

FRESH-WATER DIATOMS FROM SAGAR IN THE MYSORE STATE

BY H. P. GANDHI

M. N. College, Visnagar (N G)

(Received for publication on December 11, 1958)

SYNOPSIS

IN this paper an illustrated systematic account is presented of Diatoms collected during a botanical excursion in January 1955 from Sagar area in the Mysore State. Some notes on their occurrence and distribution also are given

INTRODUCTION

In the series of papers by the author on the Diatomflora of South-Western Zone of India, this one is based on several algal collections made from the vicinity of Sagar in the Mysore State. It lies at about 91 miles North-West of Birur on Birur-Talguppa line of the Southern Railway. Its geographical location is at 14° 10' N. and 74° 70' E. approximately, on one of the spurs of the Western Ghats. It has an annual rainfall of about 40-45 inches and an elevation over 1,900 feet above the mean-sea-level. The climate is moderate.

This place was visited on one of the botanical excursions during January 1955 leading to the Jog-falls. During a couple of days stay here, besides several phanerogamic plants (specimens are deposited at the Rajaram College Herbarium), quite many algal samples were gathered. Majority of these come from a rivulet which drains into the Saravati River system, some from a pond in neighbourhood of the railway station and other miscellaneous pools and puddles.

The algal samples from rivulet were taken by scraping the slimy and Podostemad encrustations on the rocky bed continuously moistened by running water and from pools and puddles there with abundant brown, loosely cluttered, living and dead vegetable matter. All these samples, on the spot, were preserved in 5% formalin. On return to the Rajaram College, where the author was working, all the samples were examined carefully besides many others till April 1956.

From the observations it was noted that the collections from the rivulet yielded a rich harvest of diatoms quite many of them being interesting in several respects. There is present the representative element of Java, Bali, Sumatra Islands (Hustedt, 1936, 1938-39), some of Indo-Malaya Archipelago (Hustedt, 1942) and Sino-Japanese type

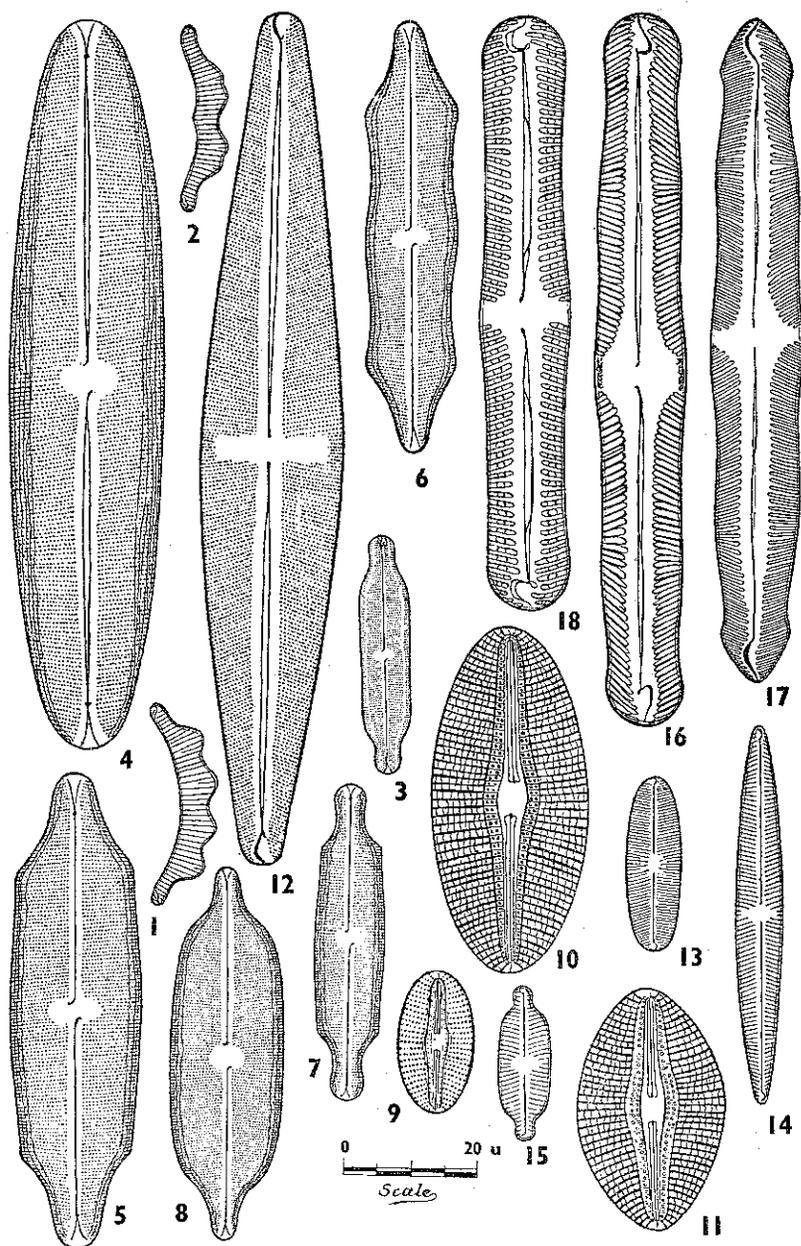
(Skvortzow, 1928, 1937) The Java, Bali, Sumatra and Indo-Malayan element can be spoken of essentially as tropical (Patrick, 1948), is the case here also, whereas the Sino-Japanese is subtropical to temperate. The tropical element here confines chiefly to hilly districts, as is understood from the present situation, also from the Jog-falls (the account is under preparation) and some similar localities on the Western Ghats. The geographical limits of these diatoms are extended and several new records for India are registered, besides some new for the Science.

So far the Diatomflora of this area is nowhere recorded, hence the author has an interest to present the said account. While preparing this paper, over 150 papers and monographs have been consulted though many of them do not appear in the bibliography. The new types recorded, of everyone except in a few cases, numerous specimens were observed and carefully considered. Further, full descriptions are given in cases of diatoms appearing as new for India or for the Science. Likewise the illustrations are given but some others are redrawn to suggest an improved aspect, correction or some new feature of interest over the existing Indian records. In certain cases more than one illustration is given to suggest the range of variation noted within the species since this aspect relates to life-history phases of such diatoms.

The number of diatoms discovered from the present area, there are about 62.5% species already recorded from different parts of India by previous workers. Of such species it is proposed here to give a list with a view to be brief. It is also that with the exception of a few individuals they do not represent any special feature of interest. However, while listing up these species, it is felt desirable to represent them into categories on the basis of their frequency, occurrence and distribution as could be made out from the collection, thus:—

The following diatoms were found to be widespread or common in the area and they ranged up to the Jog-falls. These were mostly seen in large numbers, quite many of them were gregarious, in one or the other body of water. The list runs thus: *Synedra ulna* (Nitz.) Ehr., *S*—v. *amphihynchus* (Ehr.) Grun., *Achnanthes minutissima* Kütz., *A. exigua* Grun., *Stauroneis phaniceron* Ehr., *S*—f. *producta* Gandhi, *Navicula mutica* Kütz., *N. pupula* Kütz., *N*—v. *capitata* Hust., *N. cryptocephaloides* Hust. (Fig. 36, 53), *N. cari* Ehr. v. *angusta* Grun. (Fig. 14), *N. dicephala* (Ehr.) W. Sm. v. *sphaerophora* A. Cl. (Fig. 15), *Pinnularia interrupta* W. Sm. (Fig. 19), *P. viridis* (Nitz.) Ehr., *P*—v. *intermedia* Cleve, *Amphora ovalis* Kütz. v. *pediculus* Kütz., *Cymbella amphicephala* Naeg. (Fig. 41), *Gomphonema parvulum* (Kütz.) Grun., *G. lanceolatum* Ehr., *G. subapicatum* Frit. & Rich., *G. clevei* Fricke (Fig. 48), *Nitzschia palea* (Kütz.) W. Sm., *Surirella linearis* W. Sm. (Fig. 29), *S. tenera* Greg., *S*—v. *nervosa* A. S. and *S. subsalsa* W. Sm. All these diatoms ecologically either belong to lithophilous benthos or autophytic microphytic formation.

The diatoms, *Synedra ulna* (Nitz.) Ehr. v. *danica* (Kütz.) Grun., *Eunotia pectinalis* (Kütz.) Rabh. v. *gibbulosus* Venkat. (Fig. 33), *Caloneis silicula* (Ehr.) Cl., *C*—f. *recta* Jur. (= *C*—v. *interrupta* Venkat.),



TEXT-FIGS 1-18. Fig 1. *Eunotia camelus* (Grun.) Å. Berg v. *karveerensis* Gandhi. Fig 2. *Eunotia camelus* v. *ventricosa* Gandhi. Fig 3. *Neidium affine* (Ehr.) Cl. v. *longiceps* (Greg) Cl. Fig 4. *Neidium iridis* (Ehr.) Cl. Fig 5. *Neidium productum* (W Sm) Cl. v. *bombayensis* Gonzalves and Gandhi. Fig 6. *Neidium*

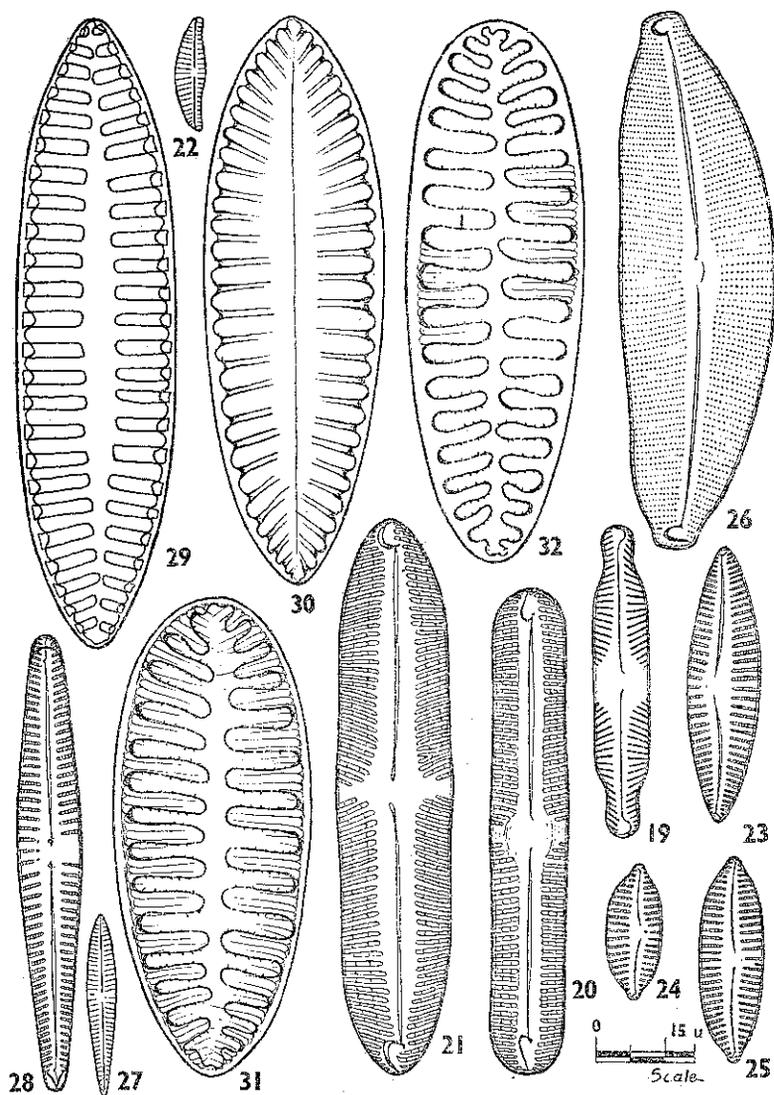
gracile Hustedt. Fig. 7. *Neidium capitellata* sp. nov. Fig. 8. *Neidium grandis* sp. nov. Fig. 9. *Diploneis elliptica* (Kütz.) Cl. Figs. 10-11. *Diploneis elliptica* v. *ladogensis* Cl. Fig. 12. *Stauroneis phanicerteron* Ehr. v. *cumenifera* (Mayer) Cl. Fig. 13. *Navicula cocconeiformis* Greg. v. *oblonga* v. nov. Fig. 14. *Navicula cari* Ehr. v. *angusta* Grun. Fig. 15. *Navicula dicephala* (Ehr.) W. Sm. v. *sphaerophora* A. Cl. Fig. 16. *Pinnularia graciloides* Hustedt. Fig. 17. *Pinnularia sagittata* sp. nov. Fig. 18. *Pinnularia mysorensis* sp. nov.

Neidium affine (Ehr.) Cl. v. *longiceps* (Greg.) Cl. (Fig. 3), *Navicula cuspidata* Kütz., *N*—v. *ambigua* (Ehr.) Cl., *Pinnularia acrosphaeria* (Bréb.) W. Sm., *P. microstauron* (Ehr.) Cl. v. *ambigua* Meister, *Gomphonema intricatum* Kütz. v. *vibrio* (Ehr.) Cl. (Fig. 46), *G. spicula* Gandhi (Fig. 50), *Epithemia zebra* (Ehr.) Kütz., *Rhopalodia gibba* (Ehr.) O. Müll. and *Nitzschia lorenziana* Grun. v. *subtilis* Grun., appeared in a smaller number and some as stray forms. This group element here is characteristic of bodies of water (fresh-water) other than streams and the rivulet, and the individual species occurred with benthos of the loose soil.

The following are the characteristic species of standing water in the rivulet and streams, since they seldom occurred elsewhere. Leaving a few of these, they were fairly represented in several pools, puddles and ditches. Of these species, *Eunotia pectinalis* (Kütz.) Rabh. v. *neglecta* Gandhi and *E. camelus* (Grun.) Å. Berg v. *karveerensis* Gandhi (Fig. 1), were planktonic or subplanktonic elements—occurring in free-floating chain or ribbon-like formations. *Caloneis silicula* (Ehr.) Cl., *Cymbella aspera* (Ehr.) Cl., *C. aspera?* (Fig. 45), *C. bengalensis* Grun. and *Surirella subsalsa* W. Sm., represent lithophilous benthos group since all these species were found to form slimy deposition on partially submerged rocks or loose stones. The diatoms, *Surirella linearis* W. Sm., *S. tenera* Greg., *S.*—v. *nervosa* A.S., *S. subsalsa* W. Sm. and *Nitzschia tryblionella* Hantz. v. *victoriae* Grun., appeared well in number with brownish masses of dead vegetable matter lying on loose soil (benthos of the loose soil); whereas, *Eunotia pectinalis* (Kütz.) Rabh. v. *neglecta?* (Fig. 34), *E. camelus* v. *ventricosa* Gandhi (Fig. 2), *Neidium productum* (W. Sm.) Cl. v. *bombayensis* Gonzal. and Gandhi (Fig. 5), *Pinnularia acrosphaeria* (Bréb.) W. Sm. and *P. angustefasciata* A. Cl. (Fig. 21), were represented as stray specimens.

Again, the diatoms: *Eunotia pectinalis* v. *gibbulosus* Venkat., *E.*—v. *neglecta* Gandhi, *Navicula cari* v. *angusta* Grun., *N. dicephala* v. *sphaerophora* A. Cl., *Pinnularia interrupta* W. Sm., *P. viridis* (Nitz.) Ehr., *P.*—v. *intermedia* Cleve, *Nitzschia tryblionella* v. *victoriae* Grun., *Surirella linearis* W. Sm. (Fig. 29), *S. tenera* Greg., *S.*—v. *nervosa* A. S. and *S. subsalsa* W. Sm. and a few others, are known mostly from several hilly districts of the Western Ghats as this zone has been a subject of the author's exploration. From the observations, two points become more or less apparent, viz (1) this element is probably characteristic of the hilly regions, and (2) the range of its distribution extends from Bombay-Salsette Islands down upto the Jog-falls.

Regarding all other diatoms notes are given under the individual species as it is being felt convenient.



TEXT-FIGS. 19-32 Fig. 19. *Pinnularia interrupta* W. Smith. Fig. 20. *Pinnularia cardinaliculus* (Cl.) Lund. Fig. 21. *Pinnularia angustefasciata* A. Cl. Fig. 22. *Cymbella javanica* Hustedt. Fig. 23. *Cymbella japonica* Reichelt. Figs. 24-25. *Cymbella sagarensis* sp. nov. Fig. 26. *Cymbella rivuleris* sp. nov. Fig. 27. *Gomphonema acuminatum* Ehr. v. *directum* A. Cl. Fig. 28. *Gomphonema tropicale* Brun. Fig. 29. *Surirella linearis* W. Sm. Fig. 30. *Surirella celebesiana* Hustedt. Figs. 31-32. *Surirella horrida* Hustedt f. *minor* f. nov.

A SYSTEMATIC ENUMERATION OF THE DIATOMS

1 *Eunotia pectinalis* v *gibbulosus* Venkat.

(Text-Fig. 33)

The illustration depicts a deformed valve noted in the collection. The deformity appears at one end which is much broader than the other and some striae are incompletely formed.

2 *Eunotia pectinalis* v. *neglecta* Gandhi

(Text-Fig. 34)

Gandhi, *Diat. Radhanagari*, 1957, 47, pl. 13, f. 3-5: Length 55-60 μ , breadth 6-7 μ and striae 14-15 in 10 μ .

Some slim looking forms of which the illustration is given occurred in the collection from this area which resembled the said type in shape and somewhat in range of dimensions. However, they tended to show two differences from the others and those recorded from Radhanagari material, viz., (1) the striae are closely and more uniformly set and (2) the raphe at the polar nodule seemed to be sharply bent or reflexed as seen in *E. pseudopectinalis* Hust. (Hustedt, *Diat. Sarek.*, 1924, 547, t. 18, f. 1; Cleve-Euler, *Diat. Schwed. Finn.*—II, 1953, 92, f. 418). But unfortunately due to paucity of the material studies could not be made with any certainty. Hence, such forms I treat under the said type till I get more material of the same.

3 *Caloneis silicula* (Ehr.) Cl. f. *recta* Jur.

Jurilj, A., *Diat. Ochrida Lake*, 1954, 144, f. 49 c; Venkataraman, G., *Diat. S. I.*, 1956, 4, f. 9 (= *C. silicula* v. *interrupta* Venkat.)

With *C. silicula* (Ehr.) Cl., some stray specimens also occurred having the central area widened to sides as illustrated by Venkataraman. From the study of these specimens and subsequent comparison with illustrations and descriptions given by Jurilj for *C. silicula* f. *recta* Jur. (described in 1952) and by Venkataraman for *C. silicula* v. *interrupta* Venkat. (described in 1956), I make out no difference whatsoever between these. Hence, according to rule of priority, I consider *C. silicula* v. *interrupta* Venkat. to be *C. silicula* f. *recta* Jur. The dimensions recorded of the local forms are: length 20-30 μ , breadth 5-6 μ and striae 18-20 in 10 μ .

4 *Neidium affine* (Ehr.) Cl. v. *longiceps* (Greg.) Cl.

(Text-Fig. 3)

Gandhi, *Soil Diat. Kolhapur*, 1956, 403, f. 1: Length 33-40 μ , breadth 6-6-7 μ and striae 26-28 in 10 μ .

The specimens from this region show larger dimensions and somewhat capitate ends than those recorded from Kolhapur region.

5 *Neidium iridis* (Ehr.) Cl

(Text-Fig 4)

Hustedt, *Bacil.*, 1930, 245, f. 379; Cleve-Euler, A., *Diat. Schwed Finn.*—IV, 1955, 119, f. 1174 *a-b* (= *N. iridis* v. *genuina* May. f. *major* A. Cl); Donkin, *Brit. Diat.*, 1871–73, 30, pl. 5, f. 6 (= *Navicula iridis* Ehr.); Van Heurck, *Treat. Diat.*, 1896, 220, pl. 5, f. 212 (= *Nav. iridis* Ehr.): Valves 86–132 μ long and 18–24 \cdot 2 μ broad, linear-elliptical with more or less broadly rounded ends. Raphe thick with central pores bent in opposite directions and terminal fissures bifurcated. Axial area narrowly linear, somewhat widened in between; central area fairly large, somewhat obliquely elliptical or subrounded. Striæ 16–18 in 10 μ , clearly punctate, slightly obliquely disposed in the middle and convergent at the ends, crossed by a few longitudinal furrows near the margins.

Hustedt indicates in his illustration rather more narrowed apices due to which the outline appears lanceolate-elliptical. The specimens observed from this area are distinctly like those illustrated by Donkin, Van Heurck and Cleve-Euler.

This species was collected in a good number from among the Podostemad encrustations and some pools and puddles in the rivulet. It occurred as lithophilous benthos as well as the benthos of the loose soil. It is a very conspicuous diatom being large and robust. Moderately distributed in the region.

6. *Neidium productum* (W Sm.) Cl v. *bombayensis* Gonzal and Gandhi

(Text-Fig 5)

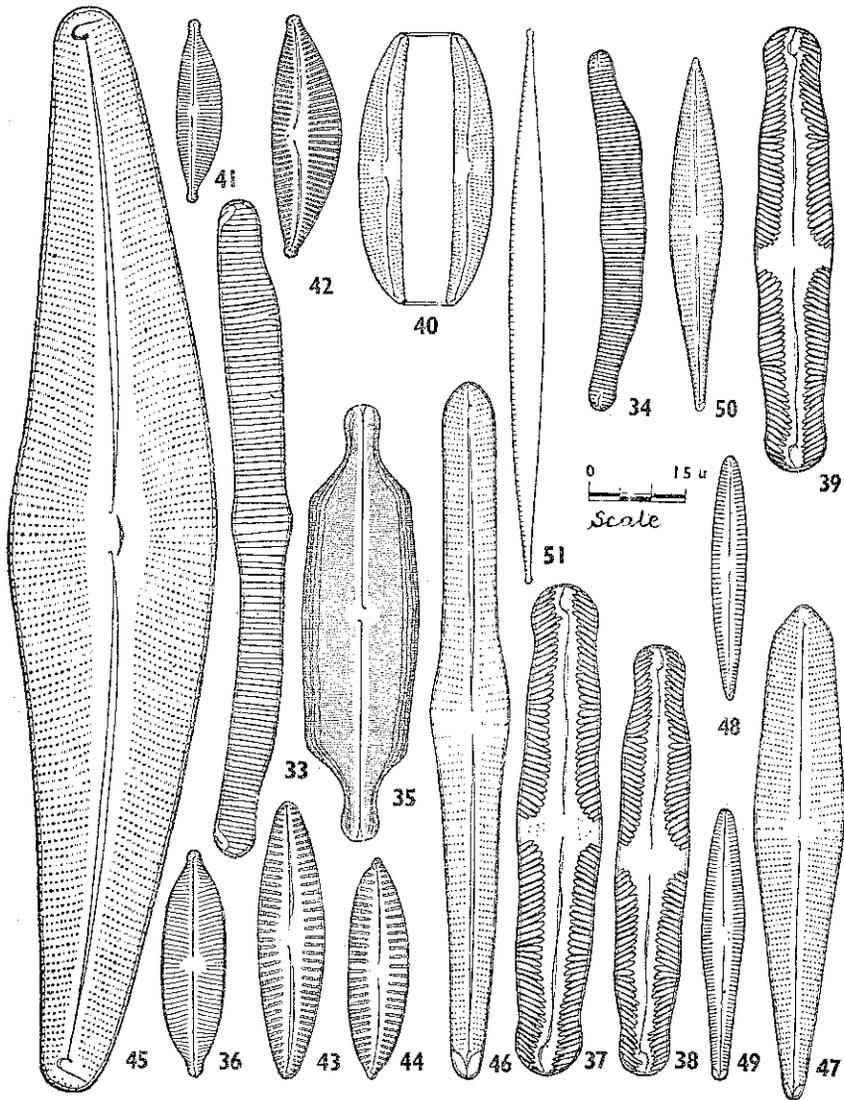
Gonzalves and Gandhi, *Diat. Bom. Sals.*—II, 1953, 250, f. 81: Length 68–83 \cdot 6 μ , breadth 18–22 μ and striæ 20–22 in 10 μ .

The specimens collected from this region show a smaller range of dimensions and somewhat less produced apices than those recorded from Bombay and Salsette Islands.

7 *Neidium gracile* Hustedt

(Text-Fig 6)

Hustedt, *Diat. Sunda-Exped.*, 1938, 406, t. 16, f. 8–9: Valves 44–60 \cdot 5 μ long and 10–13 \cdot 2 μ broad, linear, sides clearly triundulate with somewhat abruptly narrowed, gracefully produced, cuneate rounded ends. Raphe thin and straight with central pores bent in opposite directions and terminal fissures bifurcated. Axial area narrow, linear; central area quite large, rounded or feebly obliquely elliptical. Striæ 20–22 in 10 μ , clearly punctate, slightly obliquely set in the middle and convergent at the ends, crossed by a few longitudinal furrows near the margins.



TEXT-FIGS. 33-51. Fig. 33. *Eunotia pectinalis* (Kütz.) Rabh. v. *gibbulosus* Venkat. Fig. 34. *Eunotia pectinalis* v. *neglecta* Gandhi. Fig. 35. *Neidium capitellata* sp. nov. Fig. 36. *Navicula cryptocephaloides* Hustedt. Figs 37-39. *Pinularia graciloides* Hustedt. Fig. 40. *Amphora ovalis* Kütz. v. *affinis* Kütz. Fig. 41. *Cymbella amphicephala* Naeg. Fig. 42. *Cymbella affinis* Kütz. Fig. 43. *Cymbella japonica* Reichelt. Fig. 44. *Cymbella sagarensis* sp. nov. f. *gracilis* f. nov. Fig. 45. *Cymbella aspera* (Ehr.) Cl. Fig. 46. *Gomphonema intricatum* Kütz. v. *vibrio* (Ehr.) Cl. Fig. 47. *Gomphonema lanceolatum* Ehr. f. *turris* (Ehr.) Hustedt. Fig. 48. *Gomphonema clevei* Fricke. Fig. 49. *Gomphonema clevei* v. *bipunctata* v. nov. Fig. 50. *Gomphonema spicula* Gandhi. Fig. 51. *Nitzschia pseudogracilis* sp. nov.

This species was seen in a small number in brownish stuff formed with Podostemad encrustations in the rivulet. Elsewhere in the locality not seen. It is interesting that this species appears like *N hitchcockii* (Ehr.) Cl. [Cleve-Euler, *Diat. Schwed Fimm.*—IV, 1955, 116, f. 1169 a; Donkin, *Brit. Diat.*, 1871-73, 29, pl. 5, f. 4 (= *Navicula hitchcockii* Ehr.)], and it is known only from Java, Bali and Sumatra islands, therefore, its occurrence in India extends the geographical limits.

8. *Neidium capitellata* sp. nov.

(Text-Figs. 7, 35)

Valvæ 46-86 μ longæ atque 10-23 μ latæ, lineares-ellipticæ, ad margines paululum triundulatæ atque apicibus abrupte constrictis, producto-rotundato-capitatis. Raphe tenuis et recta, ornata poris centralibus inclinata in directione contraria ac fissuris terminalibus bifurcatis. Area axialis angusta-linearis ac paululum dilatata in medio; area centralis ampla, rotundata. Striæ 26-28 in 10 μ , subtiliter punctatæ sed distincte, radiales in medio ac paululum convergentes ad apice, sulcis longitudinalibus paucibus interruptæ ad margines.

Valves 46-86 μ long and 10-23 μ broad, linear-elliptical with feebly triundulate sides and abruptly narrowed, produced, capitate rounded ends. Raphe thin and straight with central pores bent in opposite directions and terminal fissures bifurcated. Axial area narrow, linear and somewhat widened in between; central area fairly large and rounded. Striæ 26-28 in 10 μ , finely but distinctly punctate, radial in the middle and very slightly convergent at the ends, crossed by a few longitudinal furrows near the margins.

This species shows some resemblance with *N. productum* v. *bombayensis* Gonzal. and Gandhi, described above in its outline, central and axial areas. However, it differs from it in having capitate ends. Moreover, the striæ are much denser and more finely punctate. Further, the middle striæ are not at all obliquely disposed as could be discerned by actual comparison. It is, therefore, regarded as a new species.

This species was observed in Podostemad encrustations in running water of the rivulet forming slimy films. It also occurred in some pools and puddles cluttered with brownish masses of matter. Stray specimens also were seen in a pond. Fairly distributed in the locality. This form was also collected from Lonavla Hill-station from similar habitats as well as from some clusters of wet liverworts, some years ago. Slide no. 750.

9. *Neidium grandis* sp. nov.

(Text-Fig. 8)

Valvæ 45-55 μ longæ atque 14-14.5 μ latæ, lineares-ellipticæ, marginibus paululum convexo, apicibus abrupte constrictis in leviter inflexo atque distincte producto-rotundatis. Raphe tenuis et recta, poris centralibus distincte inclinata in directione contraria ac fissuris terminalibus bifurcatis. Area axialis angusta, linearis; area centralis

ampla, elliptica vel rotundata Striæ 26–28 in 10μ , subtiliter punctatæ, radiales, sulcis longitudinalibus paucibus interruptæ ad margines

Valves 45–55 μ long and 14–14.5 μ broad, linear-elliptical, margins feebly convex, towards the ends abruptly narrowed in a smooth arch into narrowed rounded ends distinctly produced Raphe thin and straight with central pores distinctly bent in opposite directions and terminal fissures bifurcated Axial area narrow, linear; central area fairly wide, elliptical to rounded Striæ 26–28 in 10μ , finely punctate and radial, crossed by some longitudinal furrows near the margins

This diatom is curious in that it does not exactly resemble, (1) *Neidium dubium* (Ehr.) Cl. (Hustedt, *Bacil.*, 1930, 246, f. 384; Jutilj, *Diat. Ochrida Lake*, 1954, 143, f. 47 c-d; Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 116, f. 1170 a-d (= *N. dubium* v. *genuinum* Mayer); Van Heurck, *Treat. Diat.*, 1896, 221, pl. 5, f. 215 (= *Navicula dubia* Ehr.); Donkin, *Brit. Diat.*, 1871–73, 30, pl. 5, f. 5 (= *Nav. dubia* Ehr.); (2) *Neidium productum* (W. Sm.) Cl. (Hustedt, *op. cit.*, 245, f. 383; Cleve-Euler, *op. cit.*, 118, f. 1171 a-c; Tiffany and Britton, *Alg. Illinois*, 1952, 263, pl. 71, f. 820 [= *N. productum* (W. Sm.) Pfit.]; or (3) *Neidium bruunii* Foged (Foged, N., *Diat. Rennell Isl.*, 1957, 61, pl. 5, f. 7), although it has a shape similar to all these three species. The apices in the forms collected here are more produced, narrower and prominent than in *N. dubium*. These forms are comparatively larger with larger central area and greater number of striæ, thus they differ from *N. dubium*. With *N. productum*, they differ in having more abruptly narrowed and less produced ends besides having dense, finely punctate striæ and the striæ not at all obliquely set in the middle part. In this way the forms in question also differ from *N. productum*. The *Neidium bruunii* strongly resembles in shape and narrowly rostrate-rounded apices, but differs in dimensions, central area and widely set striæ (dimensions recorded by Foged for *N. bruunii* are: length 33 μ , breadth 13 μ and striæ 15–16 in 10μ), hence the present forms cannot be compared with this species also.

The material collected from Bombay and Salsette Islands (Gonzalves and Gandhi, 1953), had also yielded these forms along with *N. dubium*, and on comparison they were found to be markedly different in apices, i.e., apices in *N. dubium* were broad and shortly rostrate, besides the striæ being less denser than those found in other forms which were like the present species. Such forms were then not entertained for want of clear understanding, but now they are considered to be a new species in light of the above-mentioned facts. However, it can be said that *N. dubium*, *N. productum*, *N. bruunii* and *N. grandis*, i.e., the present species, have more or less a similar outline.

This species was collected in a good number from encrustations formed by Podostemads and some Myxophyta. It was also seen in samples from pools, puddles and ditches in the rivulet, mixed up in brownish masses of dead vegetable matter. Common in the locality and noted up to the Jog-falls Slide no. 751

10. *Diploneis elliptica* (Kütz.) Cl

(Text-Fig. 9)

Hustedt, *Bacil.*, 1930, 250, f. 395; Cleve-Euler, *Diat. Schwed. Finn.*—III, 1953, 78, f. 646 b (= *D. elliptica* v. *genuina* Meister); Van Heurck, *Treat. Diat.*, 1896, 201, pl. 4, f. 156 (= *Navicula elliptica* Kütz.); Donkin, 1871-73, 7, pl. 1, f. 6 a-b (= *Nav. elliptica*): Valves 20-40 μ long and 11-15 μ broad, elliptical to slightly rhombic-elliptical. Raphe between the ribs, ribs widened in the central nodule. Axial area very narrow, central area slightly inflated. Furrows narrow, widened in the middle, lanceolate. Costæ 10-13 in 10 μ , radial at the ends, alternating with a single row of coarse punctæ (alveoli).

This species was well represented in the locality particularly in encrustations of Podostemads. It was also found in various other pools and puddles there in the rivulet. Some miscellaneous samples of algæ also contained it but sparingly. Well distributed up to the Jog-falls.

11. *Diploneis elliptica* v. *ladogensis* Cl.

(Text-Figs. 10-11)

Hustedt, *Bacil.*, 1930, 250, f. 396; Skvortzow, *Diat. Kizaki Lake*, 1937, 32, pl. 2, f. 3, 6; Cleve-Euler, *Diat. Schwed. Finn.*—III, 1953, 78, f. 646 A, b-c: Valves 23-51 \cdot 4 μ long and 12-24 \cdot 2 μ broad, elliptical to rhombic-elliptical. Raphe between the ribs, ribs widened in the central nodule. Axial area very narrow, central area slightly dilated, quadrate to elliptical. Furrows separating 1-2 alveoli from the rest, narrowly lanceolate and dilated in the middle. Costæ about 9 in 10 μ (8-9 \cdot 5 in 10 μ), radial at the ends, alternating with a single row of very coarse punctæ or alveoli, alveoli 8-9 in 10 μ , alveoli somewhat irregularly arranged due to which longitudinal ribs become irregular.

This diatom was observed in several collections from the rivulet, occurring both in Podostemad encrustations as well as in pools and puddles. It was found either in association of the above species or independently forming local colonies. Fairly well distributed in the area upto the Jog-falls.

12. *Stauroneis phanicenteron* Ehr. v. *crumenifera* (Mayer) Cl.

(Text-Fig. 12)

Cleve-Euler, *Diat. Schwed. Finn.*—III, 1953, 210, f. 944 h-i: Valves 122-156 μ long and 19-22 rarely 24 μ broad, narrow rhombic-lanceolate with scarcely produced somewhat blunt ends. Raphe thick with conspicuous central pores and slightly curved terminal fissures. Axial area narrow, linear; central area a linear stauros with short striæ. Striæ 18-20 in 10 μ , clearly punctate, punctæ fine, striæ strongly radial towards the apices.

This diatom was represented in a good number primarily in some pools and puddles in the rivulet, mixed up with brownish slimy matter and secondarily in encrustations on the wet rocks. Some stray specimens were also seen in a pond and a slowly flowing watercourse.

13 *Navicula cocconeiformis* Greg v. *oblonga* v. nov.

(Text-Fig 13)

Valvæ 20–26 μ longæ atque 8–8.5 μ latæ, oblongo-ellipticæ Raphe tenuis et recta, poris centralibus distincte atque fissuris terminalibus curvatis Area axialis angustissima; area centralis minuta, elliptica Striæ 18–24 in 10 μ , tenues, ubique radiales, striæ longæ ac brevis alternare in medio.

Valves 20–26 μ long and 8–8.5 μ broad, oblong-elliptical. Raphe thin and straight with central pores distinct and terminal fissures curved. Axial area very narrow; central area small and elliptical. Striæ 18–24 in 10 μ , fine, radial throughout, long and short striæ alternate in the middle.

This diatom differs from *N. cocconeiformis* Greg (Hustedt, *Bacil.*, 1930, 290, f. 493), in having oblong-elliptical outline. It is referred to the said type since its middle striæ are similarly arranged though they are slightly fewer in number. Another similar looking form is *N. limatoides* Hust (Hustedt, *Diatomfl. norddeut. Seen*, 1950, 350, t. 38, f. 34–35), but in this form the striæ are distantly set and the middle striæ, though some are short, do not regularly alternate as seen in the present species. Since, the present diatom compares well with *N. cocconeiformis* in arrangement of the middle striæ, it is hence considered to be its new variety.

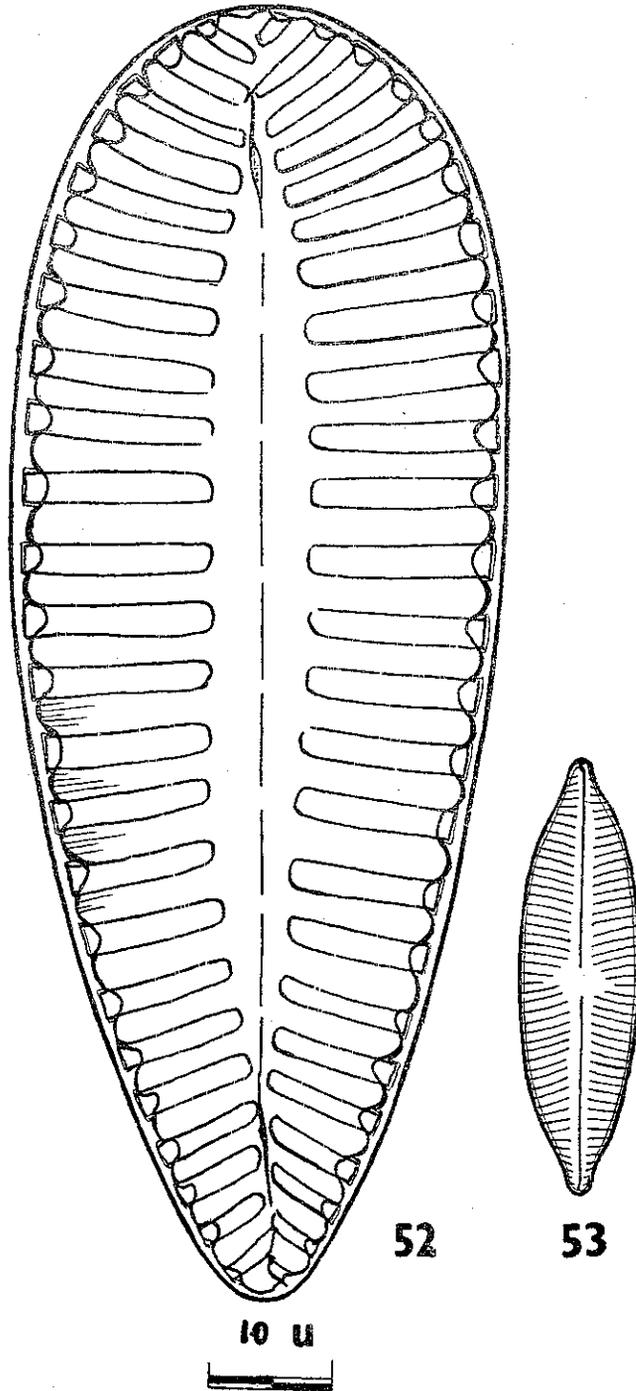
This diatom was collected from some pools and puddles in the rivulet occurring there with brownish masses of slimy matter. In Podostemad encrustations, it was seen as a stray form. It occurred only in about 15% of samples. Slide no 748.

14 *Navicula cryptocephaloides* Hust.

(Text-Figs 36, 53)

Hustedt, *Diat. Sunda-Exped*, 1938, 261, t. 18, f. 1–2; Gandhi, *Diat. Hirebhasgar-dam*, 1957, 257, f. 12 (= *N. rostellata* Kütz.): Valves 30–40 μ long and 8–10 μ broad, linear-lanceolate with somewhat abruptly constricted, produced rounded ends. Raphe thin and straight with terminal fissures curved. Axial area narrow, linear; central area fairly wide, rounded or slightly quadrate. Striæ 12–14 in 10 μ , lineate, slightly radial in the middle and convergent at the ends.

With the availability of Hustedt's monograph on Java, Bali and Sumatra Diatoms and occurrence of diatoms looking similar to those described as *N. rostellata* Kütz., with hesitation, from the Hirebhasgardam area, it became imperative to re-examine them. As a consequence of the re-examination, it was realized that present specimens as well as *N. rostellata* from the Hirebhasgar-dam area could be referable to *N. cryptocephaloides* Hust. This is being done here. The number of striæ 10–14 in 10 μ , recorded for Hirebhasgar specimens, should be noted as 12–14 in 10 μ .



TEXT-FIGS. 52-53. Fig 52 *Swirella capronioides* sp nov Fig 53 *Navicula cryptocephaloides* Hust

15. *Pinnularia graciloides* Hustedt

(Text-Figs. 16, 37-39)

Hustedt, *Diat. Sunda-Exped.*, 1938, 293, t. 22, f. 9-10; *Diat. Wallacea-Exped.*, 1942, 82, f. 155-58; *Diat. Tobasees Sumatra*, 1936, 159, t. 2, f. 13 (= *P. gracilis* Hust): Valves 66-120 μ long and 11-13 μ broad, linear, sides triundulate sometimes more bulged in the middle with capitate rounded ends. Raphe thin or thick, somewhat undulate to appear complex with unilaterally bent central pores and bayonet-shaped terminal fissures. Axial area fairly wide, linear about $\frac{1}{2}$ - $\frac{1}{4}$ the width of the valve; central area large, rhomboid, reaching the sides, in larger specimens some irregular markings or punctæ are seen on either sides of the central nodule or towards the margins. Striæ 9-11 in 10 μ , somewhat thick and closely set, strongly radial in the middle and convergent at the ends.

Hustedt has described this species from Sumatra region as *P. gracilis* which does not show scattered punctæ in the central area, while other specimens collected by him from Java, Bali and Sumatra islands and Indo-Malaya Archipelago region, are described and illustrated to have some scattered punctæ in the central area, at least in some cases. In addition to this, the original name *P. gracilis* is changed to *P. graciloides* for the reason of two such names already existing in the literature. Also with more detailed observations, particularly of Indo-Malayan material, the larger length is registered which now becomes from a maximum of 85 μ to 125 μ . The raphe in the original illustration was shown to be thin but undulate (hence complex), is now indicated to be complex in material from Sunda- and Wallacea-expeditions. While considering *P. gibba* Ehr. f. *subundulata* Mayer (Hustedt, *Bacil.*, 1930, 327, f. 601), the outline is remarkably similar as also the range of dimensions and the arrangement of striæ. The only differences which could be pointed out are: (1) the raphe is very straight in *P. gibba* f. *subundulata* with approximate central pores and curved terminal fissures, (2) the striæ though practically the same in number are not set so closely in *P. gibba* f. *subundulata*. Cleve-Euler refers *P. gibba* f. *subundulata* to *P. stauoptera* (Rabh.) Cl. v. *longa* A. Cl. (Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 67, f. 1091 *g-i*), but the illustrations given do not compare well with that of Hustedt's. With these considerations and the material at my disposal, I consider my specimens fitting well with *P. graciloides*, and so they are treated. The point, of punctæ being absent on either side of the central nodule in some of the present forms is treated as an exception, since such specimens have been recorded by Hustedt also.

This species was collected in a good number from several bodies of fresh-water found in the region. It was specially more frequent in pools and puddles in the rivulet, where it occurred in brownish masses of matter (as a benthos of loose soil). It is a common diatom in the locality.

16. *Pinnularia interrupta* W. Sm.

(Text-Fig. 19)

The species collected from this region show a wider range of dimensions: length 34–52·8 μ , breadth 6·6–8·2 μ , than those recorded from the Hirebhasgar-dam area. Moreover, the apices are only slightly capitate.

17. *Pinnularia sagittata* sp. nov.

(Text-Fig. 17)

Valvæ 90–95·8 μ longæ atque 12·5–13 μ latæ, sublineares, marginibus aliquantum sed distincte triundulatæ, apicibus distincte constrictis, acuto-cuneatæ, capitatæ. Raphe tenuis, aliquantum undulata vel subcomplexa, ornata poris centralibus proximæ positæ cum paulum unilateraliter inclinata atque fissuris terminalibus paulum curvatis. Area axialis ampla, circiter $\frac{1}{4}$ latitudinis valvæ, linearis vel sublinearis; area centralis magna, rhomboidea, parva versus ad margines perveniens. Striæ 10–12 in 10 μ , aliquantum crassa, radiales in medio ac in utroque apice convergentes.

Valves 90–95·8 μ long and 12·5–13 μ broad, sublinear with weak but distinct triundulate sides and distinctly narrowed, acutely-wedge-shaped capitate ends. Raphe thin but somewhat undulate or subcomplex with closely set central pores unilaterally bent and weakly curved terminal fissures. Axial area fairly wide, about $\frac{1}{4}$ the width of the valve, linear or sublinear; central area large, rhomboid, narrowly reaching the sides. Striæ 10–12 in 10 μ , slightly thick, radial in the middle and convergent at the ends.

This species resembles *P. stauoptera* Grun., described and illustrated by Berg. (Berg, *Diat. Sophia-Exped.*, 1945, 17, t. 5, f. 175) and Cleve-Euler [Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 67, f. 1091 d–e (= *P. stauoptera* v. *clevei* Meister)], in having acutely-wedge-shaped capitate ends, but in no other details. There are no other similar forms known from the literature, hence it is considered tentatively as a new species.

This species was collected from pools and ditches in the rivulet where it occurred in brownish masses of matter, in a small number. Some stray specimens also were recorded from *Podostemad* encrustations. It is rare in the locality. Slide no. 752.

18. *Pinnularia cardinaliculus* (Cl.) Lund.

(Text-Fig. 20)

Lund, J. W. G., *Brit. Alg.*, 1950, 281–84, f. 1 A–I: Valves 72·2–90 μ long and 12·2–15 μ broad, linear with very weakly inflated middle part and broadly rounded ends. Raphe slightly thickened and straight with central pores unilaterally bent and terminal fissures clearly curved, bayonet-shaped. Axial area fairly wide, $\frac{1}{4}$ – $\frac{1}{3}$ the width of the valve; central area quite large reaching the sides. Striæ 8–9 in 10 μ , thick

with faint narrow longitudinal band, radial in the middle and convergent at the ends

This species was seen in pools and puddles in the rivulet along with the above type. It occurred either singly or in short catenate colonies formed in pale brown matter (probably a benthos of the loose soil). A few stray specimens were also recorded from a pond. Sparingly distributed in the locality. It is also recorded from the Jog-falls

19. *Pinnularia angustefasciata* A. Cl.

(Text-Fig. 21)

The specimens recorded from this region are somewhat broader ($17.6\ \mu$ broad) than those recorded from Mugad. Also the apices are more clearly cuneate.

20. *Pinnularia mysorensis* sp. nov.

(Text-Fig. 18)

Valvæ $82.5-110\ \mu$ longæ atque $15.6-18\ \mu$ latæ, lineares, paulum dilatata in medio, apicibus late rotundata. Raphe crassa, distincte complexa, ornata poris centralibus unilateraliter inclinata ac fissuris terminalibus crassa ac semicirculares. Area axialis lata, $\frac{1}{4}-\frac{1}{3}$ latitudinis valvæ; area centralis ampla, parva versus ad margines perveniens. Striæ 7-8 in $10\ \mu$, crassa, radiales in medio ac convergentes in utroque apice, evoluta vittæ longitudinalibus angusta cum languida.

Valves $82.5-110\ \mu$ long and $15.6-18\ \mu$ broad, linear with slightly dilated middle part and broadly rounded ends. Raphe thick, clearly complex with central pores unilaterally bent and terminal fissures thick and clearly semicircular. Axial area fairly large, $\frac{1}{4}-\frac{1}{3}$ the width of the valve; central area large but narrowly reaching the sides. Striæ 7-8 in $10\ \mu$, thick, radial in the middle and convergent at the ends, longitudinal bands present, narrow and faint.

This species resembles *P. hartleyana* Grev. (Mills, *Diat. Warri*, 1932, 390, pl. 2, f. 17), in the outline, but greatly differs in dimensions ($230-66 \times 30-37\ \mu$ and striæ?). Moreover, the raphe is not indicated to be complex due to which the comparison is difficult. Another similar looking species is *P. rivularis* Hust. [Hustedt, *Diat. Tobasees Sumatra*, 1936, 160, t. 5, f. 35 (dimensions $70-85 \times 10-12\ \mu$; striæ 9 in $10\ \mu$); *Diat. Sunda-Exped.*, 1938, 393, t. 23, f. 3; *Diat. Wallacea-Exped.*, 1942, 207, f. 166, which agrees in the outline and somewhat in range of dimensions of the present diatom. However, the present forms have distinctly complex raphe and closely set striæ having longitudinal bands though narrow and faint. Hustedt does not indicate such a kind of raphe in his specimens from the Sunda-expedition and Sumatra material, but his Indo-Malayan forms are shown to have thick simple raphe. Moreover, *P. rivularis* is being referred to the "Distantes" group, which suggests and shows the striæ to be very thick or distantly set from one another. In these characters the present specimens differ

Further, they do not show any closeness with any other species of *Pinularia*, hence they are considered to be a new species.

This species was collected from pools and puddles in the rivulet where it occurred in brownish masses of dead vegetable matter in a good number. A few stray or isolated specimens also were recorded from Podostemad encrustations and a pond Slide no 755.

21. *Amphora ovalis* Kütz v. *affinis* Kütz

(Text-Fig 40)

Van Heurck, *Treat. Diat.*, 1896, 127, pl. 1, f. 17; Jutilj, *Diat. Ochrida Lake*, 1954, 147, f. 56 c: Frustules 44–56 μ long and 22–24 μ broad, linear-elliptical with truncate ends in girdle view. Valves 6–6.5 μ broad, lunate with ventral side slightly inflated in the middle and narrowed rounded ends. Raphe thin, arcuate with central pores reflexed towards the dorsal side in a graceful arc, terminal fissures ventrally bent. Axial area very narrow; central area large, reaching the ventral side, on the dorsal side quadrate, bounded by striae. Striae 14–16 in 10 μ , radial on the dorsal side and on the ventral side radial in the middle and convergent at the ends, striae clearly lineate, lineations irregularly arranged due to which several longitudinal lines of irregular nature appear evidently.

This diatom was collected from a pond in good number, but it was more frequent in pools and puddles in the rivulet embedded in brownish masses of matter. It is probably a benthos of the loose soil. Its range of distribution found up to the Jog-falls. It is also recorded from Kolhapur.

22. *Cymbella amphicephala* Naeg

(Text-Fig 41)

Hustedt, *Bacil.*, 1930, 355, f. 651; Voigt, *genre Cymbella*, 1943, 6, pl. 1, f. 11; Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 151, f. 1223 *a-b* (= *C. amphicephala* v. *genuina* Mayer): Valves 30–34 μ long and 8–8.5 μ broad, asymmetrical, semilanceolate, ventral side slightly convex in the middle, ends constricted and produced capitate. Raphe thin and very straight and terminal fissures dorsally bent. Axial area very narrow; central area very small. Striae 13–14 in 10 μ on the dorsal side and 14–16 in 10 μ on the ventral side, very slightly radial and not at all coarsely, clearly punctate.

This species has been described in the Indian literature, but for the certain obvious reasons it has been redescribed and illustrated.

23. *Cymbella affinis* Kütz.

(Text-Fig 42)

Hustedt, *Bacil.*, 1930, 362, f. 671; Skvortzow, *Diat. Kizaki Lake*, 1937, 49, pl. 11, f. 9–10; Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 158, f. 1242: Valves 35–38 μ long and 10–11 μ broad, asymmetrical,

dorsal side highly convex, ventral side slightly convex; ends constricted, rostrate to subcapitate. Raphe slightly thick, arcuate with terminal fissures dorsally bent. Axial area narrow, sublinear; central area distinct with a stigma on the ventral side. Striæ 10–14 in 10μ , radial, distinctly punctate, striæ somewhat closer at the ends.

This species was collected from some pools and puddles in the rivulet where it occurred in brownish masses of dead vegetable matter. A few stray specimens were also seen in other samples. Not common in the area.

24. *Cymbella javanica* Hustedt

(Text-Fig 22)

Hustedt, *Diat. Sunda-Exped.*, 1938, 424, t. 25, f. 1–3: Valves 13–18 μ long and 4–4.5 μ broad, asymmetrical with more strongly convex dorsal side than the ventral side, ends constricted, somewhat produced, rounded and ventrally bent. Raphe thin and straight with small terminal fissures. Axial area quite narrow; central area little expanded. Striæ 11–13 in 10μ , radial and somewhat closely set at the ends.

This species was found abundantly growing in several pools and puddles in the rivulet as benthos of the loose soil. In Podostemad encrustation it seemed to form thin films of pale brown hue (benthos—lithophilous). Well distributed in the area and up to the Jog-falls.

25. *Cymbella japonica* Reichelt

(Text-Figs 23, 43)

Skvortzow, *Diat. Kizaki Lake*, 1937, 49, pl. 10, f. 4; pl. 11, f. 1, 7; Hustedt, *Diat. Sunda-Exped.*, 1938, 419, t. 25, f. 20; Fukushima, *Diat. Oze*, 1954, 613, f. 6 C: Valves 38.5–46 μ long and 10–12 μ broad, subsymmetrical, lanceolate, dorsal side slightly more convex than the ventral, ends acute to obtusely rounded. Raphe thick, slightly arcuate with central pores ventrally bent and terminal fissures dorsally directed. Axial area moderately wide, lanceolate; central area fairly large, more widened on the ventral side with an isolated stigma. Striæ 7–8 in the middle on the dorsal side otherwise 9–10 in 10μ , coarse and clearly lineate, radial throughout or probably perpendicular to the middle line towards the ends.

This species was collected in abundance from all the region from Sagar to the Jog-falls. It mostly occurred in encrustations formed by Podostemads, mosses and liverworts growing on wet rocks. It is mostly a lithophilous benthos. It is so far known from Japan, Java, Bali and Sumatra Islands. Its find in Indian region makes extension of the geographical distribution.

26. *Cymbella sagarensis* sp. nov.

(Text-Figs. 24–25)

Valvæ 19–38 μ longæ atque 8–10 μ latæ, subsymmetrice, margine dorsali plusculum convexo quam ventrali, in medio paulum recta;

apicibus abrupte constrictis, brevi-rostrato, acuto-rotundatæ. Raphe tenuis vel crassa, leniter centrica, poris centralibus ventrali inclinata, fissuris terminalibus ad marginem dorsalem versus flexis. Area axialis lata, linearis; area centralis latere ventrali dilatata cum uno punctum distincta. Striæ 8-10 in 10μ , aliquantum radiales ac distincte lineatæ.

Valves 19-38 μ long and 8-10 μ broad, subsymmetrical, dorsal side slightly more convex than the ventral, somewhat straight in the middle with abruptly narrowed, shortly rostrate, acutely rounded ends. Raphe thin or coarse, slightly arcuate and almost central. Axial area fairly wide, linear; central area on the ventral side dilated with a distinct stigma. Striæ 8-10 in 10μ , slightly radial and distinctly lineate.

This species appears to be a distinctive one and does not agree with any similar looking forms in the literature. It is, therefore, considered to be a new species.

This species was collected from a large number of pools, puddles and ditches in the rivulet. It also occurred in encrustations formed by Podostemads and some Myxophyta. In other bodies of fresh-water, it occurred but in smaller numbers. Well represented in the area and also recorded from the Jog-falls. It is probably a benthos of the loose soil as well as of the rocks and stones. Side no. 756

27. *Cymbella sagarensis* f. *gracilis* f. nov.

(Text-Fig. 44)

Valvæ 33-35 μ longæ atque 8-9 μ latæ, subsymmetrice, elliptico-lanceolatæ, apicibus paulum constrictis, rostratis. Striæ 8-9 in 10μ radiales ac distincte lineatæ. In coeteris ut typus

Valves 33-35 μ long and 8-9 μ broad, subsymmetrical, elliptical-lanceolate with slightly constricted rostrate ends. Striæ 8-9 in 10μ radial and distinctly lineate. In all other details like the type.

This diatom is a graceful looking one on account of a smooth dorsal arch. It was collected along with the above type but in a smaller number. Slide no. 756-57.

28. *Cymbella aspera* (Ehr.) Cl.

(Text-Fig. 45)

Length 90-170 μ , breadth 24-30 μ , striæ 7-9 in 10μ and the punctæ of the striæ 13-15 in 10μ .

The form illustrated in my paper on Partabgarh Diatoms, is probably *C. bengalensis* Grun. (Voigt, *genre Cymbella*, 1943, 11, pl. 2, f. 1; Skvortzow, *Diat. Philippines*, 1937, 292, pl. 2, f. 9). This I refer to, because the ventral side is distinctly more or less uniformly convex and it has comparatively finer punctæ of the striæ. The other specimens collected from this region agree well with illustration given by Cleve-Euler [Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 166, f. 1256 a-c (= *C. aspera* v. *genuina* A. Cl.) and Iyengar and Subrahmanyam (= *Fossil Diat.*, 1943, 232, f. 25-26)] for *C. aspera*.

The illustration, which I presently give for *C. aspera*, shows a strong resemblance with *C. aspera* v. *elongata* Skv. (Skovtsov, *Diat. N. Manchuria*, 1928, 46, pl. 4, f. 4) (dimensions: 192–340 × 37–45 μ , striæ 8–9 in 10 μ and punctæ 12–15 in 10 μ), on account of a strong inflation on the ventral side which appears quite out of line connecting the apices. Thus, the form agrees well with *C. aspera* v. *elongata* Skv., except for the dimensions. However, I refer this illustrated form to *C. aspera* only, because of the paucity of the material.

29. *Cymbella rivularis* sp. nov.

(Text-Fig. 26)

Valvæ 68–102 μ longæ atque 22–26 μ latæ, asymmetricæ, margine dorsali valde convexa, ventrali inflata, recta vel paulum convexa cum leniter sed distincte triundulata; apicibus constrictæ ac brevi-rostrato-subtruncatæ. Raphe crassa, arcuata, excentrica vel leniter excentrica, poris centralibus distincte ventrali inclinata, fissuris terminalibus ad marginem dorsalem versus flexis. Area axialis modice, sublinearis; area centralis paulum unilateraliter dilatata. Striæ latere dorsali 8–9 in 10 μ in medio ac in utroque apice 9–11 in 10 μ , striæ latere ventrali 9–10 in medio ac 10–12 in 10 μ in utroque apice, ubique radiales, clare punctatæ, punctis 16–18 in 10 μ , punctæ latere dorsali crassa quam latere ventrali.

Valves 68–102 μ long and 22–26 μ broad, asymmetrical, dorsal side strongly convex and ventral side inflated, straight or slightly convex with feeble but distinct triundulations; ends constricted, shortly rostrate and truncate. Raphe thick, arcuate, excentric to slightly excentric with central pores distinct and ventrally bent and terminal fissures dorsally bent. Axial area moderate, sublinear; central area slightly unilaterally widened. Striæ on the dorsal side 8–9 in 10 μ in the middle and 9–11 in 10 μ at the ends, on the ventral side 9–10 in the middle and 10–12 in 10 μ at the ends, radial throughout, clearly punctate, punctæ 16–18 in 10 μ , punctæ of the dorsal side coarser than the ventral one.

This species does not agree with any known species of *Cymbella*, hence it is considered to be a new species.

This species was collected in a good number from pools and puddles in the rivulet. It also occurred in encrustations formed by Podostemads and some Myxophyta. In a pond it was seen as a stray form. Common in the region. For its coarser structure and robustness it appears like *C. aspera* (Ehr.) Cl. Slide no. 759.

30. *Gomphonema acuminatum* Ehr. v. *directum* A. Cl.

(Text-Fig. 27)

Cleve-Euler, *Diat. Schwed. Finn.*—IV, 1955, 174, f. 1262 z-d: Valves 28–34 μ long and 5.5–6 μ broad, lanceolate-clavate with acute ends. Raphe thin and straight. Axial area linear; central area small, slightly

unilateral with an isolated stigma. Striæ 10-12-14 in 10μ , fine and radial.

This diatom was collected in a small number from some of the pools in the rivulet. It occurred in brownish matter with other forms.

31. *Gomphonema intricatum* Kütz. v. *vibrio* (Ehr.) Cl

(Text-Fig. 46)

This diatom is being described by a previous worker, but specimens collected from this area show a wider range of dimensions (length 90-110 μ , breadth 10-3-12 μ and striæ 7-8 in the middle up to 10 in 10μ at the ends). The specimens are more linear-clavate with a sharply defined median gibbosity than those previously illustrated. Some of the specimens of which an illustration is given tended to show somewhat obtusely-cuneate apex. This illustration more or less agrees with that of Cleve-Euler's.

32. *Gomphonema lanceolatum* Ehr. f. *turris* (Ehr.) Hust.

(Text-Fig. 47)

Hustedt, *Diat. Tobasees Sumatra*, 1936, 166, t. 3, f. 323 (= *Gomphonema lanceolatum* f. *turris* Ehr. n. comb); *Diat. Sunda-Exped.*, 1938, 437, t. 26, f. 8-11 [= *G. lanceolatum* f. *turris* (Ehr. e.p.) Hust.]: Valves 67-73 $\cdot 7\mu$ long and 11-12 $\cdot 2\mu$ broad, lanceolate-clavate with slightly constricted, broadly wedge-shaped apex and attenuated base. Raphe thin and straight. Axial area sublinear; central area quite large, unilaterally expanded with an isolated stigma on the opposite side. Striæ 9-10 in 10μ , clearly punctate and radial.

This diatom was collected in a small number from a pond and some ditches but in a good number from the rivulet. It occurred in brownish masses of decaying vegetable matter. Fairly distributed in the locality.

33. *Gomphonema tropicale* Brun

(Text-Fig. 28)

Skvortzow, *Diat. Chengtu*, 1938, 491, pl. 1, f. 1-5, pl. 2, f. 10: Valves 68-80 μ long and 9-10 μ broad, narrowly lanceolate-clavate, apices broadly rounded. Raphe thick with fissures in the central nodule transversely common-shaped and terminal fissures distinct. Axial area linear; central area large, unilaterally reaching the side, on the opposite side 2-4 stigmas present one at an end of every middle striæ. Striæ 5-7 in the middle and 6-9 in 10μ at the ends, radial and clearly lineate.

This species was collected in a small number from pools and puddles in the rivulet. It was found mixed up in decaying vegetable matter. Some samples of Podostemad encrustations also yielded it but as a stray form. Not common in the locality.

34 *Gomphonema clevei* Fricke

(Text-Fig. 48)

Hustedt, *Diat. Sunda-Exped.*, 1938, 441, t. 27, f. 15-18; Fukushima, *Diat. Oze*, 1954, 614, f. 5 G; Skvortzow, *Diat. Kizaki Lake*, 1937, 51, pl. 13, f. 33, 40 (= *G. vastum* Hust. v. *elongata* Skv.); Gandhi, *Diat. Hirebhasgar*, 1958, 261, f. 20 (= *G. vastum* v. *elongata* Skv.): Length 20-40 μ , breadth 4.5-5.5 μ and striæ 13-16 in 10 μ .

While going through the literature which has been available lately, I consider Skvortzow's *G. vastum* v. *elongata* to be *G. clevei* Fricke, this also renders correction of my so described specimens from the Hirebhasgar-dam area. Skvortzow probably based his new variety on the basis of *G. vastum* Hust (Hustedt, *Bacil. Aokikosee*, 1927, 166, t. 5, f. 4), which has short marginal striæ and large axial area, and Skvortzow's form differing from it in not possessing capitate apex.

35 *Gomphonema clevei* v. *bipunctata* v. nov

(Text-Fig. 49)

Valvæ 36-44 μ longæ atque 6-6.5 μ latae, lanceolatae-clavatae, ad basim leniter productis ac rotundatis. Raphe tenuis et recta. Area axialis late-lanceolata; area centralis indistincta sed duplici stigmata evoluta. Striæ 16-17 in 10 μ , ut in typus.

Valves 36-44 μ long and 6-6.5 μ broad, lanceolate-clavate with somewhat narrowed, produced rounded base. Raphe thin and straight. Axial area broadly lanceolate; central area not defined but with two stigma. Striæ 16-17 in 10 μ , as in the type.

This diatom differs from the type in having lanceolate-clavate outline with somewhat produced ends and two stigma in the central area.

This form was collected in a very small number along with the type from Podostemad encrustations. Rather rare in the locality. Slide no. 761.

36. *Nitzschia pseudogracilis* sp. nov

(Text-Fig. 51)

Valvæ 70-82.5 μ longæ atque 4.5-5 μ latae, tenui-lanceolatae, apicibus tenui-rostratae ac brevi-capitatae. Carina ex-centro, carina puncta 11-12 in 10 μ , minuta. Striæ circiter 35 in 10 μ , tenues atque indistincte.

Valves 70-82.5 μ long and 4.5-5 μ broad, narrowly lanceolate, ends narrowly produced and shortly capitate. Keel excentric, keel puncta 11-12 in 10 μ , small. Striæ about 35 in 10 μ , fine and indistinct.

This species resembles *N gracilis* Hantz. (Hustedt, *Bacil.*, 1930, 416, f. 794), in narrowly produced, slightly capitate ends and somewhat in range of dimensions. However, the local specimens have clearly lanceolate outline, greater breadth, keel punctæ fewer in number, hence they differ. With *N. obsidialis* Hust. (Hustedt, *Diat. Albert-Nationalpark*, 1949, 148, t. 13, f. 25), it strongly resembles in the outline but differs in dimensions, number and organisation of keel punctæ. With these observed differences, the present specimens are tentatively considered to be a new species.

This species was seen in a good number in collections mostly made from pools and puddles in the rivulet. It occurred in brownish masses of decaying vegetable matter. A few samples from other wet situations also yielded it but sparingly. Fairly common in the locality. It is a benthos of the loose soil as understood from its habitat. Slide no. 763

37. *Suirella linearis* W. Sm

(Text-Fig. 29)

Hustedt, *Bacil.*, 1930, 434, f. 837; Cleve-Euler, *Diat. Schwed. Finn.* —V, 1952, 109, f. 1535 *a-b* (= *S. linearis* v. *genuina* A. Cl.): Valves 82–110 μ long and 20–25 μ broad, linear with cuneate ends. Axial field somewhat narrow, linear-lanceolate. Flap margin narrow but with clear flap projections. Costæ 22–24 in 100 μ .

This species is being described by a previous worker from India, but the differences found in the local forms happen to be gross than the recorded ones, hence the need for description and reillustration was felt. The present species very closely agrees with Hustedt's and Cleve-Euler's specimens.

38. *Suirella celebesiana* Hust

(Text-Fig. 30)

Hustedt, *Diat. Wallacea-Exped.*, 1942, 161, f. 403–6: Valves 75–80 μ long and 26–28 μ broad, heteropolar, subovate with cuneate rounded ends, apex somewhat broader than the base. Axial field narrowly lanceolate with a median line. Marginal folds not very clear, flap projections also not clear. Costæ 28–32 in 100 μ , strongly radial at the apices, striæ indistinctly punctate and the punctæ irregularly disposed.

The species collected from this region shows somewhat more cuneate apex and apparent heteropolar nature. In all other details it agrees very closely with the type.

This species was seen as a stray form in some collections from pools and puddles in the rivulet. Rare in the locality.

39. *Swirella horrida* Hust. f. *minor* f. nov.

(Text-Fig. 31-32)

Valvæ 55-74·8 μ longæ atque 24-28 μ latæ, paulum heteropolares, ovatæ-elliptice, apice late-rotundatis, basi late subcuneatis. Area axialis angustissima. Rugæ marginales angusta fere non-clara, rugæ projectionibus marginata. Costæ 16-19 in 100 μ , paulum radiales in utroque apice. Costæ marginibus aculeatæ vel punctatæ. Striæ circiter 8-9 in 10 μ , tenues sed distincte.

Valves 55-74·8 μ long and 24-28 μ broad, slightly heteropolar, ovate-elliptical with broadly rounded apex and broad subcuneate base. Axial field very narrow. Flap margin narrow, almost indistinct, flap projections marginal. Costæ 16-19 in 100 μ , slightly radial at the apices. On the margin of the costæ some points or prickles present. Striæ 8-9 in 10 μ , fine but distinct.

This diatom collected from the area resembles well with *S. horrida* Hust. (Hustedt, *Diat. Wallacea-Exped.*, 1942, 157, f. 394-5) in practically all the characters, except that it is much smaller in dimensions. A similar form is described by Skvortzow as *S. margaritifera* Hust. (Skvortzow, *Diat. Baikal Lake*, 1937, 358, pl. 16, f. 5, pl. 17, f. 2), of which two illustrations given are quite different in their outlines, but the present ones agree with "Fig. 2 on Pl. 1". However, the present form is not referred to Skvortzow's type, since the dimensions are not known. Moreover, the striæ observed in the local specimens are definitely very few in number.

This diatom was collected in a good number from pools and puddles in the rivulet and also from Podostemad encrustations. From the collections it appears that it is primarily a benthos of the loose soil and secondarily a lithophilous one. Fairly distributed in the area. Slide no. 764.

40. *Swirella capronioides* sp. nov.

(Text-Fig. 52)

Valvæ 96·8-104 μ longæ atque 40·7 μ latæ, heteropolares, ovatæ, basi cuneatæ. Area axialis anguste-lanceolata cum linea media ubique interrupta ad terminalibus spinosa. Rugæ marginales evoluta cum projectionibus distincta. Costæ 18-20 in 100 μ , valde, radiales in utroque apice, clare lineares ut in *S. capronii* Bréb., striæ tenues, indistincte.

Valves 96·8-104 μ long and 40·7 μ broad, heteropolar, ovate with cuneate base. Axial field narrowly lanceolate with a middle line interrupted throughout and beset with spines at both ends. Flap marginal with clear flap projections. Costæ 18-20 in 100 μ , strong, radial at the ends, clearly linear as seen in *S. capronii* Bréb., striæ fine and indistinct.

This species is being described in an earlier paper on Partabgarh Diatoms (Gandhi, *Diat. Partabgarh*, 1955, 335, f. 53) as *S. tenera* v. *splendidula* A.S., but with close comparison and observation it seems to differ from it in several respects, except for the outline. Firstly, the middle line has distinct spines at both the ends, axial field clearly defined and narrowly lanceolate, dimensions quite large and the costæ well marked which are gracefully linear with truncate ends. In all these features it closely agrees with *S. carponii* Bréb. However, it differs from *S. carponii* (Hustedt, *Alg. Bremen*, 1909, 450, f. 11-12; *Bacil.*, 1930, 440, f. 857), in being smaller in dimensions with larger number of costæ. Moreover, the apex is much broader than in *S. carponii* due to which the present forms appear clearly wedge-shaped. Further, the spines at either end of the median line are not formed on elevated cushions. These differences appear to be quite large from that of *S. carponii*, hence, the present specimens are considered to be a new species, including *S. tenera* v. *splendidula* A.S. of my paper on Partabgarh Diatoms. Slide no. 766.

SUMMARY

For the first time the Diatom flora of Sagar in Mysore State has been explored and an illustrated account is presented in these pages.

From the examination of these diatoms several interesting aspects are unfolded. The flora is essentially tropical in nature and it is comparable with that of Java, Bali, Sumatra and Indo-Malayan region. The range of geographical distribution of some of the species is extended. The fact which can be derived from the present investigation is that the Western Ghats region abounds in diatoms and is likely to yield an extremely rich harvest if extensive explorations are carried out.

In this paper some of the diatoms are readjusted with the availability of the fresh-literature. Under the individual species, some notes on ecology, occurrence and distribution of the same, are also given.

From this area, in all 74 diatoms have been recorded representing 16 genera. Of these, 15 are new records for India and 8 species, 2 varieties and 2 forms are considered to be new for the Science.

ACKNOWLEDGEMENT

The author expresses his grateful thanks to Drs. Å. Berg, J. W. G. Lund, A. Jurilj, N. Foged, H. Fukushima and several other friends both here and abroad for their kindness in sparing their valuable publications.

REFERENCES

- BERG, Å. 1945. Diatomeen von der Sophia-Expedition in Jahre 1883, *Ark. Bot.* 32 A (1): 1-34.
- CLEVE-EULER, A. 1951-55. Die Diatomeen von Schweden und Finnland—I, V, II, III, IV. *K. Svenska Vetens. Acad. Handl.* Fjärde Ser. 2 (1): 1-163; 3 (3): 1-153; 4 (1): 1-158; 4 (5): 1-255; 5 (4): 1-232.

- DONKIN, A. S. 1871-73. *The Natural History of the British Diatomaceæ*, Pts. I-III, pls. 1-12, pp. 1-74, London.
- FOGED, N. 1957. 1. Diatoms from Rennell Island *Natur Hist. Rennell Isl., Brit. Solomon Isl.* 3: 6-117.
- FUKUSHIMA, H. 1954. Diatom Flora of Oze *Sci. Resear. Ozegahara Moor* 1954: 602-21.
- GANDHI, H. P. 1955. A contribution to our knowledge of the fresh-water Diatoms of Partabgarh, Rajasthan. *J. Indian bot. Soc.* 34: 307-38
- . 1956 a. A contribution to our knowledge of fresh-water Diatomaceæ of South-Western India I Fresh-water Diatoms of Dharwar. *Ibid.* 35: 194-209
- . 1956 b. A preliminary account of the soil Diatom-flora of Kolhapur *Ibid.* 35: 402-8
- . 1957 a. The fresh-water Diatoms from Radhanagari—Kolhapur *Ceylon J. Sci. (Biol. Sect.)* 1: 45-57.
- . 1957 b. Some common fresh-water Diatoms from Gersoppa-Falls (Jog-falls) *J. Poona Univ. (Sci. Sect.)* 1957: 13-21
- . 1957 c. A contribution to our knowledge of the Diatom genus 'Pinnularia'. *J. Bom. nat. Hist. Soc.* 54: 845-52
- . 1958 a. Fresh-water Diatom-flora of the Hirebhasgat-Dam area—Mysore State. *J. Indian bot. Soc.* 37: 249-65.
- . 1958 b. Fresh-water Diatoms from Kolhapur and its immediate environs. *J. Bom. nat. Hist. Soc.* 55: 493-511
- GONZALVES, E. A. AND GANDHI, H. P. (1952-54). A systematic account of the Diatoms of Bombay and Salsette Pts. I-III *J. Indian bot. Soc.* 31: 117-51; 32: 239-63; 33: 338-50.
- HUSTEDI, F. 1909. Beiträge zur Algenflora von Bremen. II. Die Bacillariaceen-vegetation des Torfkanals *Abh. naturw. Ver. Bremen.* 19: 419-52
- . 1927. Bacillariales aus dem Aokikosee in Japan. *Arch. Hydrobiol. (u. Planktonk.)* 18: 155-72.
- . 1930. Bacillariophyta (Diatomeæ) in A. Pascher's *Die Süßwasserflora Mitteleuropas.* 10: Jena.
- . 1936. Die Fossile Diatomeenflora in den Ablagerungen des Tobasees auf Sumatra *Arch. Hydrobiol. (u. Planktonk.)* Suppl. 14: 143-92.
- . 1938. Systematische und ökologische Untersuchungen über die Diatomeen-Flora von Java Bali und Sumatra nach dem Material der Deutschen Limnologischen Sunda-Expedition *Ibid.* 15: 131-77; 187-295; 293-506; 638-790.
- . 1942. Süßwasser-Diatomeen des indomalayischen Archipels und der Hawaii Inseln, nach dem Material der Wallacea-Expedition. *Int. Rev. Ges. Hydrobiol. Hydrogr.* 42: 1-252
- . 1949. Süßwasser-Diatomeen aus dem Albert-Nationalpark in Belgisch-Kongo. *Expl. Parc nat.-Albert Miss. H. Damas* 1935-36, 8: 1-199.
- . 1950. Die Diatomeenflora norddeutscher Seen mit besonderer Berücksichtigung des holsteinischen Seengebiets *Arch. Hydrobiol. (u. Planktonk.)* 43: 329-458
- IYENGAR, M. O. P. AND SUBRAHMANYAN, R. 1943. Fossil Diatoms from the Karewa Beds of Kashmir. *Proc. nat. Acad. Sci., India* 13: 225-36.

- JURILJ, A. 1954. Flora and vegetation of Diatoms from Ochrida Lake in Jugoslavia *Jugoslav. Akad. Znan Umjet* 1954: 99-190.
- LUND, J. W. G. 1950. Contributions to our knowledge of British Algae. *Hydrobiologia* 2: 281-84.
- MILLS, F. W. 1932. Some Diatoms from Warri, South Nigeria. *J. roy. microsc. Soc.* 52: 383-94.
- PATRICK, R. 1948. Factors effecting the distribution of Diatoms. *Bot. Rev.* 14: 473-524.
- SVKORIZOW, B. W. 1928. Diatoms from Khingan, North Manchuria. *Philipp. J. Sci.* 35: 39-51.
- . 1937 a. Diatoms from Kizaki Lake, Honshu Island, Nippon. *Ibid.* 61: 9-73.
- . 1937 b. Diatoms from Biwa Lake, Honshu Island, Nippon. *Ibid.* 61: 253-96.
- . 1937 c. Diatoms from Olhan Gate of Baikal Lake, Siberia. *Ibid.* 62: 293-377.
- . 1937 d. Diatoms from the Philippines—I Diatoms from drinking water, Balara Rizal Province. *Ibid.* 64: 287-98.
- . 1938 a. Fresh-water Diatoms from environs of Vladivostok. *Ibid.* 65: 251-61.
- . 1938 b. Diatoms from Chengtu, Szechwan, Western China. *Ibid.* 66: 479-96.
- IFFANY, L. H. AND BRITTON, M. E. 1952. *The Algae of Illinois*. Univ. Chicago Press, Chicago.
- VAN HEURCK, H. 1836. *A Treatise on the Diatomaceæ* (translated by W. E. Baxter), London.
- VENKATARAMAN, G. 1939. A systematic account of some South Indian Diatoms. *Proc. Indian Acad. Sci.* B 10: 293-368.
- . 1956. *Contributions to Our Knowledge of Fresh-water Diatoms of South India*. Government Press, Madras, 1956: 1-20.
- VOIGT, M. 1943. Note sur quelques espèces Chinoises du genre *Cymbella*. *Not. Bot. Chin. Muèse Heude* 1943 (5): 1-46.