

Flora of Koh Chang.

Contributions to the knowledge of the vegetation in the
Gulf of Siam.

By

Johs. Schmidt.

Part VII.

(C. H. Ostenfeld: Marine Plankton Diatoms. — E. Østrup: Fresh-water Diatoms. —
F. Heim: Diptero-carpaceae.)

Marine Plankton Diatoms

by **C. H. Ostenfeld** — Copenhagen.

The following list of marine Plankton Diatoms is the result of an examination of the same 10 samples from which Johs. Schmidt¹⁾ has published the Peridinales. All the samples were obtained from the surface of the Sea in the inner part of the Gulf of Siam and were preserved in formaline.

This is a list of the samples collected:

- | | | |
|--------|-------------|--|
| No. 1. | 25/12 1896. | Strait between Lem Ngob and Koh Chang. |
| „ 2. | 9/1 1900. | Between Koh Kahdat and Koh Kut. |
| „ 3. | 11/1 1900. | S. of Koh Chang. |
| „ 4. | 16/1 1900. | W. of Koh Chang, N. of Koh Savan. |
| „ 5. | 17/1 1900. | W. of Koh Chang, S. of Koh Savan. |
| „ 6. | 18/1 1900. | S. of Koh Chang. |
| „ 7. | 27/1 1900. | North End of Koh Kut. |
| „ 8. | 28/1 1900. | 7 miles S. of Koh Kut. |
| „ 9. | 31/1 1900. | 18 miles W. of Koh Chang. |
| „ 10. | 21/3 1900. | 1—2 miles S. of Koh Kram. |

¹⁾ Johs. Schmidt: Peridinales, in Flora of Koh Chang, Part IV, p. 129.
Reprinted from Botanisk Tidsskrift. Vol. 24, Aug. 1901.

The sample No. 1 is rather rich, but the main part consists of detritus and the few present diatoms are partly dead and broken; the samples No. 2 to No. 7 also contain but few Diatoms and Nos. 8 and 9 nearly none, while they are rich in *Trichodesmium* and *Heliostrichum*; they are of a more oceanic character than the other samples. On the other hand the sample No. 10 (gathered in March) is very rich in Diatoms as well in quality as in quantity, and it looks to me as if the coast-water in the Gulf of Siam in the spring produces a rich plankton, just as in our more temperate waters.

With regard to Plankton type in Cleve's sense, I must admit that most of the present samples ought to be classified among „Tropical Neritic Plankton“¹⁾, except Nos. 8 and 9 which belong to „Desmoplankton“.

In the list the genera are arranged about as in F. Schütt: Bacillariaceae in Engler & Prantl, *Natürliche Pflanzenfamilien*, 1, 1 b, 1896.

Behind the number of the sample I have indicated in brackets the frequency of the species by the ordinary plankton-symbols of frequency, viz.:

<i>c</i>	means	<i>predominant</i>
†	„	<i>rather common</i>
<i>r</i>	„	<i>rare</i>
<i>rr</i>	„	<i>very rare</i> (only a few specimens seen).

Bacillariaceae.

A. *Centricae*.

Coscinodiscaeae.

Hyalodiscus Ehbgr.

1. *H. sp.*

A very delicate *Hyalodiscus* without any visible structure is not rare in the samples.

2 (r) — 3 (r) — 4 (rr) — 5 (rr) — 6 (rr) — 7 (rr) — 10 (rr).

¹⁾ P. T. Cleve: *The Seasonal Distribution of Atlantic Plankton Organisms*. Göteborg, 1900, p. 24. [In the list abbreviated to „Atl. Plankt. Organisms“.]

Stephanopyxis Ehbq.

2. **S. Palmeriana** (Grev.) Grun., Diat. Franz Joseph Land p. 38; A. Schmidt, Atlas d. Diat. Kunde, Pl. 130, f. 1, Pl. 123, f. 41 (f. *javanica* Grun.); Leuduger-Fortmorel, Diatomées de la Malaisie, Ann. du Jard. bot. de Buitenzorg, XI, 1893, p. 45; Otto Müller, Ber. Deutsch. Botan. Gesellsch. 1901, Bd. 19, p. 196, f. 1. *Creswellia Palmeriana* Grev., Trans. Microsc. Soc. 1865, p. 2, Pl. 1, f. 9; Cleve, Diat. f. the Sea of Java, Bih. till K. Svenska Vet. Akad. Handl. Bd. 1, 11, 1873, p. 8.

10 (rr).

Area: Neritic species, found in the Malay Archipelago, South China Sea, Arafura Sea, Australia.

Sceletonema Grev.

3. **S. costatum** (Grev.) Cleve, Diat. of the Sea of Java, 1873, p. 7; Leuduger-Fortmorel, l. c. p. 47; Van Heurck, Synopsis Pl. 91, f. 4; de Wildeman, Prodrome de la flore algologique des Indes Néerlandaises, 1897, p. 130; Lemmermann, Planktonalgen, Ergebnisse einer Reise nach dem Pacific, Abh. Nat. Verein, Bremen, XVI, 2, 1899, p. 317 and 329; Cleve, Atl. Plankton Organisms, p. 351; A Treatise of Phytoplankton, Upsala, 1897, p. 25; Pl. f. the Indian Ocean and the Malay Archipelago, p. 23, K. Sv. Vet. Akad. Handl. 35, No. 5, 1901 [1902].

1 (+) — 2 (rr) — 6 (rr).

Area: Baltic, North Sea, Coasts of British Isles, Ireland, Shetland to Westmannaö (South of Iceland). Gulf of Bengal, Malay Archipelago, Pearl Harbour at Oahu (Sandwich Islands). Certainly a neritic species of the temperate and subtropical regions of all oceans.

Coscinodiscus Ehbq.

4. **C. bengalensis** Grun., Van Heurck, Synopsis, Pl. 132, f. 9; Rattray, Coscinodiscus, Proc. Royal Soc. Edinburgh, vol. 16, 1888—89, p. 580; Cleve, Pl. f. the Ind. Ocean and the Malay Archip., p. 20.

I refer a small form with radially arranged rows of very fine markings to this species.

2 (rr) — 3 (rr).

Area: Gulf of Bengal, Malay Archipelago.

5. **C. excentricus** Ehbq., Abh. Berl. Akad. 1839, p. 146, Mikrogeologie tab. 18. f. 32, tab. 21, f. 6; Van Heurck, Synopsis, Pl. 130, f. 4, 7; Leuduger-Fortmorel, l. c. p. 44; de Wildeman, l. c. p. 143; Cleve, Atl. Plankt. Organisms, p. 318; Pl. f. the S. Atlantic and the S. Indian Ocean, Öfv. af K. Sv. Vetensk. Förhandl. 1900, No. 8 [1901], p. 930; Pl. f. the Ind. Ocean and the Malay Archip., p. 20.

2 (rr) — 6 (rr).

Area: Found in all the Oceans, mostly along the coasts.

6. **C. Janischii** A. Schmidt, Atl. d. Diat. Kunde, Pl. 64, f. 3, 4. Rattray, Coscinodiscus, p. 543 and v. *arafurensis* p. 544; Grunow, Denksch. d. Wiener Akad. d. Wissensch. 1884, p. 76; *C. arafurensis* var. nov. Castr., Challenger Report, Botany, Vol. II, 1886, p. 153, Pl. 2, f. 4; *C. craspedodiscus* Castr. ibid. Pl. 3, f. 5; *C. Janischii* Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 20.

3 (rr) — 10 (rr).

Area: Gulf of Bengal, Malay Archipelago, Arafura Sea.

7. **C. nobilis** Grun., Journ. Roy. Microsc. Soc. 1879, p. 687, Pl. 1, f. 1; Leuduger-Fortmorel, l. c. p. 45; Rattray, Coscinodiscus, p. 545; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 20 and p. 56; *C. papuanus* Castr., Challenger Report p. 154, Pl. 3, f. 3.

The form observed resembles very much *C. papuanus* Castracane l. c.; it is about 250—300 μ in diameter; and I am following Professor Cleve in regarding *C. papuanus* as a form of *C. nobilis*.

3 (+) — 10 (rr).

Area: Great Britain. Gulf of Guinea, Malay Archipelago, Arafura Sea, South China Sea.

8. **C. oculus iridis** Ehb., Abhandl. Berl. Akad. 1839, p. 147; *C. centralis* var. nov., Castr., Challenger, Pl. 2, fig. 3.

A form which agrees very well with the that figured by Castracane l. c., was found sparingly in one of the samples.

3 (rr).

Area: Found in all Oceans.

9. **C. radiatus** Ehb., Abhandl. Berl. Akad. 1839, p. 148, Pl. 3, f. 1 a-c.

Forms, which I refer to this species, were found rather sparingly in most of the samples.

2 (r) — 3 (rr) — 4 (rr) — 6 (rr) — 7 (rr) — 10 (rr)

Area: Found in all Oceans.

Palmeria Grev.

10. **P. Hardmaniana** Grev., Van Heurck, Treatise on the Diatomaceae 1896, p. 538, f. 286; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 22 and p. 56.

The interesting form of which I have given some figures, belongs to the genus *Palmeria* and I prefer identifying it with the only known species *P. Hardmaniana*, although the figure by Van Heurck is rather different. My specimens are very delicate, 500—650 μ long and 250—

300 μ broad, the valves are semi-lunate with very fine radiating points, hyaline central space and coarser points within the margins, but the more robust striae which Van Heurck l. c. p. 539 mentions, are only obscure in my form. The girdle is very unequal, narrow on the straight side and very broad on the curved side, so that the whole frustule resembles a piece of an orange.

Curious is a curved fissure on the valves; in most specimens which I have seen, this fissure was a place of refuge for a little protist, probably

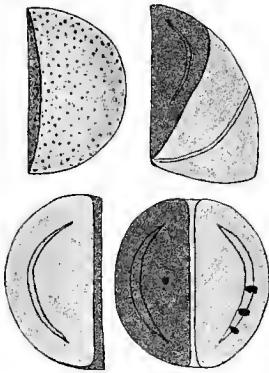


Fig. 1. *Palmeria Hardmaniana* Grev.
Cells in different views ($\frac{200}{1}$).

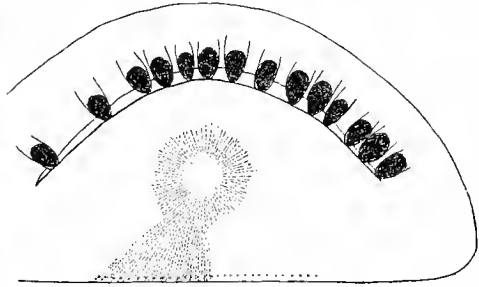


Fig. 2. *Palmeria Hardmaniana* Grev.
showing the *Amphorella*'s fixed to the scale. ($\frac{200}{1}$)

an *Amphorella borealis* (Hensen) Dad., var. nov.; the small, more or less numerous, organisms were fixed to the inner side of the fissure.

Chromatophores are numerous, small, dispersed on the inner side of the frustules; the nucleus is placed close to the one valve.

Professor Cleve l. c. seems to take this large diatom as an asymmetrical form of *Coscinodiscus nobilis*, but I am quite convinced that this is not the case; on the other hand I believe, that the genus *Palmeria* is close to *Coscinodiscus*, and that Schütt in Engler & Prantl has made a mistake in placing his *Euodia* (incl. *Palmeria*) among the *Biddulphioideae*, remote from the *Discoideae*. I should prefer placing it close to the genera *Ethmodiscus* and *Coscinodiscus*.

3 (rr) — 7 (rr) — 10 (rr).

Area: Malay Archipelago, China.

Actinodisceae.

Asterolampra Ehb.

11. *A. rotula* Grev. in Transact. Microsc. Soc. 1860, p. 111, Pl. 3, f. 5; Lemmermann, l. c. p. 317 and 319, Pl. 2, f. 35; Ostenfeld & Schmidt, Pl. f. the Red Sea etc., Vid. Medd. Nath. For. Kjøbenhavn, 1901, p. 152; Schröder, Phytoplankton des Golfes von Neapel, Mitteil. a. d. Zool. Stat. zu

Neapel, Bd. XIV, 1900, p. 22; Cleve, Atl. Plankt. Organisms, p. 283; Pl. f. the Indian Ocean and the Malay Archip. p. 17; *A. Grevillei* var. *adriatica* Grun. in Van Heurck, Synopsis, Pl. 127, f. 12.

2 (rr) — 10 (rr).

Area: Tropical Western Atlantic Ocean, Mediterranean, Gulf of Aden, Indian Ocean. Pacific Ocean near the Sandwich Islands.

Asteromphalus Ehbgs.

12. **A. flabellatus** (Bréb.) Grev., Quart. Journ. Microsc. Soc. 1859, p. 160, Pl. 7, f. 4; Van Heurck, Synopsis, Pl. 127, f. 5, 6 (var. *tergestina*); Cleve, Pl. f. the Ind. Ocean and the Malay Archip., p. 17; Diat. f. the Sea of Java, 1873, p. 5; Leuduger-Fortmorel, l. c. p. 43.

7 (rr).

Area: Mediterranean; Malay Archipelago, South China and Japan Seas; in Guano from Peru and California.

Solenieae.

Corethron Castr.

13. **C. criophilum** Castr., Challenger Report, p. 85, Pl. 21, f. 12, 14, 15; Cleve, Pl. f. the S. Atl. and the S. Ind. Ocean, p. 929; Pl. f. the Ind. Ocean and the Malay Archip., p. 20; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc., p. 156; *C. hystrix* Hensen, V. Bericht der Kommiss. in Kiel 1883, Pl. 5, f. 49; Cleve, Fish. Board for Scotland, 1896, p. 298, f. 15; Atl. Plankt. Organisms, p. 315; Lemmermann, l. c. p. 318.

10 (rr).

Area: Eastern part of Atlantic Ocean from Iceland southwards, Red Sea and Gulf of Aden, Antarctic Ocean (S. Atlantic and S. Indian Ocean) 32° S.—45° S. and 6° W.—91° E., Pacific Ocean at Vancouver Island.

14. **C. pennatum** (Grun.) Ostf. ms.; *Actiniscus pennatus* Grun. in Van Heurck, Synopsis, Pl. 82 bis, f. 11, 12; *Corethron hispidum* Castracane, Challenger Report, p. 86, Pl. 21, f. 3, 5; Lemmermann, l. c. p. 380, Pl. 3, f. 37, 43—46; Cleve, Pl. f. the Ind. Ocean and the Malay Archip., p. 20; Pl. f. the S. Atl. and the S. Indian Ocean, p. 930; ?*C. Murrayanum* Castr. l. c. p. 86, Pl. 21, f. 4.

I should think that the fragment figured in Van Heurck's Synopsis as *Actiniscus pennatus*, is the same form as known as *Corethron hispidum* Castr. (incl. *C. Murrayanum* which only differs from the typical *C. hispidum* in the smooth valves), and consequently the name *pennatus* has the priority.

6 (rr).

Area: Antarctic Ocean (S. Atlantic and S. Indian Ocean), Pacific Ocean at Vancouver Island.

Lauderia Cleve.

15. **L. annulata** Cleve, Diat. f. the Sea of Java 1873, p. 8, Pl. I, f. 7; Peragallo, Monogr. du Genre Rhizosolenia (Le Diatomiste Vol. 1, 1892), p. 105, Pl. 1, fig. 11; Castr., Challenger p. 89, Pl. VIII, f. 7; Ostenfeld & Schmidt, Pl. from the Red Sea, etc. p. 158; Leuduger-Fortmorel, l. c. p. 47; Gran, Nyt Magaz. Naturv. Kristiania, 1900, p. 109, Pl. IX, f. 1—4; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 21; non Cleve, Phytoplankton Pl. II, fig. 13—15.

1 (rr) — 3(+) — 4(rr) — 6(rr) — 10(r).

Area: Red Sea, Gulf of Bengal, Malay Archipelago, Antarctic Ocean.

Detonula (Schütt) Gran.

16. **D. delicatula** (Perag.) Gran, Nyt Magaz. Naturv. 1900, p. 112; *Lauderia delicatula* Perag., Monogr. Rhiz. p. 105, Pl. 1, f. 13; Cleve, Phytoplankton, p. 24, Pl. 2, f. 21; Schröder, Neapel p. 23, Pl. 1, f. 9 a, b; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 157.

A species of *Detonula* which I refer with some hesitation to *D. delicatula*, has been found in some of the samples.

1 (rr) — 6(rr) — 10(rr).

Area: Tropical Atlantic Ocean, Mediterranean, Red Sea(?).

17. **D. Moseleyana** (Castr.) Gran, Nyt Magaz. Naturv. 1900, p. 113; Ostenfeld & Schmidt, Plankt. from the Red Sea, etc. p. 157; *Lauderia? Moseleyana* Castr., Challenger Report, p. 90, Pl. 24, f. 9; Monogr. Rhiz., p. 105, Pl. 1, f. 10.

2 (rr) — 3(rr).

Area: Red Sea, Arafura Sea.

Leptocylindrus Cleve.

18. **L. danicus** Cleve, Kanonbaaden „Hauch“s Togter, Kjøbenhavn, p. 54 (1879); Bih. t. Sv. Vet. Akad. Handl. XX, 3, No. 2, p. 15, Pl. 2, f. 4, 5; Schröder, Neapel, p. 25; Cleve, Pl. f. the Red Sea, p. 1033; Pl. f. the Indian Ocean and the Malay Archip. p. 21; Atl. Plankt. Organisms p. 332.

6 (rr) — 10(rr).

Area: Eastern temperate Atlantic Ocean from Færøes and Norway southwards to Spain, Mediterranean, Red Sea, Malay Archipelago.

Dactyliosolen Castr.

19. **D. antarcticus** Castr., Challenger Report p. 75, Pl. 9, f. 7; Peragallo, Monogr. Rhiz. p. 104, Pl. 1, fig. 7; Cleve, Atl. Plankt. Organisms

p. 323; Pl. f. the S. Atlantic and the S. Indian Ocean p. 932; Pl. f. the Indian Ocean and the Malay Archip. p. 21.

2 (rr) — 6 (r).

Area: Eastern and Northern Atlantic Ocean, Antarctic Ocean, South Indian Ocean at 42°—45° S. and 3° W. to 48° E.

20. **D. mediterraneus** Perag., Monogr. Rhiz. p. 104, Pl. 1, f. 8, 9; Schröder, Neapel p. 24; Cleve, Pl. f. the S. Atl. and S. Ind. Ocean p. 932; Pl. f. the Red Sea, Öfv. af K. Sv. Vetensk. Akad. Förhandl. 1900, No. 9 [1901], p. 1033; Atl. Plankt. Organisms p. 324; Pl. f. the Indian Ocean and the Malay Archip. p. 21; Ostenfeld, Vid. Medd. Nath. For. Kjøbenhavn, 1898, p. 428; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 157.

2 (+) — 4 (rr) — 5 (rr) — 6 (+) — 7 (rr) — 10 (rr).

Area: Temperate North Atlantic Ocean, Tropical Atlantic at Puerto Cabello, Southern Atlantic and Indian Ocean at 42°—44° S. and 3° W.—48° E., Mediterranean, Red Sea, Gulf of Aden, Gulf of Bengal, Malay Archipelago.

Lauderiopsis Ostf.

21. **L. costata** Ostf. in Ostenfeld & Schmidt, Pl. f. the Red Sea, etc., p. 158, f. 10.

This genus forms a connecting link between *Lauderia*, *Dactyliosolen* and *Guinardia*.

2 (r) — 6 (+).

Area: Red Sea.

Guinardia Perag.

22. **G. flaccida** (Castr.) Perag., Monogr. Rhiz. p. 107, Pl. 1, f. 3—5; de Wildeman, l. c. p. 122; Schröder, Neapel, p. 24; Ostenfeld & Schmidt, Pl. f. the Red Sea etc., p. 158; Cleve, Atlant. Plankt. Organisms p. 328; Pl. f. the Indian Ocean and the Malay Archip. p. 21; *Rhizosolenia?* *flaccida* Castr. Challenger p. 74, Pl. 29, f. 4.

3 (r) — 6 (rr) — 10 (rr).

Area: Temperate Atlantic Ocean from Norway southwards to 16° N., Mediterranean, Red Sea, Arafura Sea, Malay Archipelago.

Rhizosolenia (Ehbg.) Btw.

23. **R. alata** Btw., Micr. Journ. 1858, p. 96, Pl. 5, f. 7; Cleve, Diat. f. the Sea of Java, 1873, p. 11; Leuduger-Fortmorel, l. c. p. 36; de Wildeman, l. c. p. 123; Grunow, Novara Exp. p. 28; Peragallo, Monogr. Rhiz. p. 115, Pl. 5, f. 11; Schröder, Neapel p. 26; Ostenfeld & Schmidt, Red Sea p. 159; Cleve, Phytoplankton p. 24; Atlant. Plankt. Organisms p. 337; Red Sea p. 1034; Pl. f. the Atlant. and Indian Ocean p. 934; Pl. f. the Ind. Ocean and the Malay Archip. p. 22.

2 (rr) — 10 (rr).

Area: Atlantic Ocean from N. of Iceland to 41° S., Mediterranean, Red Sea, Indian Ocean to 33° S., Malay Archipelago, Pacific Ocean southwards to S. of New Zealand.

R. alata Btw. var. **gracillima** (Cl.) Van Heurck, Synopsis, Pl. 79, f. 8, 10; Peragallo, Monogr. Rhiz. p. 115, Pl. 5, fig. 12; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 160; Cleve, Pl. f. the Red Sea p. 1034; Atl. Plankt. Organisms, p. 342; Pl. f. the Indian Sea and the Malay Archipelago p. 23; *R. gracillima* Cleve, New Diatoms, K. Sv. Vet. Akad. Handl. Bd. 18, 5, 1881, p. 26, Pl. VI, f. 78; Phytoplankton p. 24; Schröder, Neapel, p. 26.

2 (rr) — 4 (rr) — 10 (r).

Area: Most parts of the Atlantic Ocean, Mediterranean, Red Sea, Gulf of Aden, Malay Archipelago.

R. alata Btw. var. **indica** (Perag.) Ostf. in Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 160; *R. indica* Peragallo, Monogr. Rhiz. p. 116, Pl. 5, f. 16; *R. alata* v. *corpulenta* Cleve, Phytoplankton p. 24, Pl. 2, f. 11; Atl. Plankt. Organisms p. 340; *R. corpulenta* Cleve, Pl. of the Ind. Ocean and Malay Archip. p. 22; *R. quadrijuncta* Peragallo, Monogr. Rhiz. p. 116, Pl. 5, f. 17.

Certainly the *R. indica* and *R. quadrijuncta* of Peragallo belong to the same species and this is further identical with the var. *corpulenta* of Cleve. I have given two sketches of the calyptrae, showing different directions of the upper part.

1 (rr) — 2 (rr) — 3 (rr) — 10 (+).

Area: Tropical and Subtropical Atlantic, Red Sea, Gulf of Aden, Indian Ocean, Malay Archipelago, Yeddo Bay.

24. **R. amputata** Ostf., n. sp. (sect. *Squamosae* Perag.).

Frustules large, 80—100 μ broad; valves (calyptrae) long-conic; squamæ 5 in circumference; spine transversely cut off, with an excavation at the apex and a cavity in the lower part. Chromatophores numerous, small.

Allied to *R. arafurensis* Gastr. (Challenger Report, p. 74, Pl. 30, f. 12; Peragallo, Monogr.

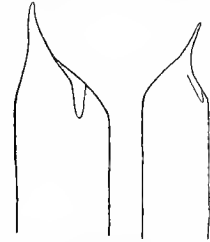


Fig. 3.

Rhizosolenia alata Btw. var. *indica* (Perag.) Ostf. Two cells with different directions of the calyptra. $\left(\frac{175}{1}\right)$.

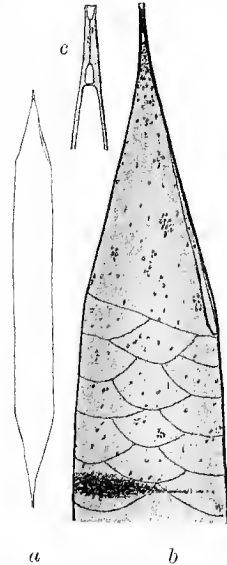


Fig. 4.

Rhizosolenia amputata Ostf. a a whole cell $\left(\frac{80}{1}\right)$, b part of a cell $\left(\frac{200}{1}\right)$, c the apex showing the form of the spine $\left(\frac{450}{1}\right)$.

Rhiz. p. 111. Pl. 3, f. 6), from which it differs mainly in the form of the spine.

10 (r).

25. **R. calcar avis** Schultze in Müll. Arch. 1858, p. 339, Pl. 13, f. 5—10; Peragallo, Monogr. Rhiz. p. 113, Pl. 4, f. 9, 10; Cleve, Diat. f. the Sea of Java, p. 11; Atl. Plankt. Organismus, p. 339; Pl. f. the Ind. Ocean and the Malay Archip. p. 22; Schröder, Neapel, p. 26.

The type has been found in a few specimens, which are quite like the specimens from the North Sea, but commonly it is replaced by the variety, var. *cochlea*, mentioned below.

1 (rr) — 10 (r).

Area: Along the Atlantic coasts of Europe, Africa and America; Mediterranean. Malay Archipelago.

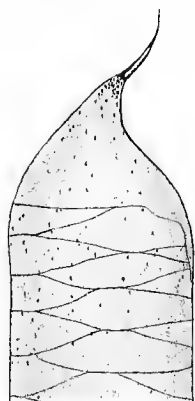


Fig. 5. *Rhizosolenia calcar avis* Schultze var. *cochlea* (Brun) Ostf. ($\frac{200}{1}$).

R. calcar avis Schultze, var. **cochlea** (Brun)

Ostf. ms.; *R. cochlea* Brun, Diat. foss. et pelag. 1891, p. 43, Pl. 19, f. 9; Peragallo, Monogr. Rhiz. p. 113, Pl. 4, f. 11; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 22 and p. 56, Pl. 8, f. 12; Lenduger-Fortmorel, l. c. p. 36; de Wildeman, l. c. p. 123.

Cleve has figured a fragment of a frustule showing numerous, small chromatophores grouped in oblique or spirally twisted bands, but the rather numerous specimens which I have seen, had the small chromatophores in more or less distinct longitudinal bands. I consider it a variety of *R. calcar avis*, corresponding to the var. *indica* of *R. alata*.

2 (rr) — 3 (rr) — 6 (r) — 10 (+).

Area: Indian Ocean, Malay Archipelago.

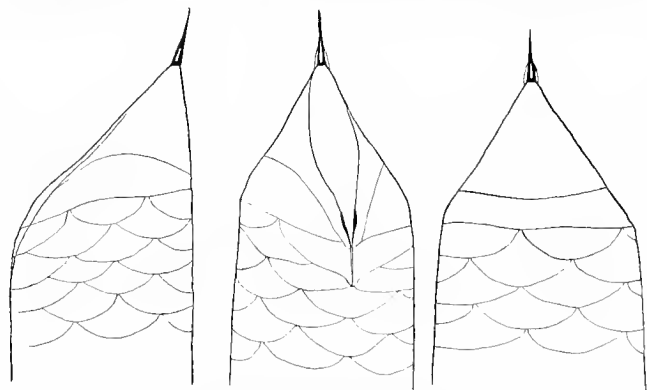


Fig. 6. *Rhizosolenia Clevei* Ostf. ($\frac{150}{1}$).

26. **R. Clevei** Ostf., n. sp. (sect. *Squamosae* Perag.).

Frustules large, 175—200 μ broad; squamæ 5 in circumference; spine as in *R. styliformis*; lines of the connection-surface with two thickened parts for the basal part of the spine; chromatophores numerous, small.

This interesting species is allied to *R. Debyana* Perag. It is the only species besides *R. styliformis* Btw., which includes the peculiar *Richelia intracellularis* Schmidt (in Ostenfeld & Schmidt, Pl. f. the Red Sea, p. 146, f. 2).

2 (rr) — 5 (rr) — 7 (+) — 10 (rr).

27. **R. cylindrus** Cleve, Phytoplankton p. 24, Pl. 2, f. 12; Atl. Plankt. Organisms p. 341; Schröder, Neapel p. 26; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 160.

I have figured two frustules of a form which I regard as *R. cylindrus* Cl., although the annulations are not quite like those figured by Cleve. The chromatophores are small.

10 (r).

Area: Tropical Atlantic Ocean, especially in its Western parts, Gulf of Naples, Gulf of Aden.

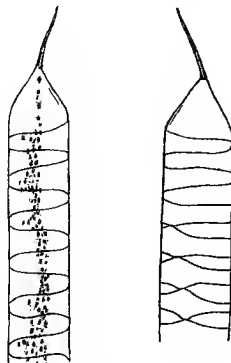


Fig. 7. *Rhizosolenia cylindrus* Cl. ($\frac{450}{1}$).

28. **R. formosa** Perag., Diat. de Villefranche p. 91, Pl. 6, f. 43, Monogr. Rhiz. p. 110, Pl. 2, f. 2; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 23; Schröder, Neapel p. 25.

3 (rr).

Area: Mediterranean, Malay Archipelago.

29. **R. hyalina** Ostf. in Ostenfeld & Schmidt, Pl. f. the Red Sea, p. 160, f. 11; *R. pellucida* Cleve, Pl. f. the Indian Ocean and the Malay Archipelago p. 23 and p. 56, Pl. 8, f. 4.

2 (r) — 3 (rr) — 10 (+).

Area: Red Sea, Gulf of Aden, Malay Archipelago.

30. **R. imbricata** Btw., Microsc. Journ. 1858, Vol. VI, p. 95, Pl. 5, f. 6; Cleve, Diat. f. the Sea of Java p. 11; Van Heurck, Synopsis Pl. 79, f. 5, 6; Peragallo, Monogr. Rhiz. p. 113, Pl. 5, f. 2, 3; Schröder, Neapel p. 26; Ostenfeld & Schmidt, Pl. f. the Red Sea etc. p. 161; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 23; *R. striata* Grev., Diat. South Pacif. III, p. 334, Pl. 3, f. 4; Peragallo, l. c. p. 114, Pl. 5, f. 1; Leuduger-Fortmorel l. c. p. 36.

1 (rr) — 2 (r) — 3 (+) — 4 (rr) — 6 (r) — 7 (rr) — 10 (+).

Area: Tropical Atlantic, Mediterranean, Red Sea, Gulf of Aden, Malay Archipelago, South-Indian and Pacific Oceans.

31. **R. robusta** Norman, Pritch. Infus. 1861, p. 866, Pl. 8, f. 42; Leuduger-Fortmorel, l. c. p. 36; Cleve, Diat. f. the Sea of Java, 1873, p. 11; Castracane, Challenger Rep., Pl. 24, f. 5; Peragallo, Monogr. Rhiz., p. 109, Pl. II, f. 1, 1 a, Pl. III, f. 1, 2; Cleve, Phytoplankton, p. 25; Atl. Plankt. Organisms, p. 345; Pl. f. the Red Sea p. 1034; Pl. f. the Indian Ocean and Malay Archip. p. 23; Schröder, Neapel p. 25; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 161.

1 (rr) — 2 (rr) — 3 (rr) — 6 (rr) — 8 (rr) — 10 (rr).

Area: Tropical Atlantic Ocean, Mediterranean, Red Sea, Indian Ocean, Malay Archipelago, Pacific Ocean.

32. **R. setigera** Btw., Microsc. Journ. 1858, p. 95, Pl. 5, f. 7; Van Heurck, Synops. Pl. 78, f. 6—8; Peragallo, Monogr. Rhiz. Pl. 4, f. 15, 16, non f. 12—14; Hensen, Fünfter Ber. Komm. Deutsch. Meere in Kiel, 1887, Pl. V, f. 38 a, b, c; Cleve, Fish. Board for Scotland 1896, p. 301, f. 12; Grunow, Novara Exp. p. 28; Cleve, Diat. f. the Sea of Java p. 11; Atl. Plankt. Organisms p. 347; Pl. f. the Ind. Ocean and the Malay Archip. p. 23; Ostenfeld & Schmidt, Red Sea, p. 171; Lemmermann, l. c. p. 317; Leuduger-Fortmorel, l. c. p. 36; de Wildeman l. c. p. 123; *R. japonica* Castr., Challenger p. 72; Pl. 23, f. 7.

The specimens are rather thin and delicate, about 8—10 μ broad.

1 (r) — 2 (rr) — 6 (rr) — 7 (rr) — 10 (+).

Area: Atlantic Coasts of Europe and North of S. America, Mediterranean, Red Sea, Indian Ocean, Malay Archipelago, Japan Sea, Pacific Ocean. — Neritic species.

33. **R. Shrubsoleii** Cleve, New Diatoms, 1881, p. 26; Van Heurck, Synopsis, Pl. 79, f. 11—13; Peragallo, Monogr. Rhiz. p. 114, Pl. 5, f. 8, 9; Cleve, Phytoplankton p. 25; Atl. Plankt. Organisms p. 347; Pl. f. the Red Sea, p. 1034; Pl. f. the Ind. Ocean and Malay Archip. p. 23; Schröder, Neapel p. 26; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 161; ?*R. atlantica* Peragallo, Monogr. Rhiz. p. 114, Pl. 5, f. 4—5.

2 (rr) — 6 (rr) — 10 (rr).

Area: Atlantic Ocean in the Eastern part from the Færøes southwards, Mediterranean, Red Sea, Gulf of Aden, Indian Ocean, Malay Archipelago, Yeddo Bay.

34. **R. Stolterfothii** Perag., Diat. de Villefranche, p. 90, Pl. 6, f. 44; Monogr. Rhiz. p. 108, Pl. 1, f. 17, 18; Cleve, Phytoplankton p. 25; Atl. Plankt. Organisms p. 348; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc.

p. 161; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 23; Schröder, Neapel p. 25; Lemmermann, l. c. p. 315.

2 (r) — 3 (rr) — 6 (r) — 7 (rr) — 10 (+).

Area: Northern Atlantic Ocean, especially in the North Sea and the English Channel, Mediterranean, Red Sea, Gulf of Aden, Malay Archipelago, China Sea, Yeddo Bay, Cook Strasse (S. of New Zealand). — Neritic species.

35. **R. styliformis** Btw., Micr. Journ. 1858, p. 96, Pl. 5, f. 5 a, b, c, d; Van Heurck, Synopsis Pl. 78, f. 1—5, Pl. 79, f. 1, 2, 4; Peragallo, Monogr. Rhiz. p. 111, Pl. 4, f. 1—5; Grunow, Novara Exp. 1870, p. 28; Cleve, Diat. f. the Sea of Java p. 11; Atl. Plankt. Organisms p. 349; Pl. f. the S. Atl. Ocean and the S. Ind. Ocean p. 935; Pl. f. the Red Sea p. 1034; Pl. f. the Ind. Ocean and the Malay Archip.; Leuduger-Fortmorel, l. c. p. 36; Lemmermann, l. c. p. 315 and p. 317; Schröder, Neapel p. 26.

The type (about 25 μ broad) is rather common in some samples, but usually it is replaced by var. *latissima*, corresponding to the var. *indica* of *R. alata*, and var. *cochlea* of *R. calcar avis*.

10 (+).

Area: Most parts of the Atlantic Ocean, Mediterranean, Red Sea, Indian Ocean, Malay Archipelago, Pacific Ocean, Antarctic Ocean.

R. styliformis Btw., var. *latissima* Btw., Microsc. Journ. Pl. 5, f. 5 c; *R. styliformis* var. *polydactyla* (Castr.) Perag., Monogr. Rhiz. p. 111, Pl. 4, f. 7; *R. polydactyla* Castr., Challenger Report p. 71, Pl. 24, f. 2; *Rh. styliformis* var. *lata* Lemmermann, l. c. p. 315 and 351.

Differs only from the main species in the size (about 60—70 μ broad).

1 (rr) — 4 (rr) — 10 (+).

Area: Antarctic Ocean, Malay Archipelago, French Pass at New Zealand.

36. **R. Temperei** Perag., Diat. Villefranche p. 91, Pl. 5, f. 40, Monogr. Rhiz. p. 110, P. 2, f. 3; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 22.

var. *acuminata* Perag., Monogr. Rhiz. p. 1, Pl. 3, f. 4; Schröder, Neapel p. 25, Pl. 1, f. 6 (f. *inaequalis*); Cleve, Atl. Plankt. Organisms p. 336; Limmerm. l. c. p. 317; *R. robusta* v. *recta* (nom. nud.) Ostenfeld, Vid. Medd. Nath. For. Kjöbenhavn, 1898, p. 427.

Only the var. *acuminata* Perag. has been found and I should think it to be a distinct

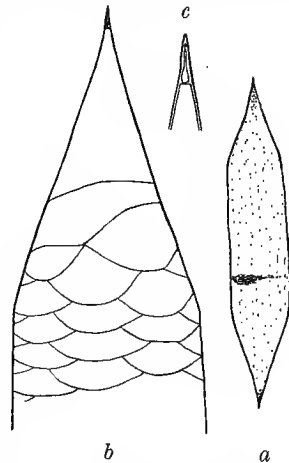


Fig. 8. *Rhizosolenia Temperei* Perag. var. *acuminata* Perag. a a whole cell ($\frac{60}{1}$). b part of a cell ($\frac{200}{1}$). c the apex, showing the form of the spine ($\frac{150}{1}$).

species, but I have never seen the true *B. Temperei*. I have figured a frustule and a part of it, showing the form of the spine.

3 (rr) — 10 (r).

Area: Of the main species: Mediterranean, Malay Archipelago; of the var. *acuminata*: Tropical Atlantic Ocean, Mediterranean, Pacific Ocean at Sandwich Islands.

Chaetocerae.

Bacteriastrum Shadb.

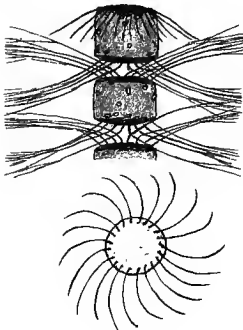


Fig. 9. *Bacteriastrum hyalinum* Laud. Part of a chain with terminal cell; beneath a terminal cell in side view, showing the terminal awns ($\frac{4.5}{1}$).

37. *B. hyalinum* Lauder, Trans. Micr. Soc. 1864, p. 8, Pl. 3, f. 7 a, b; Cleve, Atl. Plankt. Organisms p. 286; Pl. f. the Ind. Ocean and the Malay Archip. p. 18 and p. 54; *B. spirillum* ex parte and *B. varians* var. *princeps* Castr., Challenger pp. 83, 84, Pl. 14, f. 2, Pl. 29, f. 1, 3.

This interesting species which Lauder has described and figured in 1863, has been forgotten for long time; Cleve has now pointed out that it is a distinct species and I am of the same opinion. I think it must be the same species which Castracane in his report on Challenger-Diatoms has figured and named *B. varians* var. *princeps* and also his figure Pl. 29, f. 1 of *B. spirillum* belongs hereto. The fig. 9 illustrate this species.

1 (rr) — 3 (r) — 6 (+) — 10 (+).

Area: Malay Archipelago, South China Sea.

38. *B. varians* Lauder, Trans. Micr. Soc. 1864, p. 8, Pl. 3, f. 1—6; Cleve, Diat. f. the Sea of Java 1873, p. 8; Grunow, Novara Exp., 1870, p. 28; Leuduger-Fortmorel, l. c. p. 36; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 18; Schröder, Neapel p. 26; Van Heurck, Synopsis, Pl. 80, f. 3—5; *B. varians* et var., *B. brevispinum* et var., *B. spirillum* ex parte, *B. Wallichii*, var. *hispida* Castr., Challenger p. 82—84, Pl. 15, f. 6, 8, Pl. 19, f. 2, Pl. 23, f. 1, 3; *Actiniscus varians* Van Heurck, Synops. Pl. 82 bis, f. 10; *B. symmetricum* Leuduger-Fortmorel, l. c. p. 36, Pl. 7, f. 1.

I regard all the species described by Castracane and Leuduger-Fortmorel as belonging to the very variable *B. varians*.

1 (+) — 2 (r) — 3 (rr) — 4 (rr) — 5 (rr) — 6 (+) — 7 (rr) — 10 (c).

Area: Mediterranean, Red Sea, Gulf of Aden, Indian Sea, Malay Archipelago, South China Sea. A nearly allied form (var. *borealis* Ostefeld, Nyt Magazin, Kristiania, 1901, p. 293, f. 5) is common along the Coasts of Western Europe.

Chaetoceras Ehbq.

39. **C. anglicum** (Grun.) Ostf. ms.; *C. (furcellatus* Bail. var.) *anglicus* Grun. in Van Heurck, Syn., Pl. 82, f. 3; *C. didymus* v. *longicruris* Cleve, Phytoplankton p. 21, Pl. I, f. 11, non f. 17; Schröder, Neapel p. 27; Cleve, Atl. Plankt. Organisms p. 301; Pl. f. the Red Sea, p. 1033; Pl. f. the Indian Ocean and the Malay Archip. p. 19; *C. longicrura* Ostenfeld & Schmidt, Pl. f. the Red Sea p. 154.

There is no doubt that the figure in Van Heurck, Synopsis Pl. 82, f. 3 represents the species which has been named *longicruris* by Cleve, and consequently the older name *anglicus* must have the priority.

2 (rr) — 6 (rr) — 7 (rr) — 10 (r).

Area: Subtropical Atlantic Ocean, Mediterranean, Red Sea and Gulf of Aden, Gulf of Bengal, Malay Archipelago.

40. **C. Aurivillii** Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 18 and p. 54, Pl. 8, f. 10.

10 (rr).

Area: Tropical Atlantic Ocean (7° N. 53° W.), Malay Archipelago.

41. **C. breve** Schütt, Ber. d. Deutsch-Botan. Gesellsch., 1895, p. 33, f. 4 a, b; Gran, Nyt Magazin Naturv., Kristiania 1900, p. 121; Ostenfeld, ibidem 1901, p. 295, f. 6; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 18; *C. didymus* var. *hiemalis* Cleve, Phytoplankton p. 21, Pl. I, f. 18; *C. hiemalis* Cleve, K. Sv. Vet. Akad. Handl. 32, No. 8, 1900, p. 25, f. 9; Atl. Plankt. Organisms p. 304.

Professor Cleve to whom I sent my figure (fig. 10) thinks that the form belongs to the *C. breve* Schütt, and I can agree with him. It resembles striking small forms of *C. Lorenzianum* but is easily recognisable by the single chromatophore and the smooth awns.

2 (rr) — 6 (rr) — 7 (rr) — 10 (rr).

Area: Along the coasts of Europe from Westmannaö at Island southwards to the English Channel; Malay Archipelago.

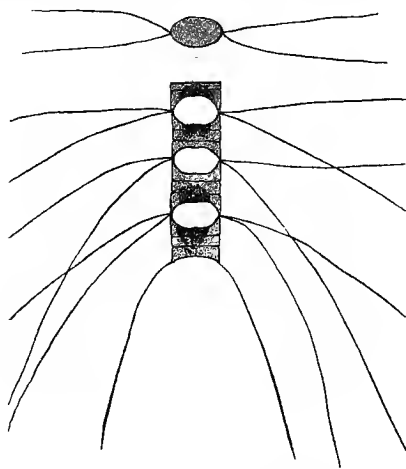


Fig. 10. *Chaetoceras breve* Schütt ($\frac{200}{1}$).

42. **C. calvum** Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 18 and p. 54, Pl. 8, f. 11.

With some hesitation I refer a form which I have seen in some of the samples to the new described *C. calvum* Cl. or to *C. tortissimum* Gran (Nyt Magaz. Naturv. Kristiania 1900, p. 122, Pl. 9, f. 25), those two species only differing in the number of chromatophores.

3 (rr) — 6 (rr) — 10 (rr).

Area: [of *C. calvum*] Malay Archipelago, [of *C. tortissimum*] coasts of the Northern part of Norway.

43. *C. clavigera* Ostf., n. sp.

Cells solitary or two together, 8—10 μ broad, mostly broader than long, awns of the one valve shorter and more clavate than those of the other valve; the thickened distal part of the awns with twisted striations and short spines. Valves elliptic. Chromatophore single, in front.

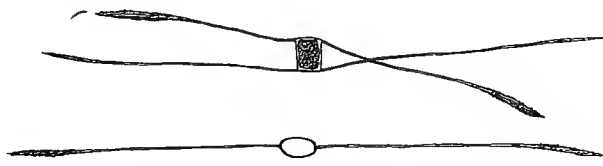


Fig. 11. *Chaetoceras clavigera* Ostf. ($\frac{450}{1}$).

This very characteristic species seems most allied to *C. simplex* Ostf. from the Caspian Sea.

6 (+).

44. *C. coarctatum* Lauder, Trans. Micr. Soc. 1864, p. 79, P. 8, f. 8; Cleve, Diat. f. the Sea of Java 1873, p. 9. Pl. II, f. 10 a, b, c; Leuduger-Fortmorel, l. c. p. 37; Cleve, Pl. f. the Red Sea p. 1032; Ostensfeld & Schmidt, Pl. f. the Red Sea, etc. p. 153; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 18 and p. 54; *C. boreale*, v. *rudis* Cleve, Phytoplankton p. 20, Pl. I, f. 5; *C. rudis* Cleve, Atl. Plankt. Organisms p. 308.

Chromatophores numerous, small. As Cleve (Pl. f. Ind. Ocean p. 54) has stated, the chains are often set with vorticells.

2 (rr) — 3 (rr) — 4 (rr) — 6 (rr) — 7 (rr) — 8 (rr) — 10 (r).

Area: Tropical Atlantic Ocean, Mediterranean, Red Sea, Indian Ocean, Malay Archipelago, Hongkong.

45. *C. compressum* Lauder, Trans. Micr. Soc. 1864, p. 78, Pl. 8, f. 6; Cleve, Diat. f. the Sea of Java 1873, p. 8; Leuduger-Fortmorel, l. c. p. 37; de Wildeman, l. c. p. 133; Ostensfeld & Schmidt, Pl. f. the Red Sea, etc. p. 153; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 18 and p. 55; *C. Kelleri* Brun, Espèc. novell., Le Diatomiste II, Pl. XVII, f. 91, 92.

I regard the *C. Kelleri* Brun which was found in oysters from Japan as identical with the *C. compressum* Lauder, and I have given a figure of the coarse, twisted awns of *C. compressum* in order to show this identity.

1 (rr) — 2 (r) — 3 (rr) — 6 (rr) — 10 (c).

Area: Red Sea, Malay Archipelago, Hongkong. — Neritic species.

46. *C. didymum* Ehb. (1845);

Cleve, Bih. t. Sv. Vet. Akad. Handl.

Bd. 20, III, No. 2, 1894, p. 13, Pl. 1, f. 3, 4; Gran, Norske Nordhavs Expedition, Protophyta p. 16, Pl. 1, f. 8—10 and Pl. III, f. 37, 38; Cleve, Atl. Plankt. Organisms p. 301; Schröder, Neapel p. 27; *C. protuberans* Castr., Challenger p. 76, Pl. 8, f. 2, non Lauder.

10 (r).

Area: Along the Atlantic Coasts of Europe, Mediterranean, Japan Sea, Puget's Sound.

47. *C. distans* Cleve, Diat. f. the Sea of Java 1873, p. 9, Pl. II, f. 11 a, b; Leuduger-Fortmorel l. c. p. 37; de Wildeman, l. c. p. 133; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 154; Cleve, Pl. f. the Indian Ocean and the Malay Archip. 1902, p. 18 and p. 55; non Van Heurck, l. c. Pl. 82, f. 4; nec Cleve, Planktonundersökningar; Bih. t. K. Sv. Vet. Akad. Handl. B. 20, III, No. 2, 1894, p. 14, Pl. II, f. 2.

The chromatophore is solitary, the hoop rather narrow (see fig. 13).

1 (+) — 2 (rr) — 4 (rr) — 5 (rr) — 6 (rr) — 7 (rr) — 10 (+).

Area: Malay Archipelago, Red Sea.

48. *C. diversum* Cleve, Diat. f. the Sea of Java 1873, p. 9, Pl. II, f. 12; Leuduger-Fortmorel, l. c. p. 37; Van Heurck, l. c. Pl. 81, f. 4; de Wildeman, l. c. p. 133; Cleve, Atl. Plankt. Organisms, p. 302; Plankt. f. the Ind. Ocean and the Malay Archipelago p. 18; Plankt. f. the Red Sea p. 154; *C. diversum* v. *tenuis* Cleve, Phytoplankton p. 21, Pl. II, f. 2; *C. diversum* v. *mediterranea* Schröder, Phytopl. d. Golfes v. Neapel, Mitteil.

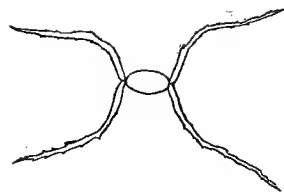


Fig. 12.
Chaetoceras compressum Laud.
Cell with twisted coarse awns,
in side view ($\frac{2.50}{1}$).

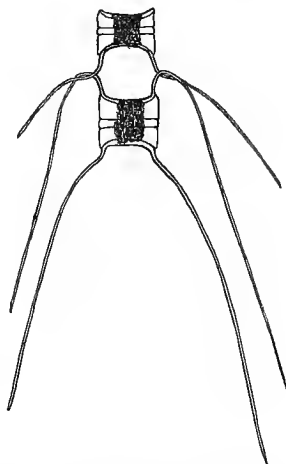


Fig. 13. *Chaetoceras distans* Cl.
Chain with chromatophores.

d. Zool. Stat. zu Neapel Bd. 14, 1900, p. 27, Pl. I, f. 1; ?*C. rude* Leuduger-Fortmorel, l. c. p. 37, Pl. VI, f. 1.

The chromatophore is solitary and in front.

Rather common: 1(c) — 2(c) — 3(r) — 4(rr) — 5(rr) — 6(+) — 7(r) 10(+).

Area: Tropical neritic form, noted from Atlantic Ocean, Mediterranean-Red Sea, Indian Ocean, Malay Archipelago.

49. *C. javanicum* Cleve, Diat. f. the Sea of Java 1873, p. 10, Pl. 2, f. 13; Pl. f. the Indian Ocean and the Malay Archip. p. 19 and p. 55; Leuduger-Fortmorel l. c. p. 37.

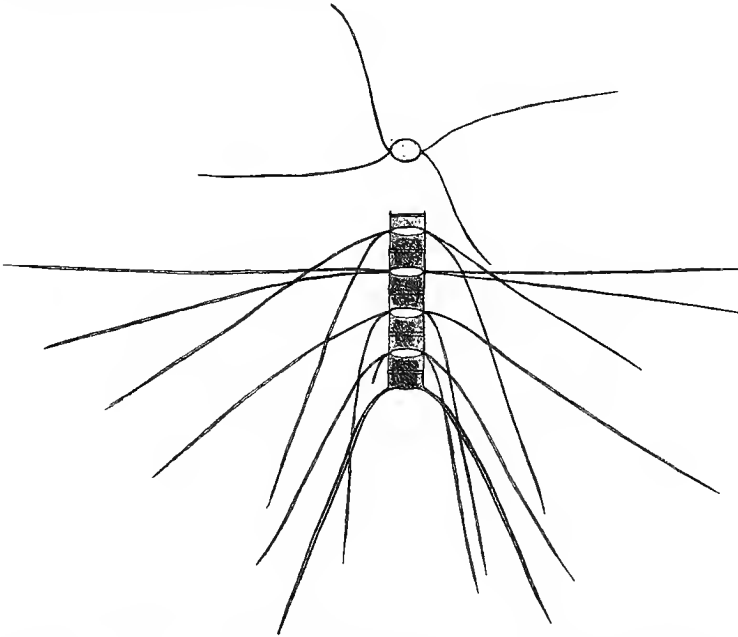


Fig. 14. *Chaetoceras javanicum* Cl. Chain in front view, cell in side view ($\frac{200}{1}$).

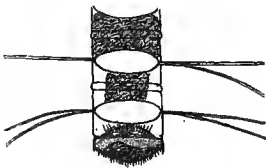


Fig. 15.
Chaetoceras javanicum Cl.
Chain with endospore in
front view ($\frac{425}{1}$).

This species is, as Cleve has lately stated, nearly akin to *C. Schüttii* Cl., if not identical; I have found some spores belonging to this species and they are about as the spores of *C. Schüttii*, both valves being spiniferous. It has one chromatophore in front; the terminal awns are diverging at an acute angle and thickened; the other awns are thin and turn off towards the ends of the chains; seen from the valves they have a characteristic curvature as shown in the figure.

1 (r) — 6 (rr) — 10 (+).

Area: Malay Archipelago.

50. **C. laeve** Leud.-Fortm., l. c. p. 38, Pl. 6, f. 2.

Leuduger-Fortmorel has (in his treatise on the diatoms of the Malay Archipelago) described and figured two species of *Chaetoceras*, viz. *C. rude* and *C. laeve*. The first of those is only a form of *C. diversum* Cleve, but the latter is a distinct species of which I here give a figure; it is related to *C. diversum*, but the thickened intercalary awns are smooth and of a characteristic curvature, first being nearly parallel and then abruptly turning off at a right angle. Chromatophore a single plate in front. Breadth of the cells 9—16 μ .

1 (+) — 6 (rr) — 10 (+).

Area: Sea of Java.

51. **C. Lorenzianum** Grun., Verhandl. d. k. k. zool.-botan. Gesellschaft., Wien 1863, p. 157, Pl. 14, f. 13; Cleve, Diat. f. the Sea of Java, 1873, p. 9; Leuduger-Fortmorel, l. c. p. 37; de Wildeman, l. c. p. 134; Van Heurck, Synopsis Pl. 82, f. 2; Cleve, Phytoplankton, p. 21, Pl. I, f. 13—15; Schröder, l. c. p. 29; Cleve, Pl. f. the Red

Sea p. 1033; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 154; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 19; Atl. Plankt. Organisms p. 306; *C. cellulosum* Lauder, Trans. Micr. Soc. 1864, p. 78, Pl. 8, f. 12; *C. distans, forma setis evidentius punctatis* Van Heurck, Syn. P. 82, f. 4.

Rather common: 1 (+) — 2 (rr) — 3 (rr) — 6 (rr) — 10 (c).

Area: Atlantic from North Sea southwards, Mediterranean, Red Sea, Gulf of Aden, Indian Ocean, Malay Archipelago, Hongkong.

52. **C. paradoxum** Cleve, Diat. f. the Sea of Java 1873, p. 10, Pl. 3, f. 16; Pl. f. the Ind. Ocean and the Malay Archip. p. 19 and p. 55; Leuduger-Fortmorel l. c. p. 37.

2 (rr) — 10 (rr).

Area: Malay Archipelago.

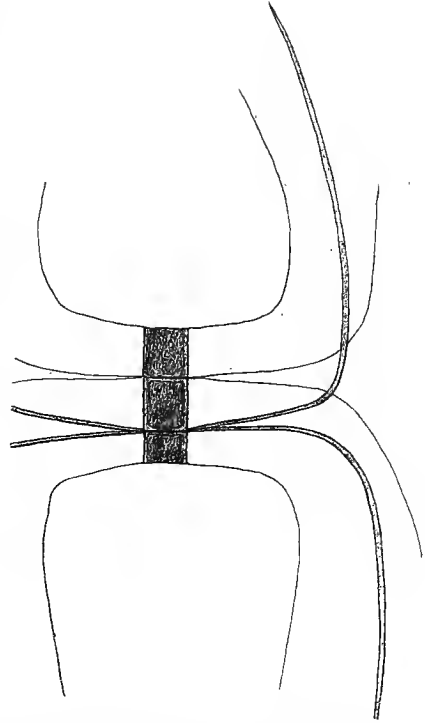


Fig. 16. *Chaetoceras laeve* Leud.-Fortm.
($\frac{450}{1}$).

53. **C. peruvianum** Btw., *Microsc. Journ.* 1856, p. 107, Pl. 7, f. 16 — 18; Cleve, *Fish. Board for Scotland*, 1896, p. 299, f. 7; Leuduger-Fortmorel, l. c. p. 37; Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 19; Pl. f. the S. Atlantic and the S. Indian Ocean, p. 929; Pl. f. the Red Sea p. 1033; Lemmermann l. c. p. 317.

This species is very variable; several new species have been described upon forms of it, but it seems incorrect to me to give them specific range. I should think they are to be arranged in three groups after their coarseness and size, viz.:

f. 1, *volans* (Schütt). Rather slender, awns rather thin: *C. volans* Schütt, *Ber. d. Deutsch. Botan. Gesellsch.* 1895, f. 20, *C. currens* Cleve, *Fish. Board for Scotland*, p. 299, f. 8. Arctic and northern Atlantic form.

f. 2, *typica*. Intermediate between 1 and 3; *C. peruvianum* Btw. l. c.; Cleve, l. c. p. 299, f. 7; Schröder, *Neapel* p. 29, Pl. 1, f. 4 (f. *gracilis*). Tropical parts of the Oceans.

f. 3, *robusta* Cleve. Coarse and with coarse awns. *C. peruvianum* v. *robustum* Cleve, *Diat. f. the Sea of Java*, 1873, Pl. 2, f. 8; *C. boreale?* Lauder, *Transact. Microsc. Soc.* Vol. 12, 1863, Pl. 7, f. 7; *C. robustum* Ostf. in *Ostenfeld & Schmidt*, Pl. f. the Red Sea, etc. p. 145; *C. curvatum* Gastr., *Challenger Report* p. 78. Tropical and Antarctic parts of the Oceans.

f. 2: 1 (rr) — 2 (rr) — 3 (rr) — 6 (r).

f. 3: 1 (rr) — 10 (+).

Area: Arctic and Atlantic Ocean, Mediterranean, Red Sea, Indian Ocean, Malay Archipelago, China Sea, Pacific Ocean, Antarctic Ocean.

54. **C. pseudoerinitum** Ostf., *Nyt Magaz. Naturv., Kristiania*, 1901, p. 300, f. 11; *C. erinitum* Gran, *Norske Nordhavs Expedition, Protophyta* 1897, p. 22, Pl. 4, f. 51, non Schütt, 1895.

This little species which I have described from Danish waters and which Gran has found on the Norwegian coasts, was also met with in the Gulf of Siam, but sparingly.

10 (rr).

Area: Limfjord, Kattgat, Coast of Norway.

55. **C. Ralfsii** Cleve, *Diat. f. the Sea of Java* 1873, p. 10, Pl. III, f. 15; Leuduger-Fortmorel, l. c. p. 37; de Wildeman, l. c. p. 134; Cleve, Pl. f. the Indian Ocean and the Malay Archipelago, p. 19 and p. 55; non Van Heurck, *Syn.*, Pl. 82 bis, f. 3.

The chromatophore is solitary and in front.

2 (rr) — 6 (rr).

• Area: Malay Archipelago.

56. **C. rostratum** Laud., *Trans. Microsc. Soc.* 1864, p. 79, Pl. 8, f. 10; Cleve, Pl. f. the Ind. Ocean and the Malay Archip. p. 19; *Ostenfeld & Schmidt*, Pl. f. the Red Sea, etc., p. 155.

This species belongs to the subgenus *Phaeoceras* Gran, which has numerous small chromatophores, also in the awns.

10 (r).

Area: Red Sea, Malay Archipelago, South China Sea.

57. *C. Schmidtii* Ostf. in Ostenfeld & Schmidt, Plankt. f. the Red Sea, etc. p. 155, f. 8; ?*C. Weissflogii* Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 15 and p. 55, non Schütt.

This species which I have described from the Red Sea, occurs also in the Gulf of Siam; and I suppose that it is the same which Cleve l. c. has identified with *C. Weissflogii* with hesitation.

10 (r).

Area: Red Sea, Malay Archipelago(?).

58. *C. secundum* Cleve, Diat. f. the Sea of Java 1873, p. 10, Pl. II, f. 14 a, b; Leuduger-Fortmorel, l. c. p. 37; de Wildeman, l. c. p. 134; Van Heurck, Synops., Pl. 82, f. 5; *C. curvisetum* Cleve, Pl. f. the Ind. Ocean and the Malay Archipelago 1902, p. 18 and p. 55, non Cleve, in Kanonbaaden Hauchs Togter, Kjöbenhavn, 1889, p. 55 with fig.

Professor Cleve supposes (in his last paper (l. c. 1902, p. 55)) that the Indian *C. secundum* is the same as *C. curvisetum* from the Temperate Atlantic, but I can not enter upon this opinion, as the spores of *C. secundum* figured by Cleve himself (1873, Pl. II, f. 14 a) are rather different from the spores of *C. curvisetum* (see Gran, Protophyta, Pl. II, f. 22).

2 (rr) — 3 (r) — 4 (rr) — 5 (rr)
— 6 (rr) — 10 (r).

Area: Malay Archipelago.

59. *C. siamense* Ostf. n. sp.

Chains straight, about 50 μ broad; valves circular; foramina lanceolate; hoop at least a third part of the cell; chromatophores two, close to the valves; awns all alike, rather robust, undulated; the one about in the sagittal plane, the other diverging at a nearly right angle.

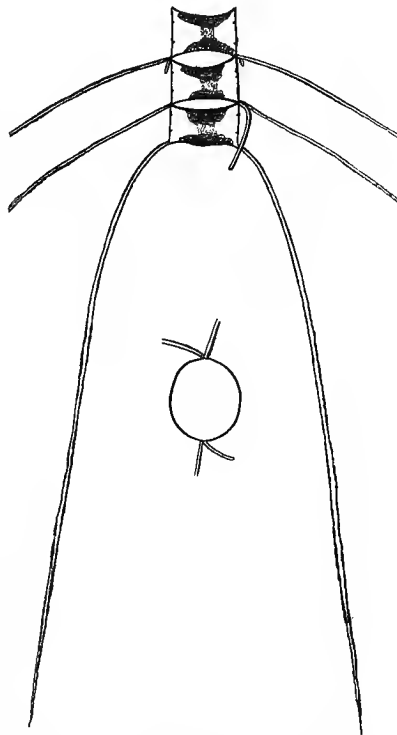


Fig. 17. *Chaetoceras siamense* Ostf., Chain in front view, cell in side view ($\frac{200}{1}$).

I have seen but few chains of this large species, which has some relations to *C. constrictum* Gran (the two chromatophores) and others to *C. teres* Cl. and *C. Weissflogii* Schütt (the form of the valves and the awns).

10 (rr).

Obs. The undulations of the awns are not well drawn in the figure.

60. *C. tetrastichon* Cleve, *Phytoplankton* p. 22, Pl. 1, f. 7; Schröder, l. c. p. 30; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 256; Cleve, Pl. f. the Indian Ocean and the Malay Archipelago p. 19.

2 (rr).

Area: Tropical Atlantic Ocean, Naples, Red Sea, Malay Archipelago.

61. *C. Vanheurckii* Gran, *Norske Nordhavs Expedition, Protophyta*, p. 18; *C. Balsii* Van Heurck *Synopsis*, Pl. 82 bis, f. 3, non Cleve.

I have found a form which I identify with the *C. Vanheurckii*, described by Gran in his excellent paper on the Norwegian species of *Chaetoceras*. My figures of a part of a chain and of the spores agree

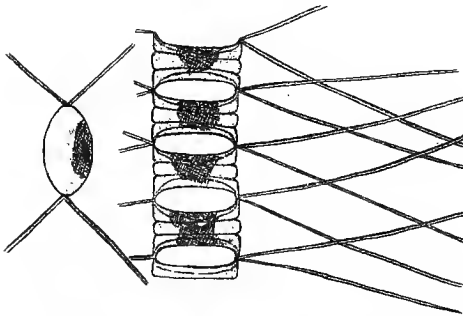


Fig. 18. *Chaetoceras Vanheurckii* Gran. Chain in front view, cell in side view ($\frac{125}{1}$).

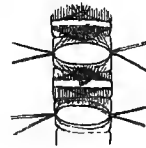


Fig. 19. *Chaetoceras Vanheurckii* Gran. Chain with endospores in front view ($\frac{225}{1}$).

rather well with the description by Gran; the chains are straight, foramina lanceolate to narrow-elliptic, hoop about a third part of the cell with constricted sutures; chromatophore one; awns straight, seen from the valve diverging at a right angle; spores about in the middle of the cells, primary valve arcuate with numerous spines, secondary valve humped with longer spines on the hump; further both valves possess along the margins a wreath of parallel, straight apiculi.

10 (r).

Area: Yeddo Bay.

Biddulphiaceae.

Schmidtiella Ostf. n. gen.

Frustules in chains. Valves broadly elliptic with undulate surface, most elevated at the sagittal plane, cohering one to another by two minute processes at the sagittal plane. Frustules in a front-view rectangular. No structure seen. Endochrome cocochromatic.

Allied to *Graya* Brun & Grove [see Van Heurck, A Treatise on the Diatomaceae p. 458, f. 187] and perhaps forming a connection between the *Chaetocereae* and the *Biddulphiaceae*.

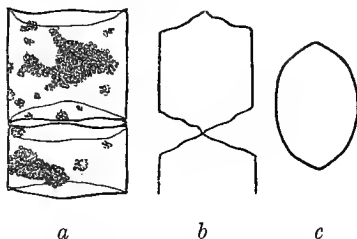


Fig. 20. *Schmidtiella pelagica* Ostf.
 a chain of two cells in front view, b in sagittal view, c cell in side view ($\frac{200}{1}$).

62. *S. pelagica* Ostf. n. sp.

Characters of the genus, frustules in front view 80μ broad, in sagittal view 40μ broad.

I have only found one chain of this interesting diatom which I name in honour of the Danish botanist Johs. Schmidt who made those rich collections in Siam which he is publishing in the „Flora of Koh Chang“.

Eucampia Ehbq.

63. *E. biconcava* (Cl.) Ostf. ms.; *Climacodium biconcavum* Cleve, Phytoplankton p. 22, Pl. 2, f. 16, 17; Atl. Plankt. Organisms p. 314; Pl. f. the Red Sea, p. 1033; Pl. f. the Indian Ocean and the Malay Archip. p. 19; *Eucampia hemiauloides* Ostf. in Ostenfeld & Schmidt, Pl. f. the Red Sea p. 157, f. 9.

According to a letter from Mr. Cleve his *Climacodium biconcavum* is identical with my *Eucampia hemiauloides*, and consequently his species-name has the priority, but as shown in my paper it must be an *Eucampia*, with the same structure as the other species of this genus.

2 (r) — 3 (rr) — 4 (rr) — 5 (rr) — 6 (rr) — 7 (r) — 10 (rr).

Area: Tropical Atlantic Ocean, Mediterranean, Red Sea, Gulf of Aden, Malay Archipelago.

64. *E. cornuta* (Cl.) Grun. in Van Heurck, Synopsis Pl. 95 bis, f. 5; Cleve, Pl. f. the Red Sea p. 1033, Pl. f. the Indian Ocean and the Malay Archip. p. 21; (?) Atl. Plankt. Organisms p. 326; *Mölleria cornuta* Cleve, Diat. f. the Sea of Java 1873, p. 7, Pl. 1, f. 6; Leuduger-Fortmorel, l. c. p. 47.

6 (rr) — 10 (r).

Area: Red Sea, Malay Archipelago; a very small form occurs in the sub-tropical N. Atlantic Ocean (Cleve).

65. **E. zodiacus** Ehb., Kreideth. p. 71, Pl. 4, f. 8; Leuduger-Fortmorel, l. c. p. 40; Cleve, Diat. f. the Sea of Java p. 7; Atlant. Plankt. Organisms p. 326; Pl. f. the Ind. Ocean and the Malay Archip. p. 21.

10 (rr).

Area: Neritic species found along the coasts of West-Europe, Malay Archipelago, Yeddo Bay in Japan, Puget's Sound.

Climacodium Grun.

66. **C. Fraunfeldianum** Grun., Novara Exp. 1870, 102, Pl. 1 A, f. 24; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 156; Cleve, Atlant. Plankton Organisms p. 314; *C. Fraunfeldii* Cleve, Pl. f. the Red Sea, p. 1033; Cleve, Pl. f. the Ind. Ocean and the Malay Archipelago p. 19; *C. Jacobi* Cleve, Phytoplankton p. 22, Pl. 2, f. 18; *Climacodium Fraunfeldii* Van Heurck, Synopsis Pl. 106, f. 5.

2 (rr) — 3 (rr) — 7 (rr) — 10 (rr).

Area: Tropical Atlantic Ocean, Red Sea, Indian Ocean, Malay Archipelago, Pacific Ocean.

Streptotheca Cleve.

67. **S. thamensis** Cleve in Shrubsole, Journ. Quekett Microsc. Club, 1890, IV, n. s. p. 259, Pl. 13, f. 4—6; Phytoplankton p. 25, Pl. 2, f. 19; Atl. Plankt. Organisms p. 353; Van Heurck, Treatise on the Diatomaceae p. 463, f. 194; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 161; *S. maxima* Cleve, Pl. f. the Indian Ocean and the Malay Archip. p. 23 and p. 57, Pl. 8, f. 5.

I am unable to see any difference of specific value between the North Sea species and the *S. maxima* described by Cleve from the Malay Archipelago, but the details given by Cleve indicate the correctness of Van Heurck in placing the genus in the neighbourhood of *Climacodium* and *Eucampia*.

2 (r) — 3 (+) — 4 (rr) — 6 (rr).

Area: Along the coasts of West Europe, N. Atlantic Ocean (rare), Red Sea, Malay Archipelago.

Ditylium Bail.

68. **D. Sol** (Van Heurck) Leuduger-Fortmorel, l. c. p. 39; De Toni, Sylloge Algarum, Vol. II, p. 1018; Cleve, Atl. Plankt. Organisms p. 325; Pl. f. the Indian Ocean and the Malay Archip. p. 21; *Triceratium Sol* Van Heurck, Synopsis Pl. 115, f. 1 (1881); A. Schmidt, Atlas d. Diatom. Kunde Pl. 152, f. 4, 5, 7-9.

2 (r) — 3 (c) — 5 (rr) — 6 (rr) — 7 (rr).

Area: Atlantic Ocean at 10° N. 53° W., Gulf of Bengal, Malay Archipelago, China Sea.

Biddulphia Gray.

69. **B. chinensis** Grev., Trans. Microsc. Soc. 1866, p. 81, Pl. 9, f. 16; Leuduger-Fortmorel, l. c. p. 39; Cleve, Diat. f. the Sea of Java 1873, p. 6; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 152, f. 6; A. Schmidt, Atlas der Diat. Kunde Pl. 122, f. 22—24.

I have given figures of this species and of the following showing the different direction of the processes and the spines.

3 (+) — 5 (rr) — 10 (rr).

Area: Red Sea, Malay Archipelago, South China Sea.

70. **B. mobilensis** Bail., Am. Journ. Sc. 1845, p. 336, Pl. 4, f. 24; Van Heurck, Synopsis Pl. 101, f. 4, Pl. 103, f. A; Cleve, Atlant. Plankt. Organisms, p. 288; Schröder, Neapel p. 30; *B. Baileyi* Smith, Brit. Diat. II, p. 50, Pl. 45, f. 322, Pl. 62, f. 322; Leuduger-Fortmorel, l. c. p. 38; *Denticella mobiliensis* Grun., de Wildeman, l. c. p. 127.

2 (r) — 3 (rr) — 4 (rr) — 5 (rr) — 6 (rr).

Area: Along the Coasts of West-Europe and North-America, Mediterranean, Indian Ocean, Malay Archipelago, Pacific Ocean. Neritic species.

Cerataulina Perag.

71. **C. Bergonii** Perag., Monogr. du genre Rhizosolenia, Le Diatomiste vol. I, p. 103, Pl. 1, f. 15, 16; Schröder, Neapel p. 30 (var. *elongata*); Cleve, Bih. t. Sv. Vet. Akad. Handl. Bd. 20, 3, 1894, No. 2, p. 11, Pl. 1, f. 6; Atl. Plankt. Organisms p. 288, Pl. f. the Red Sea, p. 1032; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 152; *Zygoceros* (?) *pelagicum* Cleve, Kanonbaaden „Hauch“ s Togter, Kjöbenhavn (1889), p. 54.

6 (rr) — 10 (rr).

Area: Temperate N. Atlantic Ocean, Mediterranean, Red Sea, Gulf of Aden.

72. **C. compacta** Ostf. in Ostenfeld & Schmidt, Pl. f. the Red Sea, 1901, p. 153, f. 7; *Rhizosolenia* (*Guinardia*?) *recta* Cleve, Pl. f. the Indian Ocean and the Malay Archipelago 1902, p. 23 and p. 57, Pl. VIII, f. 7 a, b.

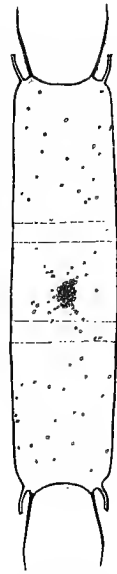


Fig. 21.
Biddulphia
chinensis Grev.
($\frac{225}{1}$).



Fig. 22.
Biddulphia
mobilensis Bail.
($\frac{225}{1}$).

There is no doubt that this species having two processes on each valve belongs to the genus *Cerataulina*, and Cleve has also indicated two in his figure 7a, so that I do not understand his reasons for taking it as a *Rhizosolenia*.

2 (rr) — 3 (+).

Area: Red Sea, Malay Archipelago.

Hemiaulus Ehbq.

73. **H. chinensis** Grev. Ann. Magaz. Nat. Hist. XVI, p. 5, Pl. 5, f. 9, 1865; *H. Heibergii* Cleve, Diat. f. the Sea of Java, 1873, p. 6, Pl. 1, f. 7; Leuduger-Fortmorel, l. c. p. 41; Cleve, Pl. f. the Red Sea, p. 1033; Pl. f. the Indian Ocean and the Malay Archip. p. 21; Atl. Plankton Organisms p. 329.

Professor Cleve informs me in a letter that his *H. Heibergii* is identical with *H. chinensis* of Greville.

6 (rr) — 10 (+).

Area: Tropical Atlantic Ocean, Red Sea, Indian Ocean, Malay Archipelago, Arafura Sea, Japan and China Seas.

B. Pennatae.

Fragilarieae.

Thalassiothrix Cleve & Grun.

74. **T. Fraunfeldii** Grun. in Cleve & Grunow, Arctische Diatomeen, K. Sv. Vet. Akad. 17, No. 2, 1880, p. 109; de Wildeman, l. c. p. 104; Castracane, Challenger Report p. 54—55, Pl. XIV, f. 7, 8 (incl. *T. curvata* Castr., Pl. XXIV, f. 6); Schröder, Neapel p. 31; Cleve, Phytoplankton p. 25; Atl. Plankt. Organisms p. 356; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 162; Van Heurck, Synopsis Pl. 37, f. 11—15; *Asterionella Fraunfeldii* Grunow, Verh. zool.-bot. Gesellsch. Wien 1863, p. 140, Pl. 14, f. 18; Cleve, Diatoms of the Sea of Java 1873, p. 12.

I should think that all the specimens belong to the var. *javanica* Grun. in Van Heurck, l. c. f. 13.

1 (+) — 2 (r) — 3 (rr) — 6 (r) — 7 (r) — 10 (+).

Area: Atlantic Ocean, Mediterranean, Red Sea, Indian Ocean, Malay Archipelago, China Sea, Japan Sea, Pacific Ocean.

75. **T. longissima** Cleve & Grunow, l. c. p. 108; Ostenfeld & Schmidt, Pl. f. the Red Sea, etc. p. 162 (*f. gracilis* Ostf.); Cleve, Phytoplankton p. 25; Atl. Plankt. Organisms p. 357; Pl. f. the S. Atlantic and the S. Indian Ocean p. 935; Pl. f. the Red Sea, p. 1035; Pl. f. the Indian Ocean

and the Malay Archip. p. 24; *Synedra Thalassiothrix* Cleve, Bih. K. Sv. Vet. Akad. Handl. 1, Nr. 13, p. 22, Pl. 4, f. 24; *Synedra* sp., Chun, Aus den Tiefen des Weltmeeres, Jena 1900, p. 206, f. 2, 3.

Most of the present specimens are very delicate (f. *gracilis* Ostf.), but also the main species has been met with.

2 (rr) — 4 (rr) — 6 (r) — 7 (rr) — 10 (+).

Area: Arctic and Northern Atlantic Ocean (especially in the Irminger Sea), Antarctic Ocean from 20° W. to 91° E., Red Sea, Gulf of Aden, Indian Ocean from c. 40° S. to 45° S., Malay Archipelago, Bering Sea. It is a bipolar species which often predominates in the samples from the Subarctic regions.

Naviculeae.

Navicula Bory.

76. **N. membranacea** Cleve, Phytoplankton 1897, p. 24, Pl. II, f. 25-28; Pl. f. the Red Sea p. 1033; Atl. Plankt. Organisms p. 333; Pl. f. the Indian Sea and the Malay Archipelago p. 22; Lemmermann l. c. p. 315.

As supplement to the figures by Cleve (Phytoplankton) I have given two figures of a frustule in valvular and in zonal view. No structure visible.

2 (rr) — 3 (rr) — 6 (rr) — 10 (rr).

Area: Subtropical Atlantic Ocean (rare), Red Sea, Malay Archipelago, Cook Strasse at New Zealand.

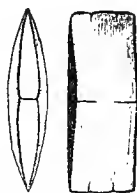


Fig. 23. *Navicula membranacea* Cl. Side view and front view ($\frac{200}{1}$).

Nitzschieae.

Nitzschia Hass.

77. **N. seriata** Cleve, Diat. of Vega, Vega-exped. vetensk. iakttagelser Pl. 38, f. 75; Atl. Plankt. Organisms p. 335; *N. fraudulentata* Cleve, Fish. Board f. Scotland 1896, p. 300, Pl. 1, f. 11; Pl. f. the Indian Ocean and the Malay Archip. p. 22; Schröder, Neapel p. 32.

1 (rr) — 2 (rr) — 6 (rr) — 10 (rr).

Area: Arctic Ocean, Northern Atlantic Ocean southwards to Azores, Mediterranean, Malay Archipelago.

4 — 8 — 1902.