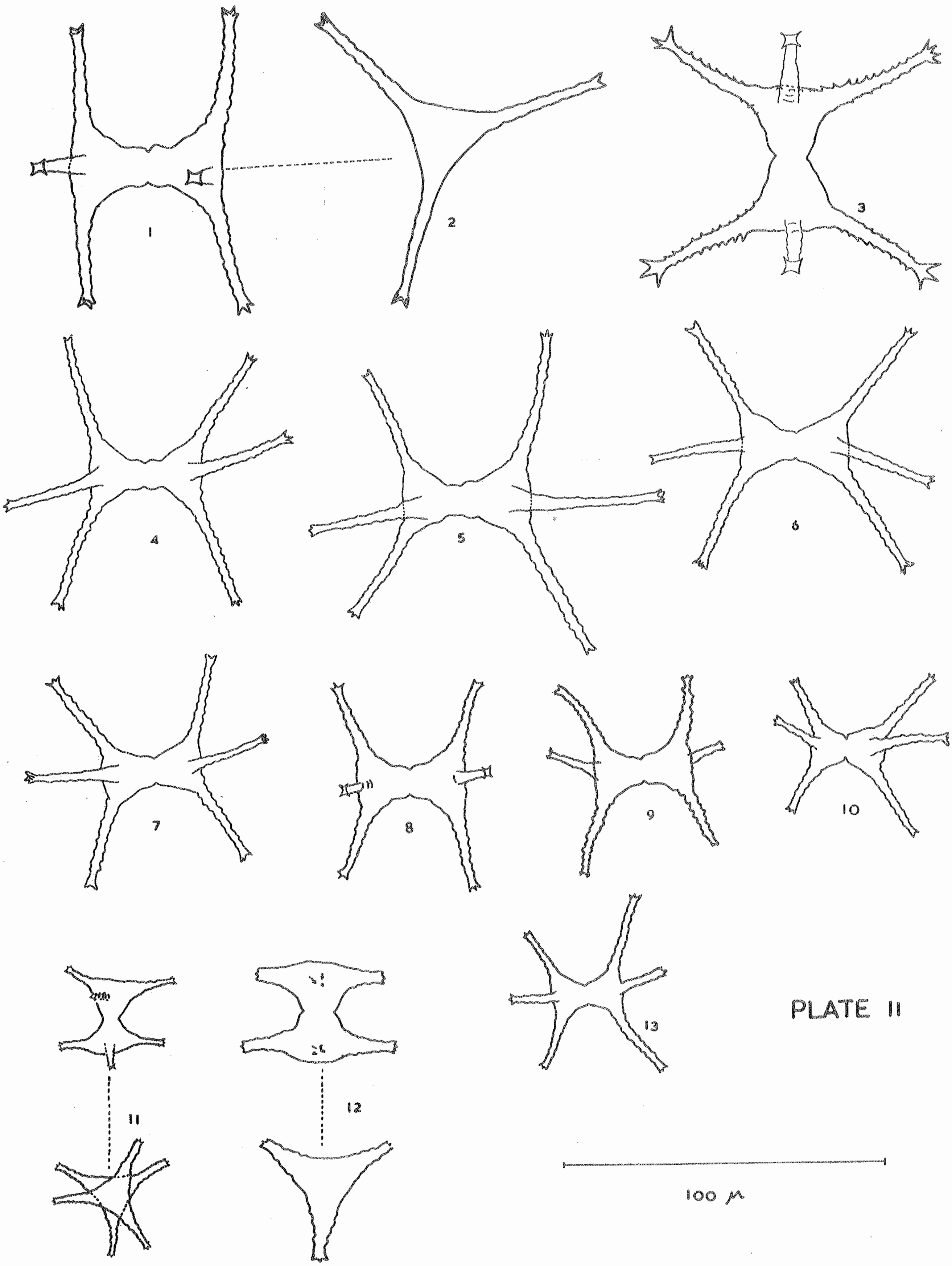

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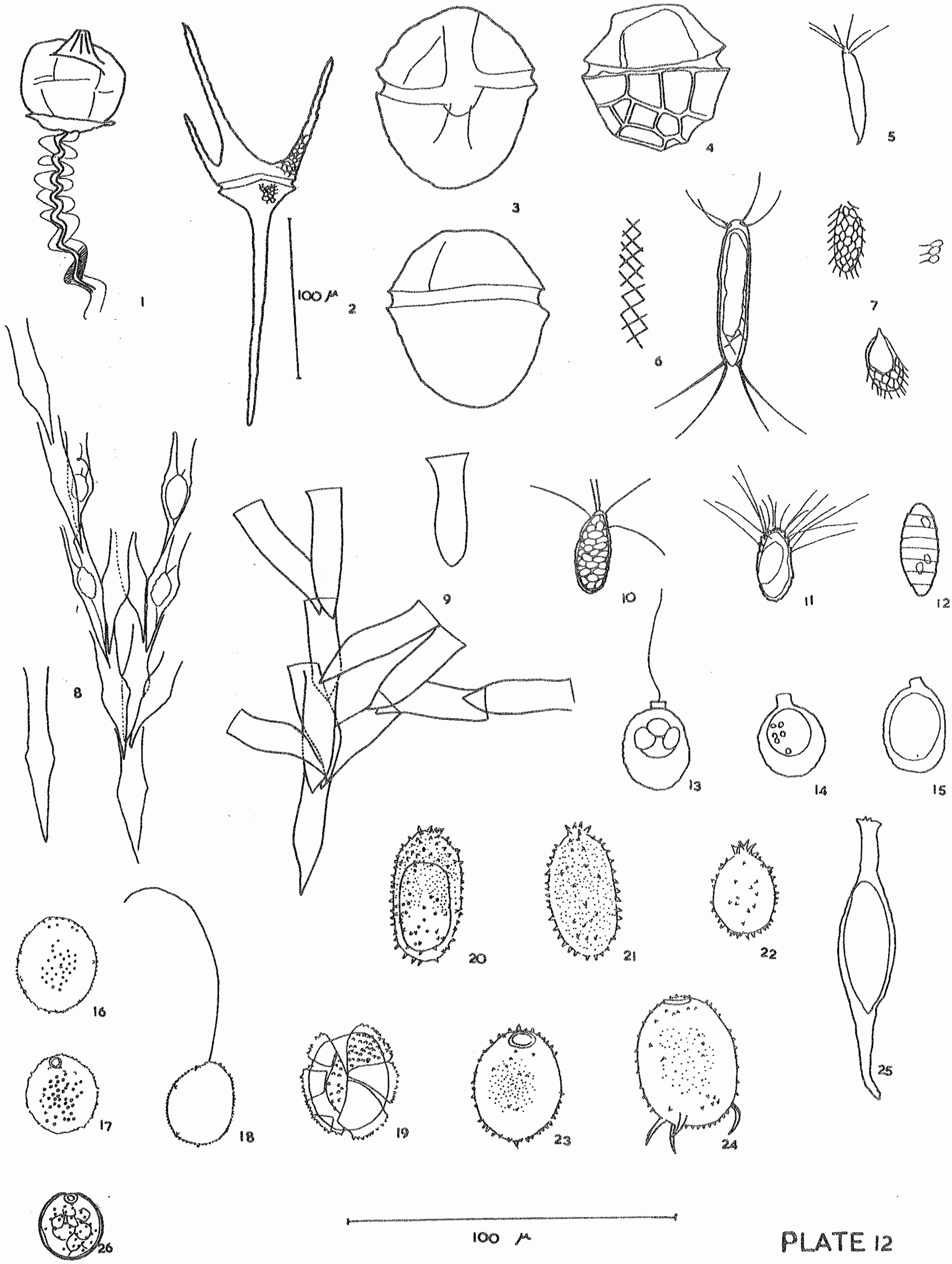
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PLATE 12

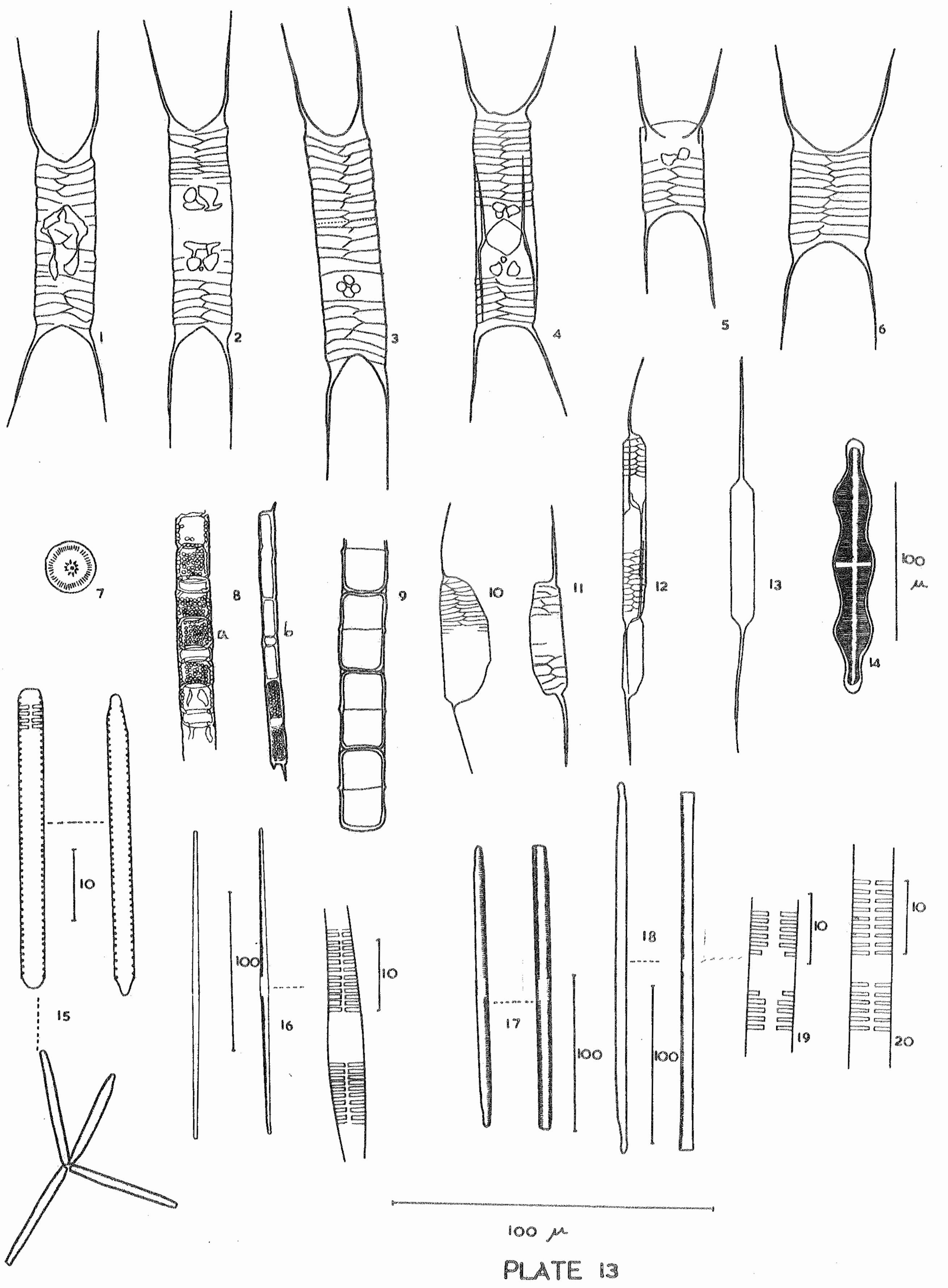

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PLATE 13

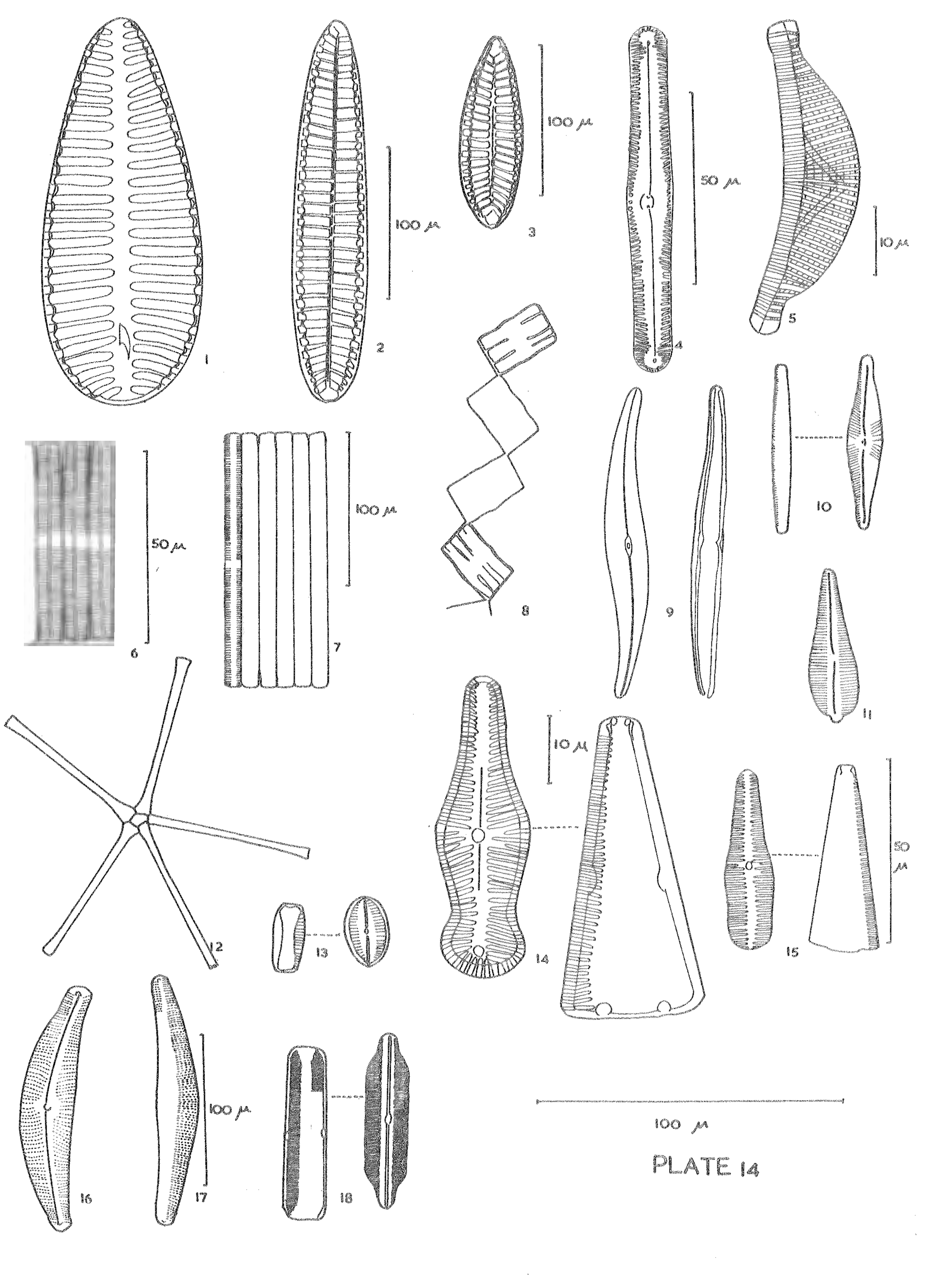
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PLATE 14

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