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A FURTHER CONTRIBUTION TO THE DIATOMFLORA OF THE JOG-FALLS, MYSORE STATE, INDIA

by H. P. Gandhi *

While relocating holotypes of new diatoms on strewn slides of the Jog-Falls material, described in an earlier paper (1966), the author had come across several interesting specimens and new taxa. These could not be taken into account owing to some difficulty. Furthermore, the earlier account was almost completed and it was not possible to include these for they needed much time to study. Now the whole study is completed and here is the supplementary record.

In this paper eightyfive diatoms are included of which twentynine are new records for India, 23-species, 5-varieties and 2-forms are considered to be new to the science. The remaining taxa are included here to suggest further variations that are noted or some which required reconsideration.

At the end of this paper, ecological and statistical data given earlier are revised in light of these new additions.

Systematic Enumeration

1. *ACHNANTHES FASCIATA* sp. nov. (Figs. 1 - 2)

Valvae 23 - 25.3 μ longae atque 2.3 μ latae, lineares, marginibus leniter convexis, apicibus paulum constrictis, late protuberantis atque cuneatis rotundatis. Rhapho-valva: rhaphe tenuis et recta, poris centralibus distinctis atque fissuris terminalibus breviter curvatis; area axialis angusta, linearis; area centralis maxima, ad latera perveniens; striae circiter 40 in 10 μ, subtilissimae, ubique aliquantum radiales. Valva sine rhaphide: pseudorhaphe angustissima, sublinearis, area centralis parva, rotundata vel elliptica in axe longo; stiae circiter 38 in 10 μ. subtilissimae et leniter ubique radiales. Holotypus: lamina vitrea no. MYS-JOG. 25 : 1650.

Valves 23 - 25.3 μ long and 2.3 μ broad, linear with feebly convex sides, ends slightly constricted, broadly produced and cuneately rounded. Valves with raphe: raphe thin and straight with central pores distinct and terminal fissures shortly curved; axial area very narrow; central area very large, reaching the sides; striae about 40 in 10 μ, rather very fine, slightly radial throughout. Valves without raphe: pseudoraphe very narrow, sublinear; central area small rounded or elliptical in long axis; striae about 38 in 10 μ, fine and slightly radial throughout.

This diatom does not compare with any of the known types, hence it is considered to be a new species.

2. *ACHNANTHES LANCEOLATA* Bréb. (Figs. 3 - 4)

Cleve - Euler, 1951 - 55, III, p. 25, f. 527 a-c, x-y : - Valves 26.7 μ long and 9 μ broad, striae 10 - 12 in 10 μ.

Here some large specimens were recorded with more rhombic-lanceolate shape and indistinctly rostrate ends. A rare specimen.

3. *ACHNANTHES LINEARIS* (W. Sm.) Grun. v. *pusilla* Grun. (Figs. 5 - 6)

Hustedt, 1927 - 66, II, p. 378, f. 821 c-d; - 1930, p. 198, f. 277 : - Valves 14.3 - 16 μ long and 2.8 - 3 μ broad, linear with almost parallel sides and broadly rounded ends. Valves with raphe: raphe thin and straight with central pores distinct and terminal fissures very short and curved; axial area narrow, linear; central area elliptical in long axis, small; striae about 18 - 20 in 10 μ, slightly radial throughout. Valves without raphe: pseudoraphe narrow, linear; central area small, elliptical; striae as on the raphe valve, middle striae somewhat widely set or sometimes one of them is absent

This diatom was found in small numbers with vegetable detritus present in pools and ditches in the river bed. It compares well with the type.

4. *ACHNANTHES MINUTISSIMA* Kütz. v. *cryptocephala* Grun. (Figs. 7 - 8)

Hustedt, 1930, p. 198, f. 275 : - Valves 11.5 - 13 μ long and 2 - 2.2 μ broad, striae about 30 in 10 μ.

This entity is illustrated to show somewhat more turgid valves.

5. *ACHNANTHES SUBMONTANA* sp. nov. (Figs. 9 - 10)

Valvae 11 - 14 μ longae atque 4.2 - 4.5 μ latae, late lanceolatae, apicibus productis ac rotundatis. Rhapho-valva: rhaphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus leviter curvatis; area axialis angusta, linearis, area centralis parva; striae circiter 30 in 10 μ, tenuis et aliquantum ubique radiales. Valva sine rhaphide: pseudo-rhaphe angusta, lineari-lanceolata; area centralis inconspicua; striae ut in rhapho-valva. Holotypus: lamina vitrea no. MYS-JOG. 25 : 1650.

Valves 11 - 14 μ long and 4.2 - 4.5 μ broad, broadly lanceolate with produced rounded ends. Valves with raphe: raphe thin and straight with distinct central pores and very shortly curved terminal fissures; axial area narrow, linear; central area small; striae about 30 in 10 μ, fine and slightly radial throughout. Valves without raphe: pseudoraphe narrowly linear lanceolate; central area not evident; striae as on the raphe valve.

This diatom resembles *A. montana* Krasske (Krasske, 1929, p. 350, f. 8 a-b; Hustedt, 1927 - 66, II, p. 398, f. 847) in shape but differs in having high density of striae. Moreover, the present diatoms are proportionately less broad. Again, they resemble *A. tenuissima* Hust. (Hustedt, 1938 - 39, p. 196, t. 13, f. 26 - 27) but Hustedt's specimens have much finer structure, therefore, the comparision is difficult. It does not agree with any other known types, hence it is considered to be a new species. This was found usually in small numbers in ditches and pools in the river bed and elsewhere.

6. *ACHNANTHES TRIGIBBA* Hust. (Figs. 11 - 12)

Frustulae anguste lineares, arcuatae in medio in aspectu zonali. Valvae 18.8 - 22 μ longae atque 2.6 μ latae in medio, lineares, trigibbosae, apicibus late rotundatis. Rhapho-valva: rhaphe tenuis et recta, poris centralibus distinctis atque fissuris terminalibus paululum curvatis; area axialis angustissima, linearis; area centralis aliquantum dilatata ac elliptica in axe longo; striae circiter 24 - 26 in 10 μ, tenuis, indistincte radiales vel perpendiculares versus lineam medivalvem, atque proxime positae plus radiales ad apicem. Valva sine rhaphide; pseudorhaphe angustissima, linearis, sed lata ac elliptico lanceolata; striae circiter 24 in 10 μ. Holotypus: lamina vitrea no. MYS-JOG. 23 : 431.

Schmidt, 1874 - 1959 *Atlas Diat.* t. 410, f. 23 - 24 : - Frustules narrowly linear and bent in the middle in the girdle view. Valves 18.8 - 22 μ long and 2.6 μ broad at the middle, linear, trigibbous, ends broadly rounded. Valves with raphe: raphe thin and straight with central pores distinct and terminal fissures very slightly curved; axial area very narrow, linear; central area slightly dilated, elliptical in long axis; striae about 24 - 26 in 10 μ, fine, indistinctly radial or perpendicular to the middle line, closely set and radial towards ends. Valves without raphe: pseudoraphe very narrowly linear but in the middle wider and elliptical lanceolate; striae about 24 in 10 μ.

This diatom very evidently compares *A. trigibba* Hust., as illustrated in the above mentioned reference. However, this author has not been able to trace its description anywhere. It is, therefore, considered as an undescribed species recorded by Hustedt. The present Latin description is made up for the same. It was found in small numbers in detritus lying in pools and ditches in the river bed below the Falls.

7. *ANOMOEONEIS EXILIS* (Kütz.) Cl. (Fig. 13)

Hustedt, 1927 - 66, II, p. 751, f. 1114 a-c; - 1930, p. 264, f. 429: - Valves 19 - 23.8 μ long and 4.7 - 5 μ broad, striae about 30 in 10 μ.

This diatom is illustrated to show further variation in its outline and slightly broad capitate ends.

8. *CALONEIS BACILLARIS* (Greg.) Cl. v. *cuneata* (Kolbe et Krieger) A. Cl. (Figs. 14 - 15)

Cleve-Euler, 1951 - 55, IV, p. 103, f. 1148 f-g: - Valves 20.4 - 26 μ long and 5 - 5.5 μ broad, linear with almost parallel sides and subcuneate ends. Raphe thin and straight with central pores distinct and terminal fissures short and slightly curved. Axial area quite narrow, linear-lanceolate; central area fairly large, about 2 μ wide, reaching the sides. Striae about 20 - 22 (rarely upto 24) in 10 μ, fine but distinct, parallel and faintly radial, fine longitudinal line present intersecting the striae near margins.

This diatom compares well with the type described and illustrated by Cleve-Euler, except that mostly small specimens were recorded from this area. This entity was found in small numbers in encrustation of wet rocks, detritus in pools and ditches in the river bed.

9. *COCCONEIS HUSTEDTII* Krasske (Figs. 16 - 20)

Krasske, 1923, p. 193, f. 10; Schmidt, 1874 - 1959, *Atlas Diat.*, t. 407, f. 24 - 29; Hustedt, 1927 - 66, II, p. 361, f. 816; - 1930, p. 192, f. 269; Cholnoky, 1966, p. 12, f. 8 - 9; Patrick and Reimer, 1966, p. 264, pl. 17, f. 9 - 10 (= *Achnanthes hustedtii* (Krasske) Patrick and Reimer) : - Valves 7.2 - 12.6 μ long and 3.8 - 5.2 μ broad, oblong elliptical to somewhat rhomboid with slightly convex sides and broadly rounded ends. Raphe thin and straight with central pores distinct; axial area very narrow, linear; central area very large rounded elliptical; striae about 18 - 20 in 10 μ, radial throughout and not interrupted by a hyaline zone near the margins. Valves without raphe: pseudoraphe broadly elliptical lanceolate; striae about 19 - 20 in 10 μ, finely punctate and radial throughout.

This diatom was found in fair numbers in samples containing slimy detritus collected from wet rocks and small puddles in the river bed. It compares very well with the type described and illustrated by Hustedt and others. From the present locality only smaller specimens were recorded. Moreover, some small specimens were found to be with slightly rhombic outline. Such specimens are also recorded by Cholnoky in his collections from Okawango swamps. Recently, Patrick and Reimer have treated this diatom under genus *Achnanthes*.

10. *CYMBELLA SAGARENSIS* Gandhi (Fig. 21)

Gandhi, 1959, p. 322, f. 24 - 25 : - Valves 18 - 20 μ long and 9.5 - 10 μ broad, striae about 7 - 10 in 10 μ, lineations 22 - 24 in 10 μ.

The presently illustrated diatom has somewhat less rostrate apices and more

width than those recorded from Sagar. In all other respects it compares well with the type.

11. *CYMBELLA VENTRICOSA* Kütz. (Fig. 22)

Cleve-Euler, 1951 - 55, IV, p. 124, f. 1177; Van Landingham, 1964, p. 47, pl. 23, f. 1 - 39 : - Valves 10 μ long and 3.8 μ broad, striae 11 - 12 in 10 μ, finely punctate.

This diatom was found to be the smallest than those recorded in the literature. It agrees well with the type except that local specimens appeared to be slightly less broad with ventral side almost faintly convex.

12. *EUNOTIA ALPINA* (Naeg.) Hust. (Figs. 23 - 25)

Hustedt, 1927 - 66, II, p. 304, f. 770; - 1930, p. 185, f. 252 : - Valves 23.8 - 76 μ long and 2.8 - 3 μ broad, apices slightly recurved and constricted, striae about 18 - 20 in 10 μ, fine but distinct.

This diatom was found in all samples but in larger numbers in slimy detritus lying in pools and ditches in the river bed.

13. *EUNOTIA LUNARIS* (Ehr.) Grun. v. *subarcuata* (Naeg.) Grun. (Fig. 26)

Hustedt, 1927 - 66, II, p. 304, f. 769 f-h : - Valves 13 - 17 μ long and 2.2 - 2.5 μ broad, slightly arcuate and ends rounded. Striae about 18 in 10 μ.

This diatom was found in very small numbers in samples collected from pools and ditches in the river bed below the Falls.

14. *EUNOTIA MONTANA* nomen. nov.

Gandhi, 1966, p. 124, f. 27 (= *E. ambigua* Gandhi).

The *E. ambigua* Gandhi, was first published by this author but as an unexpected thing happened, J. R. Carter utilised the same specific epithet later for another member of *Eunotia*. To correct this situation, this author withdraws his specific epithet "*ambigua*" in favour of Carter's. Now the substitute name is given.

15. *EUNOTIA PORCELLOIDES* sp. nov. (Fig. 27)

Valvae 28 - 30 μ longae atque 7.8 μ latae, aliquantum arcuatae, margine dorsali valde convexo, ventrali leniter concavo in arcu levi, apicibus constrictis ad partem dorsalem, late productis ac rotundatis. Nodule polares parvae in utroque apice. Striae circiter 10 - 13 in medio usque ad 15 in 10 μ ad apicem, indistincte punctatae, punctis circiter 20 - 21 in 10 μ. Holotypus: lamina vitrea no. MYS-JOG. 26 : 1651.

Valves 28 - 30 μ long and 7.8 μ broad, slightly arcuate with dorsal side highly convex and ventral side very slightly concave in a smooth arc, ends constricted on the dorsal side, broadly produced and rounded. Polar nodules small and at extreme ends. Striae 10 - 13 in the middle upto about 15 in 10 μ towards ends, indistinctly punctate, punctae about 20 - 21 in 10 μ.

This diatom resembles *E. oliffii* Chol. (Cholnoky, 1956, p. 66, f. 39 - 45 esp. 41; - 1957, p. 52, f. 69 - 73), in shape, produced rounded ends, dimensions and the organization of striae. However, it differs in density of striae which represent here coarser structure. Moreover, none of the local specimens showed either the straight or gibbous median part on the ventral side. Again, it resembles *E. porcellus* Chol. (Cholnoky, 1953 - 54, p. 210, f. 31; - 1954, p. 277, f. 36; - 1955, p. 167, f. 39 - 40; - 1959, p. 23, f. 140) but the present specimens differ both in dimensions and the number of striae. It does not agree with any other known entity of *Eunotia*, hence it is considered to be a new species.

This species was found in usually very small numbers in detritus lying in pools, puddles and ditches in the river bed.

16. *EUNOTIA PRAERUPTA* Ehr. v. *bidens* (W. Sm.) Grun. (Fig. 28)

Hustedt, 1927 - 66, II, p. 281, f. 747 A, i-m esp. k; - 1924, p. 542, t. 17, f. 29 (=*E. praerupta* v. *bidens* Grun. f. *compacta* (V.H.) : - Valves 30 - 36 μ long and 8.5 - 10 μ broad at the broadest, arcuate, linear with dorsal side strongly convex with a distinct concavity in the middle, ventral side saucer-shaped concave, ends constricted, truncately retuse capitate. Polar nodules fairly large and distinct with clear raphe ends. Striae 9 - 14 in 10 μ, coarse and distinct, more closely set than in the middle and also curved.

This diatom was found as a very stray specimen in some samples collected from pools and ditches in the river bed. It compares very well with the type described and illustrated by Hustedt

17. *EUNOTIA RIVULARIS* sp. nov. (Fig. 29)

Valvae 69 - 75 μ longae atque 7.8 - 8 μ latae, aliquantum arcuatae, lineares, lateribus paene parallelis, apicibus constrictis ad partem darsalem leviter valva gracilioribus, clare productis, oblique capitatis ac truncato-rotundatis. Nodulae polares satis magnae ac rhaphe terminalibus distinctis. Striae circiter 13 - 16 in 10 μ, plus minus equidistante evolutae sed proxime positae ad apicem, punctatae, punctis circiter 20 in 10 μ, sed indistinctis. Holotypus: lamina vitrea no. MYS-JOG. 27 : 1652.

Valves 69 - 75 μ long and 7.8 - 8 μ broad, only slightly arcuate, linear with almost parallel sides, ends constricted on the dorsal side, slightly narrower

than the valves, clearly produced, capitate, oblique and truncately rounded. Polar nodules fairly large with termination of raphe distinct. Striae 13 - 15 in 10 μ, more or less uniformly set but somewhat closer towards ends, punctate, punctae about 20 in 10 μ, but not very clear.

This species does not compare with any of the known types, hence it is considered to be a new species. This entity was found in a very small number in samples collected from pools and ditches in the river bed.

18. *EUNOTIA RUTH-PATRICKIAE* nomen nov.

Gandhi, 1966, p. 128, f. 33 (= *E. patrickiae* Gandhi).

This diatom is renamed in honour of Dr. Ruth Patrick of Philadelphia, since the specific epithet "*patrickiae*" given by this author was already occupied.

19. *EUNOTIA SARAVATHENSE* sp. nov. (Figs. 30 - 31)

Valvae 11 - 15 μ longae atque 3 - 3.2 μ latae, minutae, aliquantum arcuatae, lineares vel sublineares, pars dorsalis convexa leviter arcuate, pars ventralis paululum concava, apicibus non-constrictis, late rotundatis. Nodulae polares parvae ad extrema cum rhaphe terminalibus partim minutis. Striae circiter 13 - 14 in 10 μ, tenues sed distinctae ac plus minus aequidistante evolutae. Holotypus: lamina vitrea no. MYS-JOG. 26 : 1651

Valves 11 - 15 μ long and 3 - 3.2 μ broad, small, scarcely arcuate, linear or sublinear, dorsal side quite convex in a smooth arc, ventral side very slightly concave, ends not constricted, broadly rounded. Polar nodules small towards extremity with raphe termination small. Striae about 13 - 14 in 10 μ, fine but distinct and more or less uniformly set.

This species resembles the following entities :-

E. tenella (Grun.) Hust., Foged, 1958, p. 78, pl. 3, f. 6 (18 x 3.4 μ, str. 14 in 10 μ) it is somewhat a larger form than the present one, but it differs from Hustedt's specimens in not having rostrate apices, etc.

E. tenella, Hustedt, 1927 - 66, II, p. 284, f. 749 (6 - 35 x 3 - 4 μ, str. 16 - 20 in 10 μ), shows higher density of striae, rostrate ends. Some of the illustrations given by Hustedt resemble in shape with local forms.

E. tenella, Hustedt, 1930, p. 175, f 220 (6 - 27 x 3 μ str 16 - 20 in 10 μ) differs in having rostrate apices, more curvature, and higher density of striae.

E. raytonensis Chol., Cholnoky, 1955a, p. 168, f. 41 - 43 (10 - 15 x 3 - 4 μ str. 28 in 10 μ) resembles very closely in shape but its structure is reported to be very fine.

E. tenella v. *capensis* Chol., Cholnoky, 1959, p. 25, 143 - 150 (8 - 40 x 3 - 5 μ str. 26 in 10 μ), most of these specimens are shown with dissimilar poles, valves slightly oblique and structure stated to be much finer.

E. tenella Cholnoky, 1957b, p. 348, f. 38 - 39 (- x 5 μ, str. 13 - 15 in 10 μ); 1958, p. 115, f. 74 - 76 (str. upto 13 in 10 μ), illustrations of these entities compare present specimens but they differ from Hustedt's original specimens as illustrated, other dimensional details are not available.

E. - v. *capensis* Chol., Cholnoky, 1960, p. 243, is considered to be *E. rhomboidea* Hust., by the same author. This entity shows bulged dorsal side.

E. rhomboidea Hust., Hustedt, 1947/50, p. 435, t. 36, f. 34 - 41; t. 34, f. 28 (15 - 20 x 2 - 4 μ str. 16 - 18 in 10 μ), these are larger and asymmetrical specimens with higher density of striae.

E faba (Ehr.) Grun., Hustedt, 1927 - 66, II, p. 301, f. 767; - 1930, p. 183, f. 246) (26 - 60 x 5 - 8 μ, str. 13 - 15 in 10 μ), it is a large and robust type though it resembles in shape with present diatoms.

From the above mentioned data it appears that present specimens cannot be compared satisfactorily except *E. tenella*, described by Foged (1958) and Cholnoky (1958), which in turn differ from Hustedt's entity. For the present, therefore, it is considered best to treat these forms as a new species. This was found in a small number in detritus of pools and ditches in the river bed.

20. *EUNOTIA SUBLUNARIS* sp. nov. (Fig. 32)

Valvae 100 - 110 μ longae atque 5.2 μ latae, aliquantulum arcuatae, lineares, marginibus parallelis, apicibus indistincte constrictis ad latus dorsale, late rostratis ac rotundatis. Nodulae polares minutae. Striae circiter 20 in 10 μ, tenues sed distincte atque aequidistante positae. Holotypus: lamina vitrea no. MYS-JOG. 5 : 413.

Valves 100 - 110 μ long and 5.2 μ broad, very slightly arcuate, linear with parallel sides, ends indistinctly constricted on the dorsal side, broadly rostrate and rounded. Polar nodules very small. Striae about 20 in 10 μ, fine but distinct and uniformly set.

This diatom resembles *Desmogonium guianense* Ehr. (Schmidt, 1874 - 1959, *Atlas Diat.*, t. 293, f. 4 - 13, esp. f. 13) but it cannot be referred to this genus as the margins are not characteristically echinate. Moreover, none of the specimens observed here showed capitate apices. It also differs from *E. lunaris* (Ehr.) Grun. (Hustedt, 1927 - 66, II, p. 302, f. 769 a-b, d; - 1930, p. 183, f. 249 and many other references where the illustrations of this species occur) in having slight curvature of valves and higher density of striae (the average number of striae for *E. lunaris*, are 14 - 17 in 10 μ recorded by many authors). Cleve-Euler, has recorded a similar specimen under *E. lunaris* (Cleve-Euler, 1951 - 55, II, p; 88, f. 412 a-b, esp. 412a) which is shown to have very slightly arcuate valves and striae upto 20 in 10 μ. However, this

author is not inclined to depend on this reference as no other major works seem to support Cleve-Euler's data. With these remarks, therefore, the present diatom is considered to be a new species. It was found in a very small number in slimy detritus and encrustations of wet rocks in the river bed.

21. *FRUSTULIA JOGENSIS* sp. nov. (Fig. 33)

Valvae 39 - 42 μ longae atque 10 μ latae, lineari-lanceolatae, apicibus constrictis, rostratis ac rotundatis. Rhaphe tenuis et recta, subtilis ac inter duas costas silices inclusa. Area axialis angustissima, linearis; nodulus centralis parvus, rectangularis in axe longo, nodulae polares parvae. Striae circiter 34 in 10 μ, perpendiculares ad linem medivalvem, subtiliter punctatae, punctis circiter 34 in 10 μ, in linea longitudinali recta ordinatis. Holotypus: lamina vitrea no. MYS-JOG. 20 : 428.

Valves 39 - 42 μ long and 10 μ broad, linear lanceolate with constricted, produced beak-like rounded ends. Raphe thin, delicate and straight, enclosed between siliceous ribs. Axial area very narrow, linear; central area small, rectangular in long axis, polar nodules small. Striae about 34 in 10 μ, perpendicular to the middle line, finely punctate, punctae about 34 in 10 μ, arranged in straight longitudinal rows.

This diatom does not compare satisfactorily with any of the known types, hence it is considered to be a new species. It was collected usually in a very small number from pools, ditches, fine detritus lying in water courses on way reaching the Falls.

22. *GOMPHOCYMBELLA ANCYLI* (Cl.) Hust. (Fig. 34)

Hustedt, 1930, p. 366, f. 681; - 1948, p. 204, f. 13 - 14; Schmidt, 1874 - 1959, *Atlas Diat.*, t. 236, f. 29 - 30 (= *Cymbella ancyli* Cl.) : - Valves 38 - 40 μ long and 7 - 7.5 μ broad, asymmetrical, lanceolate-clavate, apex obtusely rounded, base narrowed, thinner than the apex but broadly rounded. Raphe somewhat thick, slightly arcuate with terminal fissures somewhat reflexed or bayonet-shaped. Axial area narrow, linear; central area slightly expanded and elliptical in long axis. Striae about 10 - 13 in 10 μ, slightly radial throughout, fine but distinctly punctate lineolate, somewhat closer towards ends.

This species was found as a very stray specimen in samples collected from rock pools in the river bed. This genus is recorded for the first time in India.

23. *GOMPHONEMA GRACILE* Ehr. (Fig 35)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 236, f. 16 etc.; Cleve-Euler, 1951 - 55, IV, p. 185, f. 1281 a-b, e : - Valves 66.2 μ long and 9.5 μ broad, striae 10 - 13 in 10 μ, finely punctate, punctae about 24 in 10 μ.

The present illustration of this diatom is given to show further range of variations. It appeared as a common species.

24. *GOMPHONEMA HEBRIDENSE* (Greg.) Hér. (Fig. 36)

Cleve-Euler, 1951 - 55, IV, p. 181, f. 1274 : - Valves 40 - 56 μ long and 6 - 8 μ broad, lanceolate clavate, in the middle clearly inflated, ends produced and rounded. Raphe thin and straight, ends in the central nodule distinct and terminal fissures shortly bayonet-shaped curved. Axial area very narrow, linear; central area slightly expanded with an isolated stigma on one side. Striae 14 - 16 in 10 μ, slightly radial but towards ends somewhat perpendicular to the middle line, indistinctly punctate.

This species compares very well with the type described and illustrated by Cleve-Euler. It was observed in a fair number in samples collected from wet encrustations of rocks in the river bed.

25. *GOMPHONEMA INTRICATUM* Kütz. v. *pusillum* May. (Fig. 37)

Cleve-Euler, 1951 - 55, IV, p. 188, f. 1283 k-m : - Valves 30 - 36.4 μ long and 6.3 μ broad, lanceolate clavate with ends acutely rounded. Raphe thin and straight. Axial area narrow, linear-lanceolate; central area very large with an isolated stigma on the opposite side. Striae 8 - 12 in 10 μ, slightly radial and fine but clearly punctate, one middle striae sometimes absent or very much shortened.

This diatom more or less compares the type given by Cleve-Euler, except that specimens observed here are somewhat broad. It is on the basis of very short median striae and large central area that it is referred to G. *intricatum*. It was found in a very small number in samples collected from wet rocks and detritus in some pools.

26. *GOMPHONEMA LACUS-RANKALA* Gandhi v. *gracilis* Gandhi

Gandhi, 1958 p. 500, f. 41 : - Valves 94 μ long and 12.8 μ broad, striae 8 - 10 in 10 μ.

This diatom was found mostly as a stray form in samples collected from pools and large ditches.

27. *GOMPHONEMA SARAVATHENSE* sp. nov. (Fig. 38)

Valvae 55 - 65 μ longae atque 7.5 - 8.5 μ latae, clavatae, in medio paulum inflatae, ad apices late rotundatis, ad basim tenues, productae ac rotundatae. Rhaphe crassa, in nodulo centrali aliquantum unilateraliter inclinata atque fissuris terminalibus hamo similibus. Area axialis tenuis, linearis; area centralis amplissima, unilateraliter perveniens, prope 1.5 μ, lata, cum duobus stigmatibus paene in nodulo centrali evolutis in extremitatibus

duarum striarum medianarum. Striae circiter 8 - 9 in 10 μ, punctatae, aliquantum plus radiales ad apicem. Holotypus: lamina vitrea no. MYS-JOG. 28 : 1653.

Valves 55 - 65 μ long and 7.5 - 8.5 μ broad, clavate, in the middle inflated, apex broadly rounded and base narrowed, produced and rounded. Raphe thick with ends in the central nodule somewhat unilaterally inclined and terminal fissures bayonet shaped curved. Axial area narrow, linear; central area very large almost unilaterally extended, about 1.5 μ broad with two stigmas almost in the middle of the central nodule at the end of two middle striae. Striae 8 - 9 in 10 μ, punctate, slightly to more radial towards ends.

This diatom does not compare with any of the known types of *Gomphonema*, hence it is considered to be a new species. It was found mostly as a stray specimen in some samples collected from pools in the river bed.

28. *GOMPHONEMA SUBMALAYENSE* sp. nov. (Fig. 39)

Valvae 39 - 58.4 μ longae atque 6.3 - 7.8 μ latae, tenuiter lanceolate-clavatae, margines interdum concavae inter mediam partem cellulae et apices in medio dilatatae, apicibus rotundatis. Rhaphe aliquantum crassa, in nodulo centrali unilateraliter inclinata ac distincta, fissuris terminalibus brevibus ac gladiiforme curvatis. Area axialis angusta, lineares lanceolata; area centralis unilateraliter circiter usque ad 2.5 μ dilatata ad latus perveniens vel interdum breves striae evolutae, ad latus oppositum 1 - 2 stigmata evoluta in extremitatibus striarum medianarum. Striae circiter 7 - 8 in medio usque ad 10 in 10 μ ad apices, striae medianae magis radiales quam striae apicales, distincte lineatae, punctis circiter 25 in 10 μ. Holotypus: lamina vitrea no. MYS-JOG. 15 : 424.

Valves 39 - 58.4 μ long and 6.3 - 7.8 μ broad, narrowly lanceolate clavate with concave sides between the middle and apices, middle part inflated, ends rounded. Raphe very slightly thick with ends in the central nodule somewhat unilaterally inclined and clear and terminal fissures short bayonet shaped. Axial area narrow, linear lanceolate; central area unilaterally much enlarged, 2.3 μ wide, reaching the side or sometimes a very short striae may be present, opposite to this 1 - 2 stigma present at the end of middle striae. Striae about 7 - 8 in the middle to 10 in 10 μ towards ends, middle striae are more radial than those towards ends, clearly lineate, lineations about 25 in 10 μ.

This diatom resembles G. *malayense* Hust. (Hustedt, 1942, p. 115, f. 244 - 245), in shape, structure and unilaterally expanded central area. However, the present specimens differ in being much smaller in size and less robust. Moreover, they have 1 - 2 stigma in the central area at the end of middle striae. Again, this species also resembles forms and varieties of G. *intricatum* Kütz., esp. v. *vibrio* Ehr. (Schmidt, 1874 - 1959, *Atlas Diat.*, t. 235, f. 1 - 17, 30 - 39, esp. f. 1, 10 - 13) but the present diatoms differ in having two stigma in the central nodule which is a feature not present in G. *intricatum*.

Moreover, the central area is extended to one side. The present diatoms, therefore, differ. They are considered to be a new species. This species was found in varying numbers in samples collected from pools, encrustations and slimy matter covering wet rocks in the river bed.

29. *GOMPHONEMA SUBTILE* Ehr. v. *malayensis* Hust. (Figs. 40 - 44)

Hustedt, 1942, p. 119, f. 258 - 260 : - The following typical dimensions were found

length	breadth	striae in 10μ
31.5 μ	6.3 μ	12 - 14
41 μ	8 μ	14 - 15 ?
42.8 μ	6.4 μ	12 - 14
43 μ	7.2 μ	13 - 15

This diatom was found in good numbers in various samples collected from wet rocks and certain pools in the river bed. A number of specimens observed, a few showed apical end either very shortly capitate or somewhat constricted and produced. However, Hustedt has stated that smaller specimens in his collections were found with more or less produced apical ends.

30. *NAVICULA ANGLICA* Ralfs (Fig. 45)

Hustedt, 1930, p. 303, f. 530 - 531; - 1914, p. 60, t. 7, f. 55 (= *N. placentula* Ehr. v. *anglica* (Ralfs) Cl.) : - Valves 18.8 - 22 μ long and 8 - 8.5 μ broad, broadly lanceolate elliptical, ends constricted and broadly rostrate rounded. Raphe thin and straight with shortly curved terminal fissures. Axial area very narrow, linear; central area small, rounded to fairly wide rectangular due to abbreviation of middle striae. Striae 11 - 14 in 10 μ, radial throughout, 1 - 2 middle ones sometimes shortened, indistinctly lineolate, at the ends somewhat closely set.

This diatom compares fairly well with the type described and illustrated by Hustedt and others, except that only smaller specimens were recorded from this area. This species was found usually in small numbers in samples collected from pools, ditches, wet encrustations of rock in the river bed.

31. *NAVICULA ANGLICA* v. *signata* Hust. (Fig. 46)

Hustedt, 1943, p. 287, t. 8, f. 26; - 1947/50, p. 348, t. 37, f. 56 - 58 : - Valves 18.6 - 20 μ long and 7.8 - 8 μ broad, elliptical lanceolate with constricted, produced, rostrate rounded ends. Raphe thin and straight with terminal fissures slightly curved. Axial area very narrow, linear; central area

fairly large, transversely elliptical with an isolated stigma on one side. Striae 12 - 13 in the middle to about 15 in 10 μ towards ends, radial throughout, punctate or lineolate.

This diatom compares well with the type. It occurred in a small number along with the above type.

32. *NAVICULA BACILLUM* Ehr. (Fig. 47)

Hustedt, 1927 - 66, III, p. 113, f. 1248 a-d (= f. *genuina*); - 1930, p. 280, f. 465 a - c : - Valves 39.5 - 45 μ long and 11.2 - 12 μ broad, linear elliptical or linear with parallel or indistinctly convex sides, ends broadly rounded and smooth. Raphe thin and straight with central pores very distinct and terminal fissures bayonet shaped curved, raphe enclosed between broad hyaline zone of siliceous membrane. Axial area very narrow, linear; central area small, elliptical in long axis. Polar nodules very large and expanded. Striae 12 - 13 - 15 in the middle to 20 - 22 in 10 μ towards ends, radial and curved throughout, clearly short dash-like punctate, fine, striae delimited by strong costae to form polar nodules.

This species was found in varying numbers in many samples collected from pools, ditches and encrustations of wet rocks in the river bed.

33. *NAVICULA BACILLUM* v. *capitata* v. nov. (Fig. 48)

Valvae 66 - 75 μ longae atque 11 - 12 μ latae, lineares, in medio aliquantulum convexae, apicibus aliquantum sed distincte constrictis, late capitatis ac rotundatis. Raphe tenuis et recta, inclusa inter costas siliquosas, poris centralibus distinctissimis, fissuris terminalibus hamo similibus curvatis. Area axialis, centralis ac polaris ut in typo. Striae circiter 13 in medio vel 20 - 22 in 10 μ ad apices, ubique radiales, curvatae ac distincte punctatae. Coeterum ut in typo. Holotypus: lamina vitrea no. MYS-JOG 26 : 1651.

Valves 66 - 75 μ long and 11 - 12 μ broad, linear with very feebly convex sides, ends slight but distinctly constricted and broadly capitate and rounded. Raphe thin and straight, enclosed between siliceous bands, central pores very distinct and terminal fissures bayonet shaped curved. Axial, central and polar areas as in the above type. Striae about 13 in the middle to 20 - 22 in 10 μ towards ends. In all other characters like the above type.

This diatom differs from the above type in having linear sides and slight but distinct capitate rounded ends. The ends are somewhat thickened. It is, therefore, considered to be a new variety. It was found usually in small numbers in wet encrustations of rocks and detritus lying in pools in the river bed.

34. *NAVICULA CHARLATII* Perag. v. *jogensis* v. nov. (Figs. 49 - 51)

Valvae 34.7 - 40 μ longae atque 7.8 - 8 μ latae, lanceolatae, marginibus distincte triundulatis, apicibus abrupte constrictis, protuberantibus ac rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, aliquantum unilateraliter inclinatis, fissuris terminalibus paulum curvatis. Area axialis angustissima, linearis; area centralis transverse rectangularis, fere magna cum uno stigmate segregato evoluta ad unum latus. Striae circiter 15 - 17 in medio usque ad 18 - 20 in 10 μ, ad apices atque gradatim magis radiales ac curvatae ad apices, striae clare punctatae (structura alveolaris), alveolae circiter 18 - 20 in 10 μ tenues ad aream axialem, distincte sulci longitudinalibus interruptis ad margines. Holotypus: lamina vitrea no. 28 : 1653.

Valves 34.7 - 40 μ long and 7.8 - 8 μ broad, lanceolate, sides clearly triundulate, ends abruptly constricted, rostrate and rounded. Raphe thin and straight with central pores distinct and somewhat unilaterally inclined, and terminal fissures slightly curved. Axial area very narrow, linear; central area transversely rectangular, fairly large with an isolated stigma on one side. Striae about 15 - 17 in the middle to 18 - 20 in 10 μ towards ends, gradually more radial and curved towards ends, clearly punctate (structure alveolar), alveoli about 18 - 20 in 10 μ, marginal row is clearly separated from the rest due to longitudinal hyaline furrow, punctae of striae are smaller towards mid axis.

This diatom comes within the cycle of *N. charlatii* Perag., but it does not compare well with any of the known forms and varieties recorded in the literature. Cholnoky has recorded also a similar entity as *N. charlatii* v. *chilensis* Hust. (Cholnoky, 1957, p. 59, f. 117), but dimensions are not available. It differs from the local specimens in having a small but distinct constriction in the middle. While checking up, var. *chilensis* Hust., described and illustrated by Hustedt (Hustedt, 1955, p. 127, f. 15; - 1927 - 66, III, p. 604, f. 1607 d) these two records differ in shape, undulate walls and apices. Infact Cholnoky's specimens could be considered as a new variety. However, the specimens recorded from this region are considered to be different, hence they are treated as new variety. This entity here is illustrated in two ways as seen under the change of focus.

This diatom was found mostly as a stray specimen in samples collected from detritus and slimy encrustations of wet rock in the river bed.

35. *NAVICULA CHARLATII* v. *lanceolata* v. nov. (Figs. 52 - 56)

Valvae 31.5 - 36.2 μ longae atque 7.8 - 9.4 μ latae, anguste ellipticae lanceolatae, apicibus aliquantum constrictis, rostratis, rotundatis. Striae circiter 15 - 17 in medio vel 18 - 20 in 10 μ ad apicem. Coeterum ut in typus. Holotypus: lamina vitrea no. MYS-JOG. 28 : 1653.

Valves 31.5 - 36.2 μ long and 7.8 - 9.4 μ broad, narrowly elliptical lanceolate, ends slightly constricted, rostrate and rounded. Striae about 15 - 17 in

the middle to 18 - 20 in 10 μ towards ends. In all other characters it is like the above type.

This diatom also belongs to the cycle of *N. charlatii* Perag. and has the identical structure. However, it differs from all the forms and varieties of *N. charlatii*, in being narrow elliptical lanceolate with rostrate ends. It resembles *N. kraeusalli* Chol. (Cholnoky, 1954, p. 284, f. 79 - 80; - 1957, p. 63, f. 135 - 136) in outline and marginal longitudinal space but *N. kraeusalli* is a robust and structurally different entity. Again, Cholnoky's *N. voigtii* Meist. (dimensions not available) Cholnoky, 1956, p. 81 f. 100, is probably comparable to *N. kraeusalli*. The *N. voigtii* Meist. (Meister, 1932, p. 38, pl. 13, f. 101 - 102; Hustedt, 1927 - 66, III, p. 625, f. 1622) as described and illustrated by Meister and Hustedt, is indeed a different species as it appears. Further, Cholnoky's *N. suecorum* Carlson (Cholnoky, 1956, p. 80, f. 97) seems to differ much from *N. suecorum*, as described and illustrated by Hustedt (Hustedt, 1949, p. 49, f. 33 - 35; - 1927 - 66, III, p. 608, f. 1610). In the latter work, Hustedt in his remarks considered Cholnoky's *N. suecorum* as a variety of *N. charlatii*. From these observations, it is felt that the present diatoms be considered as a new variety of *N. charlatii*, and under this Cholnoky's *N. suecorum* be included. Further, *N. kotschyi* Grun. as accounted by Foged (Foged, 1953, p. 43, pl. 6, f. 8; - 1955, p. 50, pl. 7, f. 4 - 5) differs from the nominate type but seems to compare here, hence this may also be included under the present taxon.

This diatom was found in small numbers in samples collected from large pools, ditches and slimy encrustations present on wet rocks in the river bed.

36. *NAVICULA CINCTAEFORMIS* Hust. (Figs. 57 - 58)

Schmidt, 1874 - 1959, *Atlas Diat.* t. 403, f. 29 - 31; Hustedt, 1938 - 39, p. 265, t. 19, f. 11 - 12; Cholnoky, 1957 a, p. 68, t. 3, f. 68; - 1962, p. 36, t. 1, f. 39; - 1963, p. 242, t. 1, f. 12 - 13 : - Valves 26.7 - 29 μ long and 7.5 μ broad, linear elliptical lanceolate with unconstricted, cuneately rounded ends. Raphe thin and straight with central pores distinct and terminal fissures shortly curved. Axial area narrow, sublinear, on one side bordered by a siliceous rib, narrower than on the other side; central area small, rounded and unilaterally dilated. Striae 11 - 13 in 10 μ, very closely set, lineolate, lineations about 24 in 10 μ, distinct, striae fairly radial in the middle and a few convergent towards extreme ends, in the middle one or two of them are very short in some specimens.

This species compares very closely the type described and illustrated by Hustedt and Cholnoky. It may be pointed out that Hustedt has recorded larger specimens (34 - 43 x 7.5 - 8 μ, str. 14 in 10 μ) and Cholnoky seemed

to have recorded smaller ones (length 30 μ) which infact compare here very well. This diatom was collected in small numbers from wet encrustations of rock, detritus lying in pools and ditches in the river bed. Further, local specimens seemed to have lower range of striae per 10 μ.

37. *NAVICULA CONFERVACEA* Kütz. f. *rostrata* Krasske (Fig. 59)

Hustedt, 1927 - 66, III, p. 205, f. 1324 e; - 1957, p. 269, f. 7; Cholnoky, 1953, p. 348, f. 4 - 6 esp. f. 4 (= *N. confervacea*) : - Valves 22.2 - 25 μ long and 6.8 - 7 μ broad, broadly lanceolate rhomboid, sides convex, concave between the middle and ends, ends slightly produced and rounded. Raphe thin and straight with central pores distinct and terminal fissures shallow curved and distinct. Axial area fairly large and lanceolate; central area 3.2 μ wide, elliptical lanceolate in long axis. Striae about 21 - 24 in 10 μ, slightly radial throughout, fine but distinctly punctate, punctae about 28 in 10 μ.

This diatom compares very closely the type described and illustrated by Hustedt, except that apices in the present specimen are not very strongly produced. Again, Cholnoky has recorded exactly a similar diatom as *N. confervacea* Kütz., but no other details are available. However, the present specimens are considered to be v. *rostrata*, for their greater resemblance. Further, the striae towards ends are noted to be somewhat closely set which feature although illustrated by Hustedt but not described. Only a few specimens were recorded from this locality in samples collected from rock pools and wet encrustations on rocks in the river bed.

38. *NAVICULA CRYPTOCEPHALA* Kütz. (Fig. 60)

Cleve-Euler, 1951 - 55, III, 154, f. 813 a-e : - Valves 27.8 μ long and 4.8 μ broad, striae 14 - 18 in 10 μ.

A number of specimens observed from this locality, some of them were found to be rather slim of which the present illustration is given.

39. *NAVICULA DECUSSIS* Østr. (Figs. 61 - 62)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 398, f. 36 - 37; Cleve-Euler, 1951 - 55, III, p. 175, f. 866 A; Hustedt, 1957, p. 290; Østrup, 1918/20, p. 29, t. 3, f. 43 (= *N. thingvillae* Østr.) : - Valves 22.5 - 24 μ long and 6.3 - 7.2 μ broad, elliptical lanceolate with constricted, capitate rounded ends. Raphe thin and straight with distinct, somewhat closely set central pores and shortly curved terminal fissures. Axial area quite narrow, linear; central area quadrately rounded with a faint but definite stigma present slightly on one side of the central nodule. Striae about 14 - 15 in the middle to 18 in 10 μ towards

ends, lineate, lineations about 28 in 10 μ, striae strongly radial, curved and reflexed by their terminations in the middle forming something like a cross, short and long ones alternating, and towards ends more or less convergent and also reflexed.

This species was found in good numbers in samples collected from rock pools and wet encrustations. It closely compares the type in all details. The stigma in the central nodule was found in all cases but sometimes it was seen with some dificulty. Østrup seemed to have missed this point.

40. *NAVICULA DIGITULUS* Hust. (Fig. 63)

Hustedt, 1927 - 66, III, p. 252, f. 1378; - 1943, p. 162, f. 26 - 30 : - Valves 18 - 23.6 μ long and 5 - 5.4 μ broad, narrowly elliptical lanceolate with broadly rounded ends. Raphe thin and straight with central pores distinct and terminal fissures shortly curved. Axial area very narrow, linear; central area small, elliptical in long axis. Striae 21 - 22 in the middle to about 30 - 33 in 10 μ towards ends, radial and finely punctate, in the middle sometimes 1 - 2 of them are abbreviated, towards ends striae are very slightly radial or probably perpendicular to the middle line.

This species compares very closely the type described and illustrated by Hustedt. It was found in varying numbers in samples collected from pools and ditches in the river bed.

41. *NAVICULA DISSIPATA* Hust. (Fig. 64 - 65)

Hustedt, 1927 - 66, III, p. 549, f. 1587 a-b; - 1944, p. 273, t. 8, f. 4 (= *N. auriculata* Hust.); Hohn and Hellermann, 1963, p. 292, pl. 3, f. 37 (= *N. auriculata*); Patrick and Reimer, 1966, p. 441, pl. 39, f. 1 (= *N. auriculata*) : - Valves 16 - 18 μ long and 5.8 μ broad, linear-elliptical with smooth broadly rounded ends. Raphe thin and straight with central pores distinct and terminal fissures slightly curved, clear row of punctae present on either sides of the raphe, punctae about 15 - 17 in 10 μ. Axial area very narrow, linear; area between the marginal striae and the row of punctae along raphe very wide, H-shaped by joining the central nodule. Striae about 16 - 19 in 10 μ, slightly radial in the middle but more so towards ends, interrupted by a very distinct longitudinal furrow or space, hence the striae appear in two concentric rings.

This species agrees very well with the type described and illustrated by Hustedt. It was found in a very small number in detritus lying in ditches and pools in the river bed.

42. *NAVICULA ELATA* sp. nov. (Fig. 73)

Valvae 23.6 - 26.7 μ longae atque 9.4 - 10 μ latae, lineari ellipticae, ad latus leniter convexis, apicibus abrupte constrictis, rostratis, subcapitatis, truncatis, rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus breviter curvatis. Area axialis angusta, linearis; area centralis quadrata vel quadrato rotundata, modice dilatata. Striae circiter 12 - 14 in 10 μ, leviter punctatae, aliquantum radiantes in mediaparte valvae ac paucae striae paulum convergentes in utroque apice; striae medianae longiores sed breviores numquam irregulariter alternantes. Holotypus: lamina vitrea no. MYS-JOG. 28 : 1653.

Valves 23.6 - 26.7 μ long and 9.4 - 10 μ broad, linear elliptical, sides feebly convex, ends abruptly constricted, rostrate, subcapitate and truncately rounded. Raphe thin and straight with central pores distinct and terminal fissures shortly curved. Axial area narrow, linear; central area quadrate or quadrately rounded, fairly widened. Striae about 12 - 14 in 10 μ, faintly punctate, slightly radial in the middle and a few slightly convergent at extreme ends, middle striae irregularly short and long but do not alternate.

This species resembles *N. exigua* (Greg.) O.M. (Hustedt, 1930, p. 305, f. 538) in range of dimensions, somewhat in outline and the number of striae. However, it differs in having slightly convergent striae towards ends. Moreover, they are not quite lineolate. It also resembles *N. anglica* Ralfs, as given by Frenguelli (Frenguelli, 1939, p. 181, t. 1, f. 19, - 1941, p. 253, t. 1, f. 15) in shape, apices but for want of diagnostic details the comparision is difficult. Moreover, striae indicated to be radial throughout. Again, *N. gastrum* (Ehr.) Donk. described and illustrated by Van Heurck (Van Heurck, 1896, p. 186, pl. 3, f. 134) also differs in dimensions, less number of striae besides they being all radial. From this data, therefore, the present diatoms do not compare satisfactorily, hence they are considered to be a new species. This species was found in small numbers in samples collected from pools, wet encrustations of rock and clusters of Bryophytes growing along the flowing water in the river bed.

43. *NAVICULA FEUERBORNI* Hust. (Figs. 66 - 67)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 403, f. 21 - 24; Hustedt, 1938 - 39, p. 269, t. 19, f. 9 - 10; Cholnoky, 1955 b, p. 19, f. 24; - 1957, p. 61, f. 126 - 127 : - Valves 31 - 40 μ long and 5 - 6.4 μ broad, narrowly lanceolate with unconstricted somewhat acutely rounded ends. Raphe thin and straight with central pores quite distinct and somewhat closely set and terminal fissures broadly curved. Axial area very narrow, linear, on one side less broad than the other and delimited by a siliceous rib; central area large, rhomboid. Striae 13 - 15 in 10 μ, closely set, radial in the middle and convergent towards ends, middle striae short and long, lineate, lineations about 24 - 25 in 10 μ, quite distinct.

This species compares very well the type described and illustrated by Hustedt except that local specimens were found to be somewhat slimmer and miniimum number of striae noted to be 13 in 10 μ. It was found in fair numbers in samples taken from wet encrustations, vegetable detritus and other stuff lying in pools and large ditches in the river bed.

44. *NAVICULA FEUERBORNI* v. *rostrata* nov. var. (Figs. 68 - 69)

Valvae 39 - 42 μ longae atque 6.4 μ latae, lineares, marginibus subparallelis, apicibus constrictis, cuneatis longe rostratis, truncatis rotundatisque. Rhaphe tenuis et recta, poris centralibus distinctis ac proxime positis; fissuris terminalibus late curvatis. Area axialis angustissima, sed ad unum latus, latior, linearis, per costam ad unum latus siliceam delimitata; area centralis magna, rhomboidea vel transverse elliptica. Striae circiter 10 - 12 (raro usave ad 14) in 10 μ, arcte positae, radiantes in medio atque convergentes ad apices, longae vel striae in medio breves evolutae, distincte lineatae, lineae circiter 22 - 24 in 10 μ. Holotypus: lamina vitrea no. MYS-JOG. 29 : 1654.

Valves 39 - 42 μ long and 6.4 μ broad, linear with subparallel sides, ends cuneately narrowed, long rostrate and truncately rounded. Raphe thin and straight with central pores distinct and closely set, terminal fissures broadly curved. Axial area very narrow, wider on one side, linear and delimited by a siliceous rib on one side; central area large, rhomboid or transversely elliptical. Striae about 10 - 12 (rarely upto 14) in 10 μ, closely set, radial in the middle and convergent towards ends, in the middle short and long ones are present, lineate, lineations about 22 - 24 in 10 μ, distinct.

This diatom compares well with *N. feuerborni* Hust. as illustrated by Cholnoky (Cholnoky, 1955b, p. 19, f. 24; 1957, p. 61, f. 126 - 127 esp. f. 126) but no dimensional details are available. The local specimens seemed to show more strongly produced ends, somewhat clearly radial and convergent striae than recorded by Cholnoky. It is considered to be a new variety because of clearly rostrate apices and more linear sides. This diatom was found in small numbers in samples collected from pools and large ditches in the river bed.

45. *NAVICULA INFLATA* sp. nov. (Fig. 70)

Valvae 33.2 - 35 μ longae atque 11 - 11.4 μ latae, late lanceolatae, ad latus convexae, apicibus constrictis, breviter capitatis ac rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, fissures terminalibus breviter curvatis. Area axialis angustissima, linearis; area centralis fere magna, quadrato rotundata, astigmata. Striae circiter 18 - 20 (raro 22) in 10 μ, modice radiales atque distincte curvatae, in medio striae alternantes longiores et breviores, ad apicem gradatim convergentes, subtiliter punctatae, punctis circiter 20 - 22 in 10 μ. Holotypus: lamina vitrea no. MYS-JOG. 29 : 1654.

Valves 33.2 - 35 μ long and 11 - 11.4 μ broad, broadly lanceolate with convex sides and distinctly constricted, shortly capitate rounded ends. Raphe thin

and straight with distinct central pores and shortly curved terminal fissures. Axial area very narrow, linear; central area quite large, quadrately rounded without stigma. Striae 18 - 20 (rarely 22) in 10 μ, fairly radial and evidently curved in the middle where short and long ones alternate, towards ends gradually convergent, very slightly closely set, finely punctate, punctae about 20 - 22 in 10 μ.

This diatom does not compare with any of the known types, hence it is considered to be a new species. It was found in usually small numbers in samples collected from pools, detritus and wet encrustations on rocks in the river bed.

46. *NAVICULA MUTICA* Kütz. f. *intermedia* Hust. (Fig. 74)

Hustedt, 1927 - 66, III, p. 585, f. 1593 a-d esp. 1593 d : - Valves 26.7 - 28 μ long and 7.5 - 8 μ broad, rhomboid lanceolate with broad truncately rounded ends. Raphe thin and straight with distinct central pores somewhat unilaterally inclined and terminal fissures shortly curved. Axial area narrow, linear; central area very large, transversely rectangular but somewhat outwardly expanded, dissimilar and with a distinct stigma present on one side. Striae about 22 - 24 in 10 μ, fairly radial throughout, clearly punctate, punctae about 20 in 10 μ, punctae somewhat dash-like or structure finely alveolar.

This diatom closely compares *N. mutica* f. *intermedia*, as described and illustrated by Hustedt, except that it has somewhat finer structure. This diatom was found in a small number in samples collected from pools and ditches in the river bed.

47. *NAVICULA OPPUGNATA* Hust. (Figs. 75 - 76)

Hustedt, 1942/45, p. 925, t. 42, f. 1; - 1947/50, p. 351, t. 37, f. 38 - 41 : - Valves 47.4 - 61.6 μ long and 9.5 - 9.8 broad, narrowly lanceolate with feebly produced, obtusely rounded ends. Raphe thin and straight with central pores distinct and terminal fissures shortly curved. Axial area very narrow, linear; central area very large, elliptical quadrate and irregular. Striae about 8.5 (9 - 10) in 10 μ, closely set, strongly radial in the middle and convergent towards ends, clearly lineate, lineations about 20 - 22 in 10 μ.

This species compares very well with the type described and illustrated by Hustedt. It was found in small numbers in samples collected from pools, ditches, wet encrustations of rocks in the river bed.

48. *NAVICULA PUSILLA* W. Sm. v. *lanceolata* Grun.

Gandhi, 1966, p. 145, f. 116 - 119 : - Valves 53 - 71 μ long and 22 - 26.5 μ broad, striae 11 - 15 in 10 μ and towards ends becoming closer upto 18 in 10 μ.

This diatom has been described by this author and remarks are given under it. Recently Hustedt described and illustrated almost an identical diatom as *N. delwarensis* Grun. (1893) (Hustedt, 1927 - 66, III, p. 680, f. 1680) and the range of dimensions given are 64 - 115 x 36 - 44 μ, striae 12 - 15 in the middle upto 18 - 20 in 10 μ towards ends, which nearly compares here. Hustedt also discussed the taxonomy of this entity. However, he did not take into account *N. pusilla* v. *lanceolata* Grun. (1860), described and illustrated by Lavrenko, Cleve-Euler and Donkin. The diagnosis given by Cleve for this entity (Cleve, 1895, p. 41) is rather incomplete and unsatisfactory, hence it is not helpful here. With these considerations, therefore, the present diatom is treated as *N. pusilla* v. *lanceolata*, till more satisfactory information is available.

49. *NAVICULA RAMOSISSIMOIDES* sp. nov. (Figs. 77 - 79)

Valvae 35 - 48 μ longae atque 4.7 - 6.3 μ latae, tenue lanceolatae, lateribus aliquantum convexis, apicibus acutis rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis ac fissuris terminalibus aliquantum curvatis. Area axialis angustissima, linearis; area centralis fere lata ac elliptica in axe longo. Striae circiter 22 (21 - 23) in 10 μ, tenues, clare lineatae, radiales in medio, aliquantum perpendiculares inter partem mediam et terminalem, atque paululum vel distincte convergentes ad apices. Holotypus: lamina vitrea no. MYS-JOG. 27 : 1652.

Valves 35 - 48 μ long and 4.7 - 6.3 μ broad, narrowly lanceolate with slightly convex sides and acutely rounded ends. Raphe thin and straight with central pores distinct and terminal fissures slightly curved. Axial area very narrow, linear; central area elliptical in long axis, fairly wide. Striae about 22 (21 - 23) in 10 μ, fine but distinctly lineate, radial in the middle, somewhat perpendicular to the middle line in between and feebly or clearly convergent towards ends.

A table of typical dimensions recorded for this diatom

length	breadth	striae in 10μ
35 μ	4.7 μ	21
41 μ	4.7 μ	22
42.5 μ	5.5 μ	22
46 μ	6.3 μ	22
48 μ	6.3 μ	21 - 23

This diatom resembles *N. ramosissima* Ag. (Cleve, 1895, II, p. 26; Cleve-Euler, 1951 - 55, III, p. 129, f. 752 b; Hustedt and Aleem, 1951, p. 186, 1 A B) in shape, lineate striae and very narrow axial area, but it differs in having higher density of striae which are more radial in the middle and certainly more or less convergent towards ends. Hence the present diatoms have different structure. They further differ from *N gracilis* Ehr. v. *schizonemoides* V.H. (Frenguelli, 1923, p. 48, t. 4, f. 20) in structure, number of striae and dimensions. There are no other similar diatoms known with which these specimens could be compared. These are therefore considered to be a new species. This species was found in fairly large numbers in samples collected from pools, large ditches, masses of wet liverworts growing over wet rocks in the river bed.

50. *NAVICULA REIMERI* sp. nov. (Figs. 80 - 84)

Valvae 9.6 - 16 μ longae atque 4.7 - 5 μ latae, lineare ellipticae vel late ellipticae lanceolatae, marginibus paulum convexis, apicibus cuneatis, acutis protuberantibus. Rhaphe tenuis et recta, poris centralibus inconspicuis; fissuris terminalibus paulum curvatis. Area axialis angustissima, linearis; area centralis aliquantulum elliptica in axe longo. Striae indistincte etiam in praeparatio Hyraci, ubique radiales. Holotypus: lamina vitrea no. MYS-JOG. 30 : 1655.

Valves 9.6 - 16 μ long and 4.7 - 5 μ broad, linear elliptical to broadly elliptical lanceolate with slightly convex sides and cuneately narrowed, acute beak like ends Raphe thin and straight with central pores inconspicuous, terminal fissures slightly curved. Axial area very narrow, linear; central area very slightly elliptical in long axis. Striae very fine and indistinct even in Hyrax preparation, very slightly radial throughout. Striae may be in order of over 40 in 10 μ.

A table of typical dimensions recorded for this diatom

length	breadth	striae in 10μ
9.6 μ	4.7 μ	?
10.6 μ	4.7 μ	40 - 42 ?
11 - 12.1 μ	4.7 μ	40 ?
12.6 μ	4.8 μ	?
15.7 μ	5 μ	40 ?
16 μ	5 μ	42

This diatom does not compare with any of the known types, hence it is considered to be a new species. It was found in good numbers in samples collected from pools, ditches and wet encrustations of rocks in the river bed. This species is named in honour of my esteemed colleague Dr. Charles Reimer of Philadelphia.

51. *NAVICULA SUBBENGALENSIS* sp. nov. (Figs. 85 - 87)

Valvae 18 - 24 μ longae atque 8.6 - 9.5 μ latae, lineare ellipticae, in medio aliquantulum convexae, apicibus abrupte constrictis, breviter rostratis, truncatis rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus breviter curvatis. Area axialis angusta, linearis; area centralis fere magna ac quadrato rotundata. Striae circiter 10 - 12 in medio vel 14 - 15 in 10 μ ad apices, radiales ac paulum curvatae in medio atque aliquae striae convergentes versus extremitates, striae in mediam partem longe ac breviter evolutae sed numquam alternantes clare punctatae, punctis 24 - 25 in 10 μ. Holotypus: lamina vitrea no. MYS-JOG. 29 : 1654.

Valves 18 - 24 μ long and 8.6 - 9.5 μ broad, linear elliptical, in the middle very slightly convex, ends abruptly constricted, shortly rostrate, truncately rounded. Raphe thin and straight with central pores distinct and terminal fissures shortly curved. Axial area narrow, linear; central area quadrately rounded and fairly large. Striae 10 - 12 in the middle upto 14 - 15 in 10 μ towards ends, radial and slightly curved in the middle and a few slightly convergent towards extremity, in the middle short and long ones present but do not alternate, punctate distinctly, punctae about 24 - 25 in 10 μ.

A table of typical dimensions recorded for this diatom

length	breadth	striae in 10μ
18 - 18.8 μ	9 μ	10 - 11/14 - 15
22.2 μ	8.6 μ	11 - 12/14
23.7 - 24 μ	9.5 μ	11 - 12/14

The present specimens resemble following entities in shape but differ structurally from all of them except *N. bengalensis* Grun., in having at least a few convergent striae towards extreme ends, besides some other details which are pointed out : -

N. von hauseniae Chol., Cholnoky, 1954 b, p. 419, t. 1, f. 64 - 66, dimensions 13 - 15 x 5 - 7 μ, str. 20 in 10 μ.

N. texana Patr., Patrick and Reimer, 1966, p. 445, pl. 39, f. 9, dimensions 18 - 22 x 5 - 7 μ, str. 18 - 21 in 10 μ.

N. orangiana Patr., l.c., p. 446, pl. 40, f. 1, dimensions 17 - 23 x 5 - 6 μ str. 20 - 26 in 10 μ.

N. ancisa Hust., Hustedt, 1927 - 66, III, p 807, f. 1778; - 1954, p. 150, f. 9, dimensions 14 x 5 - 6 μ str. 20 in 10 μ.

All these above named entities have finer structure, hence they cannot be referred to here.

N. explanata Hust., Hustedt, l.c., III, p. 805, f. 1776 a-g; - 1948, p. 207, f. 7 - 8, dimensions 28 - 32 x 9 - 11 μ, str. 12 - 20 in 10 μ, ends in this species are more rostrate and terminal fissures bent in contrary directions.

N. gastrum Ehr., Hustedt, 1930, p. 305, f. 537; Cleve-Euler, 1951 - 55, III, p. 147, f. 801, dimensions 25 - 60 x 12 - 20 μ, str. 8 - 10 in 10 μ, all striae are radial and less in number etc.

N. anglica Ralfs, Hustedt, l.c., p. 303, f. 530 - 531; Donkin, 1871 - 73, p. 35, pl. 5, f. 11 b, dimensions 20 - 40 x 8 - 14 μ, str. 9 - 12 in 10 μ, radial throughout.

N. bengalensis Grun., Hustedt, 1927 - 66, III, p. 722, f. 1703, dimensions 50 - 70 x 20 - 23 μ, str. 10 in 10 μ. It is a very large and robust form although its structure more or less resembles here.

With these observations it is seen that present diatoms do not compare satisfactorily. They are, therefore, considered to be a new species. This species was found in varying numbers in samples collected from pools, ditches, detritus and wet encrustations of rocks in the river bed.

52. *NAVICULA SUBDAPALIFORMIS* sp. nov. (Figs. 71, 88)

Valvae 33.7 - 36 μ longae atque 7.8 - 8.4 μ latae, tenue ellipticae lanceolatae, apicibus late truncatis rotundatisque. Rhaphe tenuis et recta, poris centralibus paulum sed distincte unilateraliter inclinatis, fissuris terminalibus magnis atque semicirculariter curvatis. Area axialis angustissima, linearis; area centralis magna, transversale elliptica vel rectangularis, in latere contrario pororum centralium unum stigmatem cum poro singulo forte elongato formans. Striae circiter 15 - 16 - 18 in 10 μ, ubique radiales ac curvatae, ad apices plus radiales atque magis approximatae, distincte punctatae, punctae circiter 18 in 10 μ, in seriebus longitudinalibus irregulariter undulatis, ordinatae circiter 1 - 1.2 μ ab margine valvae a costa longitudinali decussatae. Holotypus: lamina vitrea no. MYS-JOG. 29 : 1654.

Valves 33.7 - 36 μ long and 7.8 - 8.4 μ broad, narrowly elliptical lanceolate with broad truncately rounded ends. Raphe thin and straight, central pores slightly but distinctly unilaterally bent and terminal fissures large, semicircular and curved. Axial area very narrow, linear; central area large, transversely elliptical to rectangular, on the other side of the central pore one stigma with a strong elongated pore (canal like) is developed. Striae about 15 - 16 - 18 in 10 μ, radial and curved throughout, towards ends somewhat closer and strongly radial, distinctly punctate, punctae about 18 in 10 μ, punctae arranged in irregular wavy longitudinal series, about 1 - 1.2 μ away from the margin longitudinal costa intersects the striae.

This diatom resembles *N. dapalis* Freng. (Hustedt, 1927 - 66, III, p. 606, f. 1609) somewhat in outline and organisation of striae which are interrupted near the margins. However, it differs in being very small, slender, less robust and in having comparatively finer structure. Again, it resembles *N. dapaliformis* Hust. (Hustedt, 1. c., p. 605, f. 1608) in raphe, central area with stigma and strong elongated pore canal and the arrangement of striae.

However, the local specimens differ in having slim valves with broad truncately rounded ends, axial area very narrow, denser structure and terminal fissures of the raphe comparatively large and semicircular. With these observations, therefore, the present diatoms are considered to be a new species. This species was found mostly in very small numbers in samples collected from pools, wet encrustations on rocks in the river bed and masses of wet bryophytes.

53. *NAVICULA SUBDIGNA* sp. nov. (Figs. 89 - 90)

Valvae 15 - 17.2 μ longae atque 5.2 - 5.4 μ latae, ellipticae lanceolatae, lateribus convexis, apicibus constrictis, productis, late capitatis ac rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus paulum curvatis. Area axialis angusta, lineare lanceolata; area centralis magna, fere quadrata vel transversale elliptica. Striae circiter 22 - 24 in medio vel 28 in 10 μ ad apicem, indistincte punctatae, ubique fortiter radiales ac aliquantum curvatae, in medio striae breves ac longae irregulariter evolutae. Holotypus: lamina vitrea no. MYS-JOG. 28 : 1653.

Valves 15 - 17.2 μ long and 5.2 - 5.4 μ broad, elliptical lanceolate, sides convex, ends constricted, produced, broadly capitate and rounded. Raphe thin and straight, central pores distinct and terminal fissures slightly curved. Axial area narrow, linear lanceolate; central area large, almost quadrate to transversely elliptical. Striae about 22 - 24 in the middle upto 28 in 10 μ towards ends, indistinctly punctate, strongly radial and slightly curved throughout, in the middle short and long striae irregularly developed.

This diatom resembles *N. ventralis* Krasske (Krasske, 1925, p. 44, t. 1, f. 17 - 18; Schmidt, 1874 - 1959, *Atlas Diat.*, t. 400, f. 73 - 76; Hustedt, 1927 - 66, III, p. 140, f. 1273 a-d; - 1930, p. 274, f. 450 ?) somewhat in shape, number and arrangement of striae in the middle. However, it differs in having produced, comparatively narrower capitate ends, linear lanceolate axial area and curved terminal fissures. Again, present diatom differs from *N. hustedtii* Krasske (Hustedt, 1927 - 66, III, p. 150, f. 1281 a-c: - 1930, p. 273, f. 449 ?), *N. medioconvexa* Hust. (Hustedt, 1.c., p. 151, f. 1283) and *N. digna* Hust. (Hustedt, 1.c., 152, f. 1284; - 1957, p. 270, f. 14 - 15) in one or the other respects, except that its shape and ends strongly resemble *N. digna*. From these observations, it is felt here to consider present diatoms to be a new species.

This species was found in varying numbers in samples collected from pools and large ditches in the river bed.

54. *NAVICULA THIENEMANNIOIDES* sp. nov. (Fig. 91)

Valvae 15 - 18 μ longae atque 4.5 - 4.8 μ latae, anguste ellipticae, lateribus paulum convexis, apicibus distincte constrictis, productis, late subcapitatis. Rhaphe tenuis et recta, poris centralibus distinctis; fissuris terminalibus breviter curvatis. Area axialis angustissima, linearis; area centralis magna, rotundata. Striae circiter 18 - 20 in medio usque ad 24 - 26 in 10 μ ad apices, ubique radiales ac curvatae, indistincte punctatae, in medio paucae striae abbreviatae. Holotypus: lamina vitrea no. MYS-JOG. 28 : 1653.

Valves 15 - 18 μ long and 4.5 - 4.8 μ broad, narrowly elliptical with slightly convex sides, ends distinctly constricted, produced, broadly subcapitate and rounded. Raphe thin and straight, central pores distinct and terminal fissures shortly curved. Axial area very narrow, linear; central area large and rounded. Striae about 18 - 20 in the middle to 24 - 26 in 10 μ towards ends, radial and curved throughout, indistinctly punctate, a few striae shortened in the middle.

This diatom resembles *N. thienemannii* Hust. (Hustedt, 1927 - 66, III, p. 774, f. 1747; - 1938 - 39, p. 235, t. 17, f. 16 - 17) in shape, capitate ends and somewhat in central area. However, the present specimens differ in having radial and curved striae throughout which are indistinctly punctate. The terminal striae are not at all perpendicular to the middle line. These diatoms do not compare with any other similar looking forms, hence they are considered to be a new species. This species was found in varying numbers in samples collected from rock pools and wet encrustations and mosses.

55. *NAVICULA VARIOSTRIATA* Krasske (Fig. 72)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 404, f. 28 - 30; Krasske, 1923, p. 197, f. 12; - 1925, p. 44, t. 2, f. 20 - 21; Hustedt, 1927 - 66, III, p. 201, f. 1320; - 1930, p. 273, f. 447; Patrick and Reimer, 1966, p. 447, pl. 40, f. 6 : - Valves 21.5 - 31 μ long and 6 - 6.3 μ broad, linear elliptical with very slightly convex sides and broadly rounded ends. Raphe thin and straight with central pores distinct and terminal fissures very shortly curved. Axial area very narrow, linear or linear lanceolate; central area very large and rounded. Striae 16 - 19 in the middle if shortened striae are absent, to about 28 - 30 in 10 μ, fairly radial and curved throughout, finely punctate, in the middle usually many short and long striae are present alternating with one another, sometimes some of the shorter striae may be absent.

This species was found in varying numbers in samples collected from pools, ditches, wet encrustations on rocks and clusters of mosses growing in the river bed.

56. *NAVICULA VARIOSTRIATA* v. *jogensis* v. nov. (Fig. 92)

Valvae 29 - 34 μ longae atque 6 - 6.5 μ latae, lineares, marginibus leniter convexis, apicibus paulum constrictis, late productis atque rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus aliquantum curvatis. Area axialis angustissima, linearis; area centralis magna, transversale elliptica vel rotundata. Striae circiter 16 - 19 in medio usque ad 24 - 27 in 10 μ ad apices, tenuissime punctatae, modice radiales ac curvatae ut in typus. Holotypus: lamina vitrea no. MYS-JOG. 26 : 1651.

Valves 29 - 34 μ long and 6 - 6.5 μ broad, linear, sides slightly convex, ends slightly constricted, broadly produced and rounded. Raphe thin and straight, central pores distinct and terminal fissures slightly curved. Axial area very narrow, linear; central area large, transversely elliptical to rounded. Striae about 16 - 19 in the middle to 24 - 27 in 10 μ towards ends, very finely punctate, moderately radial and curved as in the above type.

This diatom differs from the type in having slightly constricted, broadly produced rounded ends. The central area is comparatively small and generally rounded. It was found in small numbers in samples collected from pools and wet encrustations of rocks in the river bed along with the type.

57. *NAVICULA VENEZUELENSIS* Hust. (Fig. 93)

Hustedt, 1956, p. 115, f. 33 - 36; Gandhi, 1959, p. 109, f. 49 - 50 : - Valves 31.5 - 34 μ long and 6.3 μ broad, striae 12 - 14 in 10 μ, lineations about 28 in 10 μ.

This species compares well with the type described and illustrated by Hustedt and Gandhi.

58. *NAVICULA VENTRALIS* Krasske (Figs. 94 - 95)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 400, f. 73 - 76; Krasske, 1925, p. 44, t. 1, f. 17 - 18; Hustedt, 1927 - 66, III, p. 140, f. 1273 a-d; - 1930, p. 274, f. 450 ?) : - Valves 13 - 17 μ long and 4 - 5.5 μ broad, elliptical with strongly convex sides and constricted broad capitate rounded ends. Raphe thin and straight, central pores inconspicuous and terminal fissures not distinctly curved. Axial area very narrow, linear; central area large transversely rectangular or quadrate. Middle rib present. Striae about 22 - 24 in the middle upto 30 in 10 μ towards ends, strongly radial throughout, indistinctly punctate, in the middle short and long striae are irregularly organised.

This diatom compares well with the type described and illustrated by Hustedt and Krasske. However, local forms slightly differ in breadth which is less. It was collected from pools and large ditches in river bed. Only a few specimens were recorded.

59. *NEIDIUM GRACILE* Hust. (Fig. 96)

Hustedt, 1938 - 39, p. 406, t. 16, f. 8 - 9 esp. 8; Gandhi, p. 311, f. 6 : - Valves 47 - 50 μ long and 7/8.2 - 8.5 μ broad, at the narrowest and broadest sides respectively, striae 21 - 22 (rarely 24) in 10 μ.

The presently illustrated specimen fully compares Hustedt's fig. 8, in the given reference. It presents a slimmer look with more rostrate, somewhat subcapitate rounded ends. Only a few specimens were collected from wet encrustations and mosses growing on wet rocks in the river bed.

60. *NEIDIUM JOGENSIS* sp. nov. (Fig. 97)

Valvae 36 - 39.5 μ longae atque 7.5 - 7.8 μ latae, lineares, marginibus parallelis, apicibus constrictis, distincte capitatis rotundatis atque humeris leviter rotundatis. Rhaphe tenuis et recta, fissuris centralibus valde flexis in directiones contrarias, fissuris terminalibus breviter furcatis. Area axialis angustissima, linearis; area centralis oblique formata, elliptica atque magna. Striae circiter 28 - 30 in 10 μ, in medio oblique positae, ad apices convergentes, subtiliter sed distincte punctatae, sulco longitudinali distincto decussatae, 2 - 3 punctae ab marginibus semoto; sulci secundarii indistincti. Holotypus: lamina vitrea no. MYS-JOG. 29 : 1654.

Valves 36 - 39.5 μ, long and 7.5 - 7.8 μ broad, linear with parallel sides, ends constricted, distinctly capitate, rounded and shoulders smoothly rounded. Raphe thin and straight, central fissures strongly bent in contrary directions and terminal fissures shortly bifurcated. Axial area very narrow, linear; central area obliquely formed, large and elliptical. Striae about 28 - 30 in 10 μ, in the middle obliquely organised and at ends convergent, fine but distinctly punctate, intersected by a clear longitudinal furrow 2 - 3 punctae away from the margins, secondary furrows not evident.

This diatom resembles *N. longiceps* (Greg.) A. Cl. v. *typicum* A. Cl. (Cleve-Euler, 1951 - 55, IV, p. 112, f. 163 a-d, esp. 1163 a), in shape, fine striae and somewhat capitate ends. However, it differs in having clearly punctate striae obliquely organised in the middle part and somewhat larger central area obliquely formed. It again differs from *N. globiceps* A. Cl. v. *biglobosum* A. Cl. (Cleve-Euler, l.c., p. 113, f. 1165 b, e. etc.) in having distinctly punctate striae whereas in Cleve-Euler's type it is much finer. In structure present diatom seems to resemble *N. javanicum* Hust. (Hustedt, 1938 - 39, p. 408, t. 16, f. 12 - 13), but it differs in size, length to breadth proportions, distinctly capitate ends and somewhat smaller and less oblique central area. With these observations, therefore, the present specimens are considered to be a new species.

This species was found in small numbers in samples collected from pools and wet encrustations of rocks in the river bed below the Falls.

61. *NITZSCHIA GRACILOIDES* sp. nov. (Fig. 98)

Valvae 45 - 48 μ longae atque 2 - 2.2 μ latae graciles, lineare lanceolatae, in medio aliquantulum linearis, apicibus constrictis, tenuibus ac longe rostratis, subcapitatis. Carina valde excentrica, angusta, puncta carina minuta, circiter 16 - 18 in 10 μ, irregulariter evoluta; duae punctae medianae non remotae. Striae circiter 40 vel plus in 10 μ tenuissimae ac vix visibiles. Holotypus: lamina vitrea no. MYS-JOG. 25 : 1650.

Valves 45 - 48 μ long and 2 - 2.2 μ broad, slender, linear lanceolate, in the middle slightly linear, ends narrowed, thin long rostrate and somewhat subcapitate. Keel very excentric, narrow, keel punctae about 16 - 18 in 10 μ, minute, irregularly set, two of the middle punctae are not distant. Striae very fine probably 40 or more in 10 μ, not clearly seen.

This diatom differs from all the similar looking types in having very fine structure, fine and larger number of keel punctae or in not having two median punctae apart. It is, hence considered to be an new species. It was found in small numbers in samples collected from pools, ditches and soft detritus lying on wet rocks in the river bed.

62. *NITZSCHIA OBTUSA* W. Sm. v. *scalpelliformis* Grun. f. *parva* Hust. (Fig. 99)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 336, f. 25 - 26; Gandhi, 1962, p. 480, f. 39; Cholnoky, 1953 - 54, p. 221, t. 4, f. 100 (= *N. parvuloides* Chol. f. *curta* Chol.) : - Valves 33 - 38 μ long and 4.7 - 5 μ broad, keel punctae variable, about 9 - 10 (7 - 10) in 10 μ, two of the middle ones are distantly set. Striae about 36 (30 - 36) in 10 μ, finely punctate.

This diatom compares very well the type described by this author, except that the local specimens seem to have higher density of striae. Cholnoky's *N. parvuloides* Chol. is probably akin to *N. ignorata* Krasske, as suggested by illustrations and description.

63. *NITZSCHIA PSEUDOFONTICOLA* Hust. (Figs. 100 - 102)

Hustedt, 1942/49/51, p. 209, f. 4 - 5; - 1957, p. 353, f. 83 - 90 : - Valves 31 - 41.8 μ long and 4.4 - 5 μ broad, narrowly lanceolate with constricted, produced very small and narrow capitate ends. Keel very excentric with keel punctae 8 - 12 in 10 μ, very irregularly set, middle two of them are not set apart, small but distinct. Striae very fine and seen with great difficulty.

This species fully compares the type described and illustrated by Hustedt, except that some larger specimens were also recorded from this area. It was found in varying numbers in samples collected from detritus lying in pools and ditches in the river bed.

64. *NITZSCHIA SOCIABILIS* Hust. (Fig. 103)

Hustedt, 1957, p. 354, f. 91 - 94 : - Valves 25.2 - 30 μ long and 3.5 - 3.8 μ broad, narrowly lanceolate with acute ends. Keel very excentric with very irregularly set keel punctae about 9 - 12 in 10 μ, two of the middle punctae not set apart. Striae very fine about 44 ? in 10 μ, dash-like, scarcely seen.

This species compares well with the type described and illustrated by Hustedt. It was found rather in very small numbers in samples collected from pools and ditches in the river bed below the falls.

65. *NITZSCHIA SUBACICULARIS* Hust. (Fig. 104)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 348, f. 76; Hustedt, 1938 - 39, p. 490, t. 41, f. 12 : - Valves 36.2 - 40 μ long and 2.6 μ broad, spindle shaped, narrowly lanceolate with long rostrate, acutely rounded thin ends. Keel very excentric and narrow, keel punctae about 13 - 16 in 10 μ, irregularly set, very small, two of the middle ones not set apart nor the keel is notched. Striae fine, about 33 in 10 μ, sometimes not quite distinct.

This species compares well with the type described and illustrated by Hustedt. He illustrated this type with capitate ends in his specimens from Belgische-Congo (Hustedt, 1949, p. 157, t. 11, f. 61). This species was usually found in small numbers in samples collected from pools and ditches in the river bed below the Falls.

66. *PINNULARIA DIVERGENTISSIMOIDES* sp. nov. (Figs. 105 - 106)

Valvae 48 - 50.5 μ longae atque 6.4 μ latae, lineares, marginibus subparallelis vel indistincte triundulatis, apicibus leniter constrictis, late subcapitatis ac rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis atque unilateraliter inclinatis, fissuris terminalibus curvatis. Area axialis angusta, sublinearis; area centralis maxima, rhomboidea ad latera perveniens. Striae circiter 10 - 11 in 10 μ, fortiter radiales in medio atque fortiter convergentes ad apices, crassae et distinctae. Holotypus: lamina vitrea no. MYS-JOG. 25 : 1650.

Valves 38 - 50.5 μ long and 6.4 μ broad, linear with subparallel or indistinctly triundulate sides, ends slightly constricted, broadly subcapitate and rounded. Raphe thin and straight, central pores distinct and unilaterally inclined and terminal fissures curved. Axial area narrow, sublinear; central area very large, rhomboid and reaching the sides. Striae about 10 - 11 in 10 μ, very strongly radial in the middle and very strongly convergent towards ends, coarse and distinct.

This diatom resembles *P. divergentissima* (Grun.) Cl. (Hustedt, 1924, p. 567, t. 19, f. 14; - 1930, p. 320, f. 581) in having slender valves, broadly capitate rounded ends and arrangement of striae. However, it differs in having linear

or very feebly triundulate sides, somewhat fewer and less radial and convergent striae. It does not compare with any other types. It is therefore considered to be a new species. It was found in small numbers in samples collected from pools and wet encrustations on rocks in the river bed.

67. *PINNULARIA INTERRUPTA* W. Sm. (Fig. 107)

Gandhi, 1959, p. 319, f. 19; 1958, p. 259, f. 15; 1960, p. 93, f. 37 - 39 : - Valves 34 - 40 μ long and 6.2 - 7.4 μ broad, striae 11 - 12 in 10 μ.

This diatom was found in good numbers in several samples collected from the area. The present illustration is given of a form which showed less capitate ends.

68. *PINNULARIA MICROSTAURON* (Ehr.) Cl. (Fig. 108)

Hustedt, 1930, p. 320, f. 582; Gandhi, 1960, p. 91, f. 28 - 29 : - Valves 47 - 57 μ long and 9.8 μ broad, striae 10 - 12 in 10 μ.

This species was found in good numbers in several samples collected from the area. The present illustration is given to indicate slightly oblique central area that was found in some specimens.

69. *PINNULARIA MICROSTAURON* f. *biundulata* O. Müll. (Fig. 109)

Hustedt, 1930, p. 320, f. 583; Müller, 1898, p. 72, t. 3, f. 7 - 8 (= v. *biundulata*); Gandhi, 1960, p. 90, f. 27 (= *P. brébissonii* v. *producta* f. *biundulata* (O. Müll.) A. Cl.) : - Valves 45 - 50.8 μ long and 8.5/9 μ broad, striae 10 - 12 in 10 μ.

The presently illustrated specimen shows somewhat cuneately rounded ends and only slightly concave sides in the middle. It was found in a small number in samples collected of detritus lying in pools and large ditches in the river bed.

70. *PINNULARIA PUSILLA* Gandhi (Fig. 110)

Gandhi, 1959, p. 111, f. 59 - 62, esp. 61 : - Valves 33.3 - 35 μ long and 6 - 6.2 μ broad, striae 12 - 13 in 10 μ, central area very large, rhomboid and reaching the sides.

This diatom compares well with the type described and illustrated by this author. However, the specimens from the present locality show slightly broad and more produced ends. The central area is also somewhat larger than recorded in earlier specimens.

71. *PINNULARIA SCHWEINFURTHI* (A.S.) Hust. (Fig. 112)

Schmidt, 1874 - 1959, *Atlas Diat.*, t. 388, f. 4 - 7; t. 44, f. 4 - 5 (= *Navicula schweinfurthi* A. S.); Cleve, 1895, II, p. 79 (= *P. divergens* W. Sm. v. *schweinfurthi* (A.S.) Cl.) : - Valves 112.2 - 118 μ long and 17.2 - 18 μ broad, linear, with sides parallel, feebly concave or convex, ends subcuneate, broadly rounded. Raphe thick but simple with central pores distinct, large comma shaped reflexed; terminal fissures thick bayonet shaped curved. Axial area wide, about 1/6 - 1/5 the width of the valves, linear; central area large, rhomboid and reaching the sides. Striae 7.5 - 9 in 10 μ, thick, closely set, strongly radial in the middle and convergent towards ends, very broad longitudinal bands intersect them.

This species compares very well with the type described and illustrated by Hustedt, but the number of striae are found to be slightly less per 10 μ than mentioned by Cleve (11 - 12 in 10 μ). This species was found in small numbers in samples collected from large pools and ditches in the river bed.

72. *PINNULARIA STOMATOPHORA* Grun. v. *gibbosa* Hust. f. *jogensis* f. nov. (Fig. 113)

Valvae 115.3 - 120 μ longae atque 14.2 - 14.5 μ latae, lineares, paulum sed distincte inflatae in medio, ad apicem dilatatae ac leviter rotundatae. Rhaphe crassa sed simplex, poris centralibus distinctis fissuris terminalibus magnis, crassis atque hamo similibus. Area axialis modice lata, linearis; area centralis magna, elliptica in axe longo, in nodulo centrali in quoque segmento scapo lunaeformi notata. Striae circiter 12 in 10 μ, crassae, arcte positae, fortiter radiales in medio atque convergentes ad apices. Holotypus: lamina vitrea no. MYS-JOG. 26 : 1651.

Valves 115.3 - 120 μ long and 14.2 - 14.5 μ broad, linear, slightly but distinctly inflated in the middle with swollen, broadly rounded smooth ends. Raphe thick but simple with central pores distinct and terminal fissures large thick and bayonet shaped. Axial area fairly large, linear; central area large eilliptical in long axis, marked on either sides by lunate hazy marking or shaft. Striae about 12 in 10 μ, thick, closely set, strongly radial in the middle and convergent towards ends, also curved.

This diatom closely resembles *P. stomatophora* v. *gibbosa* Hust., as described and illustrated by Hustedt (Hustedt, 1954, p. 126, f. 50) in shape, inflations, organisation of striae etc., but the present specimen differs in not having the central area reaching the sides. It is, therefore, considered to be a new form. It was found in small numbers in some samples collected from large pools in the river bed.

73. *PINNULARIA SUBCAPITATA* Greg. v. *hilseana* (Jan.) Müll. (Fig. 111)

Hustedt, 1930, p. 317, f. 572; Gandhi, 1960, p. 93, f. 40 : - Valves 34 - 40 μ long and 5.6 μ broad, striae 12 - 13 in 10 μ.

This diatom was found in varying numbers in samples collected from various wet situations in the area. It is distinguished from the type proper by its slender valves, comparatively small non-rhomboid central area and short subcapitate rounded ends.

74. *PINNULARIA SUBGRACILOIDES* sp. nov. (Fig. 114 - 115)

Valvae 53 - 62 μ longae atque 8.5 μ latae, lineares, marginibus indistincte triundulatis vel linearis, apicibus constrictis, aliquantum valvis angustioribus productis, subcapitatis atque rotundatis. Rhaphe tenuis et leniter undulata (subcomplexa !), poris centralibus unilateraliter inclinatis, fissuris terminalibus aliquantum crassis ac vadose curvatis. Area axialis angusta, linearis; area centralis magna, rhomboidea ad latera perveniens. Striae circiter 10 - 12 in 10 μ, valde radiales in medio, convergentes ad apices atque arcte positae. Holotypus: lamina vitrea no. MYS-JOG. 22 : 430.

Valves 53 - 62 μ long and 8.5 μ broad, linear, sides indistinctly triundulate to linear, ends constricted, slightly narrower than valves, produced, subcapitate and rounded. Raphe narrow and slightly undulate (subcomplex !), central pores unilaterally inclined and terminal fissures slightly thick and shallow curved. Axial area narrow, linear; central area large, rhombic and reaching the sides. Striae about 10 - 12 in 10 μ, strongly radial in the middle and convergent towards ends and closely set.

This diatom resembles *P. graciloides* Hust. (Gandhi, 1959, p. 318, f. 16, 37 - 39), in structure and general shape. However, it differs from it in having very linear sides with or without indistinct triundulate walls, raphe not very distinctly undulate, smaller range of dimensions and more slender look. It also resembles *P. subsimilis* recorded below, in the arrangement of striae but differs in other details. It does not compare well with any other similar forms, hence it is considered to be a new species. It was found in fair numbers in samples collected from rock pools, detritus, clusters of wet liverworts and Podostemads, encrusting wet rocks in the river bed.

75. *PINNULARIA SUBSIMILIS* sp. nov. (Figs. 116 - 118)

Valvae 43 - 67 μ longae atque 8.5 - 10 μ latae, lineares vel lineare lanceolatae, marginibus leniter concavis, convexis vel raro subparallelis, apicibus paulum sed distincte constrictis, late productis, cuneatis rotundatis Rhaphe tenuis et paulum undulata, poris centralibus distinctis atque unilateraliter inclinatis ac fissuris terminalibus leniter curvatis. Area axialis modice lata, lineare lanceolata; area centralis maxima, rhomboidea ad latera perveniens. Striae circiter 10 - 12 in 10 μ, arcte positae, valde radiales in medio ac convergentes ad apices; vitta longitudinalis indistincta. Holotypus: lamina vitrea no. MYS-JOG. 18 : 426.

Valves 43 - 67 μ long and 7.6 - 10 μ broad, linear to linear lanceolate, sides very slightly concave, convex to rarely subparallel, ends slightly but distinctly constricted, broadly produced, cuneately rounded. Raphe narrow and slightly undulate, central pores distinct and unilaterally inclined, terminal fissures slightly curved. Axial area moderately wide, linear lanceolate; central area very large, rhomboid and extended to sides. Striae 10 - 12 in 10 μ, closely set, strongly radial in the middle and convergent towards ends, longitudinal band indistinct.

A table of typical dimensions recorded for this diatom

length	breadth	striae in 10μ
43 μ	7.6 μ	10 - 11
50.6 μ	9 μ	10 - 11
50 - 57 μ	8.5 μ	10 - 12
67 μ	10 μ	10 - 12

This diatom more or less resembles *P. similis* Hust. (Schmidt, 1874 - 1959, *Atlas Diat.*, t. 385, f. 10 - 11; Hustedt, 1938 - 39, p. 291, t. 23, f. 12 - 13) as described and illustrated by Hustedt. However, the present specimens differ in having constricted, produced and cuneately rounded ends, central area much larger and clearly rhomboid than in *P. similis*, besides wider axial area. Again, they differ from *P. subcapitata* Greg., as illustrated by Hustedt (Hustedt, 1949, p. 101, t. 8, f. 6 - 15) in structure, raphe and other details although some illustrations look like some of the specimens given here. From these observations it is felt to consider these specimens as a new species. This species belongs to Divergentes group. It was found in varying numbers in samples collected from wet encrustations on rocks, rock pools, clusters of wet mosses and detritus found in the river bed.

76. *PINNULARIA VIRIDIS* (Nitz.) Ehr. (Figs. 122 - 124)

Hustedt, 1924, p. 571, t. 20, f. 3; - 1930, p. 334, f. 617 a; - 1949, p. 109, t. 8, f.21; Patrick and Reimer, 1966, p. 639, pl. 64, f. 5 : - Valves 88 - 99 μ long and 14.3 - 15.6 μ broad, striae 8.5 - 9 in 10 μ.

A table of typical dimensions recorded for this diatom

length	breadth	striae in 10μ
88 μ	14.3 μ	9
90 μ	14.3 μ	9
99 μ	15.6 μ	8.5 - 9

The specimens illustrated here particularly compare the illustration given by Hustedt, 1949, of specimens from Belgium-Congo. They evidently belong to *P. viridis* cycle because of narrow axial area, small unilaterally dilated central area and narrow longitudinal bands intersecting the striae. Moreover, some of the local specimens represented broad cuneately rounded ends. Many specimens collected from this area were found in various division stages, the illustration given here shows two forms enclosed with in the old walls.

77. *PINNULARIA VIRIDIS* v. *intermedia* Cl. (Figs. 125 - 127)

Hustedt, 1930, p. 335; Gandhi, 1957, p. 16, f. 8 : - Valves 65 - 88 μ long and 14 - 14.3 μ broad, striae 8 - 9.5 in 10 μ.

A table of typical dimensions recorded for this diatom

length	breadth	striae in 10μ
65 - 70 μ	14 μ	8 - 9
74.2 - 78 μ	14.3 μ	9 - 9.5
88 μ	14.3 μ	9

78. *PINNULARIA VIRIDIS* v. *mayeri* A. Cl. (Figs. 119 - 121)

Cleve-Euler, 1951 - 55, IV, p. 74, f. 1103 e-i; Mayer, 1940, p. 143, 164, t. 2, f. 2 (= v. *fallax* Cl.) : - Valves 60 - 72 μ long and 14 - 15 μ broad, linear with cuneately rounded to broadly rounded ends. Raphe thick, complex with central pores distinct and unilaterally bent and terminal fissures thick and curved. Axial area narrow, linear lanceolate, somewhat unilaterally formed; central area slightly expanded and unilaterally rounded. Striae 8.5 - 9 in 10 μ, scarcely radial, parallel and almost perpendicular to the middle line but towards ends very slightly convergent, thick with narrow longitudinal bands distinct.

This diatom differs from the main type in having scarcely radial or almost perpendicular striae in the middle and feebly convergent towards ends. It also fits well the description given by Cleve-Euler. This diatom was found in varying numbers in samples collected from wet rocks in the river bed. It was also found with detritus lying in pools. Some of the specimens were found in dividing stages.

79. *PINNULARIA VIRIDIS* v. *paludosa* Hust. (Fig. 128)

Hustedt, 1938 - 39, p. 405; Schmidt, 1874 - 1959, *Atlas Diat.*, t. 390, f. 8 (= *P.* (*ruttneri* var. ?) *paludosa* Hust.) : - Valves 80 - 97.5 μ long and 17 - 18 μ

broad, linear or sublinear with broadly rounded or somewhat cuneately rounded ends. Raphe thick and very strongly undulate and complex, central pores distinct and unilaterally inclined and terminal fissures thick and curved. Axial area narrow about 1/4 - 1/5 the width of the valves, linear lanceolate; central area slightly expanded and somewhat unilaterally more rounded. Striae mostly 8, rarely 8 - 9 in 10μ, slightly radial in the middle and convergent towards ends, crossed by a narrow longitudinal band.

This diatom compares well with the type described and illustrated by Hustedt. It is recognised from the type proper by strongly undulate well folded raphe and less number of striae. This entity was found in small numbers in samples collected from wet encrustations of rocks in the river bed along with above types.

80. *STAURONEIS ALPINA* Hust. (Fig. 129)

Hustedt, 1927 - 66, II, p. 782, f. 1127; - 1943, p. 154, f. 18 - 19 : - Valves 16.3 - 20.5 μ long and 4.7 - 5 μ broad, very delicate, linear with feebly convex sides in some, ends abruptly constricted, rostrate, truncately rounded. Raphe thin and straight with central pores slightly distinct and terminal fissures slightly curved. Axial area very narrow, linear; central area a rectangular stauros, 3.8 μ wide. Striae about 38 - 40 in 10 μ, very fine and finely punctate, slightly radial throughout.

This species was collected in varying numbers from pools, ditches, wet mosses growing in the river bed. It occurred in light brown slimy matter. It compares well with the type except that local specimens seem to be little broader.

81. *STAURONEIS ANCEPS* Ehr. v. *hustedtii* nov. var. (Fig. 130)

Valvae 71 - 80 μ longae atque 15.5 - 16 μ latae, lanceolatae, apicibus acutis vel indistincte productis ac rotundatis. Rhaphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus aliquantum curvatis. Area axialis angustissima, linearis; area centralis tenuis rectangulariter stauroidea, prope 1.5 μ lata. Striae circiter 28 in 10 μ, tenuissime punctatae, ubique radiales sed ad apices plus radiales. Holotypus: lamina vitrea no. MYS-JOG. 25 : 1650.

Valves 71 - 80 μ long and 15.5 - 16 μ broad, lanceolate with acute or indistinctly produced rounded ends. Raphe thin and straight with distinct central pores and slightly curved terminal fissures. Axial area very narrow, linear; central area a very narrow rectangular stauros, about 1.5 μ wide. Striae about 28 in 10 μ, finely punctate, radial to strongly radial towards ends.

This diatom compares closely *S. anceps* v. *javanica* Hust. (Hustedt, 1938 - 39, p. 222, t. 15, f. 4) in shape, apices, very narrow central area. However, no dimensional details are available. Again, Hustedt has accounted another diatom under " v. *javanica* Hustedt" (Hustedt, 1936, p. 154, t. 1, f. 10; - 1927 - 66, II, p. 774, f. 1120 e) with linear elliptical outline and short capitate rounded ends. In this latter work he seems to have given no reference to his specimen recorded from Java, Bali and Sumatra (1938 - 39). With these observations, therefore, it is felt here to give a new status to present specimens which seem to be identical of Hustedt's *S. anceps* v. *javanica* Hust. 1938 - 39. This diatom was found in very small numbers in samples collected from light brown slimy detritus lying in pools, ditches and wet encrustations of rocks, in the river bed below the Falls.

82. *STAURONEIS ANCEPS* v. *hyalina* Brun et Perag. f. *capitata* f. nov. (Figs. 131 - 132)

Valvae 63.2 - 70 μ longae atque 11.8 - 12.6 μ latae, subellipticae lanceolatae, apicibus distincte constrictis, productis ac tenue capitatis rotundatis. Striae circiter 30 - 32 in 10 μ, tenuissime-punctatae, omnino gradatim fortiter radiales. Coeterum ut in typo. Holotypus: lamina vitrea no. MYS-JOG. 27 : 1652.

Valves 63.2 - 70 μ long and 11.8 - 12.6 μ broad, subelliptical lanceolate, ends distinctly constricted, produced and narrowly capitate rounded. Striae about 30 - 32 in 10 μ, very finely punctate, throughout gradually strongly radial. In all other characters like the type.

This diatom has already been considered by the author (Gandhi, 1966, p. 160, f. 126) under *S. anceps* v. *hyalina*, but now after a close scrutiny it is felt here to give it a new designation, because of its having capitate ends as a constant feature. It was found in varying numbers in samples collected from pools and ditches in the river bed containing fine detritus.

83. *STAURONEIS KRIEGERI* Patrick (Figs. 133 - 134)

Hustedt, 1927 - 66, II, p. 780, f. 1126 a-b; Reimer, 1961, p. 203, pl. 2, f. 12; Patrick and Reimer, 1966, p. 362, pl. 30, f. 5; Hustedt, 1930, p. 257, f. 409 (= *S. pygmaea* Krieger) : - Valves 16.3 - 26.8 μ long and 5.4 - 6 μ broad, linear with almost parallel or feebly convex sides, at ends abruptly constricted, rostrate to subcapitate rounded. Raphe thin and straight, terminal fissures slightly curved. Axial area very narrow, linear; central area a narrow rectangular stauros, about 0.7 - 1 μ wide, slightly widened outwardly. Striae about 28 - 30 in 10 μ, fine clearly punctate and slightly radial throughout.

This species was found in varying numbers in samples collected from several wet situations in the river bed. It compares well with the type.

84. *STAURONEIS TENUIS* sp. nov. (Figs. 135 - 136)

Valvae 16 - 18 μ longae atque 6 μ latae, lineare ellipticae, marginibus aliquantum convexis, apicibus abrupte constrictis, breviter rosttatis, truncatis ac rotundatis. Rhaphe tenuis et recta, poris centralibus proxime positis; fissuris terminalibus breviter curvatis. Area axialis augustissima, linearis; area centralis angusta, rectangulariter stauroidea. Striae circiter 30 - 33 in 10 μ, tenuissime punctatae, modice radiales. Holotypus: lamina vitrea no. MYS-JOG. 28 : 1653.

Valves 16 - 18 μ long and 6 μ broad, linear elliptical, sides slightly convex, ends abruptly constricted, short rostrate and truncately rounded. Raphe thin and straight with central pores distinct and closely set and terminal fissures shortly curved. Axial area very narrow, linear; central area a narrow rectangular stauros. Striae about 30 - 33 in 10 μ, very finely punctate and moderately radial.

This species resembles *S. wislouchi* Poret. et Anisi. (Hustedt, 1927 - 66, II, p. 792, f. 1137), in shape and rostrate apices. However, it differs from it in having finer structure throughout, narrower stauros and uniformly set striae. It does not agree with any other similar diatom, hence it is considered to be a new species. It was found in usually small numbers in samples collected from pools, large ditches and wet encrustations of rocks in the river bed.

85. *SYNEDRA PULCHELLA* Kütz. v. *minuta* Hust. (Fig. 137)

Hustedt, 1927 - 66, II, p. 192, f. 688 i; - 1930, p. 160, f. 191 : - Valves 17.2 - 20 μ long and 4 μ broad, linear with cuneate ends. Pseudoraphe narrow, linear; central area very large reaching the sides, sides somewhat thickened in the middle. Striae about 13 in 10 μ, fine but clearly punctate and perpendicular to the middle line.

This diatom fairly compares the type illustrated and described by Hustedt, except that local specimens were found to be somewhat broad. It was found in very small numbers in samples collected from some pools and ditches in the river bed mixed in detritus.

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The Further Analysis of Diatom Samples Continued from the Previous Account

Additional Records for Table - 1

Name of the Diatom	Sample categories showing the qualitative pattern of formation							Distribution in a few neighbouring geographical regions						Known ecological data		Remarks
								Haw.Ins.I.M.A. J.B.S.Isl.	Afghanistan	Fed. S. Mal.	Sagar	Bom. Sal. Isl.		HALOBION	pH	
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
Achnanthes																
oo - *fasciata* sp.nov.		r		s		s	s									
o - *linearis* (W.Sm.) Grun.v.*pusilla* Grun.	s	s	vr	vn	s	vn	s							I	I	
oo - *submontana* sp.nov.		s		vn	s	v	r									
o - *trigibba* Hust.		s		s		s	s									
Caloneis																
o - *bacillaris* (Greg.) Cl. v. *cuneata* (Kolbe et Krieger) A.Cl.	vr	s		s		s	s									
Cocconeis																
o - *hustedtii* Krasske		lf		lf	s	vn		+	+					HP	A	**
Eunotia																
- *lunaris* (Ehr.) Grun. v.*subarcuata* (Naeg.) Grun.	vs			s	s		s			+			+	I/HP	I	
oo - *porcelloides* sp. nov.				vn	s		s									
o - *praerupta* Ehr.v. *bidens* (W.Sm.) Grun.		s		vs		r	s			+				HP	AA	
oo - *rivularis* sp. nov.				s	s	s										
oo - *saravathense* sp.nov.	s			vn	s		s									
oo - *sublunaris* sp. nov.				s	s		s									

Frustulia															
oo - *jogensis* sp. nov.		s	s	s	vs		s								
Gomphocymbella															
o - *ancyli* (Cl.) Hust.		vs		s	s	s									
Gomphonema															
o - *hebridense* (Greg.) Hér.				vn	s	vn	s								
o - *intricatum* Kütz. v. *pusillum* May	s			s		s	s								
- *lacus-rankala* Gandhi v. *gracilis* Gandhi				vs			vs								
oo - *saravathense* sp. nov.				vn	vn	s	s								
oo - *submalayense* sp. nov.			s	vn		s	vs								
Navicula															
o - *anglica* Ralfs	s			vn	s		vn	+	+	+		I	A	**	
o - - v. *signata* Hust.	s			s	s		s					I	A		
o - *bacillum* Ehr.		s		vn	s	s	s	+	+	+		I/HP	I	**	
oo - - v. *capitata* v. nov.		s		s	s		vs								
oo - *charlatii* Perag. v. *jogensis* v. nov.		s		s	s										
oo - - v. *lanceolata* v. nov.				s	s	s									
o - *cinctaeformis* Hust.		s		lf	vn		s	+	+						
o - *confervacea* Kütz. v. *rostrata* Krasske		s		s	s	s	vs					I	I		
o - *decussis* Øst.		s		lf	vn	s	s		+			I	A	**	
o - *dissipata* Hust.		s		s	s		s								
o - *digitulus* Hust.		?		vn	vn		s		+						
oo - *elata* sp.nov.		s		vn	s	s	s								
o - *feuerborni* Hust.				vn	vn	s	r	+		+		HP?	A		
oo - - v. *rostrata* v. nov.				s	vs	s									
oo - *inflata* sp.nov.	s			s	vn	s	s								

o - *mutica* Kütz.v. *intermedia* Hust.	s	s	vs	s	s		s					I	I		
o - *oppugnata* Hust.				lf	vn		s					I	A		
oo - *ramosissimoides* sp. nov.		s		f	vn	s									
oo - *reimeri* sp.nov.		vn	s	f	s	s	vs								
oo - *subbengalensis* sp. nov.		s		vn	s		vn								
oo - *subdapaliformis* sp.nov.		s		s	s		vn								
oo - *subdigna* sp. nov.		lf		lf	s	s	vn								
oo - *thienemanniioides* sp.nov.		s		s	s	vn	s								
o - *variostriata* Krasske		s		vn	vn	vn	s	+		+		HP	I		
oo - - v. *jogensis* v. nov.				s	s	vn									
- *venezuelensis* Hust.				s		s									
o - *ventralis* Krasske		s		lf	s					+		I	I		
Neidum															
oo - *jogensis* sp. nov.	s	vn	s	vn			s								
Nitzschia															
oo - *graciloides* sp. nov.		s		vn	vn	s	vn								
o - *speudofonticola* Hust.		vn		lf	s	s	vn						I	I	
o - *sociabilis* Hust.	s	vn		vn	vs		s						I	A	
- *subacicularis* Hust.		s		s	s		s								
Pinnularia															
oo - *divergentissimoides* sp.nov.		r		vn	s	s	s								
- *microstauron* (Ehr.) Cl. f. *biundulata* O. Müll.		s		vn	s		s					+	I	I	
- *pusilla* Gandhi		s		vn	s	s	vn								
o - *schweinfurthii* (A.S.)Hust.				s											

Table - 1a

				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
o	oo	Total	66	19	35	10	66	56	38	43	5	6	7	2	-	2			** 4
29	30																		
27	25	Previous total	243	162	229	90	243	218	241	230	103	122	86	82	76	135			* 6 ** 100
56	55	Grand total	309	181	264	100	309	274	279	273	108	128	93	84	76	137	Separately considered		6 104
17.80	18.12	Percentages		58.58	85.44	32.26	100.0	88.67	90.29	88.35	34.95	41.42	30.10	27.18	24.60	44.34			1.94 33.66

Now, in the Halobion Spectrum percentage values of Mesohalobous, Meso-halob./Halophilous, Halophilous and Indifferent categories are depressed and there is a corresponding rise in percentage values in categories of Indifferent/Halophobous, Halophobous and unknown ?. This clearly indicates that the diatomflora of this region is purely of fresh-water with least or no preference for chlorides. The diatoms (118 + 44 = 162) of which Halobion category is so far not certainly known, it is believed that they probably confine to Indifferent, Indifferent/Halophobous and Halophobous categories.

While referring to pH-spectrum, it now appears that only Indifferent and ? unknown categories show the percentage rise with a corresponding depression of percentage values in other categories. It is felt here that (120 + 44 = 164) taxa of which pH rate is not known - they probably belong to Indifferent, Indifferent/acidophilous and acidophilous groups. This seems to find support from the range of pH-values 6.7 to 7.5 which were recorded of waters from this area.

From the point of view of 8-dominant genera of diatoms considered here (on the basis of a genus containing 10 or more taxa), *Navicula* continues to head the list as in the neighbouring geographical regions as also mentioned earlier. Moreover, with addition of 27-*Navicula* (27 + 27) its percentage and numerical values are greatly improved from 11.11 % to 17.4757 % and 27 to 54 taxa, respectively. This has become more comparable with that of other regions.

The second place is now taken up by *Pinnularia* which was third before. Its percentage and numerical values are also improved from 10.3 % to 11.32 % and 25 to 35 taxa, respectively. It has become more important and comparable with that of Java, Bali and Sumatra Islands and Federated States of Malaya.

The *Achnanthes* with 27 taxa has receded to the third place. However, it still ramains more important than elsewhere.

The fourth place is now distinctly occupied by *Gomphonema* by competing *Nitzschia*. The *Nitzschia* has become less important in this area as well as in comparision with other neighbouring geographical areas.

The rest of the dominant genera continue to accupy the same position as stated earlier.

The percentage and numerical values of new records for India and new taxa are also increased. The new records for India have now become from 27 to 64 taxa i.e. from 11.11 % to 20.7120 % and new taxa from 25 to 54, i.e. 10.28 % to 17.476 %. It also indicates that 64-taxa which are new records for India find larger range for their geographical distribution.

(Jog-Falls Diatoms, 1966: Errata - Tab. 11 fig. no. 36 should be read as 37, Jog-Falls Diatoms, 1966: Errata - Tab. 11 fig. no. 37 should be read as 36).

N.B. The signs and symbols or abbreviations used here in Table - 1 are the same as used previously in 1966.

Table - 2

A table showing the analysis of genera of diatoms with number of taxa, percentages and their order of dominance (revised)

Name of genus	No. of taxa	%	order of dominance	New taxa	New records	Name of genus	No. of taxa	%	Order of dominance	New taxa	New records
Achnanthes	31	10.0324	III	5	10	*Gomphocymbella*	1	0.3236			1
Amphora	4	0.2945				*Gomphonema*	26	8.4142	IV	5	3
Anomoeoneis	5	1.6181			1	*Hantzschia*	4	1.2945			1
Caloneis	7	2.2654			1	*Melosira*	5	1.6181			1
Ceratoneis	1	0.3236		1		*Navicula*	54	17.4757	I	15	16
Cocconeis	4	1.2945			1	*Neidium*	7	2.2654		1	
Cyclotella	6	1.9417				*Nitzschia*	25	8.0906	V	1	2
Cymbella	13	4.2071	VIII		2	*Pinnularia*	35	11.3269	II	8	10
Diploneis	6	1.9418		2		*Rhopalodia*	4	1.2945			
Epithemia	3	0.9707				*Stauroneis*	9	2.9126		2	3
Eunotia	23	7.4434	VI	11	2	*Surirella*	16	5.1780	VII	2	1
Fragilaria	7	2.2654				*Synedra*	8	2.5890		1	1
Frustulia	5	1.6181		1							

With the further discovery of 66-diatoms from the Jog-Falls, the halobion- and pH-spectra, order of dominant genera and certain other ecological data given previously need the following modifications:

Halobion Spectrum

Halobion category		No. of forms	% out of total bulk modified %	Previous %
Mesohalobous		3	0.9709	1.23
Mesohalobous/Halophilous		1	0.3236	0.41
Halophilous		5	1.6181	2.05
Halophilous/Indifferent		7	2.2654	2.90
Indifferent	96 + 16	112	36.2459	39.50
Indifferent/Halophobous	6 + 2	8	2.5890	2.46
Halophobous	7 + 4	11	3.5596	2.90
? unknown	118 + 44	162	52.4272	48.56
Total		309	99.9997	100.01
∓			0.0003	0.01

pH - Spectrum

pH category		No. of forms	% out of total bulk modified %	Previous %
Alkaliphilous	63 + 6	69	22.3301	25.93
Alkaliphilous/Indifferent		13	4.2071	5.35
Indifferent	36 + 15	51	16.5048	14.81
Indifferent/Acidophilous		2	0.6472	0.82
Acidophilous	9 + 1	10	3.2362	3.70
? unknown	120 + 44	164	53.0744	49.39
Total		309	99.9998	100.00
∓			0.0002	

Plate - I: Figures 1 - 2. *Achnanthes fasciata* sp. nov. 3 - 4. *A. lanceolata* Bréb. 5 - 6. *A. linearis* (W. Sm.) Grun. v. *pusilla* Grun. 7 - 8. *A minutissima* Kütz. v. *cryptocephala* Grun. 9 - 10. *A. submontana* sp. nov. 11 - 12. *A. trigibba* Hust. 13. *Anomoeoneis exilis* (Kütz.) Cl. 14 - 15. *Caloneis bacillaris* (Greg.) Cl. v. *cuneata* (Kolbe et Krieger) A. Cl. 16 - 20. *Cocconeis hustedtii* Krasske 21. *Cymbella sagarensis* Gandhi, 22. *C. ventricosa* Kütz. 23 - 25. *Eunotia alpina* (Naeg.) Hust 26. *E. lunaris* (Ehr.) Grun. v. *subarcuata* (Naeg.) Grun. 27. *E. porcelloides* sp. nov. 28. *E. praerupta* Ehr. v. *bidens* (W. Sm.) Grun. 29. *E. rivularis* sp. nov. 30 - 31. *E. saravathense* sp. nov. 32. *E. sublunaris* sp. nov. 33. *Frustulia jogensis* sp. nov. 34. *Gomphocymbella ancyli* (Cl.) Hust. 35. *Gomphonema gracile* Ehr. 36. *G. hebridense* (Greg.) Hér. 37. *G. intricatum* Kütz. v. *pusillum* May. 38. *G. saravathense* sp. nov. 39. *G. submalayense* sp. nov. 40 - 44. *G. subtile* Ehr. v. *malayensis* Hust.

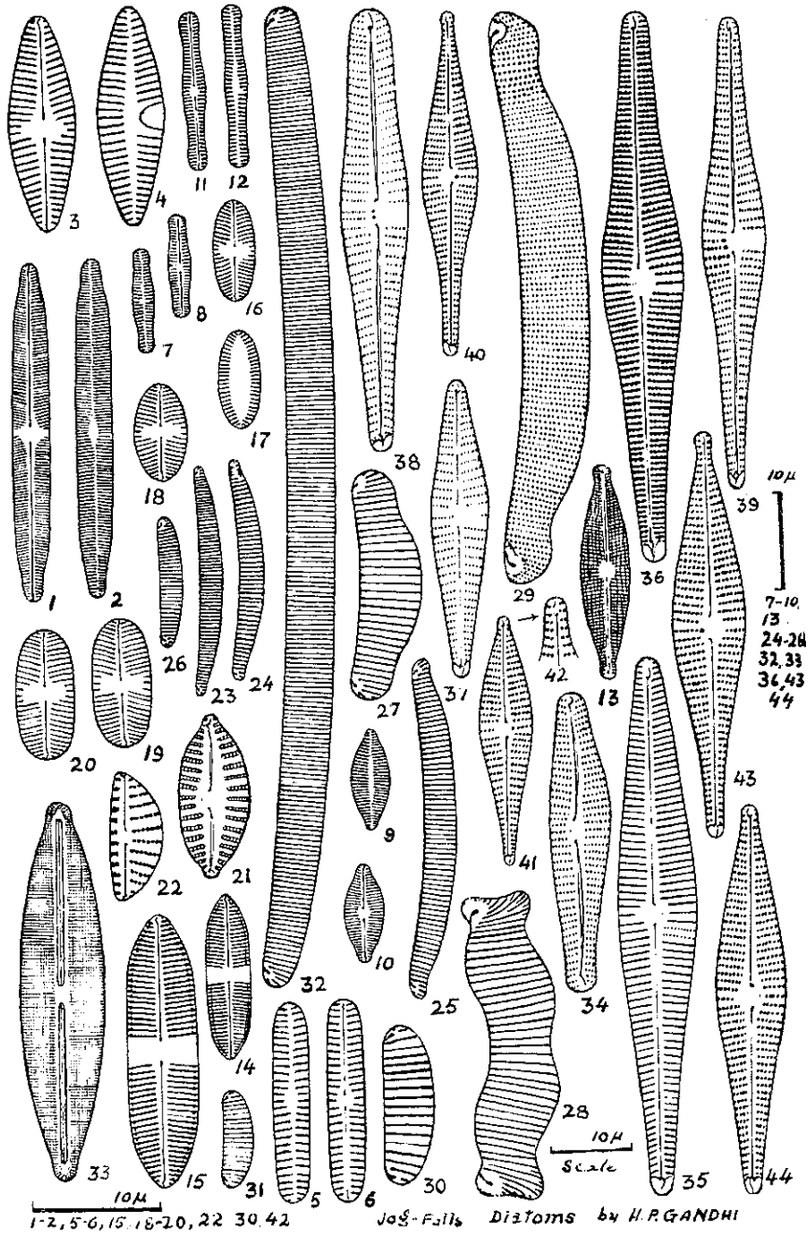

Plate - II: Figures 45. *Navicula anglica* Ralfs 46. *N.* - v. *signata* Hust. 47. *N. bacillum* Ehr. 48. *N.* - v. *capitata* v. nov. 49 - 51. *N. charlatii* Perag. v. *jogensis* v. nov. 52 - 56. *N.* - v. *lanceolata* v. nov. 57 - 58. *N. cinctaeformis* Hust. 59. *N. confervacea* Kütz. v. *rostrata* Krasske 60. *N. cryptocephala* Kütz. 61 - 62. *N. decussis* Østr 63. *N. digitulus* Hust. 64 - 65. *N. dissipata* Hust 66 - 67. *N. feuerborni* Hust. 68 - 69. *N* - v. *rostrata* var. nov. 70. *N. inflata* sp. nov. 71. *N. subdapaliformis* sp. nov. 72. *N. variostriata* Krasske.

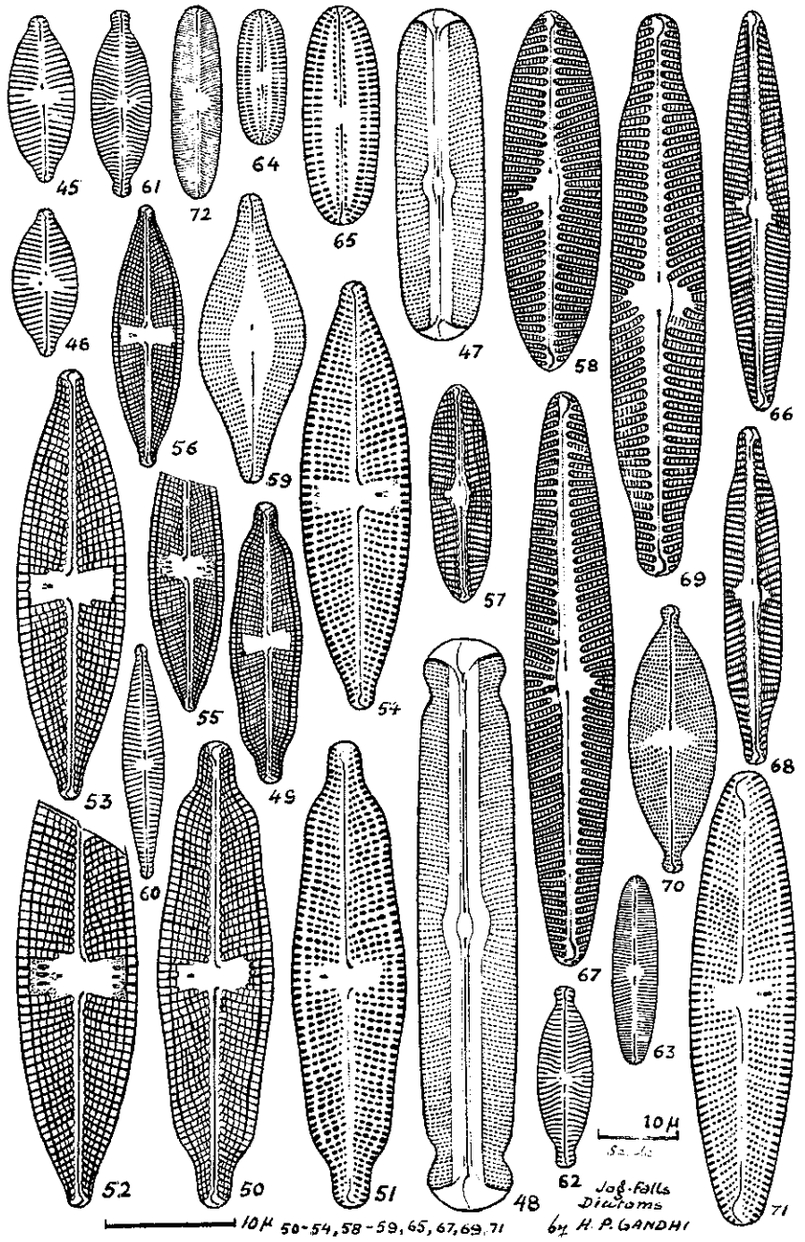

Plate - III: Figures 73. *Navicula elata* sp. nov. 74. *N mutica* Kütz. f. *intermedia* Hust. 75 - 76. *N. oppugnata* Hust. 77 - 79. *N. ramosissimoides* sp. nov. 80 - 84. *N. reimeri* sp. nov. 85 - 87. *N subbengalensis* sp. nov. 88. *N. subdapaliformis* sp. nov. 89 - 90. *N subdigna* sp. nov. 91. *N. thienemannioides* sp. nov. 92. *N. variostriata* Krasske v. *jogensis* v. nov. 93. *N. venezuelensis* Hust. 94 - 95. *N ventralis* Krasske 96. *Neidium gracile* Hust. 97. *N jogensis* sp. nov. 98. *Nitzschia graciloides* sp. nov. 99. *N. obtusa* W. Sm. v. *scalpelliformis* Grun. f. *parva* Hust. 100 - 102. *N. pseudofonticola* Hust. 103. *N. sociabilis* Hust. 104. *N subacicularis* Hust. 105 - 106. *Pinnularia divergentissimoides* sp. nov. 107. *P. interrupta* W. Sm. 108. *P. microstauron* (Ehr.) Cl. 109. *P.* - f. *biundulata* O. Müll. 110. *P. pusilla* Gandhi 111. *P. subcapitata* Greg. v. *hilseana* (Jan.) Müll.

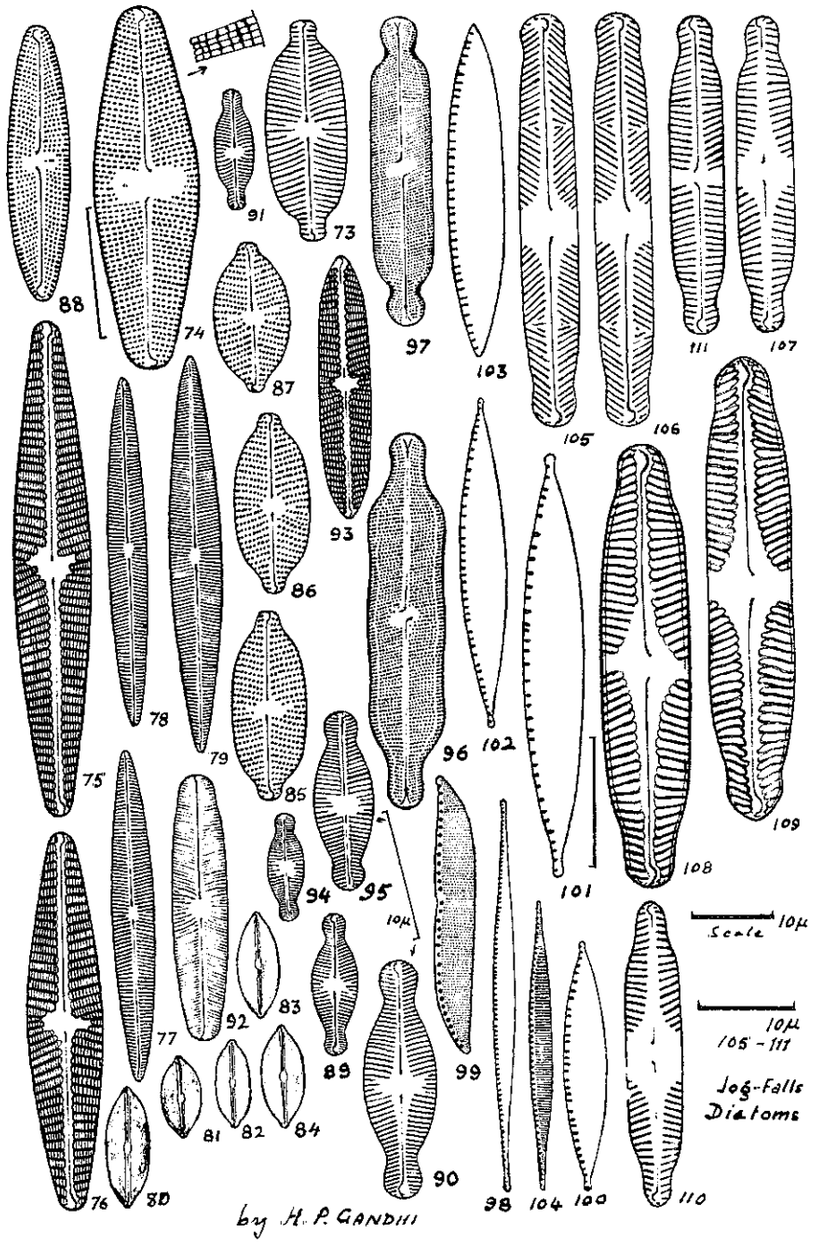

Plate - IV: Figures 112. *Pinnularia schweinfurthi* (A. S.) Hust. 113. *P. stomatophora* Grun. v. *gibbosa* Hust. f. *jogensis* f. nov. 114 - 115. *P subgraciloides* sp. nov. 116 - 118. *P. subsimilis* sp. nov. 119 - 121. *P. viridis* (Nitz.) Ehr. v. *mayeri* A. Cl.

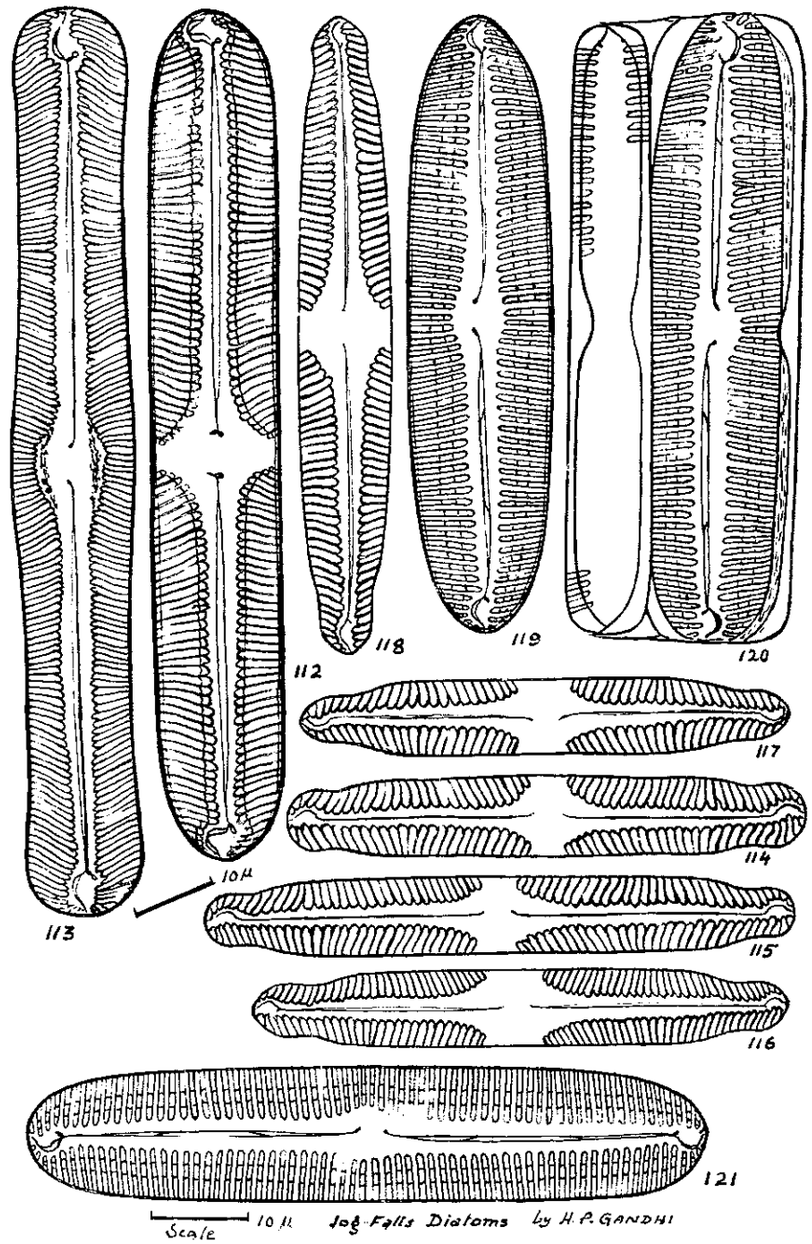

Plate - V: Figures 122 - 124. *Pinnularia viridis* (Nitz.) Ehr. 125 - 127. *P.* - v. *intermedia* Cl. 128. *P.* - v. *paludosa* Hust. 129. *Stauroneis alpina* Hust. 130. *S. anceps* Ehr. v. *Hustedtii* v. nov. 131 - 132. *S.* - v. *hyalina* Brun et Perag. f. *capitata* f. nov. 133 - 134. *S. kriegeri* Patrick 135 - 136. *S. tenuis* sp. nov. 137. *Synedra pulchella* Kütz. v. *minuta* Hust.