

## A CONTRIBUTION TO THE KNOWLEDGE OF FRESH-WATER DIATOMACEÆ OF SOUTH-WESTERN INDIA

### I. Fresh-Water Diatoms of Dharwar

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#### INTRODUCTION

THERE are only a few accounts dealing with fresh-water diatoms of India available and practically none so far covering the south-west region of the Peninsula. The following account is based on some collections in this region, at Dharwar.

#### TOPOGRAPHY AND THE CLIMATE OF DHARWAR

Dharwar, in the State of Bombay, is situated on the Poona-Bangalore line of the Southern Railway. The town proper lies at 15° 27' latitude and 75° 6' longitude on a plateau of medium height which varies between 2,400–2,544' above the mean sea-level. It has a fairly cool climate and an average annual rainfall of 32".

#### PLACES OF COLLECTION

The material for this investigation was collected from the garden reservoirs of the Karnatak College—Dharwar, by the author when he was attached to the said College during July–August 1949. He was particularly interested to know the nature of the floating frothy masses and encrustations in the reservoirs. An examination of the material revealed a mass of diatoms—particularly the *Cymbellas* embedded in gelatinous matrix and the tangled masses of some blue-green algæ. More material was then collected and preserved in 5–6% of commercial formalin. A few casual samples of algæ were also collected by the author from Kilgeri and Someswar tanks and preserved likewise during the same period. Due to unforeseen circumstances the collections, however, could not be examined then and there. The material was later studied at the Ismail Yusuf College, Jogeswari—Bombay, during 1949–51, and at the Rajaram College—Kolhapur, during 1951–55.

#### FEATURES OF THE MATERIAL

An interesting feature of the material from the garden reservoirs is the preponderance of *Cymbella cymbiformis* (Ag ?) Kütz. and its varieties. They were found embedded in the gelatinous floating flakes and as encrustations in the reservoirs. Associated with these forms

the following occur in good numbers: *Achnanthes microcephala* Kütz v. *typica* A. Cl., *A. minutissima* (Kütz.) Grun. v. *genuina* A. Cl., *Stauro-nies legumen* Ehr., *Anomæoneis serians* (Bréb.) Cl. v. *modesta* A. Cl., *A. brachysira* (Bréb.) Grun. v. *genuina* A. Cl., *A. brachysira* (Bréb.) Grun. f. *subacuminata* A. Cl., *Navicula cryptocephala* Kütz. v. *subsalina* Hust., *Gomphonema parvulum* (Kütz.) V. H. v. *genuina* Mayer, *G. parvulum* v. *subellipticum* Cleve, *G. dharwarensis* sp. nov. and *Nitzschia amphibia* Grun. v. *genuina* Mayer. The other forms included in this account were present in lesser numbers. The noteworthy point regarding *Cymbella cymbiformis* and its varieties is that none of these were as large as the European specimens. It may perhaps be due to their warmer habitat in this country.

The material from Kilgeri tank resembled somewhat that of the garden reservoirs in the College; however, *Melosira granulata* (Ehr.) Ralfs. v. *typica* A. Cl., *Gomphonema subapicatum* Frit. and Rich. and *Rhopalodia gibba* (Ehr.) O. Müll. v. *genuina* A. Cl., were present in numbers.

The Someswar tank material was rich in *Cymbella ventricosa* Kütz v. *genuina* A. Cl., *Gomphonema subapicatum* Frit. and Rich., *G. montanum* Schum. v. *acuminatum* Mayer, *Rhopalodia gibba* (Ehr.) O. Müll. v. *genuina* A. Cl. and *Nitzschia amphibia* Grun. v. *genuina* Mayer. The other forms occurred as stray forms.

In all 44 forms including a new species and a new variety, have been recorded from this area representing 18 genera.

The forms in this account are mainly arranged according to Hustedt (1930), the identification being carried out with the help of Cleve-Euler's monograph (1951-55) and other accounts.

#### BACILLARIOPHYTA (DIATOMEÆ)

A	Order	CENTRALES
I.	Suborder	DISCINEÆ
1.	Family	COSCINODISCACEÆ
(a)	Sub-family	MELOSIROIDEÆ
	Genus	<i>Melosira</i> Agardh 1824

##### 1. *Melosira granulata* (Ehr.) Ralfs. v. *typica* A. Cl.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—I, p. 25, fig. 15 a-b  
*M. granulata* (Ehr.) Ralfs.—Van Heurck, *Treat. Diat.*, p. 444, pl. 19, fig. 621; Hustedt, *Bacil.*, p. 87, fig. 44; Tiffany and Britton, *Alg. Illinois*, p. 221, pl. 59, fig. 667.

Frustules cylindrical, united in short or long chains, 9-18  $\mu$  long, 6-12  $\mu$  in diameter, end cells with short and long spines and furrows. Cell surface with 8-10 rows of aerioles in 10  $\mu$  and 10-12 aerioles in 10  $\mu$ , aerioles arranged in straight and parallel rows on the end cells and spirally on the others.

- (b) Sub-family COSCINODISCOIDEÆ  
Genus *Cyclotella* Kützing, F.I. 1834

2. *Cyclotella stelligera* Cl. and Grun.

Hustedt, *Bacil.*, p. 100, fig. 65; Venkataraman, *S.I. Diat.*, p. 298, fig. 10; Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—I, p. 43 fig. 52

Frustules in chains, rectangular in the girdle view. Valves discoid, 10–15  $\mu$  in diameter with radiating striæ; middle portion with stellate structure around a central punctum, striæ 11–12 in 10  $\mu$ .

3 *Cyclotella meneghiniana* Kütz v. *genuina* A. Cl.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—I, p. 48, fig. 63 a  
*C. Meneghiniana* Kütz.—Van Heurck, *Treat. Diat.*, p. 447, pl. 22, fig. 656; Hustedt, *Bacil.*, p. 100, fig. 67.

Frustules with undulated walls in the girdle view. Valves discoid, 11–29  $\mu$  in diameter with apparently smooth or radially punctate central field. Marginal striæ 7–9 in 10  $\mu$ , thick and radial.

4. *Cyclotella meneghiniana* Kütz v. *genuina* A. Cl. f. *binotata* Grun.  
(Fig. 1)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—I, p. 48, fig. 63 c.  
*C. meneghiniana* Kütz.—Van Heurck, *Treat. Diat.*, p. 447, pl. 22, fig. 656.

Frustules with undulated walls in the girdle view. Valves discoid, 15–25  $\mu$  in diameter with the radially punctate central field having two large distinct punctæ. Marginal striæ 8–9 in 10  $\mu$ , thick and radial.

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|----------------|--------------------------------|
| B. Order       | PENNALES                       |
| I Sub-order    | ARAPHIDINEÆ                    |
| 1 Family       | FRAGILARIACEÆ                  |
| (a) Sub-family | FRAGILARIOIDEÆ                 |
| Genus          | <i>Fragilaria</i> Lyngbye 1819 |

5. *Fragilaria rumpens* (Kütz.) Carlson v. *fragilarioides* (Grun.) A. Cl.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—II, p. 42, fig. 352, b.  
*Synedra rumpens* Kütz v. *fragilarioides* Grun.—Hustedt, *Bacil.*, p. 156, fig. 178; Gonzalves and Gandhi, *Diat. Bombay and Salsette*—I, p. 129, fig. 22.

Frustules in continuous chain. Valves linear-lanceolate with constricted slightly capitate ends, 38–52  $\mu$  long, 3–3.3  $\mu$  broad. Pseudoraphe narrow. Central area large. Striæ 10–12 in 10  $\mu$ , coarse and distinct.

Genus **Synedra** Ehrenberg 1830

6. *Synedra ulna* (Nitz) Ehr. v. *amphihynchus* (Ehr.) Grun.

Van Heurck, *Treat. Diat.*, p. 311, pl 10, fig 414; Hustedt, *Bacil.*, p. 154, fig. 167; Cleve-Euler, A., *Diat. von Schwed u. Finn.*—II, p. 62, fig. 382 g.

Frustules elongated with widened truncate ends in the girdle view. Valves narrow, linear-lanceolate, bent in the middle with capitale ends, 175–255  $\mu$  long and 5–6  $\mu$  broad. Pseudoraphe very narrow. Striæ slender but distinct 9–10 in 10  $\mu$ .

7. *Synedra acus* Kütz. v. *genuina* Mayer

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—II, p. 64, fig. 385 a–c. *S. acus* (Kütz) Grun.—Van Heurck, *Treat. Diat.*, p. 311, pl 10, fig 420; *S. acus* Kütz.—Hustedt, *Bacil.*, p. 155, fig. 170; Tiffany and Britton, *Alg. Illinois*, p. 237, pl. 63, fig. 720.

Valves weakly silicified, elongated, narrowly lanceolate, gradually tapering towards the poles, 77–133  $\mu$  long and 3.3–4  $\mu$  broad. Pseudoraphe very narrow. Central area large rectangular reaching the sides. Striæ fine those bordering the central area do not reach the centre, 13–14 in 10  $\mu$ .

II. Sub-order	MONORAPHIDINEÆ
1 Family	ACHNANTHACEÆ
(a) Sub-family	COCCONEOIDEÆ
Genus	<b>Cocconeis</b> Ehrenberg 1838

8. *Cocconeis placentula* Ehr. v. *euglypta* (Ehr.) Grun.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 8, fig. 492 e–f. *C. placentula* Ehr. v. *euglypta* (Ehr.) Cl.—Hustedt, *Bacil.*, p. 190, fig. 261; Iyengar and Subrahmanyam, *Fossil Diat.*, p. 229, figs. 7–8.

Valves broadly elliptical, 18–24  $\mu$  long and 11–12  $\mu$  broad. Valves with raphe has small roundish central area. Striæ 20–23 in 10  $\mu$ , fine but distinctly punctate, radial and interrupted by two concentric hyaline zones near the margins. Rapheless valve with narrow pseudoraphe. Striæ 17–18 in 10  $\mu$ , radial, interrupted by several longitudinal undulated hyaline bands.

Genus	<b>Achnanthes</b> Bory 1822
Sub-genus	<i>Microneis</i>

9. *Achnanthes microcephala* Kütz. v. *typica* A. Cl.

(Figs. 2–3)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 40 fig. 568 a–d; *A. microcephala* Kütz.—Van Heurck, *Treat. Diat.*, p. 281, pl. 8, fig. 332. Hustedt, *Bacil.*, p. 198, fig. 273.

Frustules small, linear, bent in the girdle view. Valves narrow, linear-lanceolate with broadly rounded capitate ends, 15–20  $\mu$  long and 3–3.5  $\mu$  broad. Valve with raphe has narrow axial area and rounded central area. Striæ 26–32 in 10  $\mu$ , radial; rapheless valve with narrow pseudoraphe, small central area and slightly radial striæ 30–35 in 10  $\mu$

10. *Achnanthes minutissima* (Kütz.) Grun v. *genuina* A. Cl.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*,—III, p. 40 fig. 567 a–f. *A. minutissima* Kütz—Hustedt, *Bacil.*, p. 198, fig. 274; Tiffany and Britton, *Alg. Illinois*, p. 242, pl. 64, fig. 727.

Frustules small, linear and bent in the girdle view. Valves narrow, linear-lanceolate with broadly rounded ends, 17–31  $\mu$  long and 3–3.7  $\mu$  broad. Central area somewhat wider on the raphe valve. Striæ fine and slightly radial, 28–30 in 10  $\mu$ .

III	Sub-order	BIRAPHIDINEÆ
1	Family	NAVICULACEÆ
(a)	Sub-family	NAVICULOIDEÆ
	Genus	<b>Mastogloia</b> Thwaites 1856

11. *Mastogloia smithii* Thwaites v. *lacustris* Grun

(Figs. 4–5)

Van Heurck, *Treat. Diat.*, p. 154, pl. 2, fig. 61; Hustedt, *Bacil.*, p. 217, fig. 316.

Frustules rectangular in the girdle view with two longitudinal septa having several chambers in a row. Valves linear-elliptical with constricted somewhat broadly rostrate ends 27–37  $\mu$  long and 10–11  $\mu$  broad. Raphe thin and straight. Axial area narrow, linear; central area fairly wide quadrate to roundish. Interseptal chambers rectangular to quadrate, almost uniform 1.2–1.5  $\mu$  wide in a row near the margins. Striæ 16–18 in 10  $\mu$ , radial and distinctly punctate.

Cleve-Euler has treated this form synonymous with *M. lacustris* Grun v. *antiqua* (Schum.) A. Cl. (Cleve-Euler, *Diat. von Schwed. u. Finn.*—III, p. 60, fig. 609 d, g) but in indices the same has been referred to *M. lacustris* v. *alpina* Brun. Under this condition the present author fails to refer his form to any one given by Cleve-Euler.

Genus **Diploneis** Ehrenberg 1840

12. *Diploneis subovalis* Cleve

Venkataraman G., *S.I. Diat.*, p. 322, fig. 74, pl. 17, figs. 3–4; Gonzalves and Gandhi, *Diat. Bombay and Salsette*—II, p. 254, fig. 87 a

Valves broadly elliptical 31–35  $\mu$  long and 18–19  $\mu$  broad. Raphe thin enclosed between the capitate horns. Costæ radial distinctly capitate under a low focus alternate with double rows of distinct punctæ 9–9.5 in 10  $\mu$  and rows of punctæ 16–18 in 10  $\mu$ . Axial field

with a row of punctæ in groups separated by a hyaline space from the inter-costal rows of punctæ.

Genus *Stauroneis* Ehrenberg 1843

13. *Stauroneis legumen* Ehr

(Fig. 6)

Van Heurck, *Treat. Diat.*, p. 161, pl. 1, fig. 59; Hustedt, *Bacil.*, p. 260, fig. 419.

Valves linear with triudulate margins and constricted, broadly rostrate ends, 14–28  $\mu$  long and 4–6  $\mu$  broad. Polar septa short and distinct. Raphe thin and straight with distinct central pores. Axial area narrow; central area somewhat a large linear stauros. Striæ slightly radial, about 30 in 10  $\mu$ , very fine and indistinctly punctate.

Genus *Anomæoneis* Pfitzer 1871

14. *Anomæoneis seriens* (Bréb.) Cl. v. *modesta* A. Cl.

(Figs. 7–8)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 197, fig. 918 c-d.

Valves rhombic-lanceolate to narrowly rhombic-lanceolate with acute ends, 22–32  $\mu$  long and 5–6  $\mu$  broad. Raphe thin and straight with closely placed central pores. Axial area narrow, linear; central area fairly large and quadrate. Striæ 27–30 in 10  $\mu$ , slightly radial, fine but distinctly punctate, crossed by 3–5 longitudinal, undulated hyaline bands 10–12 in 10  $\mu$ .

15. *Anomæoneis brachysira* (Bréb.) Grun. v. *genuina* A. Cl.

(Fig. 9)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 198, fig. 919 a-b. *A. seriens* (Bréb.) Cl. v. *brachysira* (Bréb.) Hust. f. *thermalis* (Grun.) Hust.—Hustedt, *Bacil.*, p. 264, fig. 428

Valves small, rhombic-lanceolate with feebly narrowed, produced, broadly rounded ends, 22–26  $\mu$  long and 6  $\mu$  broad. Raphe thin and straight with closely set central pores. Axial area narrow; central area moderate, roundish. Striæ 25–28 in 10  $\mu$ , radial fine but distinctly punctate, interrupted by a few longitudinal wavy hyaline bands.

16. *Anomæoneis brachysira* (Bréb.) Grun. f. *subacuminata* A. Cl.

(Fig. 10)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 198.

Valves rhombic-lanceolate with somewhat constricted, shortly produced ends, 23–33  $\mu$  long and 5–6  $\mu$  broad. In all other features like the type

This form agrees well with the type described by Cleve-Euler, who has however not given a figure. Of several specimens which I

have examined, I found their ends distinctly constricted and shortly produced as stated by Cleve-Euler.

Genus *Navicula* Bory 1822

Section—*Naviculæ orthostichæ* Cleve

17. *Navicula cuspidata* Kütz. v. *conspicua* Venkat.

Venkataraman, G., *S. I. Diat.*, p. 325, figs. 83, 88; Gonzalves and Gandhi, *Diat. of Bombay and Salsette*—III, p. 342, fig. 110.

Valves broadly lanceolate with narrowed produced rounded ends, 121–150  $\mu$  long and 32–35  $\mu$  broad. Raphe thin and straight with hook-like central pores. Axial area narrow, linear. Longitudinal striæ 9–12 in 10  $\mu$ , coarse and more widely set in the middle than at the margins; transverse striæ 14–16 in 10  $\mu$ , parallel and almost perpendicular to the middle line

18. *Navicula pseudocuspidata* nov. nom. v. *rostrata* v. nov.

(Fig. 11)

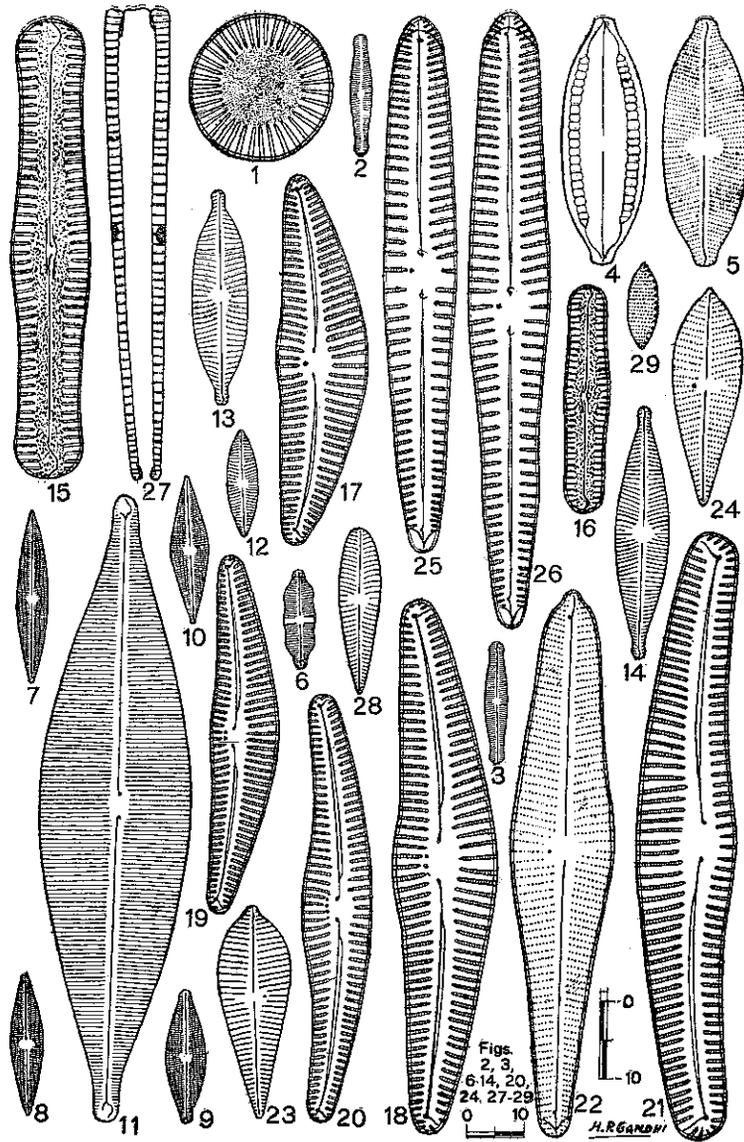
Valvæ rhombio-lanceolatæ vel late lanceolatæ, apicibus constrictis, producti atque rotundati. Raphe tenuis atque recta, poris centralibus hamosimilibus ornata. Area axialis angusta, linearis; area centralis aliquantum evoluta. Striæ longitudinales nullæ; striæ transversales parallelæ, indistincte punctatæ atque perpendiculares in lineam medium. Frustula 88–111  $\mu$  longa, 22–27  $\mu$ , lata, striæ transversæ 14–16 in 10  $\mu$ .

*Habitat.*—Atque dulcis Lacu in horto.

Valves rhombic-lanceolate to broadly lanceolate with constricted produced rounded ends. Raphe thin and straight with hook-like central pores. Axial area narrow, linear; central area slightly developed. Longitudinal striæ absent; transverse striæ parallel, indistinctly punctate and perpendicular to the middle line. Frustules 88–111  $\mu$  long and 22–27  $\mu$  broad with transverse striæ 14–16 in 10  $\mu$ .

*Habitat.*—Fresh-water. Garden reservoirs.

This form agrees well with Krishnamurthy's *Navicula cuspidata* Kütz. f. *indica* Kri. (Krishnamurthy—*Diat. S. I.*, p. 367, fig. 30), in having no longitudinal striæ and in other respects, except that the ends in this form are prominently produced and rounded. The feature of longitudinal striæ so characteristic of *N. cuspidata* Kütz., being absent in these forms—I do not think it proper to retain them under the said species. I, therefore, propose for Krishnamurthy's form the status of a new species as *N. pseudocuspidata*, and create my form a new variety of it. The present form cannot be referred to *N. halophila* (Grun.) Cl. (Hustedt, *Bacil.*, p. 268, fig. 436) for the presence of hook-like central pores which is a feature of *N. cuspidata*,



Figs. 1-29. Fig. 1. *Cyclotella meneghiniana* Kütz. v. *genuina* A. Cl. f. *binotata* Grun. Figs. 2-3. *Achnanthes microcephala* Kütz. v. *typica* A. Cl. Figs. 4-5. *Mastogloia smithii* Thwaites v. *lacustris* Grun. Fig. 6. *Stauroneis legumen* Ehr. Figs. 7-8. *Anomæoneis seriens* (Bréb.) Cl v. *modesta* A. Cl. Fig. 9. *Anomæoneis brachysira* (Bréb.) Grun. v. *genuina* A. Cl. Fig. 10. *Anomæoneis brachysira* (Bréb.) Grun. f. *subacuminata* A. Cl. Fig. 11. *Navicula pseudocuspidata* nov. nom. *rostrata* v. nov. Fig. 12. *Navicula cryptocephala* Kütz v. *subsalina* Hust Fig. 13. *Navicula viridula* Kütz. v. *capitata* Mayer. Fig. 14. *Navicula salinarum*,

Grun. v. *intermedia* (Grun.) Cl. Fig. 15. *Pinnularia acrosphaeria* (Bréb.) W. Sm. f. *undulata* Cl. Fig. 16. *Pinnularia acrosphaeria* (Bréb.) W. Sm. v. *minor* Cl. Fig. 17. *Cymbella cymbiformis* (Ag.?) Kütz. v. *unipuncta* A. Cl. Figs. 18-19. *Cymbella cymbiformis* (Ag.?) Kütz. v. *jinboi* (Pant.) A. Cl. Fig. 20. *Cymbella cymbiformis* (Ag.?) Kütz. v. *multipunctata* A. Cl. Fig. 21. *Cymbella cymbiformis* (Ag.?) Kütz. v. *nerei* (Pant.) A. Cl. Fig. 22. *Gomphonema sub-apicatum* Fritsch & Rich. Fig. 23. *Gomphonema augur* Ehr. v. *genuinum* Mayer. Fig. 24. *Gomphonema montanum* Schum. v. *acuminatum* Mayer. Figs. 25-26. *Gomphonema dharwarensis* sp. nov. Fig. 27. *Gomphonema dharwarensis* sp. nov.—girdle view. Fig. 28. *Gomphonema olivaceum* (Lyng.) Kütz. v. *balticum* Cl. Fig. 29. *Nitzschia amphibia* Grun. v. *acutiuscula* Grun.

Section—*Navicula lineolatae* Cleve

19. *Navicula cryptocephala* Kütz. v. *subsalina* Hust.

(Fig. 12)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 154, fig. 813 *i, j, n*.

Valves small, lanceolate with acutely rounded ends, 17-26  $\mu$  long and 5-6  $\mu$  broad. Raphe thin and straight. Axial area narrow, linear; central area small, roundish. Striæ 14-16 in the middle and up to 18 in 10  $\mu$  at the ends, lineate, radial in the middle and convergent at the ends.

This form agrees well with the type described by Cleve-Euler but differs from *N. cryptocephala* v. *veneta* (Kütz.) Grun. (Hustedt, *Bacil.*, p. 295, fig. 497 *a*), in having more acute ends.

20. *Navicula viridula* Kütz. v. *capitata* Mayer

(Fig. 13)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 151, fig. 805 *f, g*.

Valves linear-elliptical with somewhat produced capitate rounded ends, 35-38  $\mu$  long and 9  $\mu$  broad. Raphe thin and straight. Axial area narrow, linear; central area moderately wide, quadrate. Striæ 9-13 in 10  $\mu$ , distinctly lineate, radial in the middle and convergent at the ends.

21. *Navicula salinarum* Grun. v. *intermedia* (Grun.) Cl.

(Fig. 14)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 159, fig. 820 *b-c*.

Valves lanceolate with produced capitate ends, 38-41  $\mu$  long and 7-8  $\mu$  broad. Raphe thin and straight. Axial area narrow, linear; central area large. Striæ 14-16 in 10  $\mu$ , lineate, radial and curved in the middle and convergent at the ends, short and long striæ alternate in the middle.

Genus

*Pinnularia* Ehrenberg 1843

Section—*Nodosæ* A Cl

22. *Pinnularia acrosphæria* (Bréb.) W. Sm. f. *undulata* Cl.

(Fig. 15)

Hustedt, *Bacil.*, p. 330; Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 25, fig. 1022 c

Valves linear, inflated in the middle with broadly rounded ends, 57–62  $\mu$  long and 10.5–11  $\mu$  broad. Raphe thin and straight with closely set and unilaterally bent central pores. Axial area very wide with irregularly disposed punctæ; central area not prominent. Striæ slightly radial in the middle 9–10 in 10  $\mu$ , and scarcely convergent at the ends.

23. *Pinnularia acrosphæria* (Bréb.) W. Sm. v. *minor* Cl.

(Fig. 16)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 25, fig. 1022 d

Valves smaller than the type, 35–37  $\mu$  long and 8.8  $\mu$  broad with less dilated middle part and the ends. Striæ 12–13 in 10  $\mu$ , slightly radial in the middle or apparently parallel and scarcely convergent at the ends.

(b) *Sub-family* GOMPHOCYMBELLOIDEÆ  
*Genus* **Amphora** Ehrenberg 1840

24. *Amphora veneta* (Kütz.) Hust.

Van Heurck, *Treat. Diat.*, p. 134, pl. 1, fig. 11; Hustedt, *Bacil.*, p. 345, fig. 631; Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—III, p. 96, fig. 682 a–c.

Frustules elliptical with rounded truncate ends in the girdle view, 10–12  $\mu$  broad. Valves convex on the dorsal and somewhat concave on the ventral side with curved obtuse ends, 17–22  $\mu$  long and 3–4.5  $\mu$  broad. Raphe thin and straight with central pores dorsally bent and terminal fissures ventrally directed. Axial area narrow. Striæ fine but distinctly punctate, 16–20 in 10  $\mu$  in the middle and 20–26 in 10  $\mu$  at the ends.

*Genus* **Cymbella** Agardh 1830

25. *Cymbella turgida* (Greg.) Cl

Hustedt, *Bacil.*, p. 358, fig. 660; Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 123, fig. 1176 a–d; *Encyonema turgidum* (Greg.) Grun.—Van Heurck, *Treat. Diat.*, p. 149, pl. 1, fig. 45.

Valves convex on the dorsal and almost straight or slightly concave on the ventral side with a median inflation, ends acutely rounded, 40–54  $\mu$  long and 12–13  $\mu$  broad. Striæ distinctly lineate 8–9 in 10  $\mu$ , radial in the middle and convergent at the ends only on the ventral side.

26. *Cymbella ventricosa* Kütz v. *genuina* Mayer

Cleve-Euler, A., *Diat. von Schwed u Finn.*—IV, p. 124, fig. 1177 a-c. *C. ventricosa* Kütz.—Hustedt, *Bacil.*, p. 359, fig. 661; *Encyonema ventricosum* Kütz.—Van Heurck, *Treat Diat.*, p. 150, pl. 1, fig. 49.

Valves strongly convex on the dorsal and straight or slightly convex on the ventral side with acutely rounded ends, 29–35  $\mu$  long and 9–9.5  $\mu$  broad. Raphe thin and straight. Axial area narrow. Striæ 10–12  $\mu$  in the middle and 12–16 in 10  $\mu$  at the ends, radial, coarse, lineate and slightly convergent at the ends.

27. *Cymbella cymbiformis* (Ag. ?) Kütz v. *unipuncta* A. Cl.

(Fig. 17)

Cleve-Euler, A., *Diat. von Schwed u Finn.*—IV, p. 160, fig. 1246 a-b. *C. cymbiformis* Ehr.—Van Heurck, *Treat. Diat.*, p. 147, pl. 1, fig. 38; *C. cymbiformis* (Ag. ?, Kütz) V.H.—Hustedt, *Bacil.*, p. 362, fig. 672.

Valves sickle-shaped, asymmetrical, dorsal side convex, ventral side almost straight or concave and inflated in the middle, ends broadly rounded, 46–65  $\mu$  long and 11–13  $\mu$  broad. Raphe arcuate and thick with ventrally bent central pores and dorsally directed terminal fissures. Axial area fairly wide; central area slightly enlarged with an isolated punctum on the ventral side at the end of the central striæ. Striæ 8–10 in 10  $\mu$ , radial, strong and lineate.

28. *Cymbella cymbiformis* (Ag. ?) Kütz v. *jimboi* (Pant.) A. Cl.

(Figs. 18–19)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 160, fig. 1246 g.

Valves sickle-shaped more inflated in the middle on the ventral side than the type with broadly rounded ends, 55–75  $\mu$  long and 12–14  $\mu$  broad. Central area with 2–3 coarse punctæ on the ventral side. Striæ 9–10 in 10  $\mu$ , radial and lineate.

29. *Cymbella cymbiformis* (Ag. ?) Kütz. v. *multipunctata* A. Cl.

(Fig. 20)

Cleve-Euler, A. *Diat. von Schwed u Finn.*—IV, p. 161, fig. 1246 h, i

Valves sickle-shaped with convex dorsal and concave ventral side inflated in the middle, ends broadly rounded and truncate, 70–80  $\mu$  long and 11–13  $\mu$  broad. Central area slightly widened with 3–5 coarse punctæ on the ventral side. Striæ 7–8 in 10  $\mu$ , distinctly lineate-punctate and radial.

30. *Cymbella cymbiformis* (Ag. ?) Kütz. v. *neri* (Pant.) A. Cl.

(Fig. 21)

Cleve-Euler, A. *Diat. von Schwed. u. Finn.*—IV, p. 161, fig. 1246 k-l.

Valves narrowly sickle-shaped than the type with strongly inflated ventral side in the middle, ends gradually narrowed and broadly

truncate rounded, 60–80  $\mu$  long and 11–13  $\mu$  broad. Striæ 8–9 in 10  $\mu$  radial and lineate

Genus **Gomphonema** Agardh 1824

31. *Gomphonema subapicatum* Fritsch and Rich

(Fig. 22)

Fritsch, F. E. and Rich, F., *Diat. from Griqueland West*, p. 108, fig. 6 a–b; Abdul-Majeed, M., *Bacil.*, p. 31, pl. 3, fig. 4.

Valves lanceolate-clavate, dilated in the middle, apex wedge-shaped, somewhat constricted and subapiculate, base narrowly rounded, 48–99  $\mu$  long and 12–15.6  $\mu$  broad. Raphe thin and straight. Axial area narrow, linear; central area unilateral, fairly large with an isolated stigma on the opposite side. Striæ 9–12 in 10  $\mu$ , radial, distinctly punctate and somewhat widely set in the middle.

32. *Gomphonema augur* Ehr. v. *genuinum* Mayer

(Fig. 23)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 176, fig. 1265 a–b. *G. augur* Ehr.—Van Heurck, *Treat. Diat.*, p. 271, pl. 7, fig. 301; Hustedt, *Bacil.*, p. 372, fig. 688.

Valves broadly ovate-clavate with apiculate rounded apex and strongly attenuated base, 26–32  $\mu$  long and 8.5  $\mu$  broad. Raphe thin and straight. Axial area narrow; central area unilateral, large with an isolated stigma on the opposite side. Striæ 12–16 in 10  $\mu$ , slightly radial, indistinctly punctate and closely set at the ends.

33. *Gomphonema parvulum* (Kütz.) V. H. v. *genuinum* Mayer.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 177, fig. 1269 a–c. *G. parvulum* (Kütz.) Grun.—Van Heurck, *Treat. Diat.*, p. 272, pl. 7, fig. 306; Hustedt, *Bacil.*, p. 372, fig. 713 a.

Valves broadly lanceolate-clavate with constricted, shortly rostrate ends, 18–24  $\mu$  long and 6.6–5  $\mu$  broad. Raphe thin and straight. Axial area very narrow; central area small unilateral with an isolated stigma on the opposite side. Striæ 14–16 in 10  $\mu$ , radial and indistinctly punctate.

34. *Gomphonema parvulum* (Kütz.) V. H. v. *subellipticum* Cl.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 178, fig. 1269 h. *G. parvulum* (Kütz.) Grun. v. *subelliptica* Cl.—Hustedt, *Bacil.*, p. 373, fig. 713 b.

Frustules small. Valves clavate-elliptical with scarcely constricted produced ends, 16–18  $\mu$  long and 6–6  $\mu$  broad. Striæ 13–15 in 10  $\mu$ , radial and indistinctly punctate.

35. *Gomphonema montanum* Schum. v. *acuminatum* Mayer

(Fig. 24)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 183, fig. 1276 e–k.

Valves broadly clavate-lanceolate with wedge-shaped, slightly constricted apiculate apex and gradually narrowed towards the acutely rounded base, 35.5–40  $\mu$  long and 12  $\mu$  broad. Raphe thin and straight. Axial area narrow, linear; central area unilateral with an isolated stigma on the opposite side. Striæ 10–11 in 10  $\mu$ , radial and distinctly punctate.

36. *Gomphonema dharwarensis* sp. nov.

(Figs. 25–27)

Frustula angusta-cuneati in aspectu zonali. Valvæ lineari-clavatæ, apex sæpsi atque late cuneatis; basi gradatim fastigatæ atque acutirodati, margines aliquantum undulatis. Raphe crassa, unilateraliter inclinatis atque comma similibus in nodulus medio, fissuris terminalibus distincte. Area axialis lata; area centralis unilateraliter ornata puncto uno at latius. Striæ fortes, tenuiter radiales, lineatæ atque proxime positæ in utroque apice. Frustula 66–75  $\mu$  longa, 8–9  $\mu$  lata, striæ 6–8 in medio atque 8–12 in 10  $\mu$  in utroque apice.

*Habitat.*—Aquæ dulcis. Lacu in horto.

Frustules narrowly wedge-shaped in the girdle view. Valves linear-clavate, apex septate and broadly cuneate, base gradually narrowed and acutely rounded, margins somewhat undulated. Raphe thick with unilaterally bent, comma-shaped ends in the central nodule, terminal fissures distinct. Axial area wide; central area unilateral with an isolated stigma on one side. Striæ strong, slightly radial, lineate and closely set at the ends. Frustules 66–75  $\mu$  long, 8–9  $\mu$  broad with 6–8 striæ in the middle and 8–12 in 10  $\mu$  at the ends.

*Habitat.*—Fresh-water. Garden reservoirs.

This form resembles *G. intricatum* Kütz. and its varieties (Hustedt, *Bacil.*, pp. 187–89, figs. 697–99; Cleve-Euler, *Diat. von Schwed. u. Finn.*—IV, pp. 187–89, fig. 1283), in the outline, in number and arrangement of the striæ. However, it markedly differs from them in having cuneate septate apex and coarsely lineate striæ instead of clearly punctate ones. Moreover, the raphe ends in the central nodule are clearly comma-shaped and the central area comparatively smaller than in *G. intricatum* Kütz. It also differs from *G. dubravicense* Pant. (Cleve-Euler, *op. cit.*, p. 190, fig. 1826 *a-b*) in having no other punctæ in the mid-axial area than an isolated stigma and comma-shaped ends of the raphe in the central nodule. It also does not agree with any other forms with regards to lineate striæ and comma-shaped endings of raphe in the central nodule. It is, therefore, regarded as a new species.

37. *Gomphonema olivaceum* (Lyng.) Kütz. v. *balticum* Cl.

(Fig. 28)

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—IV, p. 192, fig. 1291 *a-d*. *G. olivaceum* (Lyng.) Kütz.—Hustedt, *Bacil.*, p. 378, fig. 719 *a*.

Valves ovate-clavate with broadly rounded apex and attenuated base, 25–30  $\mu$  long and 5.5–6  $\mu$  broad. Raphe thin and straight.

Axial area narrow; central area large unilateral without an isolated stigma. Striæ 7-12 in  $10\ \mu$ , radial and curved, indistinctly punctate and closely set at the ends.

- |                |                                 |
|----------------|---------------------------------|
| 2. Family      | <i>EPITHEMIACEÆ</i>             |
| (a) Sub-family | EPITHEMIOIDEÆ                   |
| Genus          | <b>Epithemia</b> Brébisson 1838 |

38. *Epithemia sorex* Kütz. v. *genuina* A Cl

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—V, p. 41, fig. 1412 a-b. *E. sorex* Kütz.—Van Heurck, *Treat. Diat.*, p. 295, pl. 9, fig. 351; Hustedt, *Bacil.*, p. 388, fig. 736; Iyengar and Subrahmanyam, *Fossil Diat.*, p. 233, fig. 17.

Frustules epiphytic on aquatic plants, rectangular and somewhat curved in the girdle view. Valves strongly convex on the dorsal—and slightly concave on the ventral side with constricted, rounded capitate recurved ends,  $31-37\ \mu$  long and  $8.4-9.6\ \mu$  broad. Raphe in the raphe canal strongly arcuate with central pores almost reaching the dorsal side. Costæ 5-7 in  $10\ \mu$ , strong, radial and alternating with 2-3 rows of aeriotes, rows of aeriotes 12-15 in  $10\ \mu$ .

- |                |                                 |
|----------------|---------------------------------|
| (b) Sub-family | RHOPALODIOIDEÆ                  |
| Genus          | <b>Rhopalodia</b> O. Müll. 1895 |

39. *Rhopalodia gibba* (Ehr.) O. Müll. v. *genuina* Grun.

Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—V, p. 44, fig. 1416 a, e. *R. gibba* (Ehr.) O. Müll.—Hustedt, *Bacil.*, p. 390, fig. 740; *Epithemia gibba* Kütz.—Van Heurck, *Treat. Diat.*, p. 296, pl. 9, fig. 352 a.

Frustules epiphytic on aquatic plants, broadly linear in the girdle view with notched inflation in the middle and broadly truncate ends,  $20-25\ \mu$  broad. Valves gibbous and notched on the mid-dorsal side, ventral side straight or slightly depressed towards the acutely rounded curved ends,  $8-10\ \mu$  broad and  $80-90\ \mu$  long. Costæ 5-7 in  $10\ \mu$ , strong, parallel in the middle and becoming strongly radial at the ends, alternating with 2-3 rows of aeriotes, rows of aeriotes 10-15 in  $10\ \mu$ , fine but distinct.

40. *Rhopalodia gibba* (Ehr.) O. Müll. v. *ventricosa* (Kütz.) Grun.

Hustedt, *Bacil.*, p. 391, fig. 741; Cleve-Euler, A., *Diat. von Schwed. u. Finn.*—V, p. 44, fig. 1416 c-d; *R. ventricosa* (Kütz.) O. Müll.—Tiffany and Britton, *Alg. Illinois*, p. 282, pl. 75, fig. 885; *Epithemia gibba* Kütz. v. *ventricosa* Kütz.—Van Heurck, *Treat. Diat.*, p. 296, pl. 9, fig. 354.

Frustules smaller than the type and more gibbous in the middle with truncate broadly rounded ends in the girdle view,  $30-38\ \mu$  long and  $18-19\ \mu$  broad. Costæ strongly radial towards the ends, 6-7 in  $10\ \mu$ , alternating with 2-3 rows of aeriotes, rows of aeriotes 10-14 in  $10\ \mu$ .

- |                |                               |
|----------------|-------------------------------|
| 3. Family      | <i>NITZSCHIACEÆ</i>           |
| (a) Sub-family | <i>NITZSCHIOIDEÆ</i>          |
| Genus          | <i>Nitzschia</i> Hassall 1845 |

Section—*Lineares* (Grunow) Hustedt and others

41. *Nitzschia sublinearis* Hustedt

Hustedt, *Bacil.*, p. 411, fig 786; Cleve-Euler, A., *Diat von Schwed u Finn.*,—V, p 80, fig 1481.

Valves elongated, slightly backwardly bent with long wedge-shaped, constricted somewhat capitate ends, 65–88  $\mu$  long and 5–6  $\mu$  broad. Keel excentric without any notch in the middle, keel punctæ 8–12 in 10  $\mu$ , distinct. Striæ over 30 in 10  $\mu$ , very fine.

Section—*Lanceolatae* Grunow

42. *Nitzschia amphibia* Grun. v. *genuina* Mayer

Cleve-Euler, A, *Diat. von Schwed u Finn*—V, p. 86, fig. 1496 a–c. *N amphibia* Grun.—Van Heurck, *Treat Diat.*, p. 403, pl 17, fig 563; Hustedt, *Bacil.*, p. 414, fig 793.

Valves linear to linear-lanceolate with somewhat wedge-shaped constricted ends, 29–35  $\mu$  long and 4.4–5  $\mu$  broad. Keel excentric with large keel punctæ 7–8 in 10  $\mu$ . Striæ 16–18 in 10  $\mu$ , distinctly punctate.

43. *Nitzschia amphibia* Grun. v. *acutiuscula* Grun.

(Fig. 29)

Hustedt, *Bacil.*, p. 414,; Cleve-Euler, A, *Diat von Schwed. u Finn.*—V, p 86, fig 1496 f–i

Valves lanceolate with scarcely constricted, acutely rounded ends, 14–22  $\mu$  long and 5–5.6  $\mu$  broad. Keel excentric with large keel punctæ 7–8 in 10  $\mu$ . Striæ 15–18 in 10  $\mu$ , distinctly punctate.

Section—*Obtusæ* Grun

44. *Nitzschia obtusa* W. Sm v. *scalpelliformis* Grun.

Van Heurck, *Treat Diat.*, p 397, pl. 16, fig 538; Hustedt, *Bacil.*, p. 422, fig 817 b; Venkataraman, *S. I. Diat.*, p. 355, figs. 142, 147; Cleve-Euler, A, *Diat. von Schwed u Finn.*—V, p. 78, fig 1476 f, h.

Frustules elongated and sigmoid in the girdle view, linear. Valves linear, slightly sigmoid with obliquely wedge-shaped ends, 87–100  $\mu$  long and 8–9  $\mu$  broad. Keel excentric with large rounded keel punctæ 6–8 in 10  $\mu$ , keel notched in the middle. Striæ very fine about 30 in 10  $\mu$

SUMMARY

For the first time the fresh-water Diatomaceæ of Dharwar has been investigated of which an illustrated account is given.

In the introduction topography of the place is given and mention has been made of features of the material from different places of collection.

In all 44 forms have been described and illustrations are given only of those which do not appear in the Indian literature. Of these forms, 18 are new records for India, one is a new species and one a new variety.

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