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Proceedings of the Royal Society of Edinburgh / Volume 16 / January 1890, pp 449 - 692

DOI: 10.1017/S0370164600006489, Published online: 15 September 2014

Link to this article: http://journals.cambridge.org/abstract_S0370164600006489

How to cite this article:

John Rattray (1890). A Revision of the Genus *Coscinodiscus* and some Allied Genera. . Proceedings of the Royal Society of Edinburgh, 16, pp 449-692 doi:10.1017/S0370164600006489

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A Revision of the Genus *Coscinodiscus* and some Allied Genera. By John Rattray, M.A., B.Sc., F.R.S.E. (With Three Plates.)

(Read June 17, 1889.)

The present paper is a continuation of my monographs already published by the Royal Microscopical Society, London, in their Journals for June and December 1888. It has been carried out under similar conditions in the Botanical Department of the British Museum (Natural History), South Kensington, but I am especially indebted to Edmund Grove, Esq., F.R.M.S., for much valuable co-operation, and to Julien Deby, Esq., for the readiness with which he has placed at my command the resources alike of his library and cabinet. Herr E. Weissflog and Dr James Rae, R.N., have also furnished me with many excellent preparations.

COSCINODISCUS, Ehrb. emend., *Ehrb. Abh. Ber. Ak.*,
1838, p. 128.

Valve circular, rarely regularly or bluntly and irregularly angular. Surface flat, often somewhat depressed at centre, and convex towards border, or with alternate subcentral elevations and depressions, more rarely with a sharply-defined elevated zone, or with one or more concentric low undulations. Colour transparent or smoky grey, sometimes with concentric zones of different brilliant hues. Central space angular or round, hyaline, or with a few isolated granules; rarely apiculate, sometimes indistinct, or replaced by a conspicuous or less evident rosette. Markings round and granular or angular, sometimes punctiform; the central papillæ prominent, obscure, or absent; rows radial or subradial, often in straight or curved fasciculi, those in each fasciculus parallel to that at its centre or side; secondary rows often oblique, curved or straight and decussating, more rarely regularly or irregularly concentric; the opposite valves of a frustule sometimes dissimilar; interspaces of varying size, usually largest towards centre or opposite the shorter rows, often absent. Apiculi few or many, scattered at irregular intervals over the surface, or forming one or more circlets near the border; some-

times only one present, robust and spine-like, with blunt extremities inserted at or near inner edge of border, more rarely at some distance from it; a small hyaline space sometimes present around the base of each. Border narrow or broad, hyaline or striated, the striæ sometimes faint.—*Symbolophora*, Ehrb., *pro parte*, *Mon. Ber. Ak.*, 1844, p. 74; *Endictya*, Ehrb., *ibid.*, 1845, p. 71; *Odontodiscus*, Ehrb., *pro parte*, *ibid.*, 1845, p. 72; *Heterostephania*, Ehrb., *Microg.* (plates), p. 15; *Cestodiscus*, Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 48; *Cosmiodiscus*, Grev., *ibid.*, 1866, p. 79; *Stoschia*, Janisch., van Heurck, *Syn. Diat. Belg.*, Explan. pl. cxxviii. fig. 6; *Janischia*? Grun., Van Heurck, *ibid.*, Explan. pl. xcv. *bis* figs. 10, 11; *Micropodiscus*, Grun., *Denk. Wien. Ak.*, 1884, p. 79; *Willemoesia*, Cstr., *Diat. Chall. Exped.*, 1886, p. 165; *Ethmodiscus*, Cstr., *ibid.*, p. 166.

§ I. INORDINATI.

Round or elongately elliptical. No rosette; a central space rarely present, sometimes excentric. Markings punctiform, granular or areolate, without order.

C. exasperans, sp. n. Sch., *Atl.*, pl. lviii. fig. 9 (no name).—Diam. about .018 mm. Central space and rosette absent. Markings small, round, granular, slightly smaller near the border; interspaces hyaline, largest towards the centre; non-apiculate. Border sharply defined, hyaline.

Habitat.—Monterey (Schmidt).

C. dimorphus, Cstr., *Diat. Chall. Exped.*, p. 157, pl. xvii. fig. 6.—Diam. .0225 mm. Central space absent. Markings punctiform, irregular, sometimes most crowded towards the centre, and few on a narrow band around the border or conversely, those of the two valves of a frustule dissimilarly arranged. Border sometimes distinct.—Sch., *Atl.*, pl. lvii. fig. 1 (no name).

Distinguished from *C. marginulatus* by the smaller number of markings and the absence of apiculi. Some valves approach the minute *Cyclotella pumila*, Cleve (Van Heurck, *Syn. Diat. Belg.*, pl. xciv. fig. 16).

Habitat.—South Atlantic, H.M.S. Challenger (Castracane); Sandwich Islands (Schmidt).

C. subnitidus, sp. n. Sch., *Atl.*, pl. lviii. fig. 16.—Diam. about .11 mm. Surface convex. Central space absent. Markings large, rounded, granular, with subequal hyaline interspaces. Border broad, not sharply defined on inner edge; striæ coarse, 4 to 5 in .01 mm.

Distinguished from *C. nitidus* by the more convex surface and the long striæ upon the border.

Habitat.—Springfield deposit, Barbados (Schmidt).

C. confusus, sp. n. Sch., *Atl.*, pl. lxiv. fig. 15 (no name).—Diam. .053 mm. Central space small, indefinite, rounded, rosette absent. Markings small, rounded, granular, most crowded towards the border, with interspaces irregular, largest towards the centre; disposed without order, but short irregularly oblique, straight, or slightly curved rows manifest. Border sharply defined, about $\frac{1}{4}$ of radius broad, hyaline.

Habitat.—Campeachy Bay (Schmidt).

C. sphaeroidalis, sp. n.—Diam. .045 mm. Central space absent; a subcircular space, having a few isolated round granules and about .0075 mm. broad, placed close to the border at one side of the valve. Markings round, granular, 5 in .01 mm., in rows radiating and diverging around the excentric space, separated by hyaline lines and not traceable at a distance greater than the radius from the edge of this space, on the lunate area at the opposite side of the valve smaller, and in curved oblique rows, towards the the border punctiform in evident regular oblique, decussating rows. Border narrow, striæ 8 to 10 in .01 mm.—(Pl. I. fig. 15.)

Habitat.—Monterey (Weissflog!).

Var. *cineta*. Sch., *Atl.*, pl. lviii. fig. 6.—Diam. about .07 mm. No distinct excentric hyaline space. Markings on one half of valve less sharply separated from those on remaining half, the rows of larger granules more straight. Border broad, sharply defined; oblique decussating rows evident.

Schmidt has regarded this as a probable abnormality, but it is clearly to be associated under one species with the similar valves from Monterey.

Habitat.—Springfield deposit, Barbados (Weissflog).

C. inexpectatus, sp. n. *Coscinodiscus* (?) sp. (?), Cstr., *Diat. Chall. Exped.*, p. 163, pl. x. fig. 10.—Elliptical; major axis $\cdot 143$ mm. about $1\frac{1}{2}$ times minor. Central space absent. Markings rounded, granular, 4 to 5 in $\cdot 01$ mm. A distinct hyaline band adjacent to the border, about $\frac{1}{2}$ of major axis broad, its inner edge somewhat irregular. Border narrow, hyaline.

This species forms the transition to the genus *Willemoesia*, Cstr. (*ibid.*, p. 165, pl. viii. fig. 8), which is not sufficiently distinct from *Coscinodiscus* to be separated from it.

Habitat.—Zebu, Philippine Islands (Rae).

C. tenuisculptus, sp. n. *Stoschia?* *punctata*, Grove and Sturt, *Journ. Quek. Micr. Cl.*, 1887, p. 145, pl. xiv. fig. 52.—Elongately elliptical, the sides subuniformly curved, or with evident local constrictions; length, $\cdot 1375$ mm., about 7 times the greatest breadth; surface slightly convex. Central space absent. Markings small, free round brilliant granules, with wide hyaline unequal interspaces disposed subuniformly over the general surface. Border narrow, but sharply defined.

Habitat.—Oamaru (Grove!).

C. humilis, sp. n. *Willemoesia* sp., Cstr., *Diat. Chall. Exped.*, 1886, p. 165, pl. viii. figs. 8, 8a, 8b.—Elongately elliptical; the sides slightly concave to convex; extremities unequally obtuse; length $\cdot 0625$ to $\cdot 125$ mm., from 7 to 11 times greatest breadth. Surface slightly convex. Central space absent. Markings small, round, granular, most crowded towards the border, sometimes leaving an irregular elongate hyaline area at the middle, or punctiform and closely arranged. Border narrow, hyaline.

Distinguished from *C. tenuisculptus* by the general appearance and arrangement of the markings.

Habitat.—(?) (Castracane).

C. cinctus, Kütz. *Bacil.*, p. 131, pl. i. fig. 17.—Diam. $\cdot 0835$ mm. Surface flat towards the centre, convex near the border. Central space absent. Markings round, granular, crowded towards the centre; elsewhere remote, scattered. Border distinctly defined, striæ interrupted at the middle.—Ralfs, in *Pritch. Inf.*, p. 831;

C. patina,* Bail., *Amer. Journ. Sci.*, 1843, vol. xlii. p. 96, pl. ii. figs. 13 a, b.

Seychelle specimens, .048 mm. diam., have 10 striæ in .01 mm. on the border.

Habitat.—Richmond deposit, Va. (Bailey); mud from Elbe, at Cuxhaven (Kützing); Seychelles, Mauritius, and Tonga Islands (Cleve and Grunow).

C. impolitus, sp. n. *C. antarcticus*, Cstr. (non Grunow), *Diat. Chall. Exped.*, p. 157, pl. xii. fig. 10.—Diam. .055 mm. Central space absent. Markings punctiform, closely and uniformly disposed; apiculi minute but evident, scattered over the surface at wide subregular intervals. Border narrow, hyaline.

This species approaches very close to *Melosira Borreri*, Grev. (= *M. moniliformis* and *M. lineata*, Ag.) (Van Heurck, *Syn. Diat. Belg.*, pl. lxxxv. fig. 7).

Habitat.—Heard Island, H.M.S. Challenger (Castracane).

C. insutus, sp. n. Sch., *Atl.*, pl. lvii. fig. 2 (no name).—Diam. .024 mm. Central space absent. Markings punctiform, irregular, not crowded; interspaces wide, hyaline; a cirlet of long narrow curved apiculi inserted a considerable distance within border. Border broad, sharply defined; striæ robust, 4 in .01 mm.

Habitat.—Sansego (Schmidt).

C. granulatus, Grun. *Kongl. Sv. Vet.-Ak. Handl.*, Stockholm, 1880, No. 2, p. 113, pl. vii. fig. 130.—Diam. .016 to .033 mm.; Surface not depressed at centre. Central space absent. Markings punctiform; most crowded, largest, and most evident towards the centre; apiculi at the border minute, 3 in .01 mm. Border relatively broad—about .0025 mm., sharply defined; striæ 17 to 18 in .01 mm.—*Odontodiscus granulatus*, Grun., *ibid.*, p. 113. (Pl. I. fig. 23.)

This species approaches *C. cinctus*, Kütz., but in the latter the central puncta are coarser, the apiculi are absent, and the border striæ stronger. Finmark specimens have been observed ornamented towards the centre with radiating curved faint lines instead of isolated granules, thus forming a transition to *C. marginulatus*.

* Name preoccupied by Ehrenberg in 1838.

There is systematic convenience in retaining *C. granulatus*, *C. marginulatus*, and *C. cinctus* as distinct species, though transitions occur.

Habitat.—Adria, Seychelles, Finmark (Cleve and Grunow); Quarnero (Van Heurck); Maasö, Finmark (Cleve and Möller!); Greenland (Cleve!); Kara (Cleve).

Var. conspicua, nov. Sch., *Atl. pl.* lvii. fig. 3 (without name).—Diam. .049 mm. Markings irregular, granular, smaller, and somewhat more crowded towards the border, interspaces wider; apiculi at border conspicuous, large. Border striæ 12 to 13 in .01 mm.—Cleve and Grunow, *ibid.*, p. 113.

Habitat.—Campeachy Bay (?) (Schmidt).

Var. distincta, nov.—Diam. .05 mm. Apiculi absent. Border much more evident; striæ coarse $3\frac{1}{2}$ to 4 in .01 mm.

Habitat.—Crescent City, Cal. (Weissflog!).

C. hirtulus, sp. n. *Cestodiscus (pulchellus, var. ?) hirtulus* Grun., Van Heurck, *Syn. Diat. Belg.*, pl. cxxvi. fig. 3.—Diam. .03 mm. Surface with the central portion extending to about $\frac{2}{3}$ of radius, its outer edge irregularly rounded, sharply defined. Central space and rosette absent. Markings on the central portion round, granular, irregular; a few larger triangular dark specks towards the centre, the outer portion with evident subregular striæ, 9 in .01 mm.; apiculi 8, at subequal intervals, inserted at the outer edge of the central portion. Border sharply defined, about $\frac{1}{3}$ of radius broad.—*Cestodiscus pulchellus*, Habirsh., *Cat. Diat.*, ed. 2, 1885, § *Cestodiscus*.

Habitat.—Naparima deposit, Trinidad (Van Heurck).

C. subareolatus, sp. n.—Diam. about .125 mm. Surface flat. Central space absent. Markings faint, areolate from the centre to about the semiradius, beyond this only indistinctly visible at intervals; on the outer $\frac{1}{3}$ of the radius closely disposed, distinct, radial slightly flexuous, sometimes irregular, subpruinose lines with clear linear interspaces evident. Border?—(Pl. I. fig. 10.)

Fragmentary, the outer portion of the valve being removed close to the border.

Habitat.—Gazelle Expedition (Weissflog!).

C. turgidus, sp. n. *C. velatus*, Sch., *Atl.*, pl. lxii. fig. 10.—Diam. .0375 to .0625 mm. Surface flat at the centre, convex towards the border. Central space absent. Markings polygonal, largest at the centre, decreasing rapidly towards the border; at the centre 3, at the border 6 in .01 mm. Border with inner edge indistinct; striæ coarse, irregular.

Habitat.—Springfield deposit, Barbados (Schmidt, Firth!) * Richmond, Va. (Schmidt); Cambridge deposit, Barbados (Kinker, O'Meara!) "Barbadoes" (Johnson!† O'Meara); Bridgewater, Barbados (Johnson!).†

C. anastomosans, Grun., *Denk. Wien. Ak.*, 1884, p. 75.—Diam. .18 mm. Central space hyaline, irregular. Markings unequal, varying from .002 to .02 mm. in length, and forming an irregular network of anastomosing costæ.

Grunow justly regards this as probably abnormal. He is inclined to associate it with *C. oculus-iridis*, or some allied species.

Habitat.—Santa Monica deposit (Grunow).

C. irregularis, sp. n. *C. ? pacificus*, ‡ *Cstr.*, *Diat. Chall. Exped.*, p. 158, pl. viii. fig. 5; pl. xxii. fig. 1.—Diam. .087 mm. Central space absent. Markings polygonal, unequal, from $2\frac{1}{2}$ to 3 in .01 mm.; smaller towards the border. Border distinct, about $\frac{1}{4}$ of radius broad; the striæ distant, evident, 4 to 5 in .01 mm.

Distinguished from *C. marginatus* by the less robust irregular markings. Similar irregularities are found in *C. antarcticus*, from Kerguelen. The affinity to *Endictya*, founded on the character of the border, as pointed out by Castracane, is remote.

Habitat.—Pacific Ocean, H.M.S. Challenger (Castracane).

C. luxuriosus, sp. n.—Diam. .205 mm. Surface slightly convex from the centre for about $\frac{1}{4}$ of the radius, thence flat to the border. Central space absent. Markings 4-6-, mostly 6-, angled, $2\frac{1}{3}$ to 3 in .01 mm.; central papillæ evident; a few large irregular areolæ with a distinct median line scattered irregularly among the others, and forming an indistinctly defined band adjacent to the border, and

* In the collection of Dr F. W. Griffin.

† In the collection of Dr Greville.

‡ Preoccupied by Grunow in 1884, for what he regarded a doubtful var. of *C. oculus-iridis*.

about $\frac{1}{3}$ of the radius broad; rows irregular. Border sharply defined, with widely placed subcostate striæ hardly extending to the circumference.—(Pl. I. fig. 18.)

Habitat.—Manilla (Firth!).

C. megacoccus, Cstr. *Diat. Chall. Exped.*, p. 162, pl. xvii. fig. 2.—Diam. .041 mm. Central space absent. Markings polygonal, $1\frac{1}{4}$ to $1\frac{3}{4}$ in .01 mm., unequal. Border formed by a single band of 4-angled areolæ, with inner edges somewhat convex inwards, 3 in .01 mm.

In the large size of the markings this species approaches *Stephanopyxis*. From *C. marginatus* it is distinguished by its more irregular marking and the marginal band of areolæ.

Habitat.—Pacific Ocean (Castracane).

C. nottinghamensis, Grun. Van Heurck., *Syn. Diat. Belg.*, pl. cxxix. fig. 2.—Diam. .0165 mm. Central space absent. Markings polygonal, about $3\frac{1}{2}$ in .01 mm., decreasing slightly outwards. Border about $\frac{1}{3}$ of radius broad, with closely placed radial striæ; apiculi long, delicate, numerous, inserted at inner edge of border, but extending beyond the circumference.

Habitat.—Nottingham deposit (Van Heurck).

C. antediluvianus, sp. n.—Diam. .1125 mm. Surface almost flat, slightly convex towards the border. Central space absent. Markings irregularly areolate, 4 to 5 in .01 mm., on the outer third of radius decreasing uniformly but somewhat rapidly to 8 in .01 mm. at the border; apiculi prominent close to the border, inserted at unequal intervals, varying from .005 to .015 mm. Border indistinct, striæ 6 to 8 in .01 mm.—(Pl. I. fig. 12.)

Habitat.—Santa Monica deposit (Grove!).

C. spinulosus, Ehrb. *Mon. Ber. Ak.*, 1845, p. 154.—Elliptical. Diam. .047 mm. Surface flat, slightly convex. Central space absent. Markings angular, their edges slightly spinulose—about 6 in .01 mm.; around the border a fringe of prominent closely disposed apiculi.—Ehrb., *Mikrog.*, pl. xxxviii. B. xxii. fig. 9.

This is probably a *Stephanopyxis*.

Habitat.—Fossil at Port Desire, Patagonia (Ehrenberg).

C. (?) venulosus, Cstr. *Diat. Chall. Exped.*, p. 162, pl. xvii. fig. 1.—Diam. .034 mm. Central space rounded, about $\frac{1}{8}$ of diam. broad. Markings consisting of a few wavy lines diverging outwards from the central space, and confined to the central half of the valve.

Habitat.—South of Kerguelen Island (Castracane).

§ II. CESTODISCOIDALES.

Cestodisci, Pant., *Fossil. Bacil. Ung.*, p. 73.—Circular, rarely elliptical. Central space small or absent; no rosette. Markings round or angular, cestodiscoid; rows fasciculate or radial, a distinct band adjacent to the border frequent; valves sometimes dissimilar; apiculi few or more numerous. Border striæ usually distinct.

C. proteus, Rattray. *Cestodiscus proteus*, Hardman; Van Heurck, *Syn. Diat. Belg.*, pl. cxxvi. fig. 8.—Diam. .035 to .09 mm. Surface slightly convex. Central space minute. Markings rounded, granular, decreasing slightly from the centre outwards, towards the centre 6 in .01 mm., on a marginal zone about $\frac{1}{6}$ to $\frac{1}{8}$ of radius broad, sub-punctiform; rows fasciculate, those composing each fasciculus parallel to the radial row at its middle, the inter-fasciculate radial rows most prominent between the centre and semi-radius, secondary oblique decussating rows on the marginal zone only and conspicuous; interspaces hyaline, largest opposite the ends of the shorter rows; apiculi 6 to 12 inter-fasciculate, large, inserted a short distance from the border. Border indistinctly defined, striæ evident uniform, 8 in .01 mm.

Habitat.—Naparima deposit, Trinidad (Van Heurck, Grove!).

C. stokesianus, Grun. Pant., *Fossil. Bacil. Ung.*, p. 73.—Diam. .075 mm. Central space absent. Markings rounded, granular; about 4 in .01 mm., subequal; interspaces narrow, most evident at origin of shorter rows; rows radial, straight; apiculi 6, symmetrical, free ends blunt, inserted near inner edge of border. Border sharply defined, about $\frac{1}{10}$ of radius broad, striæ evident, 6 in .01 mm.—*Cestodiscus stokesianus*, Grev., *Trans. Mic. Soc. Lond.*, 1866, p. 123, pl. xi. fig. 4; *Coscinodiscus stokesianus forma minor*, Grun.,

ibid., p. 73, pl. xxvii. fig. 257; *Coscinodiscus stokesianus forma baldjikiana*, Grun., *ibid.*, p. 73.

Distinguished from *C. superbus* (= *Cestodiscus pulchellus*, Grev.) by its smaller and more crowded markings, and more distant, less numerous apiculi.

Habitat.—Moron deposit (T. G. Stokes, Greville!).

C. moronensis, Rattray. *Cestodiscus moronensis*, Grev. MS.—Sub-circular. Diam. .075 mm. Central space absent. Markings angular towards the centre 8, gradually increasing outwards to 6, at $\frac{3}{4}$ of radius on a distinct band adjacent to border punctiform, 10 to 12 in .01 mm.; central papillæ small, but prominent; subulate spaces faint, most evident near the marginal band; rows radial, straight; secondary subconcentric bands well marked within the marginal band. Apiculi prominent at intervals of about .01 mm. Border narrow.—(Pl. II. fig. 16.)

Habitat.—Moron deposit (Johnson!).*

C. johnsonianus, Rattray. *Cestodiscus johnsonianus*, Grev., *Trans. Mic. Soc. Lond.*, 1865, p. 48, pl. v. fig. 8.—Diam. .08 mm. Central space small, indistinct. Markings rounded, granular, 6 in .01 mm., smaller and subpunctiform towards the border; interspaces evident, largest opposite origin of shorter rows; rows radial, straight, most crowded towards the border; apiculi many, stout, spine-like, with blunt extremities inserted near border at intervals of about .01 to .015 mm. at the middle of small, rounded, hyaline spaces. Border distinctly defined, striæ 6 to 8 in .01 mm. evident.

This species forms a transition to *Aulacodiscus*, from which it is distinguished by the absence of primary rays, and the more minute and simple character of the processes.

Habitat.—Moron deposit (Johnson! Greville).

C. superbus, Hardman MS. *Cestodiscus pulchellus* (?), Grev., *Trans. Mic. Soc. Lond.*, 1866, p. 123, pl. xi. fig. 5.—Diam. .0875 to .1 mm. Surface convex towards centre, a distinctly defined band adjacent to border. Central space small, indefinite. Markings dissimilar on opposite valves of same frustule: on the one rounded, pearly, within submarginal band, with distinct hyaline interspaces;

* In the collection of Dr Greville.

largest towards centre, 3 in $\cdot 01$ mm. on the submarginal band punctiform, 8 in $\cdot 01$ mm.; rows straight, radial, secondary oblique, decussating rows evident on the submarginal band: on the other subquadrate or pentagonal, $\cdot 6$ in $\cdot 01$ mm.; crowded interspaces absent, secondary rows concentric, evident. Apiculi on both valves prominent, inserted at inner edge of marginal band at intervals of $\cdot 0075$ to $\cdot 01$ mm. Border sharply defined, striæ evident, 8 in $\cdot 01$ mm.—*Cestodiscus pulchellus*, Cleve and Möll., *Diat.*, No. 162.

The name *pulchellus* cannot be adopted, there being already a *Coscinodiscus pulchellus*, Grev. (see p. 469). I have therefore used the name of Hardman's MS. species *superbus*, which seems to answer to Greville's description of the type form of *Cestodiscus pulchellus*.

Habitat.—Newcastle Estate, Barbados, abundant (Grove! Rae! Hardman!); Nancoori (Cleve and Möller! Cleve!).

Var. *nova-zealandica*, Grove MS.—Diam. $\cdot 0675$ mm. Surface without a defined band adjacent to the border. Markings rounded, granular, 3 in $\cdot 01$ mm., somewhat smaller towards border; rows radial, obscure, irregular concentric rows manifest towards border; interspaces hyaline, largest towards centre; apiculi evident at intervals of $\cdot 0075$ to $\cdot 0175$ mm. Border evident; striæ distinct, 8 in $\cdot 01$ mm.—(Pl. II. fig. 15.)

Habitat.—Oamaru deposit (Grove!).

Var. *moravica*, nov. *C. pulchellus*, var. *moravica*, Grun., Pant. *Fossil. Bacil. Ung.*, p. 73, pl. xxvii. fig. 260.—Diam. $\cdot 07$ mm. Central space absent. Markings rounded, granular, decreasing rapidly from the centre outwards, towards the border punctiform, most crowded; rows radial, alternately longer and shorter; apiculi large, numerous at regular intervals, inserted a short distance from the border.

Habitat.—Alsó-, Felső-Esztergaly, Kékkö, Szakal, Szent Peter deposits; Brünn Tegel; Newcastle deposits, Barbados (Pantocsek!).

C. pusillus, Grove MS.—Diam. $\cdot 08$ mm. Surface with a distinctly defined band adjacent to border. Central space absent. Markings angular, subequal, 8 in $\cdot 01$ mm., on the band adjacent to the border punctiform, in radial striæ 10 in $\cdot 01$ mm.; minute subulate clear spaces opposite origin of shorter rows, evident within semiradius;

rows straight, fasciculate, those in each fasciculus parallel to the central row; apiculi evident, inserted at inner edge of submarginal band at intervals of $\cdot 01$ to $\cdot 0125$ mm. Border sharply defined, narrow, striæ obscure, 12 to 14 in $\cdot 01$ mm. (Pl. II. fig. 10.)

Habitat.—Straits of Macassar, recent (Grove!).

C. ovalis, Rattray. *Cestodiscus ovalis*, Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 49, pl. v. fig. 9.—Elliptical or diamond-shaped, with angles obtuse. Major axis $\cdot 0625$ to $\cdot 1$ mm., $1\frac{1}{4}$ to $1\frac{1}{2}$ times minor. Central space absent. Markings towards the centre rounded 6, at about $\frac{2}{3}$ radius angular 8, on a sharply defined zone adjacent to the border punctiform, 12 in $\cdot 01$ mm.; rows radial, straight, the secondary oblique, decussating rows most evident on the median portion, interspaces most evident towards the centre; apiculi prominent at intervals of about $\cdot 0125$ mm., inserted at inner edge of marginal band.

In the Nancoori deposit, from the Nicobar Islands, as well as in that of Richmond, Va., are very similar specimens, but possessing a distinct pseudonodule, and to these Grunow has given the name *Actinocyclus ellipticus* (Van Heurck, *Syn. Diat. Belg.*, pl. cxxiv. fig. 10). The specimen figured by Witt from the Archangelsk Polirschiefer (*Ü. d. Polirschiefer von Archangelsk-Kurojedowo im Gouv. Simbirsk*, 1885, p. 23, pl. viii. fig. 11), as *Cestodiscus ovalis*, var.? an *Actinocyclus*? is to be associated with this species of Grunow, the pseudonodule being quite distinct.

Habitat.—Moron deposit (T. G. Stokes! Hardman!).

§ III. EXCENTRICI, Pant., *Fossil. Bacil. Ung.*, p. 72.

Central space and rosette absent. Markings angular, decreasing gradually or more rapidly from the centre outwards; radial rows obscure, oblique decussating rows evident, frequently somewhat curved towards the border; apiculi only near border, sometimes absent.

C. minuens, Rattray. *C. decrescens*,* Cstr., *Diat. Chall. Exped.*, p. 159, pl. xii. fig. 14.—Diam. $\cdot 115$ mm. Markings polygonal, decreasing from the centre to the border, towards the centre 2, towards

* Name preoccupied by Grunow.

the border 4 to 6 in $\cdot 01$ mm.; radial rows 6, inconspicuous, the oblique decussating rows straight or slightly curved; apiculi numerous, prominent, forming a circlet close to the border at short intervals.

The general arrangement of the markings resembles somewhat that of *C. excentricus*, but is less regular, the areolæ too are larger, and decrease more rapidly to the border.

Habitat.—Philippine Islands, H.M.S. Challenger (Castracane).

C. antimimos,* sp. n.—Diam. $\cdot 08$ mm. Markings round or bluntly angular, subpearly, towards the centre $2\frac{1}{2}$, decreasing gradually outwards to 3 in $\cdot 01$ mm.; central papillæ obscure; radial rows few, inconspicuous; secondary oblique, decussating rows distinctly concave towards the border; non-spiculate. Border striæ evident, 6 in $\cdot 01$ mm., short.—Cleve and Möll., *Diat.*, No. 257.—(Pl. II. fig. 11.)

Distinguished from *C. excentricus* by its much larger subpearly markings.

Habitat.—North Carolina (Cleve and Moller!).

C. antiquus. *C. (excentricus, var.?) antiquus*, Grun., *Denk. Wien. Ak.*, 1884, p. 84., pl. iv. (D), fig. 24.—Diam. $\cdot 0565$ mm. Markings hexagonal, conspicuous, decreasing from the centre outwards; towards the centre 3, towards the border 4 in $\cdot 01$ mm.; oblique, decussating rows substraight or slightly concave outwards; non-apiculate. Border sharply defined; striæ evident, distant, 3 to 4 in $\cdot 01$ mm.—*C. concavus*, Ehrb., *Mikrog.*, pl. xxi. fig. 4 (not pl. xviii. fig. 38); *C. concavus*, Greg., var., Sch., *Atl.*, pl. lix. fig. 16.

Differs from *C. excentricus* in its larger markings and more distinct border.

Habitat.—Mors deposit, Monterey tripoli (Grunow).

C. excentricus. Ehrb., *Abh. Ber. Ak.*, 1839, p. 146.—Diam. $\cdot 0525$ to $\cdot 0825$ mm. Surface flat. Markings polygonal, towards the centre 4, gradually decreasing towards the border to 8 in $\cdot 01$ mm., at the centre a single areola surrounded by 5 to 8 similar ones, whence inconspicuous radial rows proceed to the border, the oblique decus-

* ἀντίμιμος, imitating.

sating rows distinctly concave outwards; apiculi distinct, numerous at subequal distances apart, sometimes absent.—Ehrb., *ibid.*, 1841, p. 323, 371, pl. iii. 7, fig. 5; *Mikrog.*, pl. xviii. fig. 32, pl. xxi. fig. 6; W. Sm., *Syn. Brit. Diat.*, i. p. 23, pl. iii. fig. 38; Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer*, Kiel, 1874., ii. p. 94, pl. iii. figs. 36–38; *Atl.*, pl. lviii. figs. 46 to 49; Van Heurck, *Syn. Diat. Belg.*, p. 217, pl. cxxx. figs. 4, 7, 8; Janisch,* *Gazelle Exped.*, taf. ii. fig. 3; vi. figs. 3, 7–11; H. L. Sm., *Diat. Sp. Typ.*, No. 93; *Coll. Kütz. Diat.*, No. 285; Van Heurck, *Typ. Syn. Diat. Belg.*, Nos. 529, 530; Cleve and Möller, *Diat.*, Nos. 148, 150, 183, 207, 210, 211, 215, 228, 257, 258, 276. *Odontodiscus excentricus*. Ehrb., *Mon. Ber. Ak.*, 1845, p. 79; Sch., *ibid.*, 1874, ii. p. 94; Raben., *Algen. Europas*, No. 2149, 2263, 2437, 2483, 2484, 2485, 2486, 2487, 2558; *C. lineatus*, var., Habir., *Cat. Diat.*; § *Coscinodiscus*, *C. minor*, Sch., *Atl.*, pl. cxiii. fig. 9.

In Ehrenberg's early figures apiculi are not indicated; these are first noted by W. Smith. Janisch (*Abh. Sch. Ges. väter. Cult.*, 1862, p. 4), erroneously states that the markings are round. Distinguished from *C. sol*, Wallich, by the presence on the latter of a wide slightly siliceous broad external zone.

Habitat.—Chalk marl, Oran, Richmond and Petersburg, Va.; lat. 71° 19' N., long. 11° 28' W., 1319 fms., in fine yellowish-grey mud; lat. 63° 40' N., long. 5° 28' E., 569 fms., in fine light mud; Cuxhaven, North Sea; Tjörn, Cattegat, Vera Cruz (Ehernberg); Barbados (Cleve and Möller!); Bohuslan, Hvidingsoe (Schmidt); Poole Bay, near Lewes, and stomach of scallop (W. Smith); Blankenberge, Antwerp (Van Heurck); San Benito deposit, California (Grove!); Firth of Forth (Rattray!); Porto Seguro (Hardman!); † San Francisco

* To the specimens figured in Janisch's *Gazelle Expedition* plates, which, though still unpublished, have had considerable private circulation, the following names have, according to Herr E. Weissflog, been given by Janisch, namely:—Pl. I. figs. 1–5, *Stoschia admirabilis*, C. Jan., gen. et sp. n. Pl. II. fig. 1, *Coscinodiscus gigas?* var.; figs. 4, 5, *C. nodulifer*, A.S. sp. n. Pl. III. fig. 2, *C. africanus*, C. Jan., sp. n.; fig. 4, *C. praetextus*, C. Jan., sp. n.; fig. 6, *C. tumidus*, C. Jan., sp. n. Pl. IV. figs. 1, 2, *C. lentiginosus*, C. Jan., sp. n.; figs. 3, 5, *C. arafuraensis*. Pl. V. figs. 2, 3, *C. gyratus*, C. Jan., sp. n.; fig. 6, *C. atlanticus*, Grun.; fig. 7, *C. lentiginosus*, C. Jan., sp. n. Pl. VI. fig. 12, *C. bullatus*, C. Jan., sp. n.; fig. 13, *C. nobilis*, Grun.

† In the collection of Julien Deby.

(Firth!) Peruvian guano (Kinker! Rae!); Campeachy Bay (Hardman! Cleve and Moller! Grove!); Singapore (Hardman!);* Virginia (Hardman!); Sand Heads, Bengal (Greville!); Cresswell (Donkin!); † anchor ground, Reikjavik, Iceland; mud from Glückstadt; Vera Cruz; anchor ground, Laguna Harbour, 20 miles N. of Laguna, in the sea; Elbe, above Cuxhaven (Rabenhorst and Schwartz!); Carral, near Valdiva (Rabenhorst and Gerstenberger!); German Ocean (Kützing!); coast of St Paul Island, South Sea (v. Frauenfeld!); ‡ stomach of scallop, locality? (Greville! W. Smith!) Baltic Sea (Van Heurck!); Teignmouth (Arnott!); † soundings off Kurile Islands, 1329 fms. (H. L. Smith!); Cumbrae (Arnott!); † Santa Monica deposit (Hardman!); * Sawa Nada, Japan (Hardman!); * Lamlash Bay (Dickie!); Corrigihills (Dickie!); Humber (O'Meara!); Ascidia, Hull (Van Heurck! Greville!); marine deposit, Fiji Islands (Grove!); Mejillones deposit (Cleve! O'Meara!); Los Angelos deposit (O'Meara!); Knight Errant Expedition (Grove!); Macassar Straits (Grove!); Marstrand (Kinker!); Aegina (Schmidt); Kantschatka Sea, 1700 fms. (Bailey!); Rovigno, Balearic Islands; Hampshire; Patagonia; Antarctic Ocean; Delaware; Nottingham deposit, North Carolina; Pensacola, California (Cleve and Möller!); west coast Florida, U.S. Survey (Febiger!); Bohuslan; Elbing; West Prussia; Cape Wankarema; Saldanha Bay guano, Patagonian guano, Schleswig-Holstein; mud from Savannah rice fields; Mors deposit; Nankoori deposit; between Aden and Bab-el-mandeb (Cleve!); off Ascension Island, in Globigerina ooze (Grove!).

Var. *micropora*, Grun. Cleve and Möll., *Diat.*, No. 114.—Diam. .0175 to .03 mm. Markings 12 in .01 mm.; apiculi absent.

Habitat.—Mascara (Cleve and Möller!).

Var. *perpusilla*, Grun. *Denk. Wien. Ak.*, 1884, p. 84, pl. iv. (D), fig. 7.—Diam. .0075 mm. Markings minute, 24 in .01 mm.; apiculi hardly conspicuous.

O'Meara has confounded this var. with the very distinct *C. apiculatus*.

* In the collection of Julien Deby.

† In the collection of Dr Greville.

‡ Collected during the Expedition of the "Novara."

Habitat.— Franz Josef's Land (Grunow); *Ascidia*, Kinsale (O'Meara!).

Var. *punctifera*, Grun. *ibid.*, p. 84.—Diam. $\cdot 1$ mm. Markings 5 to 9 in $\cdot 01$ mm.; apiculi absent or minute, a distinct point—the rudiment of a bristle—between the central and one of the surrounding areolæ.

Habitat.—Southern Ocean (Grunow).

Var. *hyalina*, nov. *Eupodiscus eccentricus*, O'Meara, *Quart. Jour. Micr. Sci.*, 1867, p. 245, pl. vii. fig. 2.—Diam. about $\cdot 035$ mm.; a broad hyaline band adjacent to border; apiculi many, inserted at middle of this hyaline band at subequal intervals.

Habitat.—Dredged off Arran Islands, co. Galway (O'Meara).

Var. *zebuensis*, nov. *C. zebuensis*, Grun. MS.—Diam. $\cdot 0275$ to $\cdot 07$ mm. Markings towards the centre 4 or 5, decreasing outwards to 8 in $\cdot 01$ mm., a large prominent central nodule; apiculi distinct, numerous, close to border at intervals of about $\cdot 0075$ mm. Border sharply defined.

Habitat.—Campeachy Bay (Grove!), Zebu, Philippine Islands (Weissflog!).

C. decipiens, Grun. *Denk. Wien. Ak.*, 1884, p. 85.—Diam. $\cdot 024$ to $\cdot 03$ mm. Markings polygonal, decreasing uniformly but somewhat rapidly from the centre outwards; at the centre 5 to 6, towards the border 10, in $\cdot 01$ mm.; secondary oblique decussating rows concave outwards, subarcuate; apiculi many, minute but distinct, at short unequal distances.—Van Heurck, *Syn. Diat. Belg.*, pl. xci. fig. 10; Van Heurck, *Typ. Syn. Diat. Belg.*, No. 471; *C. eccentricus*, var. ? *decipiens*, Grun., *Sitzungsb. naturw. Ges. Isis*, Dresden, 1878, p. 28; pl. iv. fig. 18; *C. minor*, Anglor (non Ehrb.); *Orthosira angulata*, Greg,* *Trans. Roy. Soc. Edin.*, 1857, p. 498, pl. x. figs. 43, 43b; *C. minor*, W. Sm., *Syn. Brit. Diat.*, i. p. 23, pl. iii. fig. 36 (excl. *C. decipiens*, Grun.; Sch. *Atl.*, pl. lix. figs. 18, 19.)

Distinguished from *C. eccentricus* by the more irregular markings, which decrease more towards the border, and by the more prominent apiculi.

* "*Melosira angulata*, Greg.," *vide* Grun., *ibid.*, 1884, p. 85.

Habitat.—Baku Harbur, Caspian Sea (Grunow); Lamlash (Gregory); Woolwich (Walker Arnott, Van Heurck!).

C. minor. Ehrb., *Abh. Ber. Ak.*, 1838, p. 129, pl. iv. fig. 12e. —Diam. .0225 mm. Markings polygonal, minute, decreasing gradually from the centre outwards; at the centre 6, at the border 9 to 10 in .01 mm; rows less regular, the oblique decussating rows curved but slightly towards the border. Apiculi minute, close to the border, in the intervals delicate striæ.—Ehrb., *ibid.*, 1839, p. 147, pl. iii. fig. 2; *ibid.*, 1841, p. 371, pl. ii. 4. fig. 8; pl. ii. 6. fig. 17, pl. iii. fig. 3; *Mikrog.*, pl. xviii. fig. 31; pl. xix. fig. 3; pl. xx. 1. fig. 28; pl. xxi. fig. 5; pl. xxii. fig. 7; pl. xxxiii. 14. fig. 4 (?); pl. xxxix. 2. fig. 22 (?); Ehrb., *Die II^e Deutsch. Nordpolarf.*, 1869-70, Leipzig, 1874, p. 455, pl. ii. figs. 20, 23; Ralfs in *Pritch Inf.*, p. 831; Janisch, *Abh. Sch. Ges. väter., Cult.*, 1862, p. 4, pl. ii. A, fig. 6; Grun., *Sitzungsb. naturw. Ges. Isis*, Dresden, 1878, p. 28; Sch., *Atl.*, pl. lviii. figs. 39, 40; pl. lix. fig. 8, 9; pl. cxiii. fig. 10; Raben., *Alg. Europ.*, Nos. 2261, 2481, 2487 (excl. *C. minor*, W. Sm., *Syn. Brit. Diat.*, i. p. 23, pl. iii. fig. 36 = *Melosira nivalis* and *C. minor*, Anglor, non Ehrb. = *C. decipiens*, Grun.)

The early figures of Ehrenberg are unsatisfactory, and may indicate more than one species. The rows of smaller markings are more irregular than in *C. excentricus* and *C. sol*. Distinguished from *C. decipiens* by the less rapid diminution of the markings outwards and the less evident apiculi. The Aegina valve figured by Schmidt (*Atl.*, pl. cxiii. fig. 10) shows a transition to *C. tumidus* in the arrangement of the markings.

Habitat.—Caltanissetta (Ehrenberg, Grunow, Schmidt); Oran, Zante; Aegina, Richmond; Norwich, Con. (Ehrenberg); Peruvian and Ichaboe guanos (Janisch); Cuxhaven, S. Domingo, Haiti, Cuba, Vera Cruz (Ehrenberg); Girgenti (Grunow); Table Bay (Schmidt), lat. 71° 19' N., long. 11° 28' W., 1319 fms., in yellowish-grey mud; lat. 73° 16' N., long. 15° 48' W., 1300 fms., in fine dark brown mud; lat. 63° 40' N., long. 5° 28' E., 569 fms., in fine light grey mud; lat. 74° 18' N., long. 19° 24' W., 13 fms. (Ehrenberg); Davis Straits, deep water (O'Meara!); Nancoori (Hardman!); Cumbrae and Lamlash (Dickie!); Humber (O'Meara!); marine deposit, Fiji Islands (Grove!); Aegina (Schmidt); Algeria (Arnott!); Springfield deposit, Barbados

(Schmidt); Vera Cruz, among *Sertularia*; Elbe, above Cuxhaven (Rabenhorst and Schwarz !); Carral, near Valdiva (Rabenhorst and Gerstenberger !).

C. circumdatus. Sch., *Atl.*, pl. lix. fig. 3.—Diam. .07 mm. Markings polygonal, decreasing slightly from the centre towards the border; towards the centre 4, towards the border 6 in .01 mm.; radial rows 6 to 8, inconspicuous; the oblique decussating rows almost straight. Border about $\frac{1}{11}$ of radius broad, inner $\frac{2}{3}$ hyaline between distant subregular narrow radial lines, outer $\frac{1}{3}$ with evident striae, 8 to 10 in .01 mm.—Van Heurck, *Syn. Diat. Belg.*, pl. cxxxi. fig. 4.

Distinguished by the border.

Habitat.—Yokohama (Gründler).

C. sol. Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 38, pl. ii. figs. 1, 2.—Diam. .0625 to .15 mm. Markings on the central highly silicified portion distinct, decreasing somewhat rapidly from the centre outwards; towards the centre $4\frac{1}{2}$ to 5, towards the border 6 to 7 in .01 mm., the central areola surrounded by 6 or 7 similar areolæ, whence a corresponding number of inconspicuous radial rows pass to the border; the oblique decussating rows distinctly concave outwards, non-apiculate, the outer portion from $\frac{1}{3}$ to $\frac{1}{2}$ of radius broad, scarcely siliceous, with numerous but distinct subuniform costæ.—Ralfs, in *Pritch. Inf.*, p. 830; Sch., *Atl.*, pl. lviii. figs. 41, 42, 45; Grun., *Denk. Wien. Ak.*, 1884, p. 84; Cleve and Möll., *Diat.*, Nos. 145, 146. *Cestodiscus sol*, Wallich, in Van Heurck, *Syn. Diat. Belg.*, pl. cxxix. fig. 6.

Habitat.—From *Salpa spinosa*, South Sea (Weissflog!); surface, Gulf of Guinea (Rattray!); Cambridge deposit, Barbados (Greville!); Java Sea (Kitton, Cleve and Möller!).

§ IV. LINEATI, Pant., *Fossil. Bacil. Ung.*, p. 72.

Central space absent, rarely small; a rosette rare. Markings angular in contact; radial rows obscure; oblique, decussating rows straight. Apiculi sometimes present, a larger apiculus inserted at a greater distance from border somewhat rare.

C. subconcurvus, Grun. Sch., *Atl.*, p. lix. figs. 12, 13.—Diam.

·0275 mm. Surface slightly convex. Central space and rosette absent. Markings hexagonal, central dots sometimes evident, decreasing but slightly from the centre outwards, about $2\frac{1}{2}$ in ·01 mm. Border narrow, showing evident short radial lines.

Habitat.—Simbirsk (Schmidt).

Var. *tenuior*, nov. *C. subconcauus*, Grun., var.? Sch., *Atl.*, pl. lix. fig. 15.—Diam. ·038 mm. Markings smaller, decreasing more distinctly outwards, towards the centre 3, towards the border 4 in ·01 mm.; a single band of smaller areolæ adjacent to the border. Border smooth, narrow.

Habitat.—Simbirsk (Schmidt).

C. vigilans. Sch., *Atl.*, pl. cxiv. figs. 11, 12.—Diam. ·0455 to ·068 mm. Surface slightly convex. Central space and rosette absent. Markings round, robust, pearly, smooth, largest at the centre, decreasing rapidly near the border; at the centre 2, at the border 4 in ·01 mm.; central papillæ faint, interspaces hyaline. Border sharply defined, formed by one or two bands of rounded granules in contact laterally, and 6 or 7 in ·01 mm.

Distinguished from *C. subvelatus* by the larger size and by the form of the markings and the distinct character of the border.

Habitat.—Archanjelsk-Kurojedowo (Schmidt).

C. Mölleri. Sch., *Atl.*, pl. lix. fig. 17.—Diam. ·0625 to ·08 mm. Surface convex, and more opaque at the centre. Central space and rosette absent. Markings hexagonal, decreasing regularly but somewhat rapidly from the centre outwards, at the centre most distinct 2 to $2\frac{1}{4}$, towards the border more faint, 3 in ·01 mm.; at the border a single band of quadrate equal areolæ with longer axis at right angles to the radius, 3 in ·01 mm.; oblique decussating rows obvious, straight or slightly concave towards the border. Border narrow, hyaline.

Habitat.—Mors deposit (Schmidt, Cleve! Grunow, Möller!).*

Var. *macroporus*. Grun., *Denk. Wien. Ak.*, 1884, p. 84, pl. iv. (D), fig. 25.—Diam. ·063 to ·125 mm. Markings at the centre 2, at the border 4 in ·01 mm., their surface obsolete

* In the collections of Julien Deby and of Prof. Cleve.

and irregularly punctate, the central areola without a prominent papilla.

Habitat.—Franz Josef's Land (Grunow); Simbirsk deposit, Kitton!)*

C. heteromorphus, sp. n. Sch., *Atl.*, pl. lxxv. fig. 17 (no name).—Diam. .053 mm. Central space and rosette absent. Markings angular, about 3 in .01 mm.; central papillæ absent; adjacent to the border a broad zone, consisting of a single row of large cylindrical areolæ, with rounded outer and inner extremities, their sides straight or concavo-convex of somewhat unequal length. Border narrow.

Similar forms, but with more robust markings, occur in the Oamaru deposit, and have been regarded by Mr E. Grove either as abnormal forms of *Stephanophycis*, or as probably belonging to *Liradiscus*. The former opinion, adopted by Schmidt (*Atl.*, pl. cxxx. fig. 5) seems to me to be the more tenable.

Habitat.—Piscataway (Weissflog).

C. splendidus. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 44, pl. v. fig. 3.—Diam. .065 to .125 mm. Surface convex. Central space absent. Markings polygonal, central papillæ towards the centre $1\frac{1}{2}$, decreasing outwards to 2 or $2\frac{1}{4}$ in .01 mm., those forming the outermost band larger. Border hyaline.—Sch., *Atl.*, pl. lxxv. fig. 11.

The markings and border are similar to those of *Stephanophycis superba*, Grun. (*Denk. Wien. Ak.*, 1884, p. 91), but the latter is provided with spines.

Habitat.—Cambridge deposit, Barbados (Johnson!); † “Barbados” (Greville!); St Vincent, Austral. (Weissflog!).

C. macraeanus. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 46, pl. v. fig. 4.—Diam. .0525 to .13 mm. Surface convex towards the centre. Central space absent. Markings polygonal, $2\frac{1}{2}$ to 3 in .01 mm., subequal or somewhat smaller near the border; apiculi numerous, large, clavate, attached irregularly at the inner edge of the border. Border hyaline, sharply defined, $\frac{1}{3}$ of radius broad.

Habitat.—“Guano” (Macrae!); † Indian Ocean (Macrae, *vide* Greville); Bahia (Kitton!).

* In the collection of Julien Deby.

† In the collection of Dr Greville.

C. pulchellus. Grev., *Trans. Micr. Soc. Lond.*, 1866, p. 3, pl. i. fig. 7.—Diam. from $\cdot 06$ to $\cdot 09$ mm. Surface convex. Central space absent. Markings mostly hexagonal, $2\frac{1}{2}$ in $\cdot 01$ mm., decreasing gradually to the border, at wide irregular intervals narrower and more distinct areolæ are scattered irregularly on the middle $\frac{1}{3}$, those forming the outermost band longer but not wider, their long axis radial. Border sharply defined; striæ distinct, remote, 4 in $\cdot 01$ mm.

This species approaches *C. splendidus*, Grev., and *C. macraeanus*, Grev., but is distinguished from the former by the striated border and from the latter by the marginal apiculi. Grunow, who has justly reduced the genus *Cestodiscus* to a section of *Coscinodiscus* (Pant., *Fossil. Bacil. Ung.*, p. 73), names *Cestodiscus pulchellus*, Grev. (*Trans. Micr. Soc. Lond.*, 1866, p. 123, pl. ii. fig. 5), *Coscinodiscus pulchellus*, though distinct from Greville's *Coscinodiscus pulchellus*, which was published somewhat earlier. *Coscinodiscus* (*pulchellus*, var.?) *hirtulus*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. cxxvi. fig. 3), and *Coscinodiscus pulchellus*, var. *Trinitatis*, Grun. (Van Heurck, *ibid.*, pl. cxxvi. fig. 4), are related to Greville's *Cestodiscus pulchellus*.

Habitat.—Cambridge deposit, Barbados (Johnson!).*

C. zonulatus, sp. n. ? Sch., *Atl.*, pl. lix. fig. 6.—Diam. $\cdot 024$ mm. Central space and rosette absent. Markings regularly angular, subequal, 10 in $\cdot 01$ mm.; adjacent to the border a distinct band of large imperfect areolæ, with inner edge absent, and outer slightly convex outwards, about 5 in $\cdot 01$ mm. Border sharply defined about $\frac{1}{4}$ of radius broad, hyaline.

Habitat.—Cape of Good Hope (Schmidt).

C. aphrastos, † sp. n. Sch., *Atl.*, pl. lxxv. fig. 18.—Diam. $\cdot 0755$ mm. Central space and rosette absent. Markings pentagonal or hexagonal, about $1\frac{1}{2}$ in $\cdot 01$ mm.; at wide intervals, a few minute areolæ interspersed. Central papillæ absent. Border prominent, sharply defined, hoop-like; striæ robust, about $1\frac{1}{2}$ in $\cdot 01$ mm.

Habitat.—Campeachy Bay (Gründler).

C. concavus. Greg., *Trans. Roy. Soc. Edin.*, 1857, pl. x. fig. 47.—Diam. $\cdot 07$ to $\cdot 2375$ mm. Surface subplain, with a prominent

* In the collection of Dr Greville.

† ἀφραστός, unexpected.

border. Central space and rosette absent. Markings subpearly, robust, pentagonal or hexagonal, each with a faint central dot, $2\frac{1}{2}$ to $3\frac{1}{2}$ in $\cdot 01$ mm., decreasing but little towards the border. Border sharply defined, subopaque, broad; striæ evident, $3\frac{1}{2}$ to 4 in $\cdot 01$ mm.; a series of closely placed concentric lines sometimes visible, the outer edge rugose. Girdle aspect,* with smaller areolæ, 4 to 5 in $\cdot 01$ mm., forming straight or slightly flexuous rows parallel to the edge of the girdle; girdle narrow.—Cleve, *Bih. k. Sv. Vet.-Ak. Handl. Stockh.*, 1873, No. 11, p. 4; Sch., *Atl.*, pl. lxii. fig. 8; *C. concavus*, Ehrb., *pro parte*, *Abh. Ber. Ak.*, 1841, p. 412; *Mikrog.*, pl. xxi. fig. 4 † (excl. pl. xviii. fig. 38); *Endictya oceanica*, Ehrb., *Mon. Ber. Ak.*, 1845, p. 76; *Mikrog.*, pl. xxxv. A, 18, figs. 6, 7; Ralfs in *Pritch. Inf.*, p. 831, pl. v. fig. 70; Möll., *Typ. Pl.* 4, 4, 8, Cleve and Möll., *Diat.*, No. 110, 259; Raben., *Alg. Europ.*, No. 2556; H. L. Sm., *Diat. Sp. Typ.*, No. 148; Sch., *Atl.*, pl. lxxv. figs. 10, 12, 13, 15. *Coscinodiscus concavus*, var. *africanus*. Kütz., *Sp. Alg.*, p. 125; *C. oceanicus*, Kütz., *ibid.*, p. 126; *Melosira cribrosa*, de Bréb., W. Sm. in *Ann. and Mag. Nat. Hist.*, 1857, p. 11, pl. ii. fig. xv.; *Orthosira oceanica*, Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 96; *Endictya minor*, Sch., *Atl.*, pl. lxxv. figs. 14, 16; *Melosira oceanica*, Habirsh, *Cat. Diat.*, ed. 2, § *Endictya*.

The specimen named *C. concavus* by Ehrenberg (*Mikrog.*, pl. xviii. fig. 38), from Richmond, approaches the unnamed organism figured by Gregory from the Glenshira Sand (*Trans. Micr. Soc. Lond.*, 1857, p. 85, pl. i. fig. 52), but is distinct from the present species. *C. concavus*, var., Sch. (*Atl.*, pl. lix. fig. 16) is *C. antiquus*, Grun. W. Smith followed de Brébisson's determination of *Melosira cribrosa* provisionally, separating it from *Coscinodiscus* only because he believed that the frustules might occur concatenated. *C. concavus*, var. *africanus*, from Oran, was first differentiated by Ehrenberg as *C. concavus africae* (*Mon. Ber. Ak.*, 1844, p. 79), with $3\frac{1}{2}$ to 4 markings in $\cdot 01$ mm., but this is inadequate on which to establish a variety. Cork specimens, authenticated by Grunow as *Endictya minor* (Sch., *Atl.*, *supra*), agree with Gregory's *C. concavus*. Specimens sometimes named *Endictya oceanica* differ from *C. concavus* only in showing the markings somewhat more irregular.

* This applies to specimens hitherto named *Endictya*.

† Specimen not typical.

Habitat.—Oran deposit (Ehrenberg); Oamaru deposit (Grove and Sturt); Mejillones guano (Deby! Hardman! Firth!); Peruvian guano (Cleve! Johnson!); Chinchá Island guano (Arnott!); Arica and Saldanha Bay guanos (Ehrenberg); off Bermuda, 1075 fathoms (Rae!); Loch Fyne (Greville!); Lamlash (Gregory!) Biarritz, Bay of Biscay (Brébisson!); Black Sea (W. Smith); Java (Cleve); Amboina shell scrapings (Kinker!); Ascidia, Roundstone Bay, county Galway (O'Meara!); S. America (Möller!); * Lough Hym, county Cork (Grove!); Kirkwall, Orkney (Grove!); Edible seaweeds, India (Macrae!); Locality? (Barnett!† Weissflog!); Valparaiso (Schmidt); Villefranche, Trinidad (Cleve and Möller!); Campeachy Bay (Grove!); Monterey Stone (Cleve!); Balearic Islands, Pabillan di Pico guano, Bolivian guano (Cleve!); Port William, Falkland Islands (Rabenhorst and Schwarz!).

C. bisculptus, sp. n. *C. labyrinthus*, Roper, var.? Sch., *Atl.*, pl. lix. fig. 14.—Diam. .035 mm. Surface somewhat convex. Central space and rosette absent. Markings large hexagonal or pentagonal, unequal areolæ, 2 to 2½ in .01 mm., somewhat smallest towards the centre; within these more minute, faint, angular areolæ—the larger in obscure radial, but more evident oblique substraight decussating lines, the smaller without order. Border sharply defined, about ¼ of radius broad; striæ coarse, 3 in .01 mm.

Habitat.—Peruvian guano (Schmidt).

C. labyrinthus. Roper, *Quart. Jour. Micr. Soc.*, 1858, p. 21, pl. iii. figs. 2a, 2b.—Diam. .0625 to .0875 mm. Central space absent. Markings hexagonal towards the centre 4, decreasing gradually to the border to 6 in .01 mm., punctate, forming straight or slightly curved oblique decussating rows and distinct secondary subequal hexagonal, areolæ from .0025 to .0085 mm. broad; minute apiculi sometimes present at the border. Border indistinct; striæ 7 to 8 in .01 mm.—Ralfs in *Pritch. Inf.*, p. 831; Cleve and Möll., *Diat.*, No. 276 (excl. *C. labyrinthus*, Roper, var.? Sch., *Atl.*, pl. lix. fig. 4).

The smaller hexagonal markings recall those of *C. excentricus*, Ehrb., and of *C. sol.*, Wallich. At the centre a faint stellette is

* In the collection of Julien Deby.

† In the collection of Dr Griffin.

sometimes found. Not a *Pyxidicula*, as suggested by Grunow (*Denk. Wien. Ak.*, 1884, p. 73).

Habitat.—Californian guano (Norman!)*; stomach of *Ascidia*, Hull (Greville!); Lamlash (Greville!); Caldy, Pembrokeshire (Roper!); Hull (Firth!) †; Humber (Dickie!); California (Cleve and Möller!).

C. bipartitus, sp. n. Sch., *Atl.*, pl. lix. fig. 35.—Diam. about $\cdot 0875$ mm. Central space absent, rosette large, surrounding a single small circular areola. Markings hexagonal, $2\frac{1}{2}$ subequal, for about $\frac{3}{4}$ of radius, on outer $\frac{1}{4}$ 6 in $\cdot 01$ mm., forming a distinct band. Central papillæ absent, radial rows on inner $\frac{3}{4}$ of radius obscure, the oblique decussating straight rows manifest, on outer $\frac{1}{4}$ the radial rows evident, the secondary oblique decussating rows uniformly curved. Border narrow, hyaline; beyond the border 4 large unsilicified subrugose blunt protuberances.

Habitat.—Java (Gründler).

C. blandus. Sch., *Atl.*, pl. lix. figs. 36, 37.—Diam. about $\cdot 07$ mm. Central space small, rosette large, at the inner angles of its component areolæ distinct minute round granules. Markings hexagonal, 3 in $\cdot 01$ mm., somewhat smaller towards the periphery; the central papillæ faint, a distinct band sometimes present adjacent to the border, upon this the markings rounded granular and irregular apiculi numerous, inserted at inner edge of border. Border narrow; striæ evident, 6 in $\cdot 01$ mm.

Habitat.—Gulf of Mexico (Schmidt).

C. lineatus. Ehrb., *Abh. Ber. Ak.*, 1838, p. 129.—Rarely angular. Diam. $\cdot 05$ to $\cdot 15$ mm. Surface towards the centre flat, slightly convex near the border. Central space and rosette absent. Markings hexagonal, $2\frac{1}{2}$ to 4 in $\cdot 01$ mm., subequal, or sometimes at border 6 in $\cdot 01$ mm., their central dots distinct; apiculi small, sometimes absent. Border distinct, consisting of a few concentric rows of contiguous granules, 8 or 9 in $\cdot 01$ mm.—Ehrb., *ibid.*, 1841, p. 371, pl. i. 3. fig. 20; pl. iii. 7. figs. 7, 8; *Mikrog.*, pl. xviii. fig. 33; pl. xxii. figs. 6a, b; pl. xxxv. A, 16. fig. 3; pl. xxxv. A, 17. fig. 7;

* In the collection of Dr Greville. † In a slide prepared by Mr Norman.

Raben., *Alg. Europ.*, Nos. 2481, 2482, 2483, 2484, 2485, 2486 ; Van Heurck, *Syn. Diat. Belg.*, p. 217, pl. cxxxi. fig. 3 ; Janisch, *Gazelle Exped.*, taf. iv. fig. 8 ; taf. xx. fig. 14 ; Sch., *Atl.*, pl. lix. figs. 27-30 ; H. L. Sm., *Diat. Sp. Typ.*, No. 98 ; Cleve and Möll., *Diat.*, Nos. 57, 114, 148, 150, 162, 207, 276. *C. lineatus*, var.? Sch., *Atl.*, pl. lix. figs. 31, 32. *C. Ehrenbergii*, O'Me., *Proc. Roy. Irish Ac.*, 1875, p. 264, pl. xxvi. fig. 24. Sp. n. Sch., *Atl.*, pl. cxiv. fig. 13.

Coscinodiscus lineatus (Weisse, *Bull. Ac. Imp. Sci. St Petersburg*. 1855, p. 276, pl. i. figs. 2a, b) is perhaps *Dictyopyxis subtilis*, Ehrb., according to Grunow (*Denk. Wien. Ak.*, 1884, p. 92). Schmidt separates the specimen figured in his *Atl.*, pl. cxiv. fig. 13, because of its convexity.

Habitat.—Richmond, Va. (Ehrenberg, Bailey, Hardman! Cleve and Moller!); Caltanisetta, Peruvian and African guanos (Ehrenberg); Patos guano (Kinker!); Moron (Schmidt); marine deposit, Fiji Islands (Grove!); Sta Monica deposit, Sta Maria deposit (Grove!); Cambridge deposit, Barbados (Hardman!); Barbados (Cleve and Möller!); Californian guano (Norman!);* Rappahannock (Bailey!);* Nancoori (Cleve and Möller! Cleve! Hardman!);* Ningpo (Kinker!); Mascara (Cleve and Moller!); Kamtschatka Sea, 1700 fathoms (Bailey!); Indian Ocean, sounding by Capt. Pullen, 2200 fathoms (Greville!); Japan (H. L. Smith!); Singapore (Hardman!); Yokohama and Brazil (Schmidt); Mejillones (Cleve! O'Meara); Cambodia (Hardman!); † Monte Gubbio (Grove!); edible sea-weeds, Indian Ocean (Macrae!); Campeachy Bay (Cleve and Möller! Grove!); Cannibal Islands (Greville!); Andaman Islands (Macrae!); Cuxhaven (Bailey); Malahide and Dollymount, county Dublin; Ascidia, Roundstone Bay, county Galway (O'Meara); Patagonia, California (Cleve and Möller!); west coast, Florida, U.S. Survey (Febiger!); Yeddo; Patagonian guano; near Elbing, West Prussia; Mors deposit; Labuan; Kusu; between Aden and Bab-el-Mandeb (Cleve!); Archangelsk (Cleve); Vera Cruz, among *Sertularia*; Laguna, Mexico, on stones among Algæ; anchor ground, Laguna Harbour, 20 miles N. of Laguna in the sea (Rabenhorst and Schwarz!); Simbirsk Polirschiefer (Hardman!); † Faeroe Channel (Grove!).

* In the collection of Dr Greville.

† In the collection of Julien Deby.

C. marginato-lineatus. Sch., *Atl.*, pl. lix. fig. 33.—Diam. .0335 mm. Central space absent. Markings hexagonal, equal $3\frac{1}{2}$ to 4 in .01 mm. Border about $\frac{1}{7}$ of radius broad; striæ distinct, 6 to 8 in .01 mm., the inner half separated from the outer by a distinct narrow line.

Distinguished by the regularity of the markings and border.

Habitat.—Campeachy Bank (Schmidt).

C. peruanus, Grun. Sch., *Atl.*, pl. lviii. fig. 43.—Diam. .0425 mm. Central space absent. Markings polygonal, decreasing slightly from the centre outwards; towards the centre 5, towards the border 6 in .01 mm.; the oblique decussating rows straight or slightly curved outwards, well-marked; apiculi numerous, distinct, close to the border. Border hyaline.—Grun., *Denk. Wien. Ak.*, 1884, p. 85.

Distinguished from *C. excentricus* by the size of the markings, the apiculi, and border.

Habitat.—Peru guano (Schmidt).

C. sublineatus. *C. (excentricus, var.?) sublineatus*, Grun., *Denk. Wien. Ak.*, 1884, p. 85, pl. iv. (D), figs. 21, 22.—Diam. .032 to .053 mm. Central space and rosette absent. Markings hexagonal, gradually decreasing towards the border; at the centre 5, at the border 9 in .01 mm.; the oblique slightly bent, decussating rows distinct, non-apiculate. Border narrow, hyaline.

Distinguished from *C. excentricus* by having the markings at the border smaller in proportion to the others, and from *C. lineatus* by the less uniform markings.

Habitat.—Franz Josef's Land, White Sea (Grunow); Simbirsk Polirschiefer (Grunow).

C. anguste-lineatus. Sch., *Atl.*, pl. lix. fig. 34.—Diam. .0275 to .0455 mm. Central space and rosette absent. Markings polygonal, subequal, 6 in .01 mm. Apiculi minute, sometimes indistinct, at the border. Border narrow, hyaline.—Janisch, *Gazelle Exped.*, taf. iii. fig. 6. *C. lineatus, var. tenera*, Tru. & Witt., *Jeremie Diat.*, p. 14, pl. ii. fig. 2; Cleve and Möll., *Diat.*, No. 154.

Truan and Witt's *C. lineatus, var. tenera*, differs chiefly, according to the figure in the somewhat more distinct appearance of fasciuli

between the radial rows. It is not strictly defined by the authors.

Habitat.—Yokohama (Schmidt), Cambodia (Hardman !)* Mejilones (Hardman) ;* Los Angeles (O'Meara !); marine deposit, Fiji Islands (Grove!); rice fields, Georgia (Greville!); Zebu, Philippine Islands (Weissflog !); Jeremie deposit, Hayti (Truan and Witt); Indian Ocean, sounding by Capt. Pullen, 2200 fathoms (Greville!); Balearic Islands (Cleve and Möller !).

C. pseudo-lineatus. Pant., *Fossil. Bacil. Ung.*, p. 73, pl. ix. fig. 77.—Diam. .08 to .125 mm. Centre occupied by a single circular areola, .0025 mm. broad. Markings hexagonal, 8 to 9 in .01 mm., decreasing somewhat outwards; within the border a narrow punctate band, somewhat irregular on its inner side. Apiculi minute, numerous, forming a circle at the border, one larger inserted somewhat further inwards. Border striæ, delicate, 12 in .01 mm., merging into the adjacent band on the inner side.

Habitat.—Dolje deposit (Pantocsek !).

C. cristatus, sp. n.—sp. n.? Sch., *Atl.*, pl. lix. fig. 4.—Diam. .0305 mm. Central space and rosette absent. Markings regularly angular, 10 in .01 mm., a narrow hyaline band adjacent to the border; apiculi numerous, their outer ends obtuse, placed at the inner edge of the hyaline band. Border distinct, hyaline.

Habitat.—Peruvian guano (Schmidt).

Var. *distans*. (?) Sch., *Atl.*, pl. lix. fig. 5.—Diam. .02 mm. Markings 10 to 12 in .01 mm., secondary oblique rows distinctly curved outwards; no hyaline band adjacent to border; apiculi similar, but more distant.

Habitat.—Kings Mill (Schmidt).

C. tumidus, Janisch. Sch., *Atl.*, pl. lix. figs. 38, 39.—Diam. .164 to .2 mm. Surface convex towards the centre. Central space absent. Markings hexagonal, towards the centre 4 to 4½ in .01 mm., increasing outwards to the border to 3 in .01 mm.; oblique decussating rows, straight, or with slight bendings. Border striæ, 4 in .01 mm.—Cleve and Möll., *Diat.*, Nos. 125, 207.

Habitat.—Table Bay (Schmidt, Weissflog !); surface, Antarctic

* In the collection of Julien Deby.

Ocean, H.M.S. Challenger (Rae! Cleve and Möller!); Patagonia (Cleve and Möller!); Patagonia, 1375 fathoms, H.M.S. Challenger (Cleve!).

Var. *fasciculata*, nov.—Diam. $\cdot 2$ to $\cdot 28$ mm. Similar to the type, but markings in fasciculi, the rows in each parallel to that at its centre, the fasciculi few and wide, or numerous and narrow.

The fasciculi when wide resemble those of *C. polyradiatus*, Cstr., but the border is quite unlike that of the latter.

Habitat—Surface, Antarctic Ocean, H.M.S. Challenger (Rae!); Gazelle Expedition (Weissflog!).

C. leptopus, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxxi. figs. 5 and 6.—Diam. $\cdot 1$ mm. Central space absent. Markings hexagonal, decreasing but slightly at the border, and showing numerous round granules; towards the centre 4, towards the border 5 in $\cdot 01$ mm.; on a narrow irregular zone adjacent to the border minute round, granular; the oblique decussating rows sub-straight, evident; apiculi well defined, forming a circle close to the border at subregular intervals of about $\cdot 005$ mm., one larger inserted somewhat farther inwards. Border sharply defined; striae delicate 8 to 10 in $\cdot 01$ mm.—Cleve and Möll., *Diat.*, No. 114; Janisch, *Gazelle Exped.*, taf. v. fig. 4; *C. lineatus*, Sch., *Atl.*, pl. lix. fig. 26; *C. macraeanus*, Grun. (non Grev.), *vide* Sch., *Atl.*, *ibid.*

The large apiculus is not unlike that of *Podosira oliverana*, Grun. (Van Heurck, *ibid.*, pl. cxviii. fig. 5), found abundantly at Kerguelen by H.M.S. Challenger.

Habitat.—Off Ascension Island, S.S. Buccaneer (Grove!); Mascara (Cleve and Möller!); Californian guano (Greville!); Patos Island guano (Greville!); Mejillones guano, Balearic Islands (Van Heurck); Santa Marta deposit (Doeg!); Los Angeles (Cambridge!); Macassar Straits (Grove!). Trawled by H.M.S. Challenger, lat. $34^{\circ} 37' N.$, long. $140^{\circ} 32' E.$ (Rae!); Indian Ocean soundings, Capt. Pullen, 2200 fathoms (Greville!).

Var. *discrepans*, nov.—Diam. $\cdot 175$ mm. Markings hexagonal, at the centre of the valve an inequilateral 4-sided area, bounded by a narrow irregular band of dissimilar angular areolæ, which are continued outwards unequally from the angles towards the border;

the rows in the intervals slightly bent, oblique, and decussating; the band adjacent to the border sub-regular, with punctiform striæ 8 to 10 in .01 mm. Apiculi on border at intervals of .005 to .0075 mm.; the single large apiculus with a knob-like free end, inserted at inner edge of band adjacent to the border, about .0055 mm. long.—(Pl. II. fig. 3.)

Habitat.—Gazelle Exped. (Weissflog!).

§ V. FASCICULATI, Grun., *Denk. Wien. Ak.*, 1884, p. 80; Pant.,
Fossil. Bacil. Ung., p. 71.

Markings fasciculate, the fasciculi sometimes indistinct, or recognisable only on outer portion of valve, the rows composing each parallel to that at its centre or side; apiculi frequent.

C. vetustissimus. Pant., *Fossil. Bacil. Ung.*, p. 71, pl. xx. fig. 186.
—Diam. .075 to .1 mm. Central space and rosette absent. A small slightly excentric nodule, distinct. Markings hexagonal, increasing slightly to about the semiradius, again decreasing somewhat to the border, towards the centre and border 5, at the semiradius $4\frac{1}{2}$, in .01 mm., central papillæ distinct; irregular, on a small subcircular somewhat excentric area, about .006 mm. broad, and surrounded by an indistinct narrow, irregular, hyaline band; elsewhere in obscurely fasciculate substraight or in subradial rows, those in each fasciculus parallel to that at one of its edges, and most obvious when the papillæ are in pairs; non-apiculate. Border narrow, indistinct; striæ delicate, 8 to 10 in .01 mm.—Cleve and Möll., *Diat.*, Nos. 57, 155, 162, 164; Grun., *Bot. Centralbl.*, Bd. xxxiv. Nos. 2, 3, p. 35; *C. inæqualis*, Grove and Sturt., *Jour. Quek. Mic. Cl.*, 1887, p. 68.
—(Pl. II. fig. 17.)

In the fasciculation this species recalls *C. curvatulus*, but is distinguished by the excentric arrangement of its markings. It approaches *C. africanus*, var. *wallichiana*, Grun., in the latter respect, but Grunow's var. is non-fasciculate. In the excentric arrangement of the much smaller markings, as well as in their sub-fasciculate disposition, this species may be easily distinguished from *C. nodulifer*, Janisch.

Habitat.—Oamaru deposit (Grove! Cleve!); Yokohama (Schmidt); Cambridge deposit, Barbados (Kinker! Johnson!); Richmond, Va.

(Cleve and Möller!); Balearic Islands; Nancoori; Sta Monica deposit (Cleve and Möller!); between Aden and Bab-el-Mandeb; Mejillones guano (Cleve!); Alsó-, Felső-, Esztergaly, Kékkö and Szakal deposits (Pantocsek!).

Var. *curvatuloides*, Grove MS.—Diam. .1 mm. Markings irregular, and smallest on a small round excentric area, elsewhere subequal, $4\frac{1}{2}$ in .01 mm., and in evident fasciculate rows, those in each fasciculus parallel to that at its edge; apiculi minute, inter-fasciculate.—Cleve and Möll., *Diat.*, Nos. 57, 164.

Through this var. *C. vetustissimus* is allied to *C. curvatulus*, var. *genuina*.

Habitat.—Jackson's Paddock, Oamaru deposit (Grove!); Richmond, Va.; Sta Monica deposit (Cleve and Möller!).

C. atlanticus. Cstr., *Diat. Chall. Exped.*, p. 158, pl. v. fig. 8.—Diam. .046 mm. Central space and rosette absent. Markings round, granular, without order, and with hyaline interspaces from the centre to a little beyond the semiradius, thence polygonal, subequal, 10 in .01 mm., and in radial subfasciculate rows to the border. Border distinct, hyaline.

Habitat.—South Atlantic, H.M.S. Challenger (Castracane).

Var. *striatula*, nov. *C. atlanticus*, var., Cstr., *ibid.*, p. 158, pl. iii. fig. 7.—Diam. .0715 mm. Markings round, granular, and irregular from the centre to about $\frac{1}{4}$ of radius beyond this polygonal in evident fasciculi; those composing each fasciculus parallel to that at its centre, subequal, 6 in .01 mm. Border about $\frac{1}{3}$ of radius broad, striæ 8 to 10 in .01 mm.

Habitat.—(?) (Castracane).

C. nitidus. Greg., *Trans. Roy. Soc. Edin.*, 1857, p. 499, pl. x. fig. 45.—Diam. .03 to .075 mm. Surface almost flat. Central space absent. Markings small, rounded, subpearly, with hyaline interspaces, largest towards the centre, decreasing slightly to the border, irregular, sometimes in inconspicuous radial subfasciculate rows around the border. Border striæ, 6 in .01 mm., distinct.—Ralfs in *Pritch. Inf.*, p. 831, pl. viii. fig. 18; Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer*, Kiel, 1874, p. 94, pl. iii. fig. 32;

Sch., *Atl.*, pl. lviii. fig. 18 (excl. figs. 16, 17); Pant., *Fossil Bacil. Ung.*, p. 73, pl. xviii. fig. 166; Cleve and Möller's *Diat.*, No. 210; Janisch, *Gazelle Exped.*, taf. v. figs. 12, 14-16; *C. nitidus*, Greg., var., Cleve and Möll., *Diat.*, Nos. 150, 154, 155, 208, 257, 311; *C. foraminosus*, Grev. MS. in Coll. Brit. Mus.

Habitat.—Kékkö, Mogyorod, Szakal and Szent Peter deposits (Pantocsek); sand washings, Cumbrae (Arnott!)* Lamlash (Greville! Gregory!); Ascidia, Roundstone Bay, county Galway; Malahide, county Dublin; Restrevor, county Down; Kilkee, county Clare (O'Meara); Hvidingsoe (Schmidt); Manilla shells (Greville!); Tahiti (Kinker!); Numea Algæ (Kinker!); Manilla (Firth!); † Tamatave (Hardman!); ‡ Rio Janeiro (Hardman!); Oamaru deposit (Grove!); Campeachy Bay (Weissflog! Cleve and Möller!); Monterey (Weissflog!); § Gazelle Expedition (Weissflog!); Andaman Islands (Macrae!); || coral washings, locality? (Doeg!); shell cleanings, locality? (Doeg!); Rovigno, North Carolina, Balearic Islands, Gripp (Cleve and Möller!); Galapagos Islands, Labuan, Virgin Islands (Cleve!).

Var. *minor*. Cleve and Möll., *Diat.*, No. 154.—Diam. .025 to .0325 mm. Markings angular, 4 in .01 mm. Central papillæ prominent, rows evident near border; interspaces subobsolete.

Habitat.—Balearic Islands (Cleve and Möller!).

Var. *sparsa*. *C. nitidus*, Sch., *Atl.*, pl. lviii. fig. 17.—Diam. .035 mm. Markings round, isolated granules, with wider interspaces, smaller near the border. Border striæ more evident and longer.

Habitat.—Campeachy Bank (Schmidt).

Var. *tenuis*, nov. *C. nitidus*, Greg., var. Sch., *Atl.*, pl. lviii. fig. 19.—Diam. about .04 mm. Markings minute, with smaller hyaline interspaces, on a narrow band adjacent to the border punctiform, and forming regular radial striæ.—Sch., *Atl.*, pl. lvii. fig. 45 (?)

Habitat.—Campeachy Bank (Schmidt).

* In the collection of Dr Greville.

† In the collection of Dr F. W. Griffin.

‡ In the collection of Julien Deby.

§ This specimen has, on what seems to me insufficient grounds, been named on Weissflog's slide *C. nitidus*, var. by Grunow.

|| In the collection of Dr Greville.

Var. *moronensis*. Grun. MS.—Diam. .0875 mm. Markings with central papillæ more prominent, scabrous; secondary, irregularly, curved rows, subconcentric within the semiradius; around the border the subradial rows short, inconspicuous. Border narrow; striæ 6 or 7 in .01 mm.—(Pl. I. fig. 21.)

Habitat.—Moron deposit (Weissflog!).

C. nitidulus, Grun. Sch., *Atl.*, pl. lviii. figs. 20, 21.—Sometimes trilobate. Diam. .04 to .1175 mm. Central space absent. Markings small, round, granular, decreasing slightly towards the border; about 4 in .01 mm.; rows radial, beyond the semiradius subfasciculate; interspaces hyaline. Border distinct, narrow; striæ 6 to 8 in .01 mm.—Van Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 2; Pant., *Fossil. Bacil. Ung.*, p. 73, pl. xxiv. fig. 214; Janisch, *Gazelle Exped.*, taf. v. fig. 13.

Distinguished from *C. nitidus* by the smaller size of the markings, which decrease less towards the border.

Habitat.—Campeachy Bay (Van Heurck, Schmidt.); Szakal, Szent Peter and Dolje deposits (Pantocsek); Hong Kong (Hardman!); * Cambodia (Firth!); Springfield deposits, Barbados (Firth!); Sta Maria deposit (Grove!); Oamaru deposit (Firth!); Rio Janeiro (Hardman!); * Macassar Straits (Grove!); between Aden and Bab-el-Mandeb (Cleve!).

Var. *subradians*, nov.—Diam. .05 mm. Markings round, granular, largest at the centre, decreasing gradually outwards, punctiform at the border; interspaces wide, smallest towards the border; rows subradial, non-fasciculate, crowded on a distinct zone at the border about $\frac{1}{3}$ of the radius broad.

Habitat.—Aegina (Schmidt).

C. suspectus, Janisch. Sch., *Atl.*, pl. lix. fig. 2.—Diam. .106 mm. Central space and rosette absent. Markings polygonal, about 7 in .01 mm., decreasing slightly towards the border; rows radial or oblique and decussating, the former forming inconspicuous narrow fasciculi most evident beyond the semiradius, the latter straight or slightly curved outwards. Border narrow, hyaline.—Grun., *Denk. Wien. Ak.*, 1884, p. 85.

* In the collection of Julien Deby.

Distinguished from *C. circumdatus* by the greater irregularity of the rows about the centre and the simple border.

Habitat.—San Francisco, Cal. (Schmidt).

C. Kützingii. Sch., *Atl.*, pl. lvii. figs. 17, 18.—Diam. .0635 mm. Central space absent. Markings polygonal, about 6 in .01 mm., subequal or decreasing slightly towards the border; rows distinctly fasciculate beyond the semiradius; those in each fasciculus parallel to one another, secondary oblique decussating rows evident, and curved towards the border. Border sharply defined, bearing crowded oblique decussating rows of areolæ.—Grun. *Denk. Wien. Ak.*, 1884, p. 84; *C. marginatus*, Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer, Kiel*, 1874, p. 94, pl. iii. fig. 35.

Distinguished from *C. suspectus* by the more evident fasciculi and border, and from *C. subtilis* in the absence of apiculi. The relationship to *C. eccentricus* referred to by Grunow is more remote.

Habitat.—Cuxhaven, Firth of Tay (Schmidt); Arctic and Antarctic (Grunow).

Var. *glacialis*. Grun., *Denk. Wien. Ak.*, 1884, p. 84, pl. iv. (D), fig. 18.—Diam. .045 mm. Markings 10 in .01 mm., decreasing slightly towards the border; rows less distinctly fasciculate, a circlet of minute apiculi inserted at the border. Border striæ radial, distinct, 8 to 10 in .01 mm.

Habitat.—Franz Josef's Land; Cape Wankarema, North Siberia; Kerguelen (Grunow).

C. subglobosus. Cleve and Grun., *Denk. Wien. Ak.*, 1884, p. 84, pl. iv. (D), figs. 19, 20.—Diam. .025 to .04 mm. Surface somewhat convex. Central space absent. Markings polygonal, decreasing slightly towards the border, 8 in .01 mm.; rows radial, on outermost portion of valve parallel and subfasciculate; secondary oblique rows curved outwards, most evident towards the border.—Sch., *Atl.*, pl. lviii. fig. 44 (no name); Cleve and Möller, *Diat.*, Nos. 114, 172, 302, 319.

Distinguished from *C. Kützingii* by the more irregular markings on the central portion.

Habitat.—Arctic, Davis Straits; Franz Josef's Land, N. Siberia; Antarctic (Grunow); Davis Straits (Cleve and Moller!); Mascara, Cape Wankarema (Cleve! Cleve and Möller!); Greenland (Cleve!).

C. inclusus, sp. n. Sch., *Atl.*, pl. lvii, fig. 47 (no name).—Diam. about .07 mm. Central space distinct, rounded, slightly excentric. Markings rounded, granular, about 5 in .01 mm., smaller towards the border; rows fasciculate, those in each fasciculus parallel to the central radial row, non-apiculate. Border sharply defined, striæ 6 to 8 in .01 mm.

Habitat.—Richmond deposit, Virginia (Schmidt).

C. tuberculatus. Grev., *Trans. Micr. Soc. Lond.* 1861, p. 42, pl. iv. fig. 6.—Diam. .0375 to .0975 mm. Surface almost flat. Central space irregular, small. Markings around the central space minute, rounded, granular; beyond this polygonal $4\frac{1}{2}$ in .01 mm., subequal to the zone of the apiculi; at the border 6 in .01 mm.; rows radial or obscurely fasciculate, straight; apiculi distinct placed between the fasciculi. Border striæ delicate, 8 to 10 in .01 mm.—Sch., *Atl.*, pl. lvii. fig. 42; Grun., *Denk. Wien. Ak.*, 1884, p. 82.

This species cannot be united with *Aulacodiscus*, as suggested, with some doubt, in the second edition of Habirshaw's Catalogue, § *Coscinodiscus*. Small specimens in Weissflog's collection have been distinguished as *forma minor*, but these are quite normal. Distinguished from *C. subtilis* by its larger markings and more robust apiculi.

Habitat. — Barbados deposit (Greville! Hardman! Firth! Cleve!); Chalky mound, Barbados (Weissflog! Firth!); Cambridge deposit, Barbados (Firth! Johnson! Hardman!).

Var. *Moniceæ*. Grun. *ibid.*, p. 82, pl. iii. (C), fig. 29.—Diam. .0625 mm. Markings 3 to 5 in .01 mm., smaller close to the border; a few rows in each inconspicuous fasciculus; the apiculi interfasciculate, more evident.—*C. tuberculatus*, Grev. var.? Sch., *Atl.*, pl. lvii. figs. 40, 41.

The markings in the Barbados valves are larger than those in Sta Monica specimens. According to Schmidt, there are no pro-

cesses: "die dunkeln Flecke am Rande entstehen dadurch, dass sich je 2 bis 3 Zellchen mit Schalensubstanz füllen."

Habitat.—Sta Monica deposit (Grunow); Cambridge deposit Barbados (Johnson!).

C. isoporus. Ehrb., *Mikrog.*, pl. xxxiii. 17. fig. 3.—Diam. about .055 mm. Central space and rosette absent. Markings large, $3\frac{1}{2}$ to 4 in .01 mm., distinct, subequal to the circumference; rows radial, subfasciculate; secondary concentric rows evident.—Ralfs in *Pritch. Inf.*, p. 830.

Differs from *C. concavus* in the absence of a distinct border, and the concentric arrangement of the markings, and from *C. patina*, Ehrb., by the reduction in size, in the latter, of the markings around the evident clear border and their less conspicuous concentric arrangement.

Habitat.—Rappahannock Cliff, Virginia (Ehrenberg).

C. Payeri. Grun., *Denk. Wien. Ak.*, 1884, p. 80, pl. iii. (C), figs. 12, 13.—Diam. .024 to .03 mm. Central space small, about $\frac{1}{3}$ of diam. broad, irregular. Markings around the central space rounded, elsewhere angular, often quadrilateral; central papillæ distinct, towards the central space 5 or 6, at the border 9 in .01 mm.; rows radial, in inconspicuous fasciculi.

Habitat.—Franz Josef's Land (Grunow).

Var. *subrepleta*. Grun., *ibid.*, 1884, p. 80, pl. iii. (C), figs. 14, 15.—Diam. .034 mm. Central space subobsolete, or with small round isolated granules. Markings smaller, $4\frac{1}{2}$ to 5 in .01 mm., a band of small granules adjacent to the border.

Habitat.—Franz Josef's Land (Grunow).

C. hyalinus. Grun., *Denk. Wien. Ak.*, 1884, p. 108, pl. iii. (C), fig. 28.—Diam. .025 mm. Central space minute, inconspicuous, bearing isolated puncta. Markings punctiform, subequal, 24 in .01 mm.; rows radial to subparallel in inconspicuous fasciculi; apiculi numerous, distinct, in a single circlet. Border broad, hyaline.—Cleve and Möll., *Diat.*, No. 315; *Odontodiscus hyalinus*, Grun., *Kon. Sv. Vet.-Ak. Handl. Stockh.*, 1879, p. 113.

Distinguished from *C. bioculatus* by the absence of the two conspicuous central granules and the more numerous apiculi.

Habitat.—From iceberg, lat. 74° 48' 4" N., long. 54° 52' 8" E., August 1872 (Grunow); Cape Wankarema (Cleve and Möller! Cleve!); Tindingen, Franz Josef's Land; Kara (Cleve).

C. capensis. Grun., *Denk. Wien. Ak.*, 1884, p. 86, pl. iv. (D), fig. 29.—Diam. .032 mm. Surface with slight circular undulation about the semiradius. Central space circular, about $\frac{1}{3}$ of diam. broad, distinct, with a few isolated granules at its centre. Markings punctiform, smallest towards the border; rows straight or with slight bendings, inconspicuously fasciculate; apiculi numerous, distinct, frequently arranged in a double row. Border sharply defined, hyaline.—Cleve and Möller, *Diat.*, No. 197.

Distinguished from *C. biplicatus*, *C. pellucidus*, and *C. bengalensis* by its central space, subfasciculate rows, and apiculi.

Habitat.—Brackish water, Baaken River, S. Africa (Grunow).

C. bioculatus. Grun., *Denk. Wien. Ak.*, 1884, p. 107, pl. iii. (C), fig. 30; pl. iv. (D), fig. 1.—Diam. .02 to .03 mm. Surface convex, with faint concentric undulations. Central space subcircular, bearing two large conspicuous round granules, with evident central dot. Markings rounded, punctiform, least crowded towards the centre; rows subparallel in inconspicuous fasciculi, 18 to 22 in .01 mm.; apiculi small, but evident, close to the border, numerous, subregular.

In specimens from the Kara Sea and Cape Wankarema, N. Siberia, the markings and apiculi are more distant.

Habitat.—Franz Josef's Land (Grunow).

Var. *exigua*. Grun., *ibid.*, p. 108, pl. iv. (D), fig. 2.—Diam. .012 to .015 mm. Central space minute, the large round granule single, or sometimes two of unequal sizes, the one indistinct. Markings less evident; rows 24 to 26 in .01 mm.; apiculi minute, 4 in .01 mm.

Habitat.—Franz Josef's Land (Grunow).

C. semipennatus. Grun., *Denk. Wien. Ak.*, 1884, p. 83.—Diam. about .0305 mm. Central space absent or subobsolete. Markings rounded, or obtusely angular, granular; towards the centre 4, decreasing uniformly but considerably towards the border; rows fasciculate,

slightly curved towards the same direction; those in each fasciculus parallel to the corresponding and more conspicuous side rows; interspaces hyaline.—Sch., *Atl.*, pl. lvii. fig. 32 (no name).

Habitat.—Springfield deposit, Barbados (Schmidt); Cambridge deposit, Barbadoes (Kinker!).

C. Grunowii. Pant., *Fossil. Bacil. Ung.*, p. 74, pl. ix. fig. 74.—Diam. .062 to 0.75 mm. Surface flat, slightly convex near the border. Central space small, indistinct, almost filled in by isolated round granules. Markings obtusely angular, subequal, 7 to 8, towards the border more crowded, 9 to 10 in .01 mm.; slightly smaller at the centre than on the adjacent area, the central papillæ prominent; within the border from 10 to 23 small clear rounded subregular spaces; rows fasciculate, straight, and radial between the centre and the clear spaces near the border, the others parallel to these in the corresponding fasciculus. Border striæ delicate, 16 in .01 mm.

Habitat.—Alsö, and Felsö, Esztergály deposits (Pantocsek!).

Var. *minor*. *C. Grunowii forma minor*, Pant., *ibid.*, p. 74, pl. xiv. fig. 25.—Diam. .024 to .036 mm. Markings punctiform, 10 to 15 in .01 mm.; the fasciculi more distinct, the clear spaces within the border more irregular, sometimes larger.

Habitat.—Felsö-Esztergály deposit (Pantocsek).

C. odontodiscus. Grun., *Denk. Wien. Ak.*, 1884, p. 81, pl.iii. (C), fig. 23.—Diam. .0455 to .1125 mm. Central space absent, but a narrow hyaline ring close to the centre. Markings hexagonal, 6 to 7 in .01 mm., decreasing slightly outwards, punctiform in a narrow zone adjacent to the border; irregular at the centre within the clear band, elsewhere in subparallel rows; secondary oblique decussating rows evident; fasciculi evident, the rows composing each parallel to that at one of its edges; apiculi minute, interfasciculate.—Cleve and Möll., *Diat.*, No. 57, 162; *C. subtilis*, var., Sch., *Atl.*, pl. lvii. figs. 15, 16; *Odontodiscus spica*, Ehrb., *Mon. Ber. Ak.*, 1845, p. 79; *O. uranus*, Ehrb., *ibid.*, 1845, p. 79; *C. odontodiscus*, var. *parva-tenuistriata*, Cleve and Möll., *Diat.*, No. 276.

Habitat.—Richmond, Va. (Schmidt, Grove! Cleve and Möller!);

Patos Island guano (Norman !);* Nancoori; California; Sta Maria deposits (Grove !); Balearic Islands; Pabillan di Pico guano; Successful Bay, Kerguelen (Cleve !).

Var. *subsubtilis*, nov. *C. subtilis*, Sch., *Atl.*, pl. lvii. fig. 14.—Diam. .125 mm. Markings sometimes increasing slightly from the centre outwards or subequal; at the centre 10, at the border 8 in .01 mm.; rows straight, radial, fasciculate or subfasciculate towards the border. A narrow hyaline band adjacent to the border; apiculi minute, irregular, but interfasciculate, sometimes absent. Border striæ distinct, 6 in .01 mm.

Habitat.—Peruvian guano (Schmidt); Monterey (Kinker !); Nancoori (Hardman !); † Lobos di Afuera guano (Grove !); marine deposit, Fiji Islands (Grove !); Inland Sea, Japan, H.M.S. Challenger (Grove !); Springfield deposit, Barbados (Doeg !).

C. curvatus, Grun. Sch., *Atl.*, pl. lvii. fig. 33.—Diam. .045 to .07 mm. Central space absent or indistinct, with numerous rounded granules. Markings polygonal, subequal, 6 in .01 mm.; rows in gentle curves, fasciculate; those composing each fasciculus parallel to that at its convex edge; the curves on the two valves of a frustule in opposite directions, secondary oblique decussating rows obvious; apiculi absent.—Janisch, *Gazelle Exped.*, taf. ii. fig. 7; taf. v. figs. 2, 3, 8; taf. vi. fig. 2; taf. xx. fig. 17; *C. curvatus*, var. *inermis*, Grun., *Denk. Wien. Ak.*, 1884, p. 83, pl. iv. (D), figs. 11, 12; Sch., *Atl.*, pl. cxiii. fig. 6; Cleve and Möll., *Diat.*, Nos. 57, 154, 162, 276, 319; *C. curvatus*, var. *densius-striata* (?), Sch., *Atl.*, pl. lvii. fig. 35; *Odontodiscus curvatus*, Cleve, *Vega Exped. Vetensk. Jakttag. Stockh.*, Bd. iii. 1885, p. 488. In H. L. Sm., *Diat. Spec. Typ.*, No. 99.

This species is sometimes confounded with the very distinct *C. symmetricus*, Grev.

Habitat.—Los Angelos, Cal. (Cambridge !); Richmond deposit (Rae ! Cleve and Möller !); Caltanissetta deposit; Barbados deposit (Johnson !); Peruvian guano, Franz Josef's Land (Grunow); Bolivian guano (Cleve !); Infusorial deposit, "Algeria" (Greville !);

* In the collection of Dr Greville.

† In the collection of Julien Deby.

Yssee (Kinker!); Table Bay (Weissflog!);* Virginia (Hardman!); Nancoori, Balearic Islands (Cleve and Möller!); Melville Bay, lat. 75° 27' N., long. 64° 34' W. (O'Meara!);* Faeroe Isles (Grove!); marine deposit, Fiji Islands (Grove!); Japan (H. L. Smith!); Monterey (Cleve, Weissflog!); Ægina (Schmidt); Cape Wankarema, California (Cleve and Möller!); Patagonian guano (Cleve!); Sta Monica deposit (Grove!).

Var. *latius-striata*. Sch., *Atl.*, pl. lvii. figs. 30, 34.—Diam. .1 mm. Central space and rosette absent. Markings $3\frac{1}{2}$ to 4 in .01 mm., increasing gradually outwards to about semiradius, again decreasing similarly to the border; fasciculi distinct, rows sometimes slightly curved; apiculi absent. Border striæ, 6 in .01 mm.

Distinguished by the large size of the markings. Sometimes associated with *C. subtilis*, to which it bears no affinity.

Habitat.—Cambridge deposit, Barbados (Hardman!);† Barbados (Cleve!).

Var. *minor*. Grun., *ibid.*, 1884, p. 83, pl. iv. (D), figs. 8, 10.—Diam. .03 to .04 mm. Central space small and granular, or absent. Markings in more straight, less distinctly fasciculate rows; secondary oblique rows indistinct, non-apiculate (excl. *C. minor*, Ehrb.).

The union of *C. minor*, as figured in Schmidt's *Atlas*, pl. lviii. fig. 40, to the present var., as proposed by Grunow, is erroneous.

Habitat.—Girgenti and Caltanissetta deposits (Grunow); Nancoori deposit (Hardman!).‡

Var. *genuina*. Grun., *ibid.*, 1884, p. 83, pl. iv. (D), fig. 13.—Diam. .0325 to .125 mm. Central area small, circular, with but few granules. Markings 8 to 10 in .01 mm.; apiculi minute, interfasciculate. Border sharply defined; striæ delicate, 14 to 16 in .01 mm.—Van Heurck, *Typ. Syn. Diat. Belg.*, No. 534; Sch., *Atl.*, pl. lvii. fig. 36 (no name) and 37. *C. Szontaghii*, Pant., *Fossil. Bacil. Ung.*, p. 72, pl. xv. fig. 133.

Specimens from Bolivia pass into the var. *subocellata*, Grun.

* Procured by M'Clintock.

† In the collection of Julien Deby.

‡ *Ibid.*

Pantocsek's figure does not show the fasciculation, though this is distinct in his specimens.

Habitat.—From ice in lat. 74° 48' 4" N., long. 54° 52' 8" E., Aug. 2, 1872 (Grunow); San Francisco, Cal. (Firth!); Los Angeles, Cal. (Griffin!);* Oran, Algeria (Van Heurck!); soundings off Kurile Islands, 1329 fathoms (H. L. Smith!);† Barbados (Johnson!);‡ Richmond deposit, Va. (Rae!); Kekkö deposit (Grove!); Jack's Ranch, Cal. (Macrae!); Szakal and Szent Peter deposits (Pantocsek!).

Var. *kariana*. Cleve and Grun., *Kong. Sv. Vet.-Ak. Handl. Stockh.*, 1880, p. 113, pl. vii. fig. 129.—Diam. .023 to .024 mm. Central space absent. Markings distinct, 11 to 12 rows in each fasciculus and 13½ to 14 in .01 mm.; apiculi interfasciculate, distinct.—*Odontodiscus curvatus*, var. *kariana*, Cleve and Grun., *ibid.*, 1880, p. 113.

Habitat.—Kara Sea (Cleve and Grunow); Finmark (Cleve).

Var. *subocellata*. Grun., *ibid.*, 1884, p. 83, pl. iv. (D), fig. 15, from Bolivian guano and Cape of Good Hope (Grunow); Kerguelen Island and Challenger dredgings off Vancouver Island (Grove!), belongs to *Actinocyclus*.

Var. *recta*, nov. *C. curvatus*, var., Cstr., *Diat. Chall. Exped.*, p. 160, pl. iii. fig. 10.—Diam. .03 to .0875 mm. Markings 4 to 5 in .01 mm., arranged in straight fasciculi; apiculi distinct, interfasciculate, sometimes absent. Border with slight indentations opposite the apiculi.—Cleve and Möll., *Diat.*, Nos. 57, 164, 276; Janisch, *Gazelle Exped.*, taf. i. fig. 6; taf. iv. fig. 4.

This var. approaches var. *minor*. Specimens have sometimes been confounded with *C. barbadensis*, Grev., or regarded as fasciculate forms of *C. oculus-iridis*.

Habitat.—H.M.S. Challenger (Castracane); Richmond; Sta Monica deposit, California (Cleve and Möller!); Barbados deposit (Cleve!); Yokohama (Cleve!); Monterey stone (Cleve!); San Benito deposit, California (Grove!); Marstrand (Kinker!).

* In the collection of Dr F. W. Griffin.

† In H. L. Sm. *Diat. Spec. Typ.*, No. 93.

‡ In the collection of Dr Greville.

I have not seen *C. curvatus*, var. *barbadensis*, Cleve MS., from Barbados, nor *C. curvatus*, var. Cleve MS., from Yokohama. *C. curvatus*, var. *frigida*, Grun. (*Vega Exped., Vetensk. Jakttag. Stockh.*, Bd. iii. 1883, p. 488), remains undefined. Specimens so named were procured in Franz Josef's Land.

C. crenulatus, Grun. Sch., *Atl.*, pl. lvii. fig. 38.—Diam. .0605 mm. Central space absent. Markings polygonal, subequal, about 5 in .01 mm.; irregular on a small area at the centre, elsewhere in fasciculate rows; those composing the fasciculi parallel to that at their corresponding sides; apiculi distinct, inserted at inner edge of border and interfasciculate. Border sharply defined, its outer edge crenate, the indentations corresponding in position to the spines, its inner half with distinct striæ 6 in .01 mm., its outer half smooth.—Grun., *Denk. Wien. Ak.*, 1884, p. 83, pl. iv. (D), fig. 17.

Habitat.—Seychelles, Bolivian guano, ex *Salpa spinosa*, Southern Ocean, Balearic Islands (Grunow); Kings-Mill Islands (Schmidt).

C. æginensis. Sch., *Atl.*, pl. cxiii. figs. 13, 14.—Diam. .061 to .085 mm. Surface flat. Central space subcircular, $\frac{1}{10}$ to $\frac{1}{14}$ of diam. broad, bearing a few isolated round granules, one much larger than the others. Markings around the central space round, subequal, elsewhere polygonal, increasing outwards to about the semiradius, thence decreasing gradually to the border; towards the centre $4\frac{1}{2}$, at the semiradius $3\frac{1}{2}$ in .01 mm.; rows radial, subfasciculate beyond the semiradius, secondary oblique rows evident. Border narrow, striæ 6 in .01 mm.

Habitat.—Aegina (Schmidt).

C. simbirskianus. Grun., *Denk. Wien. Ak.*, 1884, p. 81.—Diam. .1 to .225 mm. Central space absent, sometimes minute; rosette inconspicuous or subobsolete, sometimes distinct. Markings hexagonal, increasing slightly outwards to about the semiradius, thence decreasing gradually to the border; towards the centre 4, at the semiradius 3 to $3\frac{1}{2}$, at the border 6 in .01 mm.; central papillæ evident; rows fasciculate, those in each fasciculus subparallel to that at its centre; oblique decussating rows evident. Border narrow; striæ 4 to 5 in .01 mm.—Sch., *Atl.*, pl. cxiii. figs. 11, 12.

Distinguished from *C. radiatus* by the fasciculate arrangement of the markings.

Habitat.—Simbirsk (Grunow, Grove !); Ananino deposit (Grove ! Kinker ! Rae ! Deby !); Archangelsk-Kurojedowo (Schmidt, Cleve !).

C. symmetricus. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 68, pl. viii. fig. 2.—Diam. $\cdot 075$ to $\cdot 175$ mm. Central space small, rounded, $\frac{1}{2}$ of diam. broad, sometimes absent. Markings subpearly; round or subangular, granular, 4 in $\cdot 01$ mm., subequal or slightly smaller at the border; interspaces hyaline; rows straight, fasciculate, those composing a fasciculus parallel to that at its centre; around the border a narrow hyaline clear space, irregular on its inner side, sometimes bearing a few isolated granules. Border striæ evident, 6 in $\cdot 01$ mm.—Excl. *C. symmetricus*, Sch., *Atl.*, pl. lvii. figs. 25–27; Grun., *Denk. Wien. Ak.*, 1884, p. 81.

Narrow hyaline radial spaces sometimes, in larger valves, run outwards for some distance from the central space. Quite distinct from *C. subtilis* in the size and arrangement of the markings. *C. ? clypeus*, Ehrb. (*Mikrog.*, pl. xi. fig. 6), from Bilin deposit, Bohemia, is too minute for identification. The fragments show round granular fasciculate markings with hyaline interspaces. Ehrenberg did not define the species, and regarded it as probably a fragment of *Campylodiscus clypeus*. The figure may represent a small piece of *Coscinodiscus symmetricus*, Grev.

Habitat.—Cambridge deposit, Barbados (Johnson ! Greville ! Firth !); Manilla (Firth !); Newcastle deposit, Barbados (Firth !); “Barbados” (Kinker !).

C. planiusculus, sp. n.—Diam. $\cdot 0825$ mm. Surface flat. Central space rounded, indistinct, about $\frac{1}{17}$ of diam. broad. Markings rounded or oval, with long axis radial; outlines faint; central papillæ evident; about $3\frac{1}{2}$ in $\cdot 01$ mm., subequal, on a distinct band around the border, about $\frac{1}{8}$ to $\frac{1}{6}$ of radius broad, moniliform; rows fasciculate, those in each fasciculus parallel to that at its middle. Border crenate, a minute dark speck at each indentation at intervals of about $\cdot 005$ mm.—Janisch, *Gazelle Exped.*, taf. vi. fig. 12. (Pl. I. fig. 22.)

Differs from *C. subtilis* in the shape of the markings, the monili-

form band adjacent to the border and the crenate appearance of the latter.

Habitat.—Gazelle Expedition (Weissflog!).

C. fasciculatus. O'Me., *Quart. Jour. Micr. Sci.*, 1867, p. 245, pl. vii. fig. 1.—Diam. .0825 mm. Central space circular, distinctly defined. Markings areolate, subequal to the border; rows fasciculate, 9 composing each fasciculus and parallel to that at its centre, the central radial row only extending to the central space, each adjacent pair successively terminating farther and farther from it; interspaces at origin of shorter rows hyaline; apiculi absent.

The markings are intermediate in size between those of *C. symmetricus* and of *C. Normani* or *C. subtilis*.

Habitat.—Dredged off Arran Islands, co. Galway (O'Meara).

C. echinatus, sp. n. Sch., *Atl.*, pl. lviii. figs. 35, 36 (no names).—Diam. about .03 mm. Central space minute, rosette absent. Markings angular, subequal or decreasing gradually from the centre outwards, towards the centre $4\frac{1}{2}$ to 5, towards the border sometimes 6 in .01 mm.; rows fasciculate, those in each fasciculus parallel to the central row; fasciculi few, 3 to 5. Apiculi large, spine-like, interfasciculate, inserted some distance from border. Border sharply defined, striæ 6 in .01 mm., sometimes obscure.

Habitat.—Moron deposit (Schmidt).

C. lentiginosus, Janisch. Sch., *Atl.*, pl. lviii. fig. 11.—Diam. .075 mm. Central space absent. Markings round, granular, least crowded and with narrow hyaline interspaces towards the centre, angular and more crowded around the border; towards the centre 6, at the border 8 in .01 mm.; irregular on a small indistinct central area, elsewhere in fasciculate rows, those in each fasciculus parallel to that at its middle; a minute apiculus close to the border, readily overlooked. Border striæ delicate, 16 in .01 mm.—Cleve and Möll., *Diat.*, No. 207; *C. lentiginosus*, var. *maculatus*, Grun., Cleve and Möll., *Diat.*, No. 183.

A similar spine occurs in *C. leptopus* and *C. kryophilus*. Its character is distinct from those of *Eupodiscus*, to which on its account it has sometimes been proposed to unite Janisch's species.

Habitat.—Patagonia, Antarctic Ocean (Cleve and Möller!);

Kerguelen (Grove !); Antarctic ooze 1950 fms., H.M.S. Challenger (Rae ! Kinker ! Hardman ! Grunow); lat. 46° 46' N., long. 45° 31' E., 1375 fms. H.M.S. Challenger (Castracane !); Oamaru deposit (Doeg ! Marshall!);* Table Bay (Schmidt); Challenger dredgings, off Vancouver's Island, and Globigerina ooze, off Ascension, S.S. Buccaneer (Grove).

C. kryophilus. Grun., *Denk. Wien. Ak.*, 1884, p. 81, pl. iii. (C), fig. 21.—Diam. .044 mm. Central space rounded, indistinct, about $\frac{1}{5}$ of diam. broad, bearing isolated rounded granules. Markings polygonal, minute; rows fasciculate, those composing each fasciculus parallel to the radial row at its middle; a single prominent spine inserted near the border, outside of this a circllet of numerous, closely placed minute apiculi.—Janisch, *Gazelle Exped.*, taf. iii. fig. 3.

Distinguished from *C. lentiginosus*, Janisch, by the larger spine and by the apiculi, and from *C. polyacanthus* by the smaller but more numerous apiculi.

Habitat.—Cape Wankarema, N. Siberia (Grunow).

C. symbolophorus. Grun., *Denk. Wien. Ak.*, 1884, p. 82, pl. iv. (D), figs. 3-6.—Diam. .085 to .175 mm. Surface convex. Colour at centre steel grey, an opaque ring towards the semiradius, whence dark radial bands proceed outwards. Central space small, and usually branching into a distinct star with 3 to 5 rays, sometimes absent, but around the central area a similar star with 3 to 5 lanceolate rays. Markings polygonal, decreasing regularly outwards; towards the centre 6, towards the border 8 to 9 in .01 mm.; fasciculate, those composing each fasciculus parallel to the radial row at its middle; secondary oblique decussating rows faint, often somewhat curved outwards. Border narrow, hyaline.—*Symbolophora*, sp. Ehrb., Grun., *ibid.*, 1884, p. 82; *S. microtrias*, Ehrb., *Mon. Ber. Ak.*, 1884, p. 205; *Mikrog.*, pl. xxxv. A. 21. fig. 16; *S. tetras*, Ehrb., *ibid.*, 1844; p. 205; *Abh. Ber. Ak.*, 1872, pl. xii. 2. fig. 1; *S. pentas*, Ehrb., *ibid.*, 1844, p. 205; *Mikrog.*, pl. xxxv. A. 22. fig. 19; *S. hexas*, Ehrb.,

* In the collection of F. W. Griffin. Mr Grove remarks that he has never seen this species in the Oamaru deposit, and greatly doubts its presence there, it being a form which may easily adhere to tubes and beakers.

1844, p. 205; *S. microtetras*,* Ehrb., *Mon. Ber. Ak.*, 1855, p. 302; *S. micropentas*,* Ehrb., *ibid.*, 1855, p. 302; *S. microhexas*,* Ehrb., *ibid.*, 1855, p. 302; not *S. trinitatis*, Ehrb., *ibid.*, 1844, p. 88; Ralfs in *Pritch. Inf.*, p. 833, pl. xi. fig. 36, as indicated in the second edition of Habirshaw's Catalogue, § *Symbolophora*.

By Grunow this species is brought near *C. subtilis*, but it is readily distinguished from the latter by the central star and the absence of apiculi. *Symbolophora acuta*, Ehrb., from Hollis Cliff, Virginia, of which but a fragment is figured (*Mikrog.*, pl. xxxiii. 15. fig. 21), probably belongs to the present species. *S. euprepia*, Ehrb., from Licuare River, coast land Mozambique, remains a *nomen nudum*, but may come here (see Ehrb., *Mikrog.*, p. 228). Small specimens of *C. symbolophorus* approach *C. eccentricus*.

Habitat.—Nottingham deposit, Mors deposit (Cleve! Grunow); Simbirsk Polirschiefer (Ehrenberg, Grunow); Kékkö, Szakal and Szent Peter deposits (Pantocsek); Franz Josef's Land (Grunow); pancake ice, Antarctic Ice Barrier, and sounding of 190 fms., lat. 78° 10' S., long. 162° W.; sounding 270 fms., lat. 63° 40' S., long. 55° W. (Hooker); Ananino deposit (Grove! Kinker! Hardman!); † Lumford, Jutland (Hardman!); Bermuda tripoli (Greville!); Oamaru deposit (Grove! Marshall!); Ananino deposit (Rae! Deby!).

C. stellaris. Roper, *Quart. Jour. Micr. Sci.*, 1858, p. 21, pl. iii. fig. 3.—Diam. .075 to .1 mm. Surface slightly convex. Markings, around the centre 5 or 6 large areolæ, at subequal distances apart, and tapering towards both ends, elsewhere scarcely visible, 16 to 20 in .01 mm., angular, most evident towards the centre, the rows forming fasciculi, those in each fasciculus parallel to the radial row at its middle.—*C. stellaris*, var. Cstr., *Diat., Chall. Exped.*, p. 155, pl. iii. fig. 2; *C. stellaris*, var. *fasciculata*, Cstr., *Diat., Chall. Exped.*, 1886, p. 158, pl. v. fig. 9.

The colour when dry is brownish. Castracane's Antarctic frustule seems to differ only in having four markings at the centre. Transitional forms to *C. symbolophorus* occur.

Habitat.—Caldy, Pembrokeshire (Roper! Rev. J. Guillemard);

* *Nomina nuda*, probably identical with *S. tetras*, *S. pentas*, *S. hexas*.

† In the collection of Julien Deby.

Tenby Bay (Roper!);* oyster shells, Dublin Bay (O'Meara); Mediterranean (Grunow); Balearic Islands (Weissflog!); Antarctic Ice Barrier, H.M.S. Challenger (Castracane).

Var. *Mejillonis*. Grun., *Denk. Wien. Ak.*, 1884, p. 82.—Diam. .23 mm. Markings 18 in .01 mm., central rosette with 8 large areolæ.

Habitat.—Mejillones guano (Grunow, Grove!).

C. minutellus, sp. n.—Diam. .0225 mm. Surface flat. Central space and rosette absent; a minute, somewhat excentric triangular clear area (.0025 mm. broad) with a single central dot evident. Markings polygonal, 10 in .01 mm., still smaller towards the border; rows faintly fasciculate, subradial, the secondary oblique outwardly concave, decussating rows more distinct; apiculi at the border prominent, at subequal intervals of .0076 mm., or somewhat less.—Border narrow, hyaline.—(Pl. II. fig. 5.)

Habitat.—From *Salpa spinosa*, locality? (Weissflog!).

C. subtilis. Ehrb., *Abh. Ber. Ak.*, 1841, p. 412, pl. i. 3. fig. 18; pl. iii. 7. fig. 4.—Diam. .0425 to .1125 mm. Central space and rosette absent. Markings polygonal, 6 to 10 in .01 mm., decreasing somewhat towards the border, without order on a small central area, elsewhere in fasciculate rows, about 12 forming each fasciculus at its outer extremity, and arranged parallel to the central radial row; secondary oblique decussating rows evident; apiculi sometimes present at the border, interfasciculate. Border striæ delicate, faint, 12 to 14 in .01 mm.—Ehrb., *Mikrog.*, pl. xviii. fig. 35, *a.b.*; pl. xxxiii. 13. fig. 4; pl. xxxiii. 16. fig. 7; pl. xxxiv. 7. fig. 6; pl. xxxv. 22. fig. 5; pl. xxxv. 23. fig. 5. Grev., *Quart. Jour. Micr. Sci.*, 1859, p. 81; Ralfs in *Pritch. Inf.*, p. 830; Jan., *Abh. Sch. Ges. väter. Cult.*, 1862, Heft ii. p. 4, pl. i. A, fig. 2; Janisch, *Gazelle Exped.*, taf. ii. fig. 8; iv. figs. 1, 2; v. figs. 5, 7; vi. figs. 1, 5; xx. fig. 5; Grun., *Sitzungsb. naturw. Ges. Isis, Dresden*, 1878, p. 124; Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer, Kiel*, 1874, ii. p. 94; Sch., *Atl.*, pl. lvii. figs. 11, 13, 28, 29 (no name); pl. lviii. fig. 37 (no name); Grun., *Denk. Wien. Ak.*, 1884, p. 81,

* In the collections of Dr Greville and E. Grove.

pl. ii. (C), fig. 26; Raben., *Alg. Europ.*, Nos. 2142, 2487, 2558; Van Heurck, *Syn. Diat. Belg.*, p. 218, pl. cxxxi. fig. 1; *Typ. Syn. Diat. Belg.*, Nos. 519, 520, 532, 533; Cleve and Möll., *Diat.*, Nos. 57, 125, 162, 164, 207, 211, 257, 258, 319; H. L. Smith, *Diat. Spec. Typ.*, No. 100; *C. subtilis*?, Sch., *Atl.*, pl. lviii. fig. 12 (excl. *C. radiolatus*? = *C. subtilis*, Ehrb., *Mikrog.*, pl. xxii. fig. 4).

According to Ehrenberg's original definition, there should be 12 markings in .01 mm. Fasciculi were hardly indicated in his figures, several of which approach his *C. intermedius*. There is no close affinity to *C. punctatus*, Ehrb., as he at one time believed (*Mon. Ber. Ak.*, 1844, pp. 186, 188-191). The species approaches *C. Normani*, Greg., but in the latter the markings are less regular, the fasciculi at the border consist of about 6 rows instead of 12, and the lines between the fasciculi are less distinct. Janisch erroneously describes the markings as round. Schmidt, in 1874, erroneously refers to the fasciculi as branched towards the same side by a bent ray. Specimens are sometimes confounded with *C. odontophorus*, Grun., and *C. Rothii*, Grun., and are distinguished from *C. symmetricus*, Grev., and *C. denarius*, Sch., only by their smaller markings, to which transitional forms occur, Grunow having observed forms from Monterey and Australia with $5\frac{1}{2}$ to 7 markings in .01 mm.

Habitat.—Stratford (Ehrenberg); Richmond, Va. (Ehrenberg, Rae! Cleve and Möller!); Caltanissetta (Ehrenberg); Moron deposit (Schmidt); Peruvian guano (Janisch, Schmidt); Angamos guano (Janisch); Bolivian guano (Grunow); Patos guano (Greville!); Assistance Bay, San Francisco (Ehrenberg); lat. $71^{\circ} 19' N.$, long. $11^{\circ} 28' W.$, 129 fms., in yellowish-grey mud; lat. $73^{\circ} 16' N.$, long. $15^{\circ} 48' W.$, 1300 fms., in dark greyish-brown mud; lat. $63^{\circ} 40' N.$, long. $5^{\circ} 28' E.$, 569 fms., in light grey fine mud; lat. $74^{\circ} 11' N.$, long. $15^{\circ} 19' W.$, 224 fms., in fine greyish-brown mud; lat. $74^{\circ} 33' N.$, long. $18^{\circ} 39' W.$, 90 fms., in coarse sandy mud (Ehrenberg);* pancake ice, Antarctic Ice Barrier, lat. $78^{\circ} 10' S.$, long. $162^{\circ} W.$; melted ice, lat. $75^{\circ} S.$, long. $170^{\circ} W.$; snow and ice, near Vancouver Island, lat. $70^{\circ} S.$, long. $165^{\circ} W.$; floating ice, lat. $64^{\circ} S.$, long. $160^{\circ} W.$; Gulf of Erebus and Terror, lat. $63^{\circ} 40' S.$, long. $55^{\circ} W.$, 207 fms.; ex *Salpá*, lat. $66^{\circ} S.$, long. $157^{\circ} W.$

* Specimens procured by the second German North Polar Expedition.

(Hooker); Canton (Ehrenberg); Yokohama and Arica (Schmidt); *Ascidia*, Hull (Greville !), rice fields, Georgia (Grove ! Bailey,* Greville !) Yssee (Kinker !); dredged in 28 fms., Royal Sound, Kerguelen, by H.M.S. Challenger (Rae !); † “Antarctic Ocean” (Cleve and Möller !); rice field mud, Savannah (Cleve ! H. L. Smith !) Cambodia (Hardman ! ‡ Firth !); Port Elizabeth (Hardman !); Humber (O’Meara !); Richmond Tunnel (O’Meara !); “India” (Macrae !); § Holstein (Van Heurck !); Maryland (O’Meara !); Japan (H. L. Smith !); Los Angeles deposit (O’Meara !); Cannibal Islands (Greville !); Gazelle Expedition (Weissflog !); Macassar Straits (Grove !); mud from Glückstadt; Elbe, above Cuxhaven (Rabenhorst and Schwarz !); Archangelsk (Cleve); Campeachy Bank, Gulf of Mexico (Rabenhorst and Gerstenberger !); Rappahannock River, Va. (Rogers ! Greville !); on Dutch rushes, Hull (Norman !); Virginia (Greville !); Indian Ocean soundings, Capt. Pullen, 2200 fms. (Greville !); Kannahack, Cannibal Islands (Greville !); Woodlark Island (Roberts !); Bass Straits (Greville !); Kantschatka, 1700 fms. (Greville !); Jersey (Wallich !); Patos Island guano (Greville !); shell cleanings from Singapore (Hardman !); Nicobar shell cleanings (Doeg !); Santa Marta deposit (Doeg !); coral washings, Mauritius (Doeg !); Newcastle deposit, Barbados (Doeg !); N. Atlantic, lat. 51° 20’ N., long. 52° 25’ W., 232 fms. (O’Meara !); Wexford (O’Meara !); Faeroe Isles (Grove !); Monkstown (O’Meara !); Jack’s Ranch California (Macrae !); Monterey (Schmidt); Upolu (Weissflog); Nancoori; Sta Monica deposit; Patagonia; Delaware; North Carolina; Pensacola; Cape Wankarema (Cleve ! Cleve and Möller !); Balearic Islands (Cleve !); Greenland, Yeddo, Franz Josef’s Land, Peruvian guano, Pabillan di Pico guano, Patagonian guano, Schleswig Holstein; Elbing, West Prussia; Labuan, Virgin Islands (Cleve !).

Var. *siberica*. Grun., *Kongl. Sv. Vet.-Ak. Handl. Stockh.*,

* Found in various localities in United States in 1850. Its presence, with other brackish or salt water species in the rice fields, has been held to indicate the presence of salt water much further up the river formerly than at present.

† In the collection of Dr F. W. Griffin.

‡ In the collection of Julien Deby.

§ In the collection of Dr Greville.

1880, No. 2, p. 115.—Diam. .044 mm. Markings more delicate, 15 to 16 rows in .01 mm., irregular on a small central area; fasciculi numerous, each consisting of about 12 rows; apiculi absent.

This forms transition to *C. glacialis*.

Habitat.—Jenissey (Cleve and Grunow).

Var. *lineolata*, nov.—Diam. .0575 mm. Central space subcircular, from this a single narrow straight line passing to the border and at intervals of about $\frac{1}{3}$ of the surface, two other pairs of straight rows in contact with one another. Markings in irregular inconspicuous fasciculi; apiculi at the border, inter-fasciculate; indistinct.—(Pl. I. fig. 16.)

Grunow has regarded this var. as an abnormal form of *C. subtilis*.

Habitat.—Mors Island (Weissflog!).

Var. *scabra*, nov.—Diam. .0375 to .055 mm. Central space absent. Markings 12 to 14 in .01 mm., somewhat smaller towards the border; fasciculi inconspicuous; apiculi few, indistinct at wide intervals, not between each pair of fasciculi; minute scattered hyaline specks (apiculi?) most numerous towards the centre.—(Pl. III. fig. 6.)

Habitat.—Nancoori (Weissflog!).

C. whampoensis. Grove M.S.—Diam. .075 mm. Surface with a distinct narrow elevated ring about $\frac{2}{3}$ of the radius from the centre. Central space and rosette absent. Markings hexagonal, decreasing slightly towards the border; towards the centre 8 to 10, towards the border 12 in .01 mm.; irregular on a minute round central area, elsewhere in substraight fasciculate rows, deflected slightly near the border, those in each fasciculus parallel to that at or near its middle; apiculi minute, inserted at the border at wide intervals of .0175 mm. or more, between or upon the fasciculi. Border narrow, hyaline.—(Pl. I. fig. 24.)

The elevated zone, the less regular appearance of the fasciculi at their outer ends, and the distant apiculi, distinguish this species from *C. subtilis* and *C. Rothii*.

Habitat.—Canton River, Whampo (Grove!).

C. odontophorus. *C. (subtilis* var. ?) *odontophorus*, Grun., *Denk. Wien. Ak.*, 1884, p. 82, pl. iii. (C), fig. 24.—Diam. .05 to .175 mm. Surface slightly concave at the centre, and convex towards the border. Central space and rosette absent. Markings polygonal, 6 in .01 mm.; punctiform on a distinct narrow zone extending outwards from the apiculi, thence gradually becoming more delicate and indistinct to the border; rows irregularly fasciculate, those in each fasciculus subparallel to that at its centre, or to a row near one of its edges; secondary oblique decussating rows distinct, most evident on the narrow zone at the apiculi; apiculi prominent, inserted at unequal intervals upon or between the outer ends of the fasciculi, at a considerable distance from the border. Border distinct, narrow; striæ delicate, 8 in .01 mm.

Distinguished from *C. subtilis* by the markings and apiculi.

Habitat.—California deposits (Grunow); “chalk beds between White Plains and Hot Spring Station,” California (Grove! Kinker!).

C. glacialis. *C. (subtilis*, var. ?) *glacialis*, Grun., *Denk. Wien. Ak.*, 1884, p. 82, pl. iii. (C), fig. 27.—Diam. .0215 mm. Surface slightly convex. Central space and rosette absent. Markings polygonal, 15 to 16 in .01 mm., on a small rounded central area, irregular, elsewhere forming 8 broad radiating fasciculi; apiculi at border minute, interfasciculate.

Habitat.—Under side of iceberg, lat. 74° 48' 4" N., long. 54° 52' 3" E., Aug. 1872 (Grunow).

C. polyacanthus. Grun., *Kong. Sv. Vet.-Ak. Handl. Stockh.*, 1880, No. 2, p. 112, pl. vii. fig. 127.—Diam. .026 mm. Central space absent. Markings polygonal, minute, irregular on a small indistinct central area, elsewhere in fasciculate rows, the rows composing each fasciculus 12, parallel to that at the middle, 15 to 16 in .01 mm.; secondary oblique decussating rows faint, apiculi distinct, numerous, about 5 in .01 mm., placed upon and between the outer ends of the fasciculi. Border narrow, hyaline.—*Odontodiscus polyacanthus*, Grun., *ibid.*, 1880, p. 112.

Distinguished from *C. Rothii* and *C. odontodiscus* by the more numerous and stronger apiculi.

Habitat.—Jamal (Cleve and Grunow); Franz Josef's Land

(Grunow); Baltic Sea (Grunow); Tindingen (Cleve!); San Benito deposit, California? (Grunow!?).

Var. *davisiana*. Grun., *Denk. Wien. Ak.*, 1884, p. 81, pl. iii. (C), fig. 19.—Diam. .035 mm. Markings larger, hexagonal, 10 in .01 mm.; fasciculi less evident, secondary oblique rows more indistinct; apiculi closer to the border, arranged in two concentric rows.

Habitat.—Davis Straits, Franz Josef's Land (Grunow).

Var. *intermedia*. Grun., *ibid.*, 1884, p. 81, pl. iii. (C), fig. 25.—Diam. .06 mm. Markings in evident fasciculi, the secondary oblique rows distinct; apiculi distinct, less numerous, at some distance from the border, forming a single row, and inserted at the middle of and between the fasciculi.

Habitat.—Cape Wankarema, N. Siberia (Grunow).

Var. *baltica*. Grun., *ibid.*, 1880, No. 2, p. 112.—*C. polyacanthus*, Grun., *Sitzungsb naturw. Ges. Isis, Dresden*, 1878, p. 125.—Diam. .03 to .1 mm. Central space minute and irregular, sometimes distinct, about $\frac{1}{2}$ of diam. broad, having minute isolated granules. Markings somewhat larger, rows fasciculate, 12 to 14 in .01 mm., straight and regular; apiculi some distance from the border, of variable size, especially among larger specimens, arranged usually in two subconcentric indistinct rows.—Cleve and Möller, *Diat.*, No. 237; *C. polyacanthus*, var. ? *baltica*, Grun., *ibid.*, 1884, p. 81, pl. iii. (C), figs. 17a, b; *C. balticus*, Grun., in Cleve's Coll.

Though this var. was originally named *C. polyacanthus* in 1878, it remained imperfectly defined, *C. polyacanthus* being subsequently diagnosed from Jamal valves; the original *C. polyacanthus* being at the same time (1880) reduced to var. *baltica*.

Habitat.—Waxholm, Hernösand; Rathan, Baltic Sea (Cleve! Grunow); Baltic bottom clay, black clay from Roslagen, silt from Ronneby, Dalarö, Furusund, Norrtelje (Juhlin-Dannfelt).

C. divisus. Grun., *Sitzungsb. naturw. Ges. Isis, Dresden*, 1878, p. 125.—Diam. .08 mm. Central space indistinct, rounded, with numerous isolated granules, about $\frac{1}{8}$ of diam. broad. Markings round, granular about the central space, elsewhere polygonal; about 10 in .01 mm., decreasing slightly outwards, on a distinct band

around the border, minute, 15 to 16 in $\cdot 01$ mm.; rows fasciculate, the fasciculi consisting of 8 to 10 rows, their sides almost straight or more curved; apiculi interfasciculate, minute, inserted at inner edge of marginal band.—*C. (curvatulus, var.?) divisus*, Grun., *Denk. Wien. Ak.*, 1884, p. 83, pl. iv. (D), fig. 16).

In 1878 Grunow distinguished as var. *arcuata* specimens with the edges of the fasciculi somewhat bent, those of the type being straight.

Habitat.—Peruvian guano, on *Macrocystis* and *Lessonia* from the coast of Peru (Grunow).

C. Normani, Greg., in Grev., *Quart. Jour. Micr. Sci.*, 1859, p. 80, pl. vi. fig. 3.—Diam. $\cdot 0625$ to $\cdot 1125$ mm. Surface slightly convex. Central space and rosette absent. Markings polygonal, about 8 in $\cdot 01$ mm., decreasing somewhat towards the border; rows radial, fasciculate, converging slightly towards the periphery, towards the border 6 rows composing each fasciculus; apiculi absent or minute. Border with delicate striæ of closely placed punctiform markings.—Janisch, *Gazelle Exped.*, taf. v. fig. 6; *C. fasciculatus*; Sch.,* *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer.*, Kiel, 1874, ii. p. 94; Sch., *Atl.*, pl. lvii. figs. 9, 10; *Odontodiscus subtilis*, Grun., in Sch., *ibid.*, 1874, p. 95; *C. subtilis*, var. *Normanii*, Van Heurck, *Syn. Diat. Belg.*, p. 218; *C. normanicus*, Van Heurck, *ibid.*, Explan. pl. cxxxi. fig. 1; in Van Heurck, *Typ. Syn. Diat. Belg.*, No. 532; *C. subtilis*, Ehrb., *Eul. Diat. Sp. Typ.*, No. 115 (*vide* Van Heurck); *C. curvatulus*, var. *Normanii*, Cleve, *Vega Exped. Vetensk. Jakttag. Stockh.*, 1883, Bd. iii. p. 488.

An undulation of the surface, resulting from greater prominence of the lines between the fasciculi, as referred to by Greville, is not constant. Well-preserved specimens of *C. fasciculatus*, Sch., show indications of minute processes.

Habitat.—Ex *Ascidii*, Hull (Norman); Roundstone Bay, co. Galway (O'Meara); Dutch rushes from Holland (?); Arran Islands, co. Galway (O'Meara); Cuxhaven (Schmidt); marshy ground, Wedel (Grunow); locality ? (Kinker!); Richmond tunnel (O'Meara!); Holstein (Van Heurck!); (Richmond, Va. (Rae!); Californian guano (Norman!); † Arafura Sea, H.M.S. Challenger (Doeg!).

* Not *C. fasciculatus*, O'Me., *Quart. Jour. Micr. Sci.*, 1867, p. 245, pl. vii. fig. 1.

† In the collection of Dr Greville.

C. marginulatus, Rattray. *C. marginulatus*, var. *gallopagensis*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. xciv. fig. 30.—Diam. .0315 mm. Central space and rosette absent. Markings punctiform; rows straight, inconspicuous, fasciculate; those in each fasciculus parallel to the central row; at intervals evident, radial striæ not quite reaching the centre; apiculi at the border minute, at somewhat regular intervals. Border broad, striæ evident, 8 in .01 mm.

Habitat.—Galapagos Islands (Van Heurck).

Var. *curvato-striata*, Grun. Sch., *Atl.*, pl. lvii. fig. 5.—Diam. .045 to .05 mm. Central space $\frac{1}{8}$ to $\frac{1}{20}$ of diam. broad, hyaline. Fasciculi numerous, almost straight or curved; apiculi minute, sometimes hardly visible. Border striæ 8 to 10 in .01 mm.—Van Heurck, *Syn. Diat. Belg.*, pl. xciv. fig. 32.

In Moron (?) valves, in Weissflog's collection, the striæ on the border are still more delicate, 12 to 14 in .01 mm.

- *Habitat*.—Campeachy Bay (Weissflog! Van Heurck); Moron (?) deposit (Weissflog?).

Var. *stellulifera*, Grun. Van Heurck, *ibid.*, pl. xciv. fig. 34.—Diam. .02 mm. Central space as in var. *curvato-striata*. Fasciculi separated around the central space by short straight lines, indistinct on the outer half; apiculi less evident. Border striæ more delicate.

Habitat.—Campeachy Bay (Von Heurck).

Var. *sparsa*, Grun. Van Heurck, *ibid.*, pl. xciv. fig. 31.—Diam. .035 mm. Central space absent. Markings irregular; apiculi absent. Border striæ distinct.

The var. *campechiana*, Grun. (Van Heurck, *ibid.*, pl. xciv. fig. 33), from Campeachy Bay, differs only in having evident apiculi at the border.

Habitat.—Campeachy Bay (Van Heurck).

C. angulatus, Grev., *Trans. Micr. Soc. Lond.*, 1864, p. 9, pl. ii. fig. 11.—Diam. .075 mm. Surface flat, showing an octagonal figure at inner edge of border. Central space and rosette absent. Markings polygonal, $3\frac{1}{2}$ to 4 in .01 mm., slightly smaller at the border; the rows straight parallel to those passing from the centre to the apiculi, secondary oblique rows less evident. Apiculi

obvious, placed at the angles of the octagon. Border with its inner edge distinct, about $\frac{1}{8}$ of radius broad, striæ evident, 4 to 5 in $\cdot 01$ mm.

Habitat.—Cambridge deposit, Barbados (Cleve, Greville!); Oamaru deposit (Grove!).

C. Rothii. Grun., *Denk. Wien. Ak.*, 1884, p. 29, pl. iii. (C), figs. 20a, 20b, 22.—Diam. $\cdot 07$ to $\cdot 175$ mm. Surface with faint undulations. Central space absent. Markings polygonal, 6 to 8 in $\cdot 01$ mm., decreasing slightly towards the border, irregular on a small central area, elsewhere in straight fasciculate rows, subparallel to that at centre of each fasciculus or subradial; apiculi small, placed at the middle of the outer ends of each fasciculus. Border distinct, with uniform striæ, 14 in $\cdot 01$ mm.—Cleve and Möll., *Diat.*, No. 57; *C. Rothii forma minor*, Grun.; Van Heurck, *Typ. Syn. Diat. Belg.*, No. 533; *C. symmetricus*, Kitton and Weissflog (not Grev.), *Sch. Atl.*, pl. lvii. figs. 25, 26, 27; *Heterostephania Rothii* (α) *octonaria*, Ehrb., *Mikrog.*, pl. xxxv. A, 13B. fig. 4; *H. Rothii* (β) *denaria*, Ehrb., *ibid.*, pl. xxv. A, 13B. fig. 5; *H. Rothii*, Ralfs in *Pritch. Inf.*, p. 833., pl. v. fig. 33.

Ehrenberg established but did not define *Heterostephania*, of which the only known species was *H. Rothii*; his forms *octonaria* and *denaria* founded only on the number of fasciculi may be abandoned. *C. Rothii* is sometimes distinguished from *C. subtilis* by the smaller number of rows in each fasciculus, and especially by the position of the apiculi. *C. Rothii forma minor*, Grun., differs only in its small size, $\cdot 025$ to $\cdot 0375$ mm. in diam.

Habitat.—Elbe Tertiary mud (Ehrenberg).* Ceylon (Macrae!); † Caspian Sea (Grunow); locality? (Rae!). Porto Seguro (Hardman!); Manilla (Firth!); Amboina shell scrapings (Kinker!); surface, Arafura Sea, H.M.S. Challenger (Rae!); Oamaru deposit (Marshall!); ‡ Chalky Mt., Barbados (Firth!); † Para River, S. America (Hardman!); § India (Macrae!); || Antwerp (Van Heurck!); Oamaru deposit (Grove!); Whampoa (Grove!); rice fields, Georgia (Greville!); ¶ Cambridge deposit, Barbadoes (Johnson!); || Rio Janeiro

* This diluvial formation was discovered by Roth.

† In the collection of Dr Greville. ‡ In the collection of Dr F. W. Griffin.

§ In the collection of Julien Deby. || In the collection of Dr Greville.

¶ Rare, amongst abundance of *C. subtilis*.

(Weissflog!); Curtis Straits (Roberts!); Richmond (Cleve and Möller!); Successful Bay, Kerguelen (Cleve!); Virgin Islands (Cleve!).

Var. *singaporensis*, nov.—Diam. $\cdot 085$ mm. Central rosette evident, large. Markings 4 in $\cdot 01$ mm. Adjacent to the border a sharply defined broad band with smaller markings, 6 in $\cdot 01$ mm. Apiculi large, with a median constriction and rounded extremities, inserted at inner edge of the marginal band. Border narrow, striæ 6 in $\cdot 01$ mm.

Habitat.—Singapore (Schmidt).

Var. *actinocycloides*. *C. actinocycloides*, Pant., *Fossil. Bacil. Ung.*, p. 71, pl. ix. fig. 72.—Diam. $\cdot 075$ to $\cdot 1125$ mm. Surface flat towards centre, slightly convex towards the border. Central space small, subcircular, punctate. Markings 6 towards the border, gradually diminishing to 8 in $\cdot 01$ mm.; rows parallel to that at centre of each fasciculus, secondary oblique decussating rows straight, the fasciculi separated by evident rows of small subulate hyaline interspaces; apiculi distinct.

Habitat—Kékkö, Szakal, Felső-Esztergály deposits (Pantocsek!); Kékkö deposit (Grove!); Szent Peter deposit (Grove!).

Var. *grandiuscula*, nov. Sp. n.? Sch., *Atl.*, pl. lvii. fig. 23.—Diam. $\cdot 04$ mm. Markings 6 in $\cdot 01$ mm. Apiculi prominent, placed at a considerable distance from the border.

Habitat.—Rio de Janeiro (Schmidt).

C. doljensis. Pant., *Fossil. Bacil. Ung.*, p. 72, pl. xii. p. 105.—Diam. $\cdot 036$ to $\cdot 1$ mm. Surface slightly convex towards the border. Central space minute, indefinite, with minute isolated or subangular granules. Markings delicate, 12 to 15 in $\cdot 01$ mm., somewhat less crowded towards the centre, towards the border punctiform; rows radial and subparallel, obscurely fasciculate; minute subulate hyaline spaces opposite origin of the shorter rows, on a distinct band adjacent to the border, the oblique decussating rows more manifest. Apiculi prominent at intervals of $\cdot 006$ to $\cdot 01$ mm. Border narrow, hyaline.

Habitat.—Dolje Klebschiefer (Pantocsek!).

C. barbadensis. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 43, pl. iv. fig. 9.—Diam. .035 mm. Surface flat. Central space absent. Markings polygonal, 8 in .01 mm., 9 subsymmetrical prominent rows proceeding from the centre to the border, the intervening rows subradial.

This species, like *C. senarius*, Sch. (*Atl.*, pl. lvii. fig. 24), forms the transition to *Aulacodiscus*. In the second edition of Habirshaw's Catalogue, the unnamed Springfield valves figured by Schmidt (*Atl.*, pl. lvii. fig. 32), subsequently justly separated by Grunow as *C. semipennatus* (*Denk. Wien. Ak.*, 1884, p. 83), are erroneously associated with this species.

Habitat.—Barbados deposit (Greville !).

C. Gregorii. O'Me., *Proc. Roy. Ir. Acad.*, 1875, p. 263, pl. xxvi. fig. 23.—Central space small, angular. Markings subquadrangular, smaller and more equal than in *C. nitidus*, Greg.; rows radial from the angles of the central space, fasciculate; those in each fasciculus parallel to that at its centre or subradial.

This is not *Campylodiscus*? an *Coscinodiscus*? Greg., from Glen-shira Sand (*Trans. Micr. Soc. Lond.*, 1857, p. 84, pl. i. fig. 50), as stated by O'Meara, Gregory's specimens being devoid of a central space, and having large rounded sparsely placed markings in rows partly parallel and partly radial, among the rows a broad rectangular cross being faintly visible.

The *C. semipennatus*, Grun. (Sch., *Atl.*, pl. lvii. figs. 32, 32*), from Barbados, is not so close to *C. Gregorii*, O'Me., as it is to Gregory's valves. *C. Gregorii* differs from *C. senarius*, Sch., in the presence of a central space, and in having less evident rays between the fasciculi.

Habitat.—Arran Island; *Ascidia*, Roundstone Bay, co. Galway; *Ascidia*, co. Clare (O'Meara).

C. denarius. Sch., *Atl.*, pl. lvii. figs. 19, 20, 21.—Diam. .053 to .0755 mm. Central space absent. Markings polygonal, equal, 3½ to 4 in .01 mm., rows fasciculate, those of each fasciculus parallel to the radial row at its centre, secondary straight oblique decussating rows obvious. Border striæ sometimes distinct, 8 in .01 mm.—*C.*

* In the collection of Dr Griffin, and procured in the original sample sent to Firth by Kitton.

denarius, var., Sch., *Atl.*, pl. lvii. fig. 22; *C. (symmetricus, var.) denarius*, Sch., Cleve and Grun. in *Moll.*, *Diat.*, No. 183.

The fasciculi sometimes do not reach the centre, because of the extension inwards of the rows belonging to the adjacent fasciculi. Distinguished from *C. subtilis* by the larger more uniform markings.

Habitat.—Springfield deposit, Barbados (Doeg! Schmidt!); Campeachy Bank, Sansego (Schmidt); Cambridge deposit, Barbados (Greville!); Chalky Mount, Barbados (Firth!); * Antarctic Ocean (Cleve and Möller!).

Var. *variolata*. *C. variolatus*, Cstr., *Diat. Chall. Exped.*, p. 155, pl. ii. fig. 5.—Diam. $\cdot 0\text{f}8$ mm. Surface spotted at wide irregular intervals with small groups of more prominent granules. Border narrow, hyaline.

Habitat.—Phillipine Islands, H.M.S. Challenger (Castracane).

Coscinodiscus? Ehrb., *Abh. Ber. Ak.*, 1871, p. 140, pl. i. (B), fig. 20.—A minute fragment showing closely placed angular markings in straight fasciculate rows, which are parallel to that at the centre of the fasciculus. Border hyaline, distinct.

In the second edition of Habirshaw's Catalogue, this is associated with a valve indicated as *Coscinodiscus*, sp.? Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer, Kiel*, 1874, p. 95, pl. iii. fig. 42), but it is more nearly allied to *C. denarius*, var., Sch. (*Atl.*, pl. lvii. fig. 19), from Sansego.

C. senarius. Sch., *Atl.*, pl. lvii. fig. 24.—Diam. $\cdot 04$ mm. Central space absent. Markings polygonal, equal, 4 in $\cdot 01$ mm.; rows fasciculate, those composing each fasciculus parallel to that at its middle, the interfasciculate rows most prominent; secondary oblique decussating rows straight, non-apiculate. Border narrow, striæ delicate, 12 to 14 in $\cdot 01$ mm.—Janisch, *Gazelle Exped.*, taf. vi. fig. 5.

Habitat.—Springfield deposit, Barbados (Schmidt).

C. partitus. Grove and Sturt MS.—Diam. $\cdot 05$ mm. Central space minute, rosette absent. Markings subactinocycloid, rounded, granular, towards centre 6, towards border more crowded, sub-punctiform, 8 in $\cdot 01$ mm.; rows straight, fasciculate, inconspicuous,

those in each fasciculus parallel to the central row; interfasciculate radial rows most evident, secondary oblique decussating rows most obvious towards border; interspaces minute, most evident towards centre; apiculi distinct, inserted a short distance from border. interfasciculate. Border narrow, striæ delicate, 10 in $\cdot 01$ mm.—Cleve and Möll, *Diat.*, Nos. 114, 162.—(Pl. III. fig. 5.)

Habitat.—Totara, Oamaru (Grove !); Mascara, Nancoori (Cleve and Möller !).

C. extravagans. Sch., *Atl.*, pl. lviii. fig. 33.—Diam. $\cdot 053$ mm. Central space distinct, circular, about $\frac{1}{6}$ of diam. broad. Markings small, granular, about 6 in $\cdot 01$ mm., more crowded, somewhat smaller on a distinct marginal zone about $\frac{1}{3}$ to $\frac{2}{3}$ of radius broad; rows radial, fasciculate, those between the fasciculi most prominent; those composing each fasciculus parallel to the radial row at its middle, secondary oblique rows evident on the marginal zone; interspaces hyaline at the inner ends of the shorter rows; apiculi large, conical, interfasciculate, inserted at inner edge of marginal zone. Border hyaline.

Habitat.—Yokohama (Schmidt).

C. interlineatus, sp. n.—Diam. $\cdot 06$ mm. Surface flat. Central space and rosette absent. Markings hexagonal, 8 to 10 in $\cdot 01$ mm., somewhat smaller towards the border, rows fasciculate, those in each fasciculus parallel to that at its middle; secondary oblique decussating rows straight, slightly flexuous or concave outwards, obvious; between each fasciculus a distinct radial row, the fasciculi 7, unequal; apiculi evident, interfasciculate, inserted at the border. Border indistinct.—(Pl. I. fig. 6.)

Differs from *C. senarius*, Sch., by the more delicate markings and apiculi.

Habitat.—Newcastle deposit, Barbados (Weissflog !); Nancoori deposit (Cleve !).

C. actinosus, Grove MS.—Diam. $\cdot 06$ mm. Surface slightly convex near the border. Central space inconspicuous, round, with rounded granules at its middle. Markings actinocycloid, round, granular, faint; towards the border angular and in contact, towards the centre 8, towards the border 10 in $\cdot 01$ mm.; interspaces small and

hyaline towards the centre, most evident opposite origin of shorter rows; rows fasciculate, straight, those in each fasciculus parallel to that at its centre, interfasciculate radial rows evident; secondary oblique decussating rows most evident towards the border. Border distinct, striæ delicate, 14 to 16 in .01 mm.—(Pl. II. fig. 7.)

Habitat.—Manilla Algæ (Grove!).

C. obnubilus, Rattray. *C. umbonatus*,* Cstr., *Diat.*, *Chall. Exped.*, p. 156, pl. ii. fig. 8.—Diam. .077 mm. Surface rising steeply from the centre for about $\frac{1}{3}$ of radius, thence descending rapidly outwards, becoming slightly concave, near the border flat. Central space subcircular, about $\frac{1}{12}$ of diameter broad, with several isolated granules at its middle. Markings punctiform, subequal, about 8 in .01 mm., most crowded towards the border; rows fasciculate, those composing each fasciculus parallel to the radial rows at one of its sides or subradial; interspaces small, hyaline, opposite the origin of the shorter rows; apiculi distinct, inserted at the border, interfasciculate. Border distinct, narrow.

Habitat.—Pacific Ocean, 2900 fms., H.M.S. Challenger (Castracane).

§ VI. RADIATI, Grun., *Denk. Wien. Ak.*, 1884, p. 70; Pant., *Fossil.*

Bacil. Ung., p. 69. *Pseudostephanodiscus*, Grun., *ibid.*, p. 85.

Clivosi, Pant., *ibid.*, p. 72. *Eleganti*, Pant., *ibid.*, p. 73.

Surface flat, rarely undulate, centre sometimes depressed. Markings rounded or areolate; rows radial, sometimes faintly fasciculate towards the border; apiculi sometimes present.

C. diversus. Grun., *Denk. Wien. Ak.*, 1884, p. 72.—Diam. .07 to .135 mm. Central space absent. Markings rounded, pearly, with hyaline interspaces from the centre for $\frac{1}{2}$ to $\frac{2}{3}$ of radius, increasing slightly outwards; on the outer portion polygonal, $2\frac{1}{2}$ to 3, at the border 6 in .01 mm.; central papillæ distinct; secondary oblique rows indistinct. Border with inner edge indistinct; striæ obvious, radial or subradial, about 6 in .01 mm.—Sch., *Atl.*, pl. lxii. figs. 13-15 (without name); *C. carabicus*, Tru. and Witt., *Jeremie Diat.*, p. 13, pl. ii. fig. 3.

* Name preoccupied by Gregory for a different species.

Grunow considers that this may be an abnormal form of *C. radiatus*. To me it seems to be more allied to *C. marginatus*.

Habitat.—Springfield deposit, Barbados, and Cambridge deposit, Barbados (Schmidt, Hardman!);* “Barbados deposit” (Rae! Greville!).

Var. *completa*.—Diam. .1125 to .14 mm. Central space small, angular, .0035 to .005 mm. broad; the bounding areolæ inconspicuous. Markings polygonal and in contact to the central space, towards the centre $3\frac{1}{2}$, increasing outwards to $2\frac{1}{2}$ in .01 mm. at about $\frac{3}{4}$ of the radius, again decreasing to the border, punctate; secondary oblique rows obvious.

Habitat.—Barbados deposit (Rae!).

C. profundus. Ehrb., *Mon. Ber. Ak.*, 1854, p. 238.—Diam.?. Central space and rosette absent. Markings somewhat larger at centre, about semiradius $6\frac{1}{2}$ to 7 in .01 mm., near border smaller and more crowded; interspaces distinct, most evident opposite the shorter rows, at about $\frac{2}{3}$ of radius from centre.—Ehrb., *Mikrog.*, pl. xxxv. B.B. fig. 8; Ralfs in *Pritch. Inf.*, p. 830.

Ehrenberg's figure shows the markings as subcircular and as decreasing gradually from the centre outwards, but more rapidly near the border.

Habitat.—Atlantic Ocean, 2000 fms.; lat. $62^{\circ} 6' N.$, long. $32^{\circ} 21' W.$, 1540 fms.; lat. $59^{\circ} 12' N.$, long. $50^{\circ} 38' W.$; lat. $58^{\circ} 3' N.$, long. $51^{\circ} 50' W.$;† northern and equatorial zone, 16 to over 2000 fms. (Ehrenberg).‡

C. antarcticus. *C. (subglobosus, var.?) antarcticus*, Grun., *Denk. Wien. Ak.*, 1884, p. 84, [pl. iv. (D), fig. 23.—Diam. .03 mm. Central space and rosette absent. Markings irregular, polygonal, increasing from the centre to about the semiradius, again diminishing towards the border; at the centre 8, at the semiradius 4, towards the border 8 in .01 mm.; rows indistinct; on outer half of valve inconspicuous, irregular, concentric bands; apiculi numerous, inserted close to the border, Border with inner edge indistinct; striæ irregular, 10 to 12 in .01 mm.

* In the collection of Dr Greville.

† *Mon. Ber. Ak.*, 1861, p. 280.

‡ *Abh. Ber. Ak.*, 1872, p. 263.

The valve named *C. decipiens*, Grun. (Sch., *Atl.*, pl. lix. fig. 18), from Table Bay, is distinct, though Grunow has proposed to unite them; in the latter the markings are largest at the centre, and the apiculi are more prominent.

Habitat.—Antarctic, Kerguelen (Grunow).

C. lanceolatus. Cstr., *Diat. Chall. Exped.*, p. 164, pl. xvii. fig. 19.—Elliptical to subdiamond-shaped. Major axis $\cdot 0775$ mm., about $2\frac{1}{2}$ times minor. Central space and rosette absent. Markings polygonal, largest and subequal on a small indefinite central area, thence decreasing to the border; at the centre 3, at the border 6 in $\cdot 01$ mm.; irregular or in faint radial rows.

This species forms a transition to the untenable genus *Stoschia*.

Habitat.—South of Australia, H.M.S. Challenger (Castracane).

C. velatus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 78.—Diam. about $\cdot 055$ mm. Central space and rosette absent. Markings angular, robust, pearly, about $2\frac{1}{2}$ in $\cdot 01$ mm., punctate; rows obscurely radial, subregularly concentric.—Ehrb., *Mikrog.*, pl. xviii. fig. 37; Ralfs in *Pritch. Inf.*, p. 830.

Ehrenberg regarded this species as probably belonging to *Eupodiscus*. With this, owing to the absence of processes, it cannot be united. It is closely allied to *Stephanopyxis*. It also approaches *C. marginatus*.

Habitat.—Richmond deposit, Va. (Ehrenberg).

C. marginatus. Ehrb., *Abh. Ber. Ak.*, 1841, p. 142.—Diam. from $\cdot 0375$ to $\cdot 15$ mm. Central space absent. Markings polygonal, somewhat pearly, with large, round central papillæ; towards the centre 2 to $2\frac{1}{2}$ in $\cdot 01$ mm., decreasing gradually towards the border. Border distinct, $\cdot 0025$ to $\cdot 0075$ mm. broad, with coarse striæ, 4 in $\cdot 01$ mm.—Ehrb., *Mikrog.*, pl. xviii. fig. 44; pl. xxxiii. 12. fig. 13; pl. xxxviii. B. 22. fig. 8; Cleve and Möll., *Diat.*, No. 114, 164, 215; H. L. Sm., *Diat. Sp. Typ.*, Nos. 94, 95; Sch., *Atl.*, pl. lxii. figs. 1, 2, 3, 4, 5, 9, 11, 12; pl. lix. fig. 11 (no name); *C. fimbriatus limbatus*,* Ehrb., *Mikrog.*, pl. xix. fig. 4; Sch., *Atl.*, pl. lxv. figs. 3-6; pl. cxiii. fig. 2; *C. limbatus*, Ehrb., *Mon. Ber. Ak.*, 1840, p. 206;

* Quoted "*C. fimbriato-limbatus*," by Grunow, *Denk. Wien. Ak.*, 1884, p. 72.

Mikrog., pl. xx. figs. 29a, b; Sch., *Atl.*, pl. lxxv. fig. 7; * Raben., *Alg. Europ.*, Nos. 2484, 2485; *C. radiatus f. heterosticta*, Grun. in Pant., *Fossil. Bacil. Ung.*, p. 70, pl. xx. fig. 184; *C. oculus-iridis*, Sch. in *Atl.*, pl. cxiii. fig. 2; *C. subconcauus forma major*, Sch., *Atl.*, pl. lxxii. fig. 7; † (excl. *C. limbatus*, Jan. et Raben.—Raben., *Beitr. Kennt. u. Verbreit. Alg.*, Leipzig, 1863, p. 7, pl. iv. fig. 1; and *C. marginatus*, Kütz., *Bacil.*, p. 131, pl. i. fig. 7).

Hardman's original Monterey specimen, on which *C. robustus*, Grev., was founded, is not in the Grevillean Collection of the British Museum, but two specimens on a slide of Bermuda tripoli, labelled by Greville "*C. robustus*," and now in this collection, belong to *C. marginatus*. The *C. limbatus*, Jan. et Raben., has a central space, markings increasing to about the semiradius, and again decreasing to the border. Forms occur in Cambridge deposit, Barbados, similar to that figured by Schmidt (*Atl.*, pl. lxxv. fig. 7). Stokes has labelled specimens of this species *C. ambiguus*.

Schmidt is only prohibited from uniting the specimens figured on pl. lxxii. figs. 11, 12, with *C. velatus* by the small size of the markings and the absence of the fine puncta which, according to Grunow, cover the surface of that species.

Habitat.—Richmond, Va.; tripoli from Columbia River Oregon, Patagonian tufa; plastic clay, Aegina (Ehrenberg, Schmidt); Nottingham, U.S. (Hardman!); ‡ San Diego, San Pedro (H. L. Smith!); Bajtha, Elesd Alsö, Felső-Esztergally, Kékkö, Mogyorod, Szakal, and Dolje deposits (Pantocseck!); sounding from 2950 fms., H.M.S. Challenger (Rae!); "California" (Deby! Cleve!); Cambridge deposit, Barbados (Hardman!); † Monterey (Stokes! § Firth! Greville! Cleve!); Sta Barbara deposit (Kinker!); Moron deposit (Kinker!); Faeroe Channel (Grove!); Nagy-Kurtos deposit, Hungary (Rae! Deby!); Nancoori (Hardman!); soundings off Kurile Islands, 1329 fms. (H. L. Smith!); Behring Sea, 1681 fms. (H. L. Smith!); Los Angeles (Hardman! Cambridge!); || Oamaru deposit (Grove!);

* Quoted "*C. fimbriatus*, Sch. (nec. Ehrb.);" by Grunow, *ibid.*, p. 72.

† Grunow (*Denk. Wien. Ak.*, 1864, p. 72) refers to this simply as *C. subconcauus*, Grun., and proposes to name it *C. marginatus*, var. *subconcaua*, or better, to unite it to *C. robustus*, Grev., the markings towards the centre being 2, towards the border 3 to 3½ in .01 mm. The central papillæ are prominent, as in *C. robustus*.

‡ In the collection of Julien Deby.

§ In the collection of E. O'Meara.

|| In the collection of Dr Griffin.

"Barbados" (Johnson! Cleve!); Rappahannock River, Va. (Rogers!); * Kékkö and Sta Maria deposits (Grove!); Szent Peter deposit (Pantocsek! Grove!); San Benito deposit, California (Grove!); Kamtschatka Sea, 1700 fms. (Greville! Bailey!); Atlantic Telegraph soundings (Roper!); * Piscataway deposit (Greville!); Santa Monica deposits (Cleve and Möller! Firth!); * King's Mill (Schmidt); Nicobar Islands (Schmidt); Mascara (Cleve and Möller!); Nottingham deposit, Md. (Cleve and Möller!); Brünn Tegel (Cleve!); Holland's Cliff (Cleve!); anchor ground, Laguna Harbour, 20 miles N. of Laguna in the sea (Rabenhorst and Schwarz!); Marstrand (Kinker!).

Var. *decussata*, nov.—Diam. .115 mm. Markings 3 in .01 mm., subequal to the zone at the border, the secondary oblique decussating rows obvious; radial rows not differentiated. Border more sharply defined.

Habitat.—Roundstone Bay, Ireland (O'Meara!).

Var. *latemarginata*. Pant., *Fossil. Bacil. Ung.*, p. 70, pl. xxii. fig. 201.—Diam. .057 mm. Markings subequal, 3 in .01 mm. Border sharply defined. Striæ more distant.

Habitat.—Elesd deposit, Hungary (Pantocsek!).

Var. *intermedia*, Rattray. *C. robustus*, var. *intermedia*, Grun., *Denk. Wien. Ak.*, 1884, p. 72.—Diam. .165 mm. Markings increasing slightly outwards, those at the centre somewhat larger than those on the adjoining area; near the centre 2, towards the border $1\frac{1}{2}$, at the border 3 to $3\frac{1}{2}$ in .01 mm.—*C. robustus*, Sch. (not Grev.), *Atl.*, pl. lxii. fig. 6.

C. robustus. Grev., *Trans. Micr. Soc.*, Lond., 1866, p. 3, pl. i. fig. 8.—Diam. from .0825 to .325 mm. Surface slightly convex towards centre. Central space and rosette absent. Markings pearly, $1\frac{1}{2}$ to 2 in .01 mm., subequal for about $\frac{2}{3}$ of radius, smaller towards the border, at intervals smaller areolæ sometimes distinct among the larger, the central papillæ prominent; radial rows inconspicuous, sometimes secondary, subconcentric or short oblique decussating rows visible. Border prominent, sharply defined, from $\frac{1}{11}$ to $\frac{1}{20}$ of radius broad; striæ evident, 4 to 6 in .01 mm.—Sch.,

* In the collection of Dr Greville.

Atl., pl. lxii. figs. 16, 17; Grun. *Denk. Wien. Ak.*, 1884, p. 72; H. L. Sm., *Diat. Spec. Typ.*, No. 99; Janisch, *Gazelle Exped.*, taf. iv. figs. 10, 11; *C. marginatus*, var. *submarginata*, Grun., *ibid.*, p. 72; *C. subvelatus*, Grun.—Sch., *Atl.*, pl. lxxv. fig. 9; *C. kinkerianus*, Tru. and Witt, *Jeremie Diat.*, p. 13, pl. iii. fig. 1.

In a Santa Monica form .13 mm. in diam., discovered by Dr Rae, the usual striated border was surrounded by a second more sharply defined but narrower band, with a slightly convex surface, and bearing delicate striæ, 8 to 10 in .01 mm.; at one place this band is interrupted and somewhat more convex on the two sides of the break. This gives it the appearance of an elastic spring enveloping the valve.

Habitat.—Santa Monica deposit (Kinker! Hardman! Weissflog! Rae! Firth!); Santa Maria deposit (Rae! Grove!); Santa Marta deposit (Doeg!); Nagy-Kurtos deposit, Hungary (Rae! Deby!); Monterey (Weissflog! Hardman!); Mejillones (O'Meara! Hardman!); Jeremie deposit (Truan and Witt); Los Angeles (O'Meara!); Japan (H. L. Smith!); Sea of Kamtschatka, 1700 fms. (Bailey!); Brünn Tegel (Cleve); San Pedro (Grove!).

Var. *kittoniana*, nov.—Diam. .1125 to .225 mm. Markings $1\frac{1}{2}$ to $1\frac{3}{4}$ in .01 mm., central papillæ prominent, forming transversely truncated cones, with finely but evidently and closely furrowed sides.

Habitat.—Holothurians, China (Macrae!).

Var. *fragilis*, nov.—Diam. .1875 mm. Markings more minute; at the centre $2\frac{1}{2}$, at the border 3, in .01 mm.; adjacent to border a single band of markings elongated radially; central papillæ more faint, puncta distinct; oblique decussating rows more evident.

Habitat.—Santa Maria deposit (Rae!).

C. implicatus, sp. n.—Diam. .15 to .25 mm. Surface somewhat convex towards the centre. Central space and rosette absent. Markings hexagonal, decreasing but very slightly outwards; at the centre $3\frac{1}{3}$, towards the border $4\frac{1}{2}$ in .01 mm.; rows irregular, oblique, straight or curved, forming short, inconspicuous broad fasciculi, that are interrupted by those meeting them at variable angles.

Border sharply defined, $\frac{1}{14}$ to $\frac{1}{18}$ of radius broad; striæ distinct, 4 in .01 mm.—(Pl. III. fig. 1.)

This species does not strictly belong either to the *Radiati* or to the *Fasciculati*. It is placed here for convenience, since it approaches *C. robustus* in general appearance.

Habitat.—Sta Maria deposit (Rae!); Sta Marta deposit (Doeg!).

Var. *picturata*, nov.—Diam. .3 mm. Markings angular or subrotund; surface mottled with dark, mostly quadrangular spots, which are somewhat more crowded on the flattened central portion than towards the border. Border striæ 6 in .01 mm.—(Pl. III. fig. 11.)

Habitat.—Santa Monica deposit (Thum!).*

C. glaberrimus, sp. n.—Diam. .1 to .1075 mm. Surface flat from the centre to about semiradius, thence sloping somewhat steeply to the border. Central space and rosette absent. Markings polygonal, pearly, subequal to semiradius, largest about $\frac{2}{3}$ of radius from the centre, thence decreasing to the border, towards the centre $3\frac{1}{2}$, at $\frac{2}{3}$ of radius 3, in .01 mm.; secondary oblique decussating rows faint. Border broad, with inner edge indistinct; striæ 4 to 5 in .01 mm.—(Pl. I. fig. 19.)

Distinguished from *C. diversus* by the presence of a central space and the polygonal outline of the markings on the central half of the valve.

Habitat.—Cambridge deposit, Barbados (Rae!).

C. obscurus. Sch., *Atl.*, pl. lxi. fig. 16.—Diam. .09 to .165 mm. Central space minute, sometimes absent. Markings subpearly, with central dots evident, increasing but slightly outwards; towards the centre $2\frac{1}{2}$, at about $\frac{1}{2}$ of radius from centre 2, at the border 4 to 5 in .01 mm.; secondary oblique rows inconspicuous, at the origin of the shorter rows are small clear spaces, readily overlooked. Border striæ coarse, 4 to 6 in .01 mm.—Grun., *Denk. Wien. Ak.*, 1884, p. 74; *Cestodiscus obscurus*, Van Heurck, *Syn. Diat. Belg.*, pl. cxxix. fig. 4.

This species is intermediate in the appearance of its markings between *C. crassus*, Bail., and *C. radiatus*, Ehrb., on the one hand,

* In the collection of Julien Deby.

and *C. marginatus*, Ehrb., on the other. Van Heurck's figure is from a photograph by Dr Woodward.

Habitat.—Moron deposit (Greville! Grunow); Sta Monica deposit (Rae!); Szent Peter and Dolje deposits (Pantocsek); sounding, lat. 3° 1' S., long. 33° 50' W., H.M.S. Challenger (Rae!); Virginia (Greville!); Sta Maria deposit (Grove!).

Var. *minor*, nov. *C. obscurus*, var.? Sch., *Atl.*, pl. lxi. figs. 17, 18.—Diam. .05 to .06 mm. Markings smaller, 3 in .01 mm. Border striæ longer.—Grun., *ibid.*, 1884, p. 74.

Habitat.—Moron deposit (Greville!).

C. radiatus. Ehrb., *Abh. Ber. Ak.*, 1839, p. 148, pl. iii. figs. 1 a-c (excl. d).—Diam. .0675 to .18 mm. Central space absent. Markings polygonal, 2 to 2½ in .01 mm., subequal from the centre for about ¼ of radius, thence decreasing sometimes to 6 in .01 mm., in inconspicuous radial sometimes subfasciculate rows, central dots faint.—Ehrb., *Mikrog.*, pl. xix. fig. 1; pl. xxii. fig. 3; pl. xxxiii. 13. figs. 2, 2*; pl. xxxiii. 16. fig. 6; pl. xxxv. A. 17. fig. 6 (excl. pl. xx. 1. fig. 27; pl. xxi. fig. 1); Ralfs in *Pritch. Inf.*, p. 831, pl. xi. figs. 39, 40; Sch., *Atl.*, pl. lx. figs. 5, 6, 9; pl. lxii. fig. 18; pl. lxv. fig. 8; Grun., *Denk. Wien. Ak.*, 1884, p. 71; pl. iii. (c), figs. 4, 7; in H. L. Smith, *Diat. Spec. Typ.*, No. 99; Cleve and Möll., *Diat.*, Nos. 57, 114, 155, 164, 207, 211, 215, 257; Raben., *Alg. Europ.*, Nos. 2263, 2437, 2487; Coll., *Kütz. Diat.*, No. 902; *C. caspius*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 170, pl. xii. fig. 14; *C. argus*, Sch. (non Ehrb.), *Atl.*, pl. lxi. fig. 13 (excl. *C. radiatus*, Weisse, *Bull. Acad. Imp. St Petersburg.*, 1868, p. 122, pl. i. fig. 25; and *C. radiatus*, Bail, *Amer. Jour. Sci.*, xlii. 1842, p. 95, pl. ii. fig. 14).

Schumann (*Schrift. Phys. Oek. Ges. Königsberg*, 1867, p. 61) proposed to break up this species restricting *C. radiatus* for those forms in which the markings are angular, and decrease from the centre outwards from about 6 to 7½ in .01 mm. Other forms from the Baltic, with round markings and fine short furrows within the border, 16½ in .01 mm., he named *C. vicinus*; but the definition of this last species, which is not accompanied by a figure, is inadequate, and the name may be abandoned.

His *C. fallax* (*ibid.*, p. 62, pl. iii. fig. 76) with, in the dry state, round markings, between which smaller faint granules, each resolvable under high powers into two, occur, is also *C. radiatus*, Ehrb. In balsam *C. fallax*, like *C. radiatus*, showed hexagonal markings, and by good illumination smaller granules at their angles. *C. caspius*, Ehrb., was only distinguished by having the rows inconspicuously radial and the secondary oblique curved rows evident. Oamaru specimens show transitions to *C. argus*, and have the rows subfasciculate, with sometimes a distinct central rosette. Schmidt misinterprets Ehrenberg's *C. argus*, in overlooking the increase of the markings outwards (*Atl.*, pl. lxi. fig. 13).

Habitat.—White chalk marl, Caltanissetta; Polirschiefer, Stratford Cliff, Va.; Zante, Plattenmergel; plastic clay, Aegina; tripoli, San Francisco, Cal. (Ehrenberg); Ichaboe guano (O'Meara!); dredged in 1319 fathoms, lat. 71° 19' N., long. 11° 28' W., in yellowish-grey mud; in 1300 fathoms, lat. 73° 16' N., long. 15° 48' W., in dark greyish-brown mud; and in 569 fathoms, lat. 63° 40' N., long. 5° 28' W., in clear grey fine mud (Ehrenberg); Caspian Sea, 14 to 422 fathoms; North Sea, at Cuxhaven; Baltic, at Wismar (Ehrenberg); Mors deposit (Schmidt and Cleve!); Vera Cruz, Mexico (Ehrenberg); off Ascension Island, 1845 fathoms, S.S. Buccaneer (Grove!); Cambridge deposit, Barbados (Hardman!); sounding, lat. 3° 1' S., long. 33° 50' W., H.M.S. Challenger (Rae!); "Atlantic Ocean" (Schmidt); Mascara (Cleve and Möller!); "Virginia" (Hardman!); Kékkö deposit (Grove!); Oamaru deposit (Grove! Doeg!); Hong Kong and Monte Gubbio (Grove!); marine deposit, Fiji Islands (Grove!); Japan (H. L. Smith!); "Barbados" (Johnson!); Newcastle deposit, Barbados (Grove!); marshy ground from Wedel (Schmidt); Aegina (Schmidt); San Benito deposit, California (Grove!); Balearic Islands, Sta Monica deposit, Patagonia, Delaware, North Carolina (Cleve and Möller!); Yedo, Mejillones guano, Bohuslan, mud from Elbing, West Prussia, Saldanha Bay guano, Patagonian guano, Schleswig-Holstein, Labuan, Nancoori deposit, Cape Wankarema, between Aden and Bab-el-Mandeb (Cleve!); Grip, 70 fathoms; Kiel; Brünn Tegel (Cleve); anchor ground, Reikjavik, Iceland; mud from Glückstadt; Elbe, above Cuxhaven (Rabenhorst and Schwarz!); coast of St Paul Island, South Sea (von Frauenfeld!); Oran marl

(Ehrenberg, Kützing!); coasts of Britain (Grove! Rattray!); Kirkwall and Faeroe Islands (Grove!); Marstrand (Kinker!).

Var. *subaequalis*. Grun., *ibid.*, p. 72, pl. iii. (C), fig. 3.—Diam. .12 mm. Markings as in the type, but subequal almost to the border, around which on a narrower zone they are larger than in the type.—*C. radiatus*, var. *abyssalis*, Cstr., *Diat. Chall. Exped.*, p. 165, pl. xxix. figs. 2, 11, 15; Sch., *Atl.*, pl. cxiii. fig. 15 (no name).

Castracane's var. *abyssalis*, which is not sufficiently characterised, is provisionally placed here from his note that the markings gradually diminish in size to the border.

Habitat.—Oran, Monterey and Nancoori Island deposits (Grunow); Atlantic Ocean, H.M.S. Challenger (Castracane); Monkstown, in tide pool (O'Meara!); Cambridge deposit, Barbados (Greville!); San Diego (Gründler).

Var. *glacialis*. Grun., *ibid.*, Expl. pl. iii. (C), fig. 1; *C. borealis*, Ehrb., *Mon. Ber. Ak.*, 1861, p. 294 (not *C. borealis*, Bail., *Amer. Jour. Sci.*, 1856, vol. xxii. p. 3).—Diam. .1 to .15 mm. Surface flat; central rosette absent. Markings subequal, 3 to $3\frac{1}{2}$ decreasing to 4 in .01 mm. at the border; central papillæ delicate.—*C. radiatus*, var. *borealis*, Grun., *ibid.*, p. 72; Sch., *Atl.*, pl. cxiii. fig. 8; *C. radiatus*, Sch., *Atl.*, pl. cxiii. fig. 8.

The varietal name *glacialis* given, by Grunow in the explanation of his plate, is better than *borealis*, as it avoids confusion with Bailey's species.

Habitat.—Lat. 62° 40' N., long. 29° W., 1000 fathoms; lat. 62° 6' N., long. 32° 21' W., 1540 fathoms; lat. 59° 12' N., long. 50° 38' W., 1833 fathoms; lat. 58° 3' N., long. 51° 50' W., 1840 fathoms; lat. 60° 5' N., long. 50° 27' W., 2090 fathoms (Ehrenberg); Franz Josef's Land (Grunow! Cleve!); Aegina (Schmidt).

Var. *media*. Grun., *ibid.*, p. 72, pl. iii. (C), fig. 2.—Diam. .075 to .14 mm. Markings $3\frac{1}{2}$ to 4 in .01 mm., gradually decreasing towards the border, where they are 6 to $6\frac{1}{2}$ in .01 mm.—Sch., *Atl.*, pl. cxiii. fig. 21; *C. radiatus*, Sch., *Atl.*, pl. lx. fig. 10; *C. radio-*

latus, Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer*, Kiel, 1874, p. 94.

Schmidt, in 1878, stated that this form is the traditional type of *C. radiatus*, Ehrb., but in Ehrenberg's original definition the markings are given as about 2 in .01 mm. Los Angeles specimens have been observed by Grunow occasionally to have on their valves groups of larger markings, forming 4- to 6-angled rosettes.

Habitat.—Atlantic sounding for telegraph cable (Greville!); Oran, Nancoori and Los Angeles deposits (Grunow); King's Bay, Spitzbergen, 160 fathoms (Cleve); Davis Straits (Cleve); Franz Josef's Land (Grunow); Baltic (Schumann); Gulf of California (H. L. Smith!); Sussex (Dickie!); Cambridge deposit, Barbados (Hardman!);* Peruvian guano (Hardman!);* Lumford, Jutland (Hardman!);* Nottingham, U.S. (Hardman!);* Compeachy Bay (Hardman!); Rio Janeiro (Hardman!); Californian guano (Norman!);† Teignmouth (Arnott!);† Melville Bay, lat. 75° 27' N., long. 64° 34' W. (O'Meara!); Nottingham deposit (Hardman!);* Lamlash Bay (Dickie! Gregory!);† *Ascidia*, Belfast (O'Meara!); Maryland (O'Meara!); Mejillones deposit (O'Meara!); rice fields, Georgia (Greville!); Gulf of Mexico (Schmidt); Algeria (Arnott!); Indian Ocean soundings, Capt. Pullen, 2200 fathoms (Greville! Roper!);† shell cleanings from Singapore (Hardman!);† Bay of Bengal (Macrae!)

Var. *minor*. *C. radiatus f. minor*, Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer*, Kiel, 1874, p. 94, pl. iii. fig. 34.—Diam. .03 to .0525 mm. Markings 4 in .01 mm. at the centre, decreasing to 8 to 9 in .01 mm. at the border, the radiating rows less obvious. Border striæ, 6 to 8 in .01 mm.—*C. radiatus*, var. *parva*, Grun., *Sitzungsb. Naturw. Ges. Isis, Dresden*, 1878, p. 124, pl. iv. fig. 16; *C. devius*, Sch., *Atl.*, pl. lx. figs. 1-4; Van Heurck, *Syn. Diat. Belg.*, pl. cxxx. fig. 3; Cleve and Möller, *Diat.*, No. 150.

Habitat.—Peruvian guano, Rio de Janeiro, Santos, Campeachy Bay, Japan, and Baku Harbour, Caspian Sea (Grunow); Hvidingsoe (Schmidt); Nancoori (Hardman!);* Manilla (Hardman!).*

* In the collection of Julien Deby.

† In the collection of Dr Greville.

Var. *irregularis*, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxix. fig. 1.—Obtusely triangular, sometimes elliptical. Diam. about .105 mm. Markings $5\frac{1}{2}$ to 6 in .01 mm., subequal almost to the border; radial rows straight or curved, evident.

This var. is distinguished from var. *glacialis* by the size of the markings and the arrangement of the rows. Transitional to the untenable genus *Stoschia*.

Habitat.—Naparima deposit (Van Heurck).

Var. *crenulata*, Rattray. *C. radiatus*, var., Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 48, pl. ii. fig. 22.—Diam. about .025 mm. Markings sub-equal. Border crenate.

Habitat.—From *Salpæ*, Indian Ocean (Wallich).

C. luctuosus, Grove MS.—Diam. .0875 to .125 mm. Surface rising gradually from centre to about semiradius, thence descending with a similar slope to border, convex. Central space and rosette absent. Markings at centre obtusely angular, soon becoming acutely angular and areolate, subequal, $3\frac{1}{2}$ in .01 mm.; rows straight. Border sharply defined, $\frac{1}{5}$ to $\frac{1}{2}$ of radius broad; striæ obvious, 5 to 6 in .01 mm.—(Plate III. figs. 8, 9.)

Habitat.—Troublesome Gully, Oamaru (Grove!).

C. compositus, Rattray. Sp. n.? Sch., *Atl.*, pl. lix. fig. 10.—Diam. .023 mm., central space and rosette absent. Markings angular, towards the centre about 6 in .01 mm., decreasing slightly towards the border, central dots absent; rows inconspicuous, secondary oblique rows obscure. Border sharply defined, about $\frac{1}{4}$ of radius broad; striæ evident, about 4 in .01 mm.

Habitat.—Nottingham (Schmidt).

C. egregius, Rattray. Sp. n.? Sch., *Atl.*, pl. lvii. fig. 39.—Diam. .03 mm. Central space and rosette absent. Markings angular, increasing to about semiradius, thence decreasing gradually to the border; towards the centre 4, at semiradius 3, towards border $3\frac{1}{2}$ in .01 mm; central dots evident, radial rows inconspicuous, secondary curved rows evident; a distinct sharply defined band with faint striæ 6 in .01 mm. adjacent to border, prominent truncate, but small markings

(processes?) at intervals of about $\cdot 01$ mm. inserted at inner edge of marginal band. Border narrow, hyaline.

Habitat.—Table Bay (Schmidt).

C. pectinatus, Rattray. *C. decipiens*, Grun.; Sch., *Atl.*, pl. lix. figs. 18, 19.—Diam. $\cdot 024$ to $\cdot 0515$ mm. Central space and rosette absent. Markings angular, subequal, or increasing somewhat to about semiradius, again decreasing to border; towards centre $4\frac{1}{2}$ to 5, about semiradius $3\frac{1}{2}$, near border 4, in $\cdot 01$ mm.; secondary oblique decussating rows manifest; apiculi prominent, long acicular, inserted at inner edge of border, and reaching outwards to its outer edge. Border distinct; striæ faint, 6 in $\cdot 01$ mm.

The name *decipiens* cannot be adopted here, having been already applied to a distinct form.

Habitat.—Table Bay (Schmidt).

C. bulliens. Sch., *Atl.*, pl. lxi. figs. 11, 12.—Diam. $\cdot 05$ to $\cdot 1075$ mm. Central space absent. Markings polygonal; at the centre $2\frac{1}{2}$ to 3, increasing to the semiradius to $1\frac{1}{2}$ or 2, again gradually decreasing to the border to 6, in $\cdot 01$ mm.; the largest areolæ forming a conspicuous zone. Border indistinctly defined; striæ short, inconspicuous, 6 in $\cdot 01$ mm.—Cleve and Möll., *Diat.*, No 215. *C. ebulliens*, var. Cstr., *Diat. Chall. Exped.*, p. 159, pl. v. fig. 1.

Some small specimens from Cambridge deposit show only a single band of large markings. This species has sometimes been confounded with *C. heteropus*.

Habitat.—Springfield deposit, Barbados (Schmidt, Grunow); Maryland (Kinker!); Szent Peter deposit (Pantocsek); Cambridge deposit, Barbados (Greville! Johnson! Hardman!);* Oamaru deposit (Grove!); Barbados (Johnson!);† Nottingham deposit (Cleve and Möller!); Maryland (Cleve!).

C. asperulus. Grun., *Denk. Wien. Ak.*, 1884, p. 73.—Diam. $\cdot 088$ to $\cdot 093$ mm. Central space absent. Surface somewhat convex, but with slight slope to the border. Markings polygonal; towards the centre 3 to $3\frac{1}{2}$, at the border 4, in $\cdot 01$ mm.; distinctly punctate.

* In the collection of Julien Deby.

† In the collection of Dr Greville.

Distinguished from *C. radiatus* by the more convex surface and the evident punctation of the markings.

Habitat.—Church Hill, Richmond (Grunow); Dolje deposit (Pantocsek!).

C. subangulatus. Grun., *Denk. Wien. Ak.*, 1884, p. 73.—Outline irregular, obtusely angular. Diam. .06 mm. Surface very convex at the border. Markings polygonal; towards the centre 3, at the border 4 to $4\frac{1}{2}$ in .01 mm., distinctly punctate. Border striæ evident, radial or oblique, 4 to 5 in .01 mm., its inner edge indistinct.

Habitat.—Moron deposit (Grunow, Greville!).

C. nodulifer, Janisch. Sch., *Atl.*, pl. lix. figs. 21–23.—Diam. .065 to .1 mm. Central space and rosette absent, but one (rarely a few) evident nodules present. Markings angular, $3\frac{1}{2}$ to 4 in .01 mm., decreasing slightly around the border; radial rows inconspicuous, the oblique decussating rows more distinct. Border sharply defined; striæ evident 4 to 6 in .01 mm.—Cleve and Möll., *Diat.*, No. 57, 155; Janisch, *Gazelle Exped.*, taf. ii. figs. 4–5.

Habitat.—Richmond, Va. Balearic Islands (Cleve and Möller!) Sta Monica deposit (Grove!); California, *Gazelle Exped.* (Schmidt); Islay, Peru (Kitton!); Isle of Muntok, near Sumatra (Grove!); Macassar Straits (Grove!); Indian Ocean sounding, Capt. Pullen, 2200 fathoms (Greville!); coral washings, locality? (Doeg!); Atlantic Ocean, lat. $3^{\circ} 3' N.$, long. $15^{\circ} W.$ (O'Meara!); off Ascension Island, S.S. *Buccaneer* (Rattray! Grove!); Galapagos Island (Cleve!) Patagonian guano; between Aden and Bab-el-Mandeb (Cleve!).

Var. apiculata, nov. *C. nodulifer* (Janisch), Sch., *Atl.*, pl. lix. fig. 20.—Diam. .0685 to .15 mm. Central nodule single, larger. Markings decreasing more around the border; apiculi numerous, subregular, placed at inner side of border.

Habitat.—Campeachy Bay (Schmidt); trawled at lat. $12^{\circ} 42' N.$, long. $152^{\circ} 1' W.$, in 2900 fathoms, by H.M.S. *Challenger* (Rae!).

C. radiosus, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 7.—Diam. .09 to .11 mm. Surface almost flat, or somewhat convex towards the centre. Central space absent. Markings poly-

gonal; towards the centre 6 to 9, gradually decreasing towards the border to 9 or 10 in .01 mm.; secondary oblique rows evident; minute, subulate spaces at origin of the shorter rows.—Grunow, *Denk. Wien. Ak.*, 1884, p. 72; Janisch, *Gazelle Exped.*, taf. v. fig. 9; taf. vi. fig. 4.

This species was formerly associated by Grunow with *C. radiolatus*, Ehrb., a species that cannot be determined with certainty. The specimens referred to from Macassar Straits are more convex towards the centre, and have been authenticated by Grunow.

Habitat.—Monterey and Barbados deposits (Grunow); South Sea (Grunow); Los Angeles (O'Meara!); Macassar Straits (Grove!).

Var. kerguelensis. Grunow, *Denk. Wien. Ak.*, 1884, p. 73. Diam. .047 mm. Markings towards the centre 6, at the border 9 in .01 mm.; close to the border a circle of minute apiculi.

Habitat.—Kerguelen (Grunow).

C. subaulacodiscoidalis, sp. n. Sch., *Atl.*, pl. lvii. fig. 8.—Diam. .0425 mm. Surface convex. Central space absent, rosette minute. Markings angular, 6 to 8 in .01 mm., decreasing gradually towards the border; secondary oblique decussating rows evident; apiculi, six large, with a slight median constriction inserted some distance from the border at subuniform intervals. Border narrow, hyaline, sharply defined.

This species in its general characters approaches *Aulacodiscus concinnus*, Kitton, but there are no primary rays, and the processes are reduced to stout apiculi.

Habitat.—Baldjik (Schmidt).

C. Baileyi, Rattray. *Cestodiscus Baileyi*, H. L. Sm., *Amer. Quart. Jour. Microscopy*, 1878, p. 16, pl. iii. fig. 8.—Diam. .04 to .0925 mm. Central space small, rounded, indistinct, bearing isolated granules. Markings 12 in .01 mm.; rows radial, straight; distinct hyaline subulate spaces opposite origin of shorter rows, secondary oblique rows evident; apiculi distinct, at wide intervals inserted a short distance within border; inner layer of valve with a clear central space surrounded by a zone of closely disposed costæ 6 in .01 mm., outside the latter a second broad hyaline zone

adjacent to border.—*Cestodiscus Baileyi*, H. L. Sm., *Diat. Spec. Typ.*, No. 67.

This species was first collected by Lieut. Williamson (*Explor. and Surveys for Railroad Route from Mississippi River to Pacific Ocean*, vol. vi. pt. 2, "Geology," chap. iv.). Prof. H. L. Smith, in his remarks on the species, first throws doubt on the validity of the genus *Cestodiscus*.

Habitat.—Lost River, lower Klamath Lake, Oregon fossil (H. L. Smith!).

C. fragilissimus, Grun., in Van Heurck, *Syn. Diat. Belg.*, pl. cxxviii. fig. 4.—Diam. .3165 mm. Central space minute, indistinct, rounded. Markings minute, 12 in .01 mm.; secondary oblique rows manifest; apiculi distinct, scattered at wide unequal intervals, most crowded towards the border. Border narrow, hyaline.—*Ethmodiscus convexus*, Cstr., *Diat. Chall. Exped.*, 1886, p. 167, pl. iii. fig. 9.

Habitat.—Arafura Sea (Van Heurck, Castracane!).

C. asteroides. Tru. and Witt, *Jeremie Diat.*, p. 13, pl. iii. fig. 2.—Diam. .15 to .2 mm. Surface usually showing a circlet of six to twelve small shallow depressions at a distance of $\frac{1}{3}$ to $\frac{1}{4}$ of the radius from the centre. Central space absent. Markings hexagonal, on a small central area 2 to $2\frac{1}{2}$ in .01 mm., decreasing somewhat suddenly at about $\frac{1}{3}$ of the radius to 3 or $3\frac{1}{2}$, thence increasing gradually outwards to $1\frac{1}{2}$ in .01 mm., again becoming somewhat smaller at the border. Central papillæ distinct; secondary oblique, curved, decussating rows manifest. Border narrow.

In Maryland specimens the shallow depressions are not found.

Habitat.—Monte Gubbio (Grove!); Jeremie deposit (Truan and Witt!); Cove, Calvert County, Maryland (Greville!); South Naparima, Trinidad (Greville!); Nottingham deposit, Maryland (Johnson!); * Rappahannock, Va (Greville!).

C. lunatus. Grove MS.—Diam. .09 to .15 mm. Central space minute; a rosette frequently distinct, occasionally subobsolete. Surface with an evident lunate unilateral depression, its long axis at right angles and subequal to or somewhat longer than the radius,

* In the collection of Dr Greville.

about twice its greatest breadth, its outer edge more distinct, convex towards the border, its inner less curved, the extremities obtuse; the slope to the border gentle. Markings areolate, subequal, 3 to $3\frac{1}{2}$ in $\cdot 01$ mm. on the depression round, granular; with hyaline interspaces, the central papillæ prominent; rows radial, straight; secondary oblique decussating rows uniformly curved, manifest. Border relatively narrow, with coarse evident, subradial striæ about 6 in $\cdot 01$ mm.

Habitat.—Santa Barbara County, California (Grove!).

C. excavatus. Grev., Ralfs in *Pritch. Inf.*, p. 829, pl. viii. fig. 26.—Diam. from $\cdot 1$ to $\cdot 255$ mm. Surface with 1 to 3 rounded or subcuneate elevations, and alternate depressions around the centre, elsewhere subplain. Central rosette sometimes distinct. Markings hexagonal, increasing regularly outwards, but becoming somewhat smaller around the border; near the centre 4, towards the border $1\frac{1}{2}$, at the border 2, in $\cdot 01$ mm., the central dots faint; secondary oblique decussating rows evident. Border striæ 4 in $\cdot 01$ mm.—Grun., *Denk. Wien. Ak.*, 1884, p. 73.

Habitat.—Piscataway deposit (Dallas!* Rae!); Newcastle deposit, Barbados (Rae!); Holland's Cliff (Cleve); "Artesian Well" (Febiger).

Var. *genuina*. Grun., *ibid.*, p. 73.—Rarely elliptical. Diam. greater than that of the other vars., from $\cdot 25$ to $\cdot 3$ mm. Surface elevations and depressions 3.—*C. excavatus*, Grev., Sch., *Atl.*, pl. lxxv. fig. 1.

Habitat.—Piscataway deposit (Dallas!* Rae! Grunow, Deby!); Naparima (Grunow); Newcastle deposit, Barbados (Grunow, Rae!); Naparima, Trinidad (Firth! Kinker!); Richmond, Va. (Kitton); Rappahannock (Rogers!).*

Var. *quadriocellata*. Grun, *ibid.*, p. 73.—Circular or roundly elliptical. Diam. $\cdot 15$ to $\cdot 19$ mm. Surface elevations and depressions 2. Central rosette inconspicuous. Markings more uniform; towards the centre 4, towards the border 2, in $\cdot 01$ mm. Border striæ, 6 in $\cdot 01$ mm.—*C. diophthalmus*, Cstr., *Diat. Chall. Exped.*, p. 163, pl. xvi. fig. 4.

* In the collection of Dr Greville.

Habitat.—Newcastle deposit, Barbados (Rae! Weissflog! Febiger!* Grunow); trawled by H.M.S. Challenger, in 2900 fathoms, lat. 12° 42' N., long. 152° 1' W.; “Barbados” (Firth! Febiger!).

Var. *biocellata*. Grun, *ibid.*, 1884, p. 73.—Diam. .0875 to .15 mm. Surface elevation and depression opposite, roundly elliptical, edges abrupt. Markings on the elevation 6 towards its central edge, 3 towards the peripheral, in .01 mm., in radial, diverging rows; on the depression more equal and larger, 2½ in .01 mm., elsewhere as in var. *quadriocellata*.—*C. diophthalmus*, var. *monophthalma*, Cstr., *Diat. Chall. Exped.*, p. 163, pl. xvi. fig. 7.

Habitat.—Newcastle deposit, Barbados (Rae! Kitton! Weissflog! Firth! Febiger!);* Cambridge deposit, Barbados (Rae!); Hardman! † “Barbados” (Febiger!); trawled by H.M.S. Challenger, in 2900 fathoms, lat. 12° 42' N., long. 152° 1' W. (Rae!).

Var. *semilunaris*. Grun., *ibid.*, 1884, p. 73.—Diam. .1 to .1175 mm. Surface elevation semilunate, with rounded ends, sometimes short and broad, uniformly disposed with respect to the centre round which it curves, the depression slight, half inclosed by the elevation. Central rosette inconspicuous. Markings towards the centre 4, towards the border 3 in .01 mm.—*C. semilunaris*, Grun., *ibid.*, 1884, p. 71.

The vars. *quadriocellata*, *biocellata*, and *semilunaris* approach *C. crassus*, Bail., in the character of the markings; those of var. *genuina* recall *C. gigas*, Ehrb.

Habitat.—Newcastle deposit, Barbados, (Weissflog! Grove!).

Var. *deliquescens*, nov.—Diam. .0475 mm. Surface elevation and depression opposite, the former indistinct, the latter evident, but elliptical. Markings on the depression round free granules, with hyaline interspaces, elsewhere angular, 4½ in .01 mm.; towards the border smaller, rounded; between the outer ends of the radial rows

* In the collection of Herr E. Weissflog.

† In the collection of Julien Deby.

narrow hyaline areas bearing a few minute markings, attenuating inwards; secondary oblique rows obvious.—In H. L. Sm., *Diat. Spec. Typ.*, No. 99 (no name).—(Pl. III. fig. 7.)

Habitat.—Japan (H. L. Smith!).

C. decrescens, Grun. Sch., *Atl.*, pl. lxi. figs. 7 to 9, 10 (!).—Diam. .038 to .05 mm. Central space and rosette absent. Markings polygonal, with evident central papillæ; at the centre 3 in .01 mm., decreasing rapidly on outer $\frac{1}{3}$ of radius to the border; rows on the outer portion sometimes subfasciculate, secondary oblique sometimes outwardly curved decussating rows distinct towards the border.—Grun., *Denk. Wien. Ak.*, 1884, p. 80.

Distinguished from *C. marginatus* by the rapid decrease in size of the markings on the outer third of the valve. Sometimes obtusely triangular specimens occur.

Habitat.—Springfield deposit, Barbados (Grunow); Dolje (Pantocsek); Barbados (Cleve!); west coast "Florida" U.S. Survey (Febiger!); Faeroe Channel (Grove!).

Var. *irregularis*. Grun., *ibid.*, 1884, p. 80.—Obtusely triangular, two of the angles more evident than the third. Diam. .068 mm. Markings increasing slightly from the centre to about the semi-radius.

Habitat.—Springfield deposit, Barbados (Grunow).

Var. *venusta*. Grun., *ibid.*, 1884, p. 80; *C. heteroporus*, Ehrb., *forma major*, Grun., Sch., *Atl.*, pl. lxi. fig. 6.—Diam. .1135 mm. Central space minute. Markings increasing distinctly from central space for about $\frac{1}{2}$ to $\frac{5}{8}$ of radius, thence decreasing rapidly to the border; towards the centre 4, increasing to $2\frac{1}{2}$ in .01 mm.—*C. argus*, Grun. (non Ehrb.) in Sch., *Atl.*, pl. cxiii. fig. 7.

The central space and increase of the markings outwards bring this var. near to *C. heteroporus*, but the appearance of the markings and the arrangement around the border bring it nearer to *C. decrescens*. The transition from specimens like that shown in Schmidt's *Atlas*, pl. cxiii. fig. 7, to *C. bulliens*, A. S., is easy.

Habitat.—Springfield, Barbados (Grunow); Ægina (Schmidt); "Barbados earth" (Greville!).

Var. *valida*. Grun., *ibid.*, 1884, p. 80; *C. decrescens*?* Sch., *Atl.*, pl. lxi. fig. 15.—Diam. .1 mm. Central space small, about $\frac{1}{3}$ of diam. broad, angular. Markings increasing but little from centre for $\frac{1}{2}$ of radius, from the semiradius decreasing rapidly to the border; at the central space $2\frac{1}{2}$, from $\frac{1}{2}$ to $\frac{1}{2}$ of radius $1\frac{1}{2}$ to 2 in .01 mm.; rows radial, irregularly concentric bands indistinct.

Habitat.—Springfield deposit, Barbados (Schmidt, Grunow).

Var. *polaris*. Grun., *ibid.*, 1884, p. 80, pl. iii. (C), fig. 11.—Diam. .047 to .055 mm. Central space small, about $\frac{1}{19}$ of diam. broad. Markings increasing slightly outwards to the semiradius to about 3 in .01 mm.; rows subfasciculate, and secondary subconcentric rows evident.

Habitat.—Franz Josef's Land (Grunow); Monterey deposits (Hardman!)† Barbados deposits (Greville!).

Var. *repleta*. Grun., *ibid.*, 1884, p. 80, pl. iii. (C), fig. 18.—Diam. .0325 to .0825 mm. Surface convex towards the centre. Central space absent. Markings 3 to $3\frac{1}{2}$, sometimes 4, in .01 mm.; secondary concentric rows faint, oblique decussating rows undifferentiated near the border.—In H. L. Sm., *Diat. Spec. Typ.*, No. 99.

Habitat.—Franz Josef's Land (Grunow); Oamaru deposit (Grove!); Japan (H. L. Smith!); Macassar Straits (Grove!).

C. epiphanes, sp. n.—Diam. .165 to .21 mm. Surface rising slightly from the centre for about $\frac{3}{4}$ of the radius, here descending abruptly, and continuing thence on one plain to the border. Central space absent, rosette distinct. Markings hexagonal, increasing slightly from the centre to the highest zone, here decreasing suddenly, and from this subequal to the border; towards the centre 3, at the highest zone $2\frac{1}{2}$, towards the border 3 in .01 mm.; central papillæ faint, secondary oblique decussating rows evident. Border narrow; striæ faint, 8 to 10 in .01 mm.—(Pl. II. fig. 14.)

Habitat.—Richmond deposit (Deby!). ‡

* Quoted "*C. decrescens*, var.?" by Grunow (*Denk. Wien. Ak.*, 1884, p. 80).

† In the collection of Julien Deby.

‡ In a *Coscinodiscus* type-plate by Thum, in the collection of Julien Deby.

C. patina. Ehrb., *Abh. Ber. Ak.*, 1839, p. 147, pl. iii. figs. 3 a-e.—Diam. .035 to .1125 mm. Surface flat. Central space and rosette absent. Markings angular, subequal, somewhat smaller near the border; rows concentric, obvious, radial rows undifferentiated. Border narrow, hyaline.—Ehrb., *Mikrog.*, pl. xx. 1. fig. 31; Ralfs in *Pritch. Inf.*, p. 830; Janisch, *Gazelle Exped.*, taf. v. fig. 1; *C. patina*, Ehrb., *pro parte*, *Abh. Ber. Ak.*, 1838, p. 129, pl. iv. figs. 10-12 d. (Excl. *C. patina*, Bail., *Amer. Journ. Sci.*, 1842, vol. xlii. p. 96, pl. ii. fig. 13.)

The Simbrisk valve, figured by Weisse (*Bull. Acad. Imp. St. Petersb.*, 1855, p. 276, pl. i. fig. 6) has round free markings, with a more prominent circlet at the border, and is probably distinct. Ehrenberg at first embraced in *C. patina* his *C. radiatus* (*conf. Abh. Ber. Ak.*, 1839, p. 148). The specimen figured by Janisch (*Gazelle Exped.*) shows the concentric arrangement of the markings most clearly towards the border; the areolæ are at intervals irregular.

Habitat.—Zante, Caltanissetta, Oran and Grecian deposits, Cuxhaven (Ehrenberg).

C. argus. Ehrb., *Abh. Ber. Ak.*, 1838, p. 129.—Diam. from .0675 to .175 mm. Central space absent, a rosette sometimes present. Markings polygonal, increasing gradually outwards; at the centre 4, near the border 2 to 3, on a narrow zone adjacent to the border 4 or 5, in .01 mm.; secondary oblique rows indistinct or undifferentiated.—Ehrb. *ibid.*, 1839, p. 145, *Mon. Ber. Ak.*, 1844, p. 79; *Mikrog.*, pl. xxi. fig. 2 (excl. pl. xxii. fig. 5, 8); Grun., *Denk. Wien. Ak.*, 1884, p. 72; *C. irradiatus*, Harting, *Verh. Kon. Ak. Wetensch., Amsterdam*, 1864, No. ii. p. 8, pl. i. fig. 1); *C. radiatus*, Ehrb., *Mikrog.*, pl. xxi. fig. 1; *C. Woodwardii*, Sch., (not Eul.) *Atl.*, pl. lxi. fig. 2; *C. heteroporus*, Grun., in Sch., *Atl.*, pl. lxi. fig. 2.

Ehrenberg regarded this as probably a var. of *C. radiatus*; Brightwell and Grunow more correctly accept it as a distinct species. Harting points out the affinity of his *C. irradiatus* to *C. radiatus*, Ehrb., but its markings increase towards the border as in *C. argus*, to which it seems rather to belong. Some specimens belonging to this species were labelled by O'Meara *C. sinensis*.

Cleve has named *C. argus*, var. *subimpressa*, some Oamaru specimens that differ from more typical valves only in showing a subfasciculate arrangement of the markings, chiefly visible when the papillæ are in focus.

Habitat.—Oran deposit (Ehrenberg, Grunow, Greville!); Caltanisetta deposit (Ehrenberg); Richmond, Va. (Kützing); Szent Peter deposit (Pantocsek); Cuxhaven (Ehrenberg); Carpentaria Bay (Schmidt); N. America (Grunow); Banda Sea, 1200 fms. (Harting); locality? (Deby!); Japan (Kinker!); Cambodia (Hardman!); Mejillones (O'Meara!); stomach of oysters at Howth (O'Meara!); Los Angeles deposit, Cal. (O'Meara!); Cambridge deposit "Barbados" (Johnson!* Weissflog! Hardman!); Canton River, Whampoa (Grove!); Indian Ocean sounding, by Captain Pullen, 2200 fathoms (Greville!); Maryland (O'Meara!); Oamaru deposit (Cleve! Grove!).

Var. *subtraducens*, nov.—Diam. .15 to .225 mm. Central space absent or minute, rosette absent or obscure. Markings hexagonal, increasing from the centre almost to the border; towards the centre 4, near the border 3 in .01 mm.; central papillæ evident; secondary oblique curved decussating rows distinct. Border narrow; striæ, 5 to 6 in .01 mm.—(Pl. I. fig. 20.)

Transitional between *C. argus* and *C. traducens*. Specimens have sometimes been erroneously associated with *C. fimbriatus*. *C. intermedius*, Ehrb. (*Mikrog.*, pl. xxxiii. 13. fig. 3), may perhaps belong to this variety, its markings being figured as more delicate than those of *C. argus* (*Mikrog.*, pl. xxi. fig. 2). Here may also come the valve figured by Ehrenberg as *C. radiolatus?* (*Mikrog.*, pl. xxxix. 2. fig. 18), but *C. radiolatus*, Ehrb. (*Mikrog.*, pl. xxii. fig. 4), is distinct (see *infra*).

Habitat.—Jackson's Paddock, Oamaru deposit (Grove!).

C. traducens, sp. n.—Diam. .1 mm. Surface flat. Central space and rosette absent; a small central area surrounded by a sub-circular hyaline line evident. Markings hexagonal, gradually increasing in size from the central area outwards; towards the centre 8, at the border 6 in .01 mm.; irregular on the central area,

* In the collection of Dr Greville.

secondary oblique curved decussating rows distinct; a narrow hyaline band adjacent to the border. Border narrow, sharply defined, with small evident granules 6 in $\cdot 01$ mm.—*C. nebula*, Ehrb.? *Abh. Ber. Ak.*, 1872, p. 167, pl. xii. fig. 15. Sp. n.? Sch., *Atl.*, pl. lviii. fig. 12.

C. nebula, Ehrb., is an imperfectly defined species, approaching *C. radiolatus*, Ehrb., and *C. intermedius*, Ehrb.; its insertion here is provisional.

Habitat.—Railway cutting, Oamaru (Grove!) S.E. of Birjutskaja Kossa, Sea of Azof (Ehrenberg).

Var. *hispida*, nov. Sch., *Atl.*, pl. lviii. fig. 38 (no name).—Diam. about $\cdot 035$ mm. Markings 6 to 7 in $\cdot 01$ mm; apiculi prominent, numerous, at intervals of about $\cdot 0075$ mm., inserted some distance within border.

Habitat.—Yokohama (Gründler).

C. exutus, sp. n.—Diam. $\cdot 0775$ mm. Central space and rosette absent. Markings polygonal, increasing slightly outwards to the marginal band; at the centre 6 to 7, about the semiradius 5 to $5\frac{1}{2}$, on the sharply defined marginal band, 10 in $\cdot 01$ mm., this band about $\frac{1}{3}$ of radius broad; rows radial from the centre to the marginal band, upon the latter the oblique decussating rows more evident. Border narrow, distinct.

Habitat.—Los Angeles (Hardman!).*

C. debilis, sp. n.—Diam. $\cdot 3$ mm. Surface almost flat, a gentle slope near the border. Central space and rosette absent. Markings hexagonal, 5 to 7 in $\cdot 01$ mm., slightly smaller at the centre, and towards the border submoniliform; central papillæ distinct; secondary curved oblique decussating rows evident; minute subulate areas at the origin of the shorter rows. Border sharply defined, usually opaque, about $\frac{1}{3}$ of radius broad; its broad or inner portion closely and irregularly punctate; the outer with evident striæ, 6 or 7 in $\cdot 01$ mm.—(Pl. I. fig. 4.)

Habitat.—Jackson's Paddock, Oamaru deposit (Grove!).

C. dubiosus, Grun. MS.—Diam. $\cdot 0925$ to $\cdot 15$ mm. Central

* In the collection of Julien Deby.

space and rosette absent. Markings hexagonal, minute, subpunctiform, smallest and most crowded towards the border; towards the centre 8 to 10, towards the border 14 to 16 in $\cdot 01$ mm.; secondary rows slightly oblique or irregularly subconcentric, the latter more evident near the centre, narrow radial subulate clear lines opposite the origin of the shorter rows; clear irregularly disposed puncta sometimes evident. Border narrow; striæ, 10 to 12 in $\cdot 01$ mm.—Cleve and Möll., *Diat.*, No. 164; Janisch, *Gazelle Exped.*, taf. v. figs. 10, 11.

This species sometimes approaches *Podosira hormoides*, Mont. (Van Heurck, *Syn. Diat. Belg.*, pl. lxxxiv. figs. 3-6), but the markings are not in fasciculate rows. In *Podosira hormoides* Grunow has noted that the markings are grouped in almost radial lines (*Sitzungsber. naturw. Ges. Isis, Dresden*, 1878, p. 33).

Habitat.—Oamaru deposit (Grove! Doeg!); California (Arnott!)*; Monterey deposit (Hardman! * Cleve!); Sta Monica deposit (Cleve and Möller!); Java (Cleve!); Successful Bay, Kerguelen (Cleve!).

Var. *curvans*, nov.—Diam. $\cdot 11$ mm. Markings similar, but numerous hyaline subulate spaces towards the centre; the rows uniformly curved between centre and border, radial; the secondary rows but slightly oblique or almost parallel to the border.

Habitat.—Troublesome Gully, Oamaru (Grove!).

C. plicatus, Grun. Sch., *Atl.*, pl. lix. fig. 1.—Diam. $\cdot 0425$ to $\cdot 05$ mm. Surface with a short transverse central plication. Central space absent. Markings polygonal, increasing from the centre outwards, again decreasing slightly at the border; towards the centre 7, towards the border 6 in $\cdot 01$ mm.; a circlet of evident, but small, apiculi at the border.—Grun., *Denk. Wien. Ak.*, 1884, p. 73, pl. iii. (C), fig. 10.; Cleve and Möll., *Diat.*, Nos. 114, 276.

Habitat.—Polycystinous rock, Nancoori (Cleve! Grunow, Schmidt, Hardman!); † Mascara and California (Cleve and Möller!).

C. corolla. Sch., *Atl.*, pl. lviii. fig. 32.—Diam. $\cdot 047$ mm. Central space and rosette absent. Markings polygonal, 8 to 10 in $\cdot 01$

* In the collection of Dr Greville.

† In the collection of Julien Deby.

mm., decreasing slightly to the border; irregular on a small central area, elsewhere the rows radial, sometimes subfasciculate; secondary oblique decussating rows obvious; apiculi numerous, forming a circlet placed some distance from the border. Border distinctly defined, about $\frac{1}{12}$ of radius broad; striæ distinct, 5 or 6 in .01 mm.

Habitat.—Yokohama (Schmidt).

C. denticulatus. Cstr., *Diat. Chall. Exped.*, p. 155, pl. iii. fig. 8.—Diam. .13 mm. Surface slightly convex, on outer $\frac{1}{2}$ of radius. Central space and rosette absent. Markings polygonal, subequal, 8 in .01 mm.; central dots distinct; apiculi scattered over the surface at irregular wide intervals, distinct. Border sharply defined; striæ 8 to 10 in .01 mm.

This species is nearly allied to *C. radiosus*, but differs in the more uniform markings and in the apiculi. Compare also *Podosira hormoides*, Mont. (= *Melosira nummuloides*, Ehrb.) from Lima (Van Heurck, *Syn. Diat. Belg.*, pl. lxxxiv. fig. 3).

Habitat.—Pacific Ocean (Castracane).

C. impressus, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 5.—Diam. .08 mm. Surface with a long depression near the centre. Central space minute, irregular, about $\frac{1}{21}$ of diameter broad. Markings increasing gradually from the margin of the central space to the border; towards the centre 8, toward the border 7, in .01 mm.; secondary oblique rows indistinct. Border striæ, subregular, distinct, 8 to 10 in .01 mm.—Grun., *Denk. Wien. Ak.*, 1884, p. 73.

Habitat.—Sta Monica deposit (Grunow).

C. concinnus. W. Sm. *Syn., Brit. Diat.*, ii. p. 85.—Diam .062 to .35 mm. Surface somewhat convex. Central rosette of large but delicate areolæ, sometimes inconspicuous, .0075 to .01 mm. broad. Markings polygonal, delicate, most evident towards the centre, where there are 7 or 8 in .01 mm., decreasing outwards to 12 in .01 mm.; rows obscurely fasciculate; near the border at subequal intervals short narrow radial clear areas, whence faint subhyaline lines proceed inwards; a circlet of apiculi at the border, minute; 2 larger apiculi unsymmetrical close to the border, a few long acicular apiculi also sometimes present on a zone within the processes.—Roper, *Quart.*

Jour. Micr. Sci., 1858, p. 20, pl. iii. figs. 12, 12a; Ralfs in *Pritch. Inf.*, 828, pl. v. fig. 89; Janisch, *Gazelle Exped.*, taf. ii. fig. 6; H. L. Sm., *Amer. Jour. Micr.*, 1877, No. 8, p. 102; Sch., *Atl.*, pl. cxiii. figs. 8, 9; Cleve and Möll., *Diat.*, No. 215, 319; *C. ? tenuis*, Bail., *Boston Jour. Nat. Hist.*, 1862, p. 333, pl. vii. fig. 9; *C. centralis*, Schulze, *fide* Grunow, *Jour. Roy. Micr. Soc.*, 1879, p. 688 (excl. *Eupodiscus gregorianus*, de Bréb., *Jour. Quek. Micr. Cl.*, 1870. p. 41).

Bailey has seen specimens from Para River with 3 processes, but this species cannot be united to *Eupodiscus*, as suggested by Bailey, since the character of the processes of the latter is distinct.

C. concinnus, var. *kerquelenensis*, Grun., differs in the markings, decreasing outwards from 5 to 7 in .01 mm., and *C. concinnus*, var. *arafurensis*, Grun., in having a small clear circular central space and the markings 9 to 12 in .01 mm., the clear radii being very long. *Eupodiscus gregorianus*, de Bréb., is *Eup. subtilis*, Greg. (Ratray, *Jour. Roy. Mic. Soc. Lond.*, 1888, p. 915). *C. concinnus* agrees with *C. centralis*, Ehrb., in its two large unsymmetrical apiculi, but differs in the degree of fineness and arrangement of the markings.

Habitat.—Peruvian guano (Schmidt); Para River (Bailey); Kerguelen, 25 fathoms (O'Meara, Grunow, Rae!); Baltic (Flögel); stomach of Pecten, Sussex coast and Kinsale Bay (W. Smith!); Firth of Clyde (Hennedy); Cumbrae (Arnott!); Hull (Ralfs); Loch Fyne and Inveraray (Gregory!); *Ascidia*, Hull (Greville! Gregory!); Gorleston (Roper!); Caldy, Pembrokeshire (Rev. J. Guillemard); Humber dredgings (Norman); seaweeds, Ballybrack, and oyster shells, Dublin Bay (O'Meara); San Francisco, Cal. (Firth! Schmidt); Helder Algæ (Kinker!); Mejillones deposit (O'Meara!); "Barbados" (Johnson!);* stomach of Pecten, Penzance (Montgomery!);* Nottingham deposit, Cape Wankarema (Cleve and Möller! Grunow!); Schleswig-Holstein (Cleve!); Heligoland (Schulze!* Weissflog!); Firth of Forth (Grove! Ratray!); Sheerness (Grove!); Marstrand (Kinker!).

Var. *jonesiana*, Ratray. *Eupodiscus jonesianus*, Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 22, pl. ii. fig. 3.—Rarely triangular. Diam. .21 to .45 mm. Markings coarser, and more sharply defined; towards

* In the collection of Dr Greville.

the centre 6, towards the border 8, in .01 mm. ; the unsymmetrical processes 2, larger, obtusely conical, and placed towards the same side of the valve ; the clear radial lines less distinct ; long apiculi sometimes present within the processes, as in the type.—*C. concinnus*, H. L. Sm., *Diat. Spec. Typ.*, No. 92 ; *Eup. jonesianus*, Grev. ; Cleve, *Bih. Sv. Vet.-Ak. Handl.*, 1873, No. 11, p. 5, H. L. Smith, *Diat. Spec. Typ.*, No. 163 ; *Eup. commutatus*, Grun., and *Coscinodiscus commutatus*, Grun., *Denk. Wien. Ak.*, 1884, p. 79 ; Van Heurck, *Typ. Syn. Diat. Belg.*, No. 490 ; *Eup. concinnus*, var. *triangularis*, *ibid.*

Greville erroneously states that the processes are 3. In triangular specimens they occur at the middle of two of the sides.

Habitat.—Peruvian guano (Grunow) ; Hong Kong (H. L. Smith ! Hardman ! Grove ! Palmer !* Greville !) ; Yokohama (Hardman !) ; Canton River, Whampoa (Grove !) ; Schleswig (Van Heurck !) ; shell cleanings, Singapore (Hardman !) ;* Sand Heads, Bay of Bengal, Ceylon, and edible seaweeds, India (Macrae !) ;* Port Elizabeth (Hardman !) ; Java Sea (Cleve, Grunow) ; surface, Arafura Sea, H.M.S. Challenger (Rae !) ; Cherbourg (H. L. Smith !) ; Cuxhaven, Brazil, and China (Grunow) ; North Sea (Griffin !) ; trawled at lat. 34° 36' N., long. 140° 22' E., by H.M.S. Challenger (Rae !) ; † Kusu (Cleve ! O'Meara !) ; from Pecten, Penzance (Greville !) ; Bay of Bengal (Macrae !) ; Tindingen, Greenland (Cleve !) ; Java (O'Meara ! Cleve !) ; Cape Wankarema (Cleve !) ; lat. 4° 20' S., long. 105° 22' E. (Cleve !).

Var. *Moseleyi*, Rattray. *C. Moseleyi*, O'Me., *Quart. Jour. Micr. Sci.*, 1875, p. 330.—Diam. .28 to .55 mm. Colour iridescent when dry. Central rosette distinct, of large unequal areolæ. Markings towards the centre 5 to 6, at the border 8, in .01 mm. ; rows obscurely fasciculate, unsymmetrical ; processes 2, minute ; apiculi obscure. Border narrow.—O'Meara, *Jour. Lin. Soc. (Bot.)*, 1877, p. 57, pl. i. fig. 6 ; Cstr., *Diat. Chall. Exped.*, p. 153 ; *C. concinnus*, var. *kerguelensis*, Grun., *Denk. Wien. Ak.*, 1884, p. 79.

Habitat.—Kerguelen, at 25 fathoms (Rae ! Hardman ! † Peal ! † O'Meara, Grunow) ; Royal Sound, Kerguelen (Rae !).

* In the collection of Dr Greville.

† In the collection of Dr F. W. Griffin.

‡ In the collection of Julien Deby.

Var. *arafurensis*. Grun., *Denk. Wien. Ak.*, 1884, p. 79. *C. papuanus*, Cstr., *Diat. Chall. Exped.*, p. 154, pl. iii. fig. 3.—Diam. $\cdot 152$ to $\cdot 475$ mm. Central space minute, surrounded by a minute and inconspicuous rosette, sometimes hardly differentiated. Markings 9 to 12 in $\cdot 01$ mm.

This form is frequent in the Arafura Sea. The central space is smaller than figured by Castracane in all the specimens I have observed, and is not of specific value, as he maintains. He has overlooked the distinct marginal processes characteristic of the species.

Habitat.—Arafura Sea, H.M.S. Challenger (Rae! Castracane); between Kerguelen and Heard Island, H.M.S. Challenger (Rae!).

C. africanus, Janisch. Sch., *Atl.*, pl. lix. figs. 24, 25.—Sub-circular or roundly elliptical. Diam. $\cdot 035$ to $\cdot 088$ mm. Central space and rosette absent. Markings polygonal, increasing gradually outwards, and again smaller at the border; towards the centre 6, towards the border 4 in $\cdot 01$ mm.; irregular on an indistinctly defined somewhat excentric area, elsewhere the rows radial, straight, or slightly bent, sometimes indistinctly subfasciculate towards the border. Border regularly striated, sometimes double; the inner portion about $\frac{1}{3}$ of the breadth of the outer. Sometimes also with more evident striæ; oblique curved, more distant and more distinct lines.—Janisch, *Gazelle Exped.*, taf. iii. fig. 2.

This species is readily distinguished by the character of its border. From *C. vetustissimus*, Pant., it differs by the absence of a nodule from the excentric area.

Habitat.—Gazelle Expedition (Janisch); Newcastle, Barbados (Firth); off Ascension Island, S.S. Buccaneer (Grove!).

Var. *wallichiana*, Grun. Cleve and Möll., *Diat.*, No. 183, 207.—Diam. $\cdot 05$ to $\cdot 0575$ mm. Central space irregular, excentric, with a few isolated rounded granules. Markings rounded, granular; towards the excentric area 8, about the semiradius 5 to $5\frac{1}{2}$, at the border 6 in $\cdot 01$ mm.; rows radial, straight; at irregular intervals hyaline, narrow radial spaces passing inwards for a short distance from border. Border distinct; striæ delicate, 10 to 12 in $\cdot 01$ mm.—*C. africanus*, var. *rotunda*, Cstr., *Diat. Chall. Exped.*, 1886, p. 159, pl. xxiv. fig. 3.—(Pl. II. fig. 4.)

Habitat.—Antarctic Ocean, Patagonia (Cleve and Möller !); Table Bay (Cleve!).

C. mirificus. Cstr., *Diat. Chall. Exped.*, p. 154, pl. iii. figs. 6, 6a.—Diam. .326 mm. Central space irregularly subcircular, about $\frac{1}{11}$ of diam. broad. Markings hexagonal, their sides composed of closely placed round granules, the central dots distinct, decreasing but slightly to the border; towards the centre 6, at the border 8, in .01 mm. Border formed by a simple line.

In its large central space, this species approaches *C. asteromphalus* var. *pabellanica*, Grun., but is distinguished by the absence of a distinct band around the central space, and by the greater uniformity of the markings.

Habitat.—Hong Kong, in the sea, H.M.S. Challenger (Castracane).

C. Hauckii, Grun. Van Heurck., *Syn. Diat. Belg.*, pl. xciv. fig. 29.—Diam. .0365 mm. Central space absent. Markings obscure, punctiform, irregular, and with hyaline interspaces on the central portion, which extends outwards for $\frac{2}{3}$ of radius, on outer $\frac{1}{3}$ more minute, closely disposed in crowded radial lines, 16 in .01 mm.; apiculi sometimes evident, inserted near border about 2 in .01 mm.—Cleve and Möll., *Diat.*, No. 210.

Habitat.—Rovigno (Van Heurck, Cleve and Möller !); Greenland (Cleve !); Labuan? (Cleve!).

C. liocentrum. Ehrb., *Abh. Ber. Ak.*, 1870, p. 53, pl. ii. 2. fig. 9.—Diam. .075 mm. Central space extending almost to semiradius, smooth. Markings polygonal, delicate, increasing slightly outwards; rows distinct.

This species is at once characterised by the large size of the central space, in which it approaches *C. mesoleius*, Cleve.

Habitat.—Humboldt Valley deposit, Cal. (Ehrenberg).

C. vacuus, sp. n. *Melosira*? Sch., *Atl.*, pl. lviii. fig. 29.—Diam. about .03 mm. Central space large, extending outwards for about $\frac{2}{3}$ of radius. Markings minute, punctiform, forming closely disposed radial rows, on outer $\frac{1}{3}$ of radius. Border narrow, indistinct.

This is distinguished from *C. Hauckii*, Grun. (Van Heurck, *Syn.*

Diat. Belg., pl. xciv. fig. 24), by the absence of punctiform granules on the central space. In Schmidt's figure of *C. vacuus*, a minute round central areola (nodule?) is faintly indicated.

Habitat.—Cape of Good Hope (Schmidt).

C. mesoleius. Cleve, *Vega Exped. Jakttag. Stockh.*, Bd. iii., 1883, p. 503, pl. xxxviii. fig. 2.—Diam. .03 mm. Central portion hyaline, extending outwards to about $\frac{2}{3}$ of the radius, sharply defined. Markings on outer portion punctiform, 28 in .01 mm., forming radial striæ.

The valve is very thin and transparent. It approaches *C. Hauckii*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. xciv. fig. 29); but in the latter the central portion is covered with irregular scattered puncta. Both approach the genus *Cyclotella*.

Habitat.—Labuan, near Borneo, among Algæ* (Cleve!).

C. lutescens, sp. n.—Diam. .125 mm. Surface flat. Central space circular, minute, surrounded by a subobsolete band of large cuneate areolæ. Markings hexagonal, distinct, increasing outwards for about $\frac{2}{3}$ of the radius, thence decreasing to the border; towards the centre 5, at $\frac{2}{3}$ of radius $3\frac{1}{2}$, in .01 mm.; central papillæ faint; rows straight, at intervals with the markings oblique; apiculi minute, inserted at the border at intervals of about .005 mm. Border narrow; striæ faint, 8 to 10 in .01 mm.—(Pl. II. fig. 2.)

Distinguished from *C. cribrosus*, Tru. and Witt, by the gradual increase of the markings outwards.

Habitat.—Jeremie deposit, Hayti (Rae!).

C. modestus, sp. n.—Diam. .325 mm. Surface flat, becoming convex towards the border. Central space round, indistinct, about $\frac{1}{4}$ of diam. broad. Markings delicate and faint for inner $\frac{2}{3}$ of radius, more evident on the outer $\frac{1}{3}$, increasing from the central space outwards, towards the centre punctiform 8, beyond the semi-radius distinctly hexagonal, with evident central papillæ, 4 in .01 mm.; rows around the central space of unequal lengths, and separated by hyaline interspaces, towards the border subfasciculate, the fasciculi separated by fossil subhyaline radial lines; apiculi 2, unsymmetrical, separated by an interval equal to about $\frac{1}{3}$ of the

* Collected by Dr Kjellman.

circumference, small but distinct; a circlet of more minute apiculi at the border absent. Border narrow.—(Pl. I. fig. 3.)

Habitat.—Rio Janeiro (Kitton!); * Peruvian guano (Macrae!).

C. patellæformis. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 80, pl. x. fig. 4.—Diam. .07 to .1 mm. Surface slightly convex. Central space and rosette absent. Markings polygonal, in contact and without order for about $\frac{1}{3}$ of radius, thence obtusely angular, pearly, 4 in .01 mm., increasing slightly outwards and forming straight rows; secondary subconcentric rows also evident; at the origin of the shorter rows are sharply defined, irregular, elongate hyaline spaces; a narrow hyaline band within the border. Border with a single row of granules, 4 in .01 mm.—*C. detritus*, Sch., *Atl.*, pl. lviii. fig. 15.

In Greville's specimen, the undulating concentric lines crossed by stronger radial costæ—as shown in his figure—do not occur.

Habitat.—Springfield deposit, Barbados (Hardman!). †

C. oblongus. Grev., *Trans. Micr. Soc. Lond.*, 1866, p. 4, pl. i. figs. 9, 10.—Elliptical or oval, major axis .07 to .145 mm., from $2\frac{1}{3}$ to 3 times minor. Surface depressed at the centre. Central area roundly or elongately elliptical, with rounded granules irregular, or in rows parallel to the major axis. Markings round, granular, increasing slightly from the edge of the central area outwards, again decreasing towards the border; at the semiradius 4, near the border 6, in .01 mm.; rows straight only along the major and minor axes, between these slightly curved towards the major axis.—Sch., *Atl.*, pl. lxvi. figs. 10, 11; *C. oblongus forma typica*, Truan and Witt, *Jeremie Diat.*, p. 14, pl. ii. fig. 16.

Distinguished from *C. punctatus* by the presence of a central depression, the absence of a central space, and of oblique decussating rows near the border.

Habitat.—Chalky Mount., Barbados (Firth!); Barbados (Weissflog! Deby! Hardman! Kinker! Cleve! Greville!); Springfield deposits, Barbados (Johnson! Firth! ‡ Hardman!); § Pacific Ocean,

* In the collection of Herr E. Weissflog.

† In the collection of Dr Greville.

‡ In the collection of Dr F. W. Griffin.

§ In the collection of Julien Deby.

H.M.S. Challenger (Castracane); Jeremie deposit, Hayti (Truan and Witt).

C. ellipticus. Grun., *Reise. d. Novara Wien.*, 1870 (Bot. Th.), p. 104, pl. i. a. fig. 18 a, b.—Elliptical, major axis $\cdot 04$ to $\cdot 075$ mm., minor $\cdot 02$ to $\cdot 035$ mm. Central space absent. Markings rounded, granular; on the central portion large, subradial or irregular, decreasing slightly outwards, on a well-defined band at the border minute, in radiating delicate crowded striæ.

Distinguished from *Cestodiscus ovalis*, Grev., by the absence of apiculi, and from *C. oblongus*, Grev. (*Trans. Micr. Soc. Lond.*, 1866, p. 4, pl. i. figs. 9, 10), in the relatively larger size of the central area, and the greater diminution of the markings on the marginal band. In the explanation of Cleve and Möller's *Diat.*, No. 57, *C. ellipticus* is given as equivalent to *C. lewisianus*, var.; with this opinion I am unable to agree.

Habitat.—Polycistinous Rock, Nancoori (Grunow, Cleve!).

C. obovatus. Cstr., *Diat. Chall. Exped.*, p. 160, pl. viii. fig. 4; pl. xviii. fig. 7; pl. xxii. fig. 9.—Roundly elliptical or oval, major axis $\cdot 099$ mm., about $1\frac{1}{4}$ times minor. Surface almost flat. Central space and rosette absent. Markings polygonal; towards the centre 4, near the border decreasing to 6 or 8 in $\cdot 01$ mm.; rows straight and parallel to the major axis on the central portion, which is distinctly defined, and extends to about $\frac{2}{3}$ of the radius from the centre, beyond this in radial rows.

Habitat.—Pacific Ocean (Castracane!).

Var. *circularis*, nov.—Circular. Diam. $\cdot 0625$ mm. Markings similar, but the central area less distinctly defined, the rows radiating from its outer edge to the border sometimes slightly curved.

Specimens of this var. have been labelled *C. subtilis* by O'Meara.

Habitat.—Humber (O'Meara!); stomach of oysters, at Howth (O'Meara!); locality? (O'Meara!); Atlantic Ocean, lat. 3° S., long. 15° W. (O'Meara!); off Ascension Island, lat. $0^{\circ} 1' 6''$ S., long. $15^{\circ} 56' 5''$ W., 1845 fathoms, S.S. Buccaneer (Grove! Rattray!).

C. dubius, sp. n. Sch., *Atl.*, pl. lxi. fig. 14.—Diam. $\cdot 094$ mm. Surface flat from centre for about $\frac{2}{3}$ of radius, thence convex to the

border. Central space angular, about $\frac{1}{10}$ of diam. broad. Markings rounded, adjacent to the central space, elsewhere polygonal, $2\frac{1}{2}$ to 3 in $\cdot 01$ mm., subequal for about $\frac{2}{3}$ of radius, thence decreasing slightly to the border, smooth; secondary oblique rows inconspicuous. Border indistinctly defined; striæ somewhat irregular, 4 to 6 in $\cdot 01$ mm.—*C. crassus*, Bail. var.? Grun., *Denk. Wien. Ak.*, 1884, p. 74.

Habitat.—Springfield deposit, Barbados (Schmidt).

C. cingulatus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 200.—Diam. $\cdot 049$ mm. Central space small, hyaline, indistinct. Markings minute, about 13 in $\cdot 01$ mm. Border smooth, distinct.—Ehrb. *Mikrog.*, pl. xxxv. a. 21. fig. 6; Ralfs in *Pritch. Inf.*, p. 829.

In Antarctic diatomaceous gatherings I have not observed specimens similar to this. Is it possible that Ehrenberg was dealing with a valve of *C. subtilis*?

Habitat.—Antarctic Ice Barrier, lat. $78^{\circ} 10' S.$, long. $162^{\circ} W.$ (Hooker!).*

C. crassus. Bail., *Amer. Jour. Sci.*, 1856, pl. xxii. p. 4.—Diam. $\cdot 12$ to $\cdot 14$ mm. Central space small, angular to elliptical. Markings subpearly; towards the centre 3, towards the border 2 to $2\frac{1}{4}$ in $\cdot 01$ mm., at the border suddenly smaller, secondary oblique rows inconspicuous. Border striæ 4 in $\cdot 01$ mm.—Ralfs in *Pritch. Inf.*, p. 830; Grun., *Denk. Wien. Ak.*, 1884, p. 74. *C. crassus*, var., Sch., *Atl.*, pl. lxi. fig. 19.

Grunow, in his synopsis of this genus (*Denk. Wien. Ak.*, 1884, p. 71), states correctly in his section 15 that the markings become smaller both towards the centre and towards the border, but erroneously states in the following section (16) that only the outermost markings are smaller, and by this means he differentiates this species.

Habitat.—Soundings, Sea of Kamtschatka (Bailey); Monterey (Bailey); Kékkö, Szakal and Dolje deposits (Pentocsek!); Barbados (Cleve!).

Var. *morsiana*. Grun., *ibid.*, 1884, p. 74.—Diam. $\cdot 174$. Mark-

* *Fide* Ehrenberg.

ings towards the centre 3, increasing outwards to 2, at the border 8 in .01 mm., forming 3 concentric zones.

Habitat.—Mors deposit (Grunow).

Var. *gelida*. Grun., *ibid.*, 1884, p. 74, pl. iii. (C), fig. 6.—Diam. .114 mm. Markings increasing, but little from the centre outwards; towards the centre 3, towards the border $2\frac{3}{4}$, at the border 7, in .01 mm.

Distinguished from var. *morsiana* by the markings towards the border, and from *C. apiculatus*, var. *Woodwardii*, by the increase of the markings outwards.

Habitat.—Franz Josef's Land (Grunow).

Var. *algida*. Grun., *ibid.*, 1884, p. 74, pl. iii. (C), fig. 5.—Diam. .094 mm. Central smooth area small. Markings subequal, 2 to $2\frac{1}{2}$ in .01 mm., at the border $3\frac{1}{2}$ in .01 mm.

This var. approaches *C. marginatus* in the character of the markings.

Habitat.—Franz Josef's Land (Grunow).

C. heteroporus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 265.—Diam. .072 to .1125 mm. Central space small, or replaced by a small rosette. Markings at the centre $3\frac{1}{2}$ to 4, increasing outwards to an annular, somewhat elevated area about the semiradius to 2 or $2\frac{1}{2}$, again decreasing to the border to 6 or 7 in .01 mm.; rows sometimes indistinctly radial; secondary oblique rows irregular, obscure. Border striæ evident, 6 in .01 mm.—Ralfs in *Pritch. Inf.*, p. 831; Grun., *Denk. Wien. Ak.*, 1884, p. 74. *C. heteroporus*, var. Grun., in *Sch., Atl.*, pl. lxi. fig. 4.

Recent Manilla valves show a transition to *C. apiculatus*, var. *Woodwardii*. It differs from *C. crassus* in the less robust appearance of the markings and the distinctly striated border.

Habitat.—Nottingham and Monterey deposits (Grunow); Elephant Point, Bengal (Grunow); Piscataway deposit (Griffin!); Santa Monica deposit (Rae!); Delaware, Maryland (O'Meara!); Manilla (Grove!); Labuan (Cleve!); Maryland (Cleve).

Var. *moronensis*. Grun., *Denk. Wien. Ak.*, 1884, p. 75.—Diam. .1 mm. Central rosette distinct. Markings on the elevated ring

more prominent; rows distinctly radial, secondary rows more obvious. Border more sharply defined.—*C. heteroporus*, var. Grun., Sch. in *Atl.*, pl. lxi. fig. 1.

Habitat.—Moron deposit (Grunow).

C. boliviensis. Grun., *Denk. Wien. Ak.*, 1884, p. 76.—Diam. .15 to .22 mm. Central space small, irregular. Markings hexagonal, non-punctate, increasing gradually outwards for about $\frac{2}{3}$ of the radius; towards the centre 4, at about $\frac{2}{3}$ of radius 3 in .01 mm., thence decreasing rapidly to the border to 6 in .01 mm.; secondary oblique rows inconspicuous.—*C. Woodwardii*. var.? Sch., *Atl.*, pl. lx. fig. 8.

Distinguished from *C. apiculatus*, var. *ambigua*, by the increase of the markings outwards, and from *C. gigas* by their arrangement in contact around the centre. The increase in the markings outwards is greater in some specimens than in others.

Habitat.—Bolivian guano, Sta Monica deposit (Grunow); Darien (Grunow, Schmidt); Cambridge deposit, Barbados (Hardman!* Kinker!); Lobos de Afuera guano (Grove!).

Var. *spinulosa*. Grun., *ibid.*, 1884, p. 76; *C. boliviensis*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 4.—Diam. .16 to .17 mm. Central space large, circular, about $\frac{1}{10}$ of diam. broad. Markings towards the centre 5, towards the border $3\frac{1}{2}$ in .01 mm.; a circlet of numerous minute apiculi close to the border.

Habitat.—Bolivian guano (Grunow).

C. gigas. Ehrb., 1841, *Abh. Ber. Ak.*, 1841, p. 412.—Diam. .159 to .31 mm., easily seen by the naked eye. Central space subcircular, about $\frac{1}{10}$ to $\frac{1}{4}$ of diam. broad. Markings obtusely angular, and least crowded towards the centre, with central dots faint, soon becoming hexagonal, and increasing gradually outwards; towards the centre 4, towards the border $1\frac{3}{4}$ to 2 in .01 mm., at the border again small; secondary oblique decussating rows distinct. Border narrow; striæ radial, about 4 in .01 mm., subregular.—Ehrb., *Mikrog.*, pl. xviii. fig. 34; Ralfs in *Pritch. Inf.*, p. 829; Jan., *Sch. Ges. väter. Cult.*, 1862, Heft ii. p. 3, pl. 1A. fig. 12; *Gazelle*

* In the collection of Julien Deby.

Exped., taf. iii. fig. 4; vi. fig. 13; Sch., *Atl.*, pl. lxiv. fig. 1; Grun., *Denk. Wien. Ak.*, 1884, p. 76; Cleve and Möll., *Diat.*, Nos. 57, 162, 164; *C. radiatus*, Bail., *Amer. Jour. Sci.*, 1842, vol. xlii. p. 95, pl. ii. fig. 14.

In all the specimens there is a central space, not indicated in the earlier figures. Ralfs first noted the striated border, Janisch the more robust character of the markings towards the border, and Grunow the delicate puncta on the markings and their small size at the border.

Habitat.—Richmond, Va. (Ehrenberg, Kinker! Cleve and Möller!); Nancoori (Schmidt, Cleve!); Sta Monica deposit (Weissflog! Grove!); locality? (Deby!); Hong Kong (Hardman!); Peruvian guano (Cleve! Hardman!); Macabees guano (Firth!); Crescent City (Hardman!); Sea of Java (O'Meara!); Maryland (O'Meara!); Los Angeles deposit (O'Meara!); Cove Calvert county, Maryland (Greville!); Bay of Bengal (Macrae!); Sta Monica deposit, Patagonian guano (Cleve!); Marstrand (Kinker!).

Var. *punctiformis*, nov. *C. gigas*, var., Grun., *ibid.*, 1884, p. 76.—Diam. .151 mm. Markings free towards the centre, from the semiradius to the border polygonal, punctiform, almost invisible markings at origin of shorter radii.—*C. Woodwardii*, Eul., var., Grun. in Sch., *Atl.*, pl. lxv. fig. 2.

According to Schmidt, this is intermediate between *C. gigas* and *C. diorama*, Sch.

Habitat.—Aegina (Schmidt).

Var. *diorama*. Grun., *ibid.*, 1884, p. 76. *C. diorama*, Sch., *Atl.*, pl. lxiv. fig. 2.—Diam. .15 to .25 mm. Surface slightly convex. Markings towards the central space rounded 4 in .01 mm., increasing gradually but to a less degree outwards, subequal— $12\frac{1}{2}$ in .01 mm.—on outer half of valve, again decreasing gradually near the border.—*C. gigas*, var. *Montereyi*, Grun., *ibid.*, 1884, p. 76.

Grunow's var. *Montereyi* differs only in having somewhat smaller markings, $3\frac{1}{2}$ in .01 mm.

Habitat.—Santa Monica deposit (Schmidt, Cleve!); Monterey deposit (Grunow, Cleve!); Isle of Muntok, Indian Archipelago (Kitton!); Pabillan de Pico guano (Cleve!); Patagonian guano (Cleve!).

Var. *duplicata*. Grun., *ibid.*, 1884, p. 76.—Diam. .0215 mm. Markings hexagonal, placed obliquely so that their lower and upper ends are united by oblique walls.—Cleve and Möll., *Diat.*, No. 57.

Habitat.—Shokoe Hill deposit, Richmond, U.S. (Grunow); Richmond Va. (Greville! Cleve and Möller!).

Var. *californica*, nov. *C. californicus*, O'Me. MS.—Diam. .22 mm. Markings towards the central space 6 to 8, increasing outwards to 4, again decreasing to 8, in .01 mm. at the border.

Habitat.—"Guano" (O'Meara!); Medway (Dallas!)*

Var. *guineensis*, Rattray. *C. guineensis*, Grun., *Denk. Wien. Ak.*, 1884, p. 76.—Diam. .05 to .1 mm. Central space distinct. Markings hexagonal; towards the centre rounded, granular, $5\frac{1}{2}$ in .01 mm., not distinctly punctate; the interspaces provided with small hexagonally arranged puncta.

Habitat.—Brackish water, Lagos (Grunow).

Var. *laxa*, nov. *C. guineensis*, Grun., *ibid.*, p. 76.—Diam. .13 mm. Central space round with irregularly placed puncta. Markings free.

Habitat.—Monterey deposit (Grunow).

C. Janischii. Sch., *Atl.*, pl. lxiv. figs. 3, 4.—Diam. .16 to .245 mm. Central space subcircular, hyaline, $\frac{1}{2}$ to $\frac{1}{4}$ of diam. broad. Markings faint, but sharply defined, on a narrow band at the border, obtusely angular, increasing but slightly outwards, $3\frac{1}{2}$ to 4 in .01 mm., non-punctate, the central dots indistinct; rows radial, secondary rows obscure.—Grun., *Denk. Wien. Ak.*, 1884, p. 76; Janisch., *Gazelle Exped.*, taf. iv. figs. 3, 5; *C. marginatus*, Janisch. (*non Ehrb.*), *Abh. Sch. Ges. väter. Cult.*, 1882, p. 3, pl. i. a. fig. 20.

This species has sometimes been confounded with *C. gigas*.

Habitat.—"Guanos" (Grunow! Macrae! Firth!); Ichaboe guano (Janisch, Joshua! Greville!); Felső-Esztergály, Kékkö, Szent Peter deposits (Pantocsek!); Peruvian guano (Firth!); † soundings, Gulf of California (H. L. Smith!); ‡ Richmond (O'Meara!); Chincha guano (Grove!); Saldanha Bay guano (Cleve, Greville!); Cambridge deposit (?) (O'Meara!); Java, (Cleve!).

* In the collection of Dr Greville.

† In the collection of Dr F. W. Griffin.

‡ H. L. Smith, *Diat. Spec. Typ.*, No. 91.

Var. *arafurensis*. Grun., *ibid.*, 1884, p. 76.—Diam. from $\cdot 29$ to $\cdot 425$ mm. Markings increasing more from the central space outwards; towards the centre $3\frac{1}{2}$, towards the border $2\frac{1}{2}$ in $\cdot 01$ mm.—*C. arafurensis* var., Cstr., *Diat. Chall. Exped.*, p. 153, pl. ii. fig. 4; *C. craspedodiscus*, O'Me., *Quart. Jour. Micr. Sci.*, 1877, p. 463.

The presence of the large central space referred to by O'Meara in his *Coscinodiscus craspedodiscus* excludes it from *Coscinodiscus craspedodiscus*, Kütz., where there is a central rosette, and identifies it with the present var. The hoop-like appearance of the valve under a low power referred to by Castracane is not shown in his figure (*Diat. Chall. Exped.*, p. 152–154, pl. iii. fig. 5).

Habitat.—Arafura Sea, H.M.S. Challenger (Grunow, Weissflog! Rae!); Gazelle Expedition (Weissflog!); Bay of Bengal (Macrae!); "Atlantic Ocean" (Cleve).

C. entoleion. Grun. Sch., *Atl.*, pl. cxiv. fig. 3.—Diam. $\cdot 25$ to $\cdot 3$ mm. Surface slightly convex near the border. Central space circular, $\frac{1}{20}$ to $\frac{1}{24}$ of diam. broad. Markings hexagonal, increasing from the central space outwards, again decreasing near the border; towards the centre most delicate, 3 to $2\frac{1}{2}$, near the border 2 to $2\frac{1}{2}$ in $\cdot 01$ mm.; oblique decussating rows evident. Border sharply defined, narrow; striæ 4 to 5 in $\cdot 01$ mm.

Distinguished from *C. gigas* by the more delicate and smaller markings and the absence of narrow hyaline interspaces radiating outwards from the central space. Specimens have sometimes been confounded with *C. perforatus*, var. *cellulosa*, from which they differ by the marked increase of the areolæ outwards.

Habitat.—Thames mud, at Southend (Dickie!); Hungarian marl (Thum).*

C. flexilis, sp. n. Sch., *Atl.*, pl. cxiv. fig. 6.—Diam. $\cdot 15$ to $\cdot 12$ mm. Surface almost flat. Central space distinct, $\frac{1}{18}$ to $\frac{1}{24}$ of diam. broad, surrounded by an inconspicuous band of larger areolæ. Markings polygonal, mostly hexagonal, increasing for a short distance outwards from the band surrounding the central space, again gradually decreasing towards the border; towards the centre $4\frac{1}{2}$ to 5, about the semiradius 4, at the border 6, in $\cdot 01$ mm.; rows

* Fide A. Schmidt.

straight, secondary oblique decussating rows evident. Border narrow, sharply defined; striæ faint, 6 in .01 mm.

Distinguished from *C. apiculatus* by the more delicate markings that are devoid of prominent central papillæ, and by the distinct central space.

Habitat.—? (Griffin!); Chincha guano (Schmidt).

C. conformis, sp. n. Sch., *Atl.*, pl. cxiv. fig. 4.—Diam. .2 mm. Surface somewhat depressed at the centre. Central space circular, about $\frac{1}{2}$ of diam. broad, surrounded by an inconspicuous band of areolæ subobsolete on their central side. Markings 4- to 6-angled, without puncta at the angles, increasing gradually to the semiradius, again decreasing to the border; towards the central space $4\frac{1}{2}$, at the semiradius $3\frac{1}{2}$, at the border 5 or 6 in .01 mm.; central papillæ indistinct; delicate puncta at the origin of the shorter rows; secondary oblique rows short, substraight, evident. Border narrow; striæ 8 in .01 mm.

Habitat.—Arica (Schmidt).

C. josefinus. Grun., *Denk. Wien. Ak.*, 1884, p. 75, pl. iii. (C), fig. 16.—Diam. .08 mm. Surface convex. Central space small, subcircular. Markings smooth, decreasing but slightly near the border, 7 to 8 in .01 mm. Border striæ delicate, 14 in .01 mm., about $\frac{1}{16}$ of radius broad, at its middle a sharp line concentric with the outer edge.

Distinguished from *C. radiosus*, Grun., and *C. fimbriatus*, Ehrb., by the character of the border.

Habitat.—Franz Josef's Land (Grunow).

C. nobilis. Grun., *Jour. Roy. Micr. Soc. Lond.*, 1879, p. 687, pl. i. fig. 1.—Diam. .375 to .54 mm. Central space distinct, hyaline. Markings minute, about 7 in .01 mm., hexagonal towards the border, separated into obscure fasciculi by inconspicuous radial lines.—Cleve and Möll., *Diat.*, Nos. 145, 146, 162; *C. regius*, Grun., *Sitzungsber. naturw. Ges. Isis., Dresden*, 1878, p. 124.

Sometimes mistaken for *C. concinnus*, but distinguished by its large central area and more distinct radial rows of markings.

Habitat.—In *Noctiluca*, at Gorleston Pier, Suffolk, Harwich (Grunow!); *Ascidia*, Hull (Greville!); Hong Kong and Arafura Sea

(Grunow! Rattray!); Java Sea (Grunow! Cleve and Möller!); lat. $4^{\circ} 12' 7''$ N., long. $3^{\circ} 57' 5''$ E, 1460 fms. (Rae!); Isle of Muntok, Indian Archipelago (Kitton!); * Nancoori (Cleve and Möller!); Java (Cleve and Möller! Cleve!); lat. $4^{\circ} 20'$ S., long. $105^{\circ} 22'$ E. (Cleve!); surface, Gulf of Guinea, S.S. Buccaneer Exped. (Grove!).

C. Gazelle. Janisch, *Jour. Roy. Micr. Soc., Lond.*, 1879, p. 688.—Diam. 1.8 to 1.9 mm. Central space circular, about .0375 mm. broad, hyaline, bearing at its centre a group of irregular evident apiculi, and having at its boundary a circle of similar apiculi at wide unequal intervals. Markings delicate, punctiform, 6 to 7 in .01 mm.; rows straight, short secondary transverse or oblique rows obvious; adjacent to the border a distinct narrow (about .003 mm. broad) hyaline zone.† Border sharply defined, about .005 mm. broad, hyaline.—*Ethmodiscus tympanum*, Cstr., *Diat. Chall. Exped.*, 1886, p. 170, pl. xiv. fig. 3; *E.*, sp. (*fragmenta*) Cstr., *ibid.*, p. 170, pl. xiv. figs. 4a-c; *E. gigas*, Cstr., *ibid.*, p. 169, pl. xiv. fig. 5.

E. wyvilleanus, Cstr. (*ibid.*, p. 170, pl. xiv. fig. 6), differs only in having the angles of the valves rounded, and may be a var. of the present species. To the same var. belongs *E. sphaeroidalis*, Cstr., *ibid.*, p. 170, pl. xxii. fig. 10; in the specimen figured division has recently been completed.

Habitat.—Gazelle sounding No. 125, lat. $30^{\circ} 53'$ S., long. $177^{\circ} 6'$ E., depth 4151 metres (Janisch!); and sounding No. 96, lat. $9^{\circ} 57'$ S., long. $121^{\circ} 52'$ E. (Weissflog!); H.M.S. Challenger, station 265, depth 2900 fms. (Grunow!); Nottingham deposit in fragment (Grunow).

C. imperator, Janisch MS.—Diam.? Central space and rosette? Markings minute, delicate, angular, 8, towards the border recognised with greater difficulty, 10 to 12 in .01 mm.; rows straight; the oblique decussating rows faint; hyaline band adjacent to the border absent. Border narrow, hyaline.—(Pl. I. fig. 5.)

Habitat.—Gazelle Expedition, sounding No. 96, lat. $9^{\circ} 57'$ S., long. $121^{\circ} 52'$ E. (Weissflog!).

C. praetor, Grove MS.—Diam.? Surface flat. Central space

* In the collection of E. Grove.

† This also occurs in *C. rex*.

absent, a distinct central area .04 mm. broad, bounded by a narrow ring of closely disposed minute apiculi. Markings angular recognised with difficulty; within the central area 6, at the border 8 to 9 in .01 mm.; secondary oblique decussating rows short, obvious; no hyaline band at the border. The connecting zone bears straight parallel rows of short striæ, 10 in .01 mm., the rows separated by narrow hyaline lines.—(Pl. III. figs. 2 and 3.)

Habitat.—"Barbados" (Grove!).

C. punctatus. Ehrb., *Mon. Ber. Ak.*, 1884, p. 78.—Elliptical or subdiamond-shaped, major axis .0625 to .12 mm., $1\frac{1}{2}$ to $1\frac{2}{3}$ times minor. Central space small, circular sometimes bearing a few isolated round granules. Markings rounded, granular, 6 to 8 in .01 mm.; interspaces hyaline, largest towards the centre, towards the border more crowded; rows radial, straight; oblique decussating rows evident near the border. Border indistinct on inner side; striæ delicate, 8 to 10 in .01 mm.—Ehrb., *Mikrog.*, pl. xviii. figs. 40, 41; Ralfs in *Pritch. Inf.*, p. 830; H. L. Sm., *Diat. Spec. Typ.*, No. 97; Cleve and Möll., *Diat.*, No. 57.

This species is sometimes mistaken for *C. lewisianus*, but it differs in the arrangement of the markings. It differs from *Cestodiscus ovalis*, Grev., by the absence of obtuse submarginal processes. In the original definition Ehrenberg gives the markings as 12 to 13 in .01 mm.

Kitton has found frustules with very dissimilar valves in the Richmond deposit, Virginia. In one case one valve was normal, whilst the second showed a large rounded central area, with round isolated granules disposed without order, the zone adjacent to the border only appearing normal.

Grove inclines to associate this form with *Actinocyclus*, as his forms in H. L. Smith's series show pseudonodules.

Habitat.—Richmond, Va. (Greville! Bailey! * Grove! Kitton! Cleve and Möller!); Nancoori (Hardman!); Crescent City, Cal. (Weissflog!); Paita deposit, Peru (H. L. Smith!).

Var. *rhombica*, nov. *C. rhombicus*, Cstr., *Diat. Chall. Exped.*, p. 164, pl. xxii. fig. 11.—Major axis .119 mm., about $2\frac{1}{2}$ times

* In the collection of Dr Greville.

minor. Central space absent. Markings without order, but around the border smaller, and forming short radial lines.

Habitat.—Sea of Japan, H.M.S. Challenger (Castracane).

C. reniformis. Cstr., *Diat. Chall. Exped.*, p. 160, pl. xii. fig. 12.—Reniform, somewhat broader at one end than at the other. Major axis $\cdot 1725$ mm., about $2\frac{1}{2}$ times the greatest breadth. Central space and rosette absent. Markings polygonal, gradually increasing from the centre outwards; towards the centre 8, at the border 6, in $\cdot 01$ mm.; rows straight.

Grunow correctly notes (*Bot. Centralb.*, Bd. xxxiv. p. 40) that Janisch had named this form *Stoschia admirabilis* in his still unpublished manuscript of his report on the Diatoms of the Gazelle Expedition.

Habitat.—? (Castracane).

C. sarmaticus. Pant., *Fossil. Bacil. Ung.*, p. 74, pl. viii. fig. 62.—Elliptical, major axis $\cdot 016$ to $\cdot 025$ mm., about $1\frac{1}{4}$ times minor. Central space and rosette absent. Markings delicate, punctiform, least crowded and most evident towards the centre; radial rows obscure; apiculi 2, minute, inserted at the extremities of the minor axis and close to the border, sometimes absent. Border narrow but distinct, smooth.

Habitat.—Dolje deposit (Pantocsek!).

C. biangulatus. Sch., *Atl.*, pl. lxiii. fig. 13.—Diam. $\cdot 125$ to $\cdot 175$ mm. Surface slightly convex. Central space and rosette absent. Markings decreasing gradually from the border outwards; towards the centre $2\frac{1}{2}$ to 3, towards the border 4, in $\cdot 01$ mm; central papillæ distinct; rows straight, secondary oblique curved decussating rows evident. Border sharply defined, from $\frac{1}{8}$ to $\frac{1}{8}$ of radius broad, its inner edge with 2 unsymmetrical deep constrictions at an interval from each other about equal to the radius; striæ coarse, moniliform, 4 or 5 in $\cdot 01$ mm.—*C. asteromphalus*, var. *biangulata*, Cleve and Möll., *Diat.*, No. 215.

Habitat.—Nottingham deposit, Md. (Schmidt, Cleve and Möller!); Bermuda tripoli (Greville!); Calvert, county Md. (Cleve); Nagy-Kurtós deposit, Hungary (Rae! Deby!); Moron deposit (Grove).

C. asteromphalus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 77.—Diam. .085 to .3 mm. Surface slightly depressed at the centre, and convex towards the border. Central space small, obtusely angular, surrounded by a distinct rosette. Markings polygonal, robust, punctate, $3\frac{1}{2}$ to 4 in .01 mm., increasing slightly towards the border to $2\frac{1}{2}$ or 3 in .01 mm.; central dots distinct. Border distinct; striæ obvious, coarse, about 4 in .01 mm.—Ehrb., *Mikrog.*, pl. xviii. fig. 45; pl. xxxiii. 15. fig. 7; Ralfs in *Pritch. Inf.*, p. 828; Grun., *Denk. Wien. Ak.*, 1884, p. 78; Pant., *Fossil. Bacil. Ung.*, p. 71; Sch., *Atl.*, pl. cxiii. fig. 23; Van Heurck, *Typ. Syn. Diat. Belg.*, No. 508; Cleve and Möll., *Diat.*, Nos., 57, 164; Janisch, *Gazelle Exped.*, taf. iv. fig. 9; *C. asteromphalus*, var. *genuina*, Grun., *Denk. Wien. Ak.*, 1884, p. 78; *C. asteromphalus*, var. *conspicua*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxx. figs. 1, 2, 5, 6; Grun., *Denk. Wien. Ak.*, 1884, p. 78; sp. n.? Sch., *Atl.*, pl. lxiii. fig. 5.

This species is distinguished by the evident puncta on the markings. Grunow has observed in Richmond specimens a finely punctate layer detached. The places corresponding to the angles of the markings have coarse, mostly triangular dots, the round central dots are only found in perfect valves.

Habitat.—Richmond (Ehrenberg, Cleve and Möller!); and Holles Cliff deposit, Va. (Ehrenberg); guano (Grunow); Sta Monica deposit (Weissflog! Rae!); Fernando Noronha guano (Rattray!); New York, in the sea (Grunow); Arica (Schmidt).

Var. *eximia*, Grun., *ibid.*, 1884, p. 78.—Diam. .475 mm. Central space irregular, small. Markings increasing slightly outwards from central rosette to about $\frac{2}{3}$ of radius, 2 to $2\frac{1}{2}$ in .01 mm.—*C. asteromphalus*, Ehrb; Sch., *Atl.*, pl. lxiii. fig. 12.

Habitat.—Santa Monica deposit (Schmidt, Rae! Deby!). With type (Grunow).

Var. *omphalanthus*. Grun., *ibid.*, 1884, p. 78; *C. omphalanthus*, Ehrb., *Mon. Ber. Ak.*, 1844, p. 266.—Diam. .255 to .45 mm. Central space sometimes absent, rosette conspicuous or less obvious. Markings subequal to about $\frac{2}{3}$ of radius, $2\frac{1}{2}$ in .01 mm., thence decreasing gradually to the border, sometimes slightly smaller towards the central rosette. Border somewhat sharply constricted

at two somewhat distant points.—*C. omphalanthus*, Ehrb.; Ralfs in *Pritch. Inf.*, p. 828; Cleve and Möll., *Diat.*, Nos. 57, 215; Ehrb., *Diat. Spec. Typ.*, No. 6 (excl. Sch., *Atl.*, pl. lxiii. fig. 2).

The constriction at the border is similar to that of *C. biangulatus* (Sch., *Atl.*, pl. lxiii. fig. 13), but the latter is devoid of a rosette, and the dark band at the border is relatively much wider. This var. is frequently mistaken for *C. oculus-iridis*, and sometimes for *C. borealis*.

Habitat.—"Bermuda" (Eulenstein! * Greville!); Nottingham deposit (G. M. Brown! Firth! Cleve and Möller! O'Meara! Cleve! Hardman!); † Richmond, Va. (O'Meara! Cleve and Möller!); Maryland (O'Meara! Hardman!); "Virginia" (Hardman!); Calvert, county Maryland (Kinker! Weissflog!); Kékkö deposit (Grove!); Rappahannock (Greville!); Piscataway deposit (Cambridge! † Greville!); Delaware, U.S. (Cambridge!); † Patuxent earth (Rae!); † Holland's Cliff (Cleve!); San Benito deposit, California (Grove!).

Var. brightwellioides. Grun., *ibid.*, 1884, p. 78.—Diam. .1125 to .26 mm. Surface rising from the centre to the semiradius, thence descending to the border. Markings polygonal, gradually increasing outwards to the semiradius, where there is a distinct circlet of large areolæ, $2\frac{1}{2}$ in .01 mm. at right angles to the radius, thence decreasing to the border; at the centre $3\frac{1}{2}$, at the semiradius 3, at the border 3 in .01 mm.—Pant., *Fossil. Bacil. Ung.*, p. 71, pl. xvii. fig. 155.

The circlet of larger markings forms a transition to *C. bulliens*, Sch., and to the genus *Brightwellia*.

Habitat.—Santa Monica deposit (Grunow, Kinker!); Szakal and Szent Peter deposits (Pantocsek).

Var. pulchra. Grun., *ibid.*, 1884, p. 78.—Diam. .36 mm. Central space smooth, .01 mm. broad, surrounded by a distinct band of larger markings. Markings 2 to $2\frac{1}{3}$ in .01 mm., decreasing quite close to the border.

* As to this locality, Eulenstein notes—"Locus dubius, verisimiliter ad pagum hujus nominis Americæ borealis non ad *insulas* referendus."

† In the collection of Dr Griffin.

This var. approaches var. *princeps* in the character of the central space, but is distinguished by its larger markings.

Habitat.—Santa Monica deposit (Grunow).

Var. *macrantha*. Grun., *ibid.*, 1884, p. 78.—Diam. .45 mm. Central space still larger, .026 mm. broad, round, smooth, or punctate. Markings subequal, 4 in .01 mm.

Habitat.—Found on a mass of diatoms floating on the Elbe by Möller (*vide*, Grunow).

Var. *princeps*. Grun., *ibid.*, 1884, p. 78.—Diam. .5 mm. Central space subcircular, .025 mm. broad. Markings decreasing outwards to about semiradius thence increasing slightly towards the border, 5 to 6 in .01 mm.—Van Heurck, *Syn. Diat. Belg.*, pl. cxxviii. figs. 1-3.

Separated from the preceding by its smaller markings.

Habitat.—With var. *macrantha* (Grunow, Van Heurck).

Var. *pabellanica*. Grun., *ibid.*, 1884, p. 79.—Diam. .145 to .16 mm. Central space .0065 mm. broad, the surrounding band of markings evident, but less prominent than in vars. *princeps* and *macrantha*. Markings 5 in .01 mm., somewhat smaller at the border, faintly punctate.—*C. asteromphalus*, var. *pabellana*, Grun. in Van Heurck, *Syn. Diat. Belg.*, pl. cxxviii. fig. 5.

Habitat.—Pabellan de Pico guano (Grunow); Peruvian guano (Hardman !).*

Var. *hybrida*. Grun., *ibid.*, 1884, p. 79, pl. iii. (C) fig. 9.—Diam. .175 to .35 mm. Surface convex toward the border. Central rosette evident, rarely indistinct. Markings 4 in .01 mm., somewhat smaller close to the rosette than about the semiradius thence gradually decreasing towards the border to 6 in .01 mm., sometimes indistinctly punctate, a circle of minute apiculi sometimes present at the border.—Pant., *Fossil. Bacil. Ung.*, p. 71; Sch., *Atl.*, pl. cxiii. fig. 2; *C. centralis*, Sch., *Atl.*, pl. lxiii. fig. 1.

Habitat.—Felső-, Esztergály, Kekkő and Szent Peter deposits (Pantocsek) Hvidingsoe, N. Sea, Cuxhaven, Marahon mouth, Davis

* In the collection of Julien Deby.

Straits, Franz Josef's Land (Grunow); "Yssee" (Kinker!); Melville Bay (Griffin!); Los Angeles deposit (O'Meara!).

C. bisinuatus. Sch., *Atl.*, pl. lxxiii. figs. 14, 15.—Diam. from .106 to .145 mm. Surface showing 2 unsymmetrical depressions, convex inwards, close to the border. Central space absent; rosette distinct, composed of few (4 to 6) areolæ. Markings polygonal, 4 in .01 mm., decreasing for a short distance from the rosette, thence subequal, and again decreasing near the border; close to the border 7 in .01 mm.

Approaching *C. oculus-iridis* and *C. centralis*.

Habitat.—North Celebes (Grunow, Schmidt).

C. Weyprechtii. Grun., *Denk. Wien. Ak.*, 1884, p. 78, pl. iii. (C), fig. 8.—Diam. .094 mm. Surface convex. Central space minute, rosette small. Markings gradually decreasing outwards; towards the centre $5\frac{1}{2}$, towards the border 7, in .01 mm., each with a distinct central dot and minute puncta, 20 in .01 mm. Border broad, of two portions, the inner with delicate striæ 15 in .01 mm., the outer hyaline.

This species is readily distinguished by its border.

Habitat.—Franz Josef's Land (Grunow).

C. undulans, Rattray, *C. undulatus*,* Cstr., *Diat. Chall. Exped.*, p. 159, pl. viii. fig. 3.—Diam. .390 mm. Surface with two concentric elevations—one near the centre, the second close to the border. Central space irregular, about $\frac{1}{6}$ of diam. broad. Markings polygonal, largest on the elevations, increasing gradually from the central space to the inner edge of the inner elevation, decreasing suddenly at its outer edge, and again increasing to the inner edge of the outer elevation, smallest towards the border, about the semi-radius $1\frac{3}{4}$ to 2 in .01 mm.; rows indistinct upon the elevations, secondary oblique decussating rows evident.

Habitat.—Pacific Ocean, H.M.S. Challenger (Castracane).

C. convexus. Sch., *Atl.*, pl. lx. fig. 15.—Diam. .1 mm. Central space absent. Markings hexagonal, distinctly punctate, central

* Name preoccupied by Cleve (*Kongl. Sv. Vet.-Ak. Handl. Stockh.*, 1881, No. 5, p. 20).

dots minute; towards the centre 3, towards the border 5, and at the border 8, in .01 mm.; secondary oblique decussating rows evident.

Habitat.—Springfield deposit, Barbados (Schmidt, Grunow, Hardman!).

Var. *bengalensis*. Grun., *Denk. Wien. Ak.*, 1884, p. 73.—Diam. .08 to .14 mm. Markings smaller; towards the centre 4, at the border 10, in .01 mm.

Habitat.—Brackish water, coast of Bengal (Grunow).

Var. *diminuta*. Grun., *ibid.*, 1884, p. 73.—Markings still more minute; towards the centre 6 in .01 mm., less distinctly punctate.

This var. approaches *C. radiosus*, Grun.

Habitat.—Brackish water, coast of Bengal (Grunow).

C. fimbriatus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 78.—Diam. .1 to .1125 mm. Central space and rosette absent. Markings polygonal; towards the centre 4, decreasing gradually outwards to 6 or 7, in .01 mm.; radial rows most evident towards the border.—Ehrb., *Mikrog.*, pl. xxii. fig. 2; Ralfs in *Pritch. Inf.*, p. 829; Grun., *Denk. Wien. Ak.*, 1884, p. 74. *C. radiolatus*, Ehrb., *Sch. Atl.*, pl. lx. fig. 11.

Distinguished from *C. radiosus*, Grun., by its larger markings, which decrease less rapidly outwards in Grunow's species.

Habitat.—Caltanissetta (Ehrenberg); Sicilian marls (Grunow); Los Angeles deposit, Cal. (O'Meara!).

Var. *subradiata*, nov. *C. fimbriatus*, var., Van Heurck, *Syn. Diat. Belg.*, p. cxxxi. fig. 2.—Diam. .063 mm. Markings 7, increasing gradually outwards to 6, in .01 mm., about $\frac{2}{3}$ of radius from the centre, again diminishing more rapidly to the border.

Grunow, followed by Pantocsek, have united this to the species. The affinities to *C. radiatus* are striking.

Habitat.—Oran deposit (Van Heurck).

Var. *californica*. Grun., *ibid.*, 1884, p. 74.—Diam. .07 to .09 mm. Centre, often with small irregular puncta, one frequently larger than the others, and like the rudiment of a bristle. Markings

towards the centre 5 to 6 in $\cdot 01$ mm., often smaller than nearer the border, at the border 8 to 9 in $\cdot 01$ mm.

Habitat.—California deposits, San Diego (Grunow).

C. obversus, sp. n. Sch., *Atl.*, pl. lx. fig. 14 (no name).—Diam. $\cdot 075$ to $\cdot 105$ mm. Central space absent or subobsolete; rosette distinct. Markings polygonal, subequal or decreasing slightly for about $\frac{5}{8}$ of radius, thence decreasing more rapidly to the border; towards the centre 2 to $2\frac{1}{2}$, at the border 8, in $\cdot 01$ mm.; central papillæ distinct; rows sometimes obscurely fasciculate; on the outer $\frac{1}{3}$ of the radius the rows are separated by clear radial lines. Border narrow, distinct.

From *C. fimbriatus* this is distinguished by the larger more robust markings and their more rapid decrease from the centre outwards.

Habitat.—Hong Kong (Hardman!); marsh ground, Wedel (Schmidt); Cambodia (Hardman!).

Var. *tenuior*, nov.—Diam. $\cdot 0625$ mm. Central space and rosette absent. Markings subequal to about $\frac{2}{3}$ of radius, thence decreasing to the border; at the centre 6, near the border 10, in $\cdot 01$ mm.

Habitat.—Rio Janeiro (Hardman!).

C. grandineus, sp. n. Sp. aff. *C. concinno*, Sch., *Atl.*, pl. lx. fig. 16.—Diam. $\cdot 075$ to $\cdot 19$ mm. Surface moderately convex, flat on a narrow zone adjacent to the border. Central space absent; rosette distinct, sometimes inconspicuous. Markings polygonal, decreasing gradually from the centre outwards; towards the centre 4, towards the border 8, in $\cdot 01$ mm.; rows straight; secondary oblique decussating rows manifest; minute apiculi at intervals of about $\cdot 006$ mm., sometimes present at the border. Border with inner edge indistinct; striæ 4 to 6 in $\cdot 01$ mm.

This species differs from *C. concinnus*, var. *jonesiana*, by the absence of apiculi and processes, and from *C. asteromphalus*, var. *hybrida*, by the absence of a zone of somewhat larger markings about the semiradius than nearer the centre.

Habitat.—Dredged off Heard Island, in 75 fathoms, by H.M.S. Challenger (Rae!); dredged in Royal Sound, Kerguelen, 28

fathoms, by H.M.S. Challenger (Rae !); Ballybrack (O'Meara !); Nottingham, Maryland, (O'Meara !); Cambridge deposit, Barbados (Johnson !).*

Var. *dentata*, nov.—Diam. .1075 mm. Central rosette small; markings towards the centre 4, at the border 6, in .01 mm.; apiculi large, at subequal intervals of about .006 mm.

Habitat.—? (Greville !); Barbados deposit (Johnson !).*

C. centralis, emend.; *C.? centralis*. Ehrb., *Abh. Ber. Ak.*, 1838, p. 129.—Diam. .12 to .255 mm. Central space absent or minute; a rosette obvious. Markings variable in size, subequal—4 to $4\frac{1}{2}$ in .01 mm. for about $\frac{5}{8}$ of the radius, thence decreasing gradually outwards on the outer $\frac{1}{8}$; sometimes 5 in .01 mm., and decreasing gently from the semiradius; rows straight, sometimes subfasciculate towards the border, the fasciculi separated by narrow clear areas proceeding inwards from the apiculi; apiculi delicate, inserted at the border at intervals of about .006 mm., 2 larger unsymmetrical, at an interval from each other somewhat greater than the semiradius. Border narrow; striæ 6 in .01 mm.—Ehrb., *Mon. Ber. Ak.* 1844, p. 78; *Mikrog.*, pl. xviii. fig. 39; pl. xxii. fig. 1; Greg., *Trans. Roy. Soc. Edin.*, 1857, p. 501, pl. xi. fig. 49; Ralfs in *Pritch. Inf.*, p. 828; Grun., *Sitzungsab. naturw. Ges. Isis, Dresden*, 1878, p. 123; Van Heurck, *Syn. Diat. Belg.*, pl. ciii. fig. B; H. L. Smith, *Diat. Spec. Typ.*, Nos. 91, 92; Cleve and Möll., *Diat.*, Nos. 57, 164, 207, 215; *C. asteromphalus*, var. *centralis*, Grun., *Denk. Wien. Ak.*, 1884, p. 79; *C. centralis*, var. *micraster*, Grun.; Cleve and Möll., *Diat.*, No. 172; *C. centralis*, var., Cstr., *Diat. Chall. Exped.*, p. 155, pl. ii. fig. 3; *C. centralis forma minor*, Van Heurck., *Typ. Syn. Diat. Belg.*, No. 531 (excl. *C. centralis*, † Weisse, *Bull. Acad. Imp St Petersb.*, 1867, p. 122, pl. i. fig. 18; *C. centralis*, ‡ O'Me., *Proc. Roy. Irish Ac.* 1875, p. 260, pl. xxvi. fig. 19; *C. centralis*, § Sch., *Atl.*, pl. lxiii. fig. 1; *C. centralis*, Ehrb., *Mikrog.*, pl. xxi. fig. 3).

This species is sometimes confounded with *C. oculus-iridis*, *C.*

* In the collection of Dr Greville.

† This is *C. radiatus*, Ehrb.

‡ This is probably *C. subtilis*, as stated by Grunow.

§ This is *C. asteromphalus*, var. *hybrida*, Grun.

radiatus, and *C. concinnus*. In balsam preparations the apiculi are hardly visible. It has been employed along with *Rhizosolenia* and *Denticellæ* by Max Schultze in 1859 in studying the movements of the granules in the interior of the frustule. In Ehrenberg's definition, the markings are given as about 6 in .01 mm., as in some forms of *C. radiosus*, Grun. Castracane erects a var. solely on the presence of a striated border—a character clearly shown in Ehrenberg's figure (*Mikrogr.*, pl. xviii. fig. 39). Some specimens named by Van Heurck *Coscinodiscus centralis forma minor* (*Typ. Syn. Diat. Belg.*, No. 531), from the Baltic, may belong rather to *C. oculus-iridis*, owing to the increase in the size of the markings outwards; *C. centralis* is readily distinguished from *C. asteromphalus* by the presence of the 2 unsymmetrical apiculi, and cannot be united with it in the same species as proposed by Grunow. The two processes were first observed by Mr E. Grove, F.R.M.S.

Habitat.—Oran and Caltanisetta deposits (Ehrenberg); Glenshira sand (Gregory!); Cherbourg (H. L. Smith!); grey mud dredged in 569 fathoms, lat. 63° 40' N., long. 5° 28' E. (Ehrenberg); Richmond (Ehrenberg, Cleve and Möller!); some guanos (Grunow); South Sea, Lagos, North Sea, Baltic (Grunow); Heligoland (Schultze!);* *Ascidia*, Hull (Gregory!* Greville!); Loch Fyne (Gregory! Greville!); Lamlash (Gregory! Greville! Dickie!); Firth of Forth at Granton (Rattray!); Melville Bay (Deby! Barnett!); † soundings, Gulf of California (H. L. Smith!); Ballybrack (O'Meara!); from *Laminaria saccharina*, Dalkey (O'Meara!); *Ascidia*, Dublin Bay (O'Meara!); Bermuda tripoli (Greville!); Fuur deposit, Jutland (O. N. Witt!); North Atlantic, lat. 51° 20' N., long. 52° 25' W., 232 fathoms (O'Meara!); Richmond Tunnel (O'Meara!); Davis Straits (O'Meara!); Liumfiord, Jutland (Hardman!); Patos Island guano (Hardman!); ‡ Virginia (Hardman!); † Oran deposit (Deby!); Malahide (O'Meara!); Behring Sea, 1681 fathoms (H. L. Smith!); surface, Hong Kong Harbour, H.M.S. Challenger (O'Meara!); Monkstown, in tide pools (O'Meara!); *Ascidia*, Belfast (O'Meara!); Thames, at Sheerness (Grove!); Spezzia (Kinker!); Los Angeles

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† In the collection of Dr Griffin.

‡ In the collection of Julien Deby.

deposit (O'Meara!); Baltic Sea (Van Heurck!); Teignmouth Grove!); Peruvian guano (Cleve! Macrae!); Sta Monica deposit (Cleve and Möller!) Sta Maria deposit (Grove!); Davis Straits, Patagonia; Nottingham deposit, Md. (Cleve and Möller!); Möller's Elbe material (Cleve!); Patagonia, 1375 fathoms, H.M.S. Challenger (Cleve!); Faroe Channel (Grove!); west coast Florida, U.S. Survey (Febiger!); Yeddo, Bohuslan, Kusu, Pabillan de Pico guano; Greenland; Successful Bay, Kerguelen (Cleve!).

C. floridulus. Sch., *Atl.*, pl. cxiii. fig. 16, *a*, *b*, *c*.—Diam. .1135 mm. Surface flat. Central space irregular, small, about $\frac{1}{25}$ of diam. broad. Markings polygonal, largest round the central space, thence decreasing slightly outwards; towards the centre 4, towards the border 6, in .01 mm.; minute puncta at the origin of the shorter rows; rows substraight; secondary oblique decussating rows evident; minute apiculi at angles of areolæ (seen in oblique aspects). Border narrow.

Distinguished from *C. obscurus* by the size of the markings and character of the border.

Habitat.—Sta Monica (Schmidt).

C. inæquisculptus, sp. n. Roundly elliptical; major axis .175 mm., about $1\frac{1}{17}$ times minor. Surface slightly convex towards the centre. Central space absent; rosette distinct. Markings hexagonal, and increasing slightly outwards to about the semiradius, 4 to $4\frac{1}{2}$ in .01 mm. in radial rows; beyond the semiradius large, unequal, and without order; central papillæ of the smaller faint, in the larger a faint elevated central ridge. Border indistinct; striæ 6 in .01 mm.—(Pl. I. fig. 17.)

Habitat.—Moron deposit (Greville!).

C. megacentrum. Grove, MS.—Diam. .12 to .125 mm. Surface somewhat convex. Central space and rosette absent. Markings angular, $1\frac{1}{2}$ to 3 on the central area, which extends to $\frac{1}{4}$ or $\frac{1}{3}$ of the radius, beyond this $2\frac{1}{2}$ in .01 mm., and increasing gradually outwards to about $\frac{2}{3}$ of radius, thence decreasing to the border; the central papillæ prominent; irregular on the central area, beyond this in straight rows, with secondary oblique decussating

rows manifest. Border narrow; striæ evident, 6 to 8 in .01 mm.—(Pl. II. fig. 13.)

Habitat.—Oamaru deposit (Grove!).

C. discernendus. Sch., *Atl.*, pl. cxiv. fig. 1.—Diam. .272 mm. Surface flat, towards the border convex. Central space absent; rosette distinct. Markings hexagonal, towards the border obtusely angular with long axes radial, pearly, decreasing gradually outwards; towards the centre $1\frac{1}{2}$ to 2, towards the border 2 to $2\frac{1}{2}$, in .01 mm. Central papillæ prominent, those on the markings near the border placed towards their central side; secondary oblique decussating rows distinct, towards the border coarsely submoniliform, and separated by more distinct clear lines. Border narrow; striæ 8 to 10 in .01 mm.

The appearance of the markings recall those of *Aulacodiscus margaritaceus*, var. *Kinkeri*.

Habitat.—Maryland (Thum).

C. moravicus, Grun. Sch., *Atl.*, pl. cxiv. fig. 2.—Diam. .24 mm. Surface convex. Central space small; rosette distinct. Markings hexagonal, obscurely punctate, towards the border submoniliform, increasing slightly outwards for some distance from the central space, again decreasing towards the border; towards the centre $2\frac{1}{2}$, at the border 5, in .01 mm.; central papillæ faint, rows towards the border separated by evident clear lines; secondary oblique decussating rows evident. Border narrow, hyaline.

Distinguished from *C. asteromphalus* by the size and appearance of the markings.

Habitat.—Hungarian marl (Thum).

C. borealis. Bail., *Amer. Jour. Sci.*, 1856, p. 3.—Diam. .15 to .25 mm. Surface slightly depressed at the centre, somewhat convex towards the border. Central rosette usually distinct, of 6 to 8 large areolæ, sometimes subobsolete. Markings increasing regularly from the central rosette outwards; towards the rosette 3 to $3\frac{1}{2}$, near the border 2, in .01 mm.; central papillæ distinct, the division lines composed of rounded granules; secondary oblique rows distinct. Border distinct, dark, with close irregular coarse striæ.—Rafles in

Pritch. Inf., p. 828; Sch., *Atl.*, pl. lxiii. fig. 11; H. L. Sm., *Diat. Spec. Typ.*, Nos. 90, 93, 95; *C. oculus-iridis*, var. *borealis*, Cleve, *Vega Exped.*, *Vetensk. Jakttag. Stockh.*, Bd. iii. 1883, p. 488; Grun. *Denk. Wien. Ak.*, 1884, p. 77 (excl. *C. borealis*, Ehrb., *Mon. Ber. Ak.*, 1861, p. 294).

Distinguished from *C. oculus-iridis* by the coarser and more robust markings. Kitton's Holles cliff specimens sometimes show under low powers 4 minute elevations at the centre, indicating a transition to *C. excavatus* and *C. asteroides*.

Habitat.—Kamstchatka Sea, 1700 fathoms (Bailey !); Kurile Islands, 1329 fathoms (H. L. Smith !); Nottingham deposit (Kitton !); Sta Monica deposit (Weissflog, Type plate); California (Firth, * Grunow); Hong Kong (Weissflog !); Japan (Deby !); Naparima, Trinidad (Johnson !); Sta Barbara deposit (Kinker !); Cambodia (Hardman !); † Behring Sea, 1681 fathoms (H. L. Smith !); Holles cliff (Kitton !); Barbados (Johnson !); Cape Wankarema (Cleve).

C. megaporus. Ehrb., *Mon. Ber. Ak.*, 1861, pp. 280, 294.—Diam. about .23 mm. Surface slightly convex. Central rosette absent. Markings subequal, $2\frac{1}{2}$ to 3 in .01 mm.; near the border smaller, central papillæ small. Border broad.

Probably, as stated by Ehrenberg, a var. of *C. borealis*.

Habitat.—Lat. 60° 40' N. long. 29° W. 1000 fathoms; lat. 62° 6' N., long. 32° 21' W., 1540 fathoms; lat. 59° 12' N., long. 50° 38' W., 1833 fathoms (Ehrenberg).

C. oculis-iridis. Ehrb., *Abh. Ber. Ak.*, 1839, p. 147. Diam. .135 to .3 mm. Central rosette distinct, sometimes small. Markings polygonal, non-punctate; towards the rosette usually smaller, from 3 to 4, thence increasing gradually outwards to $2\frac{1}{2}$ in .01 mm., towards the border again decreasing to 5 or 6 in .01 mm.; central papillæ sometimes prominent; secondary decussating rows well marked. Border narrow; striæ 6 in .01 mm.—Ehrb., *Mikrog.*, pl. xviii. fig. 42; pl. xix. fig. 2; Jan., *Abh. Schl. Ges. väter. Cult.*, 1862, Heft ii. p. 3, pl. i. B. fig. 6; pl. ii. A. fig. 4; *Gazelle Exped.*, taf. ii. fig. 2; Sch., *Atl.*, pl. lxiii. figs. 6, 7, 9; pl. cxiii. figs. 1, 3-5,

* In the collection of Dr F. W. Griffin.

† In the collection of Julien Deby.

20; Raben., *Alg. Europ.*, Nos. 2487, 2558; Cleve and Möller, *Diat.*, Nos. 3, 57, 162, 215, 258, 259, 276, 319; *C. oculus-iridis*, var. *genuina*, Grun., *Denk. Wien. Ak.*, 1884, p. 77; *C. centralis*, Ehrb., *Mikrog.*, pl. xxi. fig. 3; H. L. Sm., *Diat. Spec. Typ.*, No. 92; *C. omphalanthus*, Grun., in Sch., *Atl.*, pl. lxiii. fig. 2.

Grunow believes that *C. oculus iridis*, var. ? *pacifica*, may belong to *C. asteromphalus*, the punctation of the markings having escaped Schmidt's observation. The specimen figured by Schmidt (*Atl.*, pl. cxiii. fig. 1) shows a less obvious increase of the markings outwards, and a more distinctly marked zone adjacent to the border; but gradations occur to such forms, as shown in fig. 3 of same plate.

Habitat.—Franz Josef's Land (Grunow!); Cherbourg (H. L. Smith!); Lümfiord, Jutland (Hardman!); mud from Glückstadt, Elbe above Cuxhaven (Rabenhorst and Schwarz!); Aegina (Schmidt); Bohuslan, and mud from Elbing, West Prussia (Cleve!); Java (Schmidt, Cleve and Möller! O'Meara!); Japan (Deby!) Inland Sea, Japan, H.M.S. Challenger (Rae!); Arafura Sea, H.M.S. Challenger (Doeg!); Japan oysters (Doeg!); Hong Kong (Deby! Hardman! Greville! Grove! Firth!); surface, Hong Kong Harbour, H.M.S. Challenger (O'Meara!); Isle of Muntok, Indian Archipelago (Grove!); Sand Heads, Bay of Bengal (Macrae!); shell cleanings, Singapore (Hardman!); Ceylon (Macrae!); edible seaweeds, India (Macrae!); East Indies (Macrae!); Spitzbergen, Santos (Cleve); Cape Wankarema (Cleve and Möller!); Greenland (Cleve!); Penang Harbour (Rae!); Kusu (Cleve! O'Meara!); H.M.S. Challenger, lat. 32° 31' N., long. 135° 39' E., 1675 fathoms (Rae!); Atlantic Telegraph soundings (Roper!); North Atlantic, lat. 51° 20' N., long. 52° 25' W., 232 fathoms (O'Meara!); "Atlantic sounding" (Weissflog!); Sea of Kamstchatka, 1700 fathoms (Bailey!); Nancoori, Pensacola, Trinidad, California (Cleve and Möller!); Cambodia (Hardman!); marine deposit, Fiji Islands (Grove!); Patagonian and Ichaboe guanos (Janisch); Lobos di Afuera guano (Grove!); Peruvian guano (Hardman! Cleve! Janisch); Bolivian guano (Cleve! Greville!); "guano" (O'Meara!); Patos Island guano (Greville!); Californian guano (Greville!); Baytha, Elesd, Alsó, Felső-, Esztergály, Kékkö, Mogyorod, Szakal, Szent-Péter and Dolje deposits (Pantocsek!); Moron deposit (Greville!); Brünn Tegel (Cleve!); Mors (Cleve); Monterey (Stokes!); Santa Maria

deposit (Kinker!); Mejillones (Cleve! O'Meara!); Santa Monica (Schmidt, Grove! Kinker!); Nottingham deposit, Md. (Greville; Cleve and Möller!); "Maryland" (O'Meara!); Richmond tunnel (O'Meara!); Richmond, Va. (Cleve and Möller!); Bermuda tripoli (Greville!); "Barbados" (Johnson!); Cambridge deposit, Barbados (Johnson!); Holland's Cliff (Cleve!); Marstrand (Kinker!).

Var. *morsiana*. Grun., *ibid.*, 1884, p. 77.—Diam. .23 mm. Surface slightly depressed towards the centre, the highest zone about $\frac{2}{3}$ of radius from centre. Central rosette distinct. Markings robust, increasing from the centre for $\frac{2}{3}$ of radius, thence diminishing to the border; towards centre 3, on highest zone 2 to $2\frac{1}{2}$, in .01 mm.—Sch., *Atl.*, pl. lxiii. fig. 9 (no name); *C. asteromphalus*, Ehrb., (*vide* Grun., *ibid.*, p. 77); Sch., *Atl.*, pl. lx. fig. 7; *Cestodiscus radiatus*, Ehrb.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxix. fig. 5.

Distinguished by the wider zone at the border, upon which the markings decrease.

Habitat.—Mors deposit (Schmidt, Cleve!).

Var. *subspinoso*. Grun., *ibid.*, 1884, p. 67.—Diam. .1665 mm. Central rosette small, often with a small central space. Markings more delicate, 4 to 5, at the border 7 to 8 in .01 mm. Apiculi minute, numerous, at subregular intervals, inserted close to border.—Sch., *Atl.*, pl. lxiii. fig. 4 (no name).

Habitat.—Mejillones guano (Grunow, Grove, O'Meara!); Ichaboe guano (Schmidt).

Var. *tenui-striata*. Grun., *ibid.*, 1884, p. 77.—Diam. .14 to .15 mm. Surface very convex on outer portion. Markings at the centre 5, towards the border 6 or 7, in .01 mm., non-apiculate.

A smaller form with smaller markings, 7 to 10 in .01 mm., occurs in the Caspian.

Habitat.—Campeachy Bay (Grunow).

Var. *stelliger*. Sch., *Atl.*, pl. lxiii. fig. 8 (no name).—Diam. 2 mm. Central rosette distinct. Markings subequal to, but more irregular than those of the type; towards the border larger, and forming a circlet of distinct rosettes, placed at regular intervals about $\frac{1}{2}$ of radius from the border.

Habitat.—Java (Schmidt).

Var. *loculifera*, nov.—Diam. $\cdot 17$ mm. Central space distinct, from $\cdot 0025$ to $\cdot 005$ mm. broad, subcircular, usually surrounded by a distinct band of large areolæ. Markings sometimes most evident on a narrow band around the border, the central papillæ faint.—(Pl. I. fig. 2.)

This var. is readily distinguished by the central space. Oamaru specimens have the band around the central space less evident, and the markings towards the centre 5, near the border $3\frac{1}{2}$ in $\cdot 01$ mm.

Habitat.—Manilla Algæ (Grove!); Jackson's Paddock, Oamaru deposit (Grove!); Springfield deposit, Barbados (Doeg!); Mejillones (Grove!).

C. annulatus. Grun., *Denk. Wien. Ak.*, 1884, p. 74, pl. v. (E), fig. 57.—Diam. $\cdot 08$ to $\cdot 165$ mm. Surface with a distinct annular depression, about $\frac{1}{10}$ of radius broad, its inner edge about $\frac{1}{3}$ of radius from the centre, beyond this slightly convex to the border. Central space minute, subcircular; surrounded by a distinct rosette or band of large areolæ. Markings pent- or hex-agonal, gradually increasing outwards; near the centre 4, towards the border 3, in $\cdot 01$ mm.; on the annular depression the areolæ replaced by isolated round granules with hyaline interspaces. Border narrow; striæ delicate, 8 to 10 in $\cdot 01$ mm.

This species is readily distinguished by the annular depression.

Habitat.—Mors deposit (Grunow, Deby!).

C. groveanus,* sp. n.—Roundly elliptical, major axis $\cdot 21$ mm. about $1\frac{1}{10}$ times minor. Surface flat from the centre for about $\frac{1}{3}$ of the radius, here rising abruptly to form a distinct elevated ring about $\cdot 01$ mm. broad, thence descending more gradually with a slight outward concavity to the border. Central rosette distinct. Markings hexagonal, subequal, $3\frac{1}{2}$ in $\cdot 01$ mm., but near the border enlarging to about $2\frac{1}{2}$; central papillæ faint; rows radial, straight; secondary oblique decussating rows most distinct near the border. Border striæ coarse, indistinct.—(Pl. I. fig. 11.)

Distinguished from all others by the prominent elevated ring. The transition to *C. excavatus*, var. *semilunaris*, Grun., is not abrupt.

Habitat.—Newcastle desposit, Barbados (Grove!).

* Dedicated to Edmund Grove, Esq., F.R.M.S., the well-known investigator of the Oamaru deposit, New Zealand.

C. suboculatus, sp. n. Sch., *Atl.*, pl. lxi. fig. 5 (no name)—Diam. .1135 mm. Surface convex towards the border. Central space minute, rosette distinct. Markings polygonal, increasing from the rosette to the semiradius, thence gradually decreasing to the border; towards the centre 4, at semiradius 3, in .01 mm. Central dots distinct. Border sharply defined, about $\frac{1}{4}$ of radius broad; striæ coarse, moniliform, 4 in .01 mm.

According to Grunow, this is allied to *C. oculus-iridis*. It is, however, readily distinguished by its more robust markings and its broader border.

Habitat.—Springfield, Barbados (Schmidt).

C. pacificus, Rattray. *C. oculus-iridis*, var. ? *pacifica*, Grun., *Denk. Wien. Ak.*, 1884, p. 77.—Diam. .25 mm. Central space absent or small; rosette distinct. Markings polygonal, decreasing from the centre to the border; towards the centre 4, towards the border 6, in .01 mm.; rows radial, straight, or subparallel; secondary oblique decussating rows evident. Border indistinct.—Sch., *Atl.*, pl. lx. fig. 13 (no name); *C. asteromphalus*, Ehrb. ? *vide* Grun., *ibid.*, 1884, p. 77.

Habitat.—Monterey (Schmidt).

C. intermixtus, sp. n.—Diam. .224 mm. Surface almost flat. Central space absent; rosette distinct. Markings hexagonal, increasing subregularly from the rosette outwards; towards the centre 4, near the border $2\frac{1}{2}$, in .01 mm.; at $\frac{2}{3}$ of the radius from the centre a distinct zone about .01 mm. broad, of much larger, unequal and irregularly arranged areolæ for the most part in 3 rows, those at the centre being largest; the central papillæ evident, rows straight. Border narrow, sharply defined; striæ 4 to 6 in .01 mm., well marked.—(Pl. I. fig. 13.)

Habitat.—Santa Monica deposit (Weissflog!).

C. Monicæ, Rattray. *C. Janischii*, var. ? *Monicæ*, Grun., *Denk. Wien. Ak.*, 1884, p. 76.—Diam. .2275 mm. Central space rounded, about, $\frac{1}{30}$ of diam. broad. Markings around the central space large, free, circular, or elliptical, forming a distinct single band, beyond this obtusely angular, subpearly, with faint central dots, gradually increasing from the central space for about $\frac{1}{2}$ of the radius, again

diminishing slightly towards the border; towards the centre 5, towards the border $3\frac{1}{2}$, in .01 mm.—Sch., *Atl.*, pl. lxiii. fig. 10 (no name).

Habitat.—Santa Monica deposit (Grunow).

C. Kurzii, Grun. Sch., *Atl.*, pl. cxiii. fig. 17.—Diam. .1135 mm. Central space small, surrounded by an inconspicuous band of areolæ. Markings sometimes rounded and free on one side, hexagonal and in contact on the opposite, increasing from the central space for about $\frac{2}{3}$ of the radius, thence decreasing rapidly to the border; towards the centre 4, at $\frac{2}{3}$ of the radius 2, at the border 6, in .01 mm.; central papillæ evident; minute puncta at the origin of the shorter rows; secondary oblique decussating rows distinct. Border narrow.

Habitat.—Elephant Point (Grunow).

C. spinuligerus, sp. n. Sch., *Atl.*, pl. lxiii. fig. 3 (no name).—Diam. .14 to .24 mm. Central space subcircular, .0065 mm. broad, surrounding band of large areolæ distinct. Markings polygonal, $3\frac{1}{2}$ in .01 mm., distinctly punctate, decreasing on outermost $\frac{1}{4}$ of radius to the border; small apiculi at the border obvious, at intervals of about .0075 mm.—Sch., *Atl.*, pl. cxiii. fig. 19 (no name); *C. asteromphalus*, var. *spinuligera*, Grun., *Denk. Wien. Ak.*, 1884, p. 79.

Sometimes united to *C. oculus iridis*. The apiculi resemble those of *C. concinnus*, W. Sm.

Habitat.—Monterey deposit (Schmidt, Grunow); Ichaboe guano (Schmidt; Sta Monica deposit (Firth!); Arica (Gründler).

C. oamaruensis. Grove and Sturt, *Jour. Quek. Micr. Cl.*, 1887, p. 68.—Diam. .185 to .25 mm. Surface convex towards the centre. Central space obtusely angular, about $\frac{3}{7}$ of diam. broad, surrounded by a distinct band of markings somewhat larger than those adjacent to them. Markings 4- to 6-angled, gradually decreasing from the centre outwards; towards the centre 4 to $4\frac{1}{2}$, towards the border 6 to 7, in .01 mm.; central papillæ small, indistinct; rows straight, or showing wide gentle curves; apiculi near the border minute, at unequal intervals of .0075 to .01 mm.; at the origin of the shorter rows minute puncta sometimes present. Border narrow,

hyaline.—Grun., *Bot. Centralbl.*, Bd. xxxiv. Nos. 2, 3, p. 35.—(Pl. I. fig. 1.)

The central space and surrounding band are similar to those of *C. asteromphalus*, var. *pabellanica*, Grun., but the markings of the latter are quite distinct. I agree with Mr Grove that this species cannot be assimilated to *C. perforatus*, var. *cellulosa*, as stated by Grunow.

Habitat.—Oamaru deposit (Grove!); Cambridge deposit Barbados (Johnson!)*

C. umbonatus. Greg., *Trans. Roy. Soc. Edin.*, 1857, p. 500, pl. x. fig. 48.—Diam. .13 mm. Surface with central portion convex for about $\frac{3}{4}$ of radius, sharply defined, thence almost flat to the border. Central space absent; rosette distinct, .0075 mm. broad. Mark areolate, subequal, 4 in .01 mm.; close to the border submoniliform rows, distinct; the secondary oblique rows less obvious.—Jan. *Abh. Schl. Ges. väter. Cult.*, 1861, pl. ii. fig. 5, 1862, p. 5.

The radiating lines between the markings noted by Janisch are not found in the type.

Habitat.—Lamlash (Gregory!);* Peruvian guano (Janisch).

C. Weissflogii. Sch., *Atl.*, specimen plate (Einladung zur Subscription), 1874, fig. 5.—Diam. .0375 mm. Surface with 8 submarginal bullations having the peripheral portion most prominent. Central space circular, obscure, a distinct rosette of 3 areolæ meeting at its middle. Markings minute, 12 to 14 in .01 mm., rows straight; no primary rays corresponding to the bullations, surface scabrous.—(Pl. I. fig. 25.)

This species is, in the opinion of Kitton, a *Melosira*. In the 8 submarginal bullations it shows affinity to the *Inflati* section of the genus *Aulacodiscus*.

Habitat.—New Zealand deposits (Kitton!); Samoa (Schmidt).

C. theskelos, † sp. n.—Diam. .13 mm. Surface bearing a number of subradial curved or flexuous distinct lines, simple, or once dichotomous, and uniting around the centre to form a sharply curved

* In the collection of Dr Greville.

† θεσκελος, wonderful.

line. Central space and rosette absent. Markings hexagonal, largest and most unequal on a small central area, beyond this decreasing but slightly outwards, 8 to 9 in $\cdot 01$ mm.; rows radial or subradial, the secondary oblique straight or slightly curved rows more evident. Border narrow; striæ delicate, 8 to 10 in $\cdot 01$ mm.—(Pl. II. fig. 19.)

This genus forms the transition to the genus *Asteromphalus*.

Mr Kitton possesses an abnormal specimen of *Arachnoidiscus ornatus*, Ehrb., from Hong Kong, where the areolæ are irregularly disposed, and the surface is marked at irregular intervals by well-defined straight and curved, branching, or anastomosing lines, which seem to be homologues of the costate rays of that species, and correspond to the irregularly radial lines of *Coscinodiscus theskelos*. The radial costæ of *Stictodiscus Crozierii*, Kitton (*Month. Micr. Jour.*, vol. x. p. 275, pl. xxxviii. fig. 2), first found by Capt. Crozier in the Mauritius, but also occurring in the West Indies, have a similar character.

Habitat.—Santa Marta deposits, Cal. (Doeg!).

C. duriusculus, sp. n. Sch., *Atl.*, pl. lviii. fig. 8 (no name).—Diam. about $\cdot 0255$ mm. Central space and rosette absent. Markings round, granular, about 6 to 7 in $\cdot 01$ mm.; rows distinct, substraight, separated by wide hyaline cuneate interspaces. Border sharply defined, broad; striæ obvious, distant, 4 to 5 in $\cdot 01$ mm.

The arrangement of the markings and the border distinguish this from all other species.

Habitat.—Patuxent River (Schmidt).

C. rotula, Grun. Sch., *Atl.*, pl. lvii. figs. 6, 7.—Diam. about $\cdot 0275$ to $\cdot 03$ mm. Central space circular, $\frac{1}{12}$ of diam. broad, sometimes excentric. Markings around the central space largest, consisting of free granules tapering outwards, elsewhere punctiform in straight or slightly curved widely separated radial rows; interspaces hyaline. Border sharply defined, with distinct granules opposite the ends of the radial rows.

Habitat.—Campeachy Bay (Schmidt, Weissflog!).

C. stelliger, Grun. Sch., *Atl.*, pl. lviii. fig. 10.—Diam. about $\cdot 035$ mm. Central space circular, $\frac{1}{3}$ to $\frac{1}{2}$ of diam. broad, bearing a

few rounded isolated granules. Markings rounded, granular, most prominent near the margin of the central space, faint beyond the semiradius; rows widely separated by hyaline interspaces. Border distinct, sharply defined, with delicate markings only opposite the ends of the radial rows.

Distinguished from *C. rotula* by its larger markings; the central space does not become excentric.

Habitat.—Campeachy Bay (Schmidt).

C. perminutus, sp. n. *Melosira?* Sch., *Atl.*, pl. lix. fig. 7.—Diam. about .03 mm. Central space distinct, circular, $\frac{1}{6}$ to $\frac{1}{7}$ of diam. broad. Markings punctiform, with small interspaces; rows straight, interspaces widest opposite origin of shorter rows; adjacent to border a distinct band of large areolæ 5 in .01 mm.; a few scattered prominent round granules forming a circlet a short distance within the border, and one present at middle of central space. Border sharply defined, from $\frac{1}{4}$ to $\frac{1}{5}$ of radius broad, hyaline.

Habitat.—Campeachy Bank (Schmidt).

C. lunæ. Ehrb., *Mon. Ber. Ak.*, 1844, p. 201.—Diam. .038 to .057 mm. Central space rounded, about $\frac{1}{10}$ of diam. broad. Markings rounded, granular, subequal, 6 to 8 in .01 mm.; rows separated by wide hyaline interspaces, only a few passing from the central space, adjacent to the border crowded on a narrow zone. Border narrow, hyaline.—Ehrb., *Mikrog.*, pl. xxxv. A. 21. fig. 7; Ralfs in *Pritch. Inf.*, p. 829; *C. cycloteris*, Cstr., *Diat. Chall. Exped.*, p. 161, pl. xxii. fig. 8.

Distinguished from *C. actinochilus* by the less crowded radial rows, and the less distinct narrower marginal zone.

Habitat.—Pancake ice, Antarctic Ice Barrier, lat. 78° 10' S., long. 162° W.; also lat. 75° S., long. 170° W.; lat. 78° 10' S., long. 162° W., 190 fathoms; from snow and ice taken from the sea, lat. 76° S., long. 165° W., near Victoria land; ex *Salpá*, lat. 66° S., long. 157° W.; Gulf of Erebus and Terror, lat. 63° 40' S., long. 55° W., 207 fathoms (Hooker); lat. 53° 55' S., long. 108° 35' E., 1950 fathoms; H.M.S. Challenger (Castracane, Rae!).

C. trochischos. Tru. and Witt, *Jeremie Diat.*, p. 14, pl. ii.

fig. 14.—Diam. $\cdot 05$ mm. Surface flat. Centre indistinctly granular; radial subuniform plications running from the centre to the border, and producing a wheel-like appearance. Markings minute, angular, 8 to 10 (?) in $\cdot 01$ mm.; radial rows between the plications evident; secondary oblique rows distinct. Border relatively broad, sharply defined; striæ delicate, but evident.

The appearance presented by the plications in the figure of Truan and Witt, are somewhat similar to the irregular clear areas found in *Aulacodiscus acutus*, Rattray (*Jour. Quek. Micr. Cl.*, vol. iv. ser. 2, p. 38, pl. iii. fig. 4).

Habitat.—Jeremie marl (Truan and Witt).

C. rhombicus, Grun. Van Heurk, *Syn. Diat. Belg.*, pl. cxxix. fig. 3.—Diamond-shaped, angles obtuse, those at extremities of major axis the more acute. Major axis $\cdot 0825$, about $2\frac{1}{3}$ times minor. Surface showing a distinct elliptical central portion. Markings rounded, granular towards middle of central area, which elsewhere is hyaline, beyond this area rounded on a narrow zone; on a distinct zone adjacent to the border more minute subpunctiform, 10 in $\cdot 01$ mm.; rows beyond central area straight, secondary oblique rows faint. Apiculi distinct, at subequal wide intervals.

Habitat.—Naparima deposit, Trinidad (Grove!).

C. rex. Wallich, *Jour. Roy. Micr. Soc. Lond.*, 1879, p. 688.—Diam. 1.25 to 1.4 mm. Central space and rosette absent, but an indistinctly defined central area, with round isolated granules and hyaline interspaces, as well as distant irregular, somewhat curved large apiculi, evident. Markings on the central area without order, beyond this area round, forming straight closely disposed radial rows, 3 in $\cdot 01$ mm.; on the sides of the cylindrical valve the rows straight, and corresponding in position to those on flat surface of valve, but the markings smaller, 5 in $\cdot 01$ mm.; central papillæ prominent; a circular smooth space sometimes present at junction of terminal and lateral portions of cylindrical valve.—Sch., *Atl.*, pl. cxiv. fig. 7; *C. regius*, Grun., *Jour. Roy. Micr. Soc. Lond.*, 1879, p. 688.

This species was originally distributed under the name of *C. rex*.

Habitat.—Bay of Bengal (Wallich, 1857; Kitton!); H.M.S. Challenger, Stat. 265, 2900 fathoms (Grunow); Nancoori (Cleve!).

C. biradiatus. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 42, pl. iv. fig. 7.—Sometimes elliptical. Diam. $\cdot 075$ to $\cdot 085$ mm. Surface slightly convex. Central space rounded, with isolated granules, sometimes absent. Markings smallest, rounded, and irregular at the centre; elsewhere obtusely angular, subpearly, enlarging to about $\frac{2}{3}$ of radius to 4 in $\cdot 01$ mm., and again decreasing slightly outwards; rows regular, alternately longer and shorter; the spaces at the origin of the shorter rows smooth, hyaline. A narrow hyaline band just within the border. Border with a single band of minute granules, 4 in $\cdot 01$.—Sch., *Atl.*, pl. lviii. fig. 2.

Habitat.—Barbados deposit (Greville! Cleve); Springfield deposit, Barbados (Schmidt, Doeg!);* Chalky Mt., Barbados (Firth!); Oamaru deposit (Grove!); Piscataway deposit (Greville!); Sta Monica deposit (Grove!).

C. elegantulus. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 42, pl. iv. fig. 8.—Diam. $\cdot 0425$ to $\cdot 1$ mm. Surface slightly convex. Central space absent. Markings polygonal, and in contact or rounded, free, and without order on a small slightly excentric area extending to about $\frac{1}{3}$ of radius or onwards to the semiradius, thence obtusely quadrangular, 4 to $4\frac{1}{2}$ in $\cdot 01$ mm., subequal, or increasing slightly outwards; rows straight or curved, the shorter rows around the border inconspicuous, irregular. Border with a single row of minute granules, 8 in $\cdot 01$ mm.—Sch., *Atl.*, pl. lviii. figs. 3-5.

Distinguished from *C. biradiatus*, Grev., by its more delicate markings and its larger central portion upon which these are irregularly placed. Its markings are smaller and less pearly than those of *C. patellæformis*, Grev., to which it is also allied.

Habitat.—Barbados deposit (Greville! Firth!); Cambridge deposit, Barbados (Rae!); Newcastle deposit (Firth!); Chalky Mount, Barbados (Weissflog!); Springfield deposit, Barbados (Doeg! Cole!).

C. aethes, sp. n.—Diam. $\cdot 05$ mm. Surface almost flat. Central space quadrate, about $\frac{1}{10}$ of diam. broad. Markings round or obtusely angular, from the central space to about $\frac{7}{10}$ of the radius

* In the collection of Dr F. W. Griffin.

subequal 4, on the remaining subopaque sharply defined band adjacent to the border 6, in $\cdot 01$ mm.; rows inconspicuous, on the outer portion of the subopaque band more evident, secondary irregular subconcentric rows faint. Border sharply defined, hoop-like; striæ delicate, 10 to 12 in $\cdot 01$ mm.—(Pl. II. fig. 8.)

Habitat.—Sta Monica, California (Deby!).*

C. apiculatus. Ehrb., *Mon. Ber. Ak.*, 1884, p. 77.—Diam. $\cdot 0825$ to $\cdot 1125$ mm. Central space distinct, irregularly rounded, about $\frac{1}{18}$ of diam. broad. Markings rounded, often compressed in the direction of the radius; sometimes polygonal, non-punctate, increasing slightly from the centre to about the semi-radius, again decreasing gradually to the border; towards the centre 4, at the border 6 to 8, in $\cdot 01$ mm. Border indistinctly defined on its inner side; striæ coarse, subregular, 6 in $\cdot 01$ mm.—Ehrb., *Mikrog.*, pl. xviii. fig. 43; Ralfs in *Pritch. Inf.*, p. 829; Grun., *Denk. Wien. Ak.*, 1884, p. 75; Sch., *Atl.*, pl. lxiv. figs. 5–8; Cleve and Möll., *Diat.*, Nos. 164, 215; Raben., *Alg. Europ.*, No. 2484; *C. apiculatus*, var., Sch., *ibid.*, pl. lxiv. fig. 9; *C. apiculatus?* Sch., *ibid.*, pl. lxiv. fig. 10.

This species, when its markings are polygonal and in contact, is distinguished from *C. radiatus*, Ehrb., by the presence of a central space. Ehrenberg compares it with *Pyxidicula gemmifera*, Ehrb. The specimen figured by Schmidt (*Atl.*, pl. lxiv. fig. 10) has an unusually prominent border.

Habitat.—Rappahannock, Va. (Bailey! † Rogers!); † Richmond, Va. (Ehrenberg, Kinker!); “America” (Ralfs); Nottingham, U.S., (Cleve and Möller! Hardman!); † “Virginia” (Hardman!); Bermuda tripoli (Greville!); Delaware, Md. (O’Meara!); Mejillones (O’Meara!); Patos Island guano (Hardman!); † Los Angeles (O’Meara!); Richmond tunnel (O’Meara!); Monkston tidepool (O’Meara!); Cambridge deposit, Barbados (Greville!); Upper Peruvian guano (Weissflog!); Piscataway (Weissflog! Greville!); Moron deposit (Greville!); Monterey stone (Greville!); Sta Monica deposit (Cleve and Möller!); Maryland (Cleve!); Laguna Harbour, anchor ground (Rabenhorst and Schwarz!).

* In a *Coscinodiscus* Type-plate by Thum, in the collection of Julien Deby.

† In the collection of Dr Greville.

‡ In the collection of Julien Deby.

Var. *Woodwardii*, Rattray. *C. Woodwardii*, Eul., *Diat. Spec. Typ.*, No. 116.—Diam. .1075 to .15 mm. Central space small, sometimes absent; rosette usually distinct. Markings polygonal, subequal, or increasing slightly outwards, again decreasing near the border; towards the rosette 4, at about $\frac{5}{8}$ of radius 3, in .01 mm.; at the border much more minute.—*C. Woodwardii*, Eul.; Sch., *Atl.*, pl. lxi. fig. 3 (not fig. 2); *C. apiculatus*, var. *ambigua*, Grun., *Denk. Wien. Ak.*, 1884, p. 75; *C. perforatus*, Cleve and Möller, *Diat.*, No. 57.

Specimens in Chinha guano are transitional to *C. Janischii*.

Habitat.—N. American tertiary deposits, mouth of the Maranhon, Cuxhaven (Grunow, Firth!); Virginia (Hardman!); Monterey (Möller!); Mejillones, Bolivia (Firth!); trawled in lat. 24° 42' N., long. 152° 1' W., by H.M.S. Challenger (Rae!); Piscataway deposit (Rogers!); * Rappahannock, Va. (Rogers! * Bailey!); Bermuda tripoli (Greville!); Delaware, Md. (O'Meara!); Richmond tunnel (O'Meara!); Richmond (Cleve and Möller!); Oamaru deposit (Grove!); Whampoa (Grove!); Chinha guano (Grove!); Lobos di Afuera guano (Grove!); Upper Peruvian guano (Weissflog!); Monterey (Weissflog! Cleve! Greville! Moller!); Moron deposit (O'Meara!); Nottingham deposit (Cleve and Möller! † Hardman! O'Meara!); Maryland (Cleve!); Pabillan de Pico guano, Holland's cliff (Cleve!).

Var. *maxima*. Grun., *ibid.*, 1884, p. 76.—Diam. .315 mm. Central space hyaline, from $\frac{1}{2}$ to $\frac{1}{3}$ of diam. broad. Markings 3½ to 4, at the border 7, in .01 mm.

Habitat.—Richmond, Va. (Grunow).

C. perforatus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 78.—Diam. .09 to .1325 mm. Central space small but distinct, without a surrounding rosette. Markings rounded and granular or polygonal, on the same or on different valves, 3½ to 4 in .01 mm., somewhat smaller towards the border, the central dots obvious; minute puncta at the inner ends of the shorter radial rows. Border striæ, 6 in .01 mm.—Ehrb., *Mikrog.*, pl. xviii. fig. 46; Sch., *Atl.*, pl. lx. fig. 12 (?); pl. lxiv. figs. 12-14; Smith, *Syn. Brit. Diat.*, ii. p. 85.

Specimens from Callao seaweeds sometimes exhibit at the

* In the collection of Dr Greville.

† *Diat.*, Nos. 215, 216.

border minute apiculi at intervals of about $\cdot 005$ mm. Grunow (*Denk. Wien. Ak.*, 1884, p. 76), says that *C. Woodwardii*, Eul., is identical with the present species. In Kitton's specimens of Eulenstein's valves, however, which I have examined, there are no puncta at the inner ends of the shorter rows. These valves are, indeed, identical with *C. apiculatus*, var. *ambigua*, Grun., which must be abandoned. Kitton's slide was obtained from Herr E. Weissflog, who purchased Eulenstein's collection at his death, and therefore knew his *C. Woodwardii*.

Schmidt's figure (*Atl.*, pl. lx. fig. 12) resembles *C. centralis* much more than *C. perforatus*, in its more prominent central rosette, more crowded markings, and the more rapid diminution of their size towards the border. Its union to *C. perforatus* is doubtful; it is based only on the presence of minute puncta, opposite the origin of the shorter rows.

Habitat.—Richmond, Va.; Arica and Peruvian guano (Schmidt, Kinker! Cleve!); Thames mud (Roper); Medway (Dallas); New Nottingham (Firth!); Callao seaweeds (Firth!); Saldanha Bay guano (Cleve!).

Var. *cellulosa*. Grun., *Denk. Wien. Ak.*, 1884, p. 75.—Diam. $\cdot 135$ to $\cdot 15$ mm. Markings hexagonal, 3 to 5 in $\cdot 01$ mm., smaller at the border; the puncta at the origin of the shorter rows indistinct; minute apiculi at intervals of about $\cdot 005$ mm., sometimes present.—Sch., *Atl.*, pl. cxiv. fig. 5; in H. L. Sm., *Diat. Spec. Typ.*, No. 90; Janisch, *Gazelle Exped.*, taf. iv. figs. 6, 7.

Habitat.—With the species and on *Macrocystis* from the coast of Peru (Grunow); Callao seaweeds (Firth!); Japan (Kinker!); Maryland deposit (Rae!); Bermuda tripoli (Greville!); Nottingham, Maryland (O'Meara!); Oamaru deposit, Jackson's Paddock (Grove!); Chinchu guano (Grove! Schmidt); Lobos di Afuera guano (Grove!); Japan (H. L. Smith!); Bolivian guano (Cleve!); San Benito deposit, California (Grove!).

Var. *delicatula*, nov. *C. perforatus*, var. *cellulosa*, Grun., *ibid.*, 1884, p. 75.—Central space minute. Markings towards the centre 5, towards the border 8, in $\cdot 01$ mm.; puncta at the origin of the shorter rows small.

This var. approaches *C. fimbriatus*.

Habitat.—Moron deposit (Grunow).

C. mossianus.* Grev., *Trans. Micr. Soc. Lond.* 1865, p. 25, pl. iv. fig. 22.—Diam. .135 mm. Surface flat to about the semi-radius, thence sloping gently to the border. Central space minute. Markings pearly, obtusely quadrangular, those in the outermost band concavo-convex with large faint rounded central dots, increasing from the centre to about $\frac{1}{3}$ of the radius to 2 or $2\frac{1}{2}$ in .01 mm., thence decreasing uniformly to the border to 3 in .01 mm., irregular around the centre, the rows separated by clear lines.

Habitat.—Cambridge deposit, Barbados (Johnson!).†

C. gemmifer. Ehrb., *Mon. Ber. Ak.*, 1844, p. 201.—Diam. about .06 mm. Central space circular, hyaline, about $\frac{1}{8}$ of diam. broad. Markings rounded, conspicuous, about 5 in .01 mm., decreasing from the central space outwards; towards the border punctiform, interspaces hyaline; rows straight.—Ehrb., *Mikrog*, pl. xxxv. a. 22. fig. 3.

By Ehrenberg, compared with *Pyxidicula gemmifera*, Ehrb., from Virginia. Not to be united to *C. elegans*, Grev., as suggested by Pantocsek, since in the latter the radial rows are more crowded. Allied to *C. cycloteres*, Cstr., but distinguished by the less uniform markings, and to *C. actinochilus*, Ehrb., where, however, the radial rows are also more numerous.

Habitat.—Ice Barrier, Antarctic, lat. $78^{\circ} 10' S.$, long. $162^{\circ} W.$; Sounding, 190 fathoms, lat. $78^{\circ} 10' S.$, long. $162^{\circ} W.$; ex *Salpá*, lat. $66^{\circ} S.$, long. $157^{\circ} W.$; Sounding, 270 fathoms, lat. $63^{\circ} 40' S.$, long. $55^{\circ} W.$ (Hooker); Monterey Stone (Cleve!).

Var. *campechiana*, nov. *C. gemmifer*, var., Grun. MS.—Diam. .0375 mm. Central space round, $\frac{1}{4}$ to $\frac{1}{8}$ of radius broad, punctate. Markings most prominent near the central space; indistinct towards the border, the interspaces minutely punctate.

Habitat.—Campeachy Bay (Weissflog!).

C. flagrans, sp. n. Sch., *Atl.*, pl. lvii. fig. 46.—Outline hexagonal, with angles obtuse and sides slightly convex. Diam. about .03 mm. Central space distinct. Markings rounded, granular, about 5 in

* Dedicated to Mr Moss of Lancaster, the friend and fellow worker of Mr Johnson.

† In the collection of Dr Greville.

·01 mm., closely disposed in the rows, interspaces hyaline; rows radial or somewhat oblique, straight; adjacent to the border a narrow hyaline band. Border striæ, evident, 6 in ·01 mm.

Habitat.—Springfield deposit, Barbados (Schmidt).

C. gemmatulus. Cstr., *Diat. Chall. Exped.*, p. 161, pl. xvii. fig. 9.—Diam. about ·04 mm. Central space indistinctly defined, about $\frac{1}{3}$ of diam. broad. Markings round, granular, subequal, minute with hyaline interspaces; a circlet of minute closely placed dots (apiculi?) at inner edge of border; rows irregular, radial. Border distinctly defined, about $\frac{1}{3}$ of radius broad; striæ delicate, 10 to 12 in ·01 mm.

Habitat.—Indian Ocean (Castracane).

C. actinochilus. Ehrb., *Mon. Ber. Ak.*, 1844, p. 200.—Diam. about ·035 mm. Central space circular, about $\frac{1}{3}$ of diam. broad, bearing isolated rounded granules. Markings granular, rounded, in straight, closely disposed rows, with interspaces at origin of shorter rows hyaline; just within the border punctiform, and arranged on a sharply defined band in still more crowded radial rows.—Ehrb., *Mikrog.*, pl. xxxv. A, 21. fig. 5; Ralfs in *Pritch. Inf.*, p. 829; *Craspedodiscus actinochilus*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 26.

Habitat.—Antarctic Ice Barrier, lat. 78° 10' S., long. 162° W. (Hooker).*

C. galapagensis, Rattray. *C. griseus*, var. *gallopagensis*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxviii. fig. 7; pl. cxxxii. fig. 1.—Diam. ·175 to ·19 mm. Surface flat from the centre to about semiradius, a slightly convex zone reaching inwards to the semiradius, about $\frac{2}{3}$ of the radius broad, and merging gradually into the almost flat portion adjacent to the border. Central space indistinct, rounded. Markings small, round or oval, granular, least crowded towards the centre, about 4 in ·01 mm.; interspaces hyaline, unequal; rows straight. Border narrow, hyaline.—(Pl. II. fig. 20.) *C. griseus*, Sch., *Atl.*, pl. lviii. fig. 1.

Distinguished from *C. nitidus* by the evident straight radial lines, sometimes most distinct on the outer half of the valve.

* *Fide* Ehrenberg.

Habitat.—Galapagos Islands (Grunow); Springfield deposit, Barbados (Schmidt); Oamaru deposit (Grove! Kinker!).

C. armatus. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 42, pl. iv. fig. 5.—Sometimes obtusely angular. Diam. .0575 mm. Surface convex. Central space rounded, about $\frac{1}{2}$ of diam. broad. Markings rounded, granular; towards the centre 5, towards the border 8, in .01 mm.; rows straight or curved, radial or subradial, sometimes forming unequal obscure fasciculi, separated towards the border by delicate, clear, slightly elevated lines. Border indistinct.—*Cosmioidiscus armatus*, Sch. (not Grev.), *Atl.*, pl. lvii. fig. 4.

The delicate elevated lines represent, as noted by Greville, the more pronounced ridges of *Biddulphia Johnsoni*, Ralfs (*Trans. Micr. Soc. Lond.*, 1866, p. 4, pl. i. fig. 11). The union of *C. armatus* with the old genus *Cestodiscus*, as suggested by Habirshaw, is undesirable.

Habitat.—Barbados deposit (Greville!); Richmond, Va. (Schmidt).

C. obliquus, Rattray. *Cosmioidiscus obliquus*, Grev. MS.—Diam. .0675 to .075 mm. Surface slightly depressed towards the centre, and convex towards the border. Central space small, circular, bearing a few rounded granules. Markings obtusely angular or suboval, with long axis radial, $5\frac{1}{2}$ to 6 near the border, decreasing to 8 in .01 mm.; rows radial, towards the border uniformly curved towards the same direction, at subregular intervals of about .005 mm. short hyaline curved lines on the convex sides of the valve, and extending a short distance inwards as attenuating subulate spaces. Border narrow; striæ 8 to 10 in .01 mm.—(Pl. I. fig. 14.)

Habitat.—Monterey deposit (Greville!); Santa Monica deposit (Grove!).

C. apages,* Rattray. *Cosmioidiscus normanianus*, Grev., *Trans. Micr. Soc. Lond.*, 1866, p. 80, pl. viii. fig. 11.—Diam. .045 to .06 mm. Surface almost flat. Central space small, indefinite. Markings small, round, free granules disposed without order, with wide hyaline interspaces between the centre and semiradius; beyond this more punctiform, crowded, 8 to 10 in .01 mm.; rows straight; distinct radial clear spaces extending from about semiradius to

* ἀπαγής, loose in texture.

border at intervals of $\cdot 01$ to $\cdot 0125$ mm., and expanding slightly outwards. Border sharply defined, hyaline.—*Coscinodiscus normanianus*, Grev., *ibid.*, Explan. pl. viii. fig. 11.

The name *normanianus* is undesirable, there being already a *C. Normanii*, which is distinct.

Habitat.—Barbados deposit (Norman, Grove!).

C. splendidulus, Rattray. *Cosmiodiscus normanianus*, Grove and Sturt (non Grev.), *Jour. Quek. Micr. Cl.*, 1887, p. 65, pl. vi. fig. 21.—Diam. $\cdot 055$ to $\cdot 075$ mm. Surface almost flat. Central space circular, about $\frac{1}{2}$ of diam. broad. Markings small, round, granular, with wide unequal interspaces, somewhat more crowded towards the border; rows straight, but inconspicuous, at regular intervals of about $\cdot 01$ mm. narrow hyaline radial lines, most distinct towards the border, the outer ends of the intervening compartments convex outwards; a distinct but small apiculus at the outer ends of the hyaline lines. Border distinct, about $\frac{1}{5}$ of radius broad, hyaline.

Habitat.—Oamaru deposit (Grove!).

C. perikomposos,* Rattray. *Cosmiodiscus elegans*, Grev., *Trans. Micr. Soc. Lond.*, 1866, p. 79, pl. viii. fig. 13.—Diam. $\cdot 0875$ to $\cdot 095$ mm. Surface slightly convex towards the border. Central space circular, $\frac{1}{2}$ to $\frac{1}{3}$ of diam. broad, faint. Markings obscure, punctiform, most distinct on the inner half of the valve, in faint radial rows; towards the border more crowded, 20 to 25 in $\cdot 01$ mm., forming punctiform, evident, straight, radial striæ, 14 in $\cdot 01$ mm., at sub-regular intervals of $\cdot 006$ to $\cdot 0075$ mm. distinct, straight, hyaline radial lines extending outwards from the central space, and most prominent towards their outer ends. Border narrow, hyaline.—(Pl. III. fig. 12.)

Habitat.—San Pedro (Grove!); Monterey (Hardman, Greville); Santa Monica deposit (Grove!).

Var. *curta*, nov.—Diam. $\cdot 04$ to $\cdot 0625$ mm. Central space distinct, rounded or irregular, small, rarely of considerable size. Markings 8 to 10 in $\cdot 01$ mm., least crowded near the centre, near border more minute, forming closely disposed radial striæ 12 in $\cdot 01$ mm.; rows separated at equal or subequal intervals by hyaline substraight lines,

* *περίκομπος*, very elegant. The specific name *elegans* is preoccupied (*q. v.*).

originating sharply at or near the semiradius, rarely nearer the central space, and terminating at inner edge of the marginal striæ. Border sharply defined, hyaline.

Habitat.—Elesd deposit (Hardman!).*

C. tenuis, Rattray. *Cosmiodiscus tenuis*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxv. fig. 13.—Diam. .055 to .0675 mm. Surface slightly convex towards the border. Central space circular, obscure or subobsolete. Markings faint, minute rounded granules most evident and most laxly disposed towards the centre; about the semiradius 6 in .01 mm., towards the border punctiform, arranged in straight radial striæ, 8 to 10 in .01 mm.; between the striæ, at subregular intervals, narrow, short, indistinct, hyaline spaces. Border distinct, from $\frac{1}{10}$ to $\frac{1}{13}$ of radius broad; striæ delicate, obscure, 16 in .01 mm.

Habitat.—Monterey deposit (Van Heurck); San Pedro (Grove!).

C. evadens, sp. n. Sch., *Atl.*, pl. lvii. fig. 44.—Diam. .0625 mm. Central space and rosette absent. Markings rounded, granular, about 5 in .01 mm., towards the border smaller; interspaces hyaline, unequal, largest towards the centre; rows straight; apiculi evident at intervals of about .015 mm., inserted at inner edge of border. Border sharply defined, narrow; striæ radial, 6 to 8 in .01 mm.

Habitat.—Springfield deposit, Barbados (Schmidt).

Var. *parvula*. Sch., *Atl.*, pl. lvii. fig. 45 (no name).—Diam. .0325 mm. Markings subequal to border, non-apiculate. Border less sharply defined; striæ short, but distinct, 6 in .01 mm.

Habitat.—Springfield deposit, Barbados (Schmidt).

C. undatus, Grun. Pant., *Fossil. Bacil. Ung.*, p. 74, pl. x. fig. 89; pl. xxvii. fig. 252. *Actinocyclus (alienus)*, Grun. var.?) *undatus*, Cleve, *Jour. Quek. Micr. Cl.*, 1885, p. 174, pl. xiii. fig. 14.—Diam. .07 to .1 mm. Surface with two concentric elevations and depressions. Central space indistinct, circular, about $\frac{1}{2}$ of diam. broad, with rounded isolated granules. Markings rounded, granular, 5 to 6 in .01 mm., near the border punctiform; rows separated by narrow

* In the collection of Mr Julien Deby.

clear lines, small subulate spaces opposite the origin of the shorter rows; apiculi sometimes many, minute, inserted close to the border, at wide subequal intervals. Border narrow.

Pantocsek's figure shows no apiculi, but in their stead small clear spaces surrounded by a faint circlet of markings. In the presence of these spaces it differs from *C. intumescens*, Pant.

Habitat.—Brünn Tegel (Cleve!); Alsó-, Felső-Esztergály, Kékkő, Szakal, Szent Peter deposits (Pantocsek!).

C. agapetos,* sp. n. *C. nitidulus*, Grun., var.? Sch., *Atl.*, pl. cxiii. fig. 18.—Diam. .05 mm. Central space and rosette absent. Markings small, rounded, granular, largest towards the centre, decreasing outwards, on a zone adjacent to the border punctiform; interspaces wide, hyaline, smaller towards the border; rows obscurely radial towards the centre, becoming obviously radial near the border. Border narrow.

Distinguished from *C. nitidulus* by the greater reduction in size of the markings outwards and the evident zone adjacent to the border.

Habitat.—Aegina (Schmidt).

C. exiguus, sp. n. Sch., *Atl.*, pl. lviii. fig. 30 (no name).—Diam. about .04 mm. Central space distinct, rounded; no rosette. Markings minute, granular; beyond the semiradius punctiform, disposed at unequal intervals in evident radial straight rows; interspaces largest towards the centre, hyaline; non-apiculate. Border sharply defined, narrow; striæ, 6 to 8 in .01 mm.

Habitat.—Campeachy Bay (Schmidt).

Var. *aequalis*, nov. Sch., *Atl.*, pl. lviii. fig. 31 (no name).—Diam. about .056 mm. Central space angular, from $\frac{1}{10}$ to $\frac{1}{12}$ of diam. broad. Markings minute, granular or subpunctiform, 5 to 6 in .01 mm., somewhat more prominent around central space; interspaces narrow, hyaline. Border sharply defined, at its middle a distinct concentric line, hyaline.

Habitat.—Mors deposit (Schmidt).

C. apollinis. Ehrb., *Mon. Ber. Ak.*, 1844, p. 200.—Diam. .0815 mm. Central space rounded, about $\frac{1}{4}$ of diam. broad, bearing a

* ἀγαπητός, lovely.

few isolated rounded granules. Markings rounded, granular, 5 in $\cdot 01$ mm., somewhat more crowded around the central space; rows straight, shorter irregular rows around the border; interspaces hyaline. Border distinct, striæ delicate.—Ehrb., *Mikrog.*, pl. xxxv. A. 22. fig. 4; Ralfs. in *Pritch. Inf.*, p. 829; *C. scintillans*, Grev., *Quart. Jour. Micr. Sci.*, 1863, p. 230, pl. ix. fig. 6 (excl. *C. scintillans*, Grev., H. L. Smith, *Diat. Sp. Typ.*, No. 99.

Habitat.—Cambridge deposit, Barbados (Browne); pancake ice, Antarctic Ice Barrier, lat. $78^{\circ} 10'$ S., long. 162° W.; lat. $78^{\circ} 10'$ S., long. 162° W., in 190 fathoms; ex *Salpis*, lat. 66° S., long. 157° W.; lat. $63^{\circ} 40'$ S., long. 55° W., in 207 fathoms (Hooker); Oamaru deposit (Grove! Doeg!); Norway (Deby!); Barbados (Cleve).

Var. *compacta*, nov. *C. scintillans*, Grev. (?) Sch., *Jahresb. d. Kom. z. Untersuch. d. deutsch. Meer*, Kiel, 1874, p. 94, pl. iii. fig. 33.—Diam. $\cdot 04$ mm. Central space more inconspicuous, rounded. Markings decreasing towards the border, the radial rows more crowded, the shorter rows larger than in type.

Habitat.—Sölsvig (Schmidt).

C. diplostictus, Grun. Van Heurck., *Syn. Diat. Belg.*, pl. cxxxii. fig. 3.—Diam. $\cdot 068$ mm. Central space indistinct. Markings of two kinds: large rounded granules at wide irregular intervals, arranged in inconspicuous radial rows, and becoming somewhat smaller towards the border; and minute puncta, least crowded towards the centre, also arranged in numerous radial rows, with hyaline interspaces opposite the ends of the shorter rows. Border sharply defined; striæ distinct, 6 to 8 in $\cdot 01$ mm.

Habitat.—Balearic Islands (Van Heurck).

C. decussatus, Grove and Sturt MS.—Diam. $\cdot 01$ mm. Surface flat, slightly convex near the border. Central space circular, about $\frac{1}{20}$ of diam. broad. Markings minute, round, granular, with unequal hyaline interspaces, most crowded towards the border; about the semiradius 6, at the border 8 or 9, in $\cdot 01$ mm.; rows straight, secondary oblique decussating rows distinct beyond the semiradius. Border narrow, distinct; striæ faint, 10 in $\cdot 01$ mm.—(Pl. I. fig. 7.)

Distinguished from *C. apollinis* by the smaller size and evident decussate arrangement of the markings.

Habitat.—Bain's Farm upper stratum, Oamaru deposit (Grove!).

C. biphicatus, Grun. Van. Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 6.—Diam. .0715 mm. Surface with an elongated somewhat curved depression on each side of the valve at about $\frac{2}{3}$ of radius from the centre. Central space angular, about $\frac{1}{2}$ of diam. broad. Markings punctiform, most evident about semiradius, around the border on a band about $\frac{1}{3}$ of radius broad, minute in crowded radial rows; rows substraight. Border narrow, hyaline.

Distinguished from *C. pellucidus* by the elongated depressions, the central space, more prominent markings, and distinct narrow band adjacent to the border.

Habitat.—Samoa Islands, Cuxhaven (Van Heurck).

C. bengalensis, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 9.—Diam. .1065 mm. Surface with a faint undulation about $\frac{2}{3}$ of radius from centre. Central space indistinct, rounded, bearing isolated granules. Markings punctiform, somewhat laxly disposed around the centre 7 to 8 in .01 mm., increasing slightly to about $\frac{2}{3}$ of radius, again decreasing to the border; secondary oblique decussating rows faint; apiculi small, at intervals of about .01 mm. Border sharply defined; striæ delicate, regular.

Distinguished from *C. pellucidus* by its somewhat more prominent markings, its apiculi, and striated border.

Habitat.—Elephant Point, Bengal (Van Heurck).

C. pellucidus, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxxii. fig. 8.—Diam. .0325 to .045 mm. Surface sometimes with a faint undulation about the semiradius. Central space absent. Markings punctiform, recognised with difficulty, least crowded towards the centre; interspaces clear; rows straight or substraight. Border hyaline.—Cleve and Möll., *Diat.*, No. 172; *Odontodiscus pellucidus*, Grun., *Vega Exped.*, *Vetensk. Jakttag. Stockh.*, Bd. iii. 1883, p. 488.

Habitat.—Davis Straits (Grunow, Cleve and Möller!); Greenland (Cleve!); Maghellan Straits (Cleve!).

C. lacustris. Grun., *Kongl. Sv. Vet.-Ak. Handl. Stockh.*, 1880., No. 2, p. 114.—Circular or elliptical. Diam. .035 to .075 mm. Surface with a slight unilateral undulation close to the centre. Central space and rosette absent. Markings minute, 6 to 10 in .01 mm.; rows radial, non-fasciculate, most distinct about semiradius; a circle of minute apiculi, about 6 in .01 mm., close to the border, within these a few scattered irregularly placed, but similar apiculi forming an indistinct inner circle.—Grun., *Denk. Wien. Ak.*, 1884, p. 85, pl. iv. (D), fig. 30; Van Heurck, *Syn. Diat. Belg.*, pl. c. fig. 42; Cleve and Möller, *Diat.*, No. 172; Van Heurck, *Typ. Syn. Diat. Belg.*, No. 535; Kitton, *Norfolk Diat.*, Nos. 3, 21; *Cyclotella punctata*, W. Sm., *Syn. Brit. Diat.*, ii. p. 87; *Stephanodiscus punctatus*, Grun.

The name *punctatus* of Smith cannot be retained, because of *Coscinodiscus punctatus*, Ehrb., which is a distinct species. Distinguished from *C. capensis* by the absence of a central space and the irregularity of the inner circle of smaller apiculi, and from *C. plicatulus* by the more delicate markings and the nearer approximation of the circle of apiculi to the border.

Habitat.—Kara Sea, Jamal (Cleve! Grunow); Market Weighton, England (Grunow); Locality (?) (Kinker!); Yorkshire (Van Heurck!); Wisbeach (S. Smith!);* Breydon (Kitton!).

Var. *septentrionalis*. *C. (lacustris, var.?) septentrionalis*, Grun., *ibid.*, 1884, p. 85, pl. iv. (D), figs. 28, 33.—Diam. .0365 to .055 mm. Surface with a short central transverse plication, most pronounced at the centre. Markings larger, 8 to 9 in .01 mm., decreasing somewhat near the border; apiculi closely placed, arranged in a single circle near the border.

Grunow has found specimens at Cuxhaven and in the Gulf of Bothnia, intermediate between this var. and the type.

Habitat.—Franz Josef's Land, Kara Sea, Jamal, Cape Wankarema (Grunow); Canton River, Whampoa (Grove!); Balearic Islands (Cleve!).

Var. *hyperborea*. *C. (lacustris, var.?) hyperboreus*, Grun., *ibid.*, 1884, p. 85, pl. iv. (D), fig. 26.—Diam. .037 mm. Undulation near the centre faint. Markings angular, 10 in .01 mm.; subequal

* In the collection of W. Smith.

to the circlet of apiculi, thence more minute to the border; apiculi more distant, forming a single circlet.—Cleve and Möll., *Diat.*, No. 319.

Habitat.—Franz Josef's Land, Kara Sea, Cape Wankarema (Grunow; Cleve and Möller!).

Var. *marina*, Grun. Cleve and Möll., *Diat.*, No. 172.—Diam. .025 to .03 mm. Markings 10 in .01 mm., most evident towards the centre, near border 12 to 14 in .01 mm.; radial rows faint, secondary oblique rows more evident slightly concave outwards; apiculi numerous, minute, about 4 in .01 mm.

Habitat.—Davis Straits (Cleve and Moller!).

Var. *australiensis*. *C. (lacustris, var. ?) australiensis*, Grun., *ibid.*, 1884, p. 86, pl. iv. (D) fig. 31 *a, b*; fig. 32.—Sometimes roundly elliptical. Diam. .02 to .073 mm. Surface convex on one half of valve, concave on the opposite; a short transverse central band. Markings punctiform, 10 to 12 in .01 mm.; apiculi distinct, forming a single circlet.

The apiculi are less crowded than in var. *septentrionalis*, but more so than in var. *hyperborea*.

Habitat.—Brackish water, Australia (Grunow); Whampoa mud, China (Kitton!); Yarra Yarra, Australia (Kitton!).

C. plicatulus, Grun., *Denk. Wien. Ak.*, 1884, p. 86, pl. iv. (D), fig. 27.—Diam. .04 mm. Central space absent. Markings small, rounded, granular, about 6 in .01 mm., smaller and subpunctiform towards the border; interspaces hyaline, irregular, subequal to the zone of the processes, thence smaller to the border; secondary irregularly concentric rows distinct; apiculi numerous, large, at subregular intervals of .005 to .006 mm., inserted some distance from the border.

Habitat.—Monterey tripoli, Cal. (Grunow).

C. pulcherrimus, sp. n.—Diam. .035 to .045 mm. Surface flat. Central space absent. Markings rounded, granular, $5\frac{1}{2}$ to 6 in .01 mm.; from the centre 5 to 8 narrow hyaline lines passing outwards to the semiradius, and terminating in funnel-shaped expansions; between the latter and the centre the markings

irregular, but beyond the semiradius in distinct, somewhat bent, subradial non-fasciculate rows. Border narrow; striæ 6 to 8 in .01 mm. distinct.—(Pl. II. fig. 1.)

Habitat.—Galapagos Islands (Weissflog!).

C. tabularis, Grun., *Denk. Wien. Ak.*, 1884, p. 86.—Diam. .0605 mm. Central space subcircular, distinct, about $\frac{1}{3}$ of diam. broad, bearing a few isolated round granules. Markings round, granular, subequal or somewhat smaller near the border, about 6 in .01 mm. interspaces hyaline; a narrow clear band about $\frac{1}{18}$ of radius broad adjacent to the border; at its outer edge distinct apiculi at intervals of about .01 mm. Border narrow, hyaline.—Sp. n.? Sch., *Atl.*, pl. lvii. fig. 43.

Habitat.—Table Bay (Schmidt).

C. Thumii. Cleve, *Jour. Quek. Micr. Cl.*, 1885, p. 175, pl. xiii. fig. 17.—Obtusely triangular, or with a unilateral compression, or circular. Diam. .075 to .125 mm. Central space subcircular, about $\frac{1}{3}$ of diam. broad, hyaline, with diverticula extending outwards between the longer rows of markings. Markings small, rounded, granular, 6 in .01 mm., subequal to but most crowded around the border; the rows straight, with wide hyaline interspaces towards the centre.—Sch., *Atl.*, pl. cxiv. fig. 10.

Specimens with two central spaces, separated by a single row of markings, sometimes occur.

Habitat.—Brünn Tegel (Weissflog!); Mähren deposit (Deby!).

C. comptus. Cstr., *Diat. Chall. Exped.*, p. 157, pl. xiii. fig. 9.—Diam. .125 mm. Central space circular, hyaline, about $\frac{1}{10}$ of diam. broad, without a distinct limiting band of markings. Markings punctiform; rows radial, only a few reaching the central space, the majority terminating about $\frac{2}{3}$ of radius from the centre, on the other $\frac{2}{3}$ of radius crowded, interspaces hyaline. Border distinct, narrow, hyaline.

Distinguished from *C. Thumii* by the smaller markings, fewer of which pass to the central space, and by their more crowded arrangement on the outer $\frac{2}{3}$ of the radius. The relationship to *C. dimorphus*, noted by Castracane, is remote.

Habitat.—Antarctic Ocean, H.M.S. Challenger (Castracane).

C. confertus, sp. n. Sch., *Atl.*, pl. lviii. fig. 22 (no name).—Diam. about .04 mm. Central space and rosette absent. Markings punctiform, interspaces large, unequal, but markings not crowded either towards centre or border; rows faint. Border indistinctly defined; striæ 6 in .01 mm.

Distinguished from *C. marginulatus* var. *sparsa*, Grun., from Campeachy Bay, by the radial arrangement of the markings and the less prominent border.

Habitat.—Cape of Good Hope (Schmidt).

C. polygonus. Cstr., *Diat. Chall. Exped.*, p. 161, pl. xxii. fig. 6.—Polygonal. Diam. about .1 mm. Central space subcircular, about $\frac{1}{5}$ of diam. broad, bearing a few isolated granules. Markings punctiform, interspaces hyaline, unequal, largest opposite the origin of the shorter rows; rows often interrupted; a narrow hyaline band adjacent to the border.

The polygonal outline of the valve is probably the result of fracture. This species is close to *C. Thumii*, but is distinguished by the absence of crowding in the arrangement of the markings towards the border, and by the hyaline zone adjacent to the latter.

Habitat.—Antarctic Ocean, H.M.S. Challenger (Castracane).

C. elongatus, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxv. fig. 14.—Elongately elliptical. Major axis .083 mm., about $5\frac{1}{2}$ times minor. Central space absent. Markings punctiform, irregular on a small central area; rows straight along the minor axis, elsewhere convex towards the extremities of the major axis and radial, most crowded on a narrow band around the border. A single interrupted row running along the major axis; apiculi 2, minute, one at each end of the major axis; interspaces hyaline.

The valve figured by Van Heurck (*ibid.*, pl. cxxv. fig. 15) is similar, but possesses an evident pseudonodule, and so belongs to *Actinocyclus*.

Habitat.—Mejillones guano (Van Heurck).

C. pauper. Tru. and Witt, *Jeremie Diat.*, 1888, p. 13, pl. ii. fig. 11.—Diam. .06 mm. Surface flat. Central space circular, $\frac{1}{2}$ of diam. broad. Markings round or obtusely angular, subpearly; towards the centre $3\frac{1}{2}$, towards the border $4\frac{1}{2}$, in .01 mm.; smaller

round punctiform granules placed irregularly amongst the larger; rows inconspicuous, most crowded, and submoniliform near the border; interspaces narrow, hyaline. Border with inner edge indistinct; striæ, 4 to 6 in $\cdot 01$ mm., evident.

Distinguished from *C. elegans* by the more irregular markings, narrower interspaces, and less evident radial rows.

Habitat.—Jeremie deposit, Hayti (Weissflog!).

C. elegans. Grev., *Trans. Micr. Soc. Lond.*, 1866, p. 3, pl. i. fig. 6.—Diam. $\cdot 045$ to $\cdot 08$ mm. Central space irregularly round, about $\frac{1}{11}$ of diam. broad. Markings round, 4 to $4\frac{1}{2}$ in $\cdot 01$ mm.; subequal to the narrow band at the border; upon this band minute granular interspaces, hyaline, large opposite the origin of the shorter rows; rows upon the band at border crowded; apiculi minute, widely placed, sometimes absent. Border striæ obvious, 6 to 8 in $\cdot 01$ mm.—Sch., *Atl.*, pl. lviii. fig. 7; Pant., *Fossil. Bacil. Ung.*, p. 73, pl. xvi. fig. 141; pl. xxiv. fig. 216; Janisch, *Gazelle Exped.*, taf. iv. fig. 6; Cleve and Möll. *Diat.*, No. 164; *C. margaritaceus*, Cstr., *Diat. Chall. Exped.*, p. 164, pl. xviii. fig. 3. In H. L. Smith, *Diat. Spec. Typ.*, No. 99.

Not to be united to *C. gemmifer*, as suggested by Pantocsek.

Habitat.—Monterey deposit (Hardman! Greville! Firth! Kinker!); Bajtha, Elesd, Kékkö, Szent Peter and Dolje deposits (Pantocsek); Piscataway (Weissflog!); Los Angeles (O'Meara! Hardman!); * Sta Monica deposit (Cleve and Möller! Cleve! Firth!); Springfield, Barbados (Doeg!); Japan (H. L. Smith!); Newcastle deposit, Barbados (Doeg!); S. California, Pacific coast (Cleve).

Var. *parvipunctata*. Tru. and Witt, *Jeremie Diat.*, p. 14, pl. ii. fig. 22.—Diam. $\cdot 08$ mm. Markings more minute; towards the centre 6, towards the border 8, in $\cdot 01$ mm.; rows radial, more numerous; interspaces less evident, small.

Habitat.—Jeremie deposit (Truan and Witt).

C. spiniferus, Grove and Sturt. Grun., in *Bot. Centralbl.*, Bd. xxxiv. Nos. 2, 3, 1888, p. 35.—Diam. $\cdot 0875$ to $\cdot 1125$ mm. Surface

* In the collection of Julien Deby.

rising from the centre for about $\frac{1}{2}$ of radius to the highest zone; this zone convex, most sharply defined on its inner side, its outer edge passing gradually into the outer portion, which slopes downwards to the border. Central space subcircular, about $\frac{1}{14}$ of diam. broad, with a few isolated granules at its middle. Markings angular, towards the centre 8, on the highest zone largest, subpearly 5, beyond this subequal to the border and 6, in $\cdot 01$ mm.; secondary subconcentric bands evident on the highest zone, distinct subulate areas opposite origin of shorter rows about the semiradius; apiculi at the border evident, rarely obscure, at intervals of about $\cdot 01$ mm. Border narrow, hyaline.—*C. elegans*, var. *spinifera*, Grove and Sturt, *Jour. Quek. Micr. Cl.*, vol. iii. ser. 2, 1887, p. 69, pl. v. fig. 9.

Grunow justly separates this from *C. elegans*, Grev., but it is quite distinct from *Cestodiscus pulchellus*, Grev., to which he is inclined to assimilate it.

Habitat.—Oamaru deposit (Doeg! Grove!).

C. griseus. Grev., *Quart. Jour. Micr. Sci.*, 1863, p. 230, pl. ix. fig. 7.—Diam. $\cdot 065$ to $\cdot 0825$ mm. Surface rising slightly from centre to about semiradius, thence sloping gradually to the border. Central space rounded, $\frac{1}{15}$ to $\frac{1}{17}$ of diam. broad, inconspicuous, bearing several rounded granules. Markings rounded, granular, 6 in $\cdot 01$ mm., decreasing slightly near the border; the rows straight or slightly bent, the shorter rows irregularly placed; interspaces narrow, minute; apiculi at intervals of about $\cdot 01$ mm., sometimes inserted at the border.—Sch., *Atl.*, pl. lviii. figs. 13, 14 (excl. fig. 1).

Small hyaline irregular spaces sometimes occur here and there on the surface, and there may be a narrow clear band within the border. Sometimes confounded with *C. apollinis*.

Habitat.—Cambridge deposit, Barbados (Greville! Johnson!); Barbados (Cleve! Firth!); Monterey (Weissflog!); Los Angeles (O'Meara!); Santa Maria deposit (Grove!); Santa Monica deposit (Cleve!).

Var. *apiculata*, nov.—Diam. $\cdot 0875$ mm. Similar to the type, but the markings increasing from the central space outwards; towards the centre 8, towards the border 6, in $\cdot 01$ mm.; the rows more crowded; a circlet of minute apiculi at the border.

Habitat.—"Barbados, 1865" (Greville!).

C. cribrosus. Tru. and Witt, *Jeremie Diat.*, p. 14, pl. ii. fig. 25.—Diam. .06 to .08 mm. Surface flat. Central space irregularly angular, small. Markings rounded, increasing slightly from the central space for about $\frac{1}{4}$ of the radius, thence subequal to the distinct band adjacent to the border, upon this band punctiform; towards the centre $3\frac{1}{2}$, at the semiradius 3, on the marginal band 6, in .01 mm.; rows straight, secondary oblique rows inconspicuous.—Sch., *Atl.*, pl. lxiv. fig. 11 (no name).

Habitat.—Jeremie deposit (Truan and Witt); Moron deposit (Schmidt).

C. subdivicus. Tru. and Witt, *Jeremie, Diat.*, p. 14, pl. ii. fig. 13.—Diam. .05 mm. Surface almost flat. Central space and rosette absent. Markings rounded or obtusely angular, decreasing gradually from the centre to the border; towards the centre 4 to $4\frac{1}{2}$ (?) in .01 mm.; at the border punctiform; rows reaching the centre few, those intervening shorter and less prominent, on a narrow band adjacent to the border, numerous.

Schmidt has assigned this species to *Actinocyclus*, but Truan and Witt have failed to find a pseudonodule, and so justly unite it to *Coscinodiscus*.

Habitat.—Jeremie deposit (Truan and Witt).

C. undulatus. Cleve, *Kongl. Sv. Vet.-Ak. Handl. Stockh.*, 1881, No. 5, p. 20, pl. v. figs. 60a, 60b.—Diam. .0575 to .096 mm. Central space elongately elliptical, major axis $\frac{1}{4}$ to $\frac{1}{3}$ of diam., 2 to 3 times minor, sometimes subcircular. Surface slightly convex or subplain at the centre; a distinct broad elevated zone about the semiradius, with the inner edge less abrupt than the outer. Markings pearly, round, granular, increasing slightly from the central space to the elevated zone; towards the centre 4, on the highest zone 4; somewhat larger but more crowded on a narrow but distinct band adjacent to the border; again smaller, punctiform, about 6 in .01 mm., interspaces hyaline. Border with its inner edge sometimes distinct, striæ moniliform, 6 to 7 in .01 mm.

Habitat.—Galapagos Islands (Weissflog! Cleve!).

C. bathyomphalus. Cleve, *Vega Exped., Vetensk. Jakttag. Stockh.*, Bd iii., 1883, p. 489, pl. xxxviii. figs. 81a, 81b.—Diam.

·02 to ·03 mm. Surface with central portion funnel-shaped, round, and sharply defined in valve aspect. Central space and rosette absent. Markings small, rounded, granular, decreasing from the edge of the central portion to the border; rows straight.

In Spitzbergen specimens the central portion extends to about $\frac{2}{3}$ of the radius, and the rows of markings are traceable to the centre. Cape Wankarema valves show the central portion extending to about $\frac{1}{4}$ of the radius, and surrounded by a distinct irregular clear band, bearing faint markings. The markings outside of this band increase gradually outwards to the border (Cleve, *ibid.*, pl. xxxviii. fig. 81*b*). The latter may be distinguished as var. *wankaremensis*.

Habitat.—Spitzbergen (Cleve!).

C. grayianus,* sp. n.—Diam. ·105 mm. Surface rising slightly from the edges of the central space to the elevated ring, the latter sharply defined, ·0075 mm. broad, placed near the semiradius, from its outer edge, a short gentle slope passing gradually into the flat band reaching the border. Central space subcircular, $\frac{1}{3}$ to $\frac{2}{3}$ of diam. broad, bearing several round isolated granules. Markings around the central space round, granular, with narrow hyaline interspaces; beyond this to the elevated ring in moniliform rows, 6 in ·01 mm., upon this ring angular 4 in ·01 mm., with distinct central papillæ and irregular, beyond this again in moniliform rows to the inner edge of the flat band adjacent to the border, upon this band round, free, granular, with narrow hyaline interspaces, 6 in ·01 mm.; apiculi minute at subregular intervals. Border ·005 mm. broad, with distinct striæ 8 in ·01 mm.—(Pl. II. fig. 12.)

Habitat.—Antarctic ooze 1950 fathoms (Rae!).

C. notabilis, sp. n.—Diam. ·1 mm. Surface almost flat. Central space circular, sharply defined, about $\frac{1}{3}$ of diam. broad. Markings subpearly, obtusely angular, increasing from the centre to about the semiradius, again decreasing to the border; towards the centre 5, at the semiradius $4\frac{1}{2}$, at the border 8, in ·01 mm.; on a narrow indistinct zone, adjacent to the border, punctiform; rows with slight bendings, separated by narrow clear lines, most evident

* Named in honour of W. J. Gray, Esq., M.D.

opposite the origin of the shorter rows. Secondary subconcentric rows evident on central $\frac{2}{3}$ of the valve. Border narrow, hyaline.—(Pl. II. fig. 6.)

Habitat.—Gazelle Expedition (Weissflog!); lat. 53° 55'S., long. 108° 35' E., 1950 fathoms, H.M.S. Challenger (Kinker!).

C. subnotabilis, sp. n.—Diam. .05 to .075 mm. Surface flat. Central space and rosette absent. Markings round, granular, subequal 7 to 8 in .01 mm., irregular, on a small indistinctly defined central, sometimes slightly excentric area, elsewhere in radial or subparallel, irregularly subfasciculate straight or slightly flexuous rows; the rows in each fasciculus parallel to those at its middle or side on the same valve; secondary concentric bands faint; interspaces between the rows linear, small and subulate at the origin of the shorter rows.—(Pl. I. fig. 8; Pl. II. fig. 18.)

Distinguished from *C. notabilis* by the absence of a central space and the smaller size of the markings.

Habitat.—Chalky Mount, Barbados (Firth!).

Var. *marina*, nov.—Diam. .055 mm. Central space small, rounded, with a small central rounded granule. Markings obtusely angular, 6 to 7 in .01 mm. Border striæ evident, 6 in .01 mm.

Habitat.—Gazelle Expedition (Weissflog!).

C. Kochii.* Pant., *Fossil. Bacil. Ung.*, p. 71, pl. xxii. fig. 197. ←Diam. .11 to .15 mm. Surface flat to semiradius, two broad low undulations on outer half of valve. Central area minute, surrounded by a narrow dark line. Markings towards the centre angular, beyond the semiradius more rounded, subequal, $7\frac{1}{2}$ to 8, on a distinct band adjacent to the border more crowded, 10 in .01 mm.; rows separated by evident clear lines, distinct subulate spaces opposite the origin of the shorter rows, and most evident towards the centre; at wide subregular intervals minute clear spaces (apiculi?) close to the border. Border narrow, hyaline.

Pantocsek's original specimen is non-fasciculate. Distinguished from *C. dubiosus* by the undulate surface, the more distinctly separated radial rows, and the more evident subulate interspaces.

Habitat.—Szent Peter deposit (Pantocsek!).

* Dedicated to Prof. A. Koch of Klausenburg.

C. biharensis. Pant., *Fossil. Bacil. Ung.*, p. 71, pl. xiv. fig. 119 ; pl. xvi. fig. 139.—Diam. .11 to .18 mm. Surface slightly depressed at centre; somewhat convex about the semiradius. Central space absent; a rosette sometimes present. Markings hexagonal, compressed in direction of radius, on a small, sharply-defined, rounded central area, extending to $\frac{1}{6}$ or $\frac{1}{7}$ of radius obtusely angular, large, unequal; beyond this much smaller, 4 to $4\frac{1}{2}$ in .01 mm., increasing slightly to about the semiradius, again decreasing gradually to the border; broadish in a direction at right angles to the radius, the central papillæ prominent; rows straight or slightly curved; secondary subconcentric rows faint. Border narrow, hyaline.

Habitat.—Elesd marl, Hungary (Pantocsek!).

C. neogradensis. Pant., *Fossil. Bacil. Ung.*, p. 74, pl. ii. fig. 18.—Diam. .06 to .13 mm. Surface with two concentric undulations about the semiradius, the inner the more evident. Central space and rosette absent. Markings towards the centre angular 8, beyond the inner undulation rounded 6, between the hyaline spaces at the border somewhat larger, 5 to $5\frac{1}{2}$ in .01 mm., these spaces 15 to 27, narrow, subregular, with their long axes radial, each formed by the interruption of a row of markings; rows straight, between the undulations moniliform. Border sharply defined; striæ delicate, 16 in .01 mm.

Distinguished from *C. intumescens* by the undulations, markings, and hyaline marginal spaces. With this *Cosmiodiscus barbadensis* (Grev., *Trans. Mic. Soc. Lond.*, 1866, p. 80, pl. viii. fig. 12) may be identical.

Habitat.—Alsö-, Felsö-, Esztergály, Kékkö, Mogyorod, Szakal and Szent Peter deposits (Pantocsek!).

C. intumescens. Pant., *Fossil. Bacil. Ung.*, p. 74, pl. ii. fig. 17.—Diam. .1 to .155 mm. Surface with a wide shallow undulation extending from a short distance within the semiradius almost to the border. Central space and rosette absent. Markings towards the centre angular $6\frac{1}{2}$, soon becoming small rounded granules, $5\frac{1}{2}$ in .01 mm., at the border on an evident band again more minute; rows straight, small subulate clear spaces opposite the origin of the shorter rows; on the band adjacent to the border minute

hyaline spaces at subregular wide intervals. Border narrow; striae obscure, 12 to 14 in .01 mm.

Pantocsek includes this species in his section *Cestodisci*. The absence of distinct apiculi and the more lax arrangement of the markings towards the border appear to me to bring it closer to the *Radiati*.

Habitat.—Bajtha, Alső-, Felső-, Esztergály, Kékkő, Mogyorod, Szakal and Szent Peter deposits (Pantocsek!).

C. hungaricus. Pant., *Fossil. Bacil. Ung.*, p. 73, pl. ix. fig. 73.—Diam. .072 to .0825 mm. Surface slightly convex, depressed at the centre; colour brown, light blue and grey in concentric zones. Central space small, but distinct, rounded. Markings round or obtusely angular, closely disposed 6, towards the border more crowded, punctiform, 8 to 9 in .01 mm.; rows straight; secondary oblique decussating rows most evident near the border; apiculi distinct, 10 to 15, at subequal intervals. Border sharply defined, about $\frac{1}{3}$ to $\frac{1}{4}$ of radius broad; striae delicate, 14 to 16 in .01 mm.

Habitat.—Kékkő, Szakal, Szent Peter and Felső-Esztergály deposits (Pantocsek!).

Var. *Szabói*, Rattray. *C. Szabói*, Pant., *Fossil. Bacil. Ung.*, p. 74, pl. xviii. fig. 167.—Diam. .064 mm. Central space small, smooth. Markings punctiform, 10 in .01 mm.; near the border a circlet of minute, rounded, distant, smooth spaces.

Habitat.—Szent Peter deposit (Pantocsek!).

C. apiculiferus,* Rattray. *C. armatus*, Pant., *Fossil. Bacil. Ung.*, p. 74, pl. x. fig. 90.—Diam. .034 to .049 mm. Surface almost flat or slightly convex, somewhat depressed at the centre. Central space and rosette absent. Markings obtusely angular; at the centre 8, soon increasing to 6 in .01 mm., and thence subequal to the border; minute, subulate, hyaline spaces opposite the origin of the shorter rows; rows straight; apiculi 7 to 14, prominent, inserted close to the border. Border narrow, hyaline.

Habitat.—Alső-, Felső-, Esztergály deposits (Pantocsek!).

C. Mártonfi.† Pant., *Fossil. Bacil. Ung.*, p. 72, pl. xv. fig. 132.

* The name *C. armatus* has been preoccupied by Greville (*Trans. Micr. Soc. Lond.*, 1861, p. 42, pl. iv. fig. 5) for a distinct form, and must be abandoned.

† Dedicated to Prof. L. Mártonfi of Számos-Ujvár.

—Diam. $\cdot 048$ to $\cdot 0625$ mm. Surface almost flat. Central space small, bearing a few isolated granules. Markings punctiform, 15 in $\cdot 01$ mm.; rows straight, most evident on outer $\frac{2}{3}$ of valve; apiculi distinct, at intervals of about $\cdot 005$ mm., forming a circlet a short distance from border. Border narrow, hyaline.

Pantocsek places this species amongst the *Fasciculati*, but in his type the rows are radial and straight, so that it belongs rather to the *Radiati*.

Habitat.—Elesd marl (Pantocsek!).

C. patera. Cstr., *Diat. Chall. Exped.*, p. 155, pl. ii. fig. 6.—Diam. $\cdot 0575$ to $\cdot 089$ mm. Surface hat-shaped, centre slightly depressed, thence rising slightly for about $\frac{1}{3}$ of radius to form a distinct circular ridge, whence it descends more rapidly, becoming almost flat near the border. Central space irregularly rounded, $\frac{1}{2}$ to $\frac{1}{8}$ of diam. broad, bearing a few isolated granules. Markings punctiform, subequal, but becoming more crowded and sometimes slightly smaller towards the border; towards the centre 8 to 10, towards the border 10, in $\cdot 01$ mm.; rows irregularly and faintly fasciculate, sometimes at unequal intervals, stopping short of the border; interspaces hyaline. Border narrow, hyaline.

Distinguished from *C. umbonatus*, Cstr. (non Greg.) by the arrangement of the markings and the absence of apiculi.

Habitat.—Pacific Ocean, 2900 fathoms, H.M.S. Challenger (Castracane); Gazelle Expedition (Weissflog!); Szent Peter deposit (Pantocsek); Barbados deposit (Johnson!).

C. densus. Grove and Sturt MS.—Diam. $\cdot 0575$ mm. Central space distinct, irregularly rounded, about $\frac{1}{2}$ of diam. broad. Markings closely disposed, rounded, granular, 6 in $\cdot 01$ mm., subequal for about $\frac{1}{2}$ of radius, somewhat smaller towards the border; radial rows obscure; short, secondary, transverse or slightly oblique, somewhat flexuous rows more evident, non-decussating for about $\frac{1}{2}$ of radius, beyond this to the border decussating, but more faint. —(Pl. II. fig. 9.)

Readily distinguished by the subopaque appearance and short secondary rows.

Habitat.—Oamaru deposit (Kinker!).

C. subsalsus. Juh.-Dannf., *Bih. Sv. Vet.-Ak. Handl. Stockh.*, 1882, p. 47, pl. iii. fig. 33.—Diam. .035 to .045 mm. Surface slightly convex. Central space and rosette absent. Markings pearly, 12 in .01 mm., somewhat less dense at the centre than about the semiradius, near the border more minute, and forming a somewhat broad distinct zone of irregular width; rows radial or subparallel, obscurely fasciculate; secondary irregular concentric bands visible.

Habitat.—Subfossil at Sunda, in Blidö Upland; Upland, Lidö, Norrtelje, Karlshamn (Juhlin-Dannfelt).

C. Trinitatis, Rattray. *Cestodiscus (pulchellus, var.) Trinitatis*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxvi. fig. 4.—Diam. .04 mm. Surface with the central portion extending to about $\frac{5}{8}$ of radius, its outer edge subcrenulate, distinct. Central space circular, about $\frac{1}{2}$ of diam. broad. Markings rounded, granular, decreasing gradually towards the border, least crowded near the central space; towards the centre 6, towards the border 12, in .01 mm.; apiculi distinct, large at somewhat unequal wide intervals, inserted near the outer edge of the central portion.—*Cestodiscus pulchellus*, Habirsh., *Cat. Diat.*, ed. 2, 1885, § *Cestodiscus*.

Habitat.—Naparima deposit (Van Heurck, Grove!).

C. disciger. Ehrb., *Mon. Ber. Ak.*, 1843, p. 271.—Diam. .056 mm. Central space distinctly defined, large, irregularly circular, not smooth. Markings minute, equal, in contact, hardly conspicuous, 15 in .01 mm.—Kütz., *Sp. Alg.*, p. 123.

Kützing, followed by Ralfs, contrasts this species with *C. perforatus*, hence the markings were probably also in radial, straight, or almost straight rows.

Habitat.—Virginian deposit (Kützing); Ems, near Wiener; marine mud, from Norderney; $2\frac{1}{2}$ fathoms, Crildmar; marshy ground, Wöhrden (Ehrenberg).

C. cervinus. Ralfs in *Pritch. Inf.*, p. 831.—Diam. .135 to .2125 mm. Surface convex towards the centre. Colour fawn. Central space and rosette absent. Markings minute; rows straight.—*Hyalodiscus cervinus*. Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 95, pl. v. fig. 9.

This approaches *C. granulatus*, but is distinguished by its convex surface and more minute markings. From *C. dubiosus* it is distinguished by the absence of subulate spaces and of clear scattered puncta. According to Mr E. Grove probably *C. radiosus*, Grun.

Habitat.—Arctic regions (Sutherland); shell cleanings, West Indies (Brightwell); ex *Ascidii*, Roundstone Bay, Co. Galway; ex *Ascidii*, Co. Clare (O'Meara).

C. granulatus. Ehrb., *Mon. Ber. Ak.*, 1845, p. 75.—Diam. .049 mm. Markings minute, granular, equal, 9 to 10 in .01 mm.; rows crowded.—Ralfs in *Pritch. Inf.*, p. 830.

The appearance of the centre of this unfigured species is unknown.

Habitat.—Stratford Cliff and Holles Cliff, Va. (Ehrenberg).

C. punctulatus. Greg., *Trans. Roy. Soc. Edin.*, 1857, p. 500 pl. x. fig. 46.—Diam. .045 to .085 mm. Central space and rosette absent. Markings faint, minute, punctiform, forming delicate radiating lines, less distinct towards the centre than the oblique decussating lines; at wide irregular intervals scattered clear but faint round dots. Border sharply defined; striæ faint, 20 to 22 in .01 mm.—Greg., *Trans. Micr. Soc. Lond.*, 1857, p. 83, pl. i. fig. 48. Ralfs in *Pritch. Inf.*, p. 831; H. L. Smith, *Diat. Sp. Typ.*, No. 96.

The fine radiating lines recall those of *C. stellaris*, Roper. Gregory regarded the valves as probably belonging to *Melosira* or *Orthosira*. O'Meara (*Proc. Roy. Ir. Ac.*, 1875, p. 265) has probably not seen the true species.

Habitat.—Jamaica (Greville!); Cumberland inlet, lat. 66° N. (Arnett!); Lamlash Bay and Loch Fyne (Gregory!); locality (?) (Rae!); *Ascidia*, Co. Clare (O'Meara).

C. radiopunctatus. Harting, *Verh. Kon. Ak. Wetensch. Amsterdam*, 1864, No. 2, p. 8, pl. i. fig. 3.—Diam. ? At the centre a minute stellette of small dark puncta. Markings small, round, granular, subequal; rows radial, inconspicuous, secondary irregularly concentric bands manifest. Border with short delicate striæ.

Harting compares the markings to those of *C. profundus*, Ehrb. (*Mikrog.*, pl. xxxv. B. fig. 8), but they are smaller. In the latter,

too, there is no central stellette, the markings decrease distinctly outwards, and there are no striæ at the border.

Habitat.—Banda Sea, 1200 fathoms; Tamelijk, 2050 fathoms (Harting).

C. clivosus. Pant., *Fossil. Bacil. Ung.*, p. 72, pl. ii. fig. 16.—Diam. $\cdot 13$ to $\cdot 15$ mm. Colour bluish at the centre, outside of this with concentric zones of brown, green, or dark grey. Surface slightly depressed at the centre for about $\frac{2}{5}$ of radius, outside of this showing 4 concentric zones, alternately elevated and depressed, the second narrowest and most sharply defined, the fourth similar, but merging gradually into the outermost portion. Central space indistinct, with scattered isolated granules sometimes absent. Markings punctiform, towards the centre more distinct and irregular. Rows 8, towards the border 10, in $\cdot 01$ mm.; rows closely disposed; a broad hyaline band within the border. Border striæ faint, 8 to 10 in $\cdot 01$ mm.

The colour of this species recalls that of some *Actinocyeli*, e.g., *A. Ehrenbergii*, Ralfs (*Pritch. Inf.*, p. 834).

Habitat.—Kékkö, Szakal, and Szent Peter deposits (Pantocsek!); Alsó-, Felső-, Esztergály, Mogyorod (Pantocsek!).

Var. *latefasciata*, Grun. Pant., *ibid.*, p. 72, pl. xxvii. fig. 253.—Diam. $\cdot 11$ mm. Central space subcircular, evident, about $\frac{1}{8}$ of diam. broad. The hyaline band within the border much wider, $\frac{1}{8}$ to $\frac{1}{4}$ of radius.

Habitat.—Alsó-, Felső-, Esztergály deposits (Pantocsek!).

C. depressus. Gregory MS.—Diam. $\cdot 03$ mm. Surface with a distinct central depression extending to about $\frac{1}{2}$ of radius. Central space and rosette absent. Markings minute, resolved with difficulty, most evident around outer edge of the depression; rows straight. Border sharply defined, with delicate striæ, 16 to 18 in $\cdot 01$ mm.

Habitat.—Arran Island (Greville!); Patos Island guano (Norman!); * Maghellan Straits (Cleve!); Cape Wankarema (Cleve!); Greenland (Cleve!).

* In the collection of Dr Greville.

C. ludovicianus,* Rattray. *Janischia? antiqua*, Grun. Van Heurck., *Syn. Diat. Belg.*, pl. xcv. *bis*, figs. 10, 11.—Diam. .335 mm. Surface slightly convex towards the centre. Central space and rosette absent. Markings minute, 16 in .01 mm.; rows radial, straight, but faint; oblique decussating rows more evident; apiculi prominent, at intervals of .01 to .015 mm., forming a circlet at a distance of .03 mm. from the border; at opposite sides of the valve the apiculi, replaced by a narrow curved hyaline band, bearing well-marked radial striæ, these bands at a somewhat greater distance from the border, and sometimes interrupted; close to the border a circlet of minute apiculi at intervals of .005 to .0075 mm., and recognised only with difficulty.

The specific name *antiquus* cannot be adopted, being preoccupied for a distinct form.

Habitat.—Jutland, Cementstein (Deby!).

C. polurrhaptos,† sp. n.—Roundly elliptical. Major axis .1125 mm., about $1\frac{2}{3}$ times the minor. Surface with two obtusely conical elevations, most evident and meeting at, the centre thence diverging and becoming more faint in outline towards the border, symmetrical with respect to the minor axis; their outer ends embracing about $\frac{1}{4}$ of the circumference. Central space and rosette absent. Markings hexagonal, most evident at the centre; towards the centre 10 to 12, towards the border 14 to 16, in .01 mm.; rows straight; secondary oblique rows obscure; minute subulate spaces opposite the origin of the shorter rows towards the centre; apiculi evident, scattered irregularly over the surface. Border sharply defined, hyaline.—(Pl. III. fig. 4.)

Cyclotella Castracanei, Eul. MS., as noted by Kitton, shows some affinity to this species in the lobes about the centre, but in the former these lobes do not meet at the centre. The valve marking is also distinct.

Habitat.—Santa Marta deposit, Cal. (Doeg!).

Grunow refers, in a note to Mr E. Grove, dated May 8, 1888, to a species which he names *C. florescens*, Grun. This, according to

* Named in honour of Mr Louis Deby.

† πολυρῥαπτος, embroidered.

Mr Grove, resembles *C. dubiosus*, but the delicate hexagonal markings are rather larger; the surface is dotted over with small spots (apiculi?), each standing in the middle of a rosette of 5 to 6 areolæ; there is a submarginal circle of apiculi; the rows are straight, radial and non-fasciculate; there are small subulate interspaces at the origin of the shorter rows, and the border is striated.

§ VII. ELABORATI.

Valves elongately elliptical. Markings rounded or granular; the rows chiefly disposed with relation to the major axis.

C. naviculoides. *C. ? naviculoides*, Tru. and Witt, *Jeremie Diat.*, p. 14, pl. ii. fig. 10.—Rhomboidal. Major axis $\cdot 0875$ to $\cdot 11$ mm., 3 to $3\frac{1}{2}$ times minor. Surface flat. Central space and rosette absent. Markings pearly, decreasing somewhat from the centre outwards about 4 in $\cdot 01$ mm.; round and irregular at the centre, obtusely angular, and in faint rows subparallel to the major axis towards the more acute extremities; irregularly transverse or oblique decussating secondary rows sometimes evident, on a sharply defined narrow band adjacent to the border punctiform, and in more evident oblique decussating rows. Border narrow; striæ obvious, 8 to 10 in $\cdot 01$ mm.

Distinguished from *C. lewisianus* by the more rhomboidal outline, and the closer arrangement of the markings, which are disposed in less evident rows.

Habitat.—Jeremie deposit (Truan and Witt); Monte Gubbio (Grove!).

C. paleaceus, Rattray. *Stoschia ? paleacea*, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxviii. fig. 6.—Elongately and irregularly elliptical, frequently with shallow lateral undulations. Major axis $\cdot 0425$ to $\cdot 1$ mm., from 4 to 8 times the longest transverse axis. Surface almost flat; central space and rosette absent. Markings polygonal, 6 to 7 in $\cdot 01$ mm. Subequal, without order or in obscure rows; around the border a distinct band of areolæ.

Habitat.—Nancoori (Hardman!); * Naparima (Kitton).

* In the collection of Julien Deby.

C. lewisianus. Grev., *Trans. Micr. Soc. Lond.*, 1866, p. 78, pl. viii. figs. 8–10.—Valve elliptical, the sides slightly protuberant at ends of minor axis. Major axis $\cdot 0875$ mm., about 2 to $2\frac{1}{3}$ times minor. Central space absent. Markings rounded, about 4 in $\cdot 01$ mm., largest and irregular around the centre; the rows straight and slightly curved along and parallel to the major axis, diverging and bent away from the minor; on a narrow band at the border crowded, and forming oblique decussating rows. Border indistinct; striæ 8 in $\cdot 01$ mm.—Sch., *Atl.*, pl. lxvi. fig. 12; Pant., *Fossil. Bacil. Ung.*, p. 70, pl. xxv. fig. 232; Cleve and Möll., *Diat.*, No. 162.

Habitat.—Nancoori (Cleve and Möller! Cleve! Kinker! Hardman!); Maryland (Cleve); Rappahannock, U.S. (Greville!); Richmond, Va. (Greville!); Szent Peter deposit (Pantocsek); Naparima, Trinidad (Firth! Kitton); Jones Cliff, Maryland (Marshall!); * Trinidad deposit (Greville!); Artesian well, Cambridge, Maryland (Doeg!); † Monroe Fortress, North America (Weissflog!); Monte Gubbio (Grove!); Nottingham deposit (Greville!); Los Angeles, Cal. (Cambridge!); ‡ Calvert County, Maryland (Grove!).

Var. *moronensis*, nov. Major axis $\cdot 0825$ mm. about $2\frac{1}{3}$ times minor. Central space absent. Markings polygonal, in contact 3 to $3\frac{1}{2}$ in $\cdot 01$ mm., subpearly, the rows arranged as in the type, the band at the border sharply defined on its inner side, with markings decreasing slightly outwards from 6 to 8 in $\cdot 01$ mm. Striated border absent.

Habitat.—Moron deposit (Hardman!). §

Var. *similis*, nov.—Rhombic. Major axis $\cdot 05$ mm., about $1\frac{2}{3}$ times minor. Markings round, granular, almost symmetrical with respect to the major and minor axes; the rows concave towards the former on each half of valve; at the centre about $3\frac{1}{2}$ in $\cdot 01$ mm., near the border crowded, subpunctiform.—(Pl. III. fig. 10.)

Habitat.—South Naparima, Trinidad (Hardman!). ||

* In the collection of Dr F. W. Griffin.

† Forwarded by Professor H. L. Smith. According to Dr Griffin, the boring also contained *Coscinodiscus excavatus* var. *genuina*, and *C. excavatus* var. *quadriocellata*.

‡ In the collection of Dr F. W. Griffin.

§ In the collection of Dr Greville.

|| In the collection of Mr Julien Dely.

C. gracilentus, sp. n.—Elongately elliptical, the extremities bluntly cuneate. Major axis $\cdot 095$ to $\cdot 125$ mm., about $5\frac{1}{2}$ times minor. Central space and rosette absent; a circular central area about $\cdot 006$ mm. broad, with irregular angular granules, and bounded by a narrow hyaline line. Markings hexagonal, $4\frac{1}{2}$ to 5 in $\cdot 01$ mm., somewhat smaller around the border; rows curving outwards from the central area, and continued almost parallel to the major axis almost to its extremities, near the latter diverging outwards; irregular along the minor axis. Border narrow, hyaline.—(Pl. I. fig. 9.)

Habitat.—Naparima, Trinidad (Weissflog! Firth!).

§ VIII. COCCONEIFORMES.

Valves roundly elliptical. Markings cocconeoid.

C. cocconeiformis. Sch., *Atl.*, pl. lviii. figs. 25, 26, 28.—Diam. $\cdot 023$ to $\cdot 035$ mm. A narrow hyaline band, sometimes tapering towards the extremities running from the centre towards the border. Markings small, round, granular, crowded on a narrow, sometimes distinctly defined band adjacent to the border; rows straight from the centre at right angles to the hyaline band, elsewhere diverging and slightly curved towards the extremities of this band; interspaces hyaline.

Distinguished by the arrangement of the markings.

Habitat.—Monterey (Schmidt, Weissflog!); Sta Marta deposit (Doeg!).

Var. *latior*, nov. Sch., *Atl.*, pl. lviii. fig. 23 (no name).—Subcircular. Diam. $\cdot 0165$ mm. Central hyaline band extending close to the border, its sides convex with a slight median constriction. Markings more minute, irregular, rows undifferentiated, the band adjacent to the border absent.

Habitat.—Campeachy Bay (Schmidt).

Var. *brevior*, nov. Sch. *Atl.*, pl. lviii. fig. 24 (no name).—Diam. $\cdot 038$ mm. Central space small, roundly elliptical. Markings subequal, or decreasing slightly towards the border, in more evident diverging rows. Border narrow, formed by two concentric bands of granules.

Habitat.—Cape of Good Hope (Schmidt).

Var. *tenuior*, nov. *C. cocconeiformis*, var. Sch., *Atl.*, pl. lviii. fig. 27.—Diam. .0425 mm. Hyaline central band narrow, extending to the border. Markings in parallel rows on a narrow but distinct median area, about the minor axis; at border more minute, forming delicate striæ.

Habitat.—Leton Bank (Schmidt).

It should be noted that specimens described by Grove and Sturt, from the Oamaru deposit, under the designation of *Triceratium coscinoides*, are rather triangular forms of *Coscinodiscus*, and thus form a connecting link to the great but heterogeneous groups of forms at present classed in the genus *Triceratium*.

SPECIES EXCLUSÆ VEL INQUIRENDÆ.

C. ? polystigma. Ehrb. (*Mon. Ber. Ak.*, 1843, p. 271), belongs to *Auliscus* (Ratray, *Jour. Roy. Micr. Soc. Lond.*, 1888, p. 897).

C. ? bifrons, Cstr. (*Diat. Chall. Exped.*, p. 156, pl. ii. fig. 1) and *C. ? janus*, Cstr. (*ibid.*, p. 157, pl. ii. fig. 2), are inadequately defined species, which, with more probability belong to *Actinocyclus*.

C. craspedodiscus, Kütz. (*Sp. Alg.*, p. 126), is *Craspedodiscus elegans*, Ehrb., but distinct from *Coscinodiscus craspedodiscus*, O'Me., and from *Craspedodiscus Coscinodiscus*, Ehrb. (*Mon. Ber. Ak.*, 1844, p. 266; *Mikrog.*, pl. xxxiii. 15. fig. 8, &c.).

C. Auliscus, Kütz. (*Sp. Alg.*, p. 126), belongs to *Auliscus* (Ratray, *Jour. Roy. Micr. Soc. Lond.*, 1888, p. 896).

C. Barklyi, Coates (*Quart. Jour. Micr. Sci.*, 1861, p. 138), from Yarra Yarra, has been correctly named by Grunow *Actinocyclus Barklyi*. The species was dedicated to Sir H. Barkly, formerly President, Royal Society, Melbourne.

C. ? rudis, Cstr. (*Diat. Chall. Exped.*, p. 162, pl. xxii. fig. 4), from the Philippine Islands, belongs to *Stephanopyxis*.

C. minimus, Schum. (*Schrift. Phys. Oek. Ges. Königsb.*, 1867, p. 62, pl. iii. fig. 72). This Baltic specimen is a *Cyclotella*, and approaches *Cy. striata*, var. *baltica*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. xcii. fig. 13), also from the Baltic.

C. minor, Weisse (*Bull. Ac. Imp. Sci. St Petersburg.*, 1855, p. 276, pl. i. fig. 4). The Simbirsk valves, so named by Weisse, were designated *C. polycora* by Ehrenberg, and belong to *Pyxidicula*.

C. parma, Bail. According to Prof. H. L. Smith (*Lens*, 1872, p. 232), who has examined the Bailey Collection bequeathed to the Boston Society of Natural History, this is *Stictodiscus californicus*, Grev. (*Trans. Micr. Soc. Lond.*, 1861, p. 79, pl. x. fig. 1), of which Bailey's *Triceratium parma* is a triangular form.

C. pyxidicula, Kütz. (*Sp. Alg.*, p. 126) is *Pyxidicula Coscinodiscus*, Ehrb. (*Mon. Ber. Ak.*, 1844, p. 85), and belongs to *Craspedodiscus*, approaching *Cr. elegans*, Ehrb.

C. cruciatus, Kütz. (*Bacil.*, p. 132, pl. xxviii. fig. 10), belongs to *Pyxidicula*. Specimens have been procured from Vera Cruz and Richmond, Va.

C. pyxis, Ehrb. (*Mikrog.*, pl. xxxiii. 13. fig. 3*), is perhaps a *Melosira*. It cannot be united to *Coscinodiscus*.

C. quindenarius. This name is erroneously quoted in Habirshaw's *Cat. Diat.*, 2nd ed., § *Coscinodiscus*, for *Actinocyclus quindenarius*, Ehrb. (*Mikrog.*, pl. xxi. fig. 17).

C. fuscus, Norman (*Trans. Micr. Soc. Lond.*, 1861, p. 7, pl. ii. fig. 3) is *Actinocyclus Ralfsii*, not *A. Barklyi*, nor *Actinoptychus Barklyi*, as stated in Habirshaw's *Cat. Diat.*, 2nd ed., § *Actinocyclus*.

C. græcus, Kütz. (*Bacil.*, p. 132), was named *Discoplea græca* by Ehrenberg (*Mon. Ber. Ak.*, 1840, p. 208; *Mikrog.*, pl. vi. 2. figs. 1 a-c). It is a *Melosira* or perhaps a *Cyclotella*. Specimens were found in Grecian marl.

C. flavicans, Ehrb. (*Abh. Ber. Ak.*, 1841, p. 412, pl. i. 3. fig. 17), has been defined as small, with delicate, non-radiate markings, being yellow by transmitted, and white by reflected light. Ralfs accepted this species (*Pritch. Inf.*, p. 831) as belonging to *Coscinodiscus*; to me it seems rather to be a *Melosira*. Simbirsk specimens, named *C. flavicans* by Weisse (*Bull. Ac. Imp. Sci. St Petersb.*, 1855, p. 276, pl. figs. 5 a, b), have coarse markings, and must be excluded. *C. flavicans?* Ehrb. (*Mikrog.*, pl. xxxix. 2. figs. 19, 20), are also distinct. Ehrenberg's original specimens were from Peru and St Domingo.

C. arafusensis. O'Me., *Quart. Jour. Micr. Sci.*, 1877, p. 463.—Diam. .375 mm. Central space small. Markings areolate, at the margin subhexagonal, diminishing in size towards the ends; shorter, broader, and more robust than in *C. craspedodiscus*, O'Me., radial rows terminating some distance from the centre, but of more equal

length than in *C. craspedodiscus*. Kitton believes that this "species," founded on specimens procured by H.M.S. Challenger in the Arafura Sea, is identical with *C. nobilis*. The comparison of the markings with those of *C. Janischii*, var. *arafurensis*, Grun., appears to me to preclude this conclusion. In a letter to Mr E. Grove, dated May 8, 1888, Grunow states that *C. arafuscensis*, O'Me., is probably identical with *C. Janischii*, var. *arafurensis*, and this seems more likely. The name may be abandoned without inconvenience. No figure of the original was published.

The specimen from Jeremie deposit, figured by Truan and Witt (*Jeremie Diat.*, p. 14, pl. ii. fig. 23), and referred to as *Coscinodiscus*? spec., is pointed out as differing from *Stephanophyxis turris* by the absence of a circlet of apiculi. Grunow, however, enrolls some Franz Josef's Land valves without apiculi as vars. of the last named species, e.g., *S. turris*, var. *cylindrus forma inermis* (*Denk. Wien. Ak.*, 1884, p. 87, pl. v. (E), figs. 10, 11), and *S. turris*, var. *arctica forma macropora*, *ibid.*, pl. v. (E), fig. 20. With this last, from the large size of its markings, the Jeremie valve seems to be identical. It also approaches *Pyxidicula Weyprechtii*, Grun., but differs in not showing a gradual diminution in size of the markings outwards.

The union of *Actinocyclus alienus*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. cxxv. figs. 10, 11), from Santa Monica; *A. incertus*, Grun. (Van Heurck, *ibid.*, pl. cxxv. fig. 4), from Santa Monica and Monterey; *A. subtilis*, Ralfs (*Pritch. Inf.*, p. 835; Van Heurck, *ibid.*, pl. cxxiv. fig. 7; pl. cxxv. figs. 9, 11; *Typ. Syn. Diat. Belg.*, Nos. 519, 520; Cleve and Möll., *Diat.*, No. 171), from Ilfracombe, Plymouth, &c.; and *A. Roperii*, Grun. (Van Heurck, *ibid.*, pl. cxxv. figs. 5, 6), from Carteret, &c., to *Coscinodiscus*, as proposed by Grun. (*Denk. Wien. Ak.*, 1884, p. 83), is undesirable since in all a pseudonodule is recognisable.

C.? ovalis. Roper (*Quart. Jour. Micr. Sci.*, 1858, p. 22, pl. iii. fig. 4), is *Actinocyclus Roperii*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. cxxv. figs. 5, 6), and synonymous with *Eupodiscus Roperii*, Breb. (*Jour. Quek. Micr. Cl.*, 1870, p. 41). The name *ovalis* (*Actinocyclus ovalis*), as being the older specific designation, should stand. Specimens were obtained by H.M.S. Challenger in a sounding made near Yedo, Japan. There is a true *Coscinodiscus ovalis* distinct from Roper's form, and devoid of a pseudonodule.

C. minutus. Kütz. (*Bacil.*, p. 131, pl. i. fig. 14).—Diam. .0125 mm. Central space and rosette absent. Markings minute, punctiform, without order. Border striæ punctate. This species, which Ralfs admits (*Pritch. Inf.*, p. 831), and which was founded on specimens procured in mud from the river Elbe at Cuxhaven by Sonder, belongs to *Cyclotella*, and is probably *Cy. salina*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. xcii. fig. 11), as found in the Thames at Greenwich. Schumann's *C. minutus* (*Schrift. Phys. Oek. Ges. Königsb.*, 1867, p. 62, pl. iii. fig. 71) is distinct, though it too belongs to *Cyclotella*.

C. sinensis. O'Me., *Quart. Jour. Micr. Sci.*, 1879, p. 122.—Diam. .3575 mm. Central space stellate, because of the different lengths of the rows of markings. Markings close, distinctly larger towards the border.

This species, procured by H.M.S. Challenger in Hong Kong Harbour, is problematical. O'Meara has so named, with a query, fossil valves from Los Angeles and Mejillones now in the British Museum, but the specimens to which his "finder" numbers refer belong to *C. gigas*, Ehrb. The original may have been *C. diorama* Sch. (*Atl.*, pl. lxiv. fig. 2), or *C. mirificus*, Cstr. (*Diat. Chall. Exped.*, p. 154, pl. iii. fig. 6), also from Hong Kong Harbour.

C. Smithii. O'Me., *Proc. Roy. Ir. Acad.*, 1875, p. 262.—This is *C. minor*, W. Sm., not Ehrb. (*Syn. Brit. Diat.*, i. p. 23, pl. iii. fig. 36), and is identical with *Melosira nivalis*, W. Sm. (*ibid.*, ii. p. 58, pl. liii. fig. 336), with which it must be united, though approaching *M. distans*, Kütz., from Bilin. O'Meara, whilst pointing out the inaccuracy of Smith's specific name *minor*, and replacing it by that of *Smithii*, continues the error with respect to the genus.

C. striatus, Kütz. (*Bacil.*, p. 131, pl. i. fig. 8), is *Cyclotella striata*, var. *intermedia*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. xcii. fig. 10), not *Cy. striata*, as stated by Van Heurck (*ibid.*, pl. xcii. fig. 6). *Cy. dallasiana*, W. Sm., now preserved in Smith's collection in the British Museum, shows no clear band between the central areolate portion and the radially striated band at the border, it is thus also identical with *C. striata*, var. *intermedia*, Grun., with which also agrees *Cosc. striatus*, Ehrb. (Jan. and Raben., in

Rabenh., *Beitr. z. näh. Kennt. u. Verbreit. d. Algen*, Leipzig, 1863, Heft i. p. 8, pl. iv. fig. 4), from Honduras and from Peruvian guano (Jan., *Abh. Schl. Ges. väter. Cult.*, 1862, Heft ii. p. 4, pl. i. A. fig. 5). In Cleve's collection, at present preserved in the Royal Botanical Museum, Stockholm, *C. striatus* is recorded from Kiel Harbour, and specimens from this locality are not unfrequent in Rabenh., *Alg. Europ.*, No. 1697.

C. varius. Schum. (*Schrift. Phys. Oek. Ges. Königsb.*, 1867, p. 62, pl. iii. fig. 76), is inadequately diagnosed—the appearances described being mostly those resulting from differences in focussing. There are about $6\frac{1}{2}$ rows of markings in .01 mm. The name may be abandoned without inconvenience.

C. heterostigma. Ehrb., *Mon. Ber. Ak.*, 1872, p. 297.—Specimens so named were recorded by Ehrenberg, from a depth of 3 fathoms, in the Greenland Sea, near Sabini Island. Ehrenberg regarded them as probably belonging to *Gallionella*. They may be united to *Melosira*. They reached .0475 mm. in diam., had punctiform irregular markings, smaller ones being disposed among the larger.

C. tenellus. Ehrb., *Mon. Ber. Ak.*, 1854, p. 238.—Diam. .075 mm. Markings $8\frac{1}{2}$ to 9 in .01 mm., equal; rows radiating. Specimens are recorded by Ehrenberg from the Atlantic Ocean. Ralfs has admitted the species, but notes that the characters given are insufficient to distinguish it from *C. radiolatus* and *C. subtilis*. The species may be abandoned without inconvenience.

Cosmiodiscus imperfectus. Grun., *Denk. Wien. Ak.*, 1884, p. 69.—Grunow refers to this species as figured in Sch., *Atl.*, pl. iii. figs. 17, 18. For pl. iii. he means pl. xxxvi. The forms are quite distinct from *Coscinodiscus punctulatus*, though distributed, according to Schmidt, as a var. of this species by Möller. I have followed Schmidt in naming them *Aulacodiscus suspectus* (Rattray, *Jour. Roy. Micr. Soc. Lond.*, 1888, p. 339), which I regard as the simplest species of the genus *Aulacodiscus*. Grunow, overlooking Schmidt's earlier name, proposed in 1884 a new one, namely, *Aulacodiscus imperfectus*, but in the same sentence he notes that the absence of processes is opposed to this determination, and so gives another name still, *Cosmiodiscus imperfectus*. The absence of processes, however, is not of itself sufficient to exclude the species from *Aulacodiscus*, since these are also entirely absent from *A.*

apedicellatus, Rattray, and abnormal valves of *A. Kittoni*. They are also sometimes absent (hence inconstant) in otherwise normal valves of *A. formosus* and *A. excavatus*. For these reasons the species seems to me to have more claim to rank with *Aulacodiscus* than with Greville's later genus *Cosmiiodiscus*.

C. vulgaris. Schum., *Schrift. Phys. Oek. Ges. Königsb.*, 1867, p. 62, pl. iii. figs. 74 *a-c*.—Surface moderately convex. Centre mostly with markings similar, sometimes larger than the others, more rarely without markings. Markings equal, angular, about $7\frac{1}{2}$ in $\cdot 01$ mm.

Schumann explains that, with the object glass raised, the markings appear round, when depressed angular and resolved into 4 smaller markings. To this he joins *C. radiatus*, Ehrb. (*Mikrog.*, pl. xxxv. A. 17. fig. 6); *C. perforatus*, Ehrb. (*Mikrog.*, pl. xviii. fig. 46); *C. intermedius*, Ehrb. (*Mikrog.*, pl. xxxiii. 13. fig. 3); and *C. radiolatus*, Ehrb. (*Mikrog.*, pl. xxxix. 2. fig. 18). The species is insufficiently diagnosed, and by the union of the above-named species of Ehrenberg it becomes too extensive. It may be abandoned, being probably identical with *C. radiosus*, Grun.

Specimens were observed by Schumann from the Baltic.

C. intermedius, Ehrb., *Mikrog.*, pl. xxxiii. 13. fig. 3.—Diam.? Central space and rosette absent. Markings increasing gradually from centre outwards; rows radial, non-fasciculate.

This species found in San Francisco tripoli cannot be determined with certainty. The markings are similar to those of *C. argus*, Ehrb. (*Mikrog.*, pl. xxi. fig. 2), though smaller. *C. radiolatus* Ehrb. (*Mikrog.*, pl. xxxix. 2. fig. 18) is identical, but distinct from *C. radiolatus* (*Mikrog.*, pl. xxii. fig. 4), which recalls *C. radiatus*, var. *subaequalis*, Grun.

C. radiolatus. Ehrb., *Abh. Ber. Ak.*, 1841, p. 412, pl. i. 3. fig. 19; pl. ii. 6. fig. 16.—Markings small, equal, 9 in $\cdot 01$ mm.; rows radial. The specimens figured by Ehrenberg (*Mikrog.*, pl. xviii. fig. 36; pl. xxii. fig. 4; pl. xxxix. 2. fig. 18), from Peru, Cuba, and Richmond, Va, disagree to a considerable extent, and may not represent the same species. Ralfs distinguished *C. radiolatus* from *C. apollinis* by the absence of a central space. Janisch, on the other hand (*Abh. Schl. Ges. väter. Cult.*, 1862, Heft ii. p. 4; pl. ii. B, fig. 17), describes the markings as strong, round, and decreasing

towards the centre and border. *C. radiolatus*, Weisse (*Bull. Ac. Imp. Sci. St Petersburg.*, 1855, p. 276, pl. i. fig. 7), in which the fasciculi recall those of *C. symmetricus*, Grev., and *C. radiolatus*, Weisse (*ibid.*, 1868, p. 122, pl. i. fig. 26),—which is identical with *C. radiatus*, Ehrb.—are thus distinct. In Prof. Cleve's collection, specimens named *C. radiolatus* from Ichaboe guano occur. Compare *C. radiosus*, Grun.

Cosmiodiscus carconensis. Möll., *Typ. Pl.*, No. 100 (*vide* Habirsh., *Cat. Diat.*, § *Coscinodiscus*.—I am unacquainted with this form. In the opinion of Mr E. Grove, F.R.M.S., it is probably an early name for *Stephanodiscus carconensis*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. xcv. figs. 1–4), which is stated by Habirshaw (*Cat. Diat.*, § *Stephanodiscus*) to be synonymous with *Coscinodiscus carconensis*.

Aulacodiscus apedicellatus, Rattray (*Jour. Roy. Micr. Soc. Lond.*, 1888, p. 349), has been sometimes associated with *Coscinodiscus*.

NOMINA NUDA.

C. actinocyclus, Ehrb., *Mikrog.*, p. 130.—Specimens procured by Dr Philippi from the Bramahputra, near Burrisal, in 17 fathoms, December and January 1842.—Ehrb., *Abh. Ber. Ak.*, 1872, p. 261.

C. amplius. Ehrb., *Abh. Ber. Ak.*, 1872, p. 202.—Specimens collected by Capt. Rogers in the China Sea, lat. 22° 36' N., long. 116° 38' E., in 17 fathoms.

C. asymmetricus, Grun., Cleve and Möll., *Diat.*, Nos. 154, 155.—Specimens procured from the Balearic Islands. This name occurs in *Denk. Wien. Ak.*, 1884, p. 86, where Grunow draws attention to its occurrence in the seas of the Southern Hemisphere up to the Antarctic Regions.

C. centranthus. Ehrb., *Mikrog.*, p. 139.—Specimens procured from the river Tenasserim, Further India.

C. delawarensis, Grun. Cleve and Möll., *Diat.*, No. 211. Specimens recorded from Delaware.

C. discoplea. Ehrb., *Mikrog.*, p. 131.—Specimens are recorded from the Ganges, near Calcutta, in March (?), April, May, and June 1842, and from the Bramahputra, near Burrisal, in June, July, August, and December 1842.

C. fasciatus. Ehrb., *Mon. Ber. Ak.*, 1855, p. 301.—Specimens recorded from Simbirsk. This may probably be synonymous with *C. simbirskianus*.

C. fenestratus. Ehrb., *Mikrog.*, p. 130.—Specimens procured by Dr Philippi, in February 1842, from the Ganges, near Calcutta. Brackish and marine. By Ehrenberg stated to be allied to *C. minor*, Ehrb.

C. indicus. Ehrb., *Mikrog.*, p. 131.—Specimens procured in December 1845, from the Ganges. Brackish or marine.

C. javanensis, Grun. Cleve and Möll., *Diat.*, No. 145.—Specimens from the Balearic Islands (?).

C. lineolatus. Ehrb., *Abh. Ber. Ak.*, 1872, p. 148.—Specimens procured in the Indian Ocean, off Zanzibar, by Capt. Pullen, in 2200 fathoms.

C. longispinus, Grun. Cleve and Möll., *Diat.*, No. 276.—Specimens procured from California.

C.? mesacmæus. Ehrb., *Mikrog.*, p. 142.—Doubtfully united to *Coscinodiscus* by Ehrenberg. Specimens were procured in Blumen-Erde, Canton, in 1847, and from a bottom deposit at the mouth of the Si-Kiang. Marine.

C. mesodiv⁺yon. Ehrb., *Mikrog.*, p. 131.—Specimens were probably procured from the mouth of the Ganges in December 1845. Fresh water. This may have been a *Melosira* or *Cyclotella*.

C. microcentrum. Ehrb., *Abh. Ber. Ak.*, 1872, p. 213.—Specimens collected by Capt. Niejahr, near Mel Island, Paranagua Bay, coast of Brazil, in phosphorescent water, August 16 to 17, 1870.

C. obliquus? This name is recorded with a query in Habirshaw's *Cat. Diat.*, 2nd ed., § *Coscinodiscus*.

C. pumilo. Ehrb., *Abh. Ber. Ak.*, 1872, p. 167.—Specimens procured by Weisse from the following localities:—Taganrog Roads, Kimburgs Kaja Kossa, south of Berdjanskaja Kossa, off Bertsanskaja Kossa, south-east of Birtjutskaja Kossa, in the Sea of Azof (Ehrenberg).

C. subtilissimus. Ehrb., *Mon. Ber. Ak.*, 1861, p. 281.—Specimens recorded from lat. 62° 6' N., long. 32° 21' W., in 1540 fathoms, and from lat. 59° 12' N., long. 50° 38' W., in 1833 fathoms.

C. japonicus. Ehrb., *Abh. Ber. Ak.*, 1872, p. 198.—Specimens were procured in the Sea of Japan, in 24, 60, and 65 (?) fathoms.

C. japonicus, Cleve,? recorded in Habirshaw's *Cat. Diat.*, 2nd ed., § *Cestodiscus*, was most probably distinct.

C. tenerrimus. Ehrb., *Abh. Ber. Ak.*, 1872, p. 208.—Specimens were procured by Capt. Gerder in the White Sea, in 1857.

C. wallichianus, Grun. Cleve and Möll., *Diat.*, No. 183.—Specimens procured from the Southern Ocean.

C. complexus, Stodder, has been recorded in Habirsh., *Cat. Diat.*, § *Coscinodiscus*. The photograph there referred to has not been published.

C. Febigerii, H. L. Sm., is also recorded in Habirsh., *Cat. Diat.*, § *Coscinodiscus*, where it is stated with some doubt to be a var. of *C. excavatus*.*

C. Challengeri, Janisch † ("fragments not rare"); *C. marylandicus*, Grun.; and *C. pumilus*, Grun., are names that have been applied to forms said to occur in Cleve and Möll., *Diat.*, No. 216, which is a preparation from the Nottingham deposit, U.S.

A very distinct and interesting species has recently been discovered by Mr Edmund Grove, and named by him *Coscinodiscus lacunosus*, of which the following is a diagnosis:—Diam. .0575 mm. Surface and central portion extending to about $\frac{1}{3}$ of radius, slightly elevated, the elevation at its outer edge passing into a faint depression, which in turn rises gently to the marginal zone. Central space distinct, angular with a single well-marked circular granule, elsewhere hyaline. Markings round, granular, closely disposed on the central elevation and near border, least crowded on the depressed zone, subequal $5\frac{1}{2}$ to 6 in .01 mm; rows radial, straight, at subregular intervals between the rows large hyaline interspaces almost as conspicuous as the intervening rows; apiculi minute but distinct, inserted at inner edge of border opposite the outer ends of the hyaline areas. Border with inner edge well defined, .002 mm. wide; striæ delicate but distinct, 8 to 10 in .01 mm.

Habitat.—Totara, New Zealand fossil (Grove!).

* With respect to *C. Febigerii*, Mr E. Grove informs me that there is no doubt as to its identity with *C. excavatus*, and that Prof. W. H. Smith himself has admitted this.

† According to Mr Grove, *C. Challengeri* is probably identical with *C. Gazella*.

The clear radial areas in this species recall those of *Aulacodiscus acutus*, Rattray (*Jour. Roy. Micr. Soc.*, 1888, p. 368; *Jour. Quek. Micr. Cl.*, vol. iv. ser. 2. (1889), p. 38, pl. iii. fig. 4).

Artificial Key.

- | | | |
|-----|---|-------------------------|
| 1. | { Surface with 8 submarginal bullations and a large central rosette of 3 areolæ, | <i>Weisehogii</i> . |
| | { No such bullations, | 2. |
| 2. | { Irregular radial distinct bent costæ passing from centre to border, sometimes branching, | <i>theskelos</i> . |
| | { No such costate lines, | 3. |
| 3. | { Markings crowded on one half of valve, on other half in distant curved rows, converging to a small excentric area, | <i>sphaeroidalis</i> . |
| | { Markings otherwise, | 4. |
| 4. | { Surface with 2 lateral obtusely conical plications meeting at centre, | <i>polurrhaptos</i> . |
| | { No such folds, | 5. |
| 5. | { A narrow hyaline band, sometimes tapering outwards, running from centre towards border. Markings towards ends of bands in curves, convex towards centre, and symmetrical with respect to the band, | <i>cocconeiformis</i> . |
| | { No such cocconeoid structure, | 6. |
| 6. | { Surface without low undulations, | 7. |
| | { Surface with low undulations, | 8. |
| 7. | { Central space absent or minute, | 9. |
| | { Central space present and more evident, | 10. |
| 9. | { Markings non-fasciculate, | 11. |
| | { Markings obviously fasciculate, | 12. |
| | { Markings obscurely fasciculate, | 13. |
| 11. | { Markings areolate, round, granular on a distinct unilateral lunate depression. A rosette usually present, | <i>lunatus</i> . |
| | { Markings angular, at centre 3½, at border 4, in .01 mm.; rows oblique, decussating, forming many distinct areas on surface. Border broad, distinct, | <i>implicatus</i> . |
| | { Markings of 2 kinds, the larger areolate unequal, 2 to 2½ in .01 mm., prominent, within these the smaller more faint, | <i>bisculptus</i> . |
| | { No such areas or markings, | 14. |
| 14. | { Valves reniform, | <i>reniformis</i> . |
| | { Valves diamond-shaped, | 15. |
| | { Valves elliptical, | 16. |
| | { Valves circular, | 17. |
| | { Valves obtusely angular. Markings towards centre 3, at border 4 to 4½, in .01 mm. | <i>subangulatus</i> . |
| | { Valves subcircular. Markings angular, towards centre 8, gradually increasing outwards for ¼ radius to 8, on a distinct band adjacent to border punctiform 10 to 12, in .01 mm.; subulate spaces evident near marginal band, | <i>moronensis</i> . |

15. { Markings areolate, at centre 3, at border 6, in
'.01 mm., irregular, *lanceolatus*.
Markings rounded at centre, on a distinct band
at border punctiform, oblique rows evident, *naviculoides*.
16. { Around border a circlet of prominent apiculi.
Markings angular, 6 in '.01 mm., *spinulosus*.
Apiculi two, one at each end of minor axis.
Markings minute, *sarmaticus*.
Apiculi prominent at intervals of '.01 to '.0125 mm.
Markings towards centre rounded 6, at $\frac{2}{3}$ radius
angular 8, on a sharp band at border puncti-
form 12, in '.01 mm., *ovalis*.
Non-apiculate, 18.
18. { Markings rounded, granular, 19.
Markings angular, 20.
19. { An elliptical central area distinct, *oblongus*.
An elongate, irregular, central hyaline area.
Markings sometimes punctiform, *humilis*.
Appearance otherwise, 21.
21. { Markings without order, 22.
Markings in more definite order, 23.
22. { Markings small, brilliant, granular, with wide
unequal hyaline interspaces. Valves elongately
elliptical, *tenuisculptus*.
Markings 4 to 5 in '.01 mm. A broad hyaline
band adjacent to border, *inexpectatus*.
23. { Markings on central portion subradial or irregular,
on a well-defined band at border minute in
radiating striae, *ellipticus*.
Markings at centre irregular, elsewhere in rows
slightly curved along, and parallel to major
axis, diverging and bent away from minor
axis, *lewisianus*.
Markings punctiform, rows curved and diverging
away from major axis, *elongatus*.
20. { An elliptical central area with markings in rows
parallel to major axis, elsewhere rows radial, *obovatus*.
No such central area, 24.
24. { Valve elongately and irregularly elliptical.
Markings 6 to 7 in '.01 mm., *paleaceus*.
Valve regularly elliptical. Markings $4\frac{1}{2}$ to 5 in
'.01 mm., smaller at border; rows curving out-
wards from central area, thence parallel to
major axis, and again diverging outwards, *gracilentus*.
17. { Markings towards centre without order, with
wide interspaces, towards border in straight
radial rows, 3 in '.01 mm.; apiculi curved,
placed towards centre, *rex*.
Appearance otherwise, 25.
25. { Markings areolate, delicate, central area distinct,
bounded by a ring of minute apiculi; rows
radial. Valve readily overlooked, *praetor*.
No such central area, 26.

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| 26. | { | Markings minute; rows radial. Surface convex, | <i>cervinius</i> . |
| | | Markings punctiform, interspaces large; rows radial, faint, | <i>confertus</i> . |
| | | Markings minute, granular, equal, 9 to 10 in .01 mm.; rows radial, crowded, | <i>granulatus</i> . |
| | | Markings punctiform, irregular, and with hyaline interspaces for $\frac{2}{3}$ of radius, on outer third more minute, forming radiating striae. Non-apiculate, | <i>Hauckii</i> . |
| 27. | { | Markings rounded, granular, irregular for $\frac{2}{3}$ of radius, on outer third forming evident striae. Apiculi 8, large, at outer edge of central portion, | <i>hirtulus</i> . |
| | | No such arrangement of markings, | 27. |
| 28. | { | On a small central area the markings large, unequal, beyond this much smaller, $2\frac{1}{2}$ in .01 mm., increasing gradually outwards to about $\frac{2}{3}$ of radius, thence decreasing; irregular on the central area, beyond it in radial rows, | <i>megacentrum</i> . |
| | | No such central area, | 28. |
| 28. | { | Five to 8 narrow hyaline lines radiating around centre, expanding outwards, and terminating at semiradius, | <i>pulcherrimus</i> . |
| | | No such hyaline areas, | 29. |
| 29. | { | Markings irregular, | 30. |
| | | Markings in more definite order, | 31. |
| 30. | { | Markings punctiform, | 32. |
| | | Markings rounded, granular, | 33. |
| | | Markings angular, | 34. |
| 32. | { | Interspaces wide, a circlet of long, narrow, curved apiculi inserted some distance from border, | <i>insutus</i> . |
| | | Interspaces unequal, largest either towards centre or towards border. Valves dissimilar, | <i>dimorphus</i> . |
| | | Interspaces subobsolete, markings crowded. Apiculi minute, scattered over surface at wide intervals, | <i>impolitus</i> . |
| | | Interspaces minute; markings largest, most crowded and most evident at centre; apiculi at border only, minute. Border broad, sharply defined, striae 17 to 18 in .01 mm., | <i>granulosus</i> . |
| 33. | { | Markings somewhat smaller towards border; interspaces largest towards centre. Border distinctly hyaline, | <i>exasperans</i> . |
| | | Markings small, more crowded towards centre. Border prominent, | <i>cinctus</i> . |
| | | Markings subpearly, rounded, robust. Interspaces wide, | <i>nitidus</i> . |
| | | Markings large, round, still more robust. Border broad, not sharply defined, with coarse striae, | <i>subnitidus</i> . |
| 34. | { | Markings 4 to 5 in .01 mm., smaller towards border; a circlet of irregular apiculi at border, | <i>antediluvianus</i> . |
| | | Markings large and irregular, on a band adjacent to border, and at irregular intervals elsewhere. A circlet of large radial subregular areolae forming the border, | <i>luxuriosus</i> . |
| | { | No such markings, | 35. |

35. { Markings $1\frac{1}{2}$ to $1\frac{3}{4}$ in $\cdot 01$ mm., at border a single band of subquadrate areolæ 3 in $\cdot 01$ mm., . . . *megacoccus*.
 Markings $2\frac{1}{2}$ to 3 in $\cdot 01$ mm., smaller towards border, not robust. Border about $\frac{1}{4}$ of radius, broad, with distant evident striæ, . . . *irregularis*.
 Markings otherwise, 36.
36. { Markings areolate to about semiradius, on outer portion distinct radial flexuous lines, . . . *subareolatus*.
 No such lines, 37.
37. { Markings towards centre 3, decreasing rapidly outwards, at border 6, in $\cdot 01$ mm. Border striæ coarse, *turgidus*.
 Markings $3\frac{1}{2}$ in $\cdot 01$ mm.; apiculi long, delicate, inserted at inner edge of border, and extending beyond circumference, *nottinghamensis*.
31. { Markings rounded, granular; towards centre 5, towards border 8, in $\cdot 01$ mm.; at intervals near border delicate, clear, elevated lines, . . . *armatus*.
 Markings largest and irregular beyond semiradius, smaller towards centre and border; rows radial. A rosette, *inæquisculptus*.
 Appearance otherwise, 38.
38. { At centre a large prominent nodule, *nodulifer*.
 No such nodule, 39.
39. { Markings in conspicuous, regular, concentric circles, *patina*.
 Markings robust, $2\frac{1}{2}$ in $\cdot 01$ mm., punctate, subregularly, but more obscurely concentric; radial rows obscure, *velatus*.
 Markings small, round, granular, subequal; radial rows inconspicuous, secondary irregularly concentric bands evident. A minute central rosette, *radiopunctatus*.
 No such concentric arrangement, 40.
40. { Rows inconspicuously radial, on outer portion obscurely fasciculate secondary oblique outwardly curved decussating rows distinct towards border, *decrescens*.
 Rows radial, 41.
 Rows oblique and decussating, 42.
41. { Surface rising for about $\frac{3}{4}$ of radius, here descending abruptly, thence flat to border; markings areolate 3, increasing outwards to $2\frac{1}{2}$ in $\cdot 01$ mm. on highest zone, here decreasing suddenly, and from this to border subequal. A rosette, . . . *epiphanes*.
 Surface with central portion convex and sharply defined. Markings areolate. A rosette, . . . *umbonatus*.
 Surface with central portion funnel-shaped. Markings granular, decreasing from edge of central portion to border, *bathyomphalus*.
 Surface regularly convex between centre and border. Markings subequal, areolate, $3\frac{1}{2}$ in $\cdot 01$ mm. Border striæ 5 to 6 in $\cdot 01$ mm., . . . *tuctuosus*.
 No such surfaces, 43.
43. { Markings somewhat excentric, 4 to $4\frac{1}{2}$ in $\cdot 01$ mm.; rows curved, *elegantulus*.
 No such excentricity or curvature, 44.

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| 44. | { Elongated subulate spaces at origin of shorter rows. Markings polygonal, without order to $\frac{1}{3}$ of radius, thence obtusely angular, 4 in '01 mm., and in radial rows, Subulate spaces opposite shorter rows. Markings 12 in '01 mm. Apiculi some distance from border. Inner layer with a zone of costæ round central space, Subulate spaces most evident towards centre. Surface undulate beyond semiradius. Markings $7\frac{1}{2}$ to 8, at border 10, in '01 mm., at wide intervals minute clear spaces close to border, No such appearance, | <i>patellæformis</i> . |
| | | <i>Baileyi</i> . |
| 45. | { Near centre a sharply defined band of 2 rows of large areolæ. Markings towards centre 4, at border $2\frac{1}{2}$, in '01 mm. A distinct rosette, No such band, | <i>intermixtus</i> . |
| | | 46. |
| 46. | { Markings resolved with difficulty, Markings larger, easily resolved, | 47. |
| | | 48. |
| 47. | { Markings 12 in '01 mm.; apiculi scattered at wide intervals over surface, but most crowded towards border, Appearance otherwise, | <i>fragilissimus</i> . |
| | | 49. |
| 49. | { Markings more delicate, rows radial. Surface with scattered clear dots, A distinct central depression. Markings most evident at its edge, | <i>punctulatus</i> . |
| | | <i>depressus</i> . |
| 48. | { Markings areolate, Markings round, granular or punctiform, | 50. |
| | | 51. |
| 50. | { Apiculate, Non-apiculate, | 52. |
| | | 53. |
| 52. | { Apiculi 7 to 14, prominent. Markings at centre 8, increasing outwards to 6, in '01 mm., then subequal, Apiculi 6, large, with slight median constriction. Markings 6 to 8 in '01 mm., decreasing near border. Rosette minute, Apiculi 2, asymmetrical at border. Markings 4 to 5 in '01 mm., decreasing gradually outwards. A rosette, Apiculi prominent, long, acicular, inserted at inner edge of border, and reaching its outer edge. Markings towards centre $4\frac{1}{2}$ to 5, at semiradius $3\frac{1}{2}$, near border 4, in '01 mm., Apiculi prominent, truncate. Markings towards centre 4, at semiradius 3, towards border $3\frac{1}{2}$, in '01 mm., radial rows inconspicuous, Apiculi scattered irregularly over surface. Markings towards centre 8 to 10, towards border 14 to 16, in '01 mm. Subulate clear lines opposite shorter rows, Apiculi scattered over surface at irregular intervals. Markings 8 in '01 mm., subequal, central dots distinct, Apiculi minute, in a circle at border. Markings towards centre 4, towards border 8, in '01 mm., | <i>apiculiferus</i> . |
| | | <i>subarilacodiscoidalis</i> . |
| | | <i>centralis</i> . |
| | | <i>pectinatus</i> . |
| | | <i>egregius</i> . |
| | | <i>dubiosus</i> . |
| | | <i>denticulatus</i> . |
| | | <i>grandineus</i> . |

53. { Two asymmetrical distant curved depressions
at border. A rosette, *bisinuatus*.
No such depressions, 54.
54. { Border broad, its inner edge with 2 asymmetrical
constrictions. No rosette, *biangulatus*.
No such constrictions, 55.
55. { Largest markings forming a conspicuous, not
sharply defined zone towards semiradius, . . . *bulliens*.
No such zone, 56.
- Markings towards centre 6 in '01 mm., decreasing
slightly outwards, secondary rows obscure.
Border sharp, $\frac{1}{2}$ of radius broad, striæ evident,
4 in '01 mm., *compositus*.
- Markings $3\frac{1}{2}$, towards border $2\frac{1}{2}$, in '01 mm.
Surface with an elevated ring about $\frac{1}{3}$ of radius
from centre, *groveanus*.
- Markings $1\frac{1}{2}$ to 2, at border 2 to $2\frac{1}{2}$, in '01 mm.,
pearly; central papillæ prominent, directed
centrally towards border, *secernendus*.
- Markings 5 to 7 in '01 mm., slightly smaller
towards centre, papillæ evident, minute sub-
ulate areas at origin of shorter rows. Border
opaque, *debilis*.
- Markings increasing gradually outwards, at
centre 8, at border 6, in '01 mm.; irregular
on a small central area, secondary oblique rows
distinct, *traducens*.
- Markings $2\frac{1}{2}$ to 3 in '01 mm., subequal, central
papillæ small. Border broad, *megaporus*.
- Markings $6\frac{1}{2}$ to 7 in '01 mm., decreasing rapidly
outwards, interspaces evident opposite shorter
rows, *profundus*.
- Markings towards centre 4, towards border 6, in
'01 mm., decrease outwards gradual. A rosette,
Markings towards centre 6 to 9, near border 9 to
10, in '01 mm.; minute subulate lines at origin
of shorter rows, *radiosus*.
- Markings towards centre 4, decreasing outwards
to 6 or 7, in '01 mm.; radial rows most evident
towards border, fimbriate, *fimbriatus*.
56. { Markings towards centre 2 to $2\frac{1}{2}$, at border 8, in
'01 mm., decrease outwards rapid; radial rows
separated by distinct lines around border,
central papillæ distinct, *obversus*.
Markings towards centre 2 to $2\frac{1}{2}$, near border 6,
in '01 mm. Border narrow, *radiatus*.
Markings towards centre 2 to $2\frac{1}{2}$, robust. Border
broad, sharply defined, striæ coarse, *marginatus*.
Markings towards centre $1\frac{1}{2}$ to $2\frac{1}{2}$, central papillæ
prominent. Border conspicuous, raised, striæ
coarse, *robustus*.
Markings towards centre 3 to 4, increasing to $2\frac{1}{2}$
or 3, at border 5 or 6, in '01 mm. Central
rosette large, *oculus-iridis*.
Markings towards centre 8, at semiradius 4,
towards border 8, in '01 mm., on outer half of
valve in inconspicuous, subconcentric bands, . . *antarcticus*.
Markings at centre large, unequal, suddenly de-
creasing to 4 or $4\frac{1}{2}$ in '01 mm., again increas-
ing to about semiradius, thence decreasing to
border. Border distinct, smooth, *biharensis*.

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| | Markings at centre 6 to 7, at semiradius 5 to 5½, on a sharply defined marginal band (¼ of radius broad) 10 in .01 mm.; rows on marginal band oblique, decussating, | <i>ecutus</i> . |
| | Markings towards centre 4, increasing outwards to 2 or 3, at border 4 or 5, in .01 mm., secondary oblique rows indistinct, | <i>argus</i> . |
| | Markings 3½, subequal to semiradius, at ¾ radius 3 in .01 mm., thence decreasing to border. Border broad, striæ 4 to 5 in .01 mm., | <i>glaberrimus</i> . |
| | Markings towards centre 3, decreasing outwards to 5, at border 8, in .01 mm.; secondary oblique rows evident, | <i>convexus</i> . |
| | Markings towards centre 3 to 3½, towards border 4, in .01 mm. Surface convex, | <i>asperulus</i> . |
| 51. | Apiculate, | 57. |
| | Non-apiculate, | 58. |
| | Apiculi robust, spine-like, with blunt free ends inserted at middle of small round hyaline spaces. Markings round, granular, 6 in .01 mm., subpunctiform towards border: Central space small, | <i>johnsonianus</i> . |
| | Apiculi robust, 6, symmetrical, free ends blunt. Markings round, granular, 4 in .01 mm., subequal. Central space absent, | <i>stokesianus</i> . |
| | Apiculi distinct. Valves dissimilar—the one with markings round, granular, 3 in .01 mm., on a submarginal band 8 in .01 mm., and in oblique decussating rows, interspaces distinct—the other with markings angular, without interspaces, | <i>superbus</i> . |
| 57. | Apiculi evident, about .015 mm. apart. Markings round, granular, about 5 in .01 mm., toward border smaller; interspaces hyaline, largest towards centre, | <i>evadens</i> . |
| | Apiculi conspicuous in a circlet some distance from border. Markings granular, secondary rows irregularly concentric, interspaces hyaline, distinct, | <i>plicatulus</i> . |
| | Apiculi distinct, a circlet close to border, within this a few scattered apiculi forming an irregular inner circlet. Markings 6 to 10 in .01 mm., | <i>lacustris</i> . |
| | Apiculi in two circlets, those of the inner prominent, distant, and at opposite sides of valve replaced by a narrow curved hyaline band, those of the outer minute, close. Markings 16 in .01 mm., | <i>ludovicianus</i> . |
| | Markings in radial rows separated by wide cuneate interspaces. Border sharp, striæ obvious, | <i>duriusculus</i> . |
| | Markings small, on a zone adjacent to border punctiform, interspaces wide, smaller towards border, rows obscurely radial towards centre, obviously radial near border, | <i>agapetos</i> . |
| 58. | Markings decreasing gradually outwards, towards centre 4 to 4½ in .01 mm., at border punctiform; rows radial, those reaching centre few, on a narrow band at border many, | <i>subdivicus</i> . |
| | Markings round for ½ to ⅔ of radius, on outer portion polygonal 2½ to 3, at border 6, in .01 mm., | <i>diversus</i> . |

12. { A distinct elevated ring at $\frac{3}{4}$ of radius from centre. Apiculi minute, *whampoensis*.
No such ring, 59.
59. { Around centre three or more large lanceolate dark distant spaces, sometimes meeting at centre to form a stelletta. Marking towards centre 6, border 8 to 9 in '01 mm., *symbolophorus*.
Around centre, five or six large areolae. Markings 16 to 20 in '01 mm., *stellaris*.
No such markings, 60.
60. { An apiculus at middle of outer ends of each fasciculus; no octagonal figure, *Röthii*.
Appearance otherwise, 61.
61. { An apiculus at middle of outer ends of each fasciculus. Surface with an octagonal figure. Apiculi placed at the angles of the octagon, *angulatus*.
Apiculi not confined to middle of outer ends of fasciculi, 62.
62. { Apiculi many upon and between the fasciculi. Markings 15 to 16 in '01 mm., *polyacanthus*.
Apiculi absent or minute, the rows in the fasciculi converging towards border, about 6 in each fasciculus at border, Markings 8 in '01 mm., decreasing a little outwards, *Normani*.
Apiculi interfasciculate, 63.
63. { Apiculi 3 to 5, spine-like, inserted some distance from border. Markings towards centre $4\frac{1}{2}$ to 5, towards border 6; rows in each fasciculus parallel to central row, *echinatus*.
Apiculi distinct. Markings cestodiscoid, angular, 8 in '01 mm., on a broad band at border punctiform 10 in '01 mm.; rows fasciculate, those in each fasciculus parallel to central row, *pusillus*.
Apiculi minute. A narrow hyaline band around central area. Markings 6 to 7 in '01 mm., rows subparallel, *odontodiscus*.
Appearance otherwise, 64.
64. { Fasciculi evident only beyond semiradius. Markings 6 in '01 mm. Border with crowded oblique decussating rows, non-apiculate, *Kützingii*.
At border a circlet of small round clear spaces, non-apiculate, *Grunowii*.
No such markings and spaces, 65.
65. { Rows in each fasciculus parallel to central row, 66.
Rows in each fasciculus parallel to corresponding side rows, 67.
Nine asymmetrical prominent rows from centre to border; intervening rows subradial, *barbadensis*.
66. { A single minute apiculus close to border. Markings towards centre 6, at border 8, in '01 mm., *lentiginosus*.
No such apiculus, 68.
68. { Prominent interfasciculate radial rows, 69.
No such rows present, 70.

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| 69. | { | A distinct marginal band. Markings granular, decreasing slightly outwards, secondary oblique rows on marginal band. Apiculi large, interfasciculate, | <i>proteus</i> . |
| | | No such marginal band, | 71. |
| 71. | { | Markings actinocycloid, towards centre 8, towards border 10, in .01 mm., decussating rows most evident towards border. Non-apiculate, | <i>actinosus</i> . |
| | | Markings sub-actinocycloid, towards centre 6, towards border subpunctiform 8, in .01 mm. Apiculi interfasciculate, distinct, some distance from border, | <i>partitus</i> . |
| | | Markings equal, 4 in .01 mm., secondary oblique rows straight. Non-apiculate, | <i>senarius</i> . |
| | | Markings equal, 8 to 10 in .01 mm., secondary oblique rows straight. Apiculi interfasciculate, | <i>interlineatus</i> . |
| 70. | { | Markings $3\frac{1}{2}$ to 4 in .01 mm.; secondary rows straight, obvious. Non-apiculate, | <i>denarius</i> . |
| | | Markings robust, increasing to semiradius, thence decreasing, at centre 4, at semiradius 3 to $3\frac{1}{2}$, at border 6, in .01 mm. Central papillæ evident, | <i>simbirskianus</i> . |
| | | Markings punctiform, | 72. |
| 72. | { | Markings 15 to 16 in .01 mm., irregular on a small round central area, elsewhere in 8 broad fasciculi. Apiculi interfasciculate, | <i>glacialis</i> . |
| | | Markings punctiform on a distinct band at border, elsewhere 6 in .01 mm. Apiculi prominent, interfasciculate, | <i>odontophorus</i> . |
| | | Markings arranged in striæ, at intervals not reaching centre. Apiculi distinct in a circlet near border. Border broad, | <i>marginulatus</i> . |
| 67. | { | Border crenulate, | <i>crenulatus</i> . |
| | | Border uniformly curved, | 73. |
| 73. | { | Fasciculi and rows curved, | 74. |
| | | Fasciculi and rows straight, | 75. |
| 74. | { | Markings areolate, 6 in .01 mm., sometimes non-apiculate, | <i>curvatus</i> . |
| | | Markings rounded, decreasing rapidly outwards. Non-apiculate, | <i>semipennatus</i> . |
| 75. | { | Markings 6 to 10 in .01 mm. Apiculi interfasciculate, | <i>subtilis</i> . |
| | | Markings 10 in .01 mm. Apiculi prominent. Valve minute, | <i>minutellus</i> . |
| | | | |
| 13. | { | Two asymmetrical distant processes. Minute apiculi at outer ends of radial clear lines. Markings 7 to 8, decreasing outwards to 12, in .01 mm., | <i>concinuus</i> . |
| | | No such processes and apiculi, | 76. |
| 76. | { | Markings excentric, | 77. |
| | | Markings non-excentric, | 78. |
| 77. | { | Markings irregular on a small excentric area. Border prominent, | <i>africanus</i> . |
| | | Markings similar. A distinct small central nodule. Border simple, | <i>vetustissimus</i> . |

78. { Markings polygonal, 7 in .01 mm., decreasing outwards; rows fasciculate beyond semiradius, oblique rows concave outwards, *suspectus*.
 Markings 8 in .01 mm., decreasing slightly towards border; rows radial, on outermost portion of valve parallel, subfasciculate secondary rows obscure, slightly concave outwards, *subglobosus*.
 Markings otherwise, 79.
79. { A distinct irregularly broad band adjacent to border. Markings 12 in .01 mm., irregular on a small central area, *subsalsus*.
 No such irregular marginal band, 80.
80. { Markings round, granular, and without order, with hyaline interspaces to about semiradius, thence more crowded in rows and subequal, 10 in .01 mm.; rows subfasciculate to border, *atlanticus*.
 Markings not so disposed, 81.
81. { Markings round, granular, subequal, 7 to 8 in .01 mm., irregular on a small indistinctly defined central area, elsewhere in radial subparallel and irregularly subfasciculate rows; secondary concentric bands faint, *subnotabilis*.
 Markings $3\frac{1}{2}$ to 4 in .01 mm., angular; radial rows faint, secondary concentric bands evident, *isoporus*.
 No concentric arrangement visible, 82.
82. { Markings punctiform, 12 to 15 in .01 mm. Apiculi large, distant. A distinct band at border, with evident oblique decussating rows, *doljensis*.
 Markings round, granular about 4 in .01 mm., beyond semiradius subfasciculate, interspaces wide, *nitidulus*.
 Markings polygonal, 8 to 10 in .01 mm. A circle of numerous apiculi a short distance within border. Border distinct, striæ evident, *corolla*.
10. { Markings consisting of a few wavy lines diverging outwards from central space, and confined to central half of valve, *venulosus*.
 No such markings, 83.
83. { Markings round, granular, 6 in .01 mm., smaller towards border, radial rows obscure, short transverse somewhat flexuous rows more evident, non-decussating except near border, *densus*.
 Markings small, round, granular, interspaces unequal, radial rows obscure, radial hyaline lines at regular intervals extending from centre, a distinct apiculus at buter end of each, *splendidulus*.
 Markings round, granular, without order to semiradius, beyond this punctiform in radial rows; radial clear spaces at subregular intervals, extending outwards from semiradius, *apages*.
 Markings obtusely angular or oval, $5\frac{1}{2}$ to 6, at border 8, in .01 mm.; rows radial, towards border uniformly curved towards same direction, with hyaline curved lines extending inwards a short distance at subregular intervals, *obliquus*.

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| | Markings punctiform, on inner half of valve in faint radial rows on outer half forming striæ 14 in '01 mm., at subregular intervals straight hyaline radial lines, most prominent at their outer ends, | <i>perikomposos.</i> |
| | Markings faint, minute, granular, most loosely disposed towards centre, at semiradius 6 in '01 mm., towards border punctiform in radial striæ, 8 to 10 in '01 mm., between the striæ at subregular intervals indistinct short hyaline spaces, | <i>tenuis.</i> |
| | Appearance otherwise, | 84. |
| 84. | Outline hexagonal. Markings round, granular, about 15 in '01 mm., rows radial or somewhat oblique, | <i>flagrans.</i> |
| | Outline polygonal, | <i>polygonus.</i> |
| | Outline diamond-shaped. Markings rounded and granular towards middle of large central area; on a distinct zone adjacent to border subpunctiform, 10 in '01 mm.; rows radial, apiculi distinct, | <i>rhombicus.</i> |
| | Outline elliptical or diamond-shaped. Markings rounded. 6 to 8 in '01 mm.; rows radial, oblique decussating rows at border; interspaces hyaline, | <i>punctatus.</i> |
| | Outline circular, | 85. |
| 85. | Central space excentric. Markings punctiform in distant rows, on a band around central space larger, | <i>rotula.</i> |
| | Central space slightly excentric. Markings round, granular, 5 in '01 mm., rows fasciculate, those in each fasciculus parallel to central row, | <i>inclusus.</i> |
| | Central space non-excentric, | 86. |
| 86. | Central space extending to $\frac{3}{4}$ radius, hyaline. Markings punctiform; rows close, radial, | <i>vacuus.</i> |
| | Central space extending almost to semiradius. Markings polygonal, delicate, increasing slightly outwards; rows radial, | <i>biocentrum.</i> |
| | Central space extending to $\frac{3}{4}$ radius, sharply defined. Markings punctiform, 28 in '01 mm., forming radial striæ, | <i>mesoleivus.</i> |
| | Central space large, not smooth. Markings 15 in '01 mm., | <i>disciger.</i> |
| | Central space large ('0375 mm. broad), at its centre a group of irregular apiculi, at its edge a circlet of similar apiculi at wide intervals. Markings 6 to 7 in '01 mm., | <i>Gazelleæ.</i> |
| | Central space otherwise, | 87. |
| 87. | Radial plications from centre to border, producing a wheel-like aspect, | <i>trochiscos.</i> |
| | No such plications, | 88. |
| 88. | Markings non-fasciculate, | 89. |
| | Markings obscurely fasciculate, | 90. |
| | Markings obviously fasciculate, | 91. |
| 89. | Surface with a distinct central portion extending to about $\frac{1}{2}$ radius, and with its outer edge crenulate, sharp, | <i>Trinitatis.</i> |
| | No such crenulate portion, | 92. |

92. { Delicate puncta at origin of shorter rows, 93.
 { No such puncta, 94.
93. { Puncta at origin of shorter rows sometimes
 visible. A distinct band of large markings
 round central space. Markings towards
 centre 4 to $4\frac{1}{2}$, towards border 6 to 7, in '01 mm.
 Apiculi near border in a cirlet, minute, *amaruensis*.
 { No such band nor apiculi, 95.
95. { Distinct apiculi at angles of areolæ, *floridulus*.
 { No such apiculi, 96.
96. { An evident rosette. Markings towards centre
 $2\frac{1}{2}$, increasing outwards for a short distance,
 at border 5 in '01 mm., submoniliform,
 obscurely punctate; central papillæ faint.
 Rows radial, *moravicus*.
 { No rosette, 97.
97. { A distinct band of large round markings around
 central space. Markings towards centre 5,
 increasing slightly for $\frac{2}{3}$ of radius, towards
 border $3\frac{1}{2}$ in '01 mm., subpearly. Central
 papillæ faint, *Moniceæ*.
 { No such distinct band, 98.
98. { Markings rounded or angular, $3\frac{1}{2}$ to 4 in '01 mm.
 Central dots distinct; central space small, *perforatus*.
 Markings robust, rounded on one side of valve,
 hexagonal on the other; towards the centre 4,
 at $\frac{2}{3}$ of radius 2, at border 6, in '01 mm.;
 decrease to border rapid. Central papillæ pro-
 minent; rows radial, *Kurzii*.
 { Markings towards centre $4\frac{1}{2}$, at semiradius $3\frac{1}{2}$, at
 border 5 or 6, in '01 mm. Central space
 rounded; no distinct central papillæ or dots, *conformis*.
 Markings towards centre $2\frac{1}{2}$, at $\frac{2}{3}$ of radius 2, at
 border 4 to 5, in '01 mm., subpearly. Central
 papillæ faint. Central space minute or sub-
 obsolete, *obscurus*.
94. { Markings unequal and irregular. Central space
 irregular, *anastomosans*.
 { No such irregular markings, 99.
99. { An elevated band at semiradius; markings
 inside this and towards border moniliform 6,
 on the elevated band 4, in '01 mm., *grayianus*.
 Highest zone reaching inwards to about $\frac{1}{4}$
 of radius, most abrupt on inner edge. Markings
 towards centre 8, on highest zone 4, beyond
 this 6, in '01 mm. Subequal subulate spaces
 opposite shorter rows, *spiniferus*.
 { No such sharp elevated band, 100.
100. { Markings of 2 kinds—the larger distant, rounded,
 in inconspicuous radial rows—the smaller
 closer, punctiform, in evident radial rows;
 hyaline spaces opposite shorter rows, *diplostictus*.
 Markings not of such distinct kinds—rounded, 101.
 { Markings not of such distinct kinds—angular, 102.

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| 101. | { | Markings 6 in .01 mm.; rows radial, separated by wide hyaline intervals; adjacent to border a distinct band, with markings similar to those on rest of valve, | <i>lunæ.</i> |
| | | Markings minute, granular, faint beyond semiradius, radial rows distinct, | <i>stelliger.</i> |
| | | Marking minute, granular, most distinct towards centre, beyond semiradius punctiform; rows radial. Border sharply defined, | <i>exiguus.</i> |
| | | Markings punctiform; rows radial, interspaces widest opposite shorter rows. Adjacent to border a band of large faint areolæ. A few scattered prominent round granules on a circlet some distance from border and one at centre, | <i>perminutus.</i> |
| | | Markings otherwise, | 103. |
| 103. | { | Adjacent to border a distinct band, with smaller markings than on rest of valve, | 104. |
| | | No such band, | 105. |
| 104. | { | The marginal band narrow, | 106. |
| | | The marginal band broad, | 107. |
| | | Central space elongately elliptical. An undulation at semiradius, with inner edge less abrupt than outer, | <i>undulatus.</i> |
| 106. | { | Markings rounded, granular, 4 to 4½ in .01 mm. Interspaces hyaline, large opposite shorter rows, | <i>elegans.</i> |
| | | Markings 6 in .01 mm. A marginal hyaline band. Apiculi distinct, | <i>tabularis.</i> |
| 107. | { | Rows radial, less crowded, and prominent within a distinct marginal band, | <i>actinochilus.</i> |
| | | No such appearance, | 108. |
| 108. | { | Markings towards centre 3½, at semiradius 3, at border 6, in .01 mm. Central space irregular, small; rows radial, secondary rows indistinct, | <i>cribrosus.</i> |
| | | Markings obtusely angular; central space subquadrate. Border hoop-like, striæ evident, | <i>aethes.</i> |
| 105. | { | Apiculate, | 109. |
| | | Non-apiculate, | 110. |
| 109. | { | Apiculi large, distant, inserted some distance within border. Markings rounded or obtusely angular; towards centre 6, towards border 8 to 9, in .01 mm., and punctiform; secondary rows most evident near border, | <i>hungaricus.</i> |
| | | Apiculi minute. Markings 6 in .01 mm., decreasing slightly near border; rows radial, interspaces narrow, | <i>griseus.</i> |
| 110. | { | Markings rounded, granular, about 5 in .01 mm., conspicuous, decreasing rapidly from centre outwards, towards border punctiform, more faint; rows radial, | <i>gemmifer.</i> |
| | | Markings rounded, granular, near border punctiform; without order, | <i>confusus.</i> |
| | | Markings rounded, granular; interspaces hyaline, unequal; rows radial, | 111. |

111. { Markings about 4 in $\cdot 01$ mm., least crowded towards centre. Border narrow, *galapagensis*.
 Markings about 4 in $\cdot 01$ mm. Border broad, sharply defined, striated, *gemmatulus*.
 Markings towards centre $3\frac{1}{2}$, towards border $4\frac{1}{2}$, in $\cdot 01$ mm.; smaller round granules at intervals among the larger; rows inconspicuous, moniliform at border, interspaces narrow, *pauper*.
 Markings otherwise, 112.
112. { Markings granular; about semiradius 6, at border 8 to 9, in $\cdot 01$ mm.; rows radial, secondary rows distinct only beyond semiradius. Central space circular. No rosette, *decussatus*.
 No such secondary rows, 113.
113. { Surface with an elongated somewhat curved depression on each side of valve, about $\frac{2}{3}$ of radius from centre. Rows radial, *biplicatus*.
 No such depressions, 114.
114. { Markings obtusely angular, robust, subpearly, 4 in $\cdot 01$ mm.; rows radial, alternately longer and shorter, spaces at origin of shorter rows hyaline, *biradiatus*.
 Markings delicate, granular, rounded, 5 in $\cdot 01$ mm.; rows radial, interspaces wide, *apollinis*.
 No such wide interspaces, 115.
115. { Markings obviously punctate, 116.
 Markings not obviously punctate, 117.
116. { Border broad, of two parts, inner striated, outer hyaline, *Weyprechtii*.
 Border simple. Markings robust, $3\frac{1}{2}$ to 4, increasing outwards to $2\frac{1}{2}$ or 3, in $\cdot 01$ mm.; central dots prominent. A rosette, *asteromphalus*.
117. { Markings in contact and angular throughout, 118.
 Markings not in contact and angular throughout, 119.
118. { Markings towards centre 3, increasing outwards to 2 at border, 5 in $\cdot 01$ mm.; secondary oblique rows not conspicuous, *crassus*.
 Markings more delicate, towards centre $3\frac{1}{2}$, increasing outwards to $2\frac{1}{2}$ on an angular somewhat elevated zone, at border 6 or 7 in $\cdot 01$ mm.; radial rows indistinct, *heteroporus*.
 Markings towards centre 4, at $\frac{2}{3}$ radius 3 in $\cdot 01$ mm., thence rapidly decreasing to border; radial rows distinct, secondary rows inconspicuous, *boliviensis*.
119. { Markings rounded, sometimes angular, towards centre 6, increasing slightly outwards, at border 6 to 8 in $\cdot 01$ mm.; central papillæ prominent, rows radial, *apiculatus*.
 Markings towards central space rounded 4, soon becoming hexagonal and gradually increasing outwards to $1\frac{1}{2}$ or 2 in $\cdot 01$ mm. near border, *gigas*.
102. { Adjacent to border a distinct band, with markings well-defined, elsewhere outlines of markings faint. Markings $3\frac{1}{2}$ to 4 in $\cdot 01$ mm., increasing but little outwards, *Janischii*.
 No such band adjacent to border, 120.

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| 120. | { | Markings minute, delicate 8, towards border recognised with difficulty, 10 to 12 in '01 mm.; rows radial, oblique rows faint; no hyaline band adjacent to border, Border narrow, hyaline, | <i>imperator</i> . |
| | | Markings punctiform, 15 in '01 mm.; rows radial. Apiculi distinct in a circlet near border, | |
| | | Appearance otherwise, | 121. |
| 121. | { | No rosette, | 122. |
| | | A rosette distinct, | 123. |
| 122. | { | A distinct band of large areolæ around large central space. Markings punctate $3\frac{1}{2}$ in '01 mm., decreasing on outer $\frac{1}{4}$ of radius. Apiculi at border obvious, | <i>spinuligerus</i> . |
| | | No such band, | |
| 124. | { | Markings punctiform, | 125. |
| | | Markings larger, | 126. |
| 125. | { | Markings 13 in '01 mm.; rows radial, | <i>cingulatus</i> . |
| | | Rows radial, only a few reaching large central space, the others mostly ending about $\frac{2}{3}$ of radius from border; interspaces large, hyaline, | |
| 126. | { | Markings rounded, granular, 6 in '01 mm.; rows radial; interspaces wide towards centre, | <i>Thumii</i> . |
| | | Markings obtusely quadrangular, pearly, increasing to $\frac{1}{3}$ of radius to 2 or $2\frac{1}{2}$, thence decreasing to border to 3 in '01 mm.; irregular around centre; rows radial, | |
| 126. | { | Markings obtusely angular, subpearly; towards centre 5, at semiradius $4\frac{1}{2}$, at border 8, in '01 mm.; radial rows separated by narrow clear lines. Secondary subconcentric rows evident, | <i>notabilis</i> . |
| | | Markings hexagonal, | |
| 127. | { | Markings increasing outwards to $\frac{2}{3}$ of radius, towards centre 5, at $\frac{2}{3}$ of radius $3\frac{1}{2}$ in '01 mm.; rows radial, at intervals the markings in isolated oblique rows. Apiculi minute, forming a circlet at border, | <i>lutescens</i> . |
| | | Markings not oblique at intervals, | |
| 128. | { | Markings towards centre 8, beyond semiradius 4, in '01 mm.; rows towards border subfasciculate. Apiculi 2, at an interval equal to about $\frac{1}{3}$ circumference, | <i>modestus</i> . |
| | | Non-apiculate, | |
| 129. | { | Markings $2\frac{1}{2}$ to 3 in '01 mm., subpearly, with central papillæ obscure, | <i>dubius</i> . |
| | | Markings towards centre 3 to $3\frac{1}{2}$, increasing outwards almost to border to 2 or $2\frac{1}{2}$ in '01 mm.; rows radial, with secondary rows evident, | |
| | | Markings towards centre $4\frac{1}{2}$, at semiradius 4, in '01 mm., smaller at border, | <i>flexilis</i> . |
| | | Markings 7 to 8 in '01 mm., decreasing but little towards border. Border striæ delicate, | |
| | | Markings towards centre 6, towards border 8, in '01 mm. Central space broad ($\frac{1}{11}$ diam.) | <i>mirificus</i> . |

123. { A distinct band of smaller markings adjacent to border. Apiculi numerous, minute, inserted at inner edge of border, *blandus*.
No such band nor apiculi, 130.
130. { Markings towards centre 3 to 3½, near border 2, in .01 mm.; robust, central papillæ prominent, Markings towards centre 4, at semiradius 3, in .01 mm. Border ¼ radius broad, striæ coarse, *borealis*.
suboculatus.
90. { Central space bearing 2 large conspicuous round granules, *bioculatus*.
No such granules, 131.
131. { Apiculi numerous, forming a double circlet; undulation about semiradius, slight, *capensis*.
No such arrangement of apiculi, 132.
132. { Apiculi many in one circlet. Markings 24 in .01 mm. Border broad, hyaline, *hyalinus*.
Apiculi large. Markings towards centre rounded 4½, outwards polygonal 6, in .01 mm. Border striæ delicate, *tuberculatus*.
No such apiculi and markings, 133.
133. { Distinct subulate spaces at origin of shorter rows. Markings 7 in .01 mm., the fasciculi separated by inconspicuous radial lines. Valve large, *nobilis*.
No such distinct subulate spaces, 134.
134. { Markings towards centre 4½, at semiradius 3½, in .01 mm., thence decreasing outwards. Centre with one large irregular marking, *æginensis*.
Markings towards centre 5 or 6, at border 9, in .01 mm.; around central space rounded, elsewhere often quadrilateral, *Payeri*.
91. { Fasciculi unequally curved, rows parallel to side row of each. Markings rounded, granular 10, in an indistinct band at border 15 to 16, in .01 mm. Apiculi interfasciculate, *divisus*.
Fasciculi not so curved. Rows parallel to central row in each fasciculus, 135.
135. { A single prominent spine-like apiculus near border, outside of this a circlet of minute apiculi, *kryophilus*.
No such apiculus, 136.
136. { Markings oval, with long axis radial or a little oblique. Border broad, striæ coarse, *planiusculus*.
No such markings, 137.
137. { Distinct radial interfasciculate rows, 138.
No radial interfasciculate rows, 139.
138. { Apiculi interfasciculate, robust; a distinct zone adjacent to border, *extravagans*.
Markings sometimes subradial, decreasing outwards, *Gregorii*.
139. { Each adjacent pair of rows in each fasciculus originating farther and farther from central row; interspaces hyaline. Non-apiculate, *fasciculatus*.
Markings subpearly, 4 in .01 mm.; around border a narrow clear space, *symmetricus*.
8. { Central space absent or minute, 140.
Central space present larger, 141.

140. { Non-apiculate, 142.
 { Apiculate, 143.
142. { Surface with several concentric zones of different
 and brilliant hues. A broad hyaline band
 within border. Central space indistinct, . . . *clivusus*.
 { No such zones, 144.
144. { Near border a circlet of radially elongate clear
 spaces. Surface with two concentric undula-
 tions. Central space absent, *neogradensis*.
 { No such clear spaces, 145.
145. { An annular depression about $\frac{1}{3}$ of radius from
 centre. Central space minute. Rosette
 distinct, *annulatus*.
 { A wide undulation extending from a short dis-
 tance within the semiradius almost to border.
 Markings towards centre $6\frac{1}{2}$, angular, soon be-
 coming rounded, and $5\frac{1}{2}$ in .01 mm. No hyaline
 band at border. Central space absent. Minute
 hyaline spaces at subregular wide intervals near
 border, *intumescens*.
 { Undulation faint near semiradius. Markings
 punctiform, delicate, least crowded towards
 centre; rows substraight, radial, *pellucidus*.
 { Appearance otherwise, 146.
146. { Alternate or opposite rounded or cuneate eleva-
 tions and depressions around centre. Central
 space absent. A rosette, *excavatus*.
 { An elongated unilateral depression near centre.
 Central space minute, *impressus*.
 { Surface with 6 to 12 shallow depressions near
 centre. Markings at centre 2 to $2\frac{1}{2}$, at $\frac{1}{3}$
 3 to $3\frac{1}{2}$, thence increasing to $1\frac{1}{2}$ in .01 mm.;
 smaller at border, *asteroides*.
143. { A short transverse central plication. Central
 space absent, *plicatus*.
 { Two shallow concentric undulations. Central
 space indistinct, granular, *undatus*.
141. { Surface hat-shaped, 147.
 { Surface with faint undulations, 148.
147. { Centre much depressed. Markings punctiform,
 fasciculate. Apiculi prominent, inserted at
 border, *obnubilus*.
 { Centre less depressed. Markings punctiform,
 faintly fasciculate, the rows at unequal inter-
 spaces stopping short of border, and leaving
 small hyaline areas, *patera*.
148. { Undulation single, about $\frac{2}{3}$ of radius from centre.
 Central space indistinct. Markings 7 to 8 in
 .01 mm. Apiculi small, *bengalensis*.
 { Two undulations, one near centre, the other close
 to border. Markings increasing outwards
 between these, largest on the elevations, . . . *undulans*.

42. { Adjacent to border a distinct zone of large areolæ, with inner edge wanting, and outer convex outwards, *zonulatus*.
 { Adjacent to border a single zone of still larger areolæ, perfect, with inner and outer edges convex, *heteromorphus*.
 { No such zone, 149.
149. { Outer portion of valve scarcely siliceous from $\frac{1}{2}$ to $\frac{1}{3}$ of radius broad, with distant subuniform costæ, *sol*.
 { Four subgelatinous, cuneate, symmetrical protuberances. A distinct band adjacent to border; within this markings in oblique rows $2\frac{1}{2}$, upon it 6, in .01 mm., and in radial rows, *bipartitus*.
 { Markings round, robust, pearly, smooth, decreasing rapidly at border; at centre 2, at border 4, in .01 mm. Border sharp, of 1 to 2 bands of round granules, *vigilans*.
 { Markings angular, 10 in .01 mm. A narrow hyaline band adjacent to border. Apiculi many, outer ends obtuse, *cristatus*.
 { No such outer portion or markings, 150.
150. { Inner $\frac{2}{3}$ of border hyaline between distant radial lines, outer $\frac{1}{3}$ with 8 to 10 striæ in .01 mm., *circumdatus*.
 { Border prominent, hoop-like, striæ $1\frac{1}{2}$ in .01 mm. Markings $1\frac{1}{2}$ in .01 mm., a few more minute at wide intervals; papillæ obscure, *aphrastus*.
 { Border subopaque, prominent, with coarse striæ. Markings 2 to $2\frac{1}{2}$ in .01 mm., radial rows inconspicuous, *concavus*.
 { Border otherwise, 151.
151. { A single large apiculus near border, outside it a circlet of more minute ones. Markings on a narrow zone adjacent to border, granular, *leptopus*.
 { No such isolated large apiculus, 152.
152. { Surface convex towards centre. Markings towards centre 4 to $4\frac{1}{2}$, towards border 3, in .01 mm., *tumidus*.
 { Surface convex; markings at centre 2, at border 3, in .01 mm.; at border a single band of quadrate, equal areolæ, *Mölleri*.
 { Surface almost or quite flat, 153.
153. { Markings hexagonal, 2 in .01 mm.; at intervals more minute, more distinct areolæ. A distinct band of larger areolæ adjacent to border, *pulchellus*.
 { No interspersed minute areolæ, 154.
154. { Markings hexagonal, $2\frac{1}{2}$ to 3 in .01 mm. Apiculi clavate at inner edge of hyaline border, *macraeanus*.
 { No such apiculi, 155.
155. { Markings $1\frac{1}{2}$, decreasing outwards to 2 in .01 mm.; a ring of very large areolæ adjacent to border. Non-apiculate, *splendidus*.
 { No such distinct ring, 156.

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| 156. | { | Markings $2\frac{1}{2}$ to 4 in '01 mm., oblique rows straight. Apiculi minute or absent, | <i>lineatus</i> . |
| | | Markings $3\frac{1}{2}$ to 4 in '01 mm., oblique rows substraight. Border $\frac{1}{2}$ of radius broad, with distinct striæ; inner and outer parts separated by a narrow line, | <i>marginato-lineatus</i> . |
| | | Markings 6 in '01 mm.; rows straight. Apiculi minute. Border narrow, | <i>anguste-lineatus</i> . |
| | | Markings 9 in '01 mm., decreasing but slightly outwards, on a narrow band at border 14 to 16 in '01 mm., oblique rows substraight, | <i>sublineatus</i> . |
| | | Oblique rows more curved, | 157. |
| 157. | { | Markings at centre 5 to 6, towards border 10, in '01 mm.; robust, decrease outwards rapid. Apiculi many, at unequal intervals, | <i>decipiens</i> . |
| | | Markings towards centre 2, at border 4 to 6, in '01 mm.; not robust, decrease outwards rapid. Apiculi many, prominent in a circle at border, Decrease in size of markings outwards more gradual, | <i>minuens</i> . |
| | | | 158. |
| 158. | { | Markings obtusely angular, subpearly, towards centre $2\frac{1}{2}$, at border 3, in '01 mm. Non-apiculate, | <i>antimimos</i> . |
| | | Markings at centre 4, towards border 8, in '01 mm.; oblique rows concave outwards. Apiculate, | <i>excentricus</i> . |
| | | Markings $2\frac{1}{2}$ in '01 mm. Border narrow. (Diam. '02), | <i>subconcauus</i> . |
| | | Markings towards centre 5, at border 6, in '01 mm. Apiculi numerous, distinct. Border broad, hyaline, | <i>peruanus</i> . |
| | | Markings at centre 6, at border 9 to 10, in '01 mm.; oblique rows curved outwards. Apiculi minute. Border narrow, | <i>minor</i> . |
| | | Markings otherwise, | 159. |
| 159. | { | Markings towards centre 4, at border 6, in '01 mm., secondary larger hexagonal areolæ distinct, | <i>labyrinthus</i> . |
| | | No such secondary areolæ, | 160. |
| 160. | { | Markings 8 to 9 in '01 mm., decreasing somewhat outwards. Centre occupied by a single, evident circular areola. Apiculi in a circle at border, | <i>pseudo-lineatus</i> . |
| | | Markings towards centre 3, towards border 4, in '01 mm. No such central areola. Border striæ 3 to 4 in '01 mm., | <i>antiquus</i> . |

ACTINOGONIUM.

Ehrb. emend., *Mon. Ber. Ak.*, 1847, p. 54.—Circular or obtusely angular. Surface with a central area, sometimes distinct. Colour pale grey, the rays more pearly. Markings on central area areolate, obtusely angular or rounded; rays broad, distinct, straight, curved or flexuous, sometimes subclavate, regular or irregular, confined to a zone about the semiradius, or extending nearer to the border, radiating to the angles of the valve, more

rarely at unequal intervals opposite its sides; on the interradial areas round or angular irregularly disposed unequal granules; interspaces unequal, hyaline. Border hyaline, sometimes broad and angular.

Van Heurck has recorded his belief that *Actinogonia* are but the "valves interieures" of *Asterolampræ*. Of this I have observed no evidence, but the possibility of their being so is to be borne in mind.

A. multiradiatum, sp. n.—Diam. .05 mm. Surface with central area, extending to about $\frac{2}{5}$ of radius from centre. Colour pale grey, somewhat darker towards border. Markings on central area sub-angular, unequal areolæ about 4 in .01 mm., most crowded at the centre; rays short, occupying middle third of valve, broad, subclavate, or with lateral irregular lobes; the interradial areas hyaline, on outer third bearing rounded or irregularly angular pearly granules, without order, and decreasing outwards, 4 to $4\frac{1}{2}$ in .01 mm.; adjacent to the border a hyaline band of unequal breadth. Border narrow, hyaline.—(Pl. III. fig. 15.)

Habitat.—Barbados deposit (Hardman!).*

A. septenarium. Ehrb., *Mon. Ber. Ak.*, 1847, p. 54.—Obtusely angular. Diam. .055 to .07 mm. Surface with central area indistinctly defined, about .01 mm. broad. Markings on central area small, round or obtusely angular subequal granules, with hyaline unequal interspaces; rays distinct, extending between central area and angles of valve; short similar rays sometimes intercalated towards outer portion of interradial areas, rarely two rays proceeding side by side towards the same angle, straight or gently curved, rarely flexuous; on the interradial areas round unequal irregularly disposed granules, with hyaline unequal interspaces, few close to the outer sides of those areas. Border angular, about $\frac{1}{10}$ of radius broad, widest opposite the middle of the interradial areas.—Ehrb., *Mikrog.*, pl. xxxvi. fig. 39; Ralfs in *Pritch. Inf.*, p. 813, pl. v. fig. 55; Ehrb., *Abh. Ber. Ak.*, 1875, p. 38, pl. i. fig. 4; Van Heurck, *Syn. Diat. Belg.*, pl. cxxvii. fig. 8; *A. quinarium*, Habirsh., *Cat. Diat.* § *Actinogonium*.

Habitat.—Cambridge deposit, Barbados (Van Heurck); Springfield deposit, Barbados (Hardman!).

* In the collection of Mr Julien Deby.

Artificial Key.

1. { Circular. Rays confined to a narrow area about semiradius. Central area sharply circumscribed. Border narrow, *multiradiatum*.
 Angular. Rays passing between central area and angles of valve. Central area not sharply circumscribed. Border angular, broad, *septenarium*.

BRIGHTWELLIA.

Ralfs, *Pritch. Inf.*, p. 940.—Circular. Surface flat from the centre outwards to the circle of large areolæ, beyond this slightly convex, and sloping downwards to the border. Colour pale smoky grey, when dry sometimes purplish or brown. Central space circular or obtusely angular, distinct, hyaline; more rarely minute or absent; a rosette rarely differentiated. Markings areolate, rarely subcircular towards the centre; a distinct cirlet formed by a single row of large areolæ, and situated between $\frac{1}{3}$ and $\frac{2}{3}$ of radius from centre; within this cirlet the rows evident, substraight, or oblique, curved, and decussating, beyond the circle radial; evident costæ and primary rays sometimes radiating at regular intervals between the cirlet of large areolæ and the border; minute apiculi sometimes present. Border narrow, hyaline, with delicate radial striæ.—*Craspedodiscus*, *pro parte*, Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 95; *Heterodictyon*, Grev., *Trans. Mic. Soc. Lond.*, 1863, p. 67.

This genus approaches *Coscinodiscus* through *C. bulliens*.

§ 1. ACOSTATÆ.

Non-costate.

B. splendida, Rattray.—*Heterodictyon splendidum*, Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 67, pl. iv. fig. 7.—Diam. .045 mm. Central space small, indistinct. Markings toward the centre subcircular, soon becoming obtusely angular; the cirlet of large areolæ at about $\frac{2}{3}$ of radius from centre, within this cirlet the markings about 4 in .01 mm., in obscure slightly curved radial rows; the secondary decussating rows undifferentiated; the hyaline interspaces largest towards the centre; beyond the cirlet the rows moniliform, with markings decreasing gradually outwards from 5 to 8 in .01 mm.,

and separated around the border by narrow hyaline lines; non-apiculate. Border hyaline.

Habitat.—Cambridge deposit, Barbados (Johnson!).

B. excellens, sp. n.—Diam. .07 mm. Central space obtusely triangular, about $\frac{1}{4}$ of diameter broad, not sharply defined. Markings towards the central space subcircular, soon becoming areolate; the circllet of large areolæ about $\frac{5}{7}$ of radius from centre; within this circllet the markings subequal, 4 in .01 mm., in evident curved oblique decussating rows; beyond the circllet decreasing gradually outwards from 5 or $5\frac{1}{2}$ to 8 in .01 mm.; minute apiculi at intervals of .0075 mm., inserted close to the border. Border striæ delicate, 14 in .01 mm.—(Pl. III. fig. 16.)

This species was labelled by Greville *B. splendida*, but his specific name cannot be adopted, since the distinct *Heterodictyon splendidum* now becomes *B. splendida*.

Habitat.—Barbados deposit (Greville!).

B. hyperborea, Grun. Van Henrek, *Syn. Diat. Belg.*, pl. cxviii. fig. 8.—Diam. .065 mm. Central space and rosette absent. Markings areolate; the circllet of large areolæ about $\frac{1}{2}$ of radius from centre, within this circllet the markings subequal, 3 to $3\frac{1}{2}$ in .01 mm., in substraight decussating rows, beyond the circle subequal, or decreasing but slightly near the border, 5 in .01 mm. Border hyaline.—Grun., *Denk. Wien. Ak.*, 1884, p. 70, pl. ii. (B), fig. 64.

Habitat.—Dredged by U.S.S. Gettysburg, lat. $35^{\circ} 25' N.$, long. $69^{\circ} 42' E.$, in 2924 fathoms; marine deposit, Franz Josef's Land (Grunow).

B. elaborata. Grev., *Trans. Micr. Soc. Lond.*, 1861, p. 73, pl. ix. fig. 1.—Diam. .08 mm. Central space absent; an inconspicuous rosette. Markings areolate; the circllet of large areolæ about $\frac{5}{8}$ of radius from the centre, within this circllet the markings increasing slightly outwards from the rosette 3 to $3\frac{1}{2}$ in .01 mm., in inconspicuous radial, and secondary oblique curved decussating rows; beyond the circllet increasing in breadth uniformly, but somewhat rapidly outwards, but subequal radially, 4 in .01 mm. Border hyaline.

Habitat.—Barbados (Johnson!).

B. coronata. Ralfs in *Pritch. Inf.*, p. 940; *Craspedodiscus*

coronatus, Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 95, pl. v. fig. 6.—Diam. $\cdot 12$ to $\cdot 185$ mm. Central space subcircular, $\frac{1}{8}$ to $\frac{1}{3}$ of diam. broad, sometimes surrounded by a band of evident areolæ. Markings areolate; the circlet of large areolæ from $\frac{2}{3}$ to $\frac{7}{10}$ of radius from centre, within this circlet the markings subequal, 4 in $\cdot 01$ mm., in regular, oblique, greatly curved, decussating rows, beyond the circlet decreasing and slightly curved outwards from 5 to 8 in $\cdot 01$ mm.; minute apiculi at intervals of about $\cdot 0075$ mm. sometimes visible, inserted close to the border at the outer ends of faint subhyaline lines. Border striæ 12 to 14 in $\cdot 01$ mm.—*B. pulchra*, Grun.; Van Heurck, *Syn. Diat. Belg.*, pl. cxxviii. fig. 9; *Bot. Centralbl.*, Bd. xxxiv. 1888, Nos. 2, 3, p. 35; Grove and Sturt, *Jour. Quek. Micr. Cl.*, 1887, p. 67; *B. Murrayi*, Cstr., *Diat. Chall. Exped.*, 1886, p. 138, pl. x. fig. 2.

Habitat.—Cambridge deposit, Barbados (Greville! Johnson!); Oamaru deposit (Grove!); Bridgewater deposit, Barbados (Johnson!); "Barbados" (Greville! Johnson!).

Var. *radians*, nov.—Diam. $\cdot 15$ mm. Central space obtusely triangular, with outwardly convex sides. Markings areolate; the circlet of large areolæ about $\frac{1}{3}$ of radius from centre, beyond this circlet the markings decreasing more distinctly outwards from 4 to 8 or 9 in $\cdot 01$ mm.; primary rays evident at intervals of $\cdot 0075$ mm., non-costate.—(Pl. III. fig. 14.)

Habitat.—Barbados deposit (Greville!).

§ 2. COSTATÆ.

Costæ distinct.

B. Johnsonii. Ralfs, *Trans. Micr. Soc. Lond.*, 1866, p. 4, pl. i. fig. 11.—Diam. $\cdot 07$ to $\cdot 1075$ mm. Central space minute, round or angular, a rosette sometimes evident. Markings areolate, sometimes subcircular towards the centre, with narrow hyaline interspaces, the circlet of large areolæ from $\frac{2}{3}$ to $\frac{3}{4}$ of radius from centre, within this circlet the markings subequal or somewhat smaller towards the centre, 3 in $\cdot 01$ mm., in obscure radial and more evident, sometimes irregularly curved or flexuous decussating secondary rows, beyond the circlet decreasing gradually outwards from 4 to 6 or $6\frac{1}{2}$ in $\cdot 01$ mm. at border, with evident primary rays at

subregular intervals, and narrow costate ridges towards the outer ends of these rays. Border with delicate striæ, 16 to 18 in .01 mm. —Walker and Chase, *New and Rare Diat.*, ii. p. 2, pl. v. fig. 10.

Habitat.—Springfield deposit, Barbados (Hardman!); “Barbados” (Johnson! Greville!); Cambridge deposit, Barbados (O’Meara!).

Artificial Key.

- | | | | |
|----|---|---|--------------------|
| 1. | { | Primary rays obvious outside of circlet of large areolæ, narrow prominent costæ at their outer ends, | <i>Johnsonii.</i> |
| | | No such costæ, | 2. |
| | { | Central space subcircular, surrounded by a band of large markings. Markings within the circlet of large areolæ in uniform, curved, decussating rows, beyond the circlet decreasing gradually outwards. Apiculi faint, | <i>coronata.</i> |
| | | Central space obtusely triangular, without a distinct limiting band of markings. Markings subcircular towards central space. Apiculi minute, but more evident, | <i>excellens.</i> |
| | | Central space minute, indistinct. Markings within the circlet of large areolæ rounded, in obscure curved radial rows, beyond the circlet the rows moniliform. Non-apiculate, | <i>splendida.</i> |
| | | No central space, | 3. |
| | { | An inconspicuous rosette. Markings outside circlet of large areolæ increasing gradually in breadth towards border, | <i>elaborata.</i> |
| | | No rosette. Markings within the circlet of large areolæ in substraight decussating rows without order, beyond the circlet subequal or slightly smaller near border, | <i>hyberborea.</i> |

STELLADICUS, GEN. N.

Circular. Central space and rosette absent. Markings: rays clavate, their inner ends rounded, meeting at centre, attenuating towards border, at middle of the interradian areas similar, but narrow faint rays extending to middle of inner ends of compartments, and continued thence as straight narrow lines to the border; the compartments each consisting of three subequal parts separated by narrow straight lines reaching the border, the inner end of each part convex towards the centre; areolate, the areolæ forming oblique, straight, decussating rows. Border narrow, hyaline.—*Asterolampra*, *pro parte* Norman, *Trans. Micr. Soc. Lond.*, 1861, p. 6.

S. stella, Rattray. *Asterolampra stella*. Norman, *Trans. Micr. Soc. Lond.*, 1861, p. 6, pl. ii. fig. 1.—Diam. .09 mm. Markings:

clavate rays 6, about .005 mm. broad at their widest part, the faint interradi-
al rays about .0025 mm. broad, the compartments reaching
about $\frac{5}{9}$ of radius from circumference, the areolæ subequal, 8 (?) in
.01 mm.

Norman provisionally united this species to *Asterolampira*. The
remarkable appearance of the compartments and rays are sufficient
to justify its separation as the type of a new genus.

Habitat.—Sierra Leone (Norman).*

ASTEROLAMPRA.

Ehrb. emend., *Mon. Ber. Ak.*, 1844, p. 73.—Circular, rarely
obtusely and regularly angular. Surface subplain, a central or
subcentral portion hyaline with distinct rays, the outer portion
with evident compartments separated by distinct, rarely sub-
obsolete, hyaline intervals. Colour subhyaline to subpearly or
pale grey. Central space sometimes distinct, hyaline, granular or
subareolate; a rosette rarely differentiated, a central areolate area
frequent. Markings on central area areolate, rarely arranged in
concentric zones; rays diverging from centre or from outer edge of
areolate area, rarely from an excentric point, straight, arcuate of
sharply geniculate at or near their middle, frequently dichotomous,
narrow, more rarely broad or subobsolete, sometimes confined to a
relatively narrow, submarginal zone; interradi-
al areas hyaline, or
with faint diffuse lines passing to centro-lateral angles of compart-
ments; compartments with inner ends convex or concave towards
the centre, sometimes transversely or obliquely truncate, rarely
asymmetrical with respect to the rays; granular, with irregular,
wide, hyaline interspaces or areolate, rarely subhyaline or minutely
punctate; the areolæ in oblique, decussating, substraight rows
parallel to the edges of the inter-compartmental intervals; fre-
quently a single row of larger areolæ fringing the compartments;
those bounding its inner edge most evident, rarely large and con-
spicuous; at each centro-lateral angle a single areola, frequently
larger and sometimes protuberant into the interradi-
al spaces; single
or double granules rarely present at outer ends of intervals. Border
narrow, hyaline, rarely broad, obtusely angular and subpearly.—

* Communicated by Mr Frederick Kitton.

Asterolampra, Grev., *pro parte*, *Trans. Micr. Soc. Lond.*, 1860, p. 162; *Craspedodiscus*, *pro parte*, Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 95.

§ 1. MARGINATÆ.

A large central areolate area. Rays many, short, confined to a submarginal zone. Compartments minute.

A. marginata. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 50, pl. viii. fig. 30.—Diam. ·0625 to ·1125 mm. Central area extending outwards for $\frac{3}{4}$ to $\frac{5}{8}$ of radius, its outer edge sinuate, subregular; a rosette distinct. Markings on central area areolate, the areolæ decreasing slightly from the rosette outwards from 4 to 5 in ·01 mm.; rows radial, straight, non-fasciculate; secondary oblique decussating rows faintly marked; rays short, straight, radiating from the distal angles of the sinuations about $\frac{1}{5}$ of radius long; the compartments restricted to a narrow (about ·0025 mm. broad) zone adjacent to the border, their inner ends convex towards the centre; the intervals represented by shallow indentations.—Eulenst., *Diat. Spec. Typ.*, No. 16; *Craspedodiscus marginatus*, Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 95, pl. v. fig. 7; Ralfs in *Pritch. Inf.*, p. 832; *A. marginata*, var. *minor*, Walker and Chase, *New and Rare Diat.*, ii. p. 7, pl. v. fig. 8.

This species forms the connecting link between *Coccinodiscus*, *Brightwellia*, and *Asterolampra*. In the first named genus it approaches *C. bulliens*, the markings on its central area also recall those of *C. concinnus*, var. *jonesiana*. The interspaces between the rays are larger, more peripherally placed, and less sharply defined than in any *Brightwellia*, whilst its regularly areolate central portion is homologous to the irregular inconstant areolate areas of *Asterolampra decora*, *A. affinis*, *A. vulgaris*, &c.

Habitat.—Barbados deposit (Johnson! Greville! Grove! Eulenstein!); Springfield deposit, Barbados (Walker and Chase); Cambridge deposit, Barbados (Deby!); Chalky Cliff, Barbados (Deby!).

§ 2. DUCTILES.

A central areolate area. Compartments conical in outline with distant subradial branching, but evident lines.

A. ralfsiana. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 50, pl. viii. fig. 31.—Diam. $\cdot 07$ to $\cdot 08$ mm. Central space sub-circular, $\cdot 0025$ to $\cdot 003$ mm. broad, sometimes slightly excentric; an evident subcentral areolate area reaching between $\frac{1}{4}$ and $\frac{1}{5}$ of radius from centre. Markings on subcentral area unequal, $2\frac{1}{2}$ to 4 in $\cdot 01$ mm., the smaller sometimes confined to a band contiguous to the central space; rays many, straight, those on one side of valve sometimes somewhat longer than those on opposite side; the compartments reaching from $\frac{1}{3}$ to $\frac{5}{17}$ of radius inwards, outline obtusely conical, sides subuniformly convex, non-areolate but with distinct subradial lines at intervals of $\cdot 0025$ to $\cdot 003$ mm., frequently dichotomising towards the border; intervals wide, reaching close to the border; adjacent to the border a cirlet of delicate subregular striæ, 4 to $4\frac{1}{2}$ in $\cdot 01$ mm.—Eul., *Diat. Spec. Typ.*, No. 16.

Habitat.—Barbados deposit (Greville! Grove, Eulenstein!); Cambridge deposit, Barbados (Deby!).

§ 3. SUBMARGARITACEÆ.

Aspect subpearly. A central space usually distinct. Rays broad or undifferentiated, the inner ends of the compartments extending to edge of central space.

A. ambigua. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 54, pl. viii. figs. 42-45.—Diam. $\cdot 0175$ to $\cdot 0525$ mm. Central space angular, distinct, hyaline, up to about $\cdot 01$ mm. broad. Markings: rays straight, sometimes slightly constricted at the middle or expanding regularly outwards and merging into the compartments; inter-radial spaces expanding outwards, at outer end trilobate, the small central lobe homologous to the interval between the compartments; two straight or slightly curved lines (concave towards each other) passing from the inner end of this lobe, and meeting at or near the inner ends of the interradian spaces; the compartments reaching about $\frac{4}{5}$ of radius inwards, sometimes indistinctly defined, subhyaline; small isolated round granules sometimes present close to the sides of the interradian spaces.

Rarely the outline of the valve is obtusely angular.

Habitat.—Cambridge deposit, Barbados (Johnson!); Barbados (Greville!); locality? (Deby!).

A. dubia. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 54, pl. vii. fig. 41.—Diam. $\cdot 0375$ mm. Central space quadrate, with sides slightly concave, hyaline. Markings: rays hardly differentiated, interradial spaces 4, cruciform ovate, their inner ends rounded, the outer subacute, homologous to the intervals between the compartments; two distinct subparallel radial lines extending from their inner ends to the sides of the protuberant outer extremities, an evident round clear granule adjacent to the border and opposite the outer ends of each interradial space; the compartments extending to edges of central space, subhyaline. Border distinct, its inner edge round.

Habitat.—Barbados deposit (Greville!).

A. aliena. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 55, pl. viii. fig. 46.—Diam. $\cdot 0525$ mm. Central space circular, about $\cdot 01$ mm. broad, not sharply defined. Markings: a minute clear round granule at middle of central area; rays broad; interradial spaces expanding uniformly outwards, the sides straight, their outer ends placed obliquely to the direction of the intervals, two faint subparallel lines extending between their inner ends and the edges of the intervals; the compartments reaching almost to the semiradius, subhyaline; the intervals narrow, of uniform breadth, a small round granule at their outer extremities. Border about $\frac{1}{4}$ of radius broad, subhyaline, its inner edge slightly angular, the angles corresponding in position to the outer ends of the intervals.

Habitat.—Barbados deposit (Greville!).

§ 4. TRADUCENTES.

Sometimes regularly polygonal. Central space distinct, granular or subareolate, rarely hyaline. Rays narrow. Compartments subhyaline, or their inner edge with a distinct band of larger areolæ, their outer portion subareolate or granular.

A. stellulata. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 54, pl. vii. fig. 40.—Sometimes regularly and obtusely polygonal. Diam. $\cdot 045$ mm. Central space irregularly concavo-convex, about $\cdot 0075$ mm. long by $\cdot 005$ mm. broad. Markings: rays 7 to 9, straight, regular; the compartments reaching about $\frac{3}{8}$ of radius inwards, their inner ends sigmoid on each side of, and protuberant

towards the centre opposite the rays; the puncta obscure, isolated towards their inner, more crowded around their outer extremities, 10 to 12 in .01 mm.; the intervals narrow, of uniform width, their outer ends convex outwards not reaching the border, a small round clear granule intervening between them and the border. Border narrow, indistinct.

Habitat.—Barbados deposit (Greville!).

A. kittoniana. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 53, pl. viii. fig. 39.—Diam. .04 to .05 mm. Central space heptangular, about $\frac{1}{3}$ of diam. broad, its sides deeply concave outwards. Markings: central space punctato-areolate; rays 7, straight; the compartments reaching from $\frac{1}{3}$ to $\frac{1}{4}$ of radius inwards, their inner ends concave inwards on each side of, but protuberant opposite, the rays, sometimes bluntly conical, their centro-lateral angles rounded, the markings obscure; the intervals alternating rapidly outwards, not reaching the border, their outer ends acute, with a minute rounded granule at each side sometimes visible.

Habitat.—Barbados deposit (Kitton, Deby!).

A. traducens, sp. n.—Diam. .0875 mm. Central area circular, .025 mm. broad. Markings on central area isolated, rounded or irregular and minute granules; rays 16, narrow; at middle of interradial spaces a narrow, sharply defined, sublinear area extending from their inner ends to the intervals; the compartments with inner ends faintly defined, an outwardly concave row of minute puncta stretching between the extremities of the adjacent intervals, those contiguous to the intervals somewhat more prominent, elsewhere the puncta more minute and obscure; intervals tapering rapidly outwards, their outer ends acute, not reaching the border. Border obtusely and subregularly polygonal.—(Pl. III. fig. 22.)

Habitat.—Barbados deposit (Deby!).

A. pulchra. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 53, pl. viii. figs. 37, 38.—Obtusely and regularly octagonal. Diam. .0625 mm. Central space distinct, $\frac{1}{3}$ to $\frac{1}{2}$ of diam. broad, its sides deeply concave outwards between the radii. Markings: on central space a few irregular, obtusely angular or subareolate granules;

rays 8, straight; at middle of interradial spaces 2, somewhat faint subparallel lines radiating to the inner edges of the intervals; the compartments reaching about $\frac{1}{3}$ of radius inwards, the inner ends concave towards the centre on each side of, but somewhat protuberant opposite, the rays, subhyaline or obscurely and minutely punctate, sometimes with a band of more prominent oblong markings at their inner ends; the intervals alternating gradually outwards, their outer ends convex, and not reaching the border with a distinct oval, obliquely placed granule at one or both sides, those belonging to one interval sometimes meeting each other at the extremity of the interval.

Habitat.—Barbados deposit (Greville).

A. scutula. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 52, pl. viii. fig. 47.—Diam. .04 mm. Central space regularly hexagonal, about .005 mm. broad, its sides convex, towards the centre hyaline. Markings: rays 6, straight; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends flat or somewhat concave, protuberant at outer ends of rays; a single large areola at their centro-lateral angles, tapering slightly outwards, its inner end convex but hardly protuberant, elsewhere the puncta obscure or unresolved; the intervals evident, expanding somewhat rapidly outwards, their outer ends rounded, reaching the border. Border narrow, hyaline.

Habitat.—Barbados deposit (Johnson!).

A. simulans. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 52, pl. viii. fig. 36.—Circular or regularly and obtusely polygonal. Diam. .0375 to .06 mm. Central space polygonal, .01 mm. broad, its sides convex towards the centre, hyaline. Markings: rays 9, straight; at middle of interradial spaces somewhat broader, more faint lines radiating to the edges of the intervals; the compartments reaching about $\frac{1}{3}$ of radius inwards, their inner ends concave, concentric, with circumference sometimes slightly protuberant at ends of rays; a distinct band of narrow radially elongate areolæ fringing their inner ends, those at the centro-lateral angles most distinct and largest; contiguous to the outer ends of the areolæ a narrow, hyaline, indistinct band concave towards the border, beyond this the puncta obscure, about 5 in .01 mm., sometimes

subareolate; intervals narrow, unequal, sometimes expanding slightly at their outer ends. Border narrow, its inner edge with minute irregularities, hyaline.

This species is sometimes confounded with *A. punctata*, from which it differs in the appearance of its central space and the sculpturing of its compartments.

Habitat.—Barbados deposit (Greville!); Springfield deposit, Barbados (Hardman!).*

A. æmulans. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 52, pl. viii. figs. 34, 35.—Diam. .05 to .075 mm. Colour pale brownish-grey at centre and along the rays, elsewhere pale smoky grey. Central portion distinct, extending outwards for $\frac{1}{3}$ to $\frac{4}{15}$ of radius. Markings on central portion areolate, the areolæ $3\frac{1}{2}$ to 4 in .01 mm.; rays straight or but slightly arcuate; the compartments reaching from $\frac{2}{3}$ to $\frac{8}{15}$ of radius inwards, their inner ends convex, with short distinct radial lines about 4 in .01 mm., and extending outwards for $\frac{1}{3}$ to $\frac{1}{4}$ of their length, their outer portion with delicate areolæ decreasing rapidly outwards from 5 or $5\frac{1}{2}$ to 8 in .01 mm.; the intervals of equal breadth, their outer ends rounded, not reaching the border. Border distinct, hyaline.

Both of the typical specimens in Greville's collection show a distinctly areolate central portion, and there is no indication of its ever being solid, as stated by Greville. In neither are the markings on the compartments isolated puncta.

Habitat.—Barbados deposit (Greville!).

§ 5. EXIMIÆ.

Central areolate area sometimes present. Rays rarely unequal, and meeting at an excentric point or absent. Compartments areolate, their inner ends convex, concave, or obliquely truncate towards the centre, sometimes bounded by a prominent areolate fringe; intervals rarely obsolete or occluded at their inner ends, reaching the border.

A. nicobarica, Grun. Van Heurck, *Syn. Diat. Belg.*, pl. cxxvii. fig. 7.—Diam. .055 mm. Central space angular, about .01 mm.

* In the collection of Mr Julien Dely.

broad. Markings: a single rounded granule at middle of central space; rays between central space and middle of inner ends of compartments absent, but well-defined, subpearly, subclavate areas, tapering gradually outwards, sometimes slightly flexed, and each with a narrow delicate flexuous line close to their edges, extending between central space and outer ends of intervals, the lines from the sides of the adjacent areas meeting one another at their inner ends; the compartments reaching about $\frac{1}{2}$ of radius inwards, their inner edge convex towards the centre, the areolæ distinct, 6 to 8 in $\cdot 01$ mm.; at irregular wide intervals a few more prominent rounded dots; the intervals not reaching the border, tapering outwards, their outer ends convex.

Habitat.—Nancoori deposit (Van Heurck).

A. punctata. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 51, pl. viii. fig. 32.—Diam. $\cdot 0625$ mm. Central areolate area subelliptical to round, about $\cdot 0075$ mm. broad. Markings on central area unequal, 4 to 5 in $\cdot 01$ mm.; rays 6 to 7, straight; the compartments reaching about $\frac{1}{4}$ of radius inwards, their inner ends transversely truncate or slightly concave inwards opposite the radii; the areolæ few, granular towards their inner ends, towards the border 6 to 7 in $\cdot 01$ mm., with hyaline interspaces; the intervals wide, sometimes expanding slightly outwards, their outer ends transversely truncate, sometimes reaching the border. Border, narrow, indistinct, subhyaline.

The smaller areolæ on the central area may be so disposed as to form an arc round a somewhat larger unilateral areola.

Habitat.—Barbados deposit (Greville!).

A. balearica. Cleve, *Kongl. Sv. Vet.-Akad. Handl. Stockh.*, 1881, Bt. xviii. No. 5, p. 20, pl. v. fig. 59.—Diam. $\cdot 0715$ mm. Central space circular, hyaline, about $\frac{1}{2}$ of diam. broad. Markings: rays straight, symmetrical; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends uniformly and considerably convex, areolate; the areolæ subequal or decreasing but slightly outwards, 9 in $\cdot 01$ mm.; the intervals of uniform breadth, their outer ends convex, reaching about $\frac{5}{8}$ of radius from centre.

From *A. Grevillei* this differs not only in the coarser character

of the areolæ, but also in the appearance of the rays and length of the intervals between the compartments. In *Asterom. centraster*, Johnson, the intervals between the compartments are continued to the centre, and their outer ends are swollen and knob-like. From *A. brebissoniana* it is readily distinguished by the straight instead of geniculate rays.

Habitat.—Balearic Islands (F. Söderlund).

A. lævis. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 51, pl. viii. fig. 33.—Diam. .0275 mm. Central rosette and areolate area absent. Markings: rays 6, straight; the compartments reaching to about $\frac{3}{8}$ of radius inwards, their inner ends transversely truncate, sometimes slightly flexuous or concave towards the centre; the areolæ obscure, least evident towards the border; the intervals extending to about $\frac{1}{2}$ of distance between their inner ends and border, tapering gradually outwards with the inner ends convex. Border narrow, hyaline, indistinct.

Habitat.—Barbados deposit (Greville!).

A. marylandica. Ehrb., *Mon. Ber. Ak.*, 1844, p. 76, fig. 10 (June 1844).—Diam. .0375 to .15 mm. Central areolate area absent. Markings: the rays 4 to 12, straight, or but slightly arcuate, diverging from the centre, sometimes dichotomous or dividing into three equal rami; the compartments reaching from $\frac{3}{8}$ to $\frac{1}{2}$ of radius inwards, their inner ends uniformly convex towards centre, sometimes truncate or slightly emarginate, rarely unsymmetrical; the areolæ distinct, subequal on inner $\frac{3}{8}$ of compartments, or decreasing more regularly outwards from 6 to 10 in .01 mm.; a band of more prominent submuriform areolæ around their edges; the intervals expanding gradually outwards, their outer ends reaching close to the border.—Müller, *Abh. Ber. Ak.*, 1841, p. 232, pl. vi. fig. 4 (no name); Bail., *Amer. Jour. Sci.*, 1845, vol. xlviii. pl. iv. fig. B; Brightw., *Quart. Jour. Micr. Sci.*, 1860, p. 94, pl. v. fig. 3; Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 47, pl. ii. figs. 14, 15; Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 108, pl. iii. figs. 1-4; Ralfs in *Pritch. Inf.*, p. 836, pl. xi. fig. 33; Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 44, pl. vii. figs. 1-3; *A. septenaria*, Johnson, *Amer. Jour. Sci.*, 1852, ser. 2, vol. xiii. p. 33; *A. impar*, Shadb., *Trans. Micr. Soc.*

Lond., 1854, p. 17, pl. i. fig. 14; *A. pelagica*, Ehrb., *Mon. Ber. Ak.*, 1854, p. 238; *A. hexactis*, Ehrb., *Abh. Ber. Ak.*, 1872, pl. ix. figs. 1, 2; *A. marylandica*, var. *ausonia*, Cstr., *Atti Accad. pontif. nuov. Lincei, Roma*, 1875, p. 393, pl. vi. fig. 4.

Dr Wallich distinguished as var. β (Wallich, *ibid.*, 1860, p. 48, pl. ii. fig. 14), forms having compartments with rounded inner ends and simple rays, and as var. γ (*ibid.*, pl. ii. fig. 15), those having the inner ends of the compartments truncate, and the rays conspicuously ramose near their central ends, the branching of the rays being symmetrical with respect to a diameter of the valve. Pérageallo (*Diat. Baie d. Villefranche*, 1888, p. 74), still adheres to Wallich's var. β , naming it *A. marylandica*, var. *major*, but it appears to me hardly sufficiently distinct from the type to merit varietal recognition. Wallich's var. γ may be named *A. marylandica*, var. *ramosa*. Forms named by Thum *A. adriatica*, Grun., and now in the collection of Mr Julien Deby, do not differ from *A. marylandica*. One of the specimens named *A. adriatica* has a delicate round granule (probably an apiculus) at the outer extremity of each interval, thus recalling *A. marylandica*, var. *ausonia*, Cstr.

Mr Edmund Grove has proposed to establish a var. *appropinquans*, for specimens in which one of the compartments is smaller than the others, two of the intercompartmental intervals being in consequence unusually approximated.

Habitat.—Maryland (Ehrenberg); Barbados deposit (Greville!); Springfield deposit, Barbados (Hardman!); Cambridge deposit, Barbados (Greville! Hardman!); Newcastle deposit, Barbados (Grove!); Piscataway deposit (Johnson, Greville! Roper!);* Monterey stone (Greville! Walker-Arnett); Richmond deposit, Va. (Johnson); Rappahannock (Greville); Bermuda tripoli (Dallas); Oamaru deposit (Grove!); Indian Ocean soundings, lat. $5^{\circ} 37' S.$, long. $61^{\circ} 33' E.$, 2200 fathoms, Captain Pullen (Greville!); Indian Ocean, off Zanzibar (Ehrenberg); from *Salpæ*, Bay of Bengal (Wallich); Alexandria (Hardman!); Port Natal (Shadbolt); from *Comatulæ*, Mediterranean Sea (Müller); *Holothuria*, China (Thum); South Naparima, Trinidad (Greville); Rembang Bay (Deby!); † Tegel von Mähren, Austria (Deby!).

* In the collection of Dr R. K. Greville.

† In a type slide of material from this locality prepared by Herr Thum.

A. rotula. Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 111, pl. iii. fig. 5.—Diam. .11 mm. Central areolate area absent. Markings: rays diverging from a central point, simple, or rarely dichotomous, straight or slightly arcuate; on the interradial spaces faint, indefinite, narrow dark bands extending for some distance inwards from the centro-lateral angles of the compartments; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner edges somewhat obliquely truncate on each side of the rays; areolæ faint; the intervals of uniform breadth, their outer ends convex close to the border.—Cstr., *Atti Accad. pontif. d. nuov. Lincei*, 1875, p. 393, pl. vi. fig. 3a; *A. Grevillii* Wallich, var. *adriatica*, Grun. in Van Heurck, *Syn. Diat. Belg.*, pl. cxxvii. fig. 12.

This species is distinguished from those forms of *Asteromphalus variabilis* having a faintly differentiated subobsolete ray by the more straight rays and the less obliquely truncate inner ends of the compartments. Pérégallo (*Diat. Baie d. Villefranche, Paris*, 1888, p. 74) has already pointed out the identity of Grunow's *A. Grevillii*, var. *adriatica* with *A. rotula*.

Habitat.—Monterey stone (Walker-Arnott); Adriatic Sea, Balearic Islands (Van Heurck).

A. dallasiana. Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 115, pl. iv. fig. 10.—Diam. .075 mm. Central areolate area absent. Markings: rays 7, slightly and uniformly arcuate towards the same direction; the compartments reaching to $\frac{2}{3}$ of radius inwards, their inner ends transversely truncate, areolate; the areolæ subequal 10, near border 12, in .01 mm.; the intervals attenuating slightly outwards, and again somewhat swollen at the extremities, reaching close to the border.—*Asteromphalus dallasianus*, Ralfs in *Pritch. Inf.*, p. 836.

Although a centro-lateral area is present there is no such subobsolete interval as would be found in *Asteromphalus*. Compare also in this respect some forms of *Asteromphalus variabilis*.

Habitat.—Nottingham deposit, U.S. (Greville!).

A. brebissoniana. Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 114, pl. iii. fig. 9.—Diam. .075 mm. Central areolate area absent. Markings: rays sharply bigeniculate about $\frac{2}{3}$ of their length from the centre, two or three adjacent rays meeting

one another a short distance from centre whither they are continued as a simple line; the compartments reaching from $\frac{5}{8}$ to $\frac{7}{8}$ of radius inwards, their inner ends transversely truncate or but slightly convex, areolate; the intervals attenuating gradually outwards, their outer ends slightly swollen and knob-like.

Greville has pointed out that the geniculate flexure of the rays found also in *Asteromphalus imbricatus*, *Asterom. Darwinii*, *Asterom. elegans*, *Asterom. Brookei*, and in a less degree in *Asterom. shadboltianus*, goes to establish the validity of the union of *Asteromphalus* and *Asterolampira* into a single genus, but this ignores the apparently more constant characters in the latter connected with the subobsolete interval between two of the compartments.

Habitat.—Monterey stone (Walker-Arnott).

A. Grevillei. Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 113, pl. iv. fig. 21.—Diam. .075 to .085 mm. Central areolate area absent, sometimes represented by two plano-convex areolæ. Markings: rays straight, or gently arcuate, diverging from an angular arched central line rarely from a central point; the compartments reaching about $\frac{1}{2}$ of radius inwards, their inner ends curved or flattened on opposite sides of rays convex towards the centre, their margin formed by a narrow subhyaline band, elsewhere minute subpunctiform granules, least evident towards the border, sometimes unresolved; the intervals of uniform breadth; their outer ends transversely truncate, sometimes terminating a considerable distance from the border. Border narrow, indistinct.—*Asteromphalus Grevillei*, Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 47, pl. ii. fig. 15.

The radii vary in number from 7 to 17, and exhibit considerable variation in their mode of origin, an adjacent pair frequently uniting and being connected by a common short central stalk with the central portion.

Habitat.—Moron deposit (Greville! Hardman!); Indian Ocean 2200 fathoms, Captain Pullen (Wallich); Rappahannock deposit, U.S. (E. W. Dallas); Monterey stone (Walker-Arnott).

A. princeps,* nov. *A. Grevillei*, var. *eximia*. Cstr., *Diat. Chall.*

* The name *eximia* cannot be adopted, as it has been preoccupied by Greville (*Trans. Micr. Soc. Lond.*, 1865, p. 99) for a distinct form (see *infra*).

Exped., 1886, p. 136, pl. v. fig. 5.—Diam. .18 mm. Central areolate area absent. Markings: rays regularly arcuate, rarely substraight, 2 or 3 short lines diverging from the centre and branching somewhat irregularly 2 to 4 times before reaching half the distance to the inner ends of the compartments; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends transversely truncate or slightly concave towards the centre, the areolæ forming a distinct band along their outer edge and 6, elsewhere in straight oblique decussating rows and about 8, in .01 mm., decreasing but slightly towards the border; the intervals attenuating regularly outwards and reaching the border. Border distinct, hyaline.

Habitat.—Equatorial Atlantic, H.M.S. Challenger (Castracane).

A. brightwelliana. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 48, pl. viii. figs. 26, 27.—Diam. .075 to .095 mm. Surface markedly convex. Central areolate area absent. Markings: rays straight or subuniformly curved, springing from a somewhat excentric point, the compartments reaching about $\frac{1}{3}$ of radius inwards, their inner ends concave towards the centre, unequal, areolate; a single band of areolæ adjacent to their inner ends large, 3 to $3\frac{1}{2}$ in .01 mm., the others much smaller 6, decreasing gradually outwards to 8 or 9 in .01 mm., the intervals of equal breadth (about .0035 to .004 mm.), their outer ends reaching the border.

Habitat.—Springfield deposit, Barbados (Hardman!); "Barbados" deposit (Greville!); Cambridge deposit, Barbados (Deby!).

A. crenata. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 47, pl. viii. figs. 4-16.—Diam. .05 to .075 mm. Central areolate area absent. Markings: rays straight; the compartments reaching about $\frac{1}{3}$ of radius inwards, their inner ends concave towards the centre and concentric with the border, areolate, a single band of large unequal areolæ at their inner ends 4 in .01 mm., and from 3 to $3\frac{1}{2}$ times as long as broad, beyond this band 6, decreasing rapidly outwards to 10 in .01 mm.; the intervals expanding slightly outwards and of uniform breadth, reaching the border.

This species is distinguished from *A. concinna* by the shape of the inner ends of the compartments and from *A. vulgaris* by their regularity.

Habitat.—Barbados deposit (Greville! Hardman!).

A. eximia. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 99, pl. viii. fig. 10.—Diam. $\cdot 0875$ to $\cdot 15$ mm. Central rosette distinct, a central areolate area about $\cdot 036$ mm. broad. Markings: on central area unequal areolæ 2 to $2\frac{1}{2}$ in $\cdot 01$ mm.; rays 22, straight; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends convex, bounded by a single band of large areolæ about 3 in $\cdot 01$ mm., and gradually decreasing in length from the radii outwards, elsewhere the areolæ quadrate, decreasing gradually from 3 to 4 in $\cdot 01$ mm.; intervals of equal breadth throughout, their outer ends convex, reaching close to the border.

Habitat.—Cambridge deposit, Barbados (Hardman); Chalky Cliff, Barbados (Deby!).

A. concinna. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 46, pl. vii. figs. 10–12.—Diam. $\cdot 075$ to $\cdot 1$ mm. Central areolate area absent. Markings: rays straight, springing from centre; the compartments reaching from $\frac{1}{3}$ to $\frac{1}{2}$ of radius inwards, their inner ends transversely truncate or slightly convex, bounded by a single band of large areolæ 4 in $\cdot 01$ mm. at their inner ends, sometimes a single large areola at each of the centro-lateral angles of the compartments; elsewhere the markings 6, decreasing gradually outwards to 8 in $\cdot 01$ mm.; the intervals expanding slightly outwards, their outer ends convex, reaching close to the border.

Habitat.—Barbados deposit (Greville!).

A. vulgaris. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 47, pl. vii. figs. 17–20.—Diam. $\cdot 0375$ to $\cdot 055$ mm. A central areolate area sometimes present. Markings on central area unequal, about 4 in $\cdot 01$ mm., rarely a single round areola only present; rays straight; the compartments reaching from $\frac{1}{3}$ to $\frac{1}{4}$ of radius inwards, their inner ends concave at the middle, bounded by a distinct band of large areolæ about 4 in $\cdot 01$ mm., those at the centro-lateral angles largest, and protruding into the interradial spaces with their central ends rounded, sometimes those of the adjacent compartments expanding towards one another at their inner ends so as almost to exclude the intervals; elsewhere the areolæ 8 to 10 in $\cdot 01$ mm.; the intervals expanding for some distance outwards, their outer ends sometimes reaching close to the border, convex outwards.—

A. vulgaris, var. *a*, Grev., *ibid*, 1862, p. 47; *A. vulgaris*, var. *b*, Grev., *ibid*, p. 47, pl. vii. fig. 21; Eul., *Diat. Spec. Typ.*, No. 16.

Rarely in valves from Cambridge deposit, Barbados, the areolæ on the central area are unequal and much larger, from $1\frac{1}{4}$ to $1\frac{1}{2}$ in $\cdot 01$ mm., and are disposed subconcentrically towards its outer margin.

Habitat.—Barbados deposit (Greville! Hardman! Eulenstein!) locality? (Deby!); Springfield deposit, Barbados (Hardman!); Cambridge deposit, Barbados (Hardman!); Oamaru deposit (Grove! Deby!).

Var. *planior*. *A. vulgaris*, var. *c*. Grev., *ibid*, 1862, p. 47, pl. vii. fig. 22.—Diam. $\cdot 07$ mm. Central area distinct, subcircular, from $\frac{1}{4}$ to $\frac{1}{2}$ of diam. broad. Markings on central area $2\frac{1}{2}$ to 3 in $\cdot 01$ mm., unequal; the compartments reaching about $\frac{2}{7}$ of radius inwards, the largest centro-lateral areolæ but slightly protuberant, sometimes bulging laterally towards their inner ends; the intervals clavate, their outer ends convex, close to the border.

Habitat.—Barbados deposit (Greville! Grove!).

Var. *cellulosa*. *A. vulgaris*, var. *d*. Grev., *ibid*, 1862, p. 47, pl. vii. fig. 23; pl. viii. fig. 24.—Diam. $\cdot 055$ to $\cdot 1$ mm., central area subcircular, from $\frac{1}{3}$ to $\frac{2}{3}$ of diam. broad, a central rosette sometimes distinct. Markings on central area subequal, 4 in $\cdot 01$ mm., without order or in obscure oblique decussating rows; the compartments reaching from $\frac{1}{4}$ to $\frac{2}{3}$ of radius inwards, the band of areolæ at their inner ends extending outwards almost to border, about 4 in $\cdot 01$ mm. across; the marginal areolæ protruding slightly at their central inwardly convex ends.

Habitat.—Barbados deposits (Greville! Deby! Grove!).

A. decorata. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 46, pl. vii. fig. 13.—Diam. $\cdot 08$ mm. Central areolate area absent. Markings: rays straight, the compartments reaching about $\frac{1}{4}$ of radius inwards, their inner ends transversely truncate, bounded by a single band of oblong areolæ 2 to $2\frac{1}{4}$ in $\cdot 01$ mm. broad and about $\cdot 01$ mm. long, those opposite the rays with long axis radial, the others becoming more and more oblique, those at the angles of the compartments $\cdot 0175$ mm. long, with outer ends attenuated; the

remaining areolæ decreasing gradually outwards from 6 to 9 in $\cdot 01$ mm.; the intervals expanding gradually outwards, their outer ends swollen, knob-like, reaching close to the border.

Habitat.—Barbados deposit (Greville!).

A. splendida. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 48, pl. viii. fig. 25.—Diam. $\cdot 09$ mm. Central areolate area distinct. Markings on central area unequal, about $2\frac{1}{2}$ in $\cdot 01$ mm.; rays straight, or but slightly arcuate, many; the compartments reaching about $\frac{1}{3}$ of radius inwards, their inner ends concave, bounded by a band of large areolæ $3\frac{1}{2}$ in $\cdot 01$ mm. broad, and extending outwards almost to the border, those at the edges of the compartments with inner ends protuberant and rounded; close to the border the areolæ obscure, subpunctiform, 12 in $\cdot 01$ mm.; the intervals of uniform ($\cdot 0025$ mm.) width, their outer ends close to the border, convex outwards.—*A. vulgaris*, var. *e.*, Grev., *ibid*, 1862, p. 47.

The great length of the areolæ at the inner ends of the compartments at once distinguishes this species from *A. vulgaris*, to which Greville united it with some hesitation.

Habitat.—Barbados deposit (Greville!).

A. uraster. Grove and Sturt, *Jour. Quek. Micr. Cl.*, 1887, p. 143, pl. xiii. fig. 42.—Diam. $\cdot 06$ mm. Central areolate area distinct. Markings on central area large, 2 to $2\frac{1}{2}$ in $\cdot 01$ mm.; rays straight, two passing to the apex of one of the compartments; the compartments reaching from $\frac{2}{3}$ to $\frac{3}{4}$ of radius inwards, conical, their inner ends obtusely angular, the areolæ evident, decreasing but slightly outwards, from $5\frac{1}{2}$ to 6 in $\cdot 01$ mm.; the intervals broad, attenuating somewhat outwards, not reaching the border; a minute round granule (apiculus?) at the outer end of each.

The apex of the compartment that receives the two radii is somewhat obliquely truncate, and slightly concave towards the centre.

Habitat.—Oamaru deposit (Gray).

A. rylandsiana. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 49, pl. viii. figs. 28, 29.—Diam. $\cdot 04$ to $\cdot 05$ mm. Central areolate area about $\cdot 01$ mm. broad. Markings on central area subequal, about 3 in $\cdot 01$ mm.; rays 7 to 12, straight, or but slightly flexed; the

compartments reaching about $\frac{3}{10}$ of radius inwards, their inner ends transversely truncate, or slightly convex towards the centre, their adjacent sides formed by a large cuneate areola, distinctly protruding by an inwardly convex inner end into the interradian space and attenuating towards the border, elsewhere the areolæ evident, decreasing rapidly outwards from 4 to 8 in .01 mm.; the intervals obsolete. Border narrow, indistinct.

Habitat.—Barbados deposit (Greville! T. G. Rylands, de Brébisson, Grove!); Springfield deposit, Barbados (Hardman!).

A. tenerrima,* sp. n.—Diam.? Central areolate area absent. Markings: rays 4 to 7, straight; the compartments reaching from $\frac{3}{8}$ to $\frac{1}{2}$ of radius inwards, their inner ends concave towards centre or transversely truncate; a single band of large areolæ bounding the inner ends, outside of this a single large lanceolate areola extending close to the border bounding the interval; elsewhere the areolæ small, evident, in distinct radial and less manifest subregular concentric zones; intervals extending to border of uniform width.—(Pl. III. figs. 18, 20.)

Habitat.—?

A. affinis. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 45, pl. vii. figs. 7-9.—Diam. .0675 to .1175 mm. Colour pale grey, the rays more opaque. Central areolate area from .0125 to .0175 mm. broad, sometimes absent; a small central space rare. Markings on central portion 2 in .01 mm., hyaline; rays straight or slightly flexuous towards the inner ends; the compartments reaching from

* This species is established on two specimens occurring in a photograph now in the possession of Mr Julien Deby, the history of which is given in a letter addressed to him by Herr E. Weissflog dated 27th July 1878. Herr Weissflog says:—"I have received a letter from Mr F. Habirshaw of New York, in which he says—'The late John E. Gavit . . . engraved the fine plate in Bailey's "New Species," &c. (Smith's *Contrib.*). He also some years ago made a plate which suddenly disappeared—neither plate nor impressions could be found. In overhauling the effects of Judge Johnson (of *Asterodiscus* in *Silliman's Jour.*) two impressions were found, and it is believed that they are the only two extant. A few days since we photographed the one sent us, and we hope that you will be pleased with the result. If there are more wanted, I would like MM. Deby and Delogne to have copies.' Herewith you will find two proofs, and you will oblige much by remitting one to M. Delogne." Nothing further is known of the specimens. They seem, however, to come from the Barbados deposit.

$\frac{1}{4}$ to $\frac{1}{2}$ of radius inwards, their inner ends slightly angular towards centre or transversely truncate, the areolæ decreasing but slightly towards the border, the outermost row more conspicuous; the intervals of equal breadth throughout, their outer ends reaching the border. Border narrow, hyaline.

Habitat.—Barbados deposit (Johnson! Deby!); Oamaru deposit (Grove!); Newcastle estate, Barbados (Grove!).

A. decora. Grev., *Trans. Micr. Soc. Lond.*, 1862, p. 45, pl. vii. figs. 4–6.—Diam. $\cdot 04$ to $\cdot 1375$ mm. Central space subtriangular or absent, central areolate area distinct, up to $\cdot 02$ mm. broad. Markings on the central area unequal, 2 to 3 in $\cdot 01$ mm., those around its edges largest; rays 5 to 19, straight, sometimes meeting at the centre; the compartments reaching about $\frac{1}{4}$ of radius inwards, their inner ends slightly concave or convex towards the centre, the areolæ at their inner ends largest, 4 in $\cdot 01$ mm., the others decreasing rapidly outwards from 6 to 10 in $\cdot 01$ mm.; the intervals of uniform breadth, reaching close to the border.—*A. decora*, var. Cstr., *Diat. Chall. Exped.*, 1886, p. 136, pl. xvi. fig. 9.

In the variation in size of the areolate central area this species approaches the forms of *A. vulgaris* and *A. rylandsiana*. The size of the markings on the compartments is less, according as the specimens decrease in size.

Habitat.—Cambridge deposit, Barbados (Greville! Hardman!); "Barbados" deposit (Greville!); Springfield deposit, Barbados (Hardman!); Oamaru deposit (Deby! Grove! Hardman!).

Var. *concentrica*, nov.—Diam. $\cdot 095$ to $\cdot 125$ mm. Central areolate area from $\cdot 0375$ to $\cdot 065$ mm. broad, a rosette sometimes evident. Markings on central area $1\frac{1}{2}$ to 2 in $\cdot 01$ mm., with central dots large, and in evident concentric, less evident radial rows; rays many; at middle of interradial space a distinct hyaline area, with inner end close to border of central area; the compartments reaching from $\frac{1}{3}$ to $\frac{2}{3}$ of radius, areolæ obvious, 4 to 8 in $\cdot 01$ mm.; the intervals gradually increasing in breadth outwards, their outer ends transversely truncate.

Habitat.—Oamaru deposit (Grove! Hardman! Deby!); Cambridge deposit, Barbados (Johnson!).

A. Weissflogii. Van Heurck, *Syn. Diat. Belg.*, pl. cxxvii. fig. 9.—
 Diam. .06 mm. Central space minute, irregular. Markings: rays
 6, straight, robust; at middle of interradial spaces faint subhyaline
 areas about .0025 mm. broad, extending between central space and
 intervals; the compartments distinct, extending from $\frac{1}{3}$ to $\frac{5}{12}$ of
 radius inwards, their inner ends concave inwards on each side of, but
 protuberant opposite the rays; delicate, radial, subindefinite, faint
 striæ, about .0025 mm. long fringing their inner edge; a somewhat
 larger more prominent areola at the centro-lateral angles; elsewhere
 the markings punctiform, obscure; the intervals sharply defined,
 tapering slightly towards, but not reaching the border with outer
 ends convex outwards; a delicate, irregularly sinuate, continuous
 zone of unequal breadth contiguous to the inner ends of the com-
 partments. Border about $\frac{1}{12}$ to $\frac{1}{15}$ of radius broad, its inner edge
 sharply defined, hyaline.—Pelletan, *Les Diat. Nat. Hist.*, tom. i.
 p. 206, fig. 112; tom. ii. fasc. i. p. 170, fig. 427; *A. (pulchra, var.?)*
Weissflogii, Grun.; Van Heurck, *loc. cit.*

In some specimens the outer ends of the intervals between the
 compartments are not swollen, as shown in Professor Van Heurck's
 figure.

Habitat.—Barbados deposit (Deby!); Cambridge deposit, Bar-
 bados (Van Heurck).

Artificial Key.

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|----|---|---|-------------------------|
| 1. | { | Rays straight or subuniformly curved, springing from a somewhat excentric point, | <i>brightwelliana</i> . |
| | | No such excentricity, | 2. |
| 2. | { | A large central areolate area; rays short, numerous, compartments convex inwards; intervals sub- obsolete, | <i>marginata</i> . |
| | | No such structure, | 3. |
| 3. | { | Compartments obtusely conical, ornamented with distinct subradial dichotomising lines, | <i>rafsiana</i> . |
| | | No such markings on the compartments, | 4. |
| 4. | { | Rays obsolete or subobsolete or broad; interradial spaces small, | 5. |
| | | Rays narrow, sublinear; valve subpearly, | 6. |
| | | Rays linear; valve more hyaline, | 7. |
| | | Rays broad, subclavate, passing between central space and intervals between compartments, with inner ends convex to centre, | <i>nicobarica</i> . |
| 5. | { | Interradial spaces tapering towards centre, | 8. |
| | | Interradial spaces tapering towards border; a distinct round granule adjacent to border opposite outer end of each, | <i>dubia</i> . |

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| 8. | { | Interradial spaces with outer ends trilobate; the median lobes homologous to subobsolete intervals between the compartments; a central hyaline area sometimes present; radii sometimes broad, | <i>ambigua.</i> |
| | | Interradial spaces with inner ends acute; a small round central granule and one at outer end of each interval. Border broad, inner edge angular, | <i>aliena.</i> |
| 6. | { | Central area granular or subareolate, | 9. |
| | | Central area hyaline, without markings, | 10. |
| 9. | { | Inner ends of compartments with short distinct radial lines, | 11. |
| | | No such radial lines. Markings on compartments obscure, at each side of the outer ends of the intervals a minute granule, | <i>kittoniana.</i> |
| | | No such radial lines. Compartments with inner ends faint, an outwardly concave row of minute puncta stretching between outer extremities of adjacent intervals, | <i>traducens.</i> |
| 11. | { | One portion of compartments areolate; no granules at outer ends of intervals, | <i>aemulans.</i> |
| | | Outer portion of compartments subhyaline or obscurely punctate, a distinct oval granule at one or both sides of outer ends of intervals, | <i>pulchra.</i> |
| 10. | { | Markings on compartments obscure, a small round granule opposite the outer end of each interval, | <i>stellulata.</i> |
| | | A distinct areola at centro-lateral angle of each compartment, hardly protuberant into interradian space, | <i>scutula.</i> |
| 7. | { | A band of large areolæ at inner ends of compartments, | 12. |
| | | No such areolate band, | 13. |
| 12. | { | The band of large areolæ prominent, 2 to 2½ in .01 mm., the lateral areolæ of each compartment not protuberant; inner ends of compartments convex inwards; the intervals expanding gradually outwards. No central areolate area, | <i>decorata.</i> |
| | | The areolæ still longer and narrower (3½ in .01 mm. across), the lateral areolæ protuberant; inner ends of compartments concave towards centre, intervals not expanding outwards. A central areolate area, | <i>splendida.</i> |
| | | The limiting band of areolæ less prominent but distinct, | 14. |
| 14. | { | Inner ends of compartments transversely truncate or convex towards centre, | 15. |
| | | Inner ends of compartments distinctly concave towards centre, | 16. |
| | | Inner ends of compartments transversely truncate or concave towards centre. A single large lanceolate areola bounding each side of the intervals between compartments. No central areolate area, | <i>tenerrima.</i> |
| | | Inner ends of compartments concave inwards on each side of rays; a delicate irregularly sinuate zone contiguous to inner ends of compartments, a minute irregular central space, | <i>Weissflogii.</i> |

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| 15. | { | Lateral areolæ larger, non-protuberant; intervals expanding slightly outwards. No areolate central area, | <i>concinna</i> . |
| | | Lateral areolæ not larger; intervals of uniform breadth; a central areolate area, | <i>decora</i> . |
| | | Lateral areolæ not larger, but larger areolæ at inner ends of compartments, gradually decreasing away from the rays; a central rosette; compartments with inner ends convex; intervals of equal breadth, Lateral areolæ not larger. Compartments with inner ends mostly convex. No areolate central area. Intervals expanding somewhat outwards, | <i>eximia</i> . |
| 16. | { | Lateral areolæ protuberant, | 17. |
| | | Lateral areolæ non-protuberant; intervals expanding slightly outwards. No central areolate area, | <i>crenata</i> . |
| 17. | { | Intervals narrow, frequently almost occluded at the inner ends. A central areolate area, | <i>vulgaris</i> . |
| | | Intervals narrow, sometimes expanding outwards; contiguous to the large areolæ, a narrow hyaline band, concave towards border, | <i>simulans</i> . |
| 18. | { | Intervals between compartments obsolete, a large subcuneate areola at sides of each compartment, and contiguous to that of adjacent compartments, | <i>rylandsiana</i> . |
| | | Intervals present. No such subcuneate areolæ, | 18. |
| 18. | { | Markings on compartments subgranular, few towards their inner ends, | <i>punctata</i> . |
| | | Markings on compartments areolate throughout, | 19. |
| 19. | { | No central areolate area, | 20. |
| | | A central areolate area present, | 21. |
| 20. | { | A subasteromphaloid centro-lateral area differentiated; inner ends of compartments transversely truncate; intervals attenuating outwards, | <i>dallasiana</i> . |
| | | No such subasteromphaloid area, | 22. |
| 22. | { | Rays sharply bigeniculate beyond their middle; compartments with inner ends slightly swollen, faint lines passing inwards a short distance from their inner ends, | <i>brebissoniana</i> . |
| | | Rays straight, | 23. |
| 23. | { | A circular hyaline central space; compartments with inner ends convex centrally, the intervals of uniform breadth, reaching $\frac{2}{3}$ of radius from centre, | <i>balearica</i> . |
| | | Compartments with inner ends transversely truncate to slightly concave inwards; intervals short, extending to half length of compartments, | <i>lævis</i> . |
| | | Compartments with inner ends somewhat obliquely truncate; intervals of equal breadth, outer ends close to border. Rays sometimes dichotomous, | <i>rotula</i> . |
| 21. | { | Compartments with inner ends transversely truncate, to concave; rays straight or curved, frequently branching 2 to 4 times before reaching half distance to compartments, | <i>princeps</i> . |
| | | Two rays passing to apex of one of the compartments, an apiculus at outer end of each interval, | <i>uraster</i> . |
| | | No such radii, | 24. |

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|-----|---|--|-------------------|
| 24. | { | Central areolate area inconspicuous—represented by two areolæ; rays sometimes dichotomous; compartments with inner ends curved or flattened on opposite sides of rays, the areolæ obscure or unresolved, | <i>Grevillei.</i> |
| | | Central areolate area sometimes large; compartments with inner ends concave to truncate, areolæ obvious, | <i>affinis.</i> |

ASTEROMPHALUS.

Ehrb. Emend., *Mon. Ber. Ak.*, 1844, p. 198.—Circular, more rarely flabelliform, oval, or suboblong. Colour pale grey or subhyaline, inconspicuous. A centro-lateral area distinct, extending to or slightly beyond the middle of the clear area, rarely quite across the latter—ovate, clavate, or with sides somewhat deeply constricted. Markings: rays distinct, simple or dichotomous, extending from the apex or also from the sides of the centro-lateral area, straight, arcuate, flexuous or sharply bigenulate, sometimes with short lateral rami passing obliquely outwards from the geniculations; interradial spaces hyaline, or with a subdistinct median area, continuous with the intervals between the compartments; the compartments equal or unequal, their inner ends convex, obliquely to transversely truncate or concave; areolæ distinct or inconspicuous, the outermost row most manifest; intervals between the compartments tapering slightly outwards, or of uniform width, their outer ends rarely expanded, sometimes not reaching border; a subobsolete interval distinct, straight, rarely distinctly arcuate; sometimes an obscure granule (apiculus?) at outer ends of intervals. Border narrow, hyaline.—*Spatangidium*, de Bréb., *Bull. Soc. Linn. Normand.*, 1857, p. 296; *Asterolampra*, Grev., *pro parte, Trans. Micr. Soc. Lond.*, 1860, p. 102; *Mesasterias*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 392; *Actinogramma*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 254.

§ 1. OBSCURI.

The outer ends of the rays penetrating a short distance into the apices of the compartments; the intercompartmental intervals prolonged as definitely marked areas to the centre.

Astreom. centraster. Johnston, *Quart. Jour. Micr. Sci.*, 1860, p. 12, pl. i. fig. 10.—Diam. about .072 mm. Colour of compart-

ments pale buff. Markings: rays straight, narrow, meeting near centre the inner ends of the intercompartmental areas, their outer ends knob-like, and reaching about $\frac{3}{7}$ of radius from centre; the compartments extending to about semiradius, their inner ends convex, inwards; the intervals attenuating slightly outwards, their outer ends swollen knob-like, reaching close to the border.—Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 124; Ralfs in *Pritch. Inf.*, p. 838.

One of the intercompartmental areas is more developed than the others at its inner end, but the outer portion of the same area is not subobsolete, as is usual in *Asteromphalus*.

Habitat.—Elide guano (Johnson).

§ 2. CENTRALES.

Clear, median portion of valve not markedly excentric. Rays straight, arcuate or geniculate; compartments with inner ends concave or convex towards centre, sometimes transversely or obliquely truncate; intervals rarely markedly expanded towards their outer ends.

Asterom. wallichianus. Ralfs in *Pritch. Inf.*, p. 837.—Rarely roundly elliptical. Diam. .0375 to .055 mm. Centro-lateral area V-shaped. Markings: rays 5 or 6, straight, diverging from centre; the compartments reaching to about semiradius, their inner ends transversely truncate or slightly concave towards centre; the concavity subconcentric with the circumference; the areolæ distinct; the intervals of uniform width, extending close to border; the subobsolete interval attenuating rapidly outwards.—Cleve, *Bih. k. Sv. Vet.-Ak. Handl. Stockh.*, 1873, Bd. 1, No. 11, p. 5, pl. i. fig. 1; *Asterolampra wallichiana*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 115, pl. iv. fig. 11.

Faint lines pass towards the centre on the interradial spaces from the inner angles of the compartments.

Habitat.—"Bermuda tripoli" (E. W. Dallas); Nottingham deposit, Maryland (Greville!); Santa Monica deposit (Hardman!).*

Astreom. variabilis, nov. *Asterolampra variabilis*. Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 111, pl. iii. figs. 6-8.—Diam. .07 to .125

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mm. Centro-lateral area V-shaped, with inner end obtuse or subacute, sometimes reaching the centre. Markings: rays substraight or somewhat curved, well-defined, frequently dichotomous, sometimes meeting in a small semicircular line curving round the centre; the compartments reaching from $\frac{2}{3}$ to $\frac{3}{4}$ of radius inwards, their inner ends obliquely truncate, on each side of rays straight or slightly concave towards the centre; areolæ distinct, decreasing gradually outwards from 5 to 8 in .01 mm.; the intervals straight or slightly arcuate, their outer ends convex outwards, sometimes hardly reaching the border.

Habitat.—Monterey stone (Greville! Arnott! Kitton!);* Santa Monica deposit (Grove!).

Asterom. Hookerii. Ehrb., *Mon. Ber. Ak.*, 1844, p. 200, pl. (June) fig. 3.—Diam. .064 mm. Centro-lateral area with sides straight, parallel or slightly concave outwards, sometimes suddenly contracting near the subobsolete interval, its inner end conical. Markings: rays straight; the compartments reaching from $\frac{1}{2}$ to $\frac{3}{8}$ of radius inwards, their inner ends rounded; areolæ delicate; the intervals attenuating slightly outwards, reaching the border.—Ehrb., *Mikrog.*, pl. xxxv. A. 21. fig. 2; Ralfs in *Pritch. Inf.*, p. 836, pl. xi. fig. 34; *A. Buchii*, Ehrb., *ibid.*, 1844, p. 200, pl. (June) fig. 4,—7 rays; *A. Cuvierii*, Ehrb., *ibid.*, 1844, p. 200, pl. (June) fig. 7,—9 rays; *Mikrog.*, pl. xxxv. A. 21. fig. 1; Janisch, *Abh. Schl. Ges. väter. Cult.*, 1861, p. 160; *A. Humboldtii*, Ehrb., *ibid.*, 1844, p. 200, pl. (June) fig. 6,—8 rays; *Mikrog.*, pl. xxxv. A. 21, fig. 3; Janisch and Rabenh., *Beitr.*, p. 4, pl. iii. fig. 11; Sch., *Atl.*, pl. xxxviii. figs. 18–20; *Asterolampra Hookerii*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 114.

Habitat.—Pancake ice, Antarctic Ice Barrier, lat. 78° 10' S., long. 162° W.; lat. 75° S., long. 170° W.; lat. 64° S., long. 160° W. (J. D. Hooker); Peruvian guano (Janisch); H.M.S. Challenger, lat. 53° 55' S., long. 108° 35' E., 1950 fathoms (Grove! Rae!).

Asterom. shadboltianus. Ralfs in *Pritch. Inf.*, p. 838.—Diam. .0775 mm. Centro-lateral area ovate, attenuating rapidly towards its outer end, angular at the centre. Markings: rays 5, straight, or with a small geniculation near their middle; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends transversely

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truncate, those bordering the subobsolete interval more oblique and concave inwards at the middle; areolæ delicate, decreasing outwards from 9 to 14 in $\cdot 01$ mm.; the intervals attenuating slightly outwards, their outer ends expanded and knob-like, not reaching the border.—*Asterolampra shadboltiana*, Grev., *Trans. Micr. Soc. Lond.*, 1860 p. 121, pl. iv. fig. 19.

Distinguished from *A. Brookei* by the outline of the centro-lateral space, the less marked geniculation of the radii, and the relatively shorter intervals between the compartments.

Habitat.—Indian Ocean soundings, 2200 fathoms, Captain Pullen (Greville!); Mejillones (Grove!).

Asterom. roperianus. Ralfs in *Pritch. Inf.*, p. 838.—Diam. $\cdot 07$ to $\cdot 165$ mm. Centro-lateral area with inner end angularly rounded, the sides sharply constricted and expanding thence to their outer ends. Markings: rays bigeniculate at their middle; the flexions more pronounced on the rays proceeding from the sides than on those passing from the extremity of the centro-lateral area; the compartments reaching to $\frac{2}{3}$ of radius inwards, their inner ends transversely truncate, those adjacent to the subobsolete interval more oblique; areolæ 12 to 16 in $\cdot 01$ mm., obscure; the intervals broad, their edges parallel, the outer ends sometimes slightly expanded, not reaching the border.—Sch., *Atl.*, pl. xxxviii. fig. 15; *Asterolampra roperiana*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 120, pl. iv. fig. 14; *Mesasterias abyssi*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 392, pl. ix. fig. 7.

Habitat.—Indian Ocean soundings, 2200 fathoms, Captain Pullen (Roper! * Greville!); Mejillones guano (Deby! Grove!).

Asterom. Brookei.† Bail., *Amer. Jour. Sci.*, vol. xxii. ser. 2, 1856, p. 2, pl. i. fig. 1.—Diam. $\cdot 0725$ to $\cdot 075$ mm. Centro-lateral area with a median constriction, its central end sometimes transversely truncate or subrotund. Markings: rays straight or slightly flexuous, sometimes sharply bigeniculate towards their outer extremities, with short lateral rami proceeding from the angles; the compartments reaching from $\frac{2}{3}$ to $\frac{1}{2}$ of radius inwards, their inner ends transversely truncate or slightly concave inwards, some-

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† Named in honour of Lieut. Brooke of the U.S. Navy.

times obtusely rounded; those bordering the subobsolete interval with the inner ends more oblique and slightly concave inwards; the areolæ evident, decreasing gradually outwards, from 8 to 10 in .01 mm.; the intervals tapering gradually outwards, their outer ends convex, reaching close to the border.—Ralfs in *Pritch. Inf.*, p. 837, pl. v. fig. 79; Cleve, *Bih. k. Sv. Vet.-Ak. Handl. Stockh.*, 1873, Bd. i. No. 13, p. 10; Sch., *Atl.*, pl. xxxviii. figs. 21–23; *Asterolampira Brookei*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 119, pl. iv. fig. 18; *Actinogramma Brookei*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 254.

Habitat.—Sea of Kamtschatka, 1700 fathoms (Bailey!); Behring Sea, 1158 fathoms (H. L. Smith!); Atlantic soundings (Roper); Santa Monica deposit; (Deby!) loc.? (Grove!).

Var. *robusta*, nov. *A. robustus*, Cstr., *Atti Accad. Pontif. nuov. Lincei*, 1875, p. 393, pl. vi. fig. 5.—Rotundato-obovate. Markings: rays sharply bigenulate at their middle; the compartments reaching from $\frac{2}{3}$ to $\frac{1}{2}$ of radius inwards, the inner ends of those adjacent to subobsolete interval transversely truncate, of the others somewhat concave inwards; intervals broad, with sides parallel reaching the border.—*A. (Brookei, var.?) robustus*, Pérangolo, *Diat. Baie Villefranche*, p. 75, pl. ii. fig. 15.

Habitat.—Mediterranean Sea (Castracane).

Asterom. Beaumontii, Ehrb., *Mon. Ber. Ak.*, 1844, p. 200, fig. 5.—Diam. .04 mm. Centro-lateral area with sides parallel, and inner ends conical. Markings: rays sharply bigenulate at their middle, the compartments reaching about $\frac{2}{3}$ of radius from circumference, conical, with inner ends obtusely angular; areolæ distinct, from 6 to 8 (?) in .01 mm.; intervals between compartments attenuating gradually outwards, reaching the border.

From this species I exclude *Spatangidium heptactis*, de Bréb. (*Bull. Soc. Linn. Normand.*, 1857, p. 292, pl. iii. fig. 2); *S. ralfsianum*, Norman (not Grev.), *Quart. Jour. Micr. Sci.*, 1859, p. 161, pl. vii. figs. 7, 8); and *Asterolampira heptactis*, Grev. (*Trans. Micr. Soc. Lond.*, 1860, p. 122), which Janisch (*Abh. Schl. Ges. väter. Cult.*, 1861, p. 160) has proposed to unite with it. Janisch also proposes to unite to *Asterom. Beaumontii* the forms figured by

Schmidt (*Atl.*, pl. xxxviii. figs. 6, 7), which belong rather to *Asterom. heptactis*.

Habitat.—Pancake ice (Pfankuchen Eise), Ice Barrier, Antarctic Ocean, lat. 78° 10' S., long. 162° W. (J. D. Hooker); H.M.S. Challenger (Deby!).

Asterom. moronensis, Rattray. *Asterolampra moronensis*, Grev., *Quart. Jour. Micr. Sci.*, 1863, p. 230, pl. ix. fig. 8.—Diam. .06 to .075 mm. Centro-lateral area with sides at first almost parallel, and then converging rapidly so as to meet about half way between centre and apices of compartments, beyond the point of union a simple line passing to the centre. Markings: rays sharply geniculate at or slightly beyond their middle, short lateral rami passing obliquely outwards from the geniculations; the compartments reaching from $\frac{2}{3}$ to $\frac{5}{8}$ of radius inwards, their inner ends obliquely truncate, straight or slightly concave towards the centre, those adjacent to the subobsolete interval with one side much longer than the other; the areolæ obvious, decreasing outwards from 6 to 10 in .01 mm., the oblique decussating rows straight or slightly curved at their inner ends; the intervals narrow, expanding gradually towards their outer ends, which reach close to the border, at the middle of the expanded portion a distinct radial dark subconical area.—Sch., *Atl.*, pl. xxxviii. fig. 24.

Habitat.—Moron deposits near Seville (Greville! Hardman! Norman!);* Santa Monica deposit (Hardman! Deby!).

§ 3. EXCENTRIC.

Sometimes elliptical, rarely suboblong. Clear median portion of valve sometimes markedly excentric; the centro-lateral area extending beyond the centre often subclavate, sometimes malleiform. The subobsolete ray rarely arcuate, the others straight or curved; a lunate ridge sometimes visible at outer ends of rays.

Asterom. wyville-thomsonianus. O'Me., *Jour. Lin. Soc.* (Botany), vol. xv. p. 57, pl. i. fig. 5.—Diam. .06 mm. Central areolate area absent. Markings: rays 6, straight; the compartments 6, five equal smaller, reaching about $\frac{2}{3}$, the sixth larger reaching about $\frac{3}{4}$ of radius inwards, their inner ends uniformly convex towards the

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centre; areolæ distinct; intervals attenuating gradually outwards, reaching the border.

Habitat.—Kerguelen Island, H.M.S. Challenger (O'Meara).

Asterom. stellatus. Ralfs in *Pritch. Inf.*, p. 838.—Diam. .045 to .07 mm. Centro-lateral area elongate, faintly subclavate with slight median constriction. Markings: rays straight or slightly curved, springing from apex and side of centro-lateral area, sometimes dichotomous; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends conical, with sides slightly convex; areolæ obscure, decreasing outwards from 14 to 20 in .01 mm., most evident near the apices of the compartments; the intervals rapidly attenuating outwards, reaching close to the border.—*Asterolampira stellata*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 124, pl. iv. fig. 20.

This species approaches *A. hiltonianus*, but is distinguished by the more straight radii, which are never geniculate; in the appearance of the centro-lateral area it comes near to *A. elegans*.

Habitat.—Indian Ocean, soundings 2200 fathoms, Captain Pullen (Greville!); *Holothuria*, China (Deby!).

Asterom. elegans. Grev., *Quart. Jour. Micr. Sci.*, 1859, p. 161, pl. vii. fig. 6.—Diam. .075 to .14 mm. Centro-lateral area elongate, its inner end rounded, straight or somewhat bent near the subsolete ray. Markings: rays simple, dichotomous, rarely branching, more frequently with sharp, rarely obtuse geniculations near their middle or somewhat closer to the central area; the compartments conical, their inner ends subacute; the areolæ most evident at the inner ends, elsewhere obscure, decreasing outwards from 12 to 16 in .01 mm.; intervals narrow, attenuating outwards, their outer ends close to the border.—Ralfs in *Pritch. Inf.*, p. 837, pl. v. fig. 87.; Sch., *Atl.*, pl. xxxviii. figs. 1, 2; *Asterolampira elegans*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 118, pl. iv. fig. 16; *Actinogramma Jupiter*, Ehrb., *Abh. Ber. Ak.*, 1872, p. 392, pl. ix. fig. 3; *Ac. Venus*, Ehrb., *ibid.*, pl. ix. fig. 4; *Ac. Saturnus*, Ehrb., *ibid.*, pl. ix. fig. 5; *Ac. Sol*, *ibid.*, pl. ix. fig. 6.

Habitat.—Indian Ocean soundings, 2200 fathoms, Captain Pullen (Greville!); Californian guano (Norman!);* dredged by

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H.M.S. Challenger, lat. $5^{\circ} 54' N.$, long. $147^{\circ} 2' W.$, 2550 fathoms (Hardman!);* Indian Ocean (Ralfs); Gazelle Expedition (Janisch); S.S. Buccaneer, off Ascension Island (Grove!).

Asterom. imbricatus. Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 46, pl. ii. fig. 9.—Roundly elliptical to subcircular. Diam. $\cdot 06$ to $\cdot 085$ mm. Centro-lateral area clavate, widest at its extremity or somewhat nearer to the narrow end, frequently extending across and beyond the centre of the valve. Markings: rays sharply bigeniculate at their middle, the geniculations regular, forming a distinct roundly elliptical figure around the centro-lateral area; the compartments reaching about $\frac{1}{3}$ of radius inwards, their inner ends conical, with sides convex, those adjacent to the subobsolete ray with ends obliquely truncate; areolæ obscure, subpunctiform; intervals narrow, at first attenuating, then subequal in breadth, their outer ends convex outwards, reaching close to border.—Ralfs in *Pritch. Inf.*, p. 837; *Asterolampra imbricata*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 119, pl. iv. fig. 17.

Wallich distinguishes as var. β , forms with "plani sutures," *i.e.*, non-geniculate rays, and as var. γ , forms with "the capitate extremity of the basal ray," *i.e.*, of the centro-lateral area emarginate. To his former var. the name *rectiradiata* may be given; the latter is unimportant.

Habitat.—Indian Ocean soundings, 2200 fathoms, Captain Pullen (Greville!); Bay of Bengal (Wallich); Natal (Roper).

Asterom. hiltonianus. Ralfs in *Pritch. Inf.*, p. 837.—Diam. $\cdot 075$ to $\cdot 135$ mm. Centro-lateral area slightly constricted at its outer $\frac{1}{3}$, sometimes attenuating gradually towards its outer end. Markings: rays springing from apex and sides of centro-lateral area, straight or subuniformly arcuate, sometimes geniculate about their middle, and concave towards the subobsolete interval, rarely dichotomous opposite central end of centro-lateral area; the compartments reaching about $\frac{2}{3}$ of radius inwards, their inner ends sharply conical, those adjacent to the subobsolete interval somewhat more obtuse, with sides somewhat convex; areolæ obscure, 20 to 24 in $\cdot 01$ mm., towards border resolved with difficulty; the

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intervals attenuating rapidly outwards, reaching close to the border.—*Asterolampra hiltoniana*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 117, pl. iv. fig. 15; H. L. Smith, *Diat. Spec. Typ.*, No. 49.

Habitat.—Indian Ocean soundings, 2200 fathoms, Captain Pullen (Greville! Roper!); Algoa Bay guano (Greville!); South Pacific, 2900 fathoms (H. L. Smith!).

Asterom. flabellatus. Grev., *Quart. Jour. Micr. Sci.*, 1859, p. 160, pl. vii. figs. 4, 5.—Flabelliform, subtriangular or sub-circular. Diam. $\cdot 0425$ to $\cdot 06$ mm., the minor axis from $\cdot 0375$ to $\cdot 05$ mm. Centro-lateral area subclavate, the sides more rarely almost parallel towards the central end, inner end rounded. Markings: rays straight or slightly curved; the compartments longer towards the subobsolete interval, reaching from $\frac{2}{3}$ to $\frac{3}{4}$ of radius inwards, their inner ends conical, sometimes transversely truncate; areolæ obscure; the intervals tapering slightly outwards, extending to border.—Janisch, *Abh. Schl. Ges. väter. Cult.*, 1861, p. 160; Ralfs in *Pritch. Inf.*, p. 837; Sch., *Atl.*, pl. xxxviii. figs. 10, 12; *A. flabellatus*, var. *tergestina*, Grun., Van. Heurck, *Syn. Diat. Belg.*, pl. cxxvii. figs. 5, 6; *Asterolampra flabellata*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 116; *Spatangidium flabellatum*, de Bréb., *Bull. Soc. Linn. Normand.*, 1857, p. 297, pl. iii. fig. 3; *S. peltatum*, de Bréb., *ibid.*, p. 298, pl. iii. fig. 4.

Habitat.—Rembang Bay (Deby!); Peruvian guano (de Brébisson, Janisch); Campeachy Bay, Yokohama and Hong Kong (Schmidt); California guano (Greville!); Corsican algæ (de Brébisson); Teignmouth Ascidia (Grove!).

Asterom. cleveanus, Grun. Sch., *Atl.*, pl. xxxviii. figs. 13, 14.—Roundly elliptical to oval. Major axis $\cdot 045$ to $\cdot 075$ mm.; minor $\cdot 04$ to $\cdot 0625$ mm. Centro-lateral area tapering towards outer ends, the inner end angular, sometimes with sides slightly concave outwards. Markings: rays springing from apex and sides of centro-lateral area, straight or concave towards subobsolete ray, sometimes dichotomous; the compartments longest towards extremities of major axis, shortest towards the minor, reaching from $\frac{1}{2}$ to $\frac{2}{3}$ of radius inwards; their inner ends rounded or somewhat obliquely truncate; areolæ delicate, 12 to 14 in $\cdot 01$ mm., the

intervals straight or slightly arcuate, of uniform breadth, their outer ends rounded close to the border, sometimes prolonged inwards as subdistinct areas on the interradial spaces.—*Asterom. wallichianus*, Cleve (not Grev.), *Bih. k. Sv. Vet.-Akad. Handl. Stockh.*, 1873, Bd. i. No. 11, p. 5, fig. 1; Cleve and Möller, *Diat.*, Nos. 145, 146.

Habitat.—Surface of Java Sea (Cleve, Schmidt); Manilla mud (Grove!); Muntok, East Indian Archipelago (Grove!).

Asterom. reticulatus. Cleve, *Bih. k. Sv. Vet.-Akad. Handl. Stockh.*, 1873, Bd. 1, No. 11, p. 5, pl. i. fig. 2.—Diam. .051 mm. Centro-lateral area with sides uniformly concave and inner end rounded, a sharp angular bend at outer extremity of one of its sides. Markings: rays arcuate, flexuous or sharply bigeniculate at their middle; the compartments reaching about $\frac{1}{4}$ of radius inwards, their inner ends transversely truncate, that on one side of subobsolete interval convex towards centre; areolæ distinct, 7 in .01 mm.; the intervals broad, expanding gradually outwards to their middle, and again contracting uniformly towards their outer subacute ends, not reaching the border, the subobsolete interval arcuate, concave towards that compartment, having the inner end convex.

Habitat.—Surface of Java Sea (Cleve).

Asterom. Darwinii. Ehrb., *Mon. Ber. Ak.*, 1844, p. 200, pl. (June), fig. 1.—Diam. .0625 to .0875 mm. Centro-lateral area short and broad, sometimes subconical, or with sides almost parallel and converging suddenly to the centre. Markings: rays sharply geniculate about their middle, with short lateral rami proceeding from the angles; the compartments few, 5, reaching from $\frac{1}{2}$ to $\frac{3}{4}$ of radius inwards, of unequal length, their inner ends transversely truncate, those bordering the subobsolete interval with the inner ends more oblique; the areolæ decreasing gradually outwards from 8 to 12 in .01 mm.; the intervals tapering outwards, their outer ends rounded, reaching close to the border.—Ralfs in *Pritch. Inf.*, p. 837, pl. v. fig. 86; Sch., *Atl.*, pl. xxxviii. fig. 16; *A. Rossi*, Ehrb., *Mon. Ber. Ak.*, 1844, p. 200, pl. (June), fig. 2; *Mikrog.*, pl. xxxv. a. 21. fig. 4; *A. Brookei*, Grun. (not Bail.), Sch., *Atl.*, pl. xxxviii. fig. 9; *Asterolampra Darwinii*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 116, pl. iv. figs. 12, 13.

Habitat.—Monterey stone (Arnott!* Kitton!)*; Antarctic Ocean, lat. 78° 10' S., long. 162° W. (Ehrenberg, Ralfs); Santa Monica deposit (Hardman!)+.

Asterom. rarus, Rattray. *A. elegans*, Grev. var. Wallich., *Trans. Micr. Soc. Lond.*, 1860, p. 46, pl. ii. fig. 10.—Diam. .0525 mm. Centro-lateral area distinct, extending over $\frac{5}{8}$ of disc, its extremity conical, the sides parallel, with a wide deep lateral conical indentation. Markings: rays of two kinds—one straight opposite the centro-lateral area, the others sharply bigeniculate at their middle; the compartments symmetrical with respect to the diameter corresponding to the subobsolete interval, of unequal length, their inner ends obtusely rounded, that opposite the subobsolete interval most obtuse; areolæ distinct, 6 in .01 mm.; the intervals tapering outwards, reaching the border.

Habitat.—*Salpæ*, Indian Ocean (Wallich).

Asterom. heptactis. Ralfs. in *Pritch. Inf.*, p. 838, pl. viii. fig. 21.—Diam. .0425 to .175 mm. Centro-lateral area subclavate, the sides slightly sinuate, sometimes almost parallel, the inner end conical. Markings: rays sharply, 1- or 2- geniculate at or slightly beyond their middle; delicate lines traceable from the geniculations to the angles of the compartments; the compartments sometimes of unequal lengths, but symmetrical with respect to the diameter corresponding to centro-lateral area, reaching from $\frac{1}{2}$ to $\frac{2}{3}$ of radius inwards, their inner ends transversely truncate or slightly concave towards centre; areolæ delicate, 6 in .01 mm.; the rows bounding the compartments obvious; intervals broad, a distinct lunate ridge at their outer ends.—*Spatangidium heptactis*, de Bréb., *Bull. Soc. Linn. Normand.*, 1857, p. 296, pl. iii. fig. 2; *S. ralfsianum*, Norman, *Quart. Jour. Micr. Sci.*, 1859, p. 161, pl. vii. figs. 7, 8; *Asterolamprea heptactis*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 122; *Asterom. ralfsianus*, Grun., Sch., *Atl.*, pl. xxxviii. figs. 5–8 (excl. *Asterom. Beaumontii*, Ehrb., *Mon. Ber. Ak.*, 1844, p. 200).

Habitat.—Californian guano (Greville!); Peruvian guano (Grove! de Brébisson, Schmidt, Greville!); Ichaboe guano (J.

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T. Norman!); Atlantic soundings (Ralfs); Gazelle Expedition, Yokohama (Schmidt); Pabellan di Pico guano (Deby!); *Holothuria*, China (Deby!); Færoe Islands, H.M.S. Knight Errant (Grove!); loc.? (Grove!).

Asterom. arachne. *Spatangidium arachne*, de Bréb., *Bull. Soc. Linn. Normand.*, 1857, p. 296, pl. iii. fig. 1.—Broadly ovate to subcircular. Diam. .045 to .06 mm. Markings: rays 5, the central subobsolete longest, its proximal end expanded, malleiform, reaching between proximal ends of lateral rays, excentric; the lateral rays in two unsymmetrical pairs, the lower pair substraight, or slightly convex towards the central ray, the upper pair more curved in their proximal portions and more convex towards the lower; their inner ends expanded but more rounded than that of central ray; their outer ends sometimes slightly swollen and not reaching the border; compartments of unequal length, their inner ends convex, that opposite the subobsolete ray concave inwards, the areolæ decreasing but slightly outwards, 6 to 7 in .01 mm.; rows evident, those adjacent to the rays somewhat more prominent. Border narrow, hyaline.—Ralfs in *Pritch. Inf.*, p. 837; Sch., *Atl.*, pl. xxxviii. figs. 3, 4; *Asterom. malleus*, Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 47, pl. ii. fig. 11; *Asterom. malleiformis*, Wallich, *ibid.*, Explan. pl. ii. fig. 11; *Asterolampira arachne*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 123; *Excentron cancroides*, Ralfs, *ibid.*, p. 837.

Habitat.—Peruvian guano (Greville! Grove!); Ichaboe guano (Norman!); Indian Ocean soundings, 2200 fathoms, by Capt. Pullen (Greville!); locality? (Dickie!); from *Salpæ*, Indian Ocean (Wallich); Guanape guano (Deby!); Arica, and Gazelle Expedition (Schmidt); S.S. Buccaneer, off Ascension Island (Grove!).

Asterom. nankooensis. Grun., *Reise d. Novara*, 1870, p. 104, pl. i. A. fig. 22.—Oval to subcircular. Length, .065 to .075 mm.; breadth, .0625 to .065 mm. Centro-lateral area with sides concave outwards, the inner end conical. Markings excentrically disposed; rays—one more robust, arcuate, proceeding from apex of centro-lateral area, a few others more delicate; the compartments of unequal lengths, their inner ends concave towards centre; areolæ

delicate; intervals expanding gradually outwards, and reaching border; their inner ends uniformly curved away from one another, closed, and continued almost to the angles of the centro-lateral area; opposite this area and at middle of largest compartments 5 short rays, the two lateral longest, attenuating outwards, and with the inner ends slightly swollen and knob-like, the subobsolete interval nearer one of the larger intervals than the other, not reaching the border.

Allied to *A. arachne*.

Habitat.—Nancoori deposit (Grunow).

Asterom. sarcophagus. Wallich, *Trans. Micr. Soc. Lond.*, 1860, p. 47, pl. ii. fig. 12.—Subregularly oblong, the sides slightly concave about their middle, the concavities of those adjacent to the subobsolete interval greater than the others. Length .045, breadth .0225 mm. Centro-lateral area expanding gradually outwards. Markings: rays 6, subuniformly arcuate, the three from each side uniting in two excentric points, which are connected by a short transverse line at right angles to the major axis; the compartments reaching from $\frac{1}{2}$ to $\frac{2}{3}$ of radius inwards, unequal, but symmetrical with respect to the major axis, their inner ends convex; areolæ distinct, $4\frac{1}{2}$ (?) in .01 mm., in obscure radial rows; the intervals attenuating outwards, their outer ends convex outwards, close to the border.—*Asterolampra sarcophagus*, Grev., *Trans. Micr. Soc. Lond.*, 1860, p. 124.

Distinguished from *A. arachne*, its nearest ally, by its outline, and the different character of its rays and compartments.

Habitat.—Indian Ocean (Wallich).

The following species from Peruvian guano have been founded on the number of the rays on the central portion of the valve, and cannot be retained:—

A. denarius. Janisch. (*Abh. Schl. Ges. väter. Cult.*, 1860, p. 160, pl. ii. B. fig. 22—unpublished). Oval. Diam. .045 mm. Rays 10, straight. Areolæ small.

A. Brébisonii. Janisch (*ibid.*, 1861, p. 160, pl. ii. B. fig. 28—unpublished). Rays 12, straight. Areolæ small, on compartments adjacent to subobsolete interval.

A. Pringsheimii. Janisch (*ibid.*, 1861, p. 160, pl. ii. B. fig. 25

—unpublished). Diam. .07 mm. Rays 14, zig-zag. Areolæ small.

A. Cohnii. Janisch (*ibid.*, 1860, p. 160, pl. ii. B. fig. 26—unpublished). Diam. .0805 mm. Rays 15, zig-zag. Areolæ small. *A. cleveanus*, Janisch, is erroneously mentioned in Habirshaw's *Cat. Diat.*, § *Asteromphalus*, as found in *Abh. Schl. Ges. väter. Cult.*, 1860, p. 160, pl. ii. B. fig. 26. The name given in the paper quoted being *A. Cohnii*.

A. Ehrenbergii. Janisch. (*ibid.*, 1861, p. 161, pl. ii. B. fig. 27—unpublished). Almost circular. Diam. .095 mm. Rays 16, zig-zag-shaped. Areolæ small.

A. Braunii. Janisch. (*ibid.*, 1861, p. 161, pl. ii. B. fig. 28—unpublished). Diam. .105 mm. Rays 17, zig-zag. Areolæ small.

Artificial Key.

- | | | | |
|----|---|---|-----------------------|
| 1. | { | Outline flabelliform to subtriangular, oval or elliptical, | 2. |
| | | Outline circular or subcircular, | 3. |
| | | Outline subregularly oblong, with sides slightly concave at their middle, | <i>sarcophagus</i> . |
| 2. | { | Compartments longest adjacent to subobsolete interval, decreasing away from this; rays simple; areolæ obscure, | <i>flabellatus</i> . |
| | | Compartments shortest at ends of minor axis; rays sometimes dichotomous; the areolæ delicate, 12 to 14 in .01 mm., | <i>cleveanus</i> . |
| 3. | { | Rays simple, | 4. |
| | | Rays sharply bigeniculate, | 5. |
| 4. | { | Intervals between compartments prolonged to centre; outer ends of rays knob-like, penetrating a short distance into compartments, | <i>centrastrer</i> . |
| | | No such structure, | 6. |
| 6. | { | Inner ends of compartments concave towards centre; centro-lateral area acutely V-shaped; subobsolete interval rapidly attenuating outwards, | <i>wallichianus</i> . |
| | | Inner ends of compartments obliquely truncate on each side of the rays; centro-lateral area sometimes with inner ends obtuse, | <i>variabilis</i> . |
| | | Inner ends of compartments rounded, | 7. |
| | | Inner ends of compartments more conical, | 8. |
| | | Inner ends of compartments concave towards centre; centro-lateral area with sides concave outwards; one ray opposite this area more robust than the others; intervals expanding outwards, | <i>nankooensis</i> . |
| 7. | { | Structure markedly excentric; central area opposite subobsolete interval, maleiform, extending across the hyaline portion of valve, | <i>arachne</i> . |
| | | Structure not markedly excentric, | 9. |

- | | | | |
|-----|---|--|---------------------------------|
| 9. | { | Compartments 6, 5 equal smaller reaching to $\frac{2}{3}$ of radius, the sixth larger, reaching to $\frac{2}{3}$ of radius, | } <i>wyville-thomsonianus</i> . |
| | { | Compartments otherwise, | 10. |
| 10. | { | Centro-lateral area ovate; rays straight or slightly flexed; intervals not reaching border, | } <i>shadboltianus</i> . |
| | { | Centro-lateral area with sides more parallel, slightly concave outwards; intervals attenuating slightly reaching border, | } <i>Hookerii</i> . |
| 8. | { | Compartments reaching about $\frac{3}{4}$ of radius inwards, longest at sides of subobsolete intervals; rays straight; intervals rapidly attenuating outwards, | } <i>stellatus</i> . |
| | { | Compartments reaching $\frac{3}{4}$ of radius inwards; rays towards subobsolete interval simply flexed, | } <i>hillonianus</i> . |
| 5. | { | Centro-lateral area sharply constricted at middle, thence expanding markedly outwards, compartments reaching to $\frac{2}{3}$ of radius inwards; the inner ends transversely truncate, | } <i>roperianus</i> . |
| | { | Centro-lateral area otherwise, | 11. |
| 11. | { | Outer ends of intervals expanded, a distinct dark area at middle of wider portion, | } <i>moronensis</i> . |
| | { | No such intervals, | 12. |
| 12. | { | Structure not markedly excentric, | 13. |
| | { | Structure markedly excentric, | 14. |
| | { | Compartments with inner ends conical, | 15. |
| 13. | { | Compartments with inner ends obtusely angular; intervals attenuating outwards, | } <i>Beaumontii</i> . |
| | { | Compartments with inner ends obtusely rounded or truncate; rays sometimes simple, sometimes wavy; geniculations not regular, | } <i>Brookei</i> . |
| 15. | { | Rays often dichotomous, bigeniculate at or within their middle; centro-lateral area elongate, | } <i>elegans</i> . |
| | { | Rays simple; the geniculations regular, forming an elliptical figure round the centro-lateral area. | |
| | { | Centro-lateral area clavate, | } <i>imbricatus</i> . |
| 14. | { | Subobsolete ray distinctly curved, | } <i>reticulatus</i> . |
| | { | Subobsolete ray straight, | 16. |
| 16. | { | Centro-lateral area with sides parallel, and showing a deep regular median indentation, | } <i>rarus</i> . |
| | { | No such indentation, | 17. |
| 17. | { | Centro-lateral area short, broad, or subconical; compartments few, large; rays geniculate about their middle. No lunate ridge, | } <i>Darwinii</i> . |
| | { | Centro-lateral area subclavate or with sides slightly sinuate to almost parallel; rays geniculate at or beyond their middle; a lunate ridge frequently present at outer ends of intervals, | } <i>heptactis</i> . |

LIRADISCUS.

Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 4.—Circular, subcircular, or elliptical. Surface slightly convex or dome-shaped, flatter towards the border. Colour pale grey. Central space absent. Markings consisting of evident or more delicate lines, anastomosing irregularly or forming subregular or unequal areolæ, on a more or less irregular

band adjacent to the border subradial, with few anastomoses or lateral rami, and sometimes dichotomous; apiculi at the angles of the meshes sometimes distinct. Border narrow, hyaline, more rarely broad, with evident striæ.

§ 1. CIRCULARES.

Outline circular.

L. furcatus. Grove, MS.—Circular. Diam. .0875 to .095 mm. Surface slightly convex. Markings prominent, areolæ at centre few, large, unequal, sometimes tiramose, and reaching .06 mm. in length, mostly 1 to $1\frac{1}{2}$ in .01 mm.; adjacent to border the lines straight or curved, radial, or subradial, frequently dichotomous, but without anastomoses; the areolæ hyaline, or with minute rounded granules at their centre. Border delicate, but distinct, about .0025 mm. broad.—(Pl. III fig. 23.)

Habitat.—Marine deposit, Fiji Islands (Grove!).

L. capensis. Cleve, *Kongl. Sv. Vet.-Akad. Handl. Stockh.*, 1881, Bt. xviii. No. 5, p. 22, pl. v. fig. 61.—Circular. Diam. .04 mm. Markings irregularly radiating or oblique, sometimes ramose, but not anastomosing lines, with large hyaline interspaces; at intervals a few rounded, elongate or irregular dots distinct. Border sharply defined; striæ obvious, 15 in .01 mm.

Cleve places this species with some hesitation in the present genus, believing that it might be better to range it in *Cyclotella*. The relationships, however, which he points out with *Cy. striata*, Kütz. (Van Heurck, *Syn. Diat. Belg.*, pl. xcii. figs. 6-8), and *Cy. dallasiana*, W. Sm., are remote, whilst the general aspect of the lines on the surface is liradiscoid.

Habitat.—Cape of Good Hope (F. Hauck).

L. barbadensis. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 5, pl. i. fig. 14.—Diam. .05 to .105 mm. Surface slightly convex for $\frac{1}{2}$ to $\frac{3}{4}$ of radius, beyond this almost flat to the border. Markings evident areolæ, from 1 to 3 in .01 mm., sometimes obtusely angular, the band adjacent to the border subregular.

Habitat.—Cambridge deposit, Barbados (Johnson!); "Barbados" (Greville! Johnson!).

§ 2. ELLIPTICAL.

Outline roundly or elongately elliptical.

(a) Elongately elliptical.

L. ellipticus. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 99, pl. viii. fig. 6.—Major axis $\cdot 0775$ to $\cdot 105$ mm., from 2 to $2\frac{5}{8}$ times minor, the extremities of the major axis acute. Surface but slightly convex. Markings delicate; areolæ 2 to $3\frac{1}{2}$ in $\cdot 01$ mm.; the band adjacent to the border narrow indistinct, with the subradial lines 4 to $4\frac{1}{2}$ in $\cdot 01$ mm.

Habitat.—Cambridge deposit, Barbados (Johnson!); “Barbados” (Greville! Johnson!).

(β) Roundly elliptical.

L. oblongus, Grun. Cleve and Möller, *Diat.*, No. 276.—Major axis $\cdot 04$ to $\cdot 05$ mm., about twice the minor; the extremities obtuse. Surface slightly convex. Markings delicate; areolæ 4 in $\cdot 01$ mm.; subequal or slightly smaller adjacent to the border, without order. Border narrow, sharply defined.

Habitat.—California (Cleve and Möller!).

L. ovalis. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 5, pl. i. figs. 15, 16.—Major axis $\cdot 04$ to $\cdot 06$ mm., from $1\frac{1}{4}$ to $1\frac{5}{11}$ times minor. Surface markedly convex. Markings prominent; the areolæ towards the centre sometimes imperfect; the band adjacent to the border irregular, narrow; apiculi irregular, inserted at the angles of the areolæ.

Greville represents the girdle as a narrow hyaline band extending for a short distance beyond the convex portion of the valve.

Habitat.—Cambridge deposit, Barbados (Johnson!); Oamaru deposit (Grove!).

L. marginatus. Grove MS.—Major axis $\cdot 0475$ mm., about $1\frac{1}{4}$ times minor; extremities obtuse. Surface slightly convex. Markings robust, areolate; the areolæ irregular and unequal, 2 to 3 in $\cdot 01$ mm., largest at the centre bearing a few faint rounded granules; marginal band distinct, its outer edge crenate. Border narrow, hyaline.—(Pl. III. fig. 13.)

Habitat.—Oamaru deposit (Grove!).

L. minutus. Grev. (*Trans. Micr. Soc. Lond.*, 1865, p. 47, pl. v. fig. 6), belongs to *Cresswellia*. The surface of the type is dome-shaped, and the markings on the central portion regular, and areolæ $3\frac{1}{2}$ to 4 in $\cdot 01$ mm.

Artificial Key.

- | | | | |
|----|---|---|----------------------|
| 1. | { | Outline circular, | 2. |
| | | Outline elliptical, | 3. |
| 2. | { | Lines not anastomosing. Border broad, striae 15 in $\cdot 01$ mm., | <i>capensis</i> . |
| | | Lines anastomosing, | 4. |
| 4. | { | Areolæ unequal, 1 to 3 in $\cdot 01$ mm. Band adjacent to border subregular, | <i>barbadensis</i> . |
| | | Areolæ unequal, few; around border the lines radial or subradial, often dichotomous, | <i>furcatus</i> . |
| 3. | { | Extremities of major axis acute. Surface slightly convex. Markings delicate, areolæ 2 to $3\frac{1}{2}$ in $\cdot 01$ mm. Band adjacent to border narrow, | <i>ellipticus</i> . |
| | | Extremities of major axis not acute, | 5. |
| 5. | { | Surface slightly convex, | 6. |
| | | Surface markedly convex. Markings prominent, areolæ often imperfect at centre; apiculi acicular, irregular, inserted at angles of areolæ, | <i>ovalis</i> . |
| 6. | { | Markings delicate, 4 in $\cdot 01$ mm., subequal; non-apiculate. Border narrow, sharply defined, | <i>oblongus</i> . |
| | | Markings evident; marginal band of areolæ distinct, its outer edge crenate; areolæ unequal, irregular, 2 to 3 in $\cdot 01$ mm., largest at the centre, | <i>marginatus</i> . |

PORODISCUS.

Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 63.—Valves elliptical, circular or rhombic; sometimes the opposite valves of a frustule of unequal sizes. Surface slightly convex, dome-shaped or conical, with transversely truncated ends. Colour pale smoky grey. Central space circular to roundly elliptical, faintly punctate or hyaline, its outline smooth or finely crenulate. Markings small, round, granular, papilliform, or areolate; rows radial, more rarely inconspicuous or undifferentiated, secondary oblique rows sometimes evident; fasciculi frequently distinct; interspaces largest near the central space, sometimes absent; spines long, acicular or hour-glass-shaped, frequent; a sharply defined marginal band rare. Border inconspicuous.—*Craspedodiscus*, *pro parte*, Grun.; Sch., *Atl.*, pl. lxvi. figs. 7-9; *Craspedoporus*, *pro parte*, Grove and Sturt, *Jour. Quek. Micr. Cl.*, 1887, p. 67.

P. splendidus. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 46,

pl. v. fig. 5.—Circular, sometimes roundly elliptical. Diam. $\cdot 075$ mm. Surface convex, forming a low dome. Central space circular, about $\cdot 015$ mm. broad, sharply defined, hyaline. Markings large, areolate, increasing slightly to about semiradius, thence decreasing similarly to the border; around central space $4\frac{1}{2}$, at semiradius 3 to $3\frac{1}{2}$ in $\cdot 01$ mm.; rows radial, straight; secondary oblique rows inconspicuous. Border inconspicuous.

Habitat.—Springfield deposit, Barbados (Hardman).

Var. *marginata*, nov. *Craspedodiscus ovalis*, Grun., in Sch., *Atl.*, pl. lxvi. fig. 6.—Roundly elliptical. Major axis $\cdot 065$ mm., about $1\frac{1}{2}$ times minor. Central space with small round, free granules. Markings areolate and subequal, 4 in $\cdot 01$ mm. for about $\frac{1}{2}$ of radius, on a distinct band adjacent to the border, round, granular, 8 in $\cdot 01$ mm.; interspaces between radial rows evident only on a band adjacent to border; secondary oblique decussating rows more evident.—*Porodiscus splendidus*, var. ? Sch., *ibid.*

Habitat.—Springfield deposit (Schmidt).

P. nitidus. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 65, pl. iv. fig. 4.—Circular or subcircular. Diam. $\cdot 05$ to $\cdot 07$ mm. Surface uniformly and moderately convex. Central space circular or roundly elliptical, hyaline, $\cdot 0075$ mm. broad. Markings areolate, rarely obtusely angular towards the central space, increasing for a short distance outwards from this space, thence decreasing gradually to the border; towards the central space $4\frac{1}{2}$, near the border 8, in $\cdot 01$ mm.; rows radial, straight, non-fasciculate. Border narrow.

The markings being areolate, there are no such hyaline interspaces as are shown in Greville's figure. Sometimes faint fasciculi are observed on one valve of a frustule, the opposite valve being non-fasciculate.

Habitat.—Cambridge deposit, Barbados (Johnson!).

Var. *armata*, nov.—Diam. $\cdot 0525$ to $\cdot 095$ mm. Central space circular, $\cdot 0075$ mm. broad. Markings sometimes forming coarse moniliform striæ towards the border; spines acicular, about $\cdot 01$ mm. long, sometimes shorter, inserted about $\frac{3}{4}$ of radius from centre; interfasciculate rarely a few at irregular intervals nearer the border. Girdle $\cdot 0125$ mm. broad in a valve $\cdot 0525$ mm. in diam., the

hyaline striæ at right angles to its edge undifferentiated.—(Pl. III. fig. 17.)

A specimen occurs in Dr Greville's collection in the British Museum, labelled *P. conicus*, and another labelled *P. major*. From both of these the present var. is quite distinct.

Habitat.—"Barbados" (Johnson! Greville!); Cambridge deposit, Barbados (Johnson!).

P. major. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 64, pl. iv. fig. 2.—Fragmentary. Diam. ? Surface slightly convex. Central space subcircular, .0175 mm. broad, bearing almost invisible minute puncta, and a large round more distinct slightly excentric granule, its outer edge minutely crenate. Markings small, round, granular; towards the central space 8, nearer the border 10, in .01 mm.; rows radial, straight, in faint fasciculi, most originating at about .015 mm. from the central space, the others proceeding from the edge of this space; interspaces at origin of shorter rows hyaline.

Habitat.—Cambridge deposit, Barbados (Greville!).

Var. *densa*, nov. *P. major*, Grev., *ibid.*, 1865, p. 46.—Diam. ? Central space circular to oval, .0075 to .01 mm. broad, its outer edge smooth. Markings subareolate, near the central space $5\frac{1}{2}$ to 6 in .01 mm.; interspaces around the central space more minute.—(Pl. III. fig. 21.)

The central space and markings at once distinguish this var.

Habitat.—Cambridge deposit, Barbados (Johnson!); "Barbados" (Greville!).

P. elegans. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 65, pl. iv. fig. 1.—Circular. Diam. .0625 to .095 mm. Surface rounded and dome-shaped. Central space circular, .0075 mm. broad, sharply defined, hyaline. Markings obtusely angular or subareolate, decreasing gradually from the central space outwards, around the central space 6, near the border 10 to 12, in .01 mm.; rows radial, straight; fasciculi distinct; interspaces minute, largest around the central space. Girdle cylindrical, .03 mm. broad, in a frustule, .06 mm. in diam.; a narrow hyaline band at each extremity;

the interval minutely punctate; at subregular intervals narrow hyaline straight lines at right angles to the edges of the valve.

The fasciculi are bounded by two adjacent radial rows, somewhat more conspicuous than the intervening rows. In one of the valves in Greville's collection it is possible to trace downwards from the central space a cylindrical siliceous tube which is of sufficient length to have passed to a plane corresponding in position to the edges of the valve.

Habitat.—Cambridge deposit, Barbados (Greville! Johnson!); "Barbados" (Greville! Johnson!).

P. spiniferus, sp. n.—Circular. Diam. .0875 mm. Surface dome-shaped. Central space circular, .0075 mm. broad. Markings areolate, subequal, 7 in .01 mm.; rows radial, straight; fasciculi evident; bounded by two rows of more prominent submuriform areolæ; spines robust, conical, about .03 mm. long, interfasciculate, forming a circlet at about $\frac{1}{3}$ of distance between central space and edge of valve. Girdle cylindrical, .0375 mm. broad; a narrow hyaline band at each extremity; the clear substraight lines at right angles to its edges distinct.—(Pl. III. fig. 19.)

Habitat.—Cambridge deposit, Barbados (Johnson!).

P. oblongus. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 63, pl. iv. fig. 5.—Subacutely elliptical. Major axis .05 mm. long, about $2\frac{1}{2}$ times minor. Surface sloping gradually downwards from edge of central space. Central space roundly elliptical, with major axis corresponding in direction to minor axis of valve. Markings angular, decreasing regularly and somewhat rapidly from central space to border; around the central space $4\frac{1}{2}$, at border 10, in .01 mm.; rows radial, substraight. Border narrow, hyaline.—*P. ovalis*, Grev., *ibid.*; Explan. pl. iv. fig. 5; *Craspedodiscus oblongus*, Grun.; Sch., *Atl.*, pl. lxvi. figs. 7-9.

This species approaches in appearance *Coscinodiscus oblongus*, Grev. (*Trans. Micr. Soc. Lond.*, 1866, p. 4, pl. i. figs. 9, 10).

Habitat.—Barbados deposit (Johnson!).

P. Stolterfothii. Cstr., *Diat. Chall. Exped.*, 1886, p. 139, pl. xii. fig. 8.—Rhombic, with angles obtuse. Major axis .077 mm. long, about $1\frac{7}{10}$ times minor. Surface slightly convex towards

centre, towards the border subplain. Central space roundly elliptical, with major axis about $\cdot 01$ mm. long, and corresponding in direction to minor axis of valve, delicately punctate. Markings areolate, gradually increasing from central space outwards; towards the central space 6 or $6\frac{1}{2}$, towards the border 4 to $4\frac{1}{2}$, in $\cdot 01$ mm.; rows radial, straight; secondary oblique decussating rows indistinct. Border narrow, hyaline.

Habitat.—Pacific Ocean, from a sounding made at the equator by H.M.S. Challenger (Castracane).

P. conicus. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 65, pl. iv. fig. 3.—Diam. $\cdot 025$ to $\cdot 0525$ mm. Major axis of frustule from $\cdot 0625$ to $\cdot 0875$ mm. Surface a more or less elongate regular cone, transversely truncate at the extremities, the opposite valves of a frustule of unequal height. Central space? Markings obtusely angular or subareolate, 6 in $\cdot 01$ mm., subequal; rows radial, straight, non-fasciculate; secondary oblique decussating rows evident, from the truncated ends of the cone a few short tapering clear lines, distinct. Girdle cylindrical, from $\cdot 025$ to $\cdot 0325$ mm. broad; a narrow band at each extremity, hyaline, the intervening portion clouded with diffuse parallel lines.

Habitat.—Cambridge deposit, Barbados (Johnson!); Barbados (Johnson! Greville!); Bridgewater deposit, Barbados (Johnson!).

P. hirsutus. Grove and Sturt, *Jour. Quek. Micr. Cl.*, 1887, p. 143, pl. xiv. fig. 54.—Circular. Diam. $\cdot 075$ to $\cdot 0875$ mm. Surface flat from central space to the sharply-defined marginal band, the latter sloping gently to the border. Central space circular, sharply defined, $\frac{1}{4}$ to $\frac{1}{8}$ of diam. broad, surrounded by a narrow, more hyaline, sometimes interrupted band, with irregular outer edge. Markings rounded, prominent papillæ, with hyaline interspaces and without order; processes hour-glass-shaped, at sub-regular intervals, inserted on inner edge of marginal band, between these processes delicate radial striæ, 6 to 8 in $\cdot 01$ mm., extending outwards to about middle of band; adjacent to border a circlet of evident papillæ at intervals of $\cdot 0075$ to $\cdot 01$ mm. Border narrow, bearing minute granules, 6 in $\cdot 01$ mm.

This species approaches *Melosira sulcata forma coronata*, Grun. (Van Heurck, *Syn. Diat. Belg.*, pl. xci. fig. 24).

Habitat.—Oamaru deposit (Grove and Sturt!).

P. interruptus. Grove and Sturt (*Jour. Quek. Micr. Cl.*, 1887, p. 67, pl. v. fig. 8) has been found by Mr H. Morland (*Jour. Quek. Micr. Cl.*, 1887, p. 167) to be the opposite valve of *Craspedoporus elegans*, Grove and Sturt (*ibid.*, 1887, p. 64, pl. v. fig. 6; Rattray, *Jour. Roy. Micr. Soc.*, 1888, p. 919).

Artificial Key.

- | | | | |
|----|---|--|------------------------|
| 1. | } | Valves irregularly conical, with transversely truncated extremities, the opposite valves of a frustule of unequal heights, | <i>conicus</i> . |
| | | Valves elliptical. Markings decreasing rapidly outwards, around central space $4\frac{1}{2}$, at border 10, in .01 mm., | <i>oblongus</i> . |
| | | Valves rhombic. Markings increasing gradually outwards, towards central space 6 to $6\frac{1}{2}$, towards border 4 to $4\frac{1}{2}$ in .01 mm., | <i>Stollerfothii</i> . |
| | | Valves circular or subcircular, | 2. |
| 2. | } | Surface slightly convex; interspaces large around central space, | <i>major</i> . |
| | | Surface almost flat to marginal band. Markings papilliform. Processes hour-glass-shaped, | <i>hirsutus</i> . |
| | | Surface dome-shaped, | 3. |
| 3. | } | Markings distinctly fasciculate, | 4. |
| | | Markings non-fasciculate, | 5. |
| 4. | } | Spines robust, conical, interfasciculate, forming a circlet at about $\frac{1}{3}$ of distance between central space and edge of valve. Markings areolate, 7 in .01 mm., | <i>spiniferus</i> . |
| | | Spines absent. Markings obtusely angular or subareolate; around central space 6, near border 10 to 12, in .01 mm., | <i>elegans</i> . |
| 5. | } | Markings areolate, increasing slightly to about semiradius, thence decreasing similarly to border; around central space $4\frac{1}{2}$, at semiradius 3 to $3\frac{1}{2}$, in .01 mm. Spines absent, | <i>splendidus</i> . |
| | | Markings towards central space $4\frac{1}{2}$, near border 8, in .01 mm., sometimes with long spines, | <i>nitidus</i> . |

THAUMATONEMA.

Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 76.—Concatenate, discoid. Surface flat, or rising but slightly from centre for $\frac{1}{2}$ to $\frac{2}{3}$ of radius, thence sloping steeply downwards to edge of girdle and slightly concave at middle of outer portion. Colour

pale grey, the processes subhyaline. Markings punctiform or areolate, forming evident radial rows or striæ; radial costæ at subregular intervals, sometimes distinct. Process single, springing from centre of valve, proximal portion nodular or elongated and columnar, distal portion biramose, the rami equal, diverging symmetrically, their outer ends swollen and knob-like, rounded or elliptical.

This genus forms the transition between the circular forms of the Diatomaceæ and the armed *Chaetocerotidæ*. Apart from the process, the valves approach *Coscinodiscus*, and the nodular proximal portion of that of *Thaumatonema costatum* is but a greater development of, and so homologous with, the nodule of *Coscinodiscus nodulifer*, this development being still more marked in *T. barbadense*.

T. barbadense. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 76, pl. v. fig. 26.—Circular. Diam. $\cdot 03$ to $\cdot 04$ mm.; height of central portion of valve above edge of girdle $\cdot 075$ to $\cdot 1$ mm. Surface flat to about $\frac{2}{3}$ of radius. Markings punctiform, closely arranged in evident striæ, the striæ 6 to $6\frac{1}{2}$ in $\cdot 01$ mm. Process $\cdot 0185$ to $\cdot 0315$ mm. long, with proximal portion columnar, the rami of the upper portion stout, distance between the extremities of the rami $\cdot 0135$ to $\cdot 0185$ mm.

Habitat.—Cambridge deposit, Barbados (Johnson!); “Barbados” (Johnson!).

T. costatum. Grev., *Trans. Micr. Soc. Lond.*, 1865, p. 97, pl. viii. fig. 3.—Fragmentary. Roundly elliptical. Major axis $\cdot 055$ mm., about $1\frac{1}{2}$ times minor. Surface flat to about semiradius. Markings areolate, increasing slightly to about semiradius, thence decreasing gradually and becoming more faint to border; at semiradius 5, at border 8 to 9, in $\cdot 01$ mm., at subregular intervals of about $\cdot 0125$ mm., radiating evident costæ. Process evident, the proximal median portion nodular, the diverging rami more delicate, straight, their outer ends elliptical, knob-like; length of rami including terminal knob $\cdot 0175$ mm., major axis of knob $\cdot 01$ mm., about $2\frac{1}{2}$ times minor.

Habitat.—Cambridge deposit, Barbados (Johnson!).

Artificial Key.

| | |
|---|--------------------|
| Markings punctiform. No costæ. Proximal portion of process columnar, | <i>barbadense.</i> |
| Markings areolate. Evident radial costæ. Proximal portion of process nodular, | <i>costatum.</i> |

PEPONIA.

Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 75.—Central portion roundly elliptical, rarely subquadrate, with obtuse angles and convex sides, opposite the extremities of the minor axis a small regular cone, with free end rounded. Surface subplain. Colour pale grey. Central space absent. Markings areolate, sometimes increasing slightly from centre to semiradius, and again decreasing to border; between the lateral cones and the central portion a narrow hyaline band, at the extremities of the cones a small round, hyaline area. Border narrow, hyaline.

P. barbadensis. Grev., *Trans. Micr. Soc. Lond.*, 1863, p. 76, pl. v. fig. 25.—Central portion with major axis from .0375 to .075 mm.; distance between apices of lateral cones .0475 to .0925 mm. Markings towards the centre 4, at the semiradius $3\frac{1}{2}$, at the border 8, in .01 mm., without order or in inconspicuous radial and short oblique rows; on the lateral cones decreasing towards their apices, sometimes absent.

Habitat.—Bridgewater deposit, Barbados (Johnson!); Cambridge deposit, Barbados (Johnson! Greville); "Barbados" (Johnson! Greville!).

EXPLANATION OF PLATES.

PLATE I.

- Fig. 1. *Coscinodiscus oamaruensis*, Grove and Sturt. × 660.
 Fig. 2. „ *oculus-iridis*, var. *loculifera*, nov. × 660.
 Fig. 3. „ *modestus*, sp. n. × 660.
 Fig. 4. „ *debilis*, sp. n. × 460.
 Fig. 5. „ *imperator*, Janisch. × 250.
 Fig. 6. „ *interlineatus*, sp. n. × 660.
 Fig. 7. „ *decussatus*, Grove and Sturt MS. × 660.
 Fig. 8. „ *subnotabilis*, sp. n. × 660.
 Fig. 9. „ *gracilentus*, sp. n. × 660.
 Fig. 10. „ *subareolatus*, sp. n. × 660 (worn specimen).
 Fig. 11. „ *groveanus*, sp. n. × 460.
 Fig. 12. „ *antediluvianus*, sp. n. × 660.
 Fig. 13. „ *intermixtus*, sp. n. × 660.
 Fig. 14. „ *obliquus*, Rattray. × 660.
 Fig. 15. „ *sphaeroidalis*, sp. n. × 660.
 Fig. 16. „ *subtilis*, var. *lineolata*, nov. × 660.
 Fig. 17. „ *inæquisculptus*, sp. n. × 460.
 Fig. 18. „ *luxuriosus*, sp. n. × 660.
 Fig. 19. „ *glaberrimus*, sp. n. × 660.
 Fig. 20. „ *argus*, var. *subtraducens*, nov. × 460.
 Fig. 21. „ *nitidus*, var. *moronensis*, Grun. MS. × 660.
 Fig. 22. „ *planiusculus*, sp. n. × 660.
 Fig. 23. „ *granulosus*, Grun. × 460.
 Fig. 24. „ *whampoensis*, Grove MS. × 660.
 Fig. 25. „ *Weissflogii*, Sch. × 660.

PLATE II.

- Fig. 1. *Coscinodiscus pulcherrimus*, sp. n. × 660.
 Fig. 2. „ *lutescens*, sp. n. × 660.
 Fig. 3. „ *leptopus*, var. *discrepans*, nov. × 660.
 Fig. 4. „ *africanus*, var. *wallichiana*, Grun. × 660.
 Fig. 5. „ *minutellus*, sp. n. × 660.
 Fig. 6. „ *notabilis*, sp. n. × 660.
 Fig. 7. „ *actinosus*, Grove MS. × 660.
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 Fig. 9. „ *densus*, Grove and Sturt MS. × 660.
 Fig. 10. „ *pusillus*, Grove MS. × 660.
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 Fig. 12. „ *grayianus*, sp. n. × 660.
 Fig. 13. „ *megacentrum*, Grove MS. × 660.
 Fig. 14. „ *epiphanes*, sp. n. × 660.
 Fig. 15. „ *superbus*, var. *nova-zealandica*, Grove MS. × 660.
 Fig. 16. „ *moronensis*, Johnson. × 660.
 Fig. 17. „ *vetustissimus*, Pant. × 660.
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- Fig. 1. *Coscinodiscus implicatus*, sp. n. × 330.
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 Fig. 3. ,, *prætor*, Grove MS. × 660 (periphery).
 Fig. 4. ,, *polurrhaptos*, sp. n. × 660.
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