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Contribution to the Desmid Flora of Papua New Guinea II

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Abstract Seventy seven taxa of 11 genera of desmids (Desmidiales, Zygnemophyceae) were identified from samples collected in Papua New Guinea by the members of an expedition of the National Science Museum, Tokyo in 1975. For nine of them this was a first finding in this territory. Light and scanning electron microscope pictorial references are given and morphological features of some species are discussed.

Key words: Desmids, flora, new records, Papua New Guinea

The historical background of extensive algal collection from Papua New Guinea kept in the National Science Museum, Tokyo was given by Gontcharov et al. (1999). Though collected more than 25 years ago this material is still a valuable source of information on algal flora of the region. In part it was examined only recently with particular emphasis made on the desmid algae. This group was rather poorly represented in most of the samples studied. Nevertheless, a number of new and interesting desmid taxa has been recorded (Gontcharov et al. l.c.; Gontcharov & Watanabe, 2000). The present paper deals with desmid algae from gatherings made in October and November 1975 by M.W. in different localities of Papua New Guinea (Fig. 1).

Specimens used in the present study are:

No 51204, 1975–10–4, stream in Keravat near Rabaul, pH=6.5, water temp. 30°C;
No 51227, 1975–10–8, stream in Variata National Park, pH=6.2, water temp. 26°C, altitude=450 m;
No 51228, 1975–10–8, pond in Variata National Park, altitude=450 m;
Nos 51230–51233, 1975–10–9, stream in Sogeri district, pH=6.5, water temp. 29°C, alt.=500 m;
No 51238, 1975–10–9, Sirinum dam in Sogeri district, pH=5.9, alt.=500 m;
Nos 51239, 51240, 1975–10–15, stream in Woitape, pH=6.5, alt.=1500 m;
No 51358, 1975–11–13, stream near Omusis, on the way to Highland Highway from Lae;

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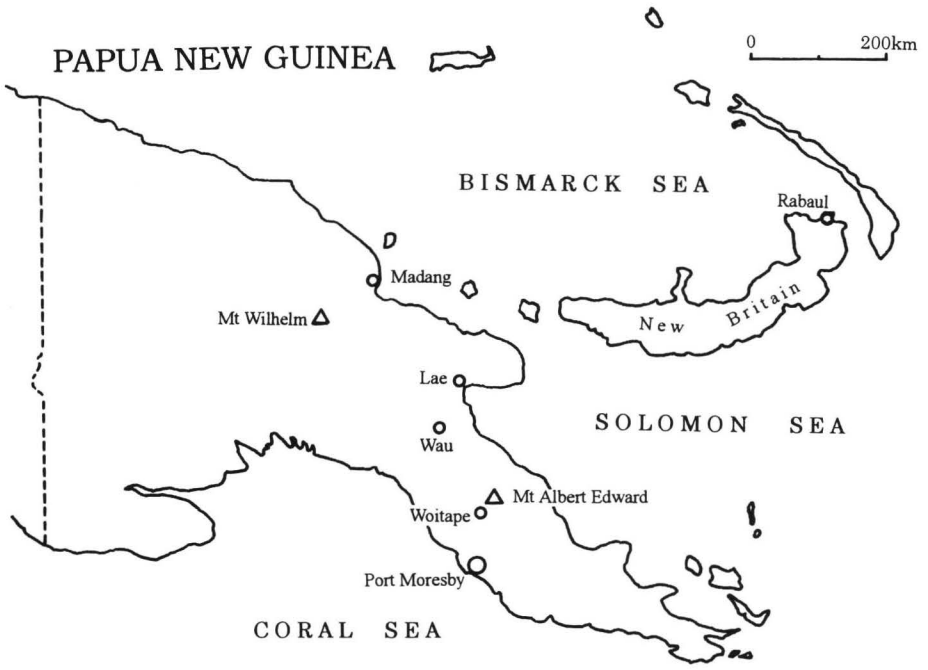

Fig. 1. Collecting sites in Papua New Guinea.

No 51371, 1975–11–17, pond in a golf course in Madang;
No 51379, 1975–11–20, on a moss at road side of Mt. Kaindi, Wau district, alt.=2100 m;
Nos 51380–51382, 1975–11–20, stream of Mt. Kaindi, alt.=2100 m;
No 51388, 1975–11–20, pond at the top of Mt. Kaindi, alt.=2200 m;
No 51392, 1975–11–22, in a drum can at the top of Mt. Kaindi, alt.=2200 m;
No 51394, 1975–11–22, pool at Mt. Kaindi, alt.=2100 m;
Nos 51410–51412, 1975–11–22, shallow pool in Kaisenik, Wau district, pH=5.9, alt.=1800 m;
No 51417, 1975–11–22, shallow pool in Kaisenik, alt.=1500 m;
No 51418, 1975–11–22, shallow pool in Kaisenik, alt.=1400 m;
No 51419, 1975–11–22, shallow pool in Kaisenik, alt.=1350 m;
No 51420, 1975–11–22, shallow pool in Kaisenik, alt.=1100 m;
No 51422, 1975–11–22, wall of road side in Kaisenik, alt.=1100 m;
Nos 51428–51431, 1975–11–23, stream at the innermost village in Kaindi, Wau district.

The methods used for light and scanning electron microscopes observation are the same as described in Gontcharov et al. (1999). Sammples are deposited in the herbarium of the National Science Museum, Tokyo (TNS).

The enumeration of the species is in accordance with the system of Růžička (1977) except the genus *Staurodesmus* Teil. The arrangement of the species within each genus is alphabetical. Taxa which had not previously been recorded from Papua New Guinea are marked with an asterisk.

All dimensions are given in micrometers; the following abbreviations are used: L=length of cell, W=width of cell, T=thickness of cell, I=breadth of isthmus, A=breadth of apex, csp=with spines, ssp=without spines, cpr=with processes, spr=without processes, No=sample number.

Species enumeration

Order Desmidiales

Family ***Closteriaceae*** Pritch.

Closterium Nitzsch ex Ralfs

Cl. acutum Bréb. ex Ralfs. No 51230.

Cl. baillyanum (Bréb.) Bréb. No 51228. Pl. I, fig. 1, 2

Cl. closterioides (Ralfs) Louis et Peeters. Nos 51228, 51232.

Cl. dianae Ehr. ex Ralfs. Nos 51388, 51410–51412, 51418, 51419, 51430, 51432, 51439.

Cl. ehrenbergii Menegh. ex Ralfs. Nos 51380, 51371.

Cl. gracile Bréb. ex Ralfs. Nos 51228, 51230, 51232.

Cl. lineatum Ehr. ex Ralfs

L 460-620 μm, W 32.5–40 μm, A 10 μm, striae 8–10 in 10 μm. Nos 51228, 51230, 51388.

Cl. moniliferum (Bory) Ehr. ex Ralfs. Nos 51204, 51227, 51231, 51392.

Cl. navicula (Bréb.) Lütkem. var. *crassum* (W. et G. S. West) Gronbl. No 51230.

Cl. ralfsii Bréb. ex Ralfs var. *gracilius* (Mask.) Krieg. No 51239.

Cl. setaceum Ehr. ex Ralfs. Nos 51230, 51232, 51239.

Cl. striolatum Ehr. ex Ralfs. Nos 51228, 51230.

Cl. rectimarginatum Scott et Prescott

L 182.5–197.5 μm, W 22.5 μm, A 5 μm. No 51232.

Cl. venus Kütz. ex Ralfs. Nos 51230, 51233.

Family ***Desmidiaceae*** Ralfs

Pleurotaenium Näg.

P. ehrenbergii (Bréb. ex Ralfs) De Bary var. *elongatum* (West) West. No 51228.

* *P. eugeneum* (Turn.) W. et G. S. West

L 425–630 μm, W 25–42.5 μm, A 17.5 μm. Nos 51232, 51371, 51388, 51417, 51430, 51420.

* *P. quantillum* (Turn.) W. et G. S. West Pl. I, fig. 3

L 220–227.5 μm, W 30–32.5 μm, A 15–17.5 μm. Nos 51418, 51420.

P. trabecula (Ehr.) Näg. No 51418.

Actinotaenium (Näg.) Teil.

A. capax (Josh.) Teil.

L 95–115 μm, W 57.5–65 μm, I 50–60 μm. No 51227, 51238.

A. cruciferum (De Bary) Teil. No 51428.

A. cucurbita (Bréb.) Teil. Nos 51228, 51232, 51238, 51428.

A. cucurbitinum (Biss.) Teil. Nos 51228, 51230, 51232.

**A. curtum* (Bréb.) Teil. ex Růžička et Pouzar Pl. I, fig. 4.

L 37.5–40 μm, W 22.5–23.7 μm. Nos 51227, 51358.

Euastrum Ehr. ex Ralfs

**E. acanthophorum* Turn. Pl. II, figs. 10, 11; pl. IV, figs. 3, 5.

L 25 μm, W 20 μm, I 7.5 μm, T 15 μm. Nos 51228, 51230, 51232.

This rare alga has an appearance and dimensions comparable with those of *E. denticulatum* (Kirchn.) Gay. From the latter taxon it differensiates in more elongated cells (L/B = 1.4–1.5), stout and long upward diverging spines at the angles of the apical lobes and more narrow apical incision.

Certain details of the cell wall decoration also distinguish these two algae. *E. acanthophorum* bears acute granules at the lateral and apical lobes and is provided with three large smooth warts and three scrobicles between them at the central protrusion. There are similar or smaller scrobicles near the protrusion and one large scrobicle is always placed at each lateral lobe. Pores of type 4 (Neuhaus & Kiermayer, 1982) are scattered on the cell surface and a few of type 5 are at the apex (Pl. IV, figs 3, 5). Each wart at the central protrusion allies with one or two pores, forming a central warts-pores complex (Neuhaus & Kiermayer, l.c.).

The taxon under discussion seems to be reported here for the first time in Papua New Guinea. However, from our point of view, alga illustrated by Vyverman (1991, pl. 138a) under the name *E. denticulatum*, may be *E. acanthophorum*. The appearance of his specimen and the pattern of the cell wall ornamentation corresponds to those described above and differs from the features depicted in *E. denticulatum* (Neuhaus & Kiermayer 1982).

E. ansatum Ehr. ex Ralfs. No 51228. Pl. II, fig. 3.

?*E. ansatum* forma Pl. II, figs 1, 2; pl. V, figs 1, 3, 5.

L 107.5–127.5 μm, W 42.5–47.5 μm, I 15–20 μm, A 25 μm, T 37.5–47.5 μm. No 51430.

This large-celled *Euastrum* species was found in large numbers and was observed under light and scanning electron microscopes. It has oblong trapeziform semicells with broadly rounded basal angles, nearly straight or slightly retuse lateral sides and truncate apex with rounded angles; apical incision is short and closed. The central part of the semicell is decorated with 5 protrusions. Widely opening sinus is a characteristic feature of this alga.

The cell wall in our plant appears punctate under LM, somewhat scrobiculated at the basal and apical angles and provided with 1 or 2 (sometimes up to 6) large pores at the centre of the semicell. The puncta correspond to pores of type 4 distributed all over the cell surface. The pores are arranged in a hexagon around one central and this pattern is more or less uniform on the entire surface of the semicell. A row of pores comes down from the apical incision (Pl. V, figs 1, 3, 5). Large pores seen under LM in fact are simple scrobicles of about 1 μm in diameter and do not possess pore channel (Pl. V, fig. 5).

Taxonomic affiliation of this alga is not firm and we assigned it to *E. ansatum* with some doubt. Our specimens are similar to *E. obesum* Josh. var. *tetmemoroides* Croasdale (Croasdale & Scott, 1976) in semicell outline but distinguish from it in presence of protrusions and scrobicles (usually called large mucilage pores in the literature). These features are typical for *E. ansatum* and some its varieties but non of them possesses widely opened sinus. The alga under consideration also have certain similarity to E. conicum (Playf.) Krieg. in appearance and presence of the scrobicles. It should be noted that all the taxa mentioned above have been described or reported from the Indo-Malaysian North-Australian phytogeographical region (Krieger, 1932) and may represent the same polymorphic species.

Features of the cell wall architecture also give no clue on affinity of the alga under discussion. Smooth cell wall as described above was reported in *E. cuneatum* and *E. ansatum* (Couté & Tell, 1981) but Neuhaus & Kiermayer (1982) illustrated a specimen of the latter species with reticulate cell wall. In *E. ansatum* var. *triporum* Krieg., other related taxon, it was reported as reticulate (Gontcharov et al., 1999) or faintly scrobiculated (Wei, 1991).

E. bidentatum Näg. No 51371. Pl. II, fig. 9.

E. cuneatum Jenn. ex Ralfs. Pl. IV, fig. 6.

L 80–85 μm, W 32.5–42.5 μm, I 12.5–17.5 μm, T 15 μm. Nos 51228, 51230, 51232.

The specimens seen possess morphological characters typical for the species under consideration. Their cell surface is smooth under the SEM and provided with pores of type 4 arranged in a hexagon around one central. A row of pores that goes from apical incision across the semicell body is detectable in this species.

E. dubium Näg. Nos 51228, 51230.

E. gaianum De Toni.

L 12.5 μm, W 10 μm. No 51230.

E. insulare (Wittr.) Roy. Nos 51230, 51232, 51388, 51394.

**E. kriegeri* Prescott Pl. II, fig. 8.

L 47.5 μm, W 35 μm. No 51371.

This rare species is reported for the first time in Papua New Guinea.

E. montanum W. et G. S. West. No 51430.

E. praemorsum (Nordst.) Schmidle. Pl. II, fig. 6.

L 57.5 μm, W 32.5 μm. Nos 51228, 51232.

E. sinuosum Lenorm. ex Arch. Pl. II, figs 4, 5; pl. V, figs 2, 4.

L 57.5 μm, W 30 μm, I 10 μm. Nos 51228, 51230.

The specimens studied represent a transitional form between several varieties of *E. sinuosum*. Our alga has 5 large pores at the protrusions and similar pores at the basal and lateral lobules of the semicell. Four more pores are placed between protrusions in the centre of the semicell (Pl. II, fig. 5). Such characters as presence and number of large pores were used to established a number of infra specific taxa within the species under discussion but their taxonomic importance seems to be questionable (Růžička, 1981). Therefore we designated our alga under the nominal variety.

The cell wall of *E. sinuosum* is smooth except for scrobicles at the angles of the apical, basal and lateral lobules and provided with scattered pores of type 4. They seem to be distributed all over the cell surface without any clear pattern. Large pores seen under LM at the protrusions and between them correspond to deep scrobicles (Pl. V, figs 2, 4). Those placed between protrusions are often surrounded by triangular depression in the cell wall. These depressions are sometimes provided with 1–3 pores but scrobicles themselves do not possess any pore channel.

Characters of the cell wall micromorphology have been described in var. *scrobiculatum* (Nordst.) Krieg. of the same species (Neuhaus & Kiermayer, 1982). Besides certain difference in the cell morphology their specimen contrasts in faintly scrobiculated and more densely porous cell wall.

E. spinulosum Delp. No 51371.

E. sublobatum Bréb. ex Rlfs var. *sumatranum* Scott et Prescott Pl. II, fig. 12.

L 20 μm, W 12.5 μm. No 51228, 51232.

**E. turnerei* West. No 51230. Pl. II, fig. 7.

Micrasterias Ag. ex Ralfs

M. decemdentata (Näg.) Archer. No 51371.

M. pinnatifida (Kütz.) Ralfs. No 51232.

Cosmarium Corda ex Ralfs

C. amoenum Bréb. ex Ralfs var. *mediolaeve* Nordst. Nos 51428, 51230, 51379, 51381, 51382.

C. askenasyi Schmidle. Nos 51228, 51230. Pl. I, fig. 5.

**C. bengalense* Turner.

L 52.5 μm, W 22.5 μm. No 51228.

C. binum Nordst. in Nordst. et Wittr. Nos 51238, 51418.

C. botrytis Menegh. ex Ralfs. Nos 51204, 51420.

C. contractum Kirchn. No 51230.

C. contractum var. *minutum* (Delp.) W. et G. S. West Pl. I, fig. 10; pl. IV, fig. 1.

L 25 μm, W 22.5–25 μm. No 51228.

The cell wall in the specimens seen was finely porous except for the central part of the semicell where the membrane is internally thickened and often yellowish.

C. granatum Bréb. ex Ralfs. No 51419.
C. hammeri Reinsch. No 51228.
C. lundelli Delp. var. *corruptum* (Turn.) W. et G. S. West. No 51228, 51230
C. margaritatum (Lund.) Roy et Biss. Nos 51227, 51371.
C. norimbergense Reinsch var. *depressum* (W. et G.S. West) Krieg. et Gerloff. No 51230.
**C. novae-semliae* Wille var. *ornatum* Mask. No 51230. Pl. I, fig. 12.
**C. novae-semliae* var. *sibiricum* Boldt. No 51230. Pl. I, fig. 11.
C. obsoletum (Hantzsch) Reinsch. Nos 51228, 51230, 51232.
C. pseudoconnatum Nordst. var. *subconstrictum* Jao. Nos 51230, 51382, 51392, 51397, 51431, 51422.
C. pyramidatum Bréb. ex Ralfs. Nos 51228, 51230.
C. quadratum Ralfs. Nos 51228, 51230, 51381, 51382.
C. tesselatum (Delp.) Nordst Pl. I, fig. 6; pl. IV, figs 2, 4.
L 107.5 μm, W 70 μm, I 52.5 μm. No 51228.

This large-celled alga has notable appearance due to the characteristic pattern of the cell wall ornamentation. It is decorated with granules arranged in regular oblique rows. Each granule is surrounded by 6 pits in a hexagon. The granules cover the entire cell surface diminishing towards the apex, which is often smooth.

C. subtumidum Nordst. No 51232.
C. tinctum Ralfs. No 51230.
Cosmarium sp. Pl. I, figs 8, 9.
L 25 μm, W 35 μm, I 10 μm, T 12.5–15 μm. No 51233.

Specimens of yet unidentified *Cosmarium* species were observed in one of our samples. It has cells broader than long, deeply constricted with closed linear sinus. The semicells are semielliptic with acutely rounded angles. In vertical view the cell is rhomboid, with rounded angles and a central protuberance on either side of the semicell. The cell wall is distinctly scrobiculated. Chloroplast has two pyrenoids. The cell shape in face and vertical views and very narrow linear sinus are characteristic features of this alga.

Xanthidium Ehr. ex Ralfs
X. multicorne Borge Pl. III, figs 5, 6, 8; pl. VI, fig. 1.
Lssp 60 μm, Wssp 45 μm, I 15 μm, Tssp 32 μm. No 51228.

This remarkable alga was rather common in the sample collected from the pond situated in Variata National Park. Its cell wall is smooth and provided with pores evenly distributed on the surface. The inflated bases of the spines lack pores.

Staurodesmus Teil.
S. incus (Bréb.) Teil. No 51228.
S. omearae (Arch.) Teil. Pl. VI, fig. 2.
Lssp 17.5 μm, Lcsp 30 μm, Wssp 12.5 μm, Wcsp 25 μm, I 7.5 μm. No 51228.

The cell wall is smooth, pores are in a few rows around the lateral angles and at

the apex.

Staurastrum Meyen ex Ralfs

S. bifidum Bréb. ex Ralfs. Nos 51228, 51232.

S. botanense Playfair var. *variabile* Krieg. Pl. III, fig. 4.

Lcpr 17.5 μm, Wspr 12.5 μm, Wcpr 22.5 μm. Nos 51228, 51232.

S. brachiatum Ralfs. Nos 51228, 51232.

S. dilatatum (Ehr.) Ralfs. No 51240.

S. gutwinskii Bernard. No. 51228. Pl. III, fig. 3.

S. irregulare W. et G. S. West. No 51228.

S. laeve Ralfs. No. 51228.

S. sexangulare (Bulnh.) Lund. Nos 51228, 51232.

Pl. III, fig. 7; pl. VI, fig. 4.

According to the description (Bulnhein, 1861: 51, Pl. 9A: 1) and numerous literature illustrations this species has serrulate processes but in our specimens cell body and processes were smooth except for 2–3 stout spines at the tip. Pores are limited in number and confined to the apex of the semicell where they form several indistinct circles around the central pore.

S. wildemanii Gutw. var. majus (W. et G. S. West) Scott et Prescott Pl. III, figs 1, 2; pl. VI, fig. 3.

Lssp 45 μm, Wssp 40–45 μm, Wcsp 80–87.5 μm, I 17.5 μm. Nos 51228, 51232.

The cell wall is smooth and provided with pores of type 1 evenly distributed on the surface. Inflated bases of the spines are lacking pores.

Hyalotheca Ehr. ex Ralfs

H. dissiliens (Smith) Breb. ex Ralfs. Nos 51228, 51230, 51232.

Desmidium Ag. ex Ralfs

D. aptogonum Bréb. ex Kütz. No 51232.

D. grevillii (Kütz.) De Bary. No 51232.

D. swartzii (Ag.) Ag. ex Ralfs. No 51232.

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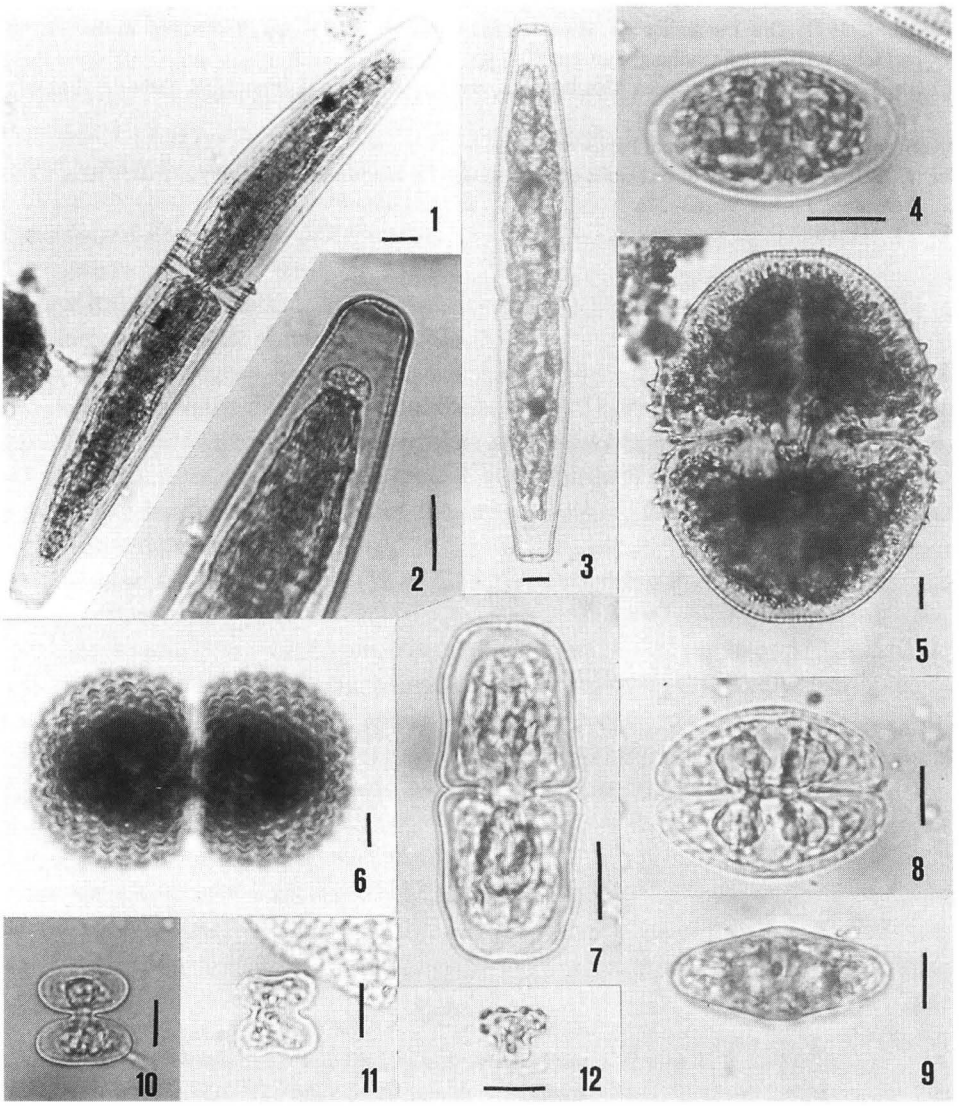

Plate I. 1, 2 *Closterium baillyanum*; 3 *Pleurotaenium quantillum*; 4 *Actinotaenium curtum*; 5 *Cosmarium askenasyi*; 6 *C. tesselatum*; 7 *C. bengalense*; 8, 9 *Cosmarium* sp.; 10 *C. contractum* var. *minutum*; 11 *C. novae-semliae* var. *sibiricum*; 12 *C. novae-semliae* var. *ornatum*. Scale bar = 10 μm.

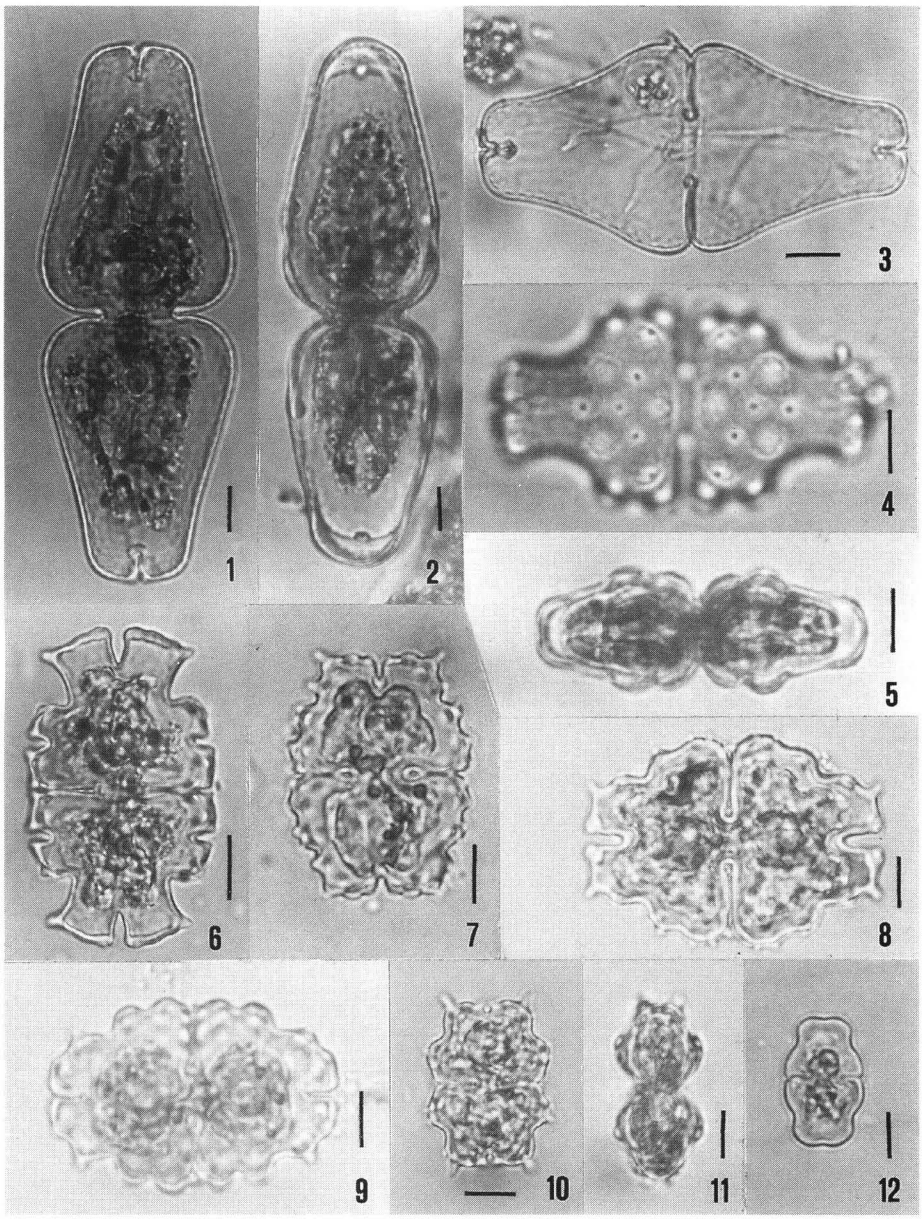

Plate II. 1, 2 ?*Euastrum ansatum* forma; 3 *E. ansatum*; 4, 5 *E. sinuosum*; 6 *E. praemorsum*; 7 *E. turnerei*; 8 *E. kriegeri*; 9 *E. bidentatum*; 10, 11 *E. acanthophorum*; 12 *E. sublobatum* var. *sumatranum*. Scale bar = 10 μm.

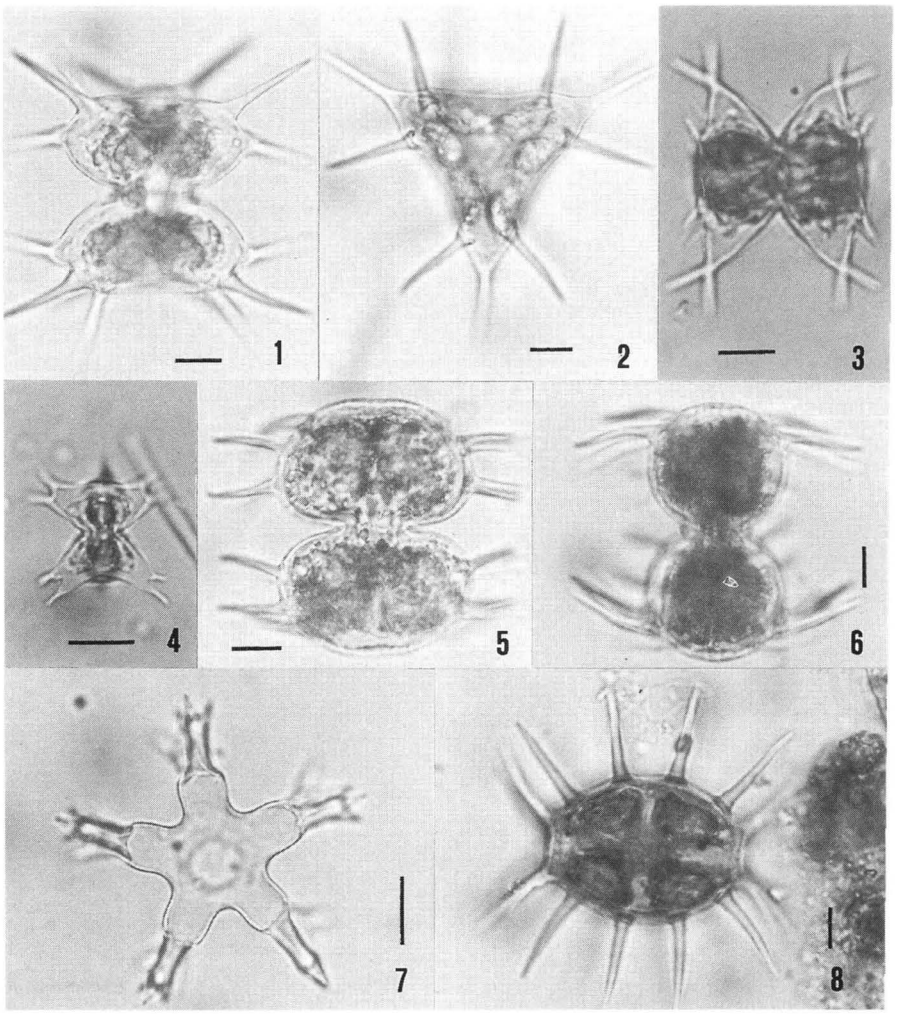

Plate III. 1, 2 *Staurastrum wildemanii* var. *majus*; 3 *S. gutwinskii*; 4 *S. botanense* var. *variabile*; 5, 6, 8 *Xanthidium multicorne*; 7 *S. sexangulare*. Scale bar = 10 μm.

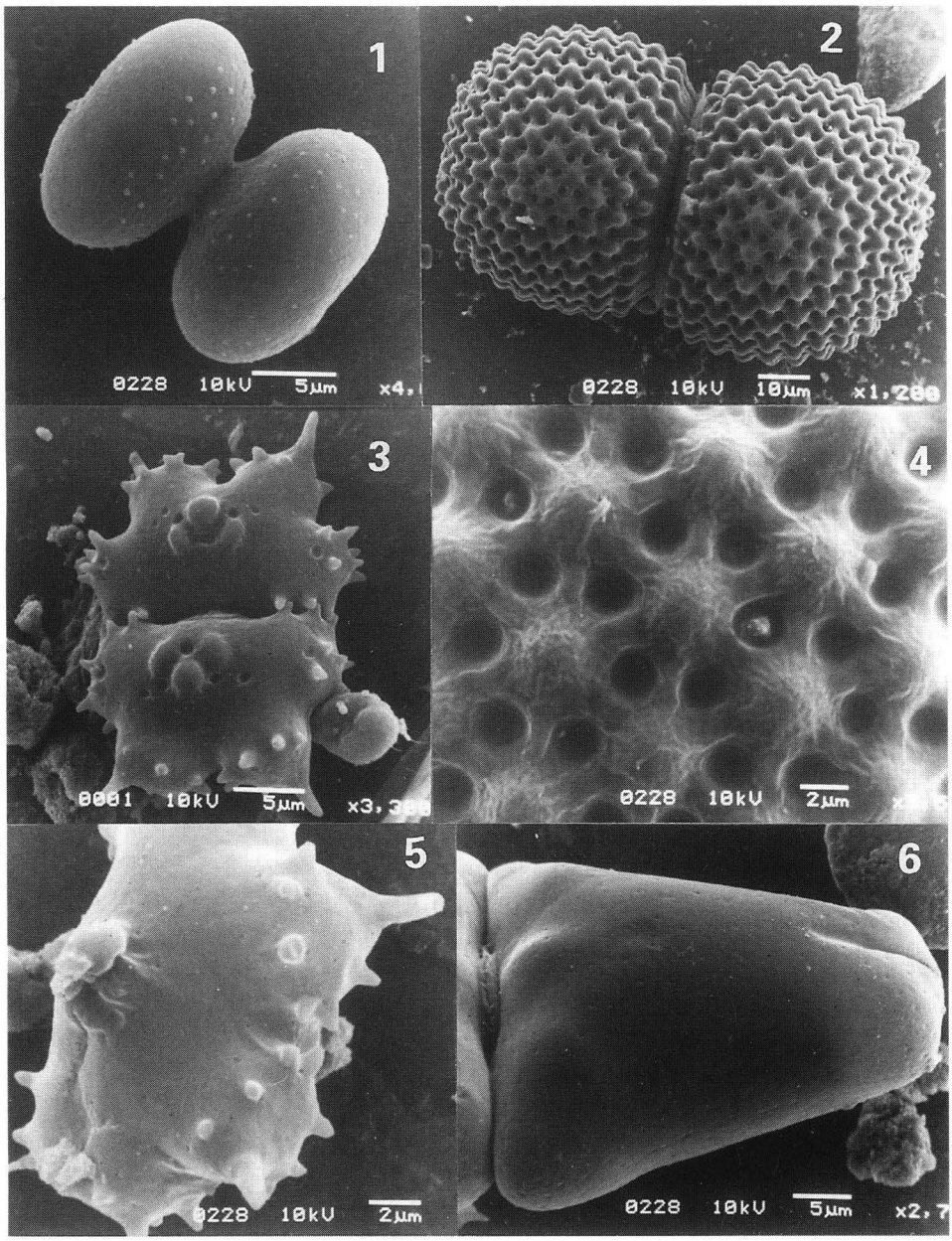

Plate IV. 1 *Cosmarium contractum* var. *minutum*; 2, 4 *C. tesselatum*; 3, 5 *Euastrum acanthophorum*; 6 *E. cuneatum*.

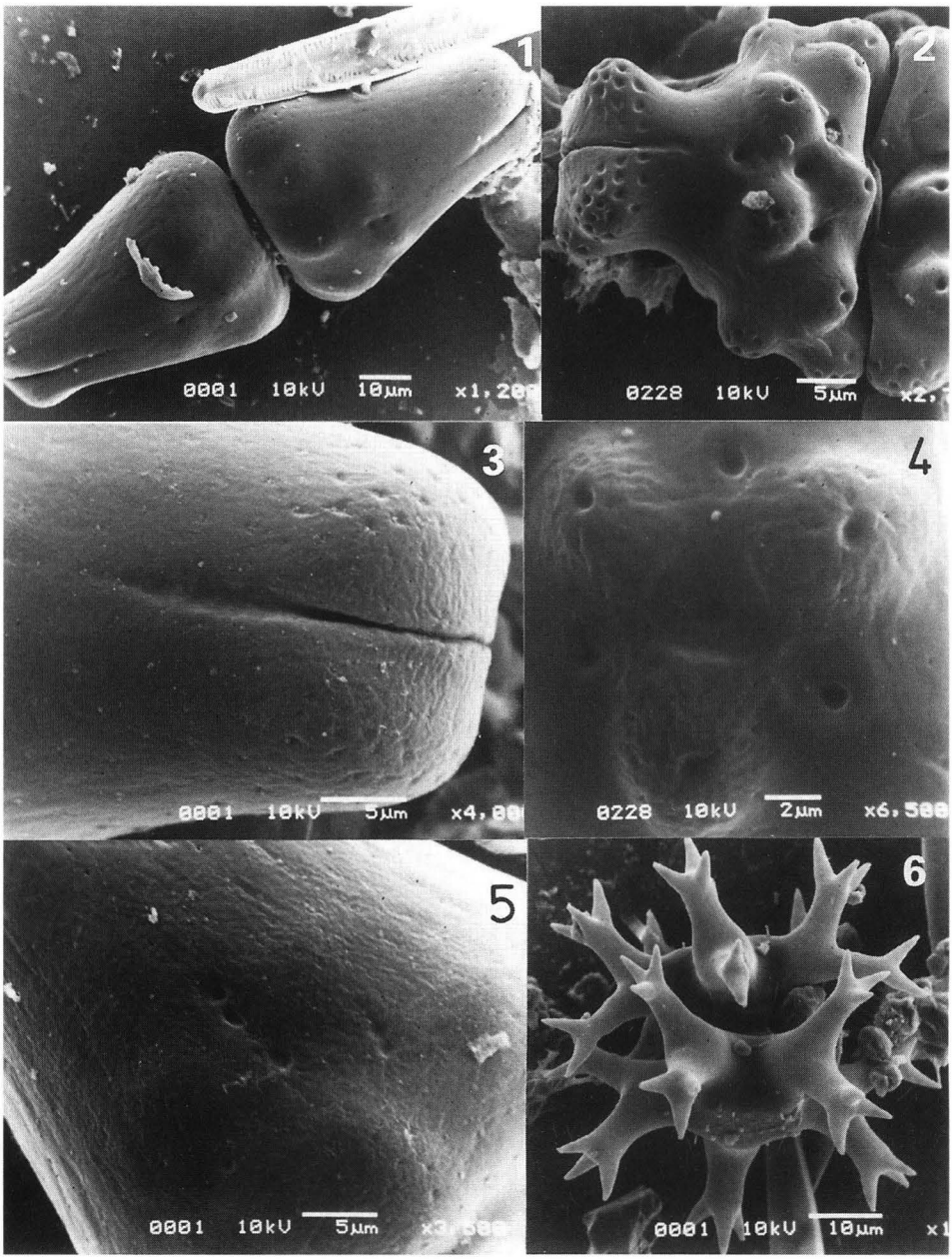

Plate V. 1, 3, 5 ?*Euastrum ansatum* forma; 2, 4 *E. sinuosum*; 6 *Staurastrum sexangulare*.

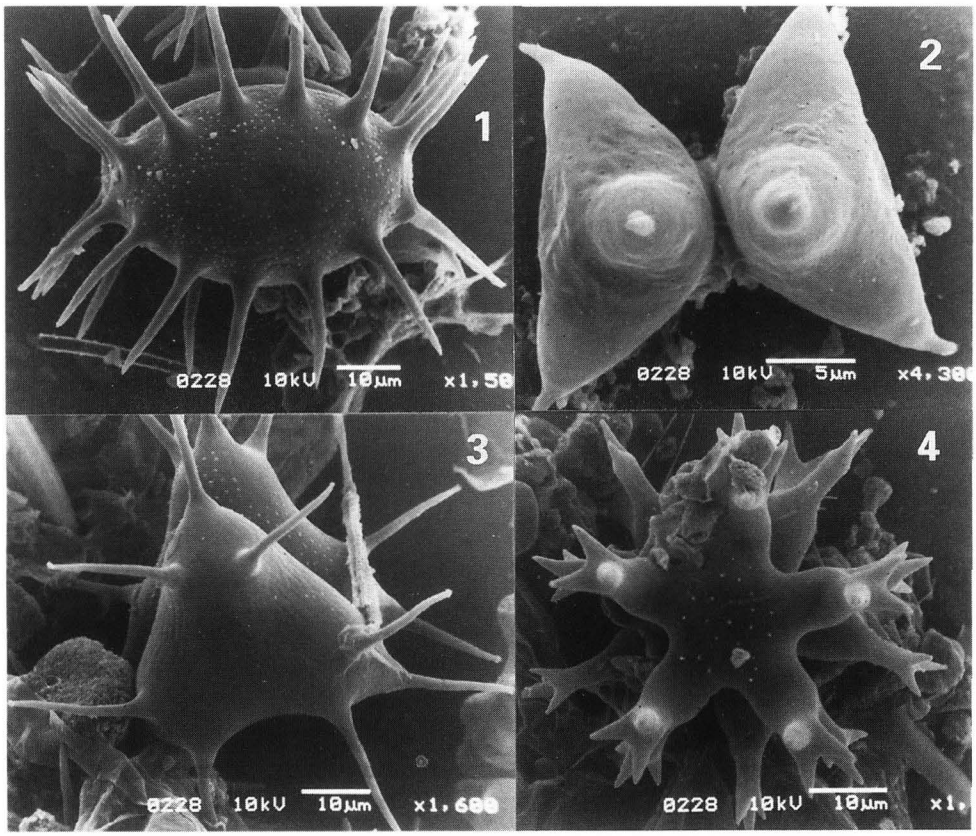

Plate VI. 1 *Xanthidium multicorne*; 2 *Staurodesmus omearae*, 3 *Staurastrum wildemanii* var. *majus*; 4 *S. sexangulare*.