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SUDANESE DESMIDS

BY

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AND

ARTHUR M. SCOTT

WITH TWO MAPS IN THE TEXT AND PLATES I—XXIX

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Foreword

by

R. GRÖNBLAD

The rather complicated history of the present paper came about in the following way. Some years ago Dr. EDNA LIND of Kampala sent me, at request, some samples of desmid-bearing material from Uganda. (These will be dealt with in another paper.) She had contact with the Hydrobiological Research Unit at the University of Khartoum, which is under the direction of Dr. J. RZÓSKA, and at her suggestion Dr. G. A. PROWSE wrote and asked if I should like to receive for identification material from the Sudan. This offer was gladly accepted, and as the desmids appeared to be quite peculiar in shape and of unusual richness I asked my friend Mr. A. M. SCOTT of New Orleans, whom I knew as a skilled student of tropical and subtropical desmids especially, if he would like to cooperate in this work, to which he agreed enthusiastically, and some of the Sudanese material was sent to him. In the summer of 1955 Mr. SCOTT stopped in London on his way to Finland, and there he met with Dr. RZÓSKA and Dr. PROWSE who happened to be on leave in England at the time. Dr. PROWSE handed his desmid drawings to Mr. SCOTT who brought them to Finland and we were able to use them in our identifications.

The plates have been inked from the drawings of Scott and Grönblad by Miss TOINI TIKKANEN, Phil.Mag., to whom the authors are grateful for skilful work.

The English text has been revised by SCOTT, and the Latin text by Dr. HANNAH CROASDALE of Hanover, N.H. (U.S.A.), to whom the authors are greatly indebted. The photomicrographs were taken by GRÖNBLAD. They, together with the drawings, may be considered as types of the new taxa. The writers are greatly indebted to Dr. HANS LUTHER who has been very helpful in making the typescript ready for printing.

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Introduction

by

G. A. PROWSE

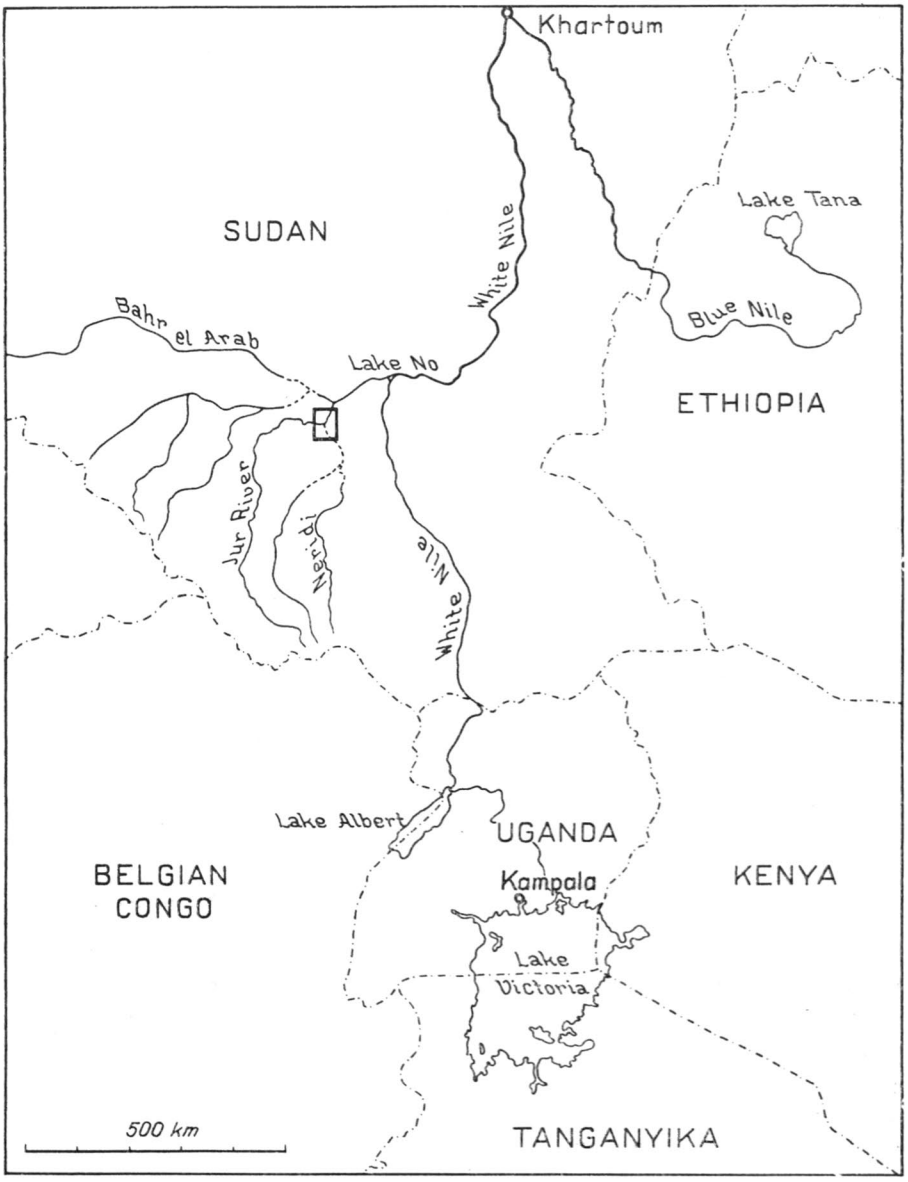
During the past fifty years several papers have been published on the algae of the river Nile, but only since 1949 has any serious study been made in that part of the Nile system within the Sudan. Of the smaller tributaries very little is known, and the present studies suggest that at least some of these tributaries may show algological features very distinct from those of the main rivers, the White Nile and the Blue Nile. The White Nile flows some 2.600 km. northwards from Lake Victoria to Khartoum, where it is joined by the Blue Nile after the latter has descended some 1.500 km. from the Abyssinian plateau. The joint rivers then flow northwards another 3.000 km. before emptying into the Mediterranean delta. Of the two main rivers about 4.500 km. are situated within the borders of the Sudan. A number of tributaries join the White Nile in southern Sudan, much of the water being emptied into vast areas of swamp, the »Sudd». Of these, the Bahr el Ghazal is a western tributary of the Bahr el Gebel, as the White Nile is called in its southern stretches in the Sudan. The Ghazal river is formed from a number of streams coming down from the Nile-Congo divide, of which only the Jur reaches the Bahr el Ghazal as open water, the others emptying into swamps. The catchment area of the Ghazal is nearly as large as France, with an annual rainfall of about 100 cm., most of which is lost by evaporation in the swamps. Near the Nile-Congo divide the country

is undulating, partly covered with gallery forests, with outcrops of lateritic ironstone. Lower down the rivers enter a flat, grassy plain, of which parts adjacent to the river are inundated during the flood season (July—October). During the dry season many of the tributaries are reduced to pools, only the Jur retaining slight flow. The swamp vegetation of the »Sudd» consists of vast areas of *Cyperus papyrus* L., *Phragmites communis* Trin. and *Vossia cuspidata* Griff. intersected by channels and small lagoons.

Lake Ambadi is a widened stretch of the Bahr el Ghazal, where the river Jur joins it. Its remoteness and difficulty of access have meant that it has been rarely visited, but in December 1953 the Hydrobiological Research Unit of the University College of Khartoum, consisting of a team of four headed by Dr. JULIAN RZÓSKA, carried out studies on the southern stretches of the White Nile. Dr. RZÓSKA was able to travel up the Bahr el Ghazal, and we are indebted to him for the collection of material on which this paper is based, and for information concerning the area. To Dr. RZÓSKA and Mr. J. F. TALLING of the University College of Khartoum we owe a debt of gratitude for provision of physical and chemical data on the waters of the area and of the White Nile. One of us, G. A. PROWSE, is indebted to both the Hydrobiological research Unit and the Department of Botany of the University of Khartoum for facilities in carrying out these studies.

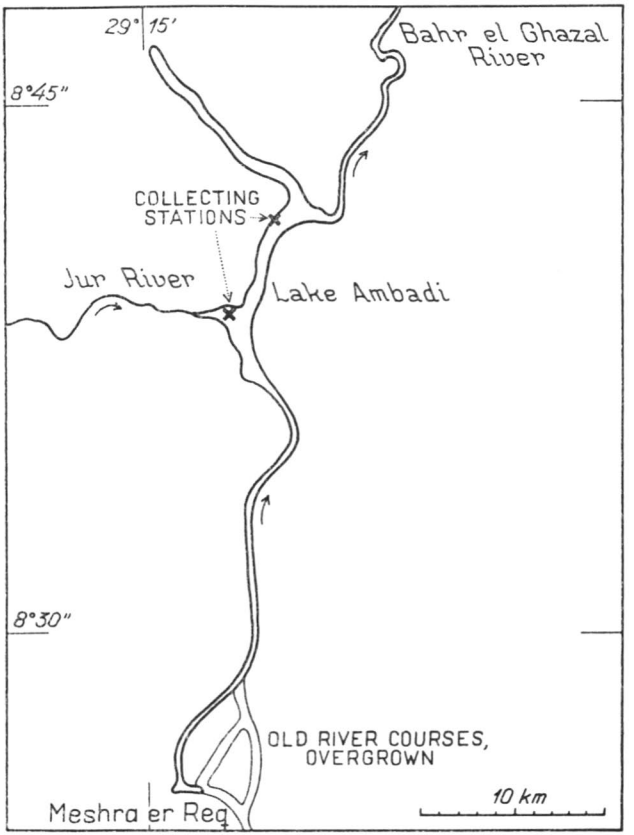
Lake Ambadi lies between 29°15′ and 29°22′ longitude and between 8°45′ and 8°35′ latitude in a flat, featureless, swamp plain, very sparsely inhabited. The current in this water-body is almost imperceptible. Over wide stretches the water is not more than 1—2 metres deep, and the bottom is covered by a dense carpet of vegetation (*Ceratophyllum, Myriophyllum, Potamogeton,* and *Utricularia,* with large clumps of the colonial protozoan, *Ophrydium,* attached). The littoral vegetation consists of various reeds and floating plants (*Nymphaea* spp., &c.), but no Papyrus. At the time of investigation, 16—18 January 1954, the following physical and chemical data were established: the transparency of the water was relatively high, reaching to the lake bottom. The temperature in the reed beds was 23.4°C; at the surface of open water 23.4°C; and at the bottom 22.4°C. The pH in the reed beds was 6.4 and in open water 6.9; the alkalinity 25.4×10^{-4} N. The dissolved oxygen was low in the reed beds, 1.8 mg./l. at the surface and 1.3 mg./l. at 1 m. depth, although cases approaching 100 % saturation were found in the middle of the lake, 8.0 mg./l. at the surface and 7.5 mg./l. at the bottom (1.5 m. depth). Chloride (Cl) was present in less than 1 mg./l. while there was a considerable concentration of dissolved silica (SiO_2), about 18 mg./l.

On the biological side there appeared to be no true zooplankton in the samples collected, but a rich assemblage of pond and littoral forms — Cladocera, few Copepods and numerous Hemiptera &c. Apart from the very rich



Map. 1. Upper Nile Basin.

variety of desmids which form the subject of this paper, the algae present in the Lake Ambadi samples appear to be very distinctive in comparison with the algal flora of other Nile waters in the Sudan. *Dinobryon sertularia* Ehr., *Botryococcus Braunii* Kütz. and *Asterococcus limneticus* G. M. Smith form an



Map. 2. Lake Ambadi Area.

important part. The main diatoms consist of *Nitzschia* spp., *Synedra* spp., *Navicula* spp. and *Stauroneis* sp. *Melosira granulata* (Ehr.) Ralfs and its var. *angustissima* O. F. Müll., which are important in the plankton of the White Nile (Brook & Rzóska 1954, Rzóska & Brook & Prowse 1955), appeared to be absent from the Lake Ambadi samples and from similar samples taken in other parts of the Bahr el Gebel (While Nile) during the same period. Of the Myxophyceae commonly found in the White Nile, only *Microcystis aeruginosa* Kütz. was present in the Lake Ambadi samples, and then only in small quantity. *Anabaena flos-aquae* Born. & Flah. and *Lyngbya limnetica* Lemm., important in the White Nile, were completely absent. Other Myxophyceae present in Lake Ambadi were *Gloeotrichia echinulata* (J. E. Smith) P. Richter, *Scytonema* spp. and *Oscillatoria* spp.

Of desmids, Brook (1954) records 19 species in the White Nile, most of them very rare in occurrence, even in net hauls. There is some evidence that

the rich variety of desmids to be found in Lake Ambadi disappears by the time the Bahr el Ghazal reaches Lake No, where it joins the Bahr el Gebel. It is perhaps of significance in this respect that the waters of the Bahr el Ghazal are more acid than those of the Bahr el Gebel, probably due to a higher concentration of dissolved CO_2, mainly derived from decomposing swamp vegetation, as can be seen from the following table:

Collecting points	Ambadi	Bentu	Ghazal	Lake No
km from Ambadi	0	5	100	203
pH	6.9	7.0	7.8	8.4
CO_2 in mg/l. (estimated from pH and alkalinity)[1] .	30	19	3	1

It can be seen that proceeding from Ambadi towards Lake No there is a general increase in the pH of the water. Simultaneously with the decrease in the density and variety of desmids there appears to be a decrease in other algae, such as *Botryococcus Braunii* and *Asterococcus limneticus*, while *Dinobryon sertularia* was not detected outside Lake Ambadi. Many more investigations, however, would have to be made during different seasons before any decisive statement could be made concerning details of spatial distribution.

[1] The presence of free acids has not been taken into account, so that it is possible that the CO_2 figures may be a little too high. The general range of variation still remains true, however.

Taxonomical part

Algae other than Desmids

by

R. GRÖNBLAD

This is a short list of algae recorded by R. G. during the study of the Desmids, and is by no means considered complete. It should be compared with the more complete list of the phytoplankton of the Blue and White Nile published by ALAN J. BROOK (1954); see also above p. 6—7.

Ankistrodesmus falcatus
Botryococcus Braunii
B. protuberans
Coelastrum cambricum
Coelosphaerium naegelianum
Diatoms (but not Attheya nor Rhizosolenia)
Gomphosphaeria lacustris
Microcystis sp.
Mougeotia sp. (ster.)
Oedogonium obtruncatum
Oocystis gigas
O. solitaria
Ophiocytium bicuspidatum
O. maius
Oscillatoria sp.
Pediastrum angulosum
P. boryanum
P. tetras
Scenedesmus acutiformis
Sc. armatus
Sc. bijuga
Sc. longispina
Sc. opoliensis
Sc. quadricauda
Sc. serratus
Sc. tetradesmiformis
Tetraedron minimum
T. regulare
T. verrucosum
Trachelomonas Denisii
T. Dybowskii

Desmids

by

R. GRÖNBLAD and A. M. SCOTT

Abbreviations:

apic. = at the apex
bas. = at the base
cpr. = with processes
crass. = thickness of cell
csp. = with spines
ist. = width of isthmus
lat. = width of cell
long. = length of cell
med. = in the middle
spr. = without processes
ssp. = without spines

All dimensions are given in microns (μ).

The authors wish to point out that, when a new forma is described without mentioning the variety to which it belongs, then it is to be understood that it belongs to the nomenclatural type variety of the species.

Gonatozygon aculeatum Hastings. — Photo 337.

Gonatozygon Brebissonii De Bary, forma. A form with transversal sutures. Long. 88; lat. max. 5, ad apices 3. — Fig. 18, 19.

This is the third *Gonatozygon* in which we have seen transversal sutures (the two others being *G. sudanense* Grönbl. & Scott n.sp. and *G. Brebissonii* var. *hirsutum* Scott & Grönbl. 1957). The occurrence of these transversal sutures leads to the assumption that besides the normal cell-division there is a secondary growth of the cell like what is known in *Penium* and *Closterium*. Unfortunately only preserved material has been available, so a closer study of the process of growth has not been possible.

Gonatozygon monotaenium De Bary. — Photo 338.
Gonatozygon monotaenium var. *pilosellum* Nordst.

Gonatozygon sudanense Grönbl. & Scott n. sp. — Fig. 1, Photo 339.

Cellulae magnae 27ies longiores quam latae, cylindricae, apices versus non attenuatae, apicibus rotundatis, inflatis. Membrana subtiliter et dense granulata granulis acutis; suturis transversis tribus; ad apices membrana rugulosa granulis maioribus coniformibus acutis. Massa chlorophyllacea axilis laminis simplicibus in partes tres divisis. Long. 215; lat. 8, ad apices 10.

Cells of large size, 27 times longer than broad, cylindrical, not thinner towards the apices which are swollen and rounded. Cell wall delicately and densely granulate, granules acute; apices coarsely granulate with conical short spine-like granules which continually decrease towards the central part; with 3 transversal sutures. Chromatophores axile lamellae, divided in 3 parts not corresponding with the sutures. Only one specimen recorded.

This species is distinguished from *G. Brebissonii* De Bary by its much broader cells which are not attenuated towards the ends.

Cylindrocystis crassa De Bary. Long. 33, lat. 16.5.

Netrium digitus (Ehr.) Itz. & Rothe. Long. 87, lat. 28.
Netrium digitus var. *Naegelii* (Bréb.) Krieger. Long. 220, lat. 42.
Netrium digitus var. *lamellosum* (Bréb.) Grönbl. Long. 200, lat. 40.

Closterium incurvum Bréb. Long. 43, lat. 7.

Closterium infractum Messik. (1929, I: 1). A thicker form with more rounded apices and ventral margin less angular. Chromatophores with one pyrenoid in each semicell. Long. 23—25, lat. 9—10. — Fig. 20.

Closterium parvulum Näg. var. *angustum* W. & W. Long. 134—156, lat. 7—11.5.

Pleurotaenium baculoides (Roy & Biss.) Playf. Long. 308, lat. bas. 16, lat. med. 14; long. 410, lat. 15.

Pleurotaenium caldense Nordst. Long. 312, lat. 21. — Fig. 335 and photo 340.

Pleurotaenium cylindricum (Turn.) W. & W. var. *Stuhlmannii* (Hieron.) Krieger. Long. 836—1079, lat. bas. 55—72. — Fig. 336 a.

Pleurotaenium Ehrenbergii (Bréb.) De Bary. Long. 590, lat. bas. 30.

Pleurotaenium eugeneum (Turn.) W. & W. var. *undulatum* (Borge) Krieger. Long. 1180, lat. 59.

Pleurotaenium indicum (Grun.) Lund. Long. 368, lat. 14. — Fig. 4, 5.

Pleurotaenium minutum (Ralfs) Delp. Long. 115—140—166, lat. 10—11.
Pleurotaenium minutum var. *gracile* (Wille) Krieger. Long. 184, lat. 7.5.

Pleurotaenium minutum (Ralfs) Delp. var. *Bourrellyi* Grönbl. & Scott n. nom. Syn. *Pl. minutum* var. *minus* Bourrelly (in BOURRELLY & LEBOIME 1946, II: 18) — non (Rac.) Krieger (1937, XXXIX: 15—18). — Fig. 2, 3 and photo 341.

Differt apice conspicue retuso. Long. 135—150, lat. bas. 8—9.

This variety has a characteristic small depression at the apices. Cf. also *Penium cylindricum* in BORGE (1903, I: 5) which has much the same shape, only BORGE's form has not the apical depression. KRIEGER (1937) has the more correct name *Pleurotaenium minutum* var. *cylindricum* (Borge) Krieger. Cf. also *Pl. minutum* var. *excavatum* Scott. & Grönbl. (1957, II: 3—4).

Pleurotaenium subcoronulatum (Turn.) W. & W. var. *africanum* Schmidle. Long. 580, lat. bas. 28.

Pleurotaenium trabecula (Ehr.) Näg. var. *maximum* (Reinsch) Roll. Long. 790, lat. 50.

Docidium baculum Bréb. Long. 188, lat. bas. 8.

Triploceras gracile Bail. var. *sudanense* Grönbl. & Scott n.var. — Fig. 6.

Proxime ad var. *bidentatum* Nordst. accedens ab illo differt verticillis paucioribus (8—10 in semicellula), aculeis multo longioribus. Long. 360—381; lat. max. csp. 39—45; lat. apic. ssp. 18, csp. 26; ist. 12.

This variety has less numerous whorls and much longer spines than var. *bidentatum* Nordst. One or two apical whorls have simple spines, sometimes one basal whorl too, all others bispinate.

Triploceras verticillatum Bail. var. *superbum* (Mask.) Nordst. f. *angustum* Grönbl. & Scott n.f. — Fig. 7, 8.

Differt cellulis angustioribus processibus dentiferis paucioribus in unoquoque verticillo — (processibus apicalibus usque ad dimidiam semicellulam bifidis, basalibus autem omnibus tridentatis); apice bifido, processibus utrisque bicuspidatis. Long. 380—438, lat. max. csp. 40—48, ist. 22.

Nearest to var. *superbum* (Mask.) Nordst. from which it is distinguished by its slenderer cells, fewer processes in each whorl and only two apical processes; the upper half of the semicell has bifid processes, the lower one trifid. Cf. SCOTT & PRESCOTT (1957, III: 11) which seems almost identical to our forma.

Euastrum angolense (W. & W) Krieger var. *crassum* Grönbl. & Scott n. var. — Fig. 26, 27.

Differt praecipue a vertice visum protuberantia centrali multo maiore truncataque; a fronte lobis polaribus minus dilatatis. Long. 19, lat. 16, crass. 12.5.

Vertical view with a much more prominent truncate central protuberance.

Euastrum ansatum Ehr. var. *dideltiforme* Ducell. (1918, p. 42, fig. 16). A rather elongated form with no central scrobicula but with a marginal thickening at the upper lateral lobe. Cell wall delicately but not densely porose. Long. 84—105, lat. 43—50, crass. 35, ist. 15—17. — Fig. 35—37.

Euastrum attenuatum Wolle var. *splendens* (Fritsch & Rich) Grönbl. & Scott n.comb. Syn. *E. splendens* Fritsch & Rich (1937, p. 175, fig. 9 A—C). — Fig. 33, 34 and photo 354.

We think this desmid cannot be separated from *E. attenuatum* from which it differs by the more prominent protuberances which are granulated as in var. *lithuanicum* Wolosz. This variety seems more closely related to our variety than the typical variety. From var. *lithuanicum* our var. *splendens* differs by the widely open sinus and the dilatate polar lobe. Unfortunately WOŁOSZYNSKA (1922) has given no vertical view. Long. 61—66, lat. 39, crass. 30, ist. 11—12.

Euastrum corpulentum Grönbl. & Scott n.sp. — Fig. 74—76 and photo 353.

Cellulae magnae, circiter $1^1/_2$plo longiores quam latae, incisura mediana profunde constrictae. Semicellulae pyramidatae incisura apicali aperta non profunda, angulis apicalibus obtuse dentatis, lateribus biundulatis, angulis basalibus rectis. A vertice visae ovali-subrectangulares polis biundulatis, lateribus triundulatis. A latere visae pyramidatae e basi rotundata lateribus convergentibus, apice subito angustato. Membrana sparse scrobiculata, inter scrobiculos dense porosa; ad basin lobi polaris fossae vel scrobiculae magnae duae, supra eas tumores duae levissimae; ad isthmum tumores maiores binae vel singulae, utrimque ad incisuram tumores maiores. Long. 116—123, lat. 69—73, crass. 48—53, ist. 20.

Cells rather large, about 1½ times as long as broad, median constriction narrowly linear, deep. Semicells pyramidate, apex truncate with an open shallow notch, apical angles with a short blunt spine or only mamillate, lateral margins biundulate, basal angles 90°. Vertical view rectangular-elliptic with biundulate poles and triundulate sides. Lateral view of semicells pyramidate with a rounded base, convergent sides and a suddenly attenuated apex. Cell wall sparsely scrobiculate and between these larger pores densely and finely porose; above the isthmus two smaller or one larger protuberance, above the sinus on each side a large protuberance; at the height of the upper lateral undulation two large pits and above them two very inconspicuous depressed protuberances.

Euastrum elegans (Bréb.) Kütz. var. *spiniferum* Grönbl. & Scott n. var. — Fig. 28 and photo 351.

Differt spinulis horizontalibus singulis in angulis subapicalibus et lateralibus. Long. 29, lat. 22, ist. 7.

With horizontal single spines at subapical and lateral angles.

Euastrum fissum W. & W. var. *subbiceps* Grönbl. & Scott n. var. — Fig. 45, 46 and photo 343.

Differt denticulis in angulis subapicalibus nullis vel valde reductis, incisura apicali introrsum dilatata, ornamentatione membranae variabili, sed plerumque irregulari. Long. 45—46, lat. 22—23, crass. 18, ist. 6.

This variety seems nearest to var. *decoratum* Scott & Presc. (1952, I: 1—2), from which it is distinguished by the different and more irregular ornaments. Cf. also *E. biceps* Fritsch & Rich (1937, p. 168, fig. 5C).

Euastrum Gessneri Krieger & Bourrelly (1956, III: 24). There were two slightly different forms in our material which we think are identical with the species described by KRIEGER & BOURRELLY. Our measurements are: long. 38—39, lat. 30—31, ist. c. 12, crass. 24; the more elongated form: long. 40—44, lat. 31—33, ist. 11—12. — Fig. 42—44.

Euastrum Luetkemuelleri Ducell. A form more attenuated towards the polar lobes and with a very slight circular depression considerably lower than in the specific form. End view thicker, almost rhomboid. Long. 27, lat. 17, crass. 13. — Fig. 9, 10.

Euastrum Luetkemuelleri var. *carniolicum* (Lütk.) Krieger. A form with all angles very much reduced, almost identical with the form from Brazil described by GRÖNBLAD (1945, fig. 59). Long. 31—33, lat. 21—22, crass. 16. ist. 7. — Fig. 24, 25.

Euastrum magniprotuberans Grönbl. & Scott n. sp. — Fig. 58—62.

Cellulae mediocres, $^1/_4$ longiores quam latae, incisura mediana lineari profunde constrictae. Semicellulae pyramidatae, incisura apicali aperta, non profunda, angulis apicalibus denticulis ornatis, marginibus lateralibus bidentatis, angulis basalibus denticulatis. Intra margines lobi polaris utrimque verrucae duae, saepe bipartitae, intra dentes laterales verrucae singulae; in medio semicellularum protuberantia magna laevis. A vertice visae subrhomboideae polis tridentatis, in medio protuberantia magna rotundata. Long. 48—54, lat. 39—40, crass. 30—38, ist. 10—12.

Cells of medium size, about $^1/_4$ longer than broad, with a deep narrowly linear constriction. Semicells pyramidate, apex with a slight median notch with a small granule on each side, apical angles with a short conical spine, basal angles with a small conical granule, sides bidentate. Cell wall within the margins with similar conical granules, subapical warts sometimes bigranulate. At the centre of the semicell a large smooth protuberance. Vertical view subrhomboid with tridentate poles and a large protuberance on each side in the middle. The front view bears some resemblance to *E. paulense* Börges. (1890, III: 17).

Euastrum nasiferum Grönbl. & Scott n. sp. — Fig. 11, 12.

Parvum, paululo longius quam latum, incisura mediana lineari profunde constrictum. Semicellulae lateribus triundulatis, apice retuso, habitu fere *E. montano* similes; utrimque supra isthmum protuberantiis singulis oblongis. Semicellulae a latere visae pyramidatae protuberantiis supra isthmum magnis. A vertice visae ellipticae utrimque in medio protuberantiis singulis magnis. Long. 19—20, lat. 16—17, crass. 12, ist. 5—6.

Cells small, slightly longer than broad with a narrowly linear, deep median constriction. Front view somewhat like *E. montanum*, but above the isthmus on each side with an oblong nose-like protuberance. Vertical view elliptical with a large protuberance on each side.

Euastrum platycerum Reinsch var. *eximium* Grönbl. & Scott n. var. — Fig. 47—49.

Differt spinulis et verrucis valde evolutis, verrucis in tumore centrali bifidis, in centro tumoris centralis et lateralium mucrone coniformi. Long. 89, lat. csp. 90, crass. csp. 48, ist. 20.

This variety differs by its very rich decoration and especially the three sharp points at the centre of the basal tumours are characteristic, likewise the bidentate or emarginate warts. It has a widely open sinus.

Euastrum platycerum var. *eximium* Grönbl. & Scott f. *clausum* Grönbl. & Scott n. f. — Fig. 50 and photo 346.

Differt a var. *eximio* sinu vix aperto, protuberantiis non mucronatis. Long. 101, lat. 94, ist. 22.

This form has a less open sinus and the basal protuberances bear no mucrones.

E. platycerum var. *eximium* and its f. *clausum* should be compared with *E. subhypochondrum* Fritsch & Rich (1937, p. 176—177, fig. 10 A—E). Especially f. *clausum* seems very much like *E. platycerum* var. *acutilobum* Krieger in GRÖNBLAD (1945, III: 64).

Euastrum praemorsum (Nordst.) Schmidle. There were several different forms belonging to this species. None of them was quite identical with the original description and figure given by NORDSTEDT (1888, III: 7) or KRIEGER (1937, 88: 18). Those nearest to the specific form are reproduced as fig. 67, 68, 70—72. Long. 71—76, lat. 42, crass. 31—32, ist. 10—11.5.

Euastrum praemorsum var. *simplicius* Grönbl. & Scott n. var. — Fig. 69, 73.

Omnia ornamenta valde reducta, prominentia centralis multo minor. Long. 46—55, lat. 27—32.

We think that *E. retrorsum* Joshua (1886) is the same plant as *E. rostratum* var. *praemorsum* Nordst. (1888). KRIEGER (1937, pag. 657) rejected *E. retrorsum* as »unsicher», though he quotes it incorrectly as »*E. retroversum*» in both his index and his list of rejected species.

Euastrum pulchellum Bréb. var. *protrusum* Grönbl. & Scott n. var. — Fig. 29, 30.

Differt lobo polari magis elongato protuberantia centrali valde prominenti, glabra vel trigranulata. Long. 29—31, lat. 21, crass. 16, ist. 6—7.

Differs by the elongated polar lobe and the much more prominent central protuberance. Cf. also *E. protuberans* Scott & Grönbl. (1957, I: 6).

Euastrum Rzoskae Grönbl. & Scott n. sp. — Fig. 51—53, 55—56 and photo 357.

Cellulae magnae, paullo longiores quam latae, incisura mediana lineari profunde constrictae. Semicellulae subtrilobulatae basi plana, angulis basalibus rectis, lobis lateralibus valde prominentibus, bipartitis, angulis mamillatis, lobo polari cuneiformi, late convexo, angulis lateralibus mamillatis. Ornamentatio membranae valde insignis: in parte centrali semicellulae depressio magna longitudinalis, sub apicem bipartita scrobiculis binis; utrimque prope partem basalem depressionis huius tumores singuli; ad basin semicellularum utrimque protuberantiis binis. A latere visae semicellulae subrectangulares, lobo polari truncato, dilatato, mamillis binis intramarginalibus; lobi lateralis lobulus superior bimamillatus, lobulus inferior trimamillatus, anguli basales mamillati, in medio altera iuxta alteram protuberantiam. A vertice visae sexangulares polis subacutis mamillatis, lobo polari subrectangulari. Long. 83—97, lat. 62—72, crass. 30—36, ist. 13—15.

Cells large, longer than broad, median constriction linear. Semicells subtrilobulate, basal angles rectangular submamillate, lateral lobes very pro-

minent and broadly retuse with 3 mamillate angles, polar lobe cuneiform with broadly convex top and mamillate lateral angles. Cell wall with peculiar ornaments: in the median part of semicell a longitudinal cup shaped large depression, narrower and bipartite at the apical end, each part with a pit; on each side of this depression a flattened tumour; at the base of the semicells on each side two protuberances. Side view of semicells subrectangular with polar lobe dilated and truncate with a pair of mamillae in the middle; lateral lobe with upper angle bimamillate, lower angle trimamillate and basal angle with 5 visible projections. Vertical view sexangular with mamillate poles, polar lobe nearly rectangular. Ventral view oblong with a median depression on each side and 9—10 intramarginal protuberances.

Euastrum Rzoskae Grönbl. & Scott var. *tribullatum* Grönbl. & Scott n. var. — Fig. 54, 57 and photo 348.

Differt cellulis minoribus, lobis lateralibus simplicibus rotundatis, lobo polari latiore apice retuso angulis lateralibus rotundatis; membrana in medio semicellularum protuberantiis ternis conspicue scrobiculatis, depressione centrali nulla, protuberantiis omnibus atque angulis scrobiculatis. Long. 63, lat. 50, crass. 28, ist. 10.

Smaller than specific form, lateral lobes simple with rounded angle, polar lobe broader with rounded lateral angles and convex or slightly retuse top. Cell wall in the centre of the semicells with 3 large flattened, coarsely scrobiculate protuberances. Without a central depression.

Euastrum sibiricum Boldt f. *africanum* Grönbl. & Scott n.f. — Fig. 21—23.

Differt lobis lateralibus obtusis sine denticulis, tumore centrali minore, e aspectu verticali subellipticum. Long. 17—18, lat. 12.5—15, crass. 11—12, ist. 5.

Not much unlike var. *exsectum* Grönbl. from which it differs by the smooth lateral lobes. Within the margins only two subapical warts, central protuberance less prominent.

Euastrum solum (Nordst.) Grönbl. & Scott comb. nov. (Syn. *E. cuneatum* Jenner v. *solum* Nordst.) var. *angustum* Grönbl. & Scott n. var. — Fig. 14—17 and photo 352.

Differt cellulis plus elongatis, apices versus sensim et multo minus attenuatis; angulis basalibus interdum protractis. A latere visum angustius apices versus sensim attenuatum. A vertice visum late ellipticum; a ventre visum medio utrimque protuberantiis singulis itaque ad polos protuberantiis singulis. (Protuberantiae hae a vertice invisibiles.) Membrana subtilissime porosa, poris in parte apicali longitudinaliter ordinatis, ceterum irregulariter sparsis. Massa chlorophyllacea axilis pyrenoidibus circiter 6—8 in utraque semicellula, partim biseriatis. Long. 110—133, lat. bas. 24—28, crass. 22—28, ist. 11.5—15.

This Desmid seems nearest to *E. cuneatum* Jenner var. *solum* Nordst. (1888) which we would prefer to call *E. solum* (Nordst.) nov. comb. The differences

are, however, sufficient to allow the separation of a new variety: var. *angustum* nob., differing with longer and slenderer cells, basal angles almost protracted and semicells very slightly tapering towards the apices, apical incision deeper.

Euastrum solum (Nordst.) Grönbl. & Scott var. *africanum* (Fritsch & Rich) Grönbl. & Scott n. comb. Syn. *E. brasiliense* Borge var. *africanum* Fritsch & Rich (1924, p. 332, fig. 9). — Fig. 13, 31, 32 and photo 342.

This variety has narrowly pyramidate semicells, basal angles more or less contracted, lower part with almost parallel sides which then suddenly become provergent. Side view thicker. Long. 92—101, lat. 30—33, crass. 30, ist. 13.

Euastrum spinulosum Delp. var. *inermius* Nordst. This variable variety of a most variable species was represented by a slightly different form with rather longer cells. Long. 58—59, lat. 43—44, crass. 31, ist. 14. — Fig. 92—94 and photo 345.

Euastrum spinulosum Delp. var. *Lindae* Grönbl. & Scott n. var. — Fig. 84—88 and photo 347.

Differt a forma typica DELPONTEi cellulis maioribus, spinis robustioribus, protuberantia centrali magna aculeis coniformibus (vel interdum emarginatis nonnullis) basi inflatis, perornata. Long. ssp. 95—96, csp. 99—101; lat. ssp. 89—93, csp. 94—102; crass. ssp. 51, csp. 59; ist. 21—23.

Cells larger, spines stouter, central protuberance with stout conical spines (which sometimes are developed into emarginate warts). This variety was first recorded by GRÖNBLAD from the samples collected by Dr. EDNA LIND in Uganda, hence the variety name.

The poor figure given by CHOLNOKY (1954, pag. 132, fig. 43) which was called *Euastrum Theronii* n. sp. looks very much like our variety.

Euastrum spinulosum Delp. f. *sudanense* Grönbl. & Scott n. f. — Fig. 89—91.

Differt cellulis robustioribus, incisionibus plus rotundatis neque tam profundis, protuberantia centrali maiore. Long. 77—78, lat. 60—66, crass. 41, ist. 18.

The size agrees with the maxima given by KRIEGER (1937) for the specific form, from which it is distinguished by the more rounded and less deep incisions, and the larger central protuberance. It is much like var. *inermius* from which it is distinguished by the conical spines.

Euastrum subcrassum Fritsch & Rich var. *elaboratum* Grönbl. & Scott n. var. — Fig. 77a, 80—82 and photo 349, 350.

Habitu speciei satis simile, tamen differt apice plus minusve protracto, angulis loborum lateralium bimamillatis; lobo polari a vertice viso plane diverso, subrhomboideo. At

ornamentatio membranae maxime differre videtur: in lobo polari scrobiculis seu fossis duabus subapicalibus, inferius protuberantiis duabus, infra eas in centro fere semicellularum scrobiculis singulis magnis in prominentia inconspicua, ad basin semicellularum prope mediam partem incisurae protuberantiis singulis parvis. Long. 66—72, lat. 37—43, crass. 25, ist. 10—13.

Despite the considerable differences this variety seems nearest to *E. subcrassum*. Lateral lobes with upper and lower angles truncate-emarginate which make the general appearance more like *E. crassum* than FRITSCH & RICH's (1937, p. 173, fig. 8 D—F) species. Apical lobe with a more or less prominent top (which is broadly rounded or slightly retuse). Cell wall much more ornamented than specific form: in the middle of the polar lobe two large pits; below them, just at the incision between polar and lateral lobes, two flattened protuberances; below these a large central pit on a very flat protuberance and further downwards two larger protuberances; within the margins at each of the angles of polar lobe and lateral lobes a protuberance or mamilla. Lateral view with a rounded top and two large protuberances on each side. Vertical view with nearly rhomboid polar lobe, thus quite different from var. *subcapitatum* nob.

Euastrum subcrassum Fritsch & Rich (1937, fig. 8, D—F and p. 176) var. *subcapitatum* Grönbl. & Scott n. var. — Fig. 77b, 78—79.

Differt lobis polaribus valde rotundatis, incisura subpolari aperta, scrobicula in medio partis basalis lobi polaris. Long. 62—69, lat. 34—35, crass. 22—25, ist. 10—11.

Very rare, details of wall difficult to see. The peculiar shape of polar lobe in top view is almost the same as in FRITSCH & RICH fig. 8 F, but in front view the polar lobe is much more rounded, almost like *E. truncatum* var. *capitatum* Hub.-Pest. Incision between polar and lateral lobes open. There seems to be a larger pit at the base of the polar lobe. On each side above the sinus single protuberances.

Cf. also *E. truncatum* W. & W. var. *trifolium* (Cohn) Krieger 1937.

Euastrum truncatiforme G. S. West (1907, VII: 3). Long. 48—52, lat. 37, crass. 20, ist. 8—9. — Fig. 63—66 and photo 344.

Shape of cells slightly different: polar lobe retuse, lateral lobes more rounded. A large pit just below the base of the polar lobe.

Euastrum unioculatum Grönbl. & Scott n. sp. — Fig. 38—41.

Cellulae mediocres, incisura lineari profunde constrictae, fere duplo longiores quam latae. Semicellulae trapeziformes — pyramidatae (habitu quemadmodum *E. eleganti* similes). Lobus polaris apice late rotundato, in margine laterali utrimque spinis singulis, lobi laterales biundulati, lobulus superior denticulo unico, anguli basales granulo coniformi; intra margines utrimque verrucis singulis et in lobo polari utrimque granulis sin-

gulis; in centro semicellularum scrobiculo vel fossa magna. A vertice visum ovale utrimque in medio fossa conspicua. Long. 48—53, lat. 28—29, crass. 18, ist. 8—9.

Cells of medium size, deeply constricted, sinus narrowly linear, nearly twice as long as broad. Semicells trapeziform — pyramidate. Polar lobe rounded with a horizontal lateral spine, lateral lobes biundulate, the upper angle with a small upwardly directed spine, basal angles with a conical granule. Within the margins there are in the polar lobe on each side a granule, and on each side of the isthmus a larger verruca. At the centre of the semicell a large pit, but no protuberance.

This species bears some resemblance to *E. elegans*, but the large central pit and the absence of a protuberance at once distinguish our new species.

Micrasterias alata Wallich. According to KRIEGER (1939, p. 61) and PRESCOTT (1952, p. 230) the tips of the lobules are trispinate. All our specimens were quadrispinate. — Photo 361.

Micrasterias crux-melitensis (Ehr.) Hass. f. *minor* Turn. (by KRIEGER (1939) called »var. *minor*»). Long. 81—90, lat. 78—82. — Fig. 124 and photo 358.

This desmid seems to be identical — or almost so — with *M. crux-melitensis* var. *aequalis* Rich (1932, p. 168, fig. 6 A) which by KRIEGER (1939, CXVI: 1) is identified as *M. radians*. We cannot see any other differences between *M. crux-melitensis* and *M. radians*, than that the latter has a more developed polar lobe which stands out considerably over the lateral lobes and has the angles provided with rather long and curved spines. If this conception is correct, then RICH's desmid is more closely related to *M. crux-melitensis*.

There were several different variants of the extremely variable *M. crux-melitensis — radians — radiata* -complex, which are difficult to identify. They are very characteristic and certainly belong to different taxa. But it seems to us questionable whether a specific difference can be maintained between such nearly related taxa as *M. crux-melitensis* and *M. radians*, and moreover there are certain varieties of *M. radiata* which seem rather close to *M. radians*. See further under *M. radians*.

Micrasterias incredibilis Grönbl. & Prowse & Scott n. sp. — Fig. 100—107 and photo 365, 403.

Cellulae asymmetricae, minores, incisura mediana introrsum lineari, mox valde aperta profunde constrictae. Semicellulis inter se valde dissimilibus: una semicellula simplicior trilobulata lobo polari angusto, elongato, apice dilatato quadrifido aculeis 4 longis instructo; lobis lateralibus fere horizontalibus, angustis, lateribus late undulatis, apicibus quadrifidis. Altera semicellula plus implicata quinquelobata: lobo basali e basi bulbiformi ad apicem quadrifidum dilatato; lobis lateralibus 4 e basi communi bulbiformi, apicibus bi-, tri-, quadri- vel quinquefidis in planos differentes oblique exeuntibus. A vertice visa semicel-

lula simplicior complanata polis bis bifidis, lobo polari quadrato angulis cuspidatis (raro bicuspidatis); semicellula altera plus implicata e centro rectangulari processibus 4 oblique exeuntibus, tri- vel quadrifidis, lobo polari in centro inter processus laterales quadrato, paulum torto, angulis cuspidatis vel raro bicuspidatis. Long. esp. 92—112, ssp. 80—90; lat. esp. 102—105; ist. 15.

Cells of rather small size, quite asymmetrically built, as long as broad, deeply constricted, inner part of sinus linear but very soon widely opening. Semicells greatly different. One semicell, the simpler one, trilobulate with a long and slender polar lobe which is dilated and quadrifid at its apex; lateral lobes horizontal, slender with slightly undulate margins and quadrifid ends. The other semicell more complicated, with one polar lobe and 4 lateral lobes, all of them shorter than those of the simpler semicell and dilated and 2—3—4—5-cuspidate (polar lobe always 4-cuspidate). Only the polar lobe lies in the same plane as the simpler semicell while the lateral lobes stand out obliquely in four directions surrounding the central polar lobe. Vertical view of the simpler semicell flattened, very slightly thicker in the middle at each side, gradually tapering towards the poles which are dilated and twice bifurcate. Vertical view of the more complicated semicell rectangular, each angle prolonged into a 3—4—5-furcate process; polar lobe quadrifid and slightly twisted. Cell wall minutely and densely porose (=punctate).

This species is quite unique as to its highly asymmetrical cells and cannot be confused with any known species. The only variation observed concerns the number of spines at the ends of the lobes. The number and the arrangement of the lobes is constant. At least about 40—50 specimens have been recorded. Further records: see *M. sudanensis* (p. 22).

The name of this species — nomen nudum — is mentioned by TEILING (1957).

Micrasterias pinnatifida (Kütz.) Ralfs ad f. *angustam* Presc. & Scott (1952) accedens. Long. 57—71, lat. 69—80. — Photo 356.

This forma is very much like f. *angusta* Presc. & Scott with the linear innermost part of the sinus. Only the polar lobe is of a different shape with constantly one spine at the lateral angles.

Micrasterias pinnatifida var. *polymorpha* Bourrelly & Manguin (1949, III: 35—38). Long. 88—92, lat. 78. — Fig. 97—99 and photo 355.

Our specimens are identical with the variety described by BOURELLY & MANGUIN, only the dimensions are slightly smaller.

The basal lobes of the chromatophores are easily mistaken as implying small basal protuberances as depicted in SCHMIDLE's (1902) figure. Thus it seems most probable that *M. pinnatifida* var. *divisa* W. West f. *major* Schmidle (1902) is the same desmid.

KRIEGER (1939 p. 21) created a new species viz. *M. divisa* Krieger for SCHMIDLE's f. *major*, leaving W. WEST's var. *divisa* still under *M. pinnatifida*. The new variety name *M. pinnatifida* var. *furcata* Krieger for var. *divisa* W. West is illegitimate.

Micrasterias radians Turn. (1892, V: 6a). The Sudanese specimens have a more elongated polar lobe with more developed lateral lobules. These specimens very much approach some forms of *M. radiata*. Long. 180—184, lat. 117—129, ist. 21. — Fig. 120—123 and photo 359, 360.

Micrasterias radians Turn. var. *ambadiensis* Grönbl. & Scott n. var. — Fig. 119 and photo 363.

Differt incisuris omnibus minus profundis, lobo polari breviore et latiore, toto habitu plus compacto. Long. 135—168, lat. 108—127, ist. 18—22.

This variety is at once distinguished by the more compact appearence, much shorter and broader polar lobe, all incisions shallower. Very often some of the ultimate lobules are not bifurcate, but bear only a single spine. We have been inclined to make a separate species of this desmid, but considering the very wide range of variation in this group we have thought it convenient to place it as a new variety of *M. radians*.

Micrasterias radians Turn. var. *ambadiensis* Grönbl. & Scott f. *latiloba* Grönbl. & Scott n. f. — Photo 362.

Differt lobulis latioribus spinis brevioribus.

Micrasterias sudanensis Grönbl. & Prowse & Scott n. sp. — Fig. 110—114 and photo 364.

Cellulae asymmetricae, minores, incisura introrsum lineari, extrorsum denique valde aperta profunde constrictae. Semicellulis inter se dissimilibus, trilobatis, lobis omnibus bifidis: una cuspide longa valde curvata, altera breviore subrecta, cuspidibus omnibus solidis e basi excavata. Una semicellula lobo polari subtriangulari cuspidibus superioribus longis in directionem fere verticalem curvatis, inferioribus brevioribus apicem versus oblique directis. Semicellula altera lobo polari praecedenti simili subtriangulari, sed cuspidibus apicalibus longissimis valde divergentibus horizontaliter fere curvatis, aculeis inferioribus apicem versus oblique directis; lobi laterales horizontales cuspidibus longioribus proxime ad isthmum versus curvatis, aculeis brevioribus subhorizontalibus apicem versus oblique directis. Massa chlorophyllacea axilis laminis utrimque binis nucleis amylaceis nonnullis sparsis. Membrana densissime subtiliter punctata (=porosa). A vertice visae fusiformes, in medio crassiores polis cuspidatis; lobo polari plerumque oblique torto. Long. csp. 124—138, ssp. 74—84; crass. 23—26; ist. 14—18.

Cells rather small, asymmetrical, slightly longer than broad, deeply constricted, inner part of sinus linear but then suddenly widely opening. Semicells trilobulate; lobes bifid with one long spine which is strongly curved and another short one which is not or only very slightly curved; all spines solid

with an excavated base. Polar lobe in one semicell with apical spines curved strongly, almost vertically upwards, lower spines of polar lobe short and directed obliquely upwards; lateral lobes with one long upwardly curved spine and another shorter, almost straight one at the sinus directed obliquely upwards. The other semicell with a similar polar lobe but the apical spines are long and strong being curved widely outwards, the lower spines short and directed obliquely outwards; lateral lobes with a long slightly upwardly curved spine nearest to the isthmus and another short and almost straight spine directed obliquely outwards. Chromatophores axile with a few scattered pyrenoids (of the same type as in *M. decemdentata*, cf. GRÖNBLAD, 1921, I: 1 —3). Cell wall densely and minutely porose (=punctate). Vertical view fusiform, thicker at the middle, attenuated towards the poles which are cuspidate; polar lobe obliquely twisted.

This species is easily distinguished by its peculiar and asymmetrical shape and cannot be confused with any other known species. The characters are very constant although at least 50—60 specimens have been examined.

The name of this species — nomen nudum — together with a figure were published by TEILING (1957).

By permission of Mr KUNO THOMASSON, Uppsala, we are able to give a further account regarding the distribution of *Micrasterias sudanensis* and *M. incredibisis* in so far as both of them have been identified by him in samples from the marshy surroundings of Lake Bangweulu.

Micrasterias tropica Nordst. var. *ambadiensis* Grönbl. & Scott n. var. — Fig. 108, 109, 116, 118 and photo 368, 369.

Differt cellulis minoribus, lobis longioribus et gracilioribus valde sursum directis; in centro semicellularum papilla plus minusve elongata saepe bidentata (seu emarginata). Long. 92—101, lat. 78—93, crass. 29—30, ist. 14—15.

Although there are already a lot of varieties described of this species, there seems to be none to which our Sudanese specimens could be referred. So we have thought it necessary to create a new variety. This is smaller than the specific variety, the lobules are slenderer and longer and upwardly curved, the polar and lateral lobules being almost parallel; in the middle of the basal part of the semicell there is a very prominent papilla which is usually emarginate at its top. (Nearly as in *M. mahabuleshwarensis* var. *surculifera* Lagerh.)

Micrasterias tropica var. *ambadiensis* Grönbl. & Scott f. *subparallela* Grönbl. & Scott n. f. — Photo 367.

Differt lobulis lateralibus subhorizontalibus longioribus. Long. 100, lat. 102.

With longer and subhorizontal lateral lobes.

Micrasterias tropica var. *elongata* Schmidle. Slightly different from SCHMIDLE's (1898) figure: cells stouter, below the apical depression a single tooth and on each side of the isthmus single teeth. Vertical view rhomboid with a large smooth protuberance on each side in the middle. Long. 110, lat. 70, crass. 30. Fig. 115—117 and photo 370.

RICH (1932, p. 168) has mentioned a »forma» of SCHMIDLE's variety, but since no drawing was given, it is difficult to know exactly what it may be like.

Micrasterias truncata (Corda) Bréb. var. *subcuneata* Grönbl. & Scott n. var. — Fig. 95.

Proxime ad var. *cuneata* (Presc. & Scott) n. comb. accedens differt cellulis paullo maioribus, prae latitudine longioribus, lobo polari altiore. Long. 45—48, lat. 51—54, ist. 12.

This variety is of small size as var. *pusilla* G. S. West (1914, XXII: 42—43), but is more like var. *cuneata* (Presc. & Scott) Grönbl. & Scott n. comb. (synon. *M. truncata* var. *pusilla* f. *cuneata* Presc. & Scott, 1952, VIII: 7), differing from that variety principally by its longer cells and higher polar lobe. The polar lobe is rather like *M. zeylanica* or *M. decemdentata*. The former, which is recorded from this sample, differs by the lateral lobes, the latter has also a different shape of the lateral lobes and the polar lobe is much more outstanding.

We are of the opinion that PRESCOTT & SCOTT's forma has no closer relations to var. *pusilla*, besides being of small size, thus we prefer a varietal rank.

Micrasterias zeylanica Fritsch (1907, p. 245 fig. 4 C). Shape of lateral lobes variable, mostly with two short convergent upper spines and one longer basal spine. Long. 32—40, lat. 40—48, ist. 10—13. — Fig. 83, 96 and photo 366, 402.

This species was originally spelled »*zeylanica*» by FRITSCH but KRIEGER (1939) changed the spelling incorrectly to »*ceylanica*». According to the rules of the nomenclature the original spelling must be used.

It seems questionable whether var. *wallichiana* (Turn.) Krieger really can be separated as a distinct taxon among the numerous individual variations of this polymorphic species. Our photo 366 is nearest to this variety, and photo 402 represents the nomenclatural variety.

Cosmarium[1] *abscissum* Lütkem. (synon. *Penium truncatum* Ralfs, in KRIEGER (1937, p. 242). Long. 18, lat. 6. — Fig. 133.

Cosmarium ambadiense Grönbl. & Scott n. sp. — Fig. 179, 184.

Magnum, cellulis prorsus non duplo longioribus quam latioribus, in medio incisura lineari profunde constrictis. Semicellulae pyramidatae apice subtruncato, angulis basalibus rectis; membrana conspicue scrobiculata, in medio supra centrum semicellulae una

[1] See also p. 45.

scrobicula vel fossa magna. A latere visae semicellulae ovales utrimque in medio fossa magna. Massa chlorophyllacea axilis laminis radiatim exeuntibus 8 et nucleis amylaceis in utraque semicellula singulis. Long. 75—81, lat. 46—51, crass. 30, ist. 16.

Cells large, not quite twice as long as broad, median constriction deep and linear. Semicells pyramidate with subtruncate apex, lateral angles 90°. Cell wall distinctly scrobiculate with a large central pit. Side view of semicells ovate, with a deep depression on each side. Chromatophores axile with a central pyrenoid and 8 radiating lamellae.

This species looks like a very large form of *C. variolatum* Lund. var. *cataractarum* Racib., but the cell wall is more densely scrobiculate and the chromatophores are quite different.

Cosmarium amoenum Bréb. — Photo 382.

Cosmarium arctoum Nordst. var. *constrictum* Grönbl. & Scott n. var. — Fig. 140, 141.

Cellulae longiores, profundius constrictae. Long. 12, lat. 8.

Cells longer with a deeper constriction. This should be compared also with *C. exiguum* Arch. from which it seems distinguished by the widely open sinus, the more pointed upper angles and the smaller size.

Cosmarium bicorne Borge (1928, I: 12). Borge says that he saw no empty cells, and since the ornament is extremely hard to see in filled cells it is possible that his plant may also have possessed the same ornamentation as is shown in our figures. Another variety which may belong to this species is *C. taxichondrum* var. *ocellatum* Schmidle (1898, II: 5 and 19) but the figures are not good enough for identification. Long. 41—47, lat. 30—35, crass. 20—22, ist. 10. — Fig. 196—200.

Cosmarium binerve Lund. (1871, Pl. III: 19 a, b, c). This species was (1920, p. 46, Pl. V: 14—15) described by Grönblad under the name »*C. pseudobinerve* n. sp.» and as a synonym »*C. binerve* var.» Dick (1919, p. 242, Pl. XII: 5) was suggested. It seems presently without question that these are identical to Lundell's species. The original description must have been founded upon an erroneous observation: the apical »jugis vel costis binis distinctis» are not costae at all, but furrows, »sulci». This has been observed quite clearly by Grönblad on material from Finland, Kuusamo and we give a copy of a figure from a Finnish specimen (Fig. 166—168). Also the Sudanese specimens have apical furrows, sulci. It is to be noted that the vertical view of apex is perfectly circular, but the basal part of the semicell is subrectangular. (cf. Lundell's fig. 19 c.). Long. 60, lat. 28. (The Finnish specimens: long. 62, lat. 31, crass. 23, ist. 11.) — Fig. 171, 172.

Cosmarium binum Nordst. Long. 57, lat. 43, ist. 16.

Cosmarium bioculatum Bréb. Long. 9.2, lat. 7.9. Membrane sparsely porose.

Cosmarium bipunctatum Boergesen. Long. 19, lat. 18, crass. 12, ist. 6.

Cosmarium capense De Toni var. *nyassae* Schmidle (1902, II: 1—2) forma. Long. 163, lat. 118, ist. 42. — Fig. 161, 162.

Cells longer and apex more broadly truncate. Chromatophores consisting of 4 parietal plates, each with one pyrenoid.

Cosmarium connatum Bréb. Specimens rather typical. Long. 66, lat. 49—50, crass. 36—40, ist. 36—39.

Cosmarium contractiforme Grönbl. & Scott n. sp. — Fig. 158, 159.

Cellulae mediocres, longiores quam latiores, in medio incisura profunda, aperta. Semicellulis subellipticis apice plus convexo. A vertice visae late ellipticae. Massa chlorophyllacea axilis nucleis amylaceis binis in utraque semicellula. Long. 42—53, lat. 30—39, crass. 28—30, ist. 9—15.

Cells of medium size, longer than broad, median constriction deep and open. Semicells subelliptical, apex more convex than base. Chromatophores axile with two pyrenoids in each semicell. We find this desmid perhaps nearest related to *C. contractum* Kirchn. with its variable forms, but the shape of the semicells does not agree with any of them and, moreover, there are two pyrenoids in each semicell. In the central part of the semicells the cell wall is distinctly porose.

We have not been able to identify this desmid with any known species.

Cosmarium contractum Kirchn. var. *ellipsoideum* (Elfv.) W. & W. f. *maculatum* Grönbl. & Scott n.f. — Fig. 155, 156.

Proxime ad var. *ellipsoideum* (Elfv.) W. & W. accedens differt parte apicali membrana incrassata et distincte scrobiculata. Long. 44, lat. 32, ist. 9.

Cosmarium contractum var. *ellipsoideum* (Elfv.) W. & W. (?) Long. 34.4, lat. 30.

In shape nearest to var. *ellipsoideum*, but with two pyrenoids, which makes the identification somewhat questionable. Cell wall covered with numerous short spine-like mucous threads.

Cosmarium controversum W. West forma. Smaller in size. Long. 66, lat. 50, crass. 32.

Cosmarium cucurbitinum (Biss.) Lütkem. var. *longum* Scott & Grönbl. (1957, VI: 6). Much the same shape as the variety from USA, but cells usually

somewhat oblique. Chromatophores axile with 2—4 pyrenoids and 6 radiating lamellae which were sometimes split up into small lobules. Long. 85, lat. 22. — Fig. 127.

Cosmarium cucurbitinum var. *truncatum* Krieger (?) (1932, IX: 15) forma. Cells slightly oblique. Long. 80, lat. 30; straight cells long. 64, lat. 25. — Fig. 132.

Cosmarium decoratum W. & W. Long. 81, lat. 63, crass. 42, ist. 30.

Cosmarium difficile Lütkem. forma. There is a refractive subapical spot visible at low power. Pores visible only with the greatest difficulty. The end- and side views are only approximately drawn. Long. 25, lat. 14, crass. 11, ist. 4. — Fig. 176 a, b.

Cosmarium diplosporum (Lund.) Lütk. var. *majus* W. West. The size of the Sudanese individuals is considerably, $1^1/_2$ times, larger than the measurements given in WEST (Mngr. II) and in SKUJA (1949, p. 122). — Fig. 131.

Cosmarium Doidgei Fritsch & Rich (1937, p. 182, fig. 12 G—I). Long. 14, lat. 15, crass. max. c. 9, ist. 4. — Fig. 213—215.

Small form with broader semicells and less retuse sides.

Cosmarium elongatum Racib. There were several different formae, which we think are best identified as belonging to RACIBORSKI's species. Some of the shorter cells are not unlike *Cosmarium lanceolatum* (Turn.) Lütkem., (1902, p. 406). On account of the rather scarce material we prefer to call them all *C. elongatum*. There were, too, some specimens not unlike elongated cells of *C. pseudotinecense* Grönbl. (1921, VII: 61), but much longer. *Penium lanceolatum* Turn. var. *subcylindricum* West & West (1902, XVIII: 5) might as well have been made a variety of *C. elongatum*. — Long. 95—184, lat. 33—42, ist. 20—30. The shortest cells perhaps belong to another species. — Fig. 128—130.

Cosmarium favum W. & W. var. *africanum* Fritsch & Rich (1937, p. 186, f. 13 A—C). In spite of the more elaborate structure of the cell wall in the Sudanese specimens we believe it is the same as was depicted somewhat schematically by FRITSCH & RICH. The cell wall looks like it at a certain position of the microscope tube; at a higher position there are to be seen in addition to the six triangular pits around each granule six very minute pores between the pits; there also appear triangular figures, perhaps costae, such as have been seen in *C. cosmetum* W. & W., *C. novae-terrae* Taylor and in SCHMIDLE's figure (1898, I: 20) of *C. multiordinatum* W. & W. Long. 60—64, lat. 46—50, crass. 35—39, ist. 16—18. — Fig. 228—230 and photos 378, 379.

Cosmarium floridanum Lütkem. var. *ambadiense* Grönbl. & Scott. n. var. — Fig. 126 and photo 371.

Differt cellulis maioribus, apice late rotundato, non truncato, incisura mediana latissime aperta lateribus rectis vel levissime convexis. Membrana sparse porosa, ad apices poris maioribus plus conspicuis et utrimque ad isthmum seriebus singulis simplicibus pororum. Long. 75—89, lat. 28—34, ist. 27—31.

From specific form distinguished by the rounded apices and a widely open shallow median constriction. For comparison we give a drawing (fig. 125) from a typical specimen from SCOTT's sample Louisiana 81, U.S.A. (long. 75, lat. 32).

Cosmarium gemma Grönbl. & Scott n. sp. — Fig. 216, 217.

Cellulae parvae paullo longiores quam latiores in medio profunde constrictae, sinu aperto. Semicellulae ovales una gemma in medio sub apicem, ceterum membrana achroa, laevis. A vertice visae ellipticae utrimque una gemma. Long. 20, lat. 16, ist. 5.

Cells of small size, slightly longer than broad; median constriction deep and open. Semicells ovate smooth, except one subapical gemmalike granule. Vertical view elliptical with one granule on each side. Sometimes the younger semicells bore no subapical gemmae.

Cosmarium globosum Bulnh. Long. 28, lat. 20, ist. 18.

Cosmarium goniodes W. & W. forma. Cells longer, twisted at the isthmus. Long. 16—17, lat. 10.

A further forma. Sides distinctly undulate, apex broadly truncate, cells larger in size. Long. 21, lat. 13. — Fig. 135.

Cosmarium Hammeri Reinsch var. *Schmidlei* Grönbl. & Scott n. nom. (syn. *C. homalodermum* var. *minor* Schmidle, 1902, p. 69, pl. I: 26). This variety has two pyrenoids in each semicell and the cells are of smaller size. Long. 33—36, lat. 30, crass. 18, ist. 9. — Fig. 163—165 and photo 375.

Cosmarium Hammeri var. *africanum* Fritsch & Rich (1937, fig. 14 C—H). Long. 22, lat. 18, crass. 12, ist. 6.

Cosmarium Lundellii Delp. var. *corruptum* (Turn.) W. & W. Cell wall sparsely porose or scrobiculate, pores less distinct in the center. Margin appears crenulate. Long. 45, lat. 40, crass. 25, ist. 21.

Cosmarium macrochondrum Grönbl. & Scott n. sp. — Fig. 231, 232, 241, 242, 246 and photo 377.

Magnum, longius quam latius, incisura mediana lineari profunde constrictum. Semicellulae trapeziformes ad pyramidatas angulis superioribus valde rotundatis, angulis basalibus minus rotundatis. Membrana granulis magnis in utroque latere 5—6 (quorum maiores singula in utroque angulo apicali), intra margines sub apicem binis, intra margines

laterales 3 et in centro semicellularum nonnullis (circ. 6) depressis, minus conspicuis sed scrobiculis satis irregulariter dispositis valde conspicuis circumdatis. In area centrali scrobiculi saepe plus conspicui quam granula videntur. A vertice visum late ellipticum polis bigranulatis, in medio seriebus obliquis granulorum (3—4, lateribus undulatis et membrana sparse scrobiculata (in medio et in ipso apice laevi). Massa chlorophyllacea axilis pyrenoidibus binis in utraque semicellula. Long. 71—83, lat. 51—62, crass. 39—41, ist. 16—18.

Cells of large size, longer than broad, median constriction deep and linear. Semicells trapeziform — pyramidate with upper angles widely rounded, basal angles less rounded. Cell wall with 5—6 large granules (which are not solid) in the margins at each side (the apical ones always more prominent, subconical); within the margins two subapical warts and near the lateral margins 3 warts; in the central part there are some 6 flattened, difficultly visible warts which are surrounded by large and very conspicuous pits somewhat irregularly arranged; these scrobiculations are much more easily visible than the granules. Vertical view broadly elliptical with bigranulate poles and two oblique rows of granules and on each side of the smooth apex with two granules; sides undulate and on each side a scrobiculate area. Chromatophores axile with two pyrenoids.

This species has some resemblance to *C. Salisburii* Fritsch & Rich (1937, Fig. 12 A—C), but the outline of the cells is different. It should also be compared with *Xanthidium decoratum* Fritsch & Rich (l.c.p. 200, f. 19 A) which has somewhat similar arrangement of the central scrobiculations and which looks much more like a *Cosmarium* in spite of the spines at the apical angles.

Cosmarium malleum Krieger (1932, X: 13) forma. Semicells broader and constriction deeper. Long. 19—20, lat. 17, crass. 13, ist. 8—9. — Fig. 146—148.

Cosmarium mansangense W. & W. (1907, XIV: 15). Vertical view circular with 17—19 granules around the perimeter. The granules appear obtuse. Chromatophores with two pyrenoids which are circular in front view and elongated in side view. Long. 52—59, lat. 25—26, ist. 18—20.

There was a form in which the basal granules were geminate (as in *C. pseudamoenum* Wille var. *basilare* Nordst.). Long. 55, lat. 23. — Fig. 224, 225.

Cosmarium Meneghinii Bréb. Perhaps nearest to the form in Insam & Krieger (1936, III: 14, 18). Long. 13.8. — Fig. 173.

Cosmarium moniliforme (Turp.) Ralfs. Long. 27—28, lat. 12.5—14, ist. 6—7.

Cosmarium monomazum Lund. Not much different from typical species. Central protuberance with three pairs of granules. Long. 32—37, lat. 29—36.

Cosmarium monomazum var. *dimazum* Krieger (1932, XI: 19). Long. 32, lat. 32.

Cosmarium monomazum Lund. var. *asymmetricum* Grönbl. & Scott n. var. — Fig. 204—206.

Protuberantiae centrales magnitudine dissimiles, asymmetrice ordinatae. Long. 33, lat. 30, crass. 23, ist. 10.

Central protuberances of unequal size and asymmetrically placed.

Cosmarium norimbergense Reinsch forma. Cells elongated with narrower apices. Long. 12, lat. 8. — Fig. 136, 137.

Cosmarium norimbergense f. *depressum* W. & W. Long. 15, lat. 13.

Cosmarium obsoletum (Hantzsch) Reinsch. Apex subtruncate. Long. 40, lat. 47.

Cosmarium obtusatum Schmidle. Long. 43—48, lat. 36—40, crass. 21—22, ist. 13—15.

Cosmarium ordinatum (Börges.) W. & W. Semicells broadly elliptical. Long. 26, lat. 25, crass. 16, ist. 9. — Fig. 188—190.

This desmid is very much like *C. ordinatum* in SCOTT & PRESCOTT (1958, XIV: 12) from Arnhem Land.

Cosmarium otus Krieger (1932, XI: 8). Very much like KRIEGER's specimen from Sumatra. KRIEGER did not see the vertical nor the side view. Cf. also HIRANO (1950 p. 52, fig. 10). Long. 49—51, lat. 45—46, crass. 25—26, ist. 14—15. — Fig. 201—203.

Cosmarium pachydermum Lund. var. *sudanense* Grönbl. & Scott n. var. — Fig. 160 and photo 374.

Differt sinu valde aperto, semicellulis late ellipticis. Long. 101, lat. 74.

The variety is distinguished by its widely open sinus and the broadly elliptical semicells.

Cosmarium permaculatum Grönbl. & Scott n. sp. — Fig. 252—254 and photo 376.

Cellulae mediocres vel maiores, paullo longiores quam latiores, constrictione profunda aperta, introrsum acuta vel sublineari. Semicellulae ellipticae; a vertice visae ellipticae. Tota membrana dense et conspicue scrobiculata, poris minimis inter scrobiculis; apex non scrobiculatus, tantum poris minimis ornata, in centro sublaevis; membrana omnis percrassa, in cellulis senioribus brunneola. Long. 66—69, lat. 48—51, crass. 30—36, ist. 18—20.

Cells of medium size, slightly longer than broad, median constriction deep, open but inwardly closed or linear. Semicells elliptical. Vertical view elliptical. Membrane very thick, all over the frontal surface densely and conspicuously scrobiculate with very fine pores between the scrobiculations; in vertical view the centre of apex appears smooth (or with very fine pores). In older semicells membrane brownish.

Cosmarium permaculatum Grönbl. & Scott var. *subnudum* Grönbl. & Scott n. var. — Fig. 247—249.

Differt cellulis plus subtrapeziformibus, constrictione aperta, membrana in parte inferiore semicellularum sine scrobiculis, tantum porosa. Long. 54—60, lat. 39—43, ist. 14.

In this variety the lower part of the semicell is only porose without any scrobiculations. The semicells are more angular, subtrapezical. Scrobiculations appear more triangular. Dimensions smaller.

There is a likeness to *C. subnudiceps* W. & W. (1898, XVII: 6).

Cosmarium portianum Arch. A form with smaller cells. Cf. West & West, Monogr. III, p. 167: »The tropical forms of this species are considerably smaller than those occurring in temperate regions». Long. 22, lat. 17, crass. 13, ist. 7.

Cosmarium protuberans Lund. Long. 18—21, lat. 16—18, crass. 12—14, ist. 12—14.

Cosmarium protuberans f. Cells subsexangular. Long. 27, lat 19. — Fig. 169, 170.

Cosmarium Prowsei Grönbl. & Scott n. sp. — Fig. 243—245, 250 and photo 380.

Magnum, longius quam latius, incisura lineari profunde constrictum. Semicellulae subrectangulares ad subellipticas angulis omnibus valde rotundatis, marginibus lateralibus 8 granulatis. Membrana intra margines superiores et apicales granulis 12 in seriem cum marginibus parallelam et in centro granulis in series transversales 3 ornata; circa granula seriebus irregularibus scrobiculorum conspicue ornata. Scrobiculi cum circulares, tum triangulares videntur prout tubus microscopicus altius aut inferius positus est. A vertice visum late ellipticum, lateribus undulatis, utrimque seriebus granulorum binis et in medio una serie granulorum abrupta ut pars centralis apicis laevis videatur. Membrana omnis valde incrassata. Massa chlorophyllacea axilis nucleis chlorophyllaceis binis in utraque semicellula. Long. 72—84, lat. 57—62, crass. 40—45, ist. 18—21.

Cells of large size, longer than broad, median constriction deep and linear. Semicells subrectangular to subelliptical, upper angles broadly rounded, basal angles subangular. Lateral margins with 8 granules on each side. Within the margins a simple series of 12 granules parallel to the margins; in the center 3 transversal rows of granules and between them irregularly arranged series of large pits and between these very fine pores; the pits appear triangular or

circular if the microscope tube is lowered or raised to a higher position. Vertical view broadly elliptical with undulate margins and on each side two series of granules, in the middle a simple series of 3+3 granules so that the central part of the apex becomes smooth; cell wall very thick. Chromatophores axile with two pyrenoids.

This species has some resemblance to *C. Salisburii* Fritsch & Rich (1937) but besides other differences it is much larger. The irregular arrangement of the central scrobiculations is very peculiar.

Cosmarium pseudamoenum Wille. Long. 45, lat. 22.

Cosmarium pseudobroomei Wolle forma. Cells of larger size. Long. 43, lat. 48, ist. 15. — Fig. 219.

There are, perhaps, some punctae around each granule which could not be seen. The size is larger than the specific form and the granules are more numerous. Vertical view not seen. Chromatophores? This desmid should also be compared with *C. pardalis* Cohn.

Cosmarium pseudoconnatum Nordst. Rather larger than NORDSTEDT's original specimens from Brazil (long. 43, lat. 28), but also larger than the dimensions given in WEST & WEST, Mngr. III (long. 47.5—57.5, lat. 33—44). The Sudanese dimensions were: long. 69—71, lat. (= crass.) 45—46.

Cosmarium pseudoexiguum Racib. forma. Broader towards the apices. Long. 21—25, lat. 11—13, ist. 4—5. — Fig. 142—144.

Another forma. Apical angles obliquely truncate. Long. 20.7, lat. 10. — Fig. 145.

Cosmarium pseudoexiguum var. *subrectangulum* W. & W. Long. 13.9.

Cosmarium pseudogranatum Nordst. (1869, III: 27) forma. This form has only the central pit but no protuberances. It would perhaps as well be described as a form of *C. granatum*. Long. 40, lat. 29—30. — Fig. 182.

Cosmarium pseudopyramidatum Lund. One of the numerous forms of this rather variable species. Cells rather broad. Long. 46, lat. 28, crass. 20—21, ist. 11.

Cosmarium pseudopyramidatum var. *oculatum* Krieger (1932, IX: 23). The refractive spot in the center of the semicells is better seen in the side view. Long. 50, lat. 32. — Fig. 180, 181.

Cosmarium pseudosulcatum Rich (in FRITSCH & RICH 1937, p. 195, f. 17 A—C). RICH (1935, p. 138, f. 14) has not quite the same ornaments of the cell wall. The regularly arranged scrobiculations below the two median warts

which are shown in RICH 1935 are not present in her figure of 1937. Our specimens were mostly smooth below these granules but we have seen one specimen which had very inconspicuous scrobiculae in the centre. So it may be that these ornaments are variable. *C. Engleri* Schmidle (1898, II: 22) seems to be something not much different, but the figures are too poor to decide as to the identity. Long. 39—45, lat. 32—36, crass. 27—28, ist. 11—12. — Fig. 183, 185—186, 187 a, b.

Cosmarium Regnellii Wille var. *chondrophorum* Skuja (1949, XXIX: 5). Cells of smaller size. Long. 15, lat. 13—14, crass. 10, ist. 4—5. — Fig. 174—175.

Cosmarium Regnesi Reinsch var. *productum* W. & W. (1902, XX: 35). This desmid looks more like a *Staurastrum*. Long. 17, lat. 15, ist. 6. — Fig. 218.

Cosmarium Salisburii Fritsch & Rich (1937, p. 182, f. 12 A—C) forma. The subapical verrucae seem to be rounded and the number of facial verrucae smaller. Pores not arranged in regular hexagons around the granules. Long. 50, lat. 38, crass. 27, ist. 12. — Fig. 236, 237.

This desmid should be compared with *C. ceratophorum* Lütkem. var. *madagascariense* Bourrelly (in BOURRELLY & LEBOIME 1946, IV: 60).

Cosmarium sinostegos Schaar. forma ad var. *obtusius* Gutw. accedens. Long. 9, lat. 11, crass. c. 6, ist. 3.5. — Fig. 238—240.

The Sudanese specimens were somewhat intermediate between specific form and var. *obtusius*, but the protuberances above the isthmus are obtuse and not so prominent.

Cosmarium Stephensii Rich (1932, fig. 9 B—E) forma *minus* Grönbl. & Scott n. f. This desmid is only half the size of the originally described species. Long. 33—38, lat. 24—30, crass. 18, ist. 9. — Fig. 210, 212.

Another forma. With one subapical wart. This we believe to be only a forma of *C. Stephensii*. Long 32, lat. 24. — Fig. 220, 221.

Cosmarium striolatum (Näg.) Arch. var. *Nordstedtii* (Moebius) Krieger (1932, p. 186, XII: 2). We think this is probably = *C. glyptodermum* W. & W. (1895, VII: 23). Long. 85—88, crass. 53—57, ist. 41. — Fig. 222, 223 and photo 381.

In vertical view the chromatophores are seen as 6 parietal bands very thick and somewhat triangular in cross section, leaving only the centre empty. The granules of the cell wall project very slightly and there are 32 of them around the periphery.

Cosmarium sublobatiforme Grönbl. & Scott n. sp. — Fig. 149, 150.

Cellulae parvae tertia parte longiores quam latiores; sinu satis profundo, obtusangulo, aperto. Semicellulis trapeziformibus angulis omnibus valde rotundatis, lateribus et apice leviter retuso; in centro protuberantia magna rotundata. A latere visae semicellulae subrhombiformes. Long. 19, lat. 14, crass. 13, ist. 7.5.

Cells small, about $^1/_3$ longer than broad, sinus not very deep, open and rounded. Semicells subtrapeziform with all angles rounded, sides and apex retuse, in the centre with a large swelling. Side view with subrhombic semicells, sinus 90°.

Front view very much like *Euastrum sublobatum* or *Cosmarium quadratulum*, but end view and lateral views rather different on account of the large central tumour.

Cosmarium subreinschii Schmidle, small specimens. Long. 13—14, lat. 10, crass. 5—6, ist. 3.4—4.

Cosmarium subretusiforme W. & W. Otherwise like the species described by WEST & WEST (1894, I: 20 and p. 5), but vertical view broader with rounded poles. On account of the very small size and the relatively low magnification used by the WESTS it is not impossible that their vertical view is incorrect. (The figure of 1894 is not so flattened and has not so sharp poles as the figure in Monogr. II, pl. LXII, fig. 19 b.) Long. 9.2, lat. 8.5, crass. 4.5. — Fig. 134.

Cosmarium taxichondrum Lund. var. *ambadiense* Grönbl. & Scott n. var. — Fig. 191—193.

Cellulae habitu proxime ad var. *sudanense* n. var. accedens differt ab illo granulis 4 apicalibus in seriem ordinatis, in angulis apicalibus granulis singulis coniformibus, in centro semicellularum granulis seu protuberantiis depressis elongatis binis, in margine laterali utrimque granulis parvis binis. Long. 28—29, lat. 28, crass. 18, ist. 8—9.

Nearest to var. *sudanense* n. var. from which it is distinguished by 4 subapical warts, one coniform subacute wart in each apical angle, two small warts in the lateral margins and two oblong and depressed warts in the centre of the semicells.

Cosmarium taxichondrum Lund. var. *sudanense* Grönbl. & Scott n. var. — Fig. 194, 195.

Differt cellulis fere circularibus, semicellulis cuneatis, angulis basalibus valde incrassatis, sub apicem granulis binis et inferius granulis ternis. Granula scrobiculis circumdata. Margines laterales undulatae. Constrictio mediana profundissima introrsum acuta, deinde dilatata, denique angustata et extrorsum fere clausa. A vertice visum fusiforme polis obtusis bigranulatis, lateribus utrimque in medio trigranulatis. Long. 32—36, lat. 33—36, crass. 20—21, ist. 10.

This variety is characterized by the almost circular outlines of the cell, semicircular or cuneiform semicells with undulate sides and mamillate basal angles. Median constriction deep and acute then widened but outwardly with convergent sides. Cell wall in the middle below apex with two granules and below these with three granules in a row, between the granules with regularly arranged pits. Vertical view fusiform with truncate and mamillate poles, in the middle on each side with 3 granules.

Cosmarium tetraodon Grönbl. & Scott n. sp. — Fig. 207—209.

Cellulae parvae, vix longiores quam latiores, in medio incisura lineari profunde constrictae; semicellulae trapeziformes angulis omnibus valde rotundatis. Membrana in medio sub apicem granulis binis magnis oblique convergentibus et supra isthmum granulo inconspicuo (tantum in cellula a latere visa vel in situ obliquo visibili); ceterum tota membrana sparse punctata. A vertice visae ellipticae utrimque in medio granulis magnis binis convergentibus. A latere visae semicellulis subcircularibus, utrimque ad apicem granulis valde prominentibus, utrimque supra isthmum granulis singulis inconspicuis. Massa chloropyllacea axilis nucleis amylaceis binis. Long. 34—36, lat. 30—33, crass. 19, ist. 10.

Cells small, not much longer than broad, median constriction deep and linear. Semicells trapeziform with all angles broadly rounded. Cell wall with two subapical obliquely convergent granules and above the isthmus a very faint granule, only visible in side and oblique views; the whole cell wall sparsely punctate (= pores). Vertical view elliptic with two prominent granules on each side. Side view of semicell circular with one subapical coniform granule on each side and a very small granule near the isthmus. Chromatophores axile with two pyrenoids.

Cosmarium tinctum Ralfs var. *tumidum* Borge forma (cf. GRÖNBLAD 1934, p. 268, f. 22—29). Cells smaller. Long. 9, lat. 8.5, ist. 6.6. — Fig. 138, 139.

Cosmarium transvaalense Fritsch & Rich (1937, p. 186, f. 13 F) forma. Not quite identical, but we suppose our specimens belong to this species. The scrobiculae are not mentioned by FRITSCH & RICH, but they say that »the markings in all aspects are rather variable». So we have found them too. Long. 47—60, lat. 37—41, ist. 11.5. — Fig. 226, 227.

This desmid should be compared with *C. ceratophorum* Lütkem. var. *madagascariense* Bourrelly (in BOURRELLY & LEBOIME 1946, IV: 60).

Cosmarium viride (Corda) Joshua forma. Median constriction deeper, chromatophores axile with a central pyrenoid and small lamellae radiating in all directions. Long. 37—44, lat. 18, ist. 10—11. — Fig. 177, 178.

Cosmarium zonatum Lund. Long. 48, lat. 27, crass. 21, ist. 7. This species seems to exhibit a considerable variation as to the shape of its cells. Our

specimens are nearest to typical species, but differ by a deep and closed median constriction.

Cosmarium zonatum Lund. var. *angustum* Grönbl. & Scott n. var. — Fig. 151 and photo 372.

Differt cellulis elongatis, apicem versus attenuatis lateribus retusis. A vertice visum ellipticum. Long. 50—54, lat. 23—24, crass. 20, ist. 10.

Cells elongated, tapering towards the apices, with retuse sides. Vertical view elliptical.

Cosmarium zonatum Lund. var. *latum* Scott & Grönbl. (1957, V: 14—16) forma. Long. 55—58, lat. 35 ist. 14. — Fig. 153, 154 and photo 384 b.

The Sudanese forma is of larger size than our variety from the United States. It resembles *C. zonatum* f. *javanicum* Gutw. in SKUJA (1949, XXVII: 21, 22) which differs considerably from GUTWINSKI's description and figures. Like our var. *latum* and its Sudanese forma it has a flattened vertical view, sinus is deep and linear, transversal rows of pores more numerous.

Cosmarium zonatum Lund. var. *obversum* Grönbl. & Scott n. var. — Fig. 152 and photo 373.

Cellulae minores, in medio incisura valde aperta et profunda, sicut formae clepsydrae similes fiant. A vertice visae circulares vel subcirculares. Massa chlorophyllacea axilis pyrenoidibus singulis in utraque semicellula et lamellis e centro divergentibus. Long. 36—40, lat. 19—21, ist. 5—8.

Cells of smaller size with deep and acute constriction; semicells subpyriform. Vertical view circular or slightly flattened. Chromatophores axile with a large central pyrenoid in each semicell and numerous radiating lobules. Cell wall with 3 (—4) rings of minute pores. Somewhat like *C. pyriforme* Nordst. (1869, p. 14 c.icon.).

Cosmarium zonatum Lund. var. *subcylindricum* Grönbl. & Scott n. var. — Fig. 157 and photo 384 c.

Differt cellulis subcylindriformibus. Long. 57, lat. 23.

Distinguished by its subcylindrical cells.

Xanthidium antilopaeum (Bréb.) Kütz. forma. The Sudanese specimens were almost identical with BORGE's (1925, IV: 12) form from Brazil. Long. csp. 76, ssp. 38; lat. csp. 92, ssp. 44; crass. 23. — Fig. 263, 264.

The number of spines is similar to *X. antilopaeum* var. *tropicum* Lagerh. (1887, p. 198. fig. xyl.), but the shape of the semicells is different.

Xanthidium calcarato-aculeatum (Hieron.) Schmidle (1898, III: 5). Sinus closed. Long. csp. 99, ssp. 58; lat. csp. 82, ssp. 55; crass. 46; ist. 19—21. — Fig. 259, 262 and photo 384 a.

In SCHMIDLE (1902, p. 71) this species — under the wrong authorship of West & West, »*X. calcarato-aculeatum* (Hieron.) W. & W.» — is made a variety of *X. trilobum* Nordst. We do not see any reason for such an arrangement, because the outline of the cells is quite different. On the other hand *X. calcarato-aculeatum* seems to be almost the same as *X. antilopaeum* var. *incertum* Schmidle (1902, II: 15) which most certainly has no close relations to *X. antilopaeum*.

Xanthidium calcarato-aculeatum (Hieron.) Schmidle var. *sudanense* Grönbl. & Scott n. var. — Fig. 260, 261.

Differt sinu valde aperto, semicellulis plus depressis. Long. csp. 82—92, ssp. 49—51; lat. csp. 73—74, ssp. 45—48; crass. 37; ist. 13—15.

This variety has a widely open sinus and more depressed semicells.

Xanthidium micracanthum Grönbl. & Scott n. sp. — Fig. 256—258.

Cellulae parvae, longiores quam latiores incisura mediana lineari profunde constrictae. Semicellulae subrectangulares ad subtrapeziformes apicem versus dilatatae, apice elevato in medio levissime retuso. In ipso apice elevato spinulis brevissimis binis geminatis, in angulis lateralibus spinis singulis paullo longioribus et intra marginem spinula unica, in margine laterali spinulis geminatis, in angulis basalibus spinulis geminatis; praeterea in parte centrali prominentia obtusa. A vertice visae ovales polis trispinatis, apice quadrispinato, in medio utrimque papilla obtusa. Long. 35—36, lat. csp. 28—30, crass. 18—21, ist. 6—7.

A small species with cells longer than broad and a deep linear median constriction. Semicells subrectangular or subtrapeziform, widened towards the apex which is elevated and very slightly retuse in the middle. In the elevated apical angles geminate short spines, in the apical angles single spines which are more robust, in the lateral sides geminate spines, in the basal angles very short geminate spines; a little above the centre a blunt protuberance. Vertical view ovate with three spines at the poles, 4 apical spines in the centre and a prominent blunt papilla on each side. There is very slight resemblance to any of the known small Xanthidia.

Xanthidium sansibarense (Hieron.) Schmidle (1898, III: 6). Differs from SCHMIDLE's and FRITSCH & RICH's (1937, fig. 19 D—F) figures by a blunt papilla in the centre of the semicell. Long. csp. 120, ssp. 80; lat. csp. 105, ssp. 63; crass. 46. — Fig. 336 c.

It may be possible that this desmid is only a individual variant of the following variety. We have seen only two cells of it and only one cell of the variety described below.

Xanthidium sansibarense (Hieron.) Schmidle var. *verrucosum* Grönbl. & Scott n. var. — Fig. 255 a, b and photo 383.

Differt area centrali semicellularum valde incrassata, granulis magnis 5—7 irregulariter dispositis ornata. A vertice visum in medio utrimque granulis magnis. Long. csp. 120, ssp. 85; lat. csp. 104, ssp. 62; crass. 46; ist. 16.

This variety is easily distinguished by the 5—7 large granules in the centre of each semicell and the very thick cell wall with conspicuous pores in the central part.

Xanthidium subtrilobum W. & W. var. *africanum* (Schmidle) Grönbl. & Scott n. comb. Syn. *X. cristatum* Bréb. var. *Delpontei* Roy & Biss. f. *africana* Schmidle (1898, III: 5). — Fig. 268, 269.

The new combination is founded principally on the very prominent central protuberances in vertical view, which are never present in *X. cristatum*. Long. csp. 99, ssp. 62; lat. csp. 93, ssp. 55; crass. 42; ist. 15.

Arthrodesmus bifidus Breb. var. *latidivergens* W. West. Long. csp. 17, ssp. 12; lat. csp. 15, ssp. 9; ist. 5. — Fig. 272.

Arthrodesmus Bulnheimii Rac. var. *subincus* W. & W. Long. csp. 36, ssp. 25; lat. csp. 45, ssp. 23; ist. 8.

Arthrodesmus convergens Ehr. Similar to the specimens from U.S.A. mentioned by Scott & Grönblad (1957, XIII: 12), but with stouter and longer spines. — Photo 385.

Arthrodesmus longispinus Borge (1903, III: 35), but semicells more depressed, almost like *Xanthidium controversum* W. West in Borge (1925, p. 36, IV: 14) which differs by a central papilla which should be visible in the vertical view. Chromatophores not seen. Long. csp. 72, ssp. 46; lat. csp. 87, ssp. 47; crass. 28; ist. 19. This desmid could easily be taken for a biradiate facies of *Staurastrum Wildemani* Gutw. but since we have seen only one specimen this question must remain open. — Fig. 273, 274 and photo 389.

Arthrodesmus maximus Borge var. *latus* Scott & Grönbl. (1957, X: 14—15). Long. csp. 51—54, ssp. 40—42; lat. csp. 90—93, ssp. 34—36; ist. 13—14. — Photo 388.

Identification somewhat doubtful since the Sudanese specimens have only one pyrenoid in each semicell.

Arthrodesmus mucronulatus Nordst. (1869, IV: 58). The shape of the cells is somewhat variable: sometimes they are quite like the original drawings by Nordstedt (1869, IV: 58), sometimes they are less depressed with a more

convex apex. The apical spines too are most variable: very often they are lacking in one or in both semicells; if there are no apical spines the apex usually is angular; cells without apical angularity have been found too. Long. 27—30, lat. csp. 35—45, ist. 11—14. — Fig. 275, 276.

Arthrodesmus psilosporus Nordst. & Löfgr. var. *retusus* Grönbl. (1945, IX: 180—182). Long. csp. 32—34, lat. csp. 30—38, crass. 11, ist. 9—11. — Fig. 270, 271.

The Sudanese form differs from the Brazilian in vertical view by the large tumour in the central part. Chromatophores axile with one central pyrenoid. Cf. also *A. phimus* Turn. (1892, XII: 9) and *A. hirundinella* Krieger (1932, XIII: 14—15).

Arthrodesmus stellifer Grönbl. & Scott n. sp. — Fig. 265—267 and photo 386.

Cellulae maiores, fere tam longae quam latae (s. sp.), in medio incisura valde aperta profunde constrictae. Semicellulae subovales apice magis convexo, quam ventre, angulis basalibus spinis singulis robustis valde incurvatis. Membrana in parte centrali semicellularum scrobiculis valde conspicuis triangularibus, quincuncialiter ordinatis ornata, in aliis partibus punctata; membrana valde incrassata. A vertice visae fusiformes utrimque in medio tumidae et incrassatae, in polis spina unica. Massa chlorophyllacea axilis chromatophoris in utraque semicellula binis, uterque chromatophorus nucleis amylaceis singulis. Long. 60; lat. csp. 72—73, ssp. 57; crass. 36—37; ist. 18.

Cells of rather large size almost as long as broad (without spines), median constriction open and deep. Semicells subovate with the apical margin more convex than the basal one; basal angles with one stout and strongly incurved spine. Membrane in the central part of semicells ornate, the ornaments consisting of triangular scrobiculations which are arranged into regular hexagons; other parts of membrane punctate (=porose). Vertical view fusiform with a thickening on each side at the middle and a stout spine at each end. Chromatophores two axile with two pyrenoids in each semicell. — The ornaments of this species are very beautiful and peculiar.

Arthrodesmus subulatus Kütz. Various forms with convergent, parallel or divergent spines. Long. 26—36, lat. csp. 58—84, ist. 6—11.

Arthrodesmus validus (W. & W.) Scott & Grönbl. (1957, p. 29). This is quite similar to what we have seen of this species from U.S.A. We think there are good reasons for separating it from the tangle of forms which have been put under the collective name of *A. incus*. The original and correct figure is published in West & West (1898, XVII: 16). — Photo 387.

Staurastrum clepsydra Nordst. var. *obtusum* Nordst. forma in Fritsch & Rich (1932, p. 174, fig. 10 A—D). Long. 27—30, lat. 30, ist. 9. Cf.

also *S. coarctatum* Bréb. forma in GRÖNBLAD (1945, X: 203). — Photo 400, 401.

Staurastrum convolutum Grönbl. & Scott. n. sp. — Fig. 281, 282.

Cellulae parvae latiores quam longiores in medio incisura aperta obtusangula profunde constrictae. Semicellulae arcuatae apice late convexo, basi excavata. Membrana rare granulata, granulis in seriebus concentricis in processibus et in seriebus parallelis inter processus ordinatis. Anguli in processus valde convergentes et inter se alternantes protracti. A vertice visae cellulae triangulares lateribus retusis, angulis attenuatis et protractis. Membrana in centro apicis laevis, aliae partes granulis regulariter ordinatis obtectae. Long. 30, lat. 40, ist. 13.

A peculiar small species with cells broader than long, median constriction open and deep and obliquely curved. Semicells curved with a convex apex and retuse basal margins. The whole semicell is somewhat like the top of a mushroom. Membrane not densely granulate, granules in concentric rings around the processes and between them in subparallel lines. Top of apex smooth (this is best seen in vertical view). The angles are bent downwardly and the semicells are alternating. Vertical view triangular with retuse sides and gradually attenuated angles.

Staurastrum cryptoedrum Skuja (1949, XXXIV: 14—15). This is a small and very peculiar species. Long. 16, lat. 14, crass. 14. — Fig. 293, 294.

Staurastrum cuspidatum Bréb. Long. 21—22, lat. csp. 22—24, ist. 5.

Staurastrum dejectum Bréb. Long. csp. 33, ssp. 22; lat. csp. 32; ist. 6.

Staurastrum Dickiei Ralfs. Long. 30; lat. ssp. 28, csp. 42; ist. 10.

Staurastrum diptilum Nordst. (1869, IV: 56). Our specimens agree exactly with NORDSTEDT's original drawings and also with SCOTT's specimens from U.S.A. in which the »twinning plane» of the paired spines varies from horizontal to almost vertical. The two semicells are slightly twisted at the isthmus. Cf. also GRÖNBLAD (1945, fig. 205). Long, csp. 16, ssp. 12; lat. csp. 18, ssp. 12; ist. 7. — Fig. 288, 289.

Staurastrum diptilum Nordst. var. *mossambicum* (Schmidle) Grönbl. & Scott n. comb. Syn. *S. mossambicum* Schmidle (1898, IV: 6 a, 6 c). Our desmid was apparently the same as seen by SCHMIDLE though his figures are poor. On the other hand we believe that this desmid cannot be separated as a species from *S. diptilum* which it resembles in other respects but that the spines are above one another when seen in vertical view. (The angles look as if there should be only a single spine attached to each angle, but there are really two spines above one another, while in the specific variety the angles in vertical

view appear bispinate.) Long. csp. 23, long. ad apices 12; lat. csp. 21; ist. 7. — Fig. 290—292.

Staurastrum distentum Wolle. Cf. WEST & WEST (1898, p. 316 c. fig. 6 d—f.) forma. Long. cpr. 31, spr. 27; lat. cpr. 44; ist. 11. — Fig. 301, 302 and photo 390.

This desmid should also be compared with *S. Engleri* Schmidle (1898, IV: 13). The deep and acute incisions between the basal parts of the processes, in vertical view, are lacking.

Staurastrum forficulatum Lund. var. *minus* (Fritsch & Rich) Grönbl. & Scott n. comb. Syn. *St. furcatum* Ehr. f. *minor* Fritsch & Rich (1937, f. 24 C—E). This desmid seems to us more closely related to *S. forficulatum* Lund. although we willingly admit its systematical position is somewhat dubious. The apical and lateral processes are highly variable and in some specimens they are very much reduced. Long. 28—34—36, lat. csp. 32—37—38, ist. 8—12. — Fig. 319—320 and photo 391; reduced form fig. 317—318.

Cf. also *S. senarium* (Ehr.) Ralfs. The processes and the cell wall are always smooth in *S. senarium*, without denticulations or granules as described by CARTER in WEST & WEST & CARTER (1923, p. 176). Such granulate forms probably belong to *S. pseudopisciforme* Eichl. & Gutw. (Cf. GRÖNBLAD, 1920, p. 74.)

Staurastrum Fuellebornei Schmidle (1902, II: 10) var. *evolutum* Grönbl. & Scott n. var. — Fig. 306—311 and photo 398, 399.

Differt ornamentis valde evolutis: ad isthmum verrucis granulosis in unoquoque angulo binis; in ipso apice processibus parvis bifidis in quoque angulo binis; ad basin processuum circulis binis granulorum; processus omnes corniformes, acuminati vel raro bifidi. A vertice visum 4—5-angulatum. Long. cpr. 52—66, spr. 30—45; lat. cpr. 57—70, spr. 24—30; ist. 17—20; facies 5-angulata long. cpr. 78, spr, 44; lat. cpr. 51; ist. c. 16.

This variety differs in having much richer ornaments: above the isthmus there are two verrucae corresponding to each angle, bearing about 6 papilla-like granules; at the apex there are small bifid warts in a ring, two corresponding to each angle; the processes are long and horn-like, attenuated towards the slightly bent ends which are acuminate or rarely bifid, at the basal part with two rings of papilliform granules. Our specimens were mostly quadrangular, only one semicell was 5-angular. On the whole all ornaments were greatly variable and reduced ornaments were met with.

Cf. also *S. Fuellebornei* var *bangweuluense* Thomasson (1957, p. 10 and fig. 18), which appears to have somewhat simpler ornaments and occurs only as 4-radiate facies.

Staurastrum furcatum Ehr. var. *asymmetricum* Grönbl. & Scott n. var. — Fig. 323, 324.

Processi apicales 6, quorum bini in quoque angulo: unus bifidus, alter simplex. Long. cpr. 46—50, lat. cpr. 43—46, ist. 16.

There are six apical processes, two at each angle: one of them simple the other bifid. Sides in vertical view stright.

Staurastrum furcatum Ehr. var. *asymmetricum* Grönbl. & Scott f. *depaupe-ratum* Grönbl. & Scott n. f. — Fig. 321, 322.

Processi apicales singuli in quoque angulo, omnes trifidi. Cellulae a vertice visae quadrangulares lateribus retusis. Long. cpr. 40, lat cpr. 42.

Apical processes reduced to only one at each angle. Processes trifid. Vertical view quadrangular with retuse sides.

Staurastrum leptocladum Nordst. var. *simplex* Fritsch & Rich (1937, p. 208, fig. 23 B). The length of the processes variable. Long. 30—34, lat. 69—90, crass. 13—14, ist. 9. — Fig. 299, 300.

The authors of this variety admit (l.c. page 209) that the body of the variety does not agree with NORDSTEDT's original figure of the species (1869, IV: 57). The present authors are of the opinion that the actual variety would much better fit into *S. grallatorium* Nordst. as a variety. (Cf. NORDSTEDT l.c. fig. 52.) There is nothing of the curvature of the processes or of the very narrow and elongated basal part as depicted by NORDSTEDT. Quite recently THOMASSON (1957, p. 14) has proposed a new name viz. »*S. richianum* (Fritsch & Rich) Thomasson n. comb.» The name »*richianum*» was, however, never created by FRITSCH & RICH so they must not be quoted in this connexion.

Staurastrum leptocladum var. *cornutum* Wille. Long. 32, lat. 105, lat. bas. 11, ist. 8.

As pointed out by GRÖNBLAD (1926, p. 29) this variety must be considered as good in spite of the opinions expressed by WEST & WEST (1898, p. 318) and by G. M. SMITH (1924, p. 102—103). The present writers have seen spineless specimens of this species in material from Lake Victoria sent by Dr. EDNA LIND, Kampala, and by the late Dr. W. KRIEGER.

Staurastrum leptodermum Lund. var. *ikapoae* (Schmidle) W. & W. (1907, p. 213, pl. XVI: 8), syn. *S. ikapoae* Schmidle (1903, II: 11). Broader form: long. csp. 58, ssp. 42; lat. csp. 33; ist. 15. Elongated form: long. csp. 51, lat. csp. 28, ist. 13. — Fig. 285, 286 (broad form); 287 (elongated form).

Cf. also *S. corniculatum* Lund. var. *spinigerum* W. West in THOMASSON (1957, fig. 21).

Staurastrum muticum Bréb. Long. 21, lat. 21, ist. 7.

Staurastrum Omearii Arch. Long. csp. 17—18, ssp. 12; lat. csp. 14—17; ist. 7—8.

Staurastrum orbiculare Ralfs forma. Differs by the open sinus. Long. 29, lat. 28, ist. 7. — Fig. 279, 280.

Staurastrum orbiculare var. *denticulatum* Nordst. (1869). Considering the variability of this species and of this variety especially, we find it convenient to delete the specific rank created by GRÖNBLAD (1945, p. 24) of *S. bidentulum* Grönbl. There are numerous intermediate formae between the variety and such forms that have smooth angles. Those intermediate formae were abundantly found in material from Uganda (coll. E. LIND). Long. 41—46, lat. 37—42, ist. 16.

Staurastrum orbiculare var. *Ralfsii* W. & W. f. *majus* W. & W. (Monogr. IV, p. 157). Our plant is still larger and broader. Long. 68, lat. 68, ist. 22.

There seem to be three separate chromatophores in each semicell, but as only one cell was found the nature of the chromatophores is obscure.

Staurastrum quadricornutum Roy & Biss. Long. cpr. 40, lat. cpr. 35, ist. 13. Fig. 336 b.

Staurastrum rotula Nordst. Vertical view cpr. diam. 61. Somewhat different from the U.S.A. form. — Fig. 305.

Staurastrum Rzoskae Grönbl. & Scott n. sp. — Fig. 312—316 and photo 397.

Cellulae maiores, cum processibus duplo fere longioribus quam latioribus, in medio incisura aperta non profunde constrictae. Semicellulae rectangulares angulis basalibus rotundatis, apice late convexo processibus 6 longis oblique sursum directis, simplicibus aut bifidis; ad basim semicellularum verrucis 9 utrimque circa isthmum. A vertice visae 9-angulares: in angulis 2 lateribus brevioribus et inter angulos lateribus singulis longioribus; intra latera breviora processibus 6. Long. cpr. 66—68, spr. 34—39; lat. cpr. 54—58, spr. 26—27; ist. 16—17.

Cells of rather large size, with processes almost twice as long as broad, median constriction open, not deep. Semicells rectangular with basal angles round, apex slightly convex and furnished with 6 divergent long processes which are smooth, gradually tapering towards the ends which are mucronate or bifurcate; at the base of the semicells, just above the isthmus a ring of 9 usually bigranulate warts. Vertical view 9-angular: six shorter sides at the angles and three slightly longer sides between them (the end view can be considered triangular); the apical processes are inserted inside the shorter sides; the verrucae are not visible, there is one of them below each angle. Chromatophores axile with one central pyrenoid and six lobules, one going into each of the processes.

Staurastrum sagittarium Nordst. forma *evolutum* Grönbl. & Scott n.f. — Fig. 303, 304.

Processibus longioribus, verrucis bifidis ad basin, apice ipso glabro. Long. 29, lat. 80, ist. 18.

This form is more spiny and apical verrucae closer to the margin. The number of the processes was always 9. (NORDSTEDT's species was described as being 7—8 radiate.)

Staurastrum Sebaldi Reinsch. var. *ornatum* Nordst. Long. 54—55, lat. cpr. 96—97, ist. 14.

? Staurastrum stelliferum Borge (1925, VI: 3—4). Long. cpr. 42, lat. cpr. 44, ist. 7. Only one semicell found.

Staurastrum subcornutum De Toni var. *parvum* Grönbl. & Scott n. var. — Fig. 283, 284.

Magnitudo cellularum tantum $^1/_2$ ad $^1/_3$ speciei. Spinae subparallelae aut vix divergentes. Long. 30—33; lat. csp. 45—48, ssp. 27—28; ist. 9—12.

This desmid is very much like a small triangular facies of *Arthrodesmus subulatus*, but since there is no direct evidence connecting them to each another we think it is best placed in *Staurastrum*. *S. subcornutum* has very much the same shape, but as it is twice or three times as large it may possibly be a separate species.

Staurastrum unicorne Turn. var. *longicolle* Grönbl. & Scott n. var. — Fig. 295—298 and photo 404.

Differt processibus multo longioribus et tenuioribus. Long. cpr. 30, lat. cpr. 37—53, ist. 7—8.

This variety has longer and slenderer processes and an evenly opening sinus, but the peculiarly shaped processes are quite similar to TURNER's (1892, XV: 16) species. Cf. also SCOTT & PRESCOTT (1958, XV: 8).

Staurastrum Wildemani Gutw. var. *majus* (W. & W) Scott & Presc. (1956, p. 353, fig. 8—12). One cell was found combining the specific form with var. *majus*. See SCOTT & PRESCOTT l.c. fig. 14.

Staurastrum Wildemani Gutw. var. *rotundatum* Grönbl. & Scott n. var. — Fig. 277, 278.

Differt a fronte semicellulis ovalibus angulis valde rotundatis, incisura mediana introrsum plus aperta et rotundata. A vertice visum lateribus latissime convexis. Spinis binis robustis in quoque angulo. Cellulis maioribus. Long. 67; lat. csp. 104, ssp. 55; ist. 25.

This variety differs by its ovate semicells, very stout spines, larger dimensions and in vertical view with slightly convex sides.

Spondylosium tetragonum W. West. Cells relatively longer than measurements given by WEST & WEST & CARTER. Long. 12—13, lat. 6.5—9. — Fig. 325.

Sphaerozosma excavatum Ralfs. Long. 11, lat. 7—7.5.

Sphaerozosma granulatum Roy & Biss. Long. 8—9, lat. 7—8.5.

Onychonema filiforme (Ehr.) Roy & Biss. forma. Semicells more broadly elliptical, median constriction linear. Long. 16, lat. 14, ist. 4. — Fig. 326.

According to the proposal of TEILING (1957, p. 78) K. THOMASSON (1957) has rejected the genus *Onychonema* Wallich and transferred these species to *Sphaerozosma* Corda. We do not feel quite sure about accepting such an arrangement.

Onychonema laeve Nordst. Long. cpr. 24, spr. 17; lat. csp. 28, ssp. 22; ist. 5.

Onychonema laeve Nordst. var. *perlatum* Grönbl. & Scott n. var. — Fig. 327 and photo 392.

Cellulae prae longitudine multo latiores. Spinis lateralibus acutis, parallelis, brevibus. Long. spr. 22; lat. csp. 41, ssp. 36.

This variety is characterized by its very broad and depressed cells; the spines are short, acute and parallel.

Hyalotheca mucosa (Mert.) Ehr. var. *minor* Roy & Biss. Long. 13, lat. 9.2.

Desmidium asymmetricum Grönbl. It seems to the present writers almost certain that the species from L. Ambadi is the same as described by GRÖNBLAD from Finland (1920, I: 5—7). We are inclined to suppose that *D. occidentale* as figured in FRITSCH & RICH (1937, fig. 29 A—B) belongs to the same species, thus being a synonym to *D. asymmetricum*. The connecting processes seen in vertical view are more narrowly oblong in the figure by GRÖNBLAD. But we give a new figure made from GRÖNBLAD's pencil sketches from material collected 1931 in Finland (Pojo, Brunkom träsk), which shows the same very broadly oblong apical processes as the Ambadi material.

Dimensions and figures: a) material from L. Ambadi: long. 22—24, lat. 24—26 (27—28 SCOTT). — Fig. 328, 329 and photo 394, 395. b) material from Finland, sample 252/1931: long. 23, lat. 32. — Fig. 330, 331.

Desmidium graciliceps (Nordst.) Lagerh. var. *elongatum* Grönbl. & Scott n. var. — Fig. 332 and photo 393.

Differt cellulis elongatis et apicibus multo angustioribus. Long. 30—31, lat. 16, lat. apic. 5.5—6.

The variety is distinguished by its elongated cells and the very narrow apices. Threads spirally twisted.

Phymatodocis irregularis Schmidle var. *profusa* Grönbl. & Scott n. var. — Fig. 333, 334 and photo 396.

Differt semicellulis valde asymmetricis, inter se dissimilibus, pyrenoidibus geminatis vel singulis in utraque semicellula. Long. 30.5, lat. 58—64 (Gbl.); long. 28, lat. 60, ist. 22. (Sc.).

In this variety the asymmetry is exaggerated so that they look much more asymmetrical than Schmidle's (1898, I: 3—9; 1902, II: 12) plant. The chromatophores are axile with one central pyrenoid in each semicell and numerous asymmetrical lobules.

ADDENDUM

Correction to Scott & Grönblad 1957.

In the paper »New and interesting Desmids from the Southeastern United States» by A. M. Scott & R. Grönblad (1957) on p. 23 a new species *Cosmarium strabo* Scott & Grönbl. was published. Meanwhile the authors have learned of *Cosmarium strabo* Brühl & Biswas 1926. This name has priority and thus the species of Scott & Grönblad must be renamed. As a new name we substitute: *Cosmarium streblon* Scott & Grönbl.

Literature

BORGE, O. 1903: Die Algen der ersten Regnellschen Expedition. II. Desmidiaceen. Arkiv f. bot. *1.*

—»— 1925: Die von Dr. F. C. Hoehne während der Expedition Roosevelt-Rondon gesammelten Süsswasseralgen. Ibid. *19.*

—»— 1928: Zellpflanzen Ostafrikas gesammelt auf der akademischen Studienfahrt 1910 von Bruno Schröder. VIII. Süsswasseralgen. Hedwigia *68.*

BORGESEN, F. 1890: Desmidieae. In: EUG. WARMING, Symbolae ad floram Brasiliae centralis cognoscendam. Vidensk. Medd. Naturhist. Foren. *1890.*

BOURRELLY, P. & LEBOIME, R. 1946: Notes sur quelques algues d'eau douce de Madagascar. Biol. Jaarboek Dodonaea *13.*

BOURRELLY, P. & MANGUIN, E. 1949: Contribution a l'étude de la flore algale d'eau douce de Madagascar: Le Lac de Tsimbazaza. Mém. Inst. Sc. Madagascar, Série B, *2.*

BROOK, ALAN J. 1954: A systematic account of the Phytoplankton of the Blue and White Niles. Annals & Mag. of Nat. Hist., Ser. 12, *7.*

BROOK, A. J. & KUFFERATH, H. & ROSS, R. & SIMS, PATRICIA, A. 1957: A Bibliography of African Freshwater Algae. Revue Algologique, N. S., *2*: 4.

BROOK, A. J. & RZÓSKA, J. 1954: The Influence of the Gebel Aulyia Dam on the Development of Nile Plankton. Journ. Animal Ecology *23*: 1.

BRÜHL, P. & BISWAS, K. 1926: Algae of the Loktak Lake. Mem. Asiat. Soc. Bengal *8.*

CHOLNOKY, B. J. 1954: Ein Beitrag zur Kenntnis des Moglflusses in Nordost-Transvaal. Österr. Bot. Zeitschr. *101.*

DICK, J. 1919: Beiträge zur Kenntnis der Desmidiaceenflora von Südbayern. I. Kryptogamische Forschungen *1*: 7.

DUCELLIER, F. 1918: Etude critique sur Euastrum ansatum Ralfs et quelques-unes de ses variétés helvétiques. Bull. Soc. Bot. Genève, 2e sér., *9.*

FRITSCH, F. E. 1907: A General Consideration of the Subaerial and Freshwater Algal Flora of Ceylon. I. Proc. R. Soc. London, Ser. B, *79.*

FRITSCH, F. E. & RICH, F. 1924: Contributions to our Knowledge of the Freshwater Algae of Africa. 4. Freshwater and Subaerial Algae from Natal. Transact. R. Soc. S. Africa *11.*

—»— & —»— 1937: Contributions . . . Freshwater Algae of Africa. 13. Ibid. *25:* 2.

GRÖNBLAD, ROLF 1920: Finnländische Desmidiaceen aus Keuru. Acta Soc. F. Fl. Fenn. *47:* 4.

—»— 1921: New Desmids from Finland and Nothern Russia. Ibid. *49:* 7.

—»— 1926: Beitrag zur Kenntnis der Desmidiaceen Schlesiens. Comment. Biol. Soc. Sc. Fenn. *2:* 5.

—»— 1934: A short report of the Freshwater-Algae recorded from the neighbourhood of the Zoological Station at Tvärminne. Memor. Soc. F. Fl. Fenn. *10.*

—»— 1945: De algis brasiliensibus. Acta Soc. Sc. Fenn., N. Ser. B, *2:* 6.

HIRANO, MINORU 1950: Further note on some so-called southern Desmids from Kansai, Middle Japan. Acta Phytotaxon. & Geobot. *14:* 2.

HURST, H. E. 1952: The Nile. London.

INSAM, J. & KRIEGER, W. 1936: Zur Verbreitung der Gattung Cosmarium in Südtirol. Hedwigia *76.*

JOSHUA, W. 1886: Burmese Desmidieae, with descriptions of new species occurring in the neighbourhood of Rangoon. Journ. Linn. Soc. London, Bot., *21.*

KRIEGER, W. 1932: Die Desmidiaceen der Deutschen Limnologischen Sunda-Expedition. Arch. f. Hydrobiol., Suppl. *11* (Trop. Binnengew. 3).

—»— 1937—39: Die Desmidiaceen Europas mit Berücksichtigung der aussereuropäischen Arten. 1—2. Teil. Rabenhorst's Krypt. -flora v. Deutschland, Österr. u.d. Schweiz, 2. Aufl., XIII Bd, 1. Abt. Leipzig.

KRIEGER, W. & BOURRELLY, P. 1956: Desmidiacées des Andes du Venezuela. Ergebn. d. Deutschen Limnol. Venezuela-Exp. 1952, Bd 1. Berlin.
LAGERHEIM, G. 1887: Ueber einige Algen aus Cuba, Jamaica und Puerto Rico. Bot. Not. *1887*.
LUNDELL, P. M. 1871: De Desmidiaceis, quae in Suaecia inventae sunt, observationes criticae. Nova Acta R. Soc. Sc. Upsal., Ser. 3, *8*.
LÜTKEMÜLLER, J. 1902: Die Zellmembran der Desmidiaceen. Beitr. z. Biol. d. Pflanzen *8*.
MESSIKOMMER, E. 1929: Die Algenvegetation der Moore am Pfäffikersee. Vierteljahrschr. Naturf. Ges. Zürich *72*.
NORDSTEDT, O. 1869: Desmidiaceae. In: EUG. WARMING, Symbolae ad floram Brasiliae centralis cognoscendam, particula 5. Vidensk. Medd. Naturhist. Foren. *1869*.
—»— 1888: Freshwater Algae, collected by Dr. S. Berggren in New Zealand and Australia. K. Sv. Vet. Akad. Handl. *22:* 8.
PRESCOTT, GERALD W. & SCOTT, ARTHUR M. 1952: The algal flora of Southeastern United States. V. Additions to our knowledge of the Desmid Genus Micrasterias 2. Transact. Am. Microsc. Soc. *71:* 3.
RICH, FLORENCE 1932: Contributions to our Knowledge of the Freshwater Algae of Africa. 10. Phytoplankton from South African Pans and Vleis. Transact. R. Soc. S. Africa *20:* 2.
—»— 1935: Contributions . . . Freshwater Algae of Africa. 11. Algae from a Pan in Southern Rhodesia. Ibid. *23:* 2.
RZÓSKA, J. & BROOK, A. J. & PROWSE, G. A. 1955: Seasonal plankton development in the White and Blue Nile near Khartoum. Proc. Int. Ass. theor. & appl. Limnology *12*.
SCHMIDLE, W. 1898: Die von Prof. Dr. Volkens und Dr. Stuhlmann in Ost-Afrika gesammelten Desmidiaceen. Engler's Bot. Jahrb. *26*.
—»— 1902: Algen, insbesondere solche des Planktons, aus dem Nyassasee und seiner Umgebung, gesammelt von Dr. Fülleborn. Ibid. *32*.
SCOTT, A. M. & GRÖNBLAD, R. 1957: New and interesting Desmids from the Southeastern United States. Acta Soc. Sc. Fenn., N. Ser. B., *2:* 8.
SCOTT, A. M. & PRESCOTT, G. W. 1956: Notes on Indonesian Freshwater Algae. I. Staurastrum wildemani Gutw. (Desmidiaceae). Reinwardtia *3:* 3.
—»— & —»— 1958 (in press): Some freshwater algae from Arnhem Land in the Northern Territory of Australia. Rep. Arnhem Land Exp. 1948, Botany vol. III. Melbourne.
SKUJA, H. 1949: Zur Süsswasseralgenflora Burmas. Nova Acta R. Soc. Sc. Upsal., Ser. IV, *14:* 5.
SMITH, G. M. 1924: Phytoplankton of the Inland Lakes of Wisconsin. Wisconsin Geol. & Nat. Hist. Survey Bull. *57*.
TEILING, E. 1957: Morphological investigations of asymmetry in desmids. Bot. Not. *110*.
THOMASSON, KUNO 1957: Notes on the Plankton of Lake Bangweulu. Nova Acta R. Soc. Sc. Upsal., Ser. IV, *17*.
TURNER, W. B. 1892: Algae aquae dulcis Indiae Orientalis. K. Sv. Vet. Akad. Handl. *25*.
University College of Khartoum 1953—1956: I—III Annual Report of the Hydrobiological Research Unit.
WEST, G. S. 1907: Report on the Freshwater Algae, including Phytoplankton, of the Third Tanganyika Expedition conducted by Dr. W. A. Cunnington, 1904 to 1905. Journ. Linn. Soc. London, Bot., *38*.
—»— 1914: A Contribution to our Knowledge of the Freshwater Algae of Columbia. Mém. Soc. Neuchâtel. Sc. Nat. *5*.
WEST, W. & WEST, G. S. 1894: New British Freshwater Algae. Journ. R. Microsc. Soc. *1894*.
—»— & —»— 1895: A Contribution to our Knowledge of the Freshwater Algae of Madagascar. Transact. Linn. Soc. London *5*.
—»— & —»— 1898: On some Desmids of the United States. Journ. Linn. Soc. London, Bot., *33*.
—»— & —»— 1902: A Contribution to the Freshwater Algae of Ceylon. Transact. Linn. Soc. London *6*.
—»— & —»— 1907: Freshwater Algae from Burma, including a few from Bengal and Madras. Ann. R. Bot. Garden Calcutta *6*.
WEST, W. & WEST, G. S. [& CARTER, N.] 1902—1923: A Monograph of the British Desmidiaceae. I—V. Ray Society, London.
WOŁOSZYNSKA, JADWIGA 1922: II. Przyczynek do znajomości glonów Litwy. Rozpr. i Wiadom. z Muz. im. Dzeduszyckich *5—6*. Lwow.

Explanation of Plates

PLATE I.

Fig. 1. Gonatozygon sudanense n. sp. × 775.
2— 3. Pleurotaenium minutum (Ralfs) Delp. var. Bourrellyi n. nom. 2 × 1214, 3 × 775.
4. » indicum (Grun.) Lund. × 445.
5. » » a copy from an original drawing made by GRUNOW, in Herb. Mus. Palat. Vindob., Coll. Grunow No 26151, × 200.
6. Triploceras gracile Bail. var. sudanense n. var. × 775.
7— 8. » verticillatum Bail. var. superbum (Mask.) Nordst. f. angustum n. f. 7 × 307, 8 × 800.
9—10. Euastrum Luetkemuelleri Ducell., f. × 1214.
11—12. » nasiferum n. sp. × 1214.
13. » solum (Nordst.) n. comb. var africanum n. var. × 775.
14—17. » » var. angustum n. var. × 445.

PLATE II.

Fig. 18—19. Gonatozygon Brebissonii DeBary 18 × 1200, 19 × 2200.
20. Closterium infractum Messik. × 1460.
21—23. Euastrum sibiricum Boldt f. africanum n. f. × 1720.
24—25. » Luetkemuelleri Ducell. var. carniolicum (Lütk.) Krieger × 1460.
26—27. » angolense W. & W. var. crassum n. var. × 2428.
28. » elegans (Bréb.) Kütz. var. spiniferum n. var. × 1550.
29—30. » pulchellum Bréb. var. protrusum n. var. × 1550.

PLATE III.

Fig. 31—32. Euastrum solum (Nordst.) n. comb. var. africanum n. var. × 600.
33—34. » attenuatum Wolle var. splendens (Fritsch & Rich) n. comb. × 800.
35—37. » ansatum Ehr. var. dideltiforme Ducell. 35 × 775, 36—37 × 800.
38—41. » unioculatum n. sp. × 840.
42—44. » Gessneri Krieger & Bourrelly 42 × 775, 43—44 × 800.
45—46. » fissum W. & W. var. subbiceps n. var. × 800.

PLATE IV.

Fig. 47—49. Euastrum platycerum Reinsch var. eximium n. var. × 600.
50. » » » » » f. clausum n. f. × 445.
51—53. » Rzoskae n. sp. × 840.

PLATE V.

Fig. 54. Euastrum Rzoskae n. sp. var. tribullatum n. var. × 445.
55—56. » Rzoskae n. sp. × 445.
57. » » var. tribullatum n. var. × 775.
58—62. » magniprotuberans n. sp. 58—59 × 775, 60—62 × 800.
63—66. » truncatiforme G. S. West, f. × 750.
67—68. » praemorsum (Nordst.) Schmidle, f. × 775.
69. » » var. simplicius n. var. × 800.
70—72. » » f. × 800.
73. » » var. simplicius n. var. × 775.

PLATE VI.

Fig. 74—76. Euastrum corpulentum n. sp. 74—75 ×600, 76 ×775.
77a. » subcrassum Fritsch & Rich. var. elaboratum n. var. ×775.
77b—79. » » var. subcapitatum n. var. ×800.
80—82. » » var. elaboratum n. var. ×800.
83. Micrasterias zeylanica Fritsch ×1214.

PLATE VII.

Fig. 84—88. Euastrum spinulosum Delp. var. Lindae n. var. 84—86 ×600, 87—88 ×800.

PLATE VIII.

Fig. 89—91. Euastrum spinulosum Delp. f. sudanense n. f. ×800.
92—94. » » var. inermius Nordst. ×775.
95. Micrasterias truncata (Corda) Bréb. var. subcuneata n. var. ×800.
96. » zeylanica Fritsch ×800.
97—99. » pinnatifida (Kütz.) Ralfs var. polymorpha Bourrelly ×445.

PLATE IX.

Fig. 100—107. Micrasterias incredibilis n. sp. 100—102 ×445, 103—106 ×600, 107 ×775.
108—109. » tropica Nordst. var. ambadiensis n. var. ×600.

PLATE X.

Fig. 110—114. Micrasterias sudanensis n. sp. 110 ×445, 111—114 ×487.
115—117. » tropica Nordst. var. elongata Schmidle × 775.
116, 118. » » var. ambadiensis n. var. ×775.

PLATE XI.

Fig. 119. Micrasterias radians Turn. var. ambadiensis n. var. ×487.
120—123. » » f. 120—121 ×487, 122 ×480, 123 ×445.
124. » crux-melitensis (Ehr.) Hass. f. minor Turn. ×445.

PLATE XII.

Fig. 125. Cosmarium floridanum Lütkem. from Louisiana, U.S.A. (SCOTT, No 81) ×775.

ERRATA

Page 34, line 8 from bottom; after »Fig. 226, 227» add: »236, 237».
Page 53, photo 380: insert Prowsei instead of subtransvaalense.

155—156. » contractum Kirchn. var. ellipsoideum (Elfv.) W. & W. f. maculatum n. f. ×445.

Explanation of Plates

PLATE I.

Fig. 1. Gonatozygon sudanense n. sp. × 775.
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Fig. 18—19. Gonatozygon Brebissonii DeBary 18 × 1200, 19 × 2200.
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29—30. » pulchellum Bréb. var. protrusum n. var. × 1550.

73. » » var. simplicius n. var. × 775.

PLATE VI.

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124. » crux-melitensis (Ehr.) Hass. f. minor Turn. ×445.

PLATE XII.

Fig. 125. Cosmarium floridanum Lütkem. from Louisiana, U.S.A. (Scott, No 81) ×775.
126. » » var. ambadiense n. var. ×775.
127. » cucurbitinum (Biss.) Lütkem. var. longum Scott & Grönbl. f. ×775.
128. » elongatum Racib., f. ad C. pseudotinecense Grönbl. acced. ×445.
129. » » f. ad C. lanceolatum acced. ×800.
130. » » f. ×445.
131. » diplosporum (Lund.) Lütkem. var. majus W. West × 445.
132. » cucurbitinum (Biss.) Lütkem. var. truncatum Krieger ×445.
133. » abscissum Lütkem. ×1214.
134. » subretusiforme W. & W. ×2119.
135. » goniodes W. & W., f. ×730.
136—137. » norimbergense Reinsch, f. ×730
138—139. » tinctum Ralfs var. tumidum Borge, f. ×1050.
140—141. » arctoum Nordst. var. constrictum n. var. ×1214.
142—144. » pseudoexiguum Racib., f. ×800.
145. » » f. ×1214.
146—148. » malleum Krieger, f. ×800.

PLATE XIII.

Fig. 149—150. Cosmarium sublobatiforme n. sp. ×1214.
151. » zonatum Lund. var. angustum n. var. ×800.
152. » » var. obversum n. var. ×775.
153—154. » » var. latum Scott & Grönbl. 153 ×880, 154 ×445.
155—156. » contractum Kirchn. var. ellipsoideum (Elfv.) W. & W. f. maculatum n. f. ×445.

Fig. 157. Cosmarium zonatum Lund. var. subcylindricum n. var. × 445.
158—159. » contractiforme n. sp. × 800.
160. » pachydermum Lund. var. sudanense n. var. × 445.
161—162. » capense De Toni var. nyassae Schmidle, f. × 265.
163—165. » Hammeri Reinsch var. Schmidlei n. nom. 163—164 × 800, 165 × 730.
166—168. » binerve Lund. drawn from a specimen from Finland (Kuusamo) × 445.
169—170. » protuberans Lund., f. × 730.
171—172. » binerve Lund. from Lake Ambadi × 445.

PLATE XIV.

Fig. 173. Cosmarium Meneghinii Bréb., f. × 1214.
174—175. » Regnellii Wille var. chondrophorum Skuja × 800.
176a, b. » difficile Lütkem., f. × 860.
177—178. » viride (Corda) Joshua, f. × 800.
179. » ambadiense n. sp. × 800.
180—181. » pseudopyramidatum Lund. var. oculatum Krieger × 775.
182. » pseudogranatum Nordst., f. × 775.
183. » pseudosulcatum Rich × 800.
184. » ambadiense n. sp. × 800.
185—187. » pseudosulcatum Rich 185—186 × 800, 187a—b × 445.
188—190. » ordinatum (Börges.) W. & W. 188 × 700, 189—190 × 860.
191—193. » taxichondrum Lund. var. ambadiense n. var. × 800.
194—195. » » var. sudanense n. var. × 775.

PLATE XV.

Fig. 196—200. Cosmarium bicorne Borge 196—199 × 800, 200 × 775.
201—203. » otus Krieger × 800.
204—206. » monomazum Lund. var. asymmetricum n. var. × 800.
207—209. » tetraodon n. sp. 207—208 × 775, 209 × 800.
210—212. » Stephensii Fritsch & Rich f. minus n. f. × 800.
213—215. » Doidgei Fritsch & Rich × 1050.
216—217. » gemma n. sp. × 800.
218. » Regnesi Reinsch var. productum W. & W. × 1100.
219. » pseudobroomei Wolle, f. × 800.
220—221. » Stephensii Fritsch & Rich, f. × 775.

PLATE XVI.

Fig. 222—223. Cosmarium striolatum Näg. var. Nordstedtii (Möb.) Krieger, 222 × 445, 223 × 775.
224—225. » mansangense W. & W., f. × 775.
226—227. » transvaalense Fritsch & Rich, f. × 445.
228—230. » favum W. & W. var. africanum Fritsch & Rich × 800.
231—232. » macrochondrum n. sp. × 445.
233—235. » transvaalense Fritsch & Rich × 780.
236—237. » Salisburii Fritsch & Rich × 850.
238—240. » sinostegos Schaar. f. ad var. obtusius Gutw. acced. × 1050.
241—242. » macrochondrum n. sp. × 445.

PLATE XVII.

Fig. 243—245. » Prowsei n. sp. 243 × 850, 244 × 800, 245 × 775.
246. » macrochondrum n. sp. × 800.
247—249. » permaculatum n. sp. var. subnudum n. var. × 800.
250. » Prowsei n. sp. × 775.
252—254. » permaculatum n. sp. 252—253 × 800, 254 × 1214.

PLATE XVIII.

Fig. 255a, b. Xanthidium sansibarense Schmidle var. verrucosum n. var. × 445.
256—258. » micracanthum n. sp. 256 × 705, 257—258 × 775.
259, 262. » calcarato-aculeatum (Hieron.) Schmidle 259 × 800, 262 × 445.
260—261. » » var. sudanense n. var. 260 × 800, 261 × 445.
263—264. » antilopaeum (Bréb.) Kütz., f. 263 × 445, 264 × 265.
265—267. Arthrodesmus stellifer n. sp. 265—266 × 445, 267 × 600.

PLATE XIX.

Fig. 268—269. Xanthidium subtrilobum W. & W. var. africanum (Schmidle) n. comb. × 800.
270—271. Arthrodesmus psilosporus Nordst. & Löfgr. var. retusus Grönbl. × 775.
272. » bifidus Bréb. var. latidivergens W. West × 1214.
273—274. » longispinus Borge × 445.
275—276. » mucronulatus Nordst. 275 × 775, 276 × 800.
277—278. Staurastrum Wildemani Gutw. var. rotundatum n. var. × 445.
279—280. » orbiculare Ralfs, f. × 800.

PLATE XX.

Fig. 281—282. Staurastrum convolutum n. sp. × 775.
283—284. » subcornutum De Toni var. parvum n. var. × 775.
285—286. » leptodermum Lund. var. ikapoae (Schmidle) W. & W. broad form, × 800.
287. » » » » elongated form, × 800.
288—289. » diptilum Nordst. × 1100.
290—292. » » var. mossambicum (Schmidle) n. comb. × 775.
293—294. » cryptoedrum Skuja × 775.
295—298. » unicorne Turn. var. longicolle n. var. 295—296 × 445, 297—298 × 850.
299—300. » leptocladum Nordst. var. simplex Fritsch & Rich × 800.
301—302. » distentum Wolle, f. × 800.

PLATE XXI.

Fig. 303—304. Staurastrum sagittarium Nordst. f. evolutum n. f. × 850.
305. » rotula Nordst., f. × 800.
306—311. » Fuellebornei Schmidle var. evolutum n. var. × 800.

PLATE XXII.

Fig. 312—316. Staurastrum Rzoskae n. sp. × 800.
317—318. » forficulatum Lund. var. minus (Fritsch & Rich) n. comb. reduced form, × 800.
319—320. » » var. minus (Fritsch & Rich) n. comb. × 800.
321—322. » furcatum Ehr. var. asymmetricum n. var. f. depauperatum n.f. × 775.
323—324. » » var. asymmetricum n. var. × 445.
325. Spondylosium tetragonum W. West × 775.
326. Onychonema filiforme (Ehr.) Roy & Biss. × 775.
327. » laeve Nordst. var. perlatum n. var. × 730.

PLATE XXIII.

Fig. 328—329. Desmidium asymmetricum Grönbl. × 775.
330—331. » » from Finland (Pojo, Brunkom träsk) × 445.
332. » graciliceps Nordst. var. elongatum n. var. × 775.
333—334. Phymatodocis irregularis Schmidle var. profusa n. var. 333 × 775, 334 × 610.
335. Pleurotaenium caldense Nordst. × 445.
336a. » cylindricum (Turn.) W. & W. var Stuhlmannii (Hieron.) Krieger × 265.
336b. Staurastrum quadricornutum Roy & Biss. × 775.
336c. Xanthidium sansibarense (Hieron.) Schmidle × 517.

Explanation of photomicrographs

PLATE XXIV.

Photo Nr 337. Gonatozygon aculeatum Hastings
338. » monotaenium De Bary
339. » sudanense n. sp.
340. Pleurotaenium caldense Nordst.
341. » minutum var. Bourrellyi n. nom.
342. Euastrum solum (Nordst.) n. comb. var. africanum n. var.
343. » fissum var. subbiceps n. var.
344. » truncatiforme G. S. West
345. » spinulosum var. inermius Nordst.
346. » platycerum var. eximium f. clausum n. f.
347. » spinulosum var. Lindae n. var.
348. » Rzoskae n. sp. var. tribullatum n. var.
349—350. » subcrassum var. elaboratum n. var.
351. » elegans var. spiniferum n. var.

PLATE XXV.

352. Euastrum solum (Nordst.) n. comb. var. angustum n. var.
353. » corpulentum n. sp.
354. » attenuatum var. splendens (Fritsch & Rich) n. comb.
355. Micrasterias pinnatifida var. polymorpha Bourrelly & Manguin
356. » pinnatifida (Kütz.) Ralfs, f.
357. Euastrum Rzoskae n. sp.
358. Micrasterias crux-melitensis (Ehr.) Hass. f. minor Turn.
359. » radians Turn.

PLATE XXVI.

360. Micrasterias radians Turn.
361. » alata Wallich
362. » radians var. ambadiensis f. latiloba n. f.
363. » radians var. ambadiensis n. var.
364. » sudanensis n. sp.
365. » incredibilis n. sp.

PLATE XXVII.

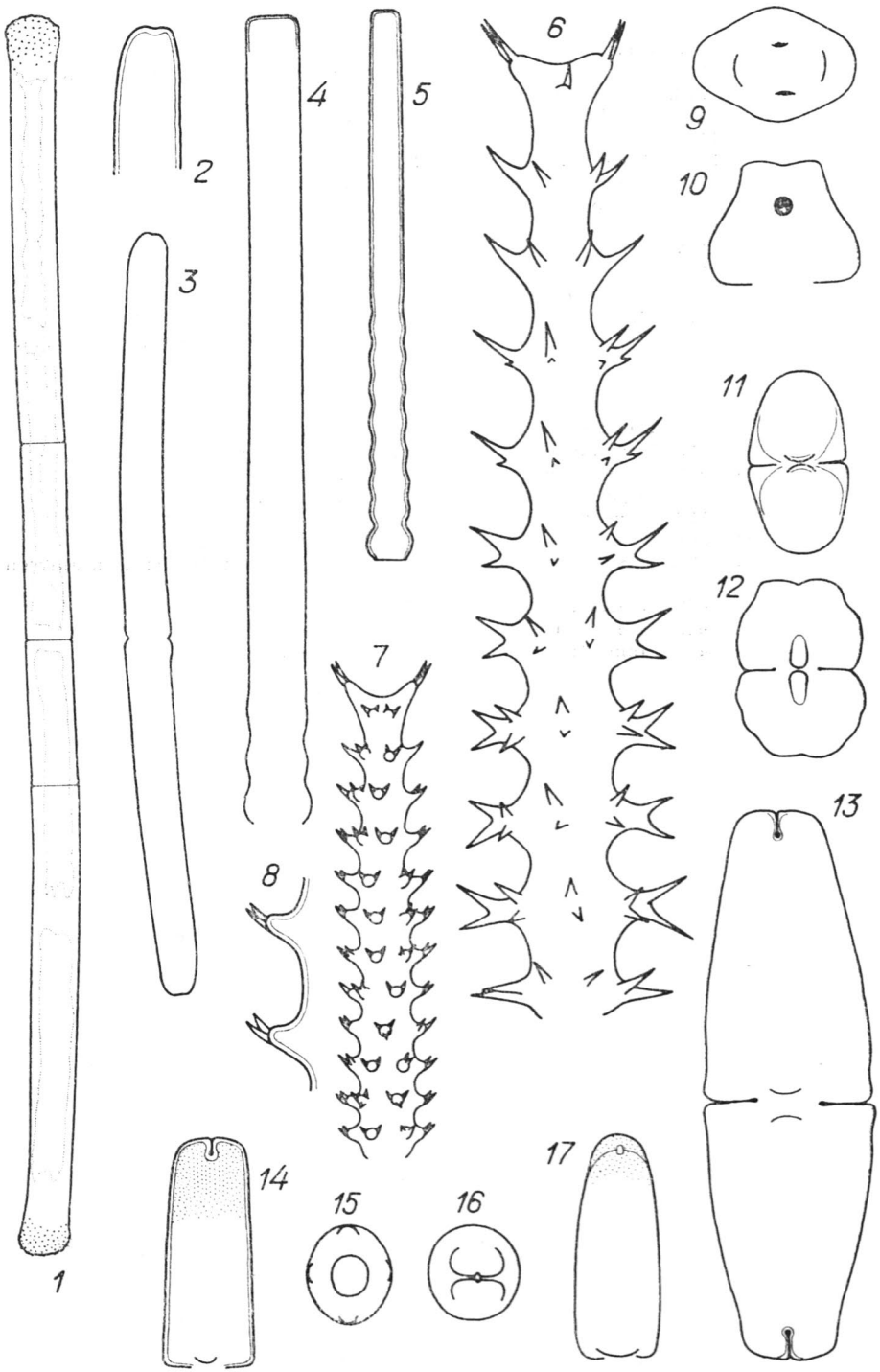
366. Micrasterias zeylanica Fritsch, f.
367. » tropica var. ambadiensis f. subparallela n. f.
368—369. » tropica var. ambadiensis n. var.
370. » tropica var. elongata Schmidle
371. Cosmarium floridanum var. ambadiense n. var.
372. » zonatum var. angustum n. var.
373. » zonatum var. obversum n. var.
374. » pachydermum var. sudanense n. var.
375. » Hammeri var. Schmidlei n. nom.
376. » permaculatum n. sp.
377. » macrochondrum n. sp.
378—379. » favum W. & W. var. africanum Fritsch & Rich

PLATE XXVIII.

380. Cosmarium subtransvaalense n. sp.
381. » striolatum (Näg.) Arch. var. Nordstedtii (Moebius) Krieger
382. » amoenum Bréb.
383. Xanthidium sansibarense var. verrucosum n. var.
384a. » calcarato-aculeatum (Hieron.) Schmidle
384b. Cosmarium zonatum var. latum Scott & Grönbl.
384c. » zonatum var. subcylindricum n. var.
385. Arthrodesmus convergens Ehr.
386. » stellifer n. sp.
387. » validus (W. & W.) Scott & Grönbl.
388. » maximus Borge v. latus Scott & Grönbl.
389. » longispinus Borge.
390. Staurastrum distentum Wolle.
391. » forficulatum Lund. var. minus (Fritsch & Rich) n. comb.

PLATE XXIX.

392. Onychonema laeve var. perlatum n. var.
393. Desmidium graciliceps var. elongatum n. var.
394—395. » asymmetricum Grönbl.
396. Phymatodocis irregularis var. profusa n. var.
397. Staurastrum Rzoskae n. sp.
398—399. » Fuellebornei var. evolutum n. var.
400—401. » clepsydra Nordst. var. obtusum Nordst. f. in FRITSCH & RICH
402. Micrasterias zeylanica Fritsch
403. » incredibilis n. sp.
404. Staurastrum unicorne var. longicolle n. var.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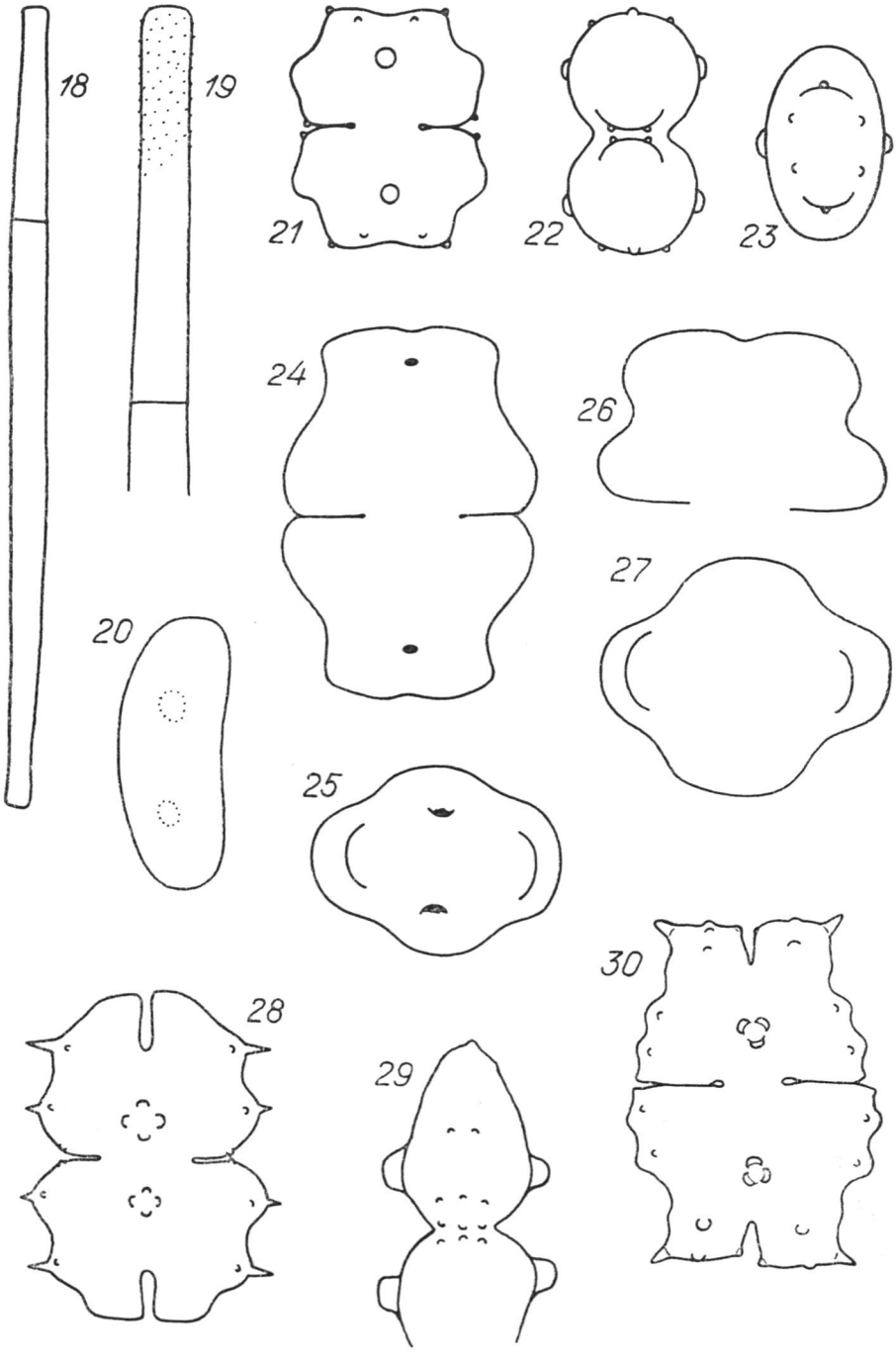
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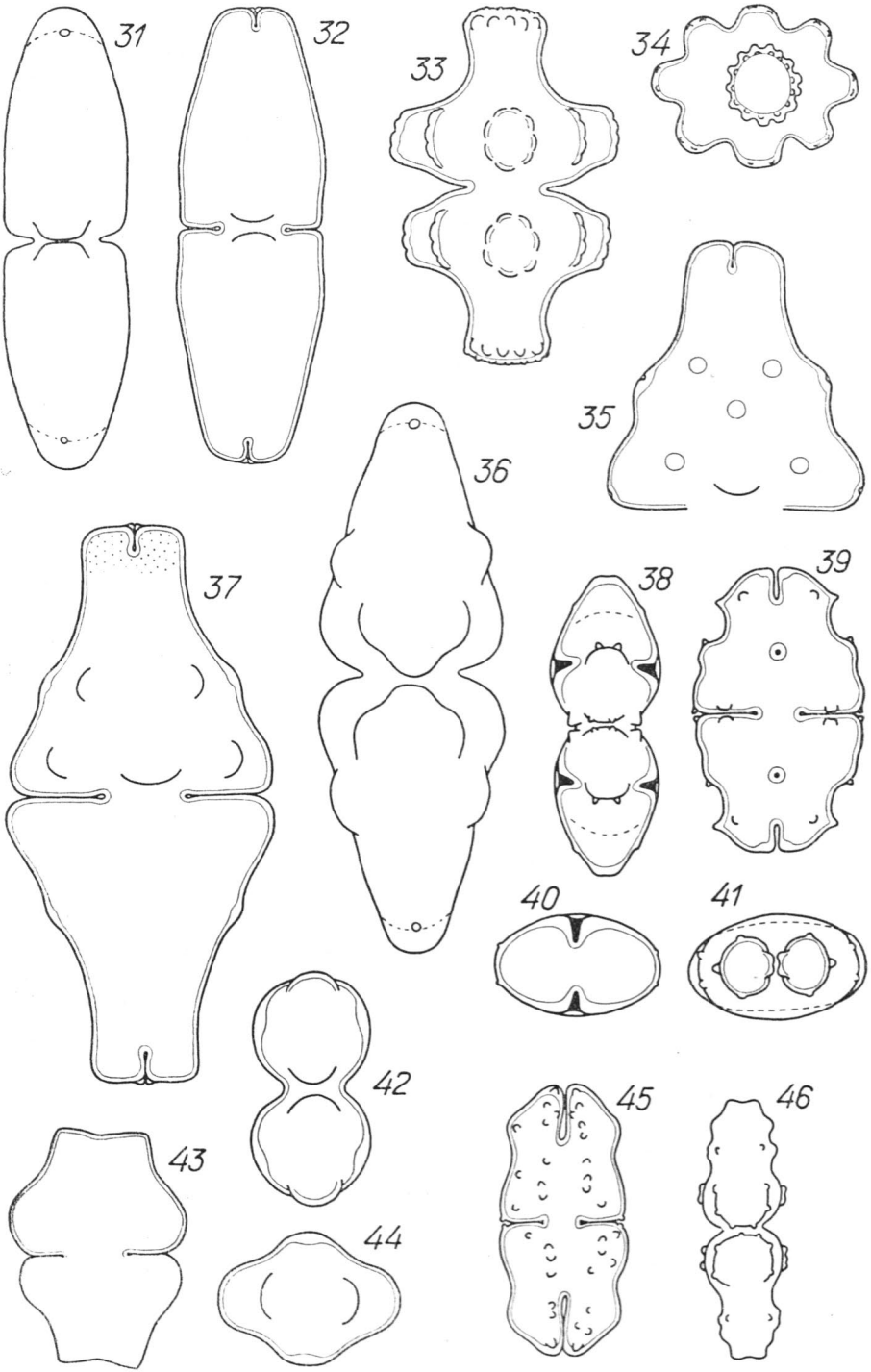
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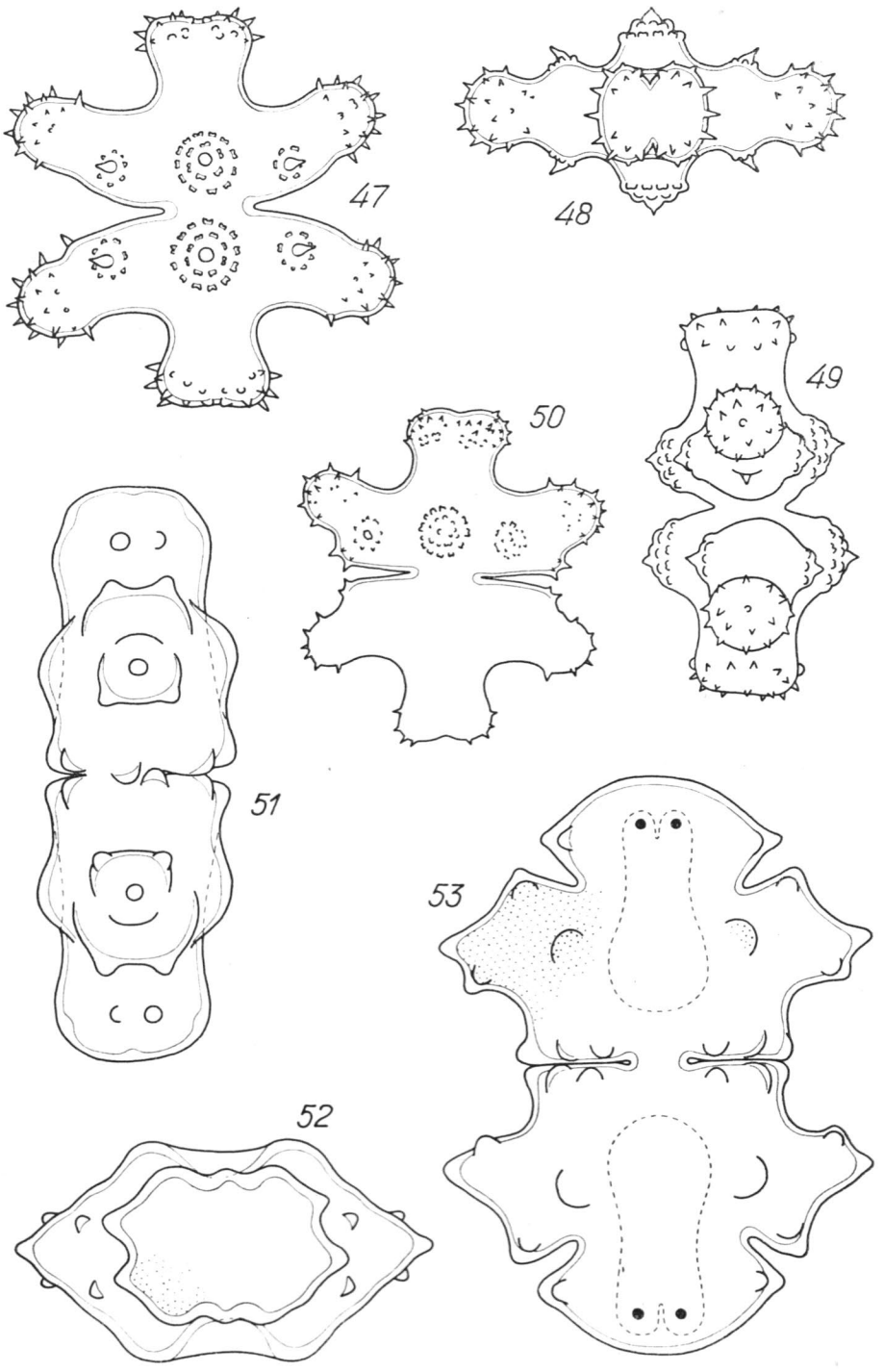
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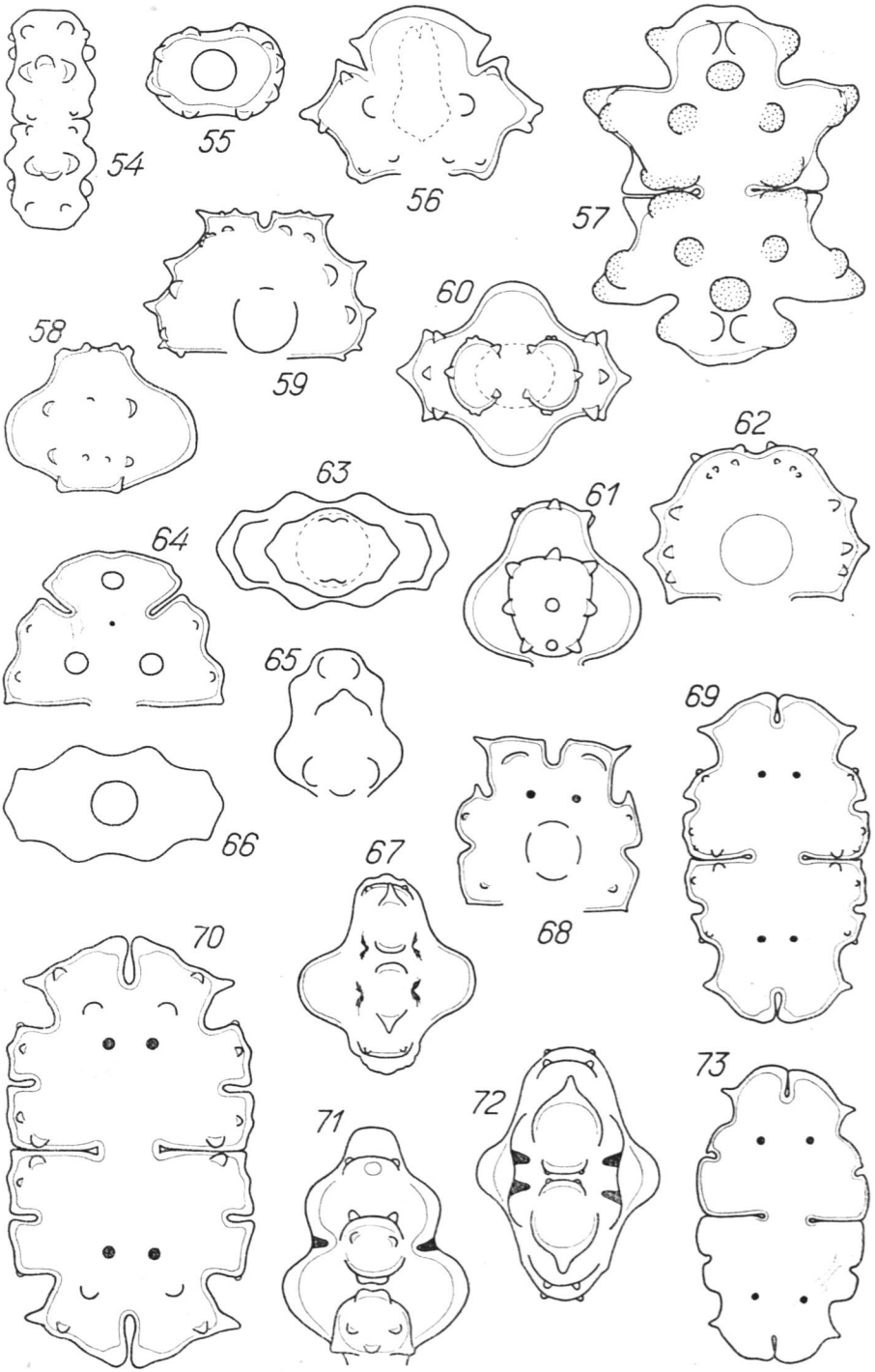
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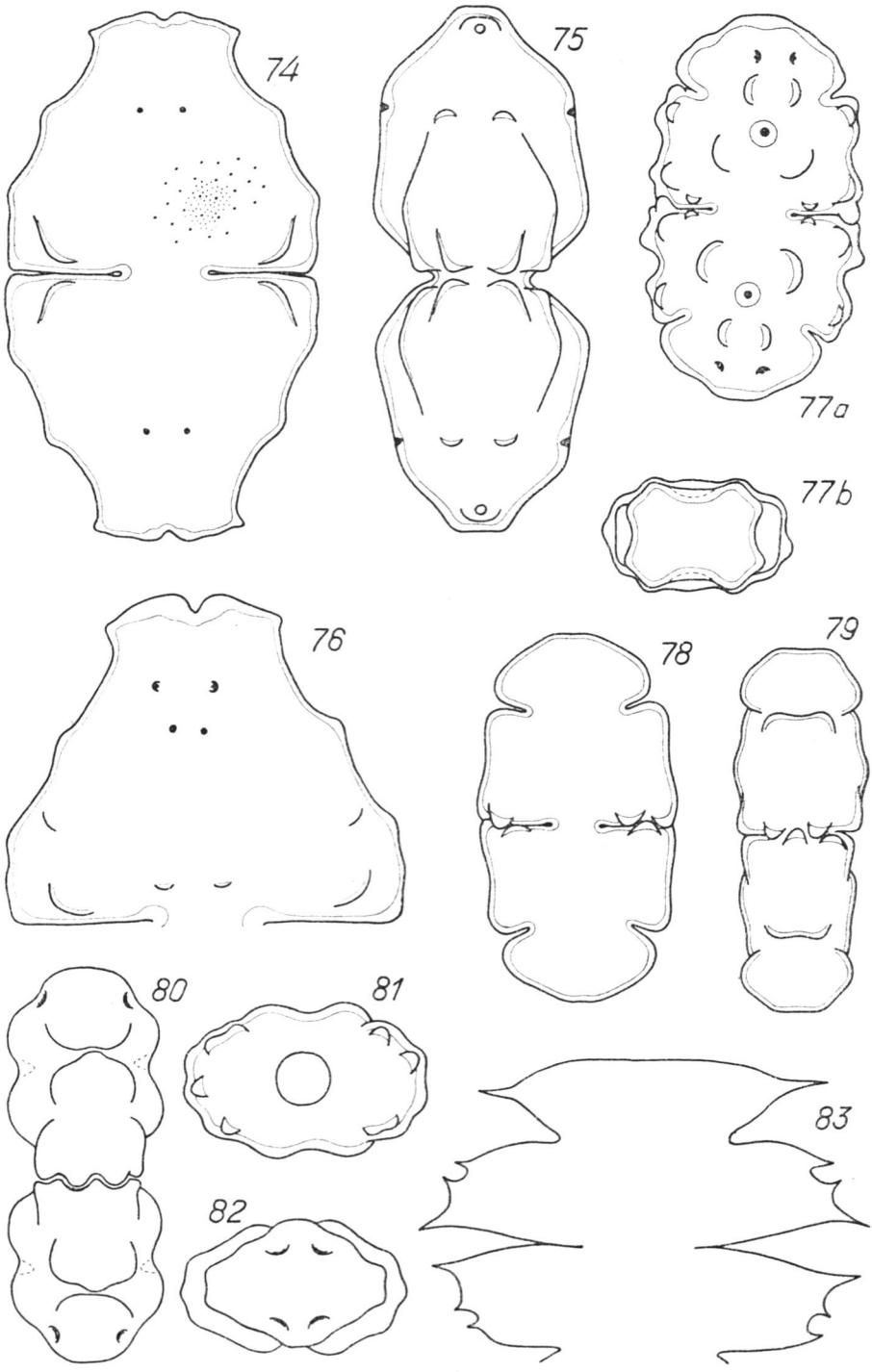
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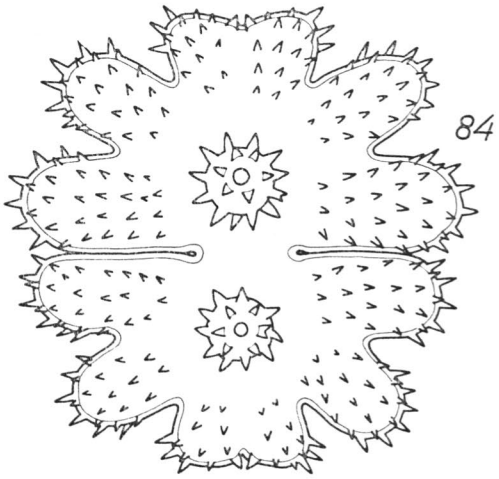
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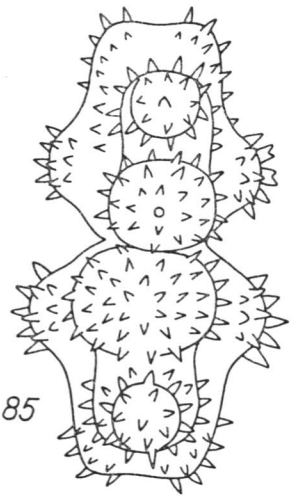
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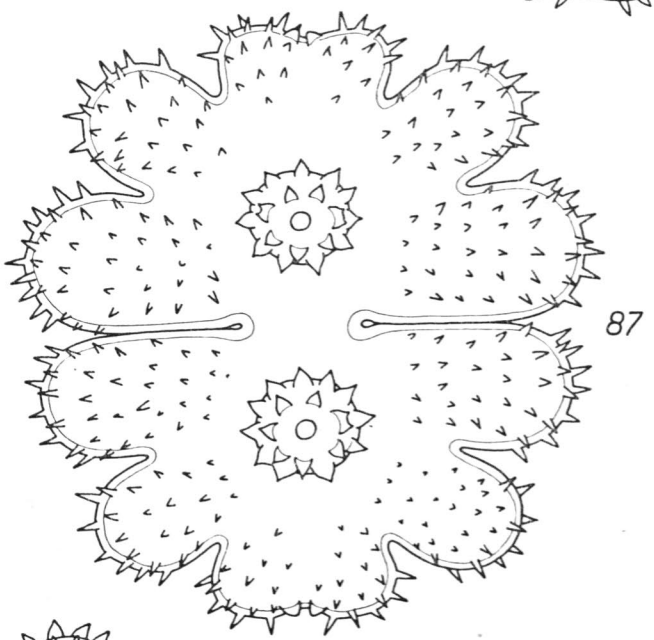
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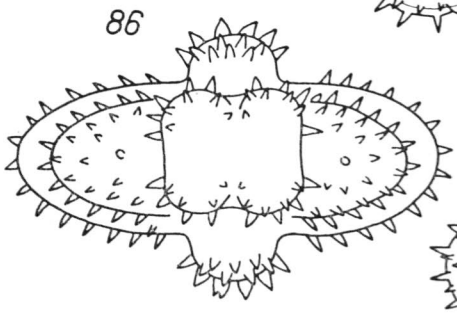
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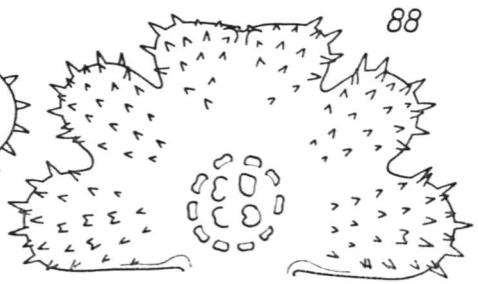
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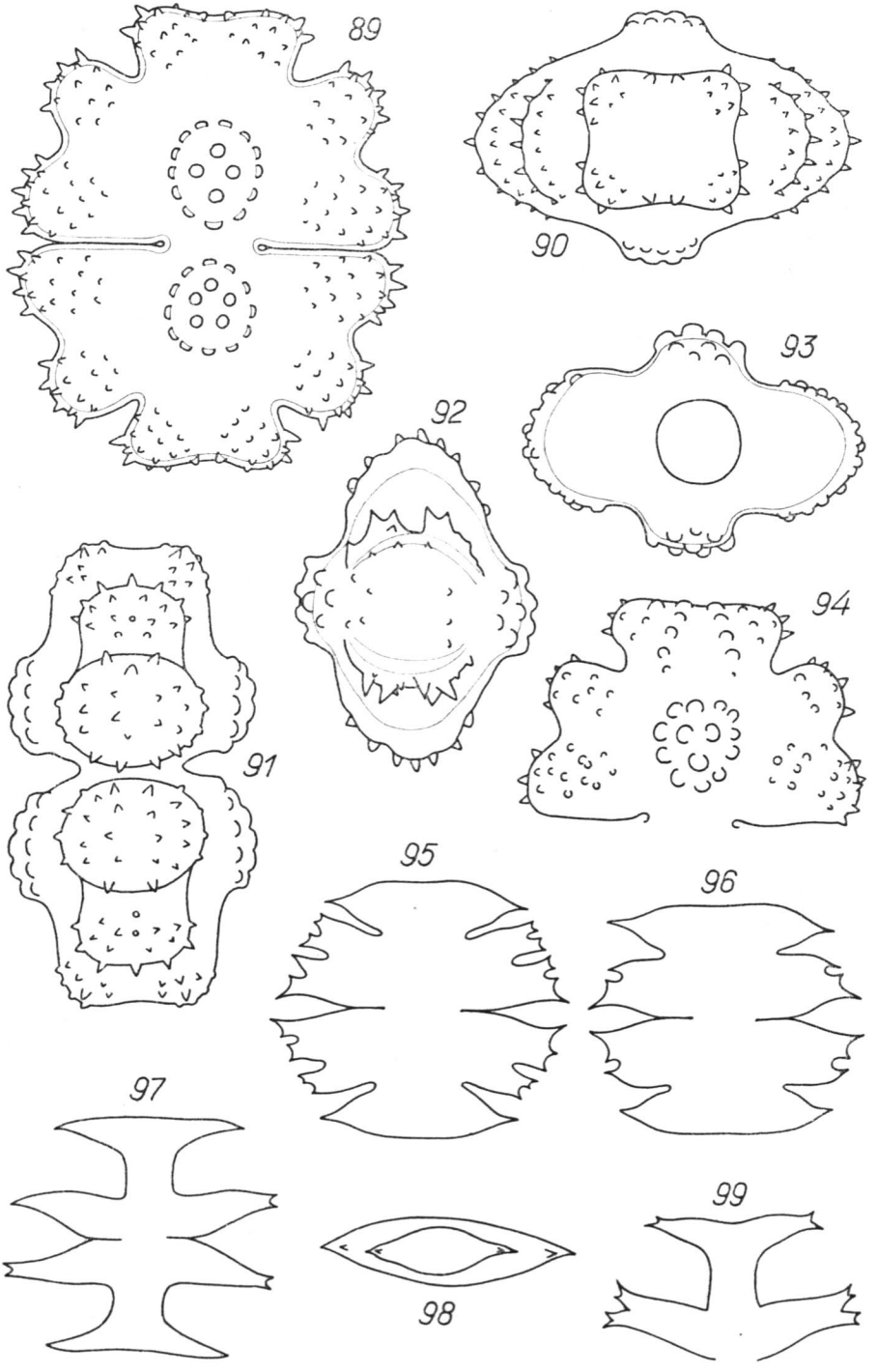
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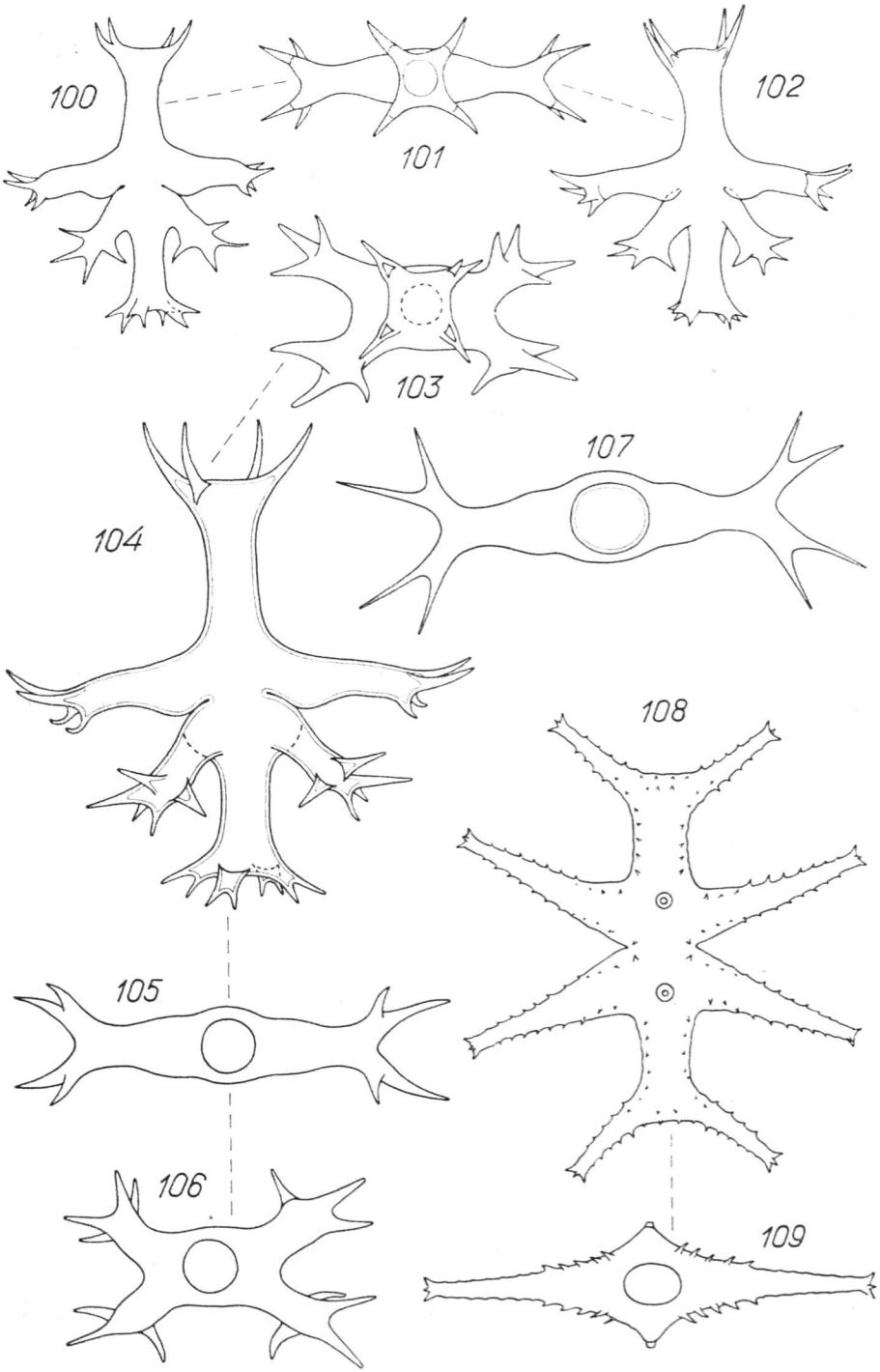
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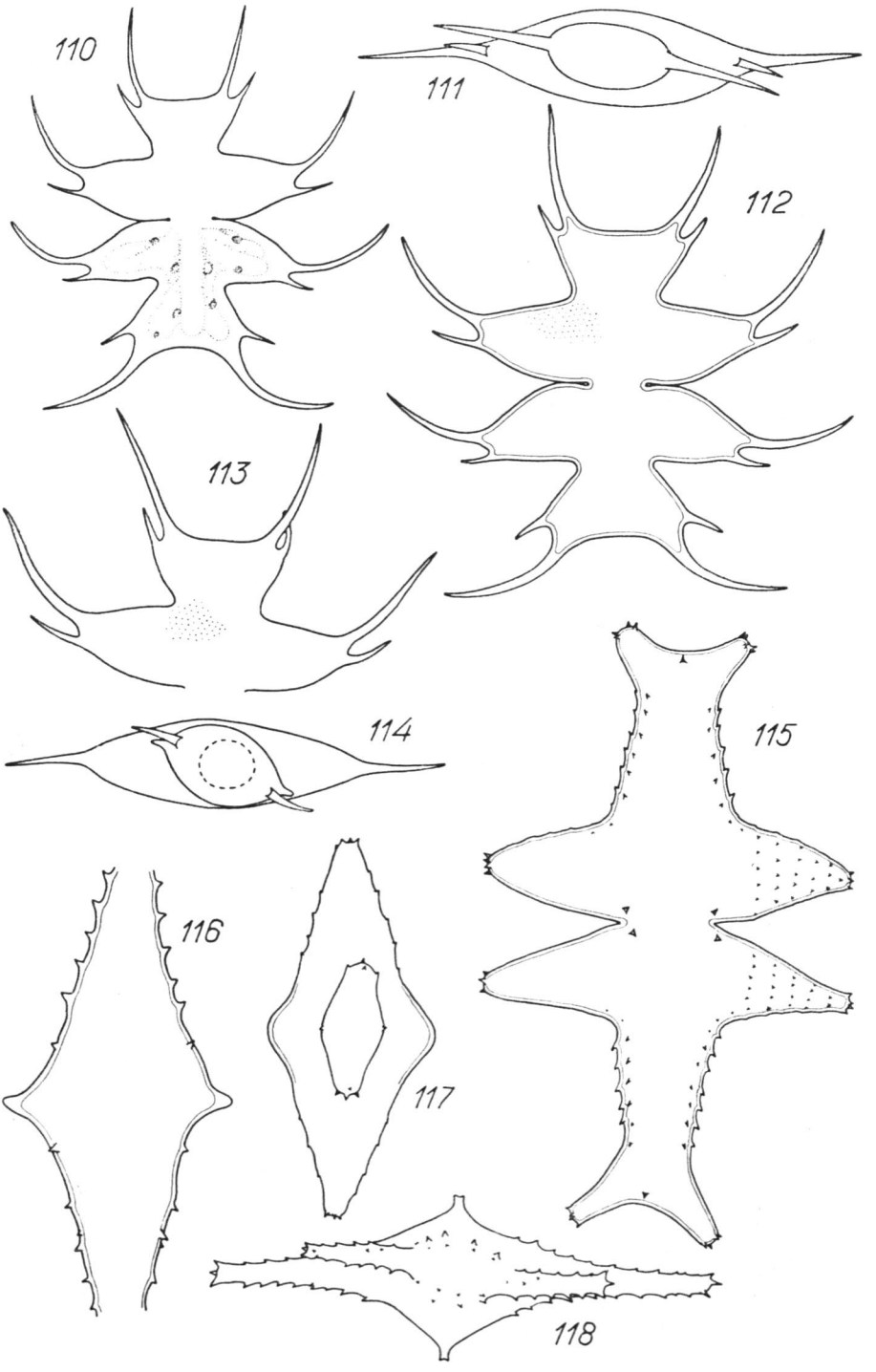
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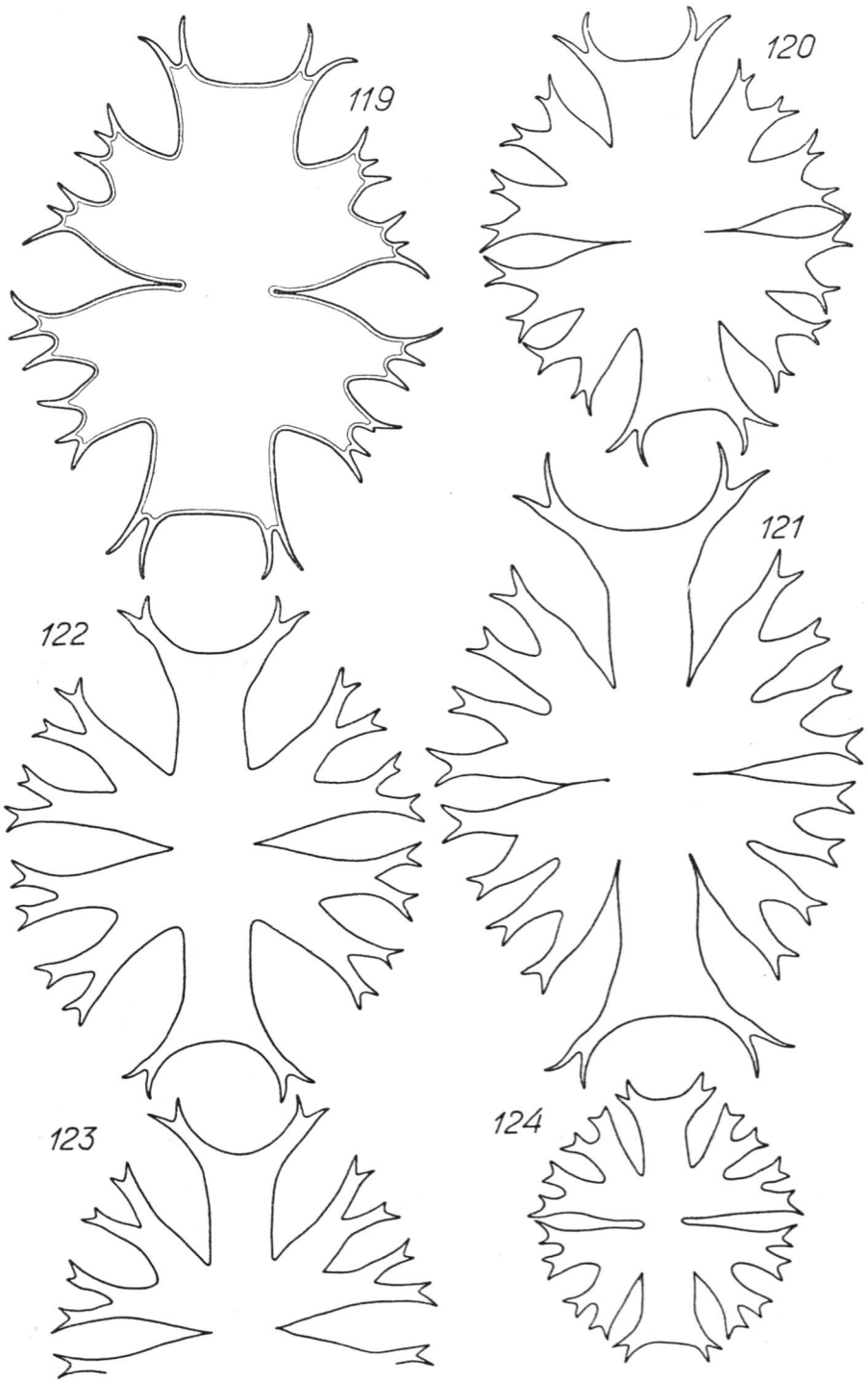
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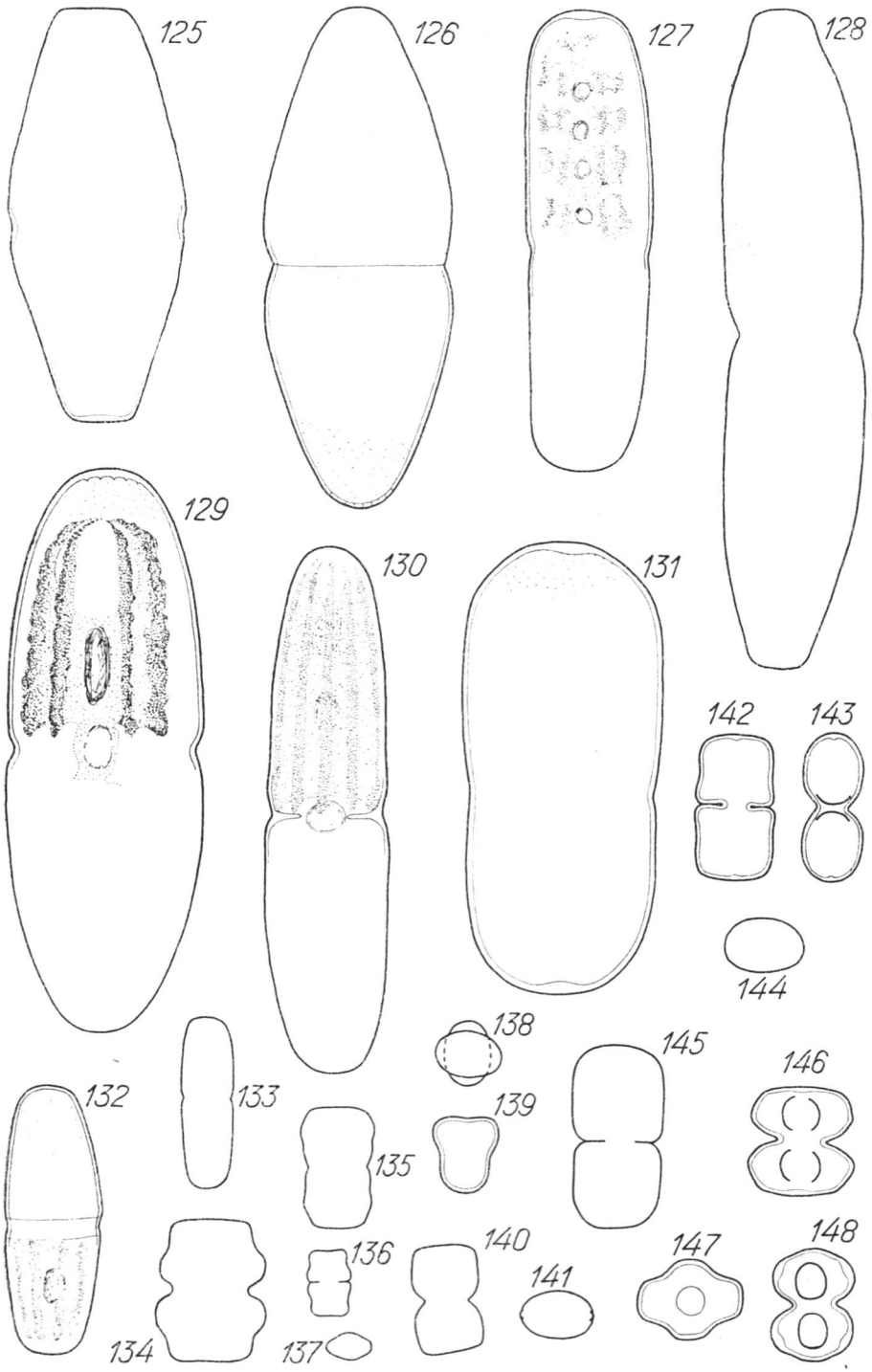
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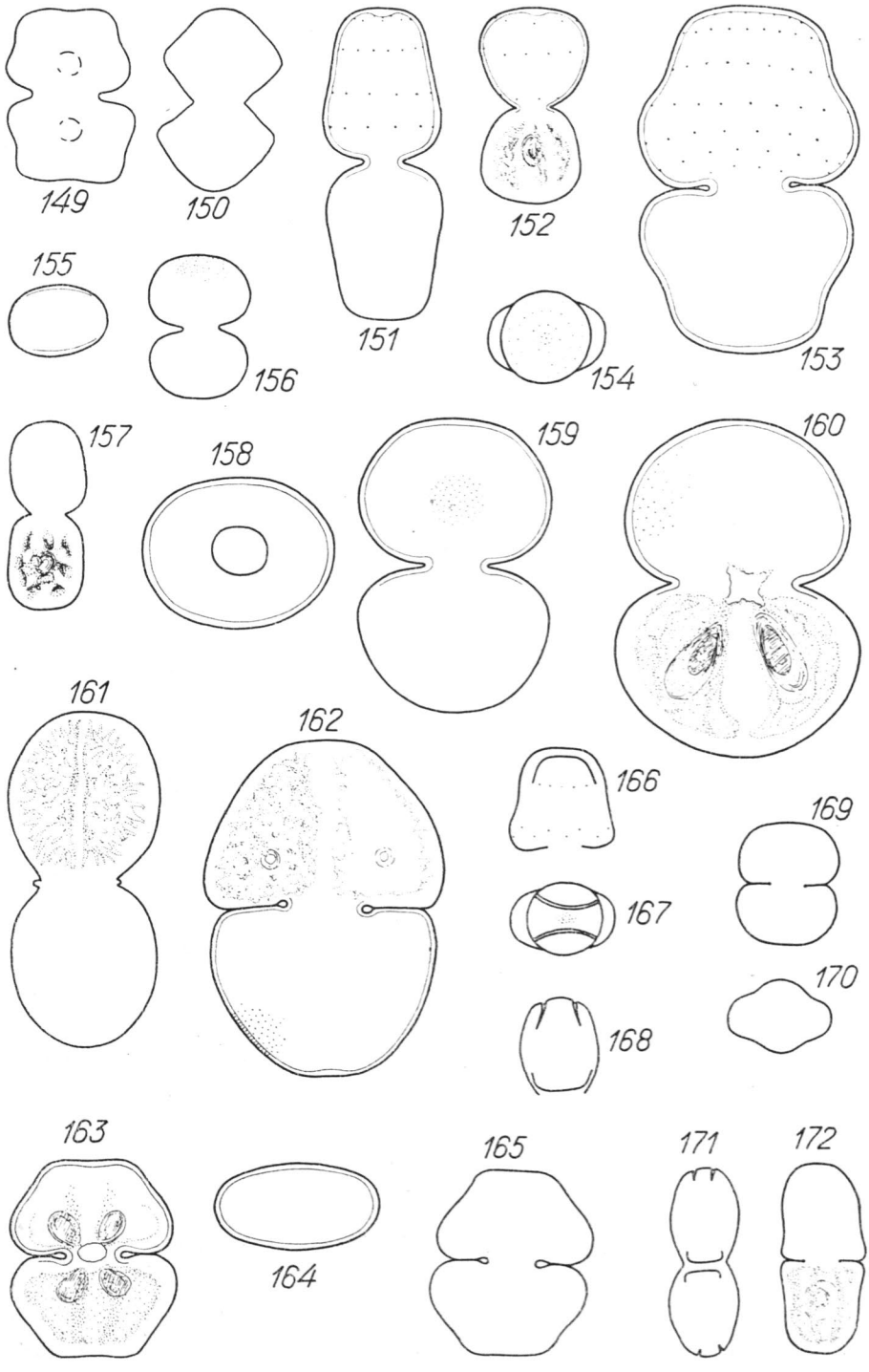
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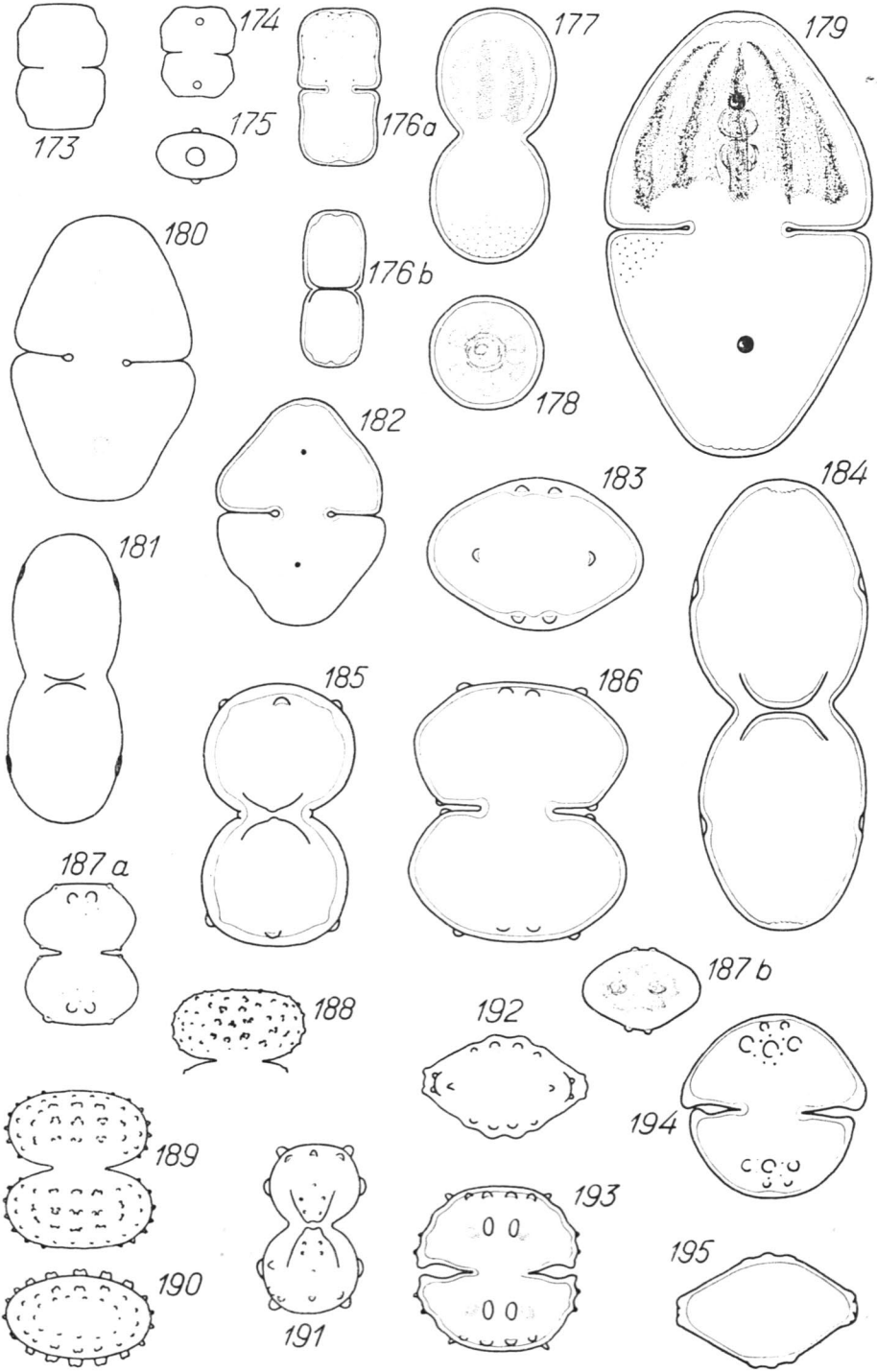
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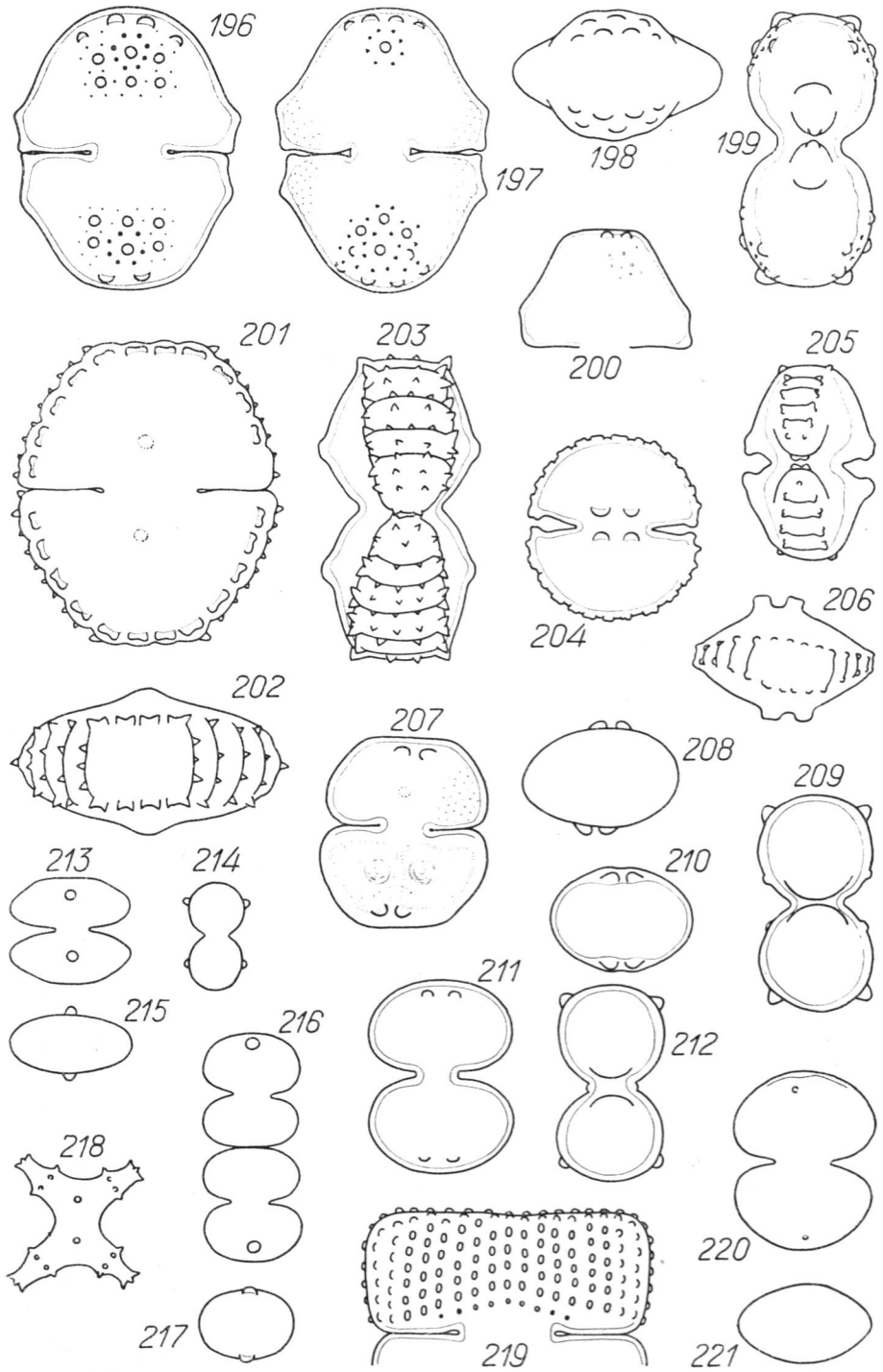
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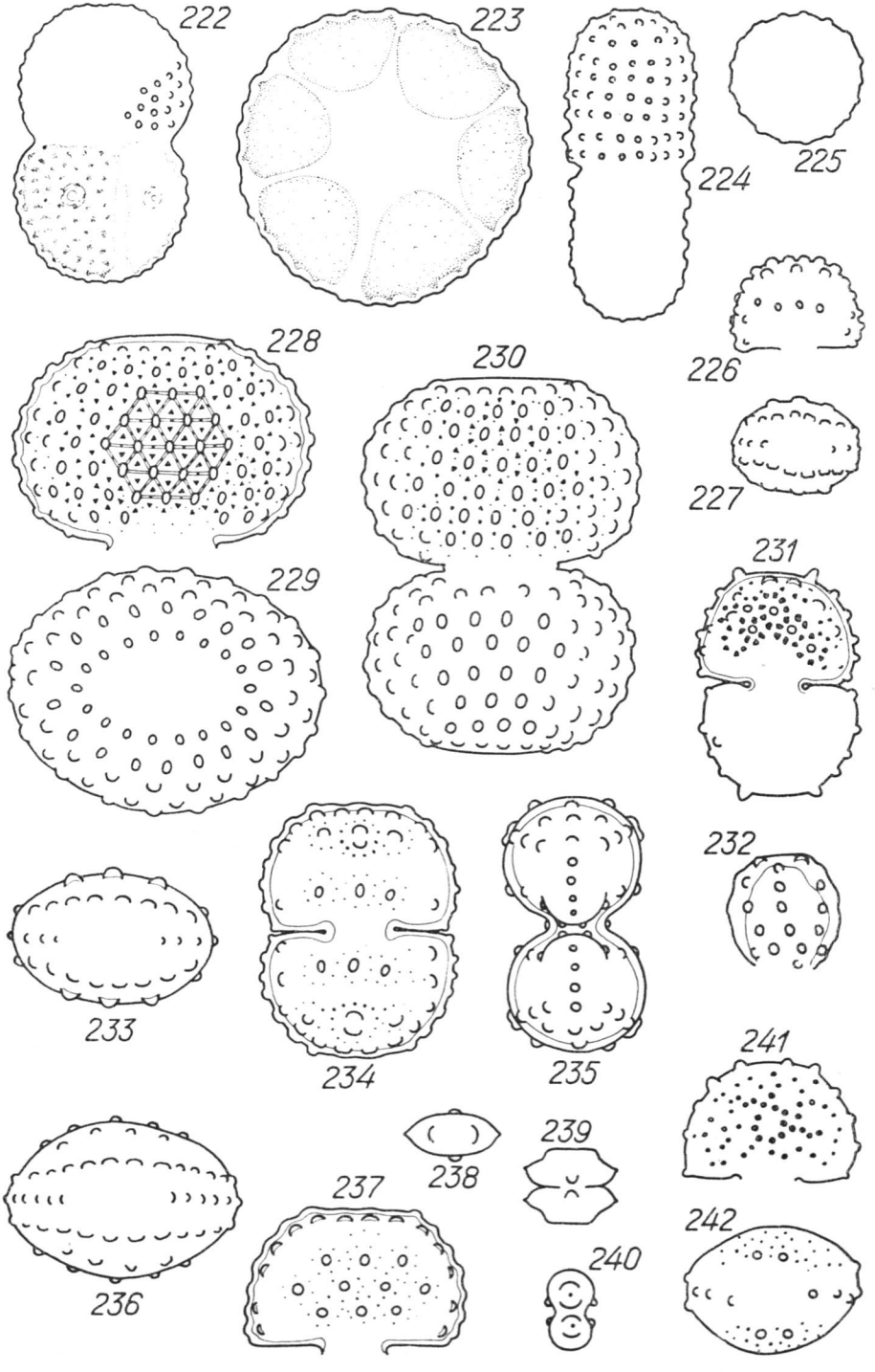
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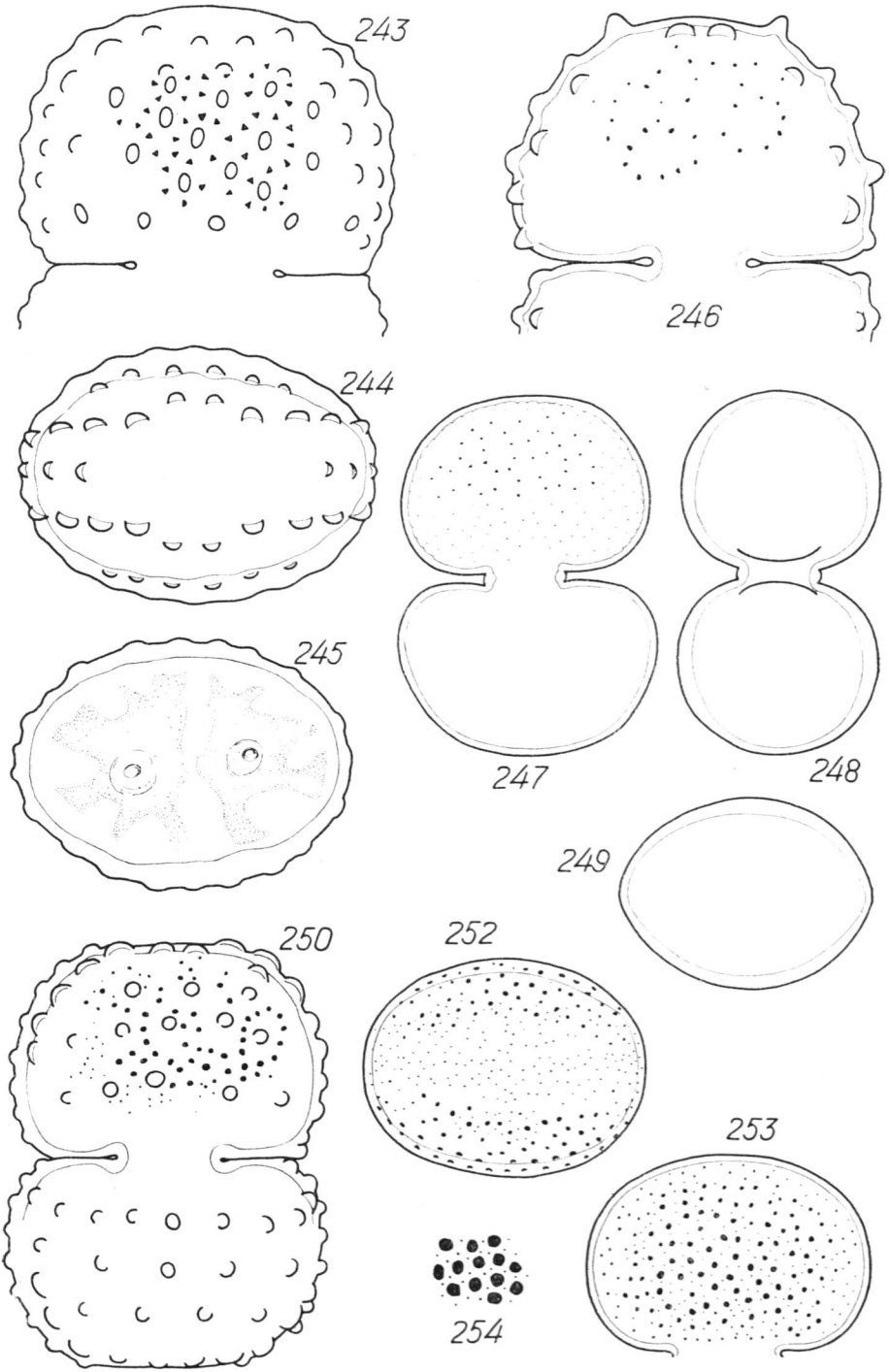
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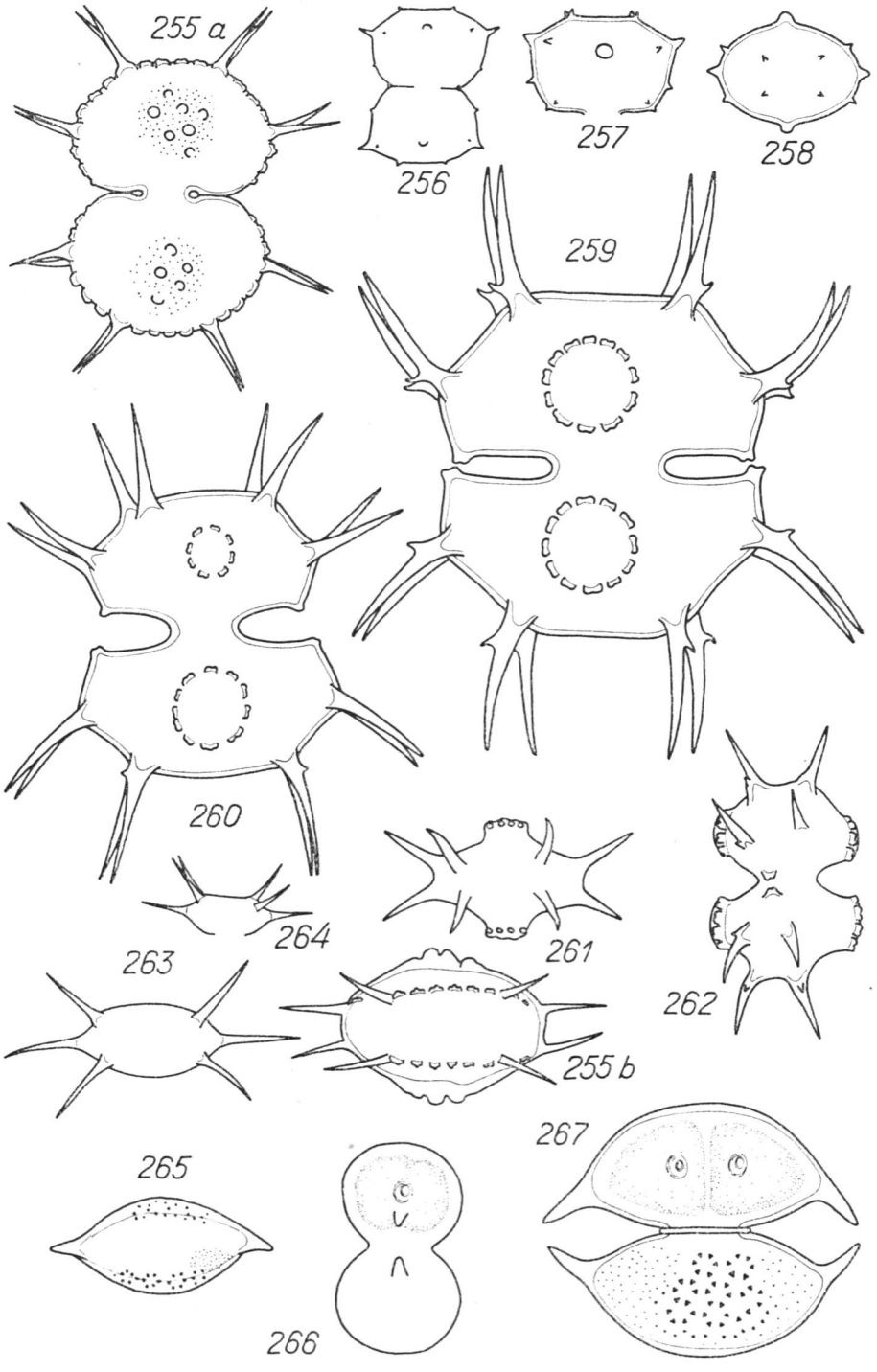
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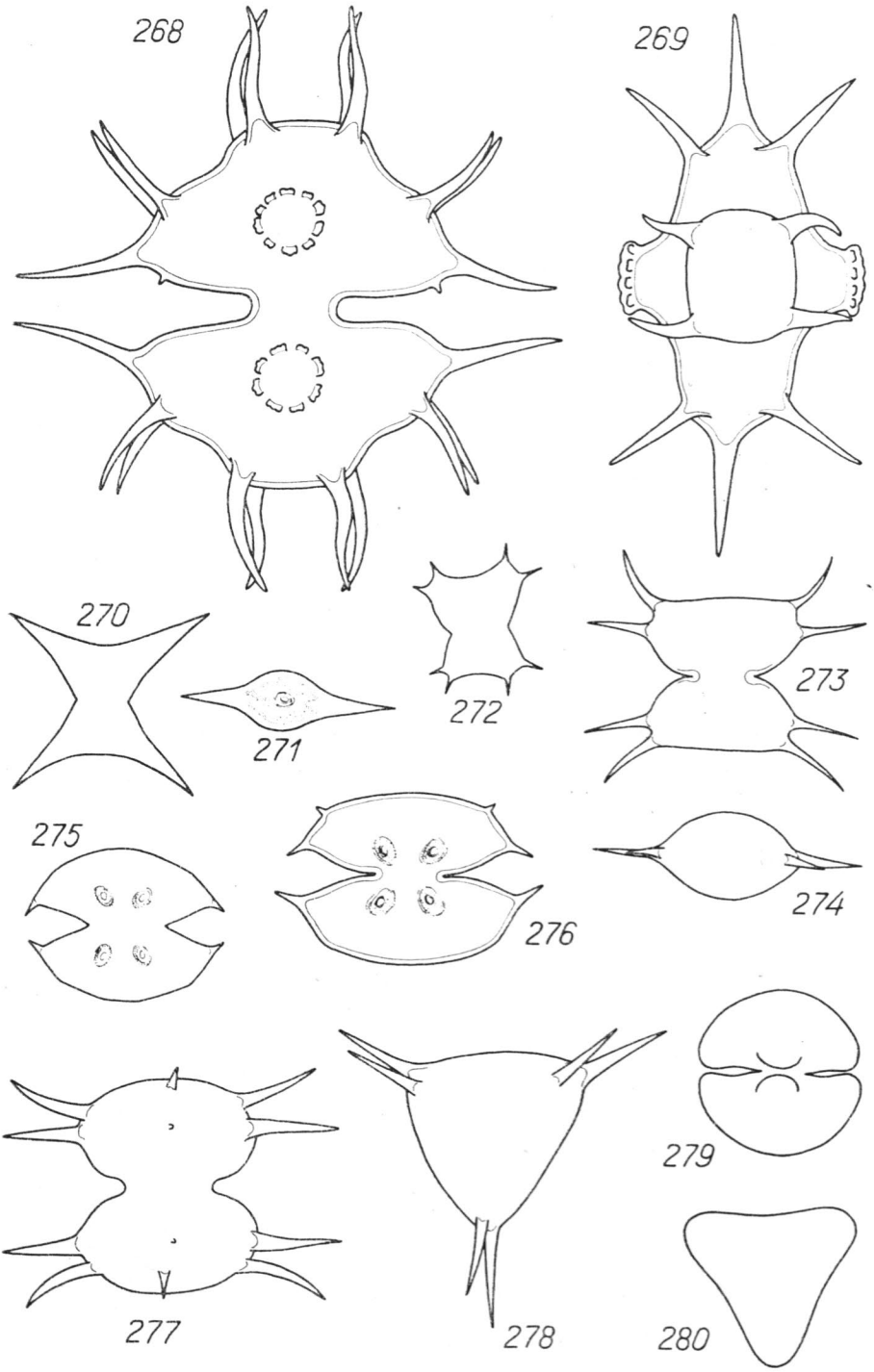
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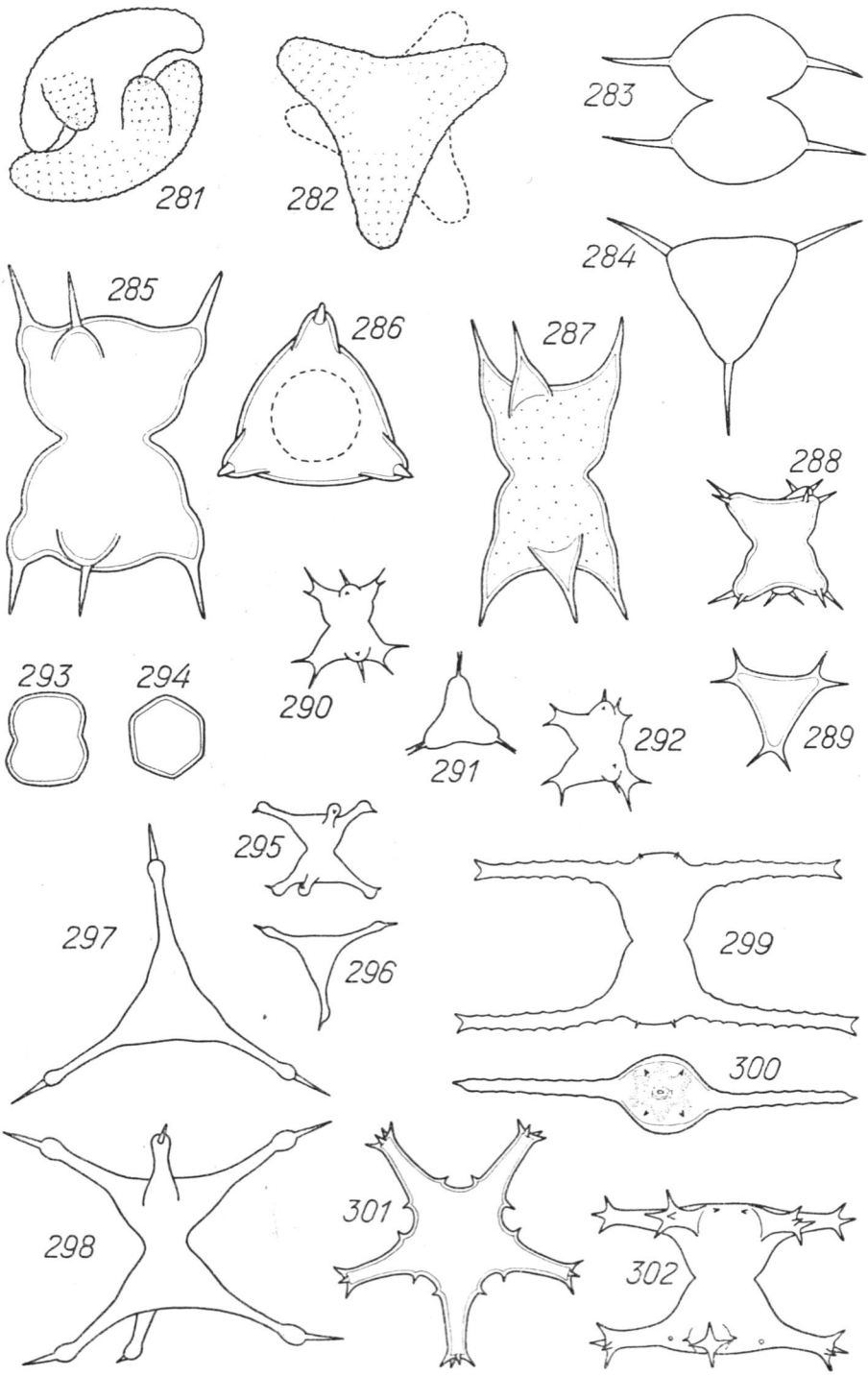
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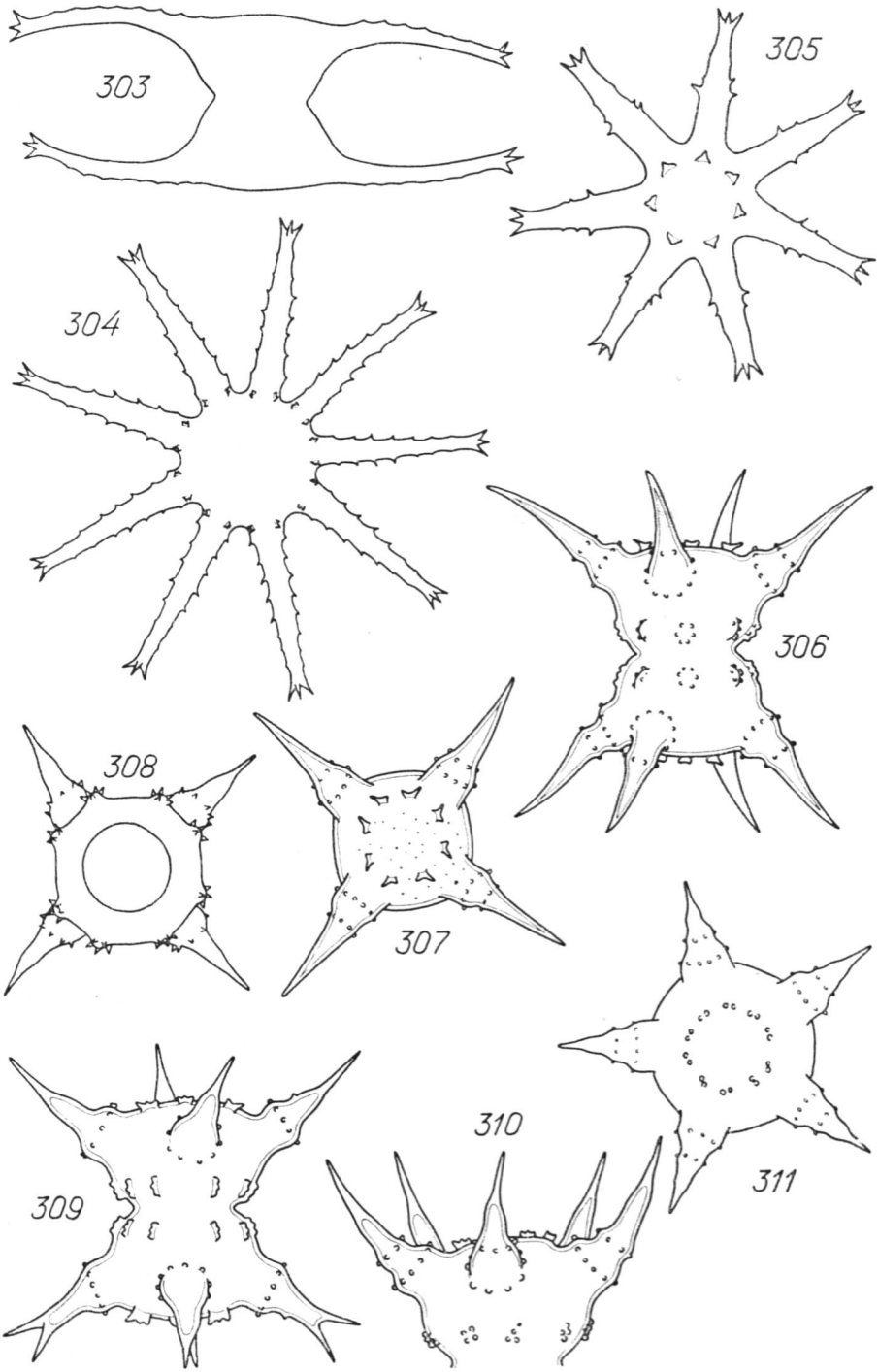
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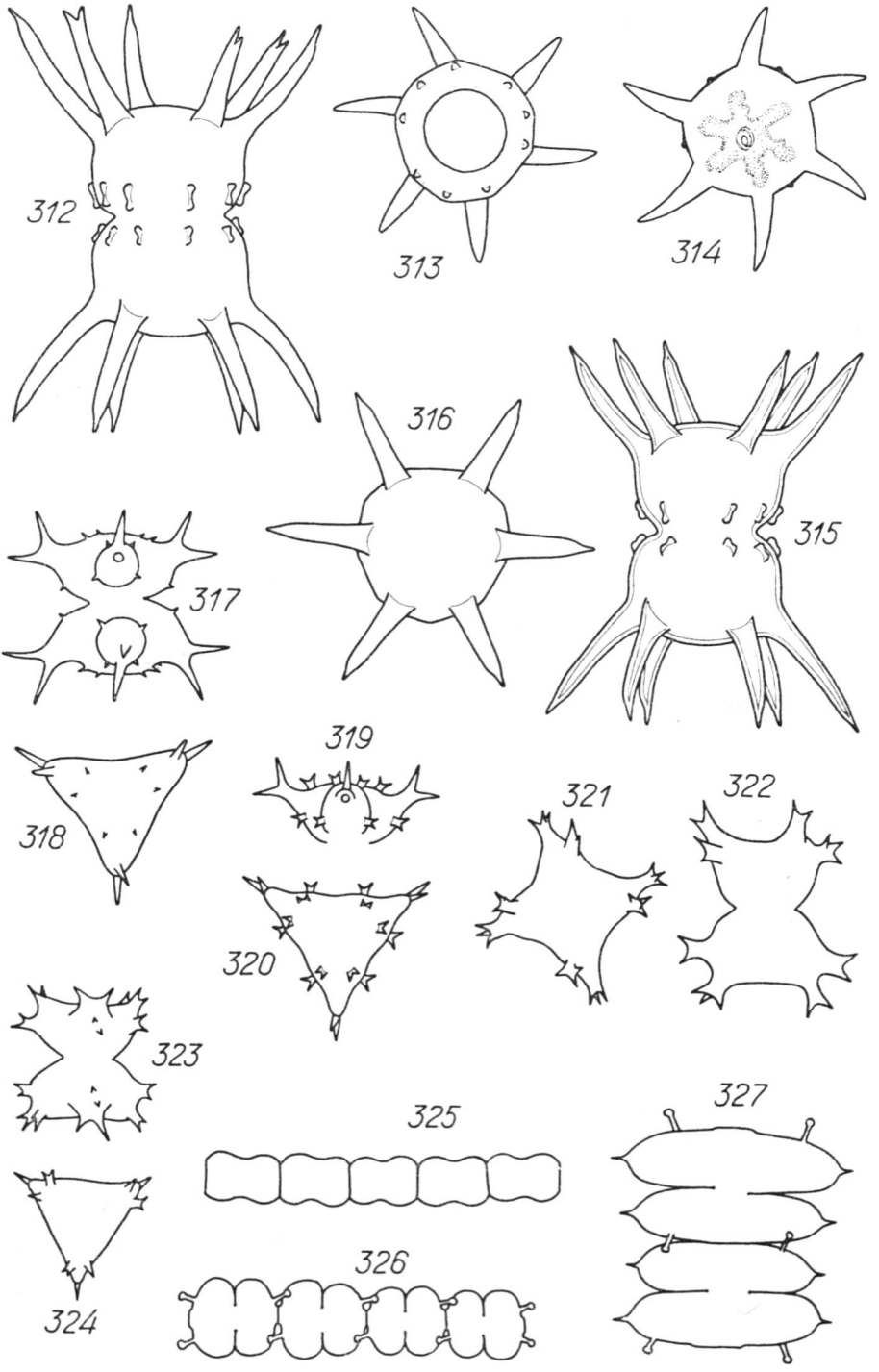
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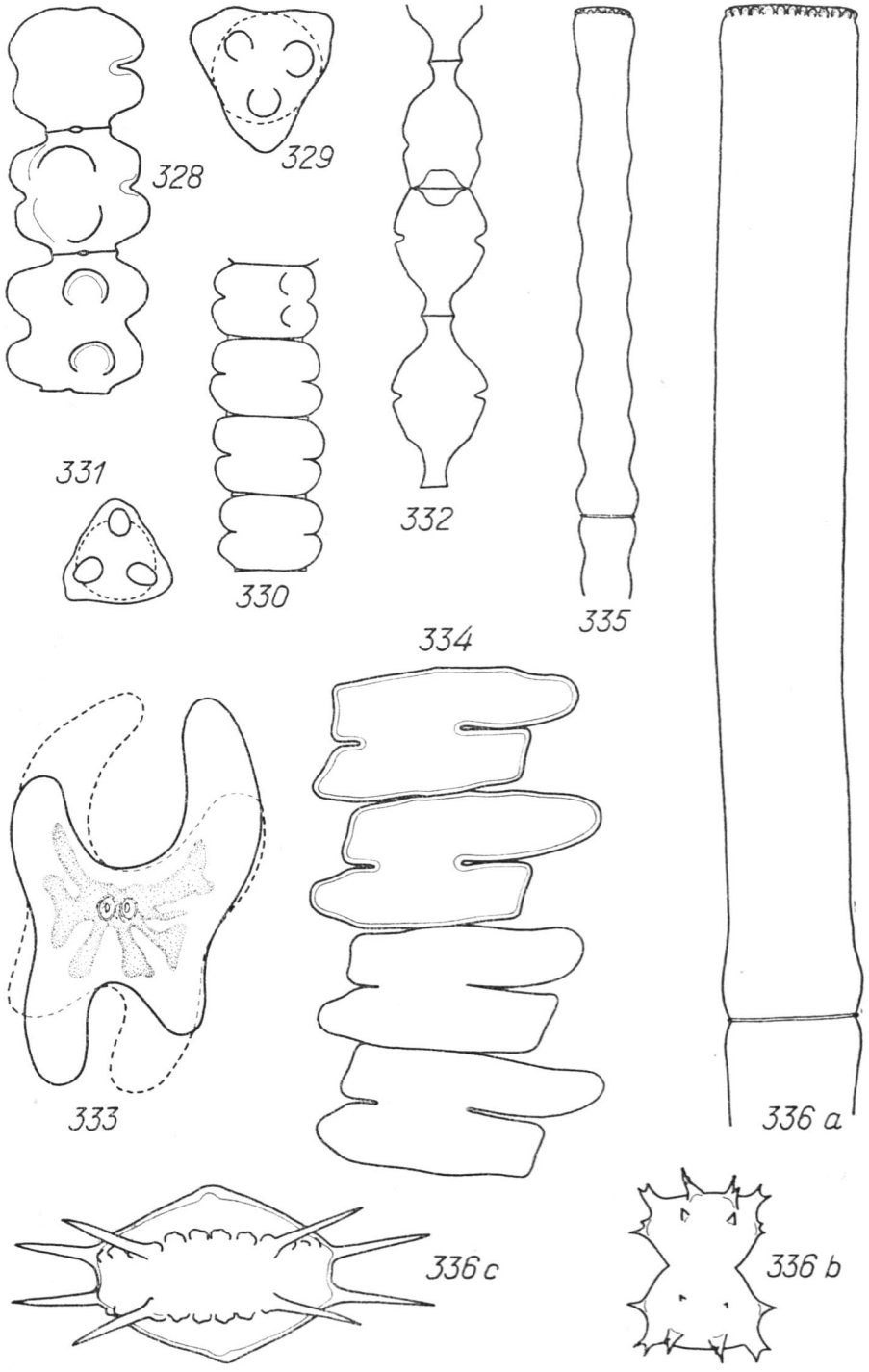
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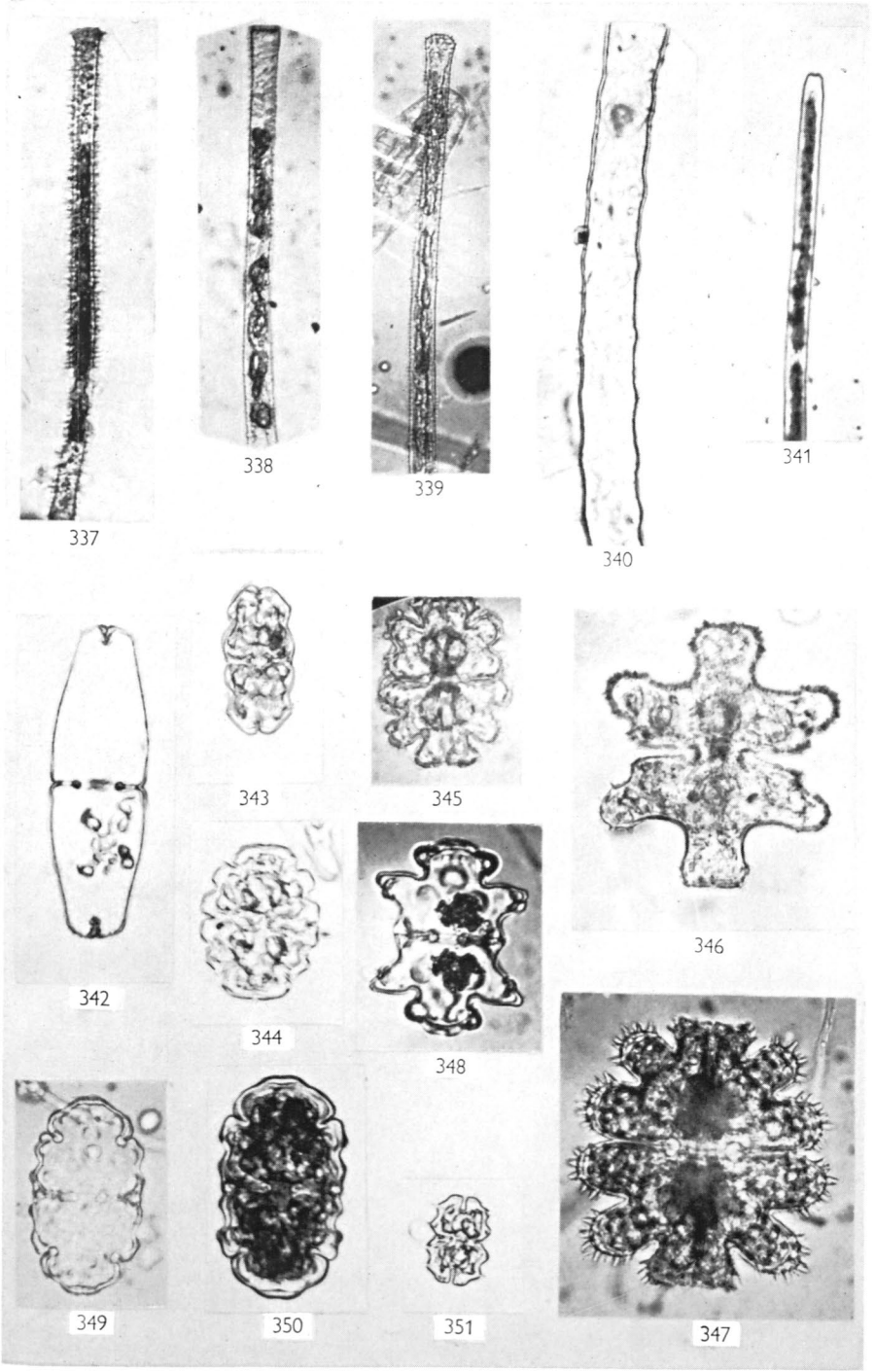
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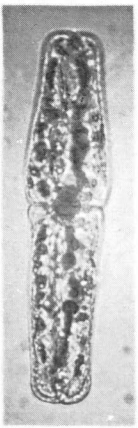

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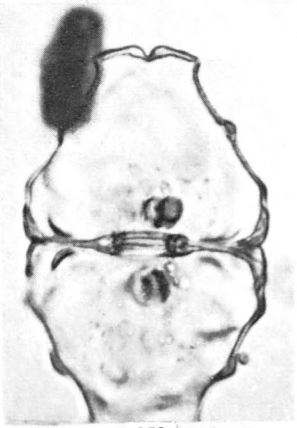

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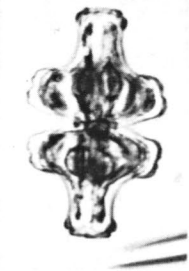

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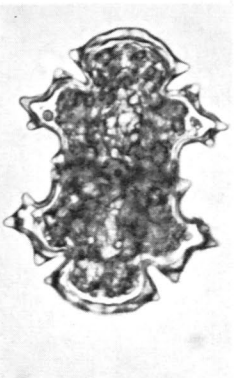

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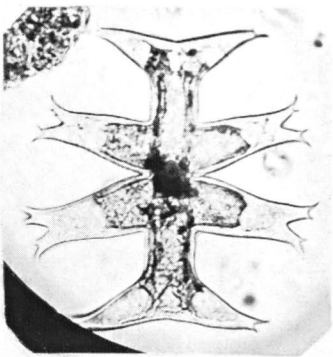

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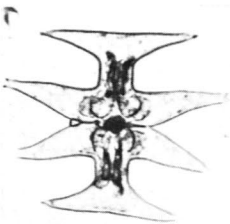

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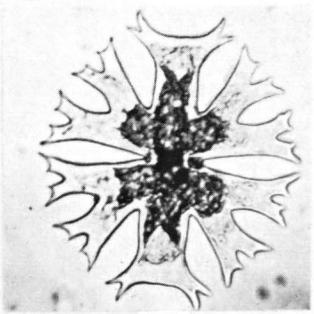

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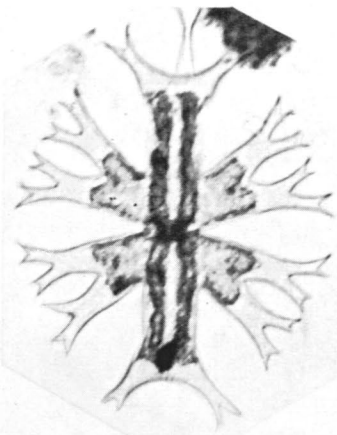

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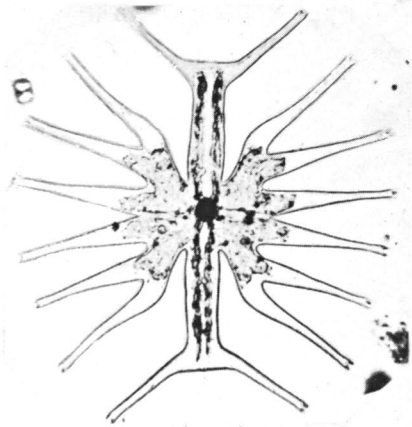

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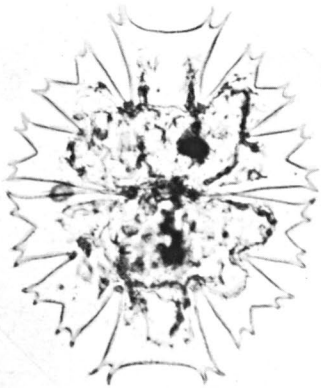

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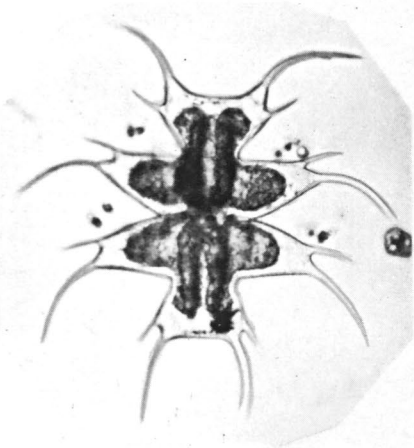

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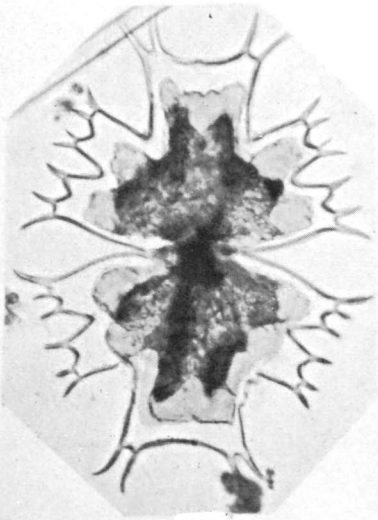

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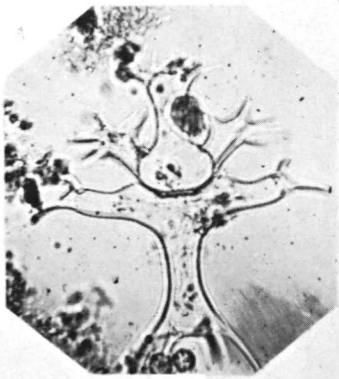

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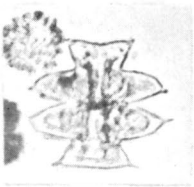

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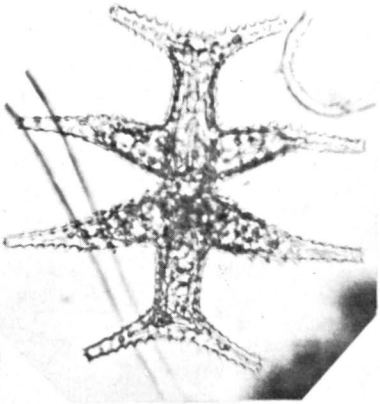

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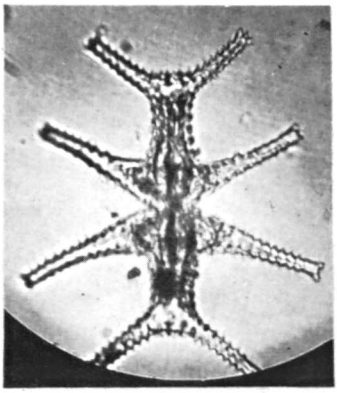

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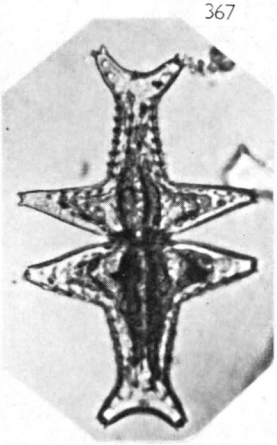

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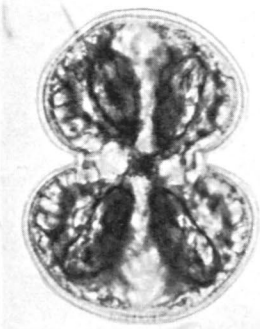

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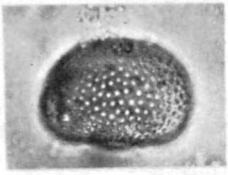

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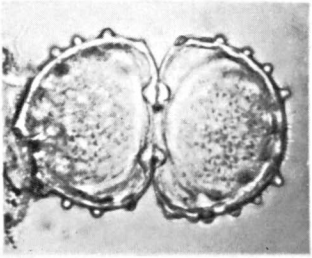

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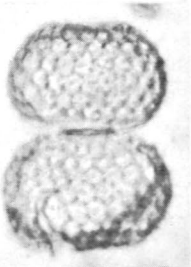

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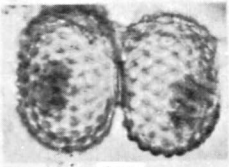

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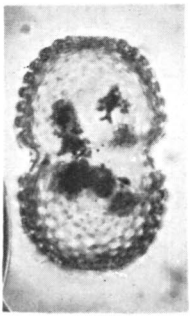

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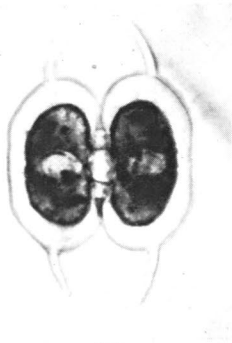

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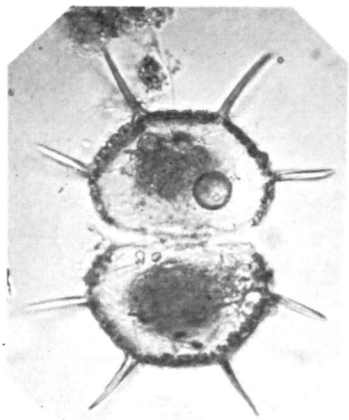

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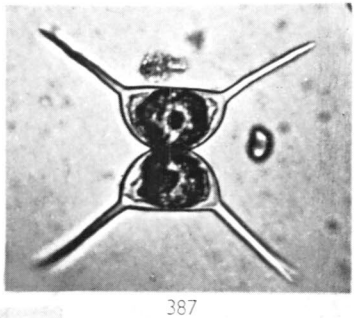
384 a

384 b.

384 c.

386



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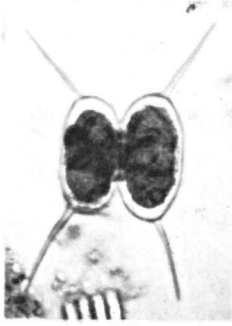

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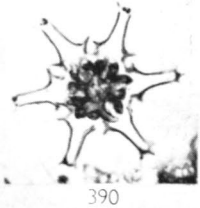

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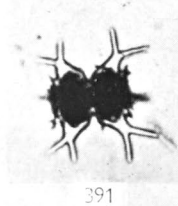

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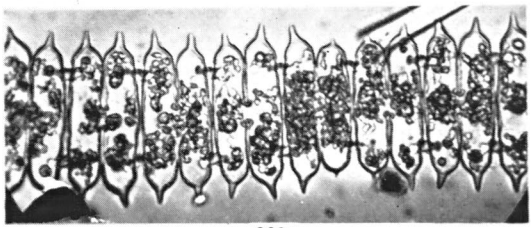

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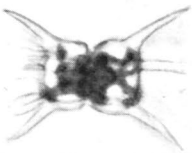

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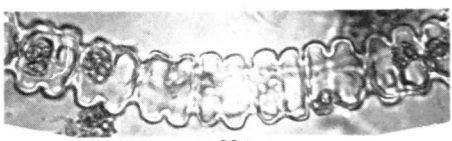

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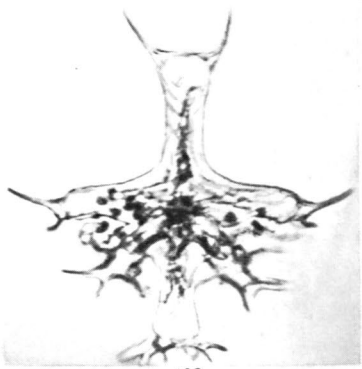

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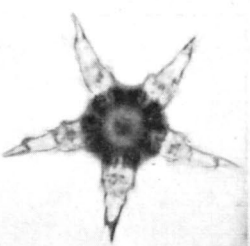

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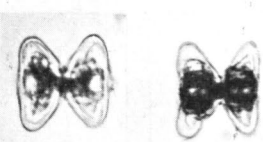

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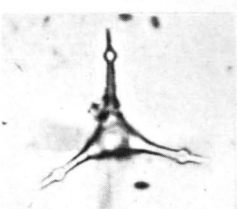

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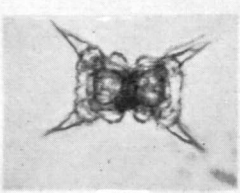

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