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The Fresh-water Diatoms from Radhanagari—Kolhapur

by

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INTRODUCTION

There are a few accounts available of fresh-water Diatomaceae of South-Western India, yet much remains to be done. It is with this that the present investigation was undertaken.

Radhanagari is a Taluka place of Kolhapur District in the Bombay State. It is situated at about 30 road miles South-west of Kolhapur, on one of the spurs of Sahyadri ranges (Western Ghats). It has an annual rainfall of over 150 inches and an elevation varying between 2,000 to 2,500 feet above mean-sea-level. The climate is fairly cool and pleasant. Radhanagari, being a hilly situation, abounds in streams, pools, puddles and other bodies of fresh-water. From several such bodies of water, the material for this investigation was collected during botanical excursions of 1953-55 to this place. As far as the author is aware, the Diatom flora has not been worked out from this area.

Several of the samples on examination showed either preponderance of *Synedras*, *Eunotias* or plenty of *Fragilaria intermedia* Grun. The other forms described in this paper were present in lesser numbers. The *Eunotia pectinalis* (Kütz.) Rabh v. *neglecta* v. nov.; *E. camelus* (Ehr. emend.) A. Berg v *kerveerensis* v. nov. and *E monodon* Ehr., were collected in long filamentous ribbons (frustules united by their valve faces), and at first sight they were thought to be some green-algae (like *Zygnema* or *Mougeotia*), very slimy to the touch. With these filamentous bodies, were found some specimens of *Surirella* and *Frustulia*, the latter being more numerous and in the free condition. In *Eunotia gracilis* (Ehr.) Rabh., the frustules were found forming short chains or ribbons attached to submerged angiosperms.

The species, varieties and forms of the genus *Eunotia* are specially critically determined, since they show a good deal of variation. For such determinations, the author had the good fortune to find practically pure strands of material. While examining the same, constant use was made of Hustedt's (1930) and Cleve-Euler's (1951-55) monographs, besides A. Berg's paper on the genus *Eunotia* Ehr., which records something like 190 forms—an excellent piece of work.

The Diatom forms included in this paper are arranged and determined according to Hustedt's (1930) and Cleve-Euler's (1951-55) monographs and other works. The detailed description has been avoided of such forms as have already been described in the Indian Literature.

In all twenty-five forms are recorded from Radhanagari area, representing ten genera. Of these, five varieties and two forms are considered to be new. A statement is also given at the end of this paper to indicate the distribution of these Diatoms in the said area and elsewhere in India as recorded by other workers

BACILLARIOPHYTA (DIATOMEAE)

A. Order	PENNALES
1. Suborder	ARAPHIDINEAE
Family	Fragilariaceæ
Subfamily	Fragilarioideæ

Genus—*Fragilaria* Lyngbye 1819.

1. *Fragilaria intermedia* Grun (Fig. 1)

Hustedt, *Bacil.*, p. 139, fig. 130 ; Venkataraman, G., *S. I. Diat*, p. 304, figs. 27, 42 (=*F. intermedia* v. *robusta* v. nov) ; Gonzalves and Gandhi, *Diat. Bombay and Salsette*—I, 123, fig. 12 (=*F. intermedia* v. *robusta* Venkat) ; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 42, fig. 353 a, c, k-l (=*F. vaucheriae* (Kütz.) Boye Pet. v. *genuina* (V. H.) A. Cl.).

Valves 50-77 μ long and 6-6.5 μ broad, linear with constricted produced or slightly capitate ends. Central area unilateral. Striae 9-11 in 10 μ.

Here, Venkataraman's *F. intermedia* v. *robusta* v nov, is reduced to the type proper. This variety was created by him on basis of larger dimensions. This reversion is considered desirable after a careful comparison with the dimensions given for the type by Hustedt (1930), Cleve-Euler (1951-55), Venkataraman (1939), Gonzalves and Gandhi (1952) and those found in the present specimens, as follows :—

Hustedt	:	Length	15-60 μ	:	Breadth	2.5-5 μ	:striae	9-13/10 μ
Cleve-Euler	:	,,	20-40 μ	:	,,	2.5-5 μ	: ,,	12-14/10 μ
Venkataraman	:	,,	72-140 μ	:	,,	5-8 μ	: ,,	11-12/10 μ
Gonz. & Gandhi	:	,,	90-119 μ	:	,,	6-7.2 μ	: ,,	9-10/10 μ
In present forms	:	,,	50-77 μ	:	,,	6-6.5 μ	: ,,	9-11/10 μ

From the above mentioned data it is clear that the dimensions for the said form intergrade, thus the reversion of *F. intermedia* v. *robusta* Venkat., is justified

Genus — *Synedra* Ehrenberg 1830

2. *Synedra ulna* (Nitz.) Ehr.

Van Heurck, *Treat. Diat.*, p. 310, pl. 10, fig. 409 ; Hustedt, *Bacil.*, p. 151, figs. 158-59 ; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 61, fig. 382 a (=*S. ulna* v. *genuina* Grun.).

Valves 100-135 μ long and 6.8-7 μ broad, linear with constricted, produced, rounded ends. Striae 9-10 in 10 μ.

3. *Synedra ulna* v. *danica* (Kütz.) Grun.

Van Heurck, *Treat. Diat.*, p. 311, pl. 11, fig. 415 ; Hustedt, *Bacil.*, p. 154, fig. 168 ; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 62, fig. 382 r.

Valves 250-275 μ long and 5 μ broad, elongated, narrowly lanceolate with constricted, somewhat capitate ends. Striae 10-11 in 10 μ.

II. Suborder	RAPHIDINEAE
(1) *Family*	Eunotiaceæ
Subfamily	Eunotioideæ

Genus — *Eunotia* Ehrenberg 1837

4. *Eunotia pectinalis* ((Kütz.) Rabh. v. *gibbulosus* Venkat., (Fig. 2)

Venkataraman G., *S. I. Diat.*, p. 309, fig. 22 ; Gonzalves and Gandhi, *Diat. Bombay and Salsette*—I, p. 135, fig. 33 ; Hustedt, *Bacil.*, p. 182, fig. 241 (=*E. pectinalis* v. *ventralis* (Ehr.) Hust.) ; Berg, A., *New species and forms of Eunotia*, p. 429, fig. 1 : 40 (=*E. pectinalis* f. *gibbosa* f. nov.) ; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 86, fig. 409 q (=*E. pectinalis* v. *gibbosa* A. Berg.).

Valves 96-111 μ long and 8.5-9 μ broad, elongated, feebly arcuate with a tumidity in the middle on the dorsal as well as on the ventral side, dorsal side somewhat straight ; ends constricted, broadly produced or feebly capitate and rounded. Striae 8-11 in 10 μ, coarse and irregularly disposed.

This form agrees well with the type given by Venkataraman and others. Cleve-Euler has also described an identical form—*E. pectinalis* v. *gibbosa* A. Berg, establishing A. Berg's form, with a maximum breadth of 7 μ, and has regarded Hustedt's *E. pectinalis* v. *ventralis* (Ehr.) Hust., synonymous with it. Here, therefore, the author is of the opinion that all these forms are identical except for minor, negligible variations. In the light of discussion given by Venkataraman under his *E. pectinalis* v. *gibbulosus* v. nov., it is apparent that Hustedt's *E. pectinalis* v. *ventralis* (Ehr.) Hust., required a new nomenclature. Here, therefore, all these forms are integrated and the nomenclature given by Venkataraman (1939) is retained.

5. *Eunotia pectinalis* v. *neglecta* v. nov. (Figs. 3-5)

Frustula in catenis, late-rectangularia in aspectu zonali. Valvæ 33-73 μ longae atque 7.7-8.8 μ latae, lineares, paullulum arcuatae, marginibus dorsum convexis, paullulum triundulatis ; ventrali latere concavo ac in medio tumido ; apices constricti ad dorsum, producti atque rotundati. Noduli polares parvi. Striae 9-11 in 10 μ, crassae atque impariter positae.

Frustules formed in chains, broadly rectangular in girdle view. Valves 33-73 μ long and 7.7-8.8 μ broad, linear, slightly arcuate, dorsal side convex, feebly triundulate ; ventral

side concave with inflation in the middle ; ends constricted on the dorsal side, produced and rounded. Polar nodules small. Striae 9-11 in 10 μ, coarse and irregularly disposed.

This form agrees with *E. pectinalis* (Kütz.) Rabh., given by Hustedt (Hustedt, *Bacil.*, p. 180, fig. 237) and others, in the arrangement of striae, and with its varieties in gibbosities. It also comes near to *E. pectinalis* v. *hybrida* A. Cl. (Cleve-Euler, *Diat. Schwed. Finn.*—II, p. 86, fig. 409 t), for the triundulate dorsal side and ventral gibbosity and striae. However, with all these resemblances, several forms examined by the author from several places, show distinctiveness from others in having feebly triundulate convex dorsal side and produced rounded or scarcely capitate ends. Moreover, some forms observed are comparatively broader and more robust than *E. pectinalis* v. *hybrida* A. Cl., besides having produced rounded and not obliquely truncate ends. It also likewise differs from *E. pectinalis* v. *ventricosa* (Ehr.) Grun. (Van Heurck, *Treat. Diat.*, p. 301, pl. 9, fig. 372) and *E. pectinalis* v. *ventralis* (Ehr.) Hust. (Cleve-Euler, *op. cit.*, p. 85, fig. 409 k-l). It does not agree with any other species or forms of *Eunotia* but in some respects with *E. pectinalis* and its varieties. It is, therefore, considered to be a new variety.

6. *Eunotia lunaris* (Ehr.) Grun.

Van Heurck, *Treat. Diat.*, p. 303, pl 9, fig. 384 ; Hustedt, *Bacil.*, p. 183, fig. 249; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 88, fig. 412 a-b (=*E. lunaris* v. *genuina* Grun.).

Valves 30-50 μ long and 3-3.2 μ broad, strongly arcuate with almost parallel sides and slightly narrowed rounded ends. Striae 15-17 in 10 μ, fine.

7. *Eunotia alpina* (Naeg.) Hust. (Fig. 6)

Hustedt, *Bacil.*, p. 185, fig. 252 ; Cleve-Euler, A., *Diat. Schwed Finn.*—II, p. 91, fig. 414 i (=*E. alpina* v. *typica* A. Cl.).

Valves 47-55 μ long and 2.5 μ broad, sublinear, arcuate with dorsal side almost straight in the middle and ends narrowed, somewhat backwardly bent and rounded. Striae 16-18 in 10 μ, fine.

8. *Eunotia monodon* Ehr. (Figs. 7-9)

Hustedt, *Bacil.*, p. 185, fig. 254 ? ; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 118, fig. 455 a-b (=*E. monodon* v. *genuina* A. Cl.) ; Berg, A., *Diat. Sophia-Expd.*, p. 9, fig. 64a (=*E. major* (W. Sm.) Rabh.)

Frustules formed in chains, broadly rectangular in girdle view. Valves 16-45 μ long and 6.5-10 μ broad, with strongly convex dorsal side bulged in the middle and almost straight on the ventral side ; ends constricted on the dorsal side, broadly produced and rounded but not at all capitate. Striae 9-14 in 10 μ.

This form agrees well with the type given by Cleve-Euler, but Hustedt's illustration differs in being strongly arcuate with somewhat capitate ends. This illustration is being regarded as *E. major* (W. Sm.) Rabh. v. *scandica* n. nom. Whereas, A. Berg's *E. major* (W.

Sm.) Rabh , particularly the fig. 64a, agrees well here and therefore treated under *E. monodon* Ehr. Further, from the material which is being examined carefully, it appears that the forms having dimensions between 16-30 μ, have comparatively closer striae, 12-14 in 10 μ, than the larger specimens which have 9-11 in 10 μ

9. *Eunotia gracilis* (Ehr.) Rabh (Fig 10)

Van Heurck, *Treat. Diat.*, p. 300, pl. 9, fig. 368 ; Hustedt, *Bacil.*, p. 185, fig. 253 ; Cleve-Euler, A., *Diat. Schwed. Finn.*—II, p. 92, fig. 417 a-c (=*E. gracilis* v. *genuina* A. Cl); Berg, A., *New species and forms of Eunotia*, p. 432, fig. 2 : 53

Frustules narrowly linear in girdle view, united in short ribbons or chains by ends. Valves 88-190 μ long and 5.5-7 μ broad, slightly arcuate, linear with swollen rounded ends. Striae 13-14 in 10 μ, fine.

10. *Eunotia camelus* (Ehr) A. Berg v. *karveerensis* v. nov (Figs. 11-13)

Frustula in catenis, late-rectangularia in aspectu zonali. Valvae valde arcuatae, 22-36 μ longae atque 5-5 5 μ latae, lineares, margine dorsali convexo ac valde pariter tetra-gibboso ac rotundato ; ventrali latere concavo ; apices ad dorsum constricti, valde attenuati, producti atque rotundati-subcapitati. Noduli polares parvi. Striae 11-13 in 10 μ, crassae atque indistincte punctatae.

Frustules in chains, broadly-rectangular in girdle view. Valves strongly arcuate, 22-36 μ long and 5-5.5 μ broad, linear, dorsal side convex with four strong, rounded, uniform humps ; ventral side concave ; ends strongly narrowed on the dorsal side, produced and rounded-subcapitate. Polar nodules small. Striae 11-13 in 10 μ, coarse and indistinctly punctate.

This form, collected in good numbers, differs from all the known humped species of *Eunotia*, in being strongly arcuate with four uniformly spaced, rounded humps on the dorsal side and much narrowed, produced, slightly capitate-rounded ends. It differs from *E. robusta* Ralfs v *tetraodon* (Ehr.) Ralfs (Hustedt, *Bacil.*, p 171, fig. 204), in being very slender (*E. robusta* v. *tetraodon* is 2-4 times broader than the present one), not at all robust and in having closer striae. Moreover, the ends in the present form are much narrower, produced and subcapitate-rounded It further differs from *E. tridentula* Ehr. and its varieties (Hustedt, *op. cit.*, p. 179-180, figs 233, 234), in striae, curvature and dimensions ; from *E. polyglyphis* Grun. (Hustedt, *op. cit.*, p. 180, fig. 235-) in not having acutely formed crests on the dorsal side, breadth and other details. A similar form has been recorded by A. Berg as *E. camelus* (Ehr. emend.) A. Berg. (A. Berg, *New species and forms of Eunotia*, p. 430, fig. 1 : 41), which agrees well in dimensions as also in general features. However, the present specimens show more prominent humps, greater arcuate nature and slightly closer striae. But, since the present specimen holds greater affinity with *E. camelus* (Ehr.) A. Berg, it is therefore considered as a new variety of *E camelus*.

11. *Eunotia camelus* (Ehr.) A. Berg. v. *gibbosa* v. nov. (Fig 14)

Frustula late rectangulares in aspectu zonali Valvae 25-30 μ longae atque 5.5 μ latae, lineares, valde arcuatae, margine dorsali convexo ac late rotundato-bigibboso ;

ventrali latere concavo, inflatione in medio distincta ; apicibus ad dorsum valde attenuatis, productis, rotundatis-subcapitatis atque aliquantum reflexis. Noduli polares parvi. Striae 12-14 in 10 μ, indistincte punctatae

Frustules broadly rectangular in girdle view. Valves 25-30 μ long and 5.5 μ broad, linear, strongly arcuate, dorsal side convex with two broadly rounded humps ; ventral side concave with a distinct inflation in the middle ; ends strongly narrowed on the dorsal side, produced, rounded-subcapitate and somewhat reflexed. Polar nodules small. Striae 12-14 in 10 μ, indistinctly punctate.

This form agrees closely with *E. camelus* (Ehr.) A. Berg (A. Berg, *op. cit.*, p. 430, fig. 1 : 41) and its above named variety, with which it occurred in smaller numbers, in the arcuate nature, produced ends and the striae. However, it differs from them in having only two broadly rounded humps on the dorsal side and, in addition, an inflation in the middle of the ventral side. It also differs from *E. Meisteri* Hust. v. *bidens* Hust. (Hustedt, *Bacil.*, p. 179, fig. 231) and *E. tridentula* Ehr. v. *bidens* (Hust.) A. Cl. (Cleve-Euler, *op. cit.*, p. 103, fig. 431 g-h), in dimensions, number of striae and the gibbosity on the ventral side. It, further, differs from *E. diodon* Ehr. (Hustedt, *Bacil.*, p. 173, fig. 207), in many respects except in number of striae. It also differs from *E. pectinalis* (Kütz.) Rabh. f. *sellula* A. Berg (A. Berg, *op. cit.*, p. 428, fig. 1: 28), in having ventral side inflation, greater depression on the dorsal side and reflexed ends, though measurements approximate it. Since, this specimen occurred with an almost pure strand of *E. camelus* v. *karveerensis* v. nov., and as it bears closer affinity with it, it is considered as a new variety of *E. camelus*

12. *Eunotia camelus* (Ehr.) A. Berg. v. *ventricosa* v. nov. (Fig. 15)

Frustula late rectangulares in aspectu zonali. Valvae 25-32 μ longae atque 5 μ latae, lineares, valde arcuatae, margine dorsali convexo ac aliquantum depressi late-bigibboso ; ventrali latere concavo, inflatione conica in medio distincta ; apicibus ad dorsum valde attenuatis, productis-subcapitatis atque aliquantum reflexis. Noduli polares parvi. Striae 12-13 in 10 μ, indistincte punctatae.

Frustules broadly rectangular in girdle view. Valves 25-32 μ long and 5 μ broad, linear, strongly arcuate, dorsal side with two broad, slightly depressed humps ; ventral side with a distinct conical inflation in the middle ; ends strongly narrowed on the dorsal side, produced-subcapitate and somewhat reflexed. Polar nodules small. Striae 12-13 in 10 μ, indistinctly punctate.

This form resembles *E. camelus* (Ehr.) A. Berg, and its above named varieties in all respects, except that it has broad, slightly depressed humps on the dorsal side and an inflation on the ventral side. In respect of the dorsal side, it appears like *E. siberica* Cl. (Krishnamurthy, *Diat. S. I.*, p. 360, fig. 15) and its varieties, e.g.—v. *genuina* A. Cl., — v. *perarcuata* A. Cl., —v. *stuxbergii* A. Berg (Cleve-Euler, *op. cit.*, pp. 87-88, fig. 411 a-c), but it strongly differs from all these in having an inflation on the ventral side, in addition to the dimensions, produced ends and arcuate nature. Likewise, it differs from *E. bidentula* W. Sm. (Van Heurck, *Treat. Diat.*, p. 302, pl. 30, fig. 828) in many respects. Further, A. Berg describes a similar form *E. pectinalis* (Kütz.) Rabh. f. *didymodon* (Grun.) A. Berg (A. Berg,

op cit., p. 426, fig 1 : 23) which has the arcuate nature and the dorsal side as in the present form. However, the present specimen differs from it in having a gibbosity on the ventral side and the dorsal side humps slightly depressed. Since, this form was found in the pure strand of *E. camelus* v. *karveerensis* v. nov., it is therefore, considered as a new variety of *E. camelus* (Ehr.) A. Berg.

Having observed an almost pure strand of *E. camelus* material in good quantity, it is felt that it is a variable species. It is locally represented by 2-3 varieties, rather distinct, which have been so treated here. From A. Berg's paper, it is seen that he has split *E. camelus* Ehr., species complex into forms or varieties of two different species, namely *E. pectinalis* (Kütz.) Rabh. and *E. camelus* (Ehr. emend.) A. Berg. Further, it appears from this author's remarks that Grunow (Banka, 1865) did recognise the variable nature of *E. camelus*, hence he (Grunow) treated some forms as : *E. camelus* v. *genuina* Grun., *E.*—v. *didymodon* Grun., and *E.*—v. *denticulata* Grun. Out of this species complex, A. Berg refers *E. camelus* v. *denticulata* Grun. to *E. camelus* (Ehr.) as emended species, while v. *genuina* and v. *didymodon*, are referred to as new forms of *E. pectinalis*, e g. *E.* —f *sellula* A. Berg, and *E.*—f. *didymodon* (Grun.) A. Berg, respectively since these latter forms have two humps on the dorsal side. With the material at my disposal, I see that *E. camelus* is likely to vary to form two humped individuals also, as represented in my *E. camelus* v. *gibbosa* and *E.*—v. *ventricosa*. These two forms differ from A. Berg's *E. pectinalis* f. *sellula* and *E.*—f. *didymodon*, in as much as they possess an inflation on the ventral side also, and some slight variations. I am, therefore of the opinion that *E. pectinalis* f. *sellula* A. Berg and *E.*—v *didymodon* (Grun.) A. Berg may be recognised under *E. camelus* (Ehr. emend.) A. Berg. Further, from the measurements and other details, it appears clearly that all these forms have a similar range of dimensions, number of striae and their arrangement, general outline and the apices. It is therefore obvious that these forms do not fit well within *Eunotia pectinalis* (Kütz.) Rabh., thus the affinity is doubtful. With this observation, I would consider *E. camelus* (Ehr. emend.) A. Berg acceptable as a main species and the following as its varieties e.g. 1) v *karveerensis* v. nov.,2) v *dentata* (A. Berg), 3) v. *sellula* (A. Berg) =(*E. pectinalis* f. *sellula* A. Berg), 4) v. *didymodon* Grun. =(*E. pectinalis* f. *didymodon* (Grun.) A. Berg, = *E. camelus* v. *didymodon* Grun.) 5) v. *gibbosa* v. nov., 6) and v *ventricosa* v. nov. It is hoped that this arrangement holds good genetically.

III Suborder MONORAPHIDINEAE

Family Achnanthaceae
Subfamily Achnanthoideae

Genus—*Achnanthes* Bory 1822.

Subgenus—Achnanthidium (Kütz.) Heiberg 1863.

13. *Achnanthes inflata* Kütz.

Hustedt, *Bacil.*, p. 209, fig. 307 ; Venkataraman, G., *S. I. Diat.*, p 314, figs. 52, 54, 67.

Valves 45-50 μ long and 10-11 μ broad, linear, much inflated in the middle and ends broadly swollen and rounded. Rapheless valve with unilaterally formed pseudoraphe,

striae 11-12 in 10 μ. Valve with raphe : central area large, reaching the side ; striae 9-11 in 10 μ, radial and coarsely punctate (structure alveolar).

IV. Suborder BIRAPHIDINEAE

(1) *Family* Naviculaceae
(a) *Subfamily* Naviculoideae

Genus—*Frustulia* (Agardh) Grun. 1865.

14 *Frustulia saxonica* Rabh v *linearis* A. Cl. f. *minor* f nov. (Fig. 16).

Valvae lineari-ellipticae, utroque apice abrupte constricto ac breviter rostrato-rotundato, 25-35 μ longae atque 9.5-10 μ latae. Raphe inter siliceis costas inclusa. Area centralis linearis, aliquantum constricta ; area polares elongata. Striae 35 in 10 μ, tenuissime punctatæ, punctis fere rectis et longitudinem ordinibus dispositis.

Valves 25-35 μ long and 9 5-10 μ broad, linear-elliptical with abruptly constricted, shortly rostrate rounded ends. Raphe enclosed between the siliceous ribs. Central area linear, slightly constricted ; polar areas elongated. Striae about 25 in 10 μ, very finely punctate with punctae arranged almost in straight, longitudinal rows.

This form agrees well with *Frustulia saxonica* Rabh. v. *linearis* A. Cl (Cleve-Euler, A., *Diat. Schwed. Finn.*—V, p. 8, fig. 1327 l), except that it is comparatively a broader form, also shorter in length. It also resembles *F. saxonica* v. *leptocephala* (Ostrup) A. Cl. (Cleve-Euler, *op. cit.*, p. 8, fig. 1327c-e) and f. *minor* f. nov., of it (fig. 1327t), in the outline and ends. However, Cleve-Euler appears to be uncertain regarding *F. saxonica* v. *leptocephala* f. *minor* f. nov. The present author has examined a number of these specimens having a fixed linear-elliptical outline unlike that of *F. saxonica* v. *leptocephala*, but varied in their ends. Some of these, on the one hand, showed shortly capitate ends as in the following case, while on the other hand, they showed shortly produced ends as in the present form. These forms being distinctive in this feature and coming very near to *F. saxonica* v. *linearis* A Cl., than to *F. saxonica* v. *leptocephala* (Ostrup) A. Cl., which has a lanceolate outline, are regarded here as a new form of *F. saxonica* v. *linearis* A. Cl.

15. *Frustulia saxonica* Rabh v *linearis* A. Cl. f. *capitata* f. nov. (Fig. 17)

Valvae 41-45 μ longae atque 10-10 2 μ latae, ut in typo supra varum apicibus breviter capitati-rotundatis. Striae 30-35 in 10 μ.

Valves 41-45 μ long and 10-10.2 μ broad, as in the above type but with shortly capitate rounded ends. Striae 30-35 in 10 μ.

This form agrees well with the above type, except that it has shortly capitate-rounded ends. It is therefore regarded as a new form.

Genus—*Stauroneis* Ehrenberg 1843

16. *Stauroneis phoenicenteron* Ehr (Fig 18)

Hustedt, *Bacil.*, p 255, fig 404 ; Cleve-Euler, A. *Diat Schwed. Finn.*—III, p. 209, fig. 944 a (=*S phoenicenteron* v. *gemina* Cl)

Valves 87-105 μ long, 17-19 μ broad lanceolate with constricted produced rounded ends. Raphe thick. Axial area narrow, linear ; central area a stauros slightly widening near the margins. Striae 18-20 in 10 μ, fine but clearly punctate.

Genus—*Pinnularia* Ehrenberg 1843.
Section—*Nodosae* A. Cl.

17. *Pinnularia acrosphaeria* Bréb.

Hustedt, *Bacil.*, p. 330, fig 610 ; Cleve-Euler, A , *Diat. Schwed Finn*—IV, p. 25, fig. 1022 a-b (=*P acrosphaeria* v *gemma* A. Cl) ; Donkin, A. S , *Brit Diat.*, p. 72, pl XII, fig. 2 (=*Navicula acrosphaeria* Bréb.).

Valves 60-79 μ long and 11-12 μ broad, linear, slightly inflated in the middle and at the ends Axial area with irregularly disposed punctae. Striae 10-12 in 10 μ.

Section—*Divergentes* Cleve

18. *Pinnularia subcapitata* Greg v. *lapponica* A. Cl. (Fig. 19). Cleve-Euler, A., *Diat Schwed. Finn.*—IV, p. 65, fig. 1090 l-m

Valves 20-27 μ long and 4-4.5 μ broad, small, linear with slightly produced, somewhat rounded subcuneate ends. Raphe thin and straight Axial area narrow : central area large, reaching the sides. Striae 12-14 in 10 μ, radial in the middle and convergent at the ends.

This form agrees well with the type given by Cleve-Euler, except that the ends of this form appear somewhat like that of P. *subcapitata* v *subrobusta* A. Cl (fig. 1090 h)

(b) *Subfamily* Gomphocymbelloideae
Genus—*Cymbella* Agardh 1830.

19 *Cymbella turgida* (Greg.) Cl.

Hustedt, *Bacil.*, p. 358, fig 660 ; Cleve-Euler, A , *Diat. Schwed. Finn.*—IV, p. 123, fig 1176 a-d.

Valves 30-35 μ long and 9-13 μ broad, strongly convex on the dorsal side, ventral side almost straight with a median inflation. Striae 8-10 in 10 μ, lineate.

20. *Cymbella ventricosa* Kütz.

Hustedt, *Bacil.*, p 359, fig 661 ; Cleve-Euler, A , *Diat Schwed. Finn.*—IV, p. 124, fig 1177 a-c (=*C. ventricosa* v. *genuina* Mayer)

Valves 25-35 μ long and 7-9 μ broad, strongly convex on the dorsal side, ventral side almost straight or scarcely convex with acutely rounded ends Striae 13-15 in 10 μ, coarse and indistinctly lineate

Genus—*Gomphonema* Agardh 1824

21. *Gomphonema sphaerophorum* Ehr. (Fig 20)

Hustedt, *Bacil.*, p 372, fig 695 ; Cleve-Euler, A , *Diat Schwed Finn* —IV, p 176, fig 1267

Valves 25-35 μ long and 7-7 5 μ broad, ovate-clavate with strongly constricted, somewhat truncate-capitate apex and attenuated, slightly capitate base. Raphe thin and straight Central area unilateral with an isolated stigma on one side. Striae 13-15 in 10 μ, radial and indistinctly punctate.

22 *Gomphonema parvulum* (Kütz.) Grun

Hustedt, *Bacil.*, p 372, fig 713 a ; Cleve-Euler ,A , *Diat Schwed Finn.*—IV, p 177, fig 1269 a-c (=*G. parvulum* v *genuinum* Mayer)

Valves 24-28 μ long and 5-6 μ broad, lanceolate-clavate with constricted produced ends. Striae 13-15 in 10 μ

23. *Gomphonema parvulum* v. *subelliptica* Cl

Hustedt, *Bacil.*, p 373, fig 713 b; Cleve-Euler, A , *Diat Schwed Finn* —IV, p 177, fig 1269 h-j (=*G. parvulum* v *subellipticum* Cl).

Valves 14-16 μ long and 5 μ broad, small, elliptical-clavate with feebly constricted apex and attenuated base Striae 13-15 in 10 μ.

24. *Gomphonema gracile* Ehr

Hustedt, *Bacil.*, p 376, fig. 702 ; Cleve-Euler, A , *Diat Schwed Finn* —IV, p 185, fig. 1281 a-b (=*G. gracile* v *genuinum* Mayer).

Valves 30-45 μ long and 7-8 μ broad, lanceolate clavate with attenuated ends. Central area unilateral with an isolated stigma Striae 10-15 in 10 μ, radial, indistinctly lineate and very closely set at the ends.

(2) *Family* Surirellaceæ
Subfamily Surirelloideæ

Genus—*Surirella* Turpin 1828

25 *Surirella tenera* Greg. v *ambigua* v nov. (Fig. 21)

Frustula cuneata in aspectu zonali. Valvae 98-105 μ longae atque 26 6 μ latae, robustae, heteropolares, lineari-ovatae, apice rotundato atque basi cuneati-rotundata. Area

axialis anguste-lanceolata cum linea media. Rugae marginales valde evolutae cum projectionibus distinctis Costae 18-22 in 100 μ, valdae, radiales in utroque apice ; striae indistincte inter costas ut in typo.

Frustules wedge-shaped in girdle view. Valves 98-105 μ long and 26.6 μ broad, robust, heteropolar, linear-ovate with rounded apex and cuneate rounded base. Axial field narrowly lanceolate with a median line. Marginal folds strongly formed with distinct projections. Costae 18-22 in 100 μ, strong, radial at the ends ; striae indistinctly present in between the costae as in the type

This form resembles *Surirella tenera* Greg. v. *nervosa* A. S., as described by Cleve-Euler (Cleve-Euler, A., *Diat. Schwed. Finn* —V, p. 104, fig. 1525 c-e) and particularly with 'fig. 1525 c', in its linear-ovate outline, marginal folds and the costae. However, it differs from it in having a more rounded base and in the absence of spines on the median line. It also shows resemblance to *S. robusta* Ehr. v. *nobilis* (W. Sm.) A. Cl. (Cleve-Euler, *op. cit.*, p. 102, fig. 1524 a-c), in its robustness, strongly undulate marginal folds (fig. 1524 a); but the larger number of costae is a distinctive feature here—in agreement with *S. tenera* Greg. and its varieties. This form, further resembles *S. linearis* W. Sm. as given by Van Heurck (Van Heurck, *Treat. Diat.*, p. 370, pl. 31, fig. 864), in the outline and rounded ends. However, this author has not given any measurements but merely stated that it "differs from *S. biseriata* of which it is probably a variety. Valve apices equally rounded sub-obtuse" —which is not in agreement with the illustration, for it shows clearly the heteropolar nature As such, the present author is unable to refer his form to it. The present form is a distinctive one and shows a greater affinity to *S. tenera* Greg., than to any other. It is, therefore, regarded as a new variety of it

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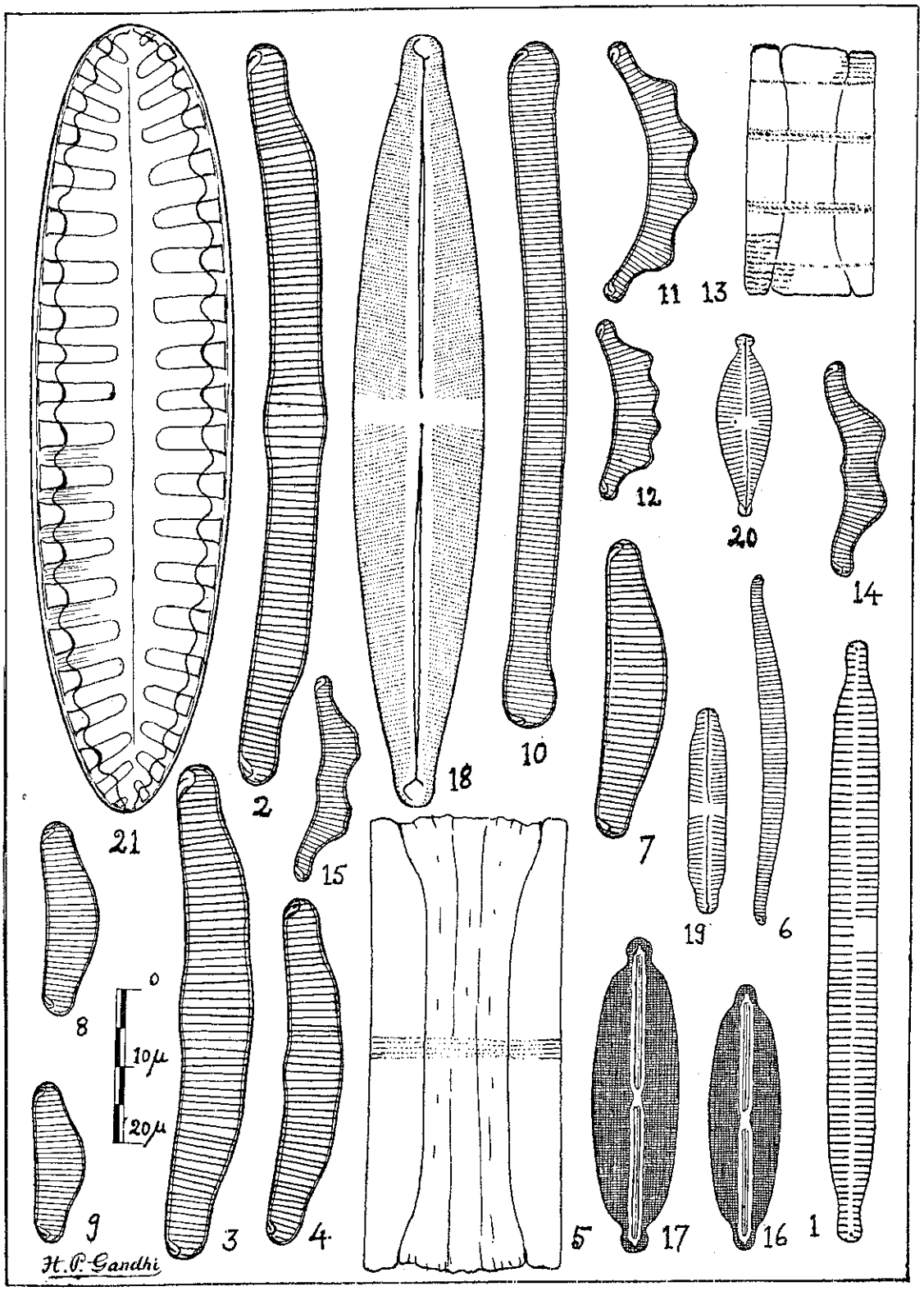
DESCRIPTION OF FIGURES IN PLATE 13

Fig 1—*Fragilaria intermedia* Grun.
Fig 2—*Eunotia pectinalis* (Kütz) Rabh. v *gibbulosus* Venkat etc
Fig 3—5—*E.*—v. *neglecta* v. nov
Fig 6—*E alpina* (Nacg.) Hust
Fig 7—9—*E monodon* Ehr.
Fig 10—*E. gracilis* (Ehr) Rabh
Fig 11—12—*E camelus* (Grun. emend) A Berg v *karvetensis* v nov.
Fig 13—*E camelus* in girdle view.
Fig 14—*E camelus* v *gibbosa* v. nov
Fig 15—*E. camelus* v *ventricosa* v. nov.
Fig 16—*Frustulia saxonica* Rabh v *linearis* A. Cl. f. *minor* nov
Fig 17—*F. saxonica* Rabh. v. *linearis* A Cl f. *capitata* f. nov
Fig 18—*Stauroneis phoenicenteron* Ehr.
Fig 19—*Pinnularia subcapitata* Greg. v. *lapponica* A Cl
Fig 20—*Gomphonema sphaerophorum* Ehr.
Fig 21—*Surirella tenera* Greg v *ambigua* v nov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H. P. Gandhi

A Statement Showing the Distribution of Diatoms in the Indian Region

Name of the Diatom (alphabetical list)	Place of collection in the locality	Places of collection in the Indian region, and their authors
		N. B the following numbers refer to the above given bibliography
Achnanthes inflata Kütz.	a pool in the river-bed	18, 27
Cymbella turgida (Greg) Cl	widely distributed	16, 17, 20, 27, 6
C. ventricosa Kütz.	pools, puddles and ditches	6, 16, 17, 22-24, 30
Epithemia alpina (Naeg) Hust	Pools, puddles	18, 28
E. camelus (Ehr emend) A Berg. v *gibbosa* v. nov.	Pools in the river-bed and streams	new record
E.—v. karveerensis v nov.	do ⎫ also recorded	do
E.—v. ventricosa v nov	do ⎭ from Sagar.	do
E. gracilis (Ehr) Rabh	Pools in the river-bed epiphytic on *Vallisneria*	7, 22, 25, 29
E. lunaris (Ehr) Grun	hilly streams, pools and puddles, dam-wall	1, 5, 6, 13, 18, 22, 30
E. monodon Ehr.	pools, puddles and ditches.	1, 6, 13, 18, 24, 27
E. pectinalis (Kütz) Rabh v. *gibbulosus* Venkat etc	Pools and puddles in the river-bed, streams.	18, 17
E.—v. neglecta v nov.	Pools, puddles, hilly streams (also recorded from Bombay and Sagar.	new record
Fragilaria intermedia Grun	widely distributed	18, 27.
Frustulia saxonica Rabh v *lineoris* A. Cl. f. minor f. nov	Hilly streams and pools of the river-bed	new record
F. saxonica v. linearis A. Cl. f. *capitata* f. nov.	do	do
Gomphonema gracile Ehr.	Pools, puddles and ditches	6, 7, 15, 16, 22, 24, 29
G. parvulum (Kütz) Grun	widely distributed	16, 17, 20, 25, 27.
Gomphonema parvulum (Kütz) Grun v *subelliptica* Cl	mostly in puddles and ditches.	17, 27
G. sphaerophorum Ehr.	pools and puddles in the river-bed.	28 ?
Pinnularia acrosphaeria Bréb.	Pools, puddles and hilly streams ; also recorded from Bombay.	7, 24, 27, 6
P. subcapitata Grun v *lapponica* A. Cl.	Hilly streams pools and ditches in the river-bed	new record for India
Stauroneis phoenicenteron Ehr.	widely distributed	6, 7, 19, 23, 24, 29, 30.
Surirella tenera Greg. *v. ambigua* v. nov.	Pools in the river-bed	new record
Synedra ulna (Nitz) Ehr.	widely distributed	widely distributed
S.—v. danica (Kütz) Grun	Pools, puddles etc	1, 16, 18.