

The Fresh-Water Diatomflora of the Jog-Falls, Mysore State

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With plates 11 (1) - 19 (9)

Introduction

The author, in course of his studies on the Diatomflora of South Western zone of the Peninsular India (1952-1963) and otherwise, has given two brief notes (1957, 1960) and stray references (1958, 1959, 1962) on diatoms of the Jog-Falls. This is all the information thus far available in this respect. Having to pass through unforeseen difficulty, financial hardship, frequent transfers or its apprehension and the attendant instability coupled with inimical attitudes typical of referees and editors of Indian scientific bodies - this discouraged the author and dissuaded him all the while from checking up the larger part of these studies completed in 1956. However, it is now felt desirable to bring them out lest they become vitiated although the local conditions and prospects have become none better.

In earlier notes (1957, 1960), the author has already given the location and some other details of this area to which it may be added that it forms the southern part of the Western Ghat ranges with practically the same geographical, climatal and topographical features as are recorded for its northern counterpart. Likewise, is the geological character mentioned by the author (1962) for Lonavla. The way to the Jog-Falls or the Gersoppa-Falls: from Bhadrawati (on Birur-Talguppa line of the Southern Railway) to Shimoga 16-kilometers by road and on to the Jog-Falls 105-kilometers again by the road is a pleasant journey through woodlands. The nearest railway station is Talguppa and from where it is located at about 16-kilometers away by the bus-route. However, it is more convenient to get a bus from Sagar as it starts from there covering a distance of about 34-kilometers.

The Jog-Falls is an enchanting spot cradled in the Western Ghats in a scenic surrounding. The river Saravati takes an abrupt leap in a

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chasm some 960 feet or 293 meters below the rocky cliffs, splitting itself into four strands so called: the Raja, the Roarer, the Rocket and the Rani, and uniting at the base in the river bed. The spectacle is said to be grand, enchanting and enthralling especially on the full-moon nights. This fall is recorded as the second highest in the world (highest is the Angels-Fall in South America), though it may not be so in expanse and magnitude.

The whole area is mountainous and heavily forested being under the direct influence of the South West monsoon winds which precipitate here heavily. In this consequence, therefore, it is punctuated with numerous small and large water courses, wet hill inclines with perpetually streaming water, water holes, pools, puddles and the like. The wet rocky cliffs with streaming water were usually found festooned with heavy growth of mosses, liverworts, various filamentous algae, thick encrustations of Cyanophyta, small ferns and a profusion of herbaceous angiosperms. The rocky bed or wet rock boulders splashed over with falling or dashing water currents in the river were mostly found overgrown with the Blue-Greens and Podostemads, the latter especially under swift currents.

In all some 30-samples of algae were collected from various wet situations mentioned above, within a compass of a mile, in 1955 (12-1-1955) besides several plant specimens on a botanical excursion to this area. Out of these, 2-3 samples originate from pools and puddles in a wet field and the rest of them from various water holes and veins along the serpentine track leading to the base of the chasm 960 feet below the cataract, and various pools, ditches and wet rocks there in the river bed. These samples tentatively are categorised as under:-

1. pools and puddles of the open land or fields with slimy matter and detritus;
2. water holes on rocky hill inclines overgrown with Bryophytes and other herbaceous plants;
3. streams oozing out from rocky hill inclines and puddles formed there sometimes with overflowing water;
4. pools and puddles or ditches in the rocky bed and other wet sheltered spots with encrustations and detritus;
5. rapidly flowing water courses fringed with Podostemads, Cyanophyta and other filamentous algae;
6. wet rocks splashed over with water having heavy coat of matter of various hues;
7. sediments and detritus in pools and ditches with still water.

Many of these samples were collected in the form of wet encrustations and some from pool detritus and sediments. The samples derived from encrustations seemed to have high Calcium carbonate content. The pH-value seemed to vary between 6.7-7.5. The stagnant pools and puddles with detritus and some water holes of "no. 2-category" seemed to be somewhat acidic to neutral and the rest of them were alkaline.

Having examined all the samples collected from this area, it can be said that so limited an area of collection it still harboured a rich variety and good number of diatoms. Other large algae also were well represented as some are accounted by IYENGAR (1958-1963). The diatom element found here is mostly of cosmopolitan nature and comparatively fair number of typically tropical forms have been noted besides some native ones. The flora fairly and favourably compares with that of Indonesian and Malayan regions as accounted by HUSIEDR (1936, 1938-1939, 1942), PAIRICK (1936) and PROWSE (1962) and contrasts from that of Afghanistan accounted by FOGED (1959) if the cosmopolitan element is set aside. In the Table 1, given at the end of the paper, this is indicated, besides several other features of the Diatomflora occurring in this area. The locally occurring elements are qualitatively determined of their frequency with reference to the above named categories, their known halobion and pH-data are indicated and also their distribution in the neighbouring geographical regions. On the basis of the existing Halobion and pH-data spectra are drawn and their results are presented with remarks. The Table 1, also provides an estimation of percentage values of different diatom populations from above stated group-bodies of water and the dominance of diatom genera in order of their precedence is indicated separately. For this purpose only such genera are considered which contained 10 or more taxa. Again, from the percentage values available, it is appreciated that how diatom populations tended to occur in different bodies of water or wet situations. A general pattern of this distribution in the locality could be thus brought into relief.

While presenting this account, all the diatom taxa are included here even though some of them are treated elsewhere with a view to present a composite picture. However, the previously recorded diatoms are merely listed and in some cases additional illustrations are given with remarks thereon, if it was felt necessary. The new records for India and new taxa are fully described. The number of illustrations are given to emphasize the variations occurring in their form or structure. All the diatoms are treated here in alphabetic order - both genera and species with their forms and varieties. This course is

followed for the sake of convenience and also to avoid taxonomic commitments in view of the new taxa discovered here and elsewhere by other workers.

Systematic Enumeration

1 *Achnanthes affinis* GRUN

HUSTEDI, 1930, 199, f. 282.

This species was found in varying number in several bodies of water but more especially in rock pools with vegetable detritus and wet mosses growing over there.

2 *Achnanthes biasoletiana* (KÜIZ.) GRUN

HUSTEDI, 1930, 199, f. 289.

This species was recorded usually in a small number in certain pools, puddles and other bodies of water with detritus.

3. *Achnanthes biasoletiana* v. *minuta* CL. (Figs 1-2)

CLEVE-EULER, 1951-55, III, 42, f. 573a-e (esp. 573a-b):— Valves 12-14 μ long, and 4.4-5 μ broad, linear-elliptical with constricted broadly rostrate rounded ends. Valve with raphe: raphe thin and straight; axial area very narrow; central area slightly formed; striae fine but clear about 24 in 10 μ , radial throughout. Valve without raphe: pseudoraphe narrow, sublinear; central area slightly formed, roundish; striae about 24-26 in 10 μ , fine but clear and radial.

This diatom was found in varying number in pools, puddles and ditches in the river bed below the cataract mixed up in slimes and detritus. It compares very closely with CLEVE-EULER's description and illustration.

4. *Achnanthes crenulata* GRUN (Figs. 154-155)

HUSTEDI, 1938, 206, t. 14, f. 7-8; GANDHI, 1960, 85, f. 17-18:— Valves 34.7 μ long and 15.8 μ broad, broadly lanceolate with acutely rounded ends. Striae on the rapheless valve about 7 in 10 μ , very coarsely punctate, alveolar, alveoli about 6-7 in 10 μ .

This species has been previously described by the author for which some illustrations were presented, the presently discovered specimen shows more lanceolate shape with acute apices and is proportionately broader than previously mentioned specimens. Recently, CHOINOKY

(1963, 158, t. 25, f. 1-2) recorded this species from Africa of which two illustrations are given - one having lanceolate shape and the other linear which is comparable to author's v. *linearis* GANDHI. PROWSE (1962, 25, pl. 4, f. V) has recorded linear specimens from Malaya and considered them to be the type proper

5. *Achnanthes crenulata* v. *elliptica* GANDHI (Figs. 156-157)

GANDHI, 1960, 86, f. 15-16:—Valves $53\ \mu$ long and $15.8\ \mu$ broad, and striae about 8 in $10\ \mu$.

This diatom has been previously recorded by the author with some illustrations and the present illustrations are given to show further range of variation as noted. MEISTER has considered such elliptical forms as *A. undata* MEIS. (1934, 97, t. 5, f. 47) but according to this author they are certainly a variety of *A. crenulata* GRUN. as suggested by the structure

6. *Achnanthes crenulata* v. *linearis* MEIS. ? GANDHI

GANDHI, 1960, 85, f. 12-14; MEISTER, 1934, 96, t. 5, f. 42.

This diatom has been previously described by the author and on the basis of very large number of specimens observed of linear outline, hence they were considered as v. *linearis* GANDHI MEISTER has also recorded such linear forms from Yokohama which seem to have somewhat larger alveoli.

7. *Achnanthes elata* (LEUD.-FORT.) GANDHI (Figs. 3-5, 158-159)

GANDHI, 1960, 82, f. 3-7, 10.

This species has already been considered by the author with certain remarks. Here some more illustrations are given to suggest the range of variation as noted in the form and structure.

8. *Achnanthes elata* v. *curvula* GANDHI (Figs. 6-7)

GANDHI, 1960, 84, f. 8, 11:—Valves $88.9\ \mu$ long and $17.8\ \mu$ broad; striae on the raphe valve 8.5 in $10\ \mu$ and on rapheless valve 8 in $10\ \mu$; alveoli about 8-9 in $10\ \mu$.

This diatom has been described by the author earlier in which smaller range of dimensions were mentioned. From further examination of the material larger forms were detected with slightly more coarsely punctate striae (alveolar structure), hence the present illustrations are given.

9. *Achnanthes exigua* GRUN.

HUSIEDI, 1930, 201, f. 286.

This species was found in varying number in several bodies of water in the region. However, it was more abundantly seen in rock pools with vegetable detritus and wet mosses growing there.

10. *Achnanthes exigua* v. *heterovalvata* KRASSKE

HUSIEDI, 1930, 202, f. 288.

This diatom was found mostly with the above type usually in a small number and its distribution seemed to be limited.

11. *Achnanthes exilis* KÜTZ.

HUSIEDI, 1930, 198, f. 278.

This species was found mostly in rock pools in the river bed mixed up in slime and vegetable detritus or clusters of wet mosses.

12. *Achnanthes hungarica* GRUN

HUSTEDT, 1930, 201, f. 283.

This species was found usually in a small number in some samples from pools and ditches in the river bed below the falls. Stray specimens also were noted from other wet situations.

13. *Achnanthes inflata* (KÜTZ.) GRUN. (Figs. 8-10)

HUSIEDI, 1930, 209, f. 307.

This species was found in varying number and seldom gregariously from among the clusters of wet mosses and liverworts growing around the ditches and pools. It also occurred in certain water streams flowing from the hill inclines. The present illustrations are given to indicate further outline variations as noted.

14. *Achnanthes inflata* v. *gibba* GANDHI

GANDHI, 1960, 81, f. 1-2.

This diatom has already been accounted.

15 *Achnanthes inflata* v. *javanica* nov. var. (Figs. 38-39)

Frustules broadly linear and bent from the middle in girdle view. Valves 70-81 μ long and 22-22.5 μ broad, linear, tri-gibbous with broadly cuneate rounded ends. Valve with raphe: raphe thin and straight with conspicuous central pores and short but clearly curved terminal fissures; axial area fairly broad, linear; central area rhomboid and reaching the sides; striae about 8-9 in 10 μ , coarsely punctate (structure alveolar), punctae 9-10 in 10 μ , radial throughout. Valves without raphe: pseudoraphe narrow and unilaterally disposed; central area absent; striae about 9-9.5 in 10 μ , coarsely punctate (structure alveolar), punctae about 10 in 10 μ , striae transverse in the middle but curved at the ends.

Frustulae late lineares, flexae in medio in aspectu zonali. Valvae 70-81 μ longae atque 22-22.5 μ latae, lineares, trigibbosae, apicibus late cuneatis rotundatis. Valvae raphida: raphe tenuis et recta, poris centralibus conspicua; fissuris terminalibus brevi sed distincte curvatis; area axialis modice lata linearis; area centralis rhomboidea ad latera perveniens; striae circiter 8-9 in 10 μ , crasse punctatae (structura alveolaris) punctis circiter 9-10 in 10 μ , ubique radiales. Valvae sine raphide: pseudoraphe angusta, unilateralis evoluta; area centralis absenta; striae 9-9.5 in 10 μ , crasse punctatae, punctis circiter 10 in 10 μ (structura alveolaris), striae transversales in medio ac curvatis ad apicem. Holotype slide no. MYS-JOG. 12:420

This diatom compares with *A. inflata* (KÜTZ.) GRUN. as recorded by BOYER (BOYER, 1916, 59, pl. 16, f. 7-8) but the description given is far from complete and no details of dimensions are available. Moreover, it is much different from the typical *A. inflata* KÜTZ. as indicated in many authentic works. FRENGUELLI considered similar looking forms as *A. inflata* v. *elata* (LEUD.-FORI) HUSI. (FRENGUELLI, 1941, 235, t. 1, f. 1-2) but these forms seem to be robust and have median tumidity more pronounced and somewhat dilated cuneately rounded apices as are noted here, and which also very favourably compare with HUSIEDI'S *A. inflata* (KÜTZ.) GRUN. (HUSIEDI, 1938, 205, t. 14, f. 11 esp.) rather than with *A. inflata* v. *elata* (LEUD.-FORI) HUSI. Again, HUSIEDI'S *A. inflata* v. *elata*, has been considered by this author as *A. elata* (LEUD.-FORI) GANDHI, a distinct species from *A. inflata* on the basis of several specimens observed of various dimensions with coarser structure. Moreover, *A. elata* is only medially gibbous (mono-gibbous type) whereas *A. inflata* is both medially and terminally gibbous (tri-gibbous type). Having observed hundreds of specimens of *A. inflata* from the entire zone of Western India and a profusion or gregarious formations of them at several localities in Junagadh - that all of them seemed to have beautifully smooth and

rounded terminal gibbositities. In this respect, therefore, the specimens of BOYER, FRENGUELLI, HUSTEDI under the quoted references and the present ones are different as they have more or less cuneately rounded apices and have coarser structure. It is, hence, felt here to consider these specimens as a new variety of *A. inflata* KÜTZ. if not a new species.

This diatom was found sparingly in samples collected from pools and ditches in the river bed below the falls, associated with wet mosses and Podostemads. Stray specimens also were found in samples from water holes on way down to the falls occasionally associated with *A. inflata*, *A. crenulata* and *A. elata* etc., mentioned above.

16 *Achnanthes jogensis* sp. nov. (Figs. 11-12)

Frustules narrowly linear, bent in the middle in girdle view. Valves 19-22 μ long and 6-6.6 μ broad, elliptic-lanceolate with constricted, short but broadly capitate ends. Valve with raphe: raphe thin and straight with distinct central pores and shortly curved terminal fissures indistinctly seen; axial area very narrow; central area elliptical in long axis; striae fine, about 18-20 in 10 μ , radial throughout, somewhat closely set towards ends. Valves without raphe: pseudoraphe narrow, linear; central area slightly formed; striae about 20-22 in 10 μ , radial throughout, in the middle a few short and long are present.

Frustulae anguste lineares, flexae in medio in aspectu zonali. Valvae 19-22 μ longae atque 6-6.6 μ latae, ellipticae lanceolatae, apicibus constrictis brevi et late capitatis. Valvae raphida: raphe tenuis et recta, poris centralibus distinctis, fissuris terminalibus brevi curvatis indistincte visibilis; area axialis angustissima; area centralis elliptica in axe longo; striae tenuis, circiter 18-20 in 10 μ , ubique radiales et proximae positae ad apicem. Valvae sine raphide: pseudoraphe anguste lineares; area centralis fere evoluta; striae circiter 20-22 in 10 μ , ubique radiales, in medio pauci striae breves et elongatae. Holotype slide no MYS-JOG 7:415

This species does not compare with any of the known similar looking types, hence it is considered as a new species.

This diatom was found in varying number in samples from pools, puddles and ditches in the river bed often mixed up in clusters of wet mosses, liverworts and other vegetable detritus. Stray specimens also were noted in samples from water holes along the track leading to the base of falls.

17 *Achnanthes lanceolata* (BRÉB.) GRUN. (Figs. 13-14, 40-41)

HUSTEDI, 1930, 207, f. 306a; 1927-1963, II, 408, f. 863a-d; SCHMIDI, 1874-1959, Atlas Diat., t. 411, f. 26-27 (esp.); VAN DER

WERFF en HUIS, 1957-1963, pl. P. C. F. XV 96a-e; CLEVE-EULER, 1951-55, III, 25, f. 527a-e, x-y (= v. *genuina* MAY):—Valves 14-29 μ long and 5-7.8 μ broad, narrowly elliptic-lanceolate with slightly or not constricted broadly rostrate rounded ends. Valve with raphe: raphe thin and straight; axial area narrow, linear; central area quite large, roundish-rectangular; striae about 9-12 in 10 μ , coarse, radial throughout and the middle 2-3 often short giving rise to large central area. Valves without raphe: pseudoraphe narrowly lanceolate following the outline of the valve; central area scarcely widened with a clear characteristic horse-shoe shaped area on one side; striae about 11-13 in 10 μ , coarse and radial.

This species was found from pools, puddles and ditches in the river bed below the cataract. It was more abundantly noted from clusters of wet mosses and liverworts along the way downwards to the falls and water holes. Specimens recorded from this area seemed to have less density of striae.

18. *Achnanthes lanceolata* f. *capitata* O. MÜLL. (Figs. 42-43)

HUSIEDI, 1930, 208; 1927-1963, 410, f. 863g-h; SCHMIDI, 1874-1959, Atlas Diat., t. 411, f. 41-42; VAN DER WERFF en HUIS, 1957-1963, pl. P. C. F. XV 96a-b:—Valves 14-20 μ long and 6-7 μ broad, elliptic lanceolate with constricted clearly capitate rounded ends. Valve with raphe: raphe thin and straight; axial area narrow, linear; central area less large than the above type, transversely elliptic-rectangular; striae 12-14 in 10 μ , coarse and radial throughout. Valve without raphe: pseudoraphe very narrowly lanceolate; central area slightly formed with a clear large characteristic horse-shoe shaped area developed on one side; striae 12-13 in 10 μ , coarse and radial.

This diatom was found in fair number from pools and ditches along with the above type, often mixed up with wet mosses and small liverworts. The presently illustrated specimens very closely compare with illustrations given by VAN DER WERFF whereas HUSIEDI's specimens seem to be somewhat more lanceolate. In a certain way present specimens tend to be intermediate between f. *capitata* and v. *rostrata* (ØST.) HUST.

19. *Achnanthes lanceolata* v. *dubia* GRUN (Figs. 15-21)

VAN HEURCK, 1896, 283, pl. 8, f. 337 (*A. lanceolata* BRÉB. v. *dubia* GRUN.); MAYER, 1917, I, 26, t. 2, f. 25a-c:—Valves 11-19 μ long and 6.3-7.8 μ broad, broadly lanceolate-elliptical with very slightly con-

stricted, produced rounded ends. Valve with raphe: raphe thin and straight with central pores distinct and terminal fissures very slightly curved at extremity; axial area narrowly linear; central area fairly wide transversely rectangular or rectangular elliptical, sometimes small but never reaching the sides; striae about 12-14-15 in $10\ \mu$, coarse and radial throughout. Valve without raphe: pseudoraphe very narrowly lanceolate or linear-lanceolate; central area scarcely formed but with a characteristic large and clear horse-shoe shaped area present on one side; striae about 13-14 in $10\ \mu$, coarse and radial throughout, sometimes one striae in the middle is shortened.

This diatom was found in a large number in some pools and ditches in the river bed with clusters of mosses, liverworts and Podostemads etc. and elsewhere in a small number particularly in water holes on way down to the falls. This diatom seems to be a subject of varied consideration by different authors and hence the taxonomic status of this is confused. HUSIEDI considered *v. dubia* GRUN. (HUSIEDI, 1927-63, II, 410, f. 863i-m) under *v. rostrata* (ØST.) HUSI. and illustrated clearly rostrate apices; MAYER has given a different illustration (MAYER, 1919, 199, t. 6, f. 22a-b) for this diatom which is comparable to *f. capitata* O. MÜLL and *v. rostrata*, in contrast to his earlier specimen; FRENGUELLI's *A. lanceolatum v. dubia* GRUN. (FRENGUELLI, 1942, 96, t. 11, f. 1-2) fairly compares here but the apices seem to be more distinctly produced, and CLEVE-EULER's illustrations indicate more acutely rounded ends. Further, HUSIEDI has described *A. lanceolata v. robusta* HUSI. (HUSIEDI, 1938, 202, t. 13, f. 47-49; SCHMIDI, 1874-1959, Atlas Diat. t. 411, f. 38-40) with which the present specimens very well compare in the outline and structure but then the density of striae noted here to be high, hence the comparison becomes difficult. However, this author feels that *A. lanceolata v. dubia* GRUN. under the given diagnosis should be considered as a distinct entity.

The typical dimensions noted for *A. lanceolata v. dubia* GRUN.

Length in μ	Breadth in μ	Striae in $10\ \mu$
11	6.3	12-14
12-6-13	6.6	12-14
12	6.6	13-14
14	7	13
15.7	7.8	11-13
16	7.7	13-14
19	7.7	11-13

20. *Achnanthes lanceolata* v. *elegans* A. CL. (Figs. 44-48)

CLEVE-EULER, 1951-55, III, 26, f. 5270:— Valves 20-26 μ long and 6.3-7.2 μ broad, lanceolate to slightly elliptic-lanceolate with distinctly produced rounded ends, sometimes ends very indistinctly capitate. Valve with raphe: raphe thin and straight with terminal fissures very slightly curved; axial area very narrow, linear; central area fairly large transversely rectangular-elliptical; striae 12-14 in 10 μ , indistinctly punctate, coarse and radial throughout but less so towards ends. Valve without raphe: pseudoraphe narrowly lanceolate; central area slightly formed in long axis with a fairly large and distinct horse-shoe area present on one side; striae 12-13 in 10 μ , coarse and radial throughout like the raphe valve.

This diatom was found in good number in pools, puddles and ditches in the river bed and other places. It occurred mixed with wet mosses, liverworts and vegetable detritus. The present specimens conform well with CLEVE-EULER's specimen.

21. *Achnanthes lanceolata* v. *laterostrata* v. nov. (Figs. 22-23)

Valves 6-10 μ long and 4.5-5.4 μ broad, elliptic-lanceolate with constricted very broadly rostrate rounded ends. Valve with raphe: raphe thin and straight with central pores distinct; axial area narrow, linear; central area fairly wide, rectangular; striae about 12-15 in 10 μ , coarse and radial throughout. Valves without raphe: pseudoraphe narrow, sublinear; central area scarcely formed with a distinct large horse-shoe shaped area developed on one side; striae 13-14 in 10 μ , radial and distinct.

Valvae 6-10 μ longae atque 4.5-5.4 μ latae, elliptic-lanceolatae, apicibus constrictis, late rostratis rotundatis. Valvae raphida: raphe tenuis et recta, poris centralibus distincte; area axialis angusta linearis; area centralis modice lata, quadrata; striae circiter 12-15 in 10 μ , crasse et ubique radiales. Valvae sine raphide: pseudoraphe angusta sublinearis; area centralis parum evoluta, ad latus unum area solea clara et magna evoluta; striae circiter 13-14 in 10 μ , radiales et distincte. Holotype slide no MYS-JOG. 26:1651

This diatom was found in varying number along with above mentioned entities in samples from pools and ditches having wet cluster of mosses and liverworts. This diatom does not compare with any of the known types having unilaterally formed horse-shoe shaped area. However, it bears evident relationship with *A. lanceolata* (BRÉB.) GRUN. with regards to structure and unilateral horse-shoe shaped area, hence it is considered as its new variety.

22 *Achnanthes lanceolata* v. *rhomboidea* v. nov. (Figs. 49-51)

Valves 10-15 μ long and 6-6.5 μ broad, clearly rhomboid elliptical with distinctly constricted broadly capitate rounded ends. Valves with raphe: raphe thin and straight with central pores distinct; axial area narrow, linear; central area quadrate or transversely rectangular; striae about 12-13 in 10 μ , coarse, distinct and slightly radial throughout. Valves without raphe: pseudoraphe narrow, lanceolate; central area rarely formed with distinct and large horse-shoe shaped area developed on one side; striae about 12 in 10 μ , coarse and slightly radial throughout, lineate.

Valvae 10-15 μ longae atque 6-6.5 μ latae, clare rhombio-ellipticae, apicibus distincte constrictis, late capitatis rotundatis. Valvae raphida: raphe tenuis et recta, poris centralibus distincte; area axialis angusta linearis; area centralis quadrata vel transapicali rectangularis; striae circiter 12-13 in 10 μ , crasse, distincte et ubique aliquantum radiales. Valvae sine raphide: pseudoraphe angusta, lanceolata; area centralis haud evoluta, ad latus unum area solea distincte et magna evoluta; striae circiter 12 in 10 μ , crasse, ubique aliquantum radiales, lineatae. Holotype slide no. MYS-JOG. 25:1650.

This diatom was found in varying number in samples from pools, puddles and ditches in the river bed below the falls in association of above mentioned forms. It is recognised as a new variety of *A. lanceolata* (BRÉB.) GRUN. because of the common range of striae and structure, besides it possessed characteristic horse-shoe shaped area on one side, but differing in the outline which is here distinctly rhomboid.

23 *Achnanthes lanceolata* v. *rostrata* (OSI.) HUSI. (Figs. 24-25, 52-53)

HUSIEDI, 1927-1963, II, 410, f. 863i-m; SCHMIDI, 1874-1959, Atlas Diat. t. 411, f. 32-35; VAN DER WERFF en HUIS, 1957-1963, pl. P. C. F. XV 96a-b; HUSIEDI, 1930, 208, f. 306b (*A. lanceolata* BRÉB. v. *rostrata* HUSI):— Valves 11-16 μ long and 5-5.7 μ broad, linear to linear elliptical with somewhat abruptly constricted, rostrate or rostrate capitately rounded ends. Valves with raphe: raphe thin and straight; axial area narrow, linear; central area fairly broad, transversely quadrate or rectangular due to shortening of the striae; striae about 11-13 in 10 μ , coarse, slightly radial throughout. Valves without raphe: pseudoraphe lanceolate broad or narrow with horse-shoe shaped area developed in the middle on one side of the wall; striae about 12-13 in 10 μ , coarse and radial throughout.

This diatom was found in varying number in several samples collected from pools, puddles, ditches and variety of water holes in the region. It was also noted from among the clusters of wet mosses and liverworts fringing the rock pools. The present specimens differ from those illustrated by VAN DER WERFF in being more linear. However, they conform with HUSTEDI's specimens. In a number of forms observed, it was also noted that in some, apices were shortly rostrate in others more evidently rostrate or indistinctly capitate.

24. *Achnanthes linearis* (W. SM.) GRUN.

HUSTEDI, 1927-1963, II, 378, 821 a-b; 1930, 198, f. 276 (= *A. linearis* W. SM.).

This species was found usually in varying number in several bodies of water in the area but it was more prevalent in clusters of wet mosses and small liverworts.

25. *Achnanthes microcephala* (KÜTZ.) GRUN.

HUSTEDI, 1927-1963, II, 376, f. 819 a-c; 1930, 198, f. 273 (= *A. microcephala* KÜTZ.)

This species was found fairly frequently in various samples from the area.

26. *Achnanthes minutissima* KÜTZ.

HUSTEDI, 1930, 198, f. 274; 1927-1963, II, 376, f. 820 a-c.

This species was found in varying number in pools, puddles and ditches but more frequently in masses of vegetable matter and wet mosses fringing the rock pools.

27. *Achnanthes minutissima* v. *cryptocephala* GRUN.

HUSTEDI, 1930, 198, f. 275; 1927-1963, II, 377, f. 820 d-e.

This diatom was found usually in a small number with the above type.

28. *Amphora ovalis* KÜTZ.

HUSTEDI, 1930, 342, f. 628.

This species was observed usually in small number in certain pools and ditches in the river bed below the falls, occurring with wet masses of Bryophytes and Podostemads, encrusting rocks.

29 *Amphora ovalis* f. *gracilis* (EHR.) CL.

HUSIEDI, 1930, 342; GANDHI, 1960b, 101, f. 60.

This diatom was found also in a small number in samples from pools, puddles and ditches in the river bed and other places. It also occurred in slimy encrustations on rocks and cluster of miscellaneous matter.

30. *Amphora ovalis* v. *pediculus* Kütz.

HUSIEDI, 1930, 343, f. 629.

This diatom was found in varying number in several samples collected from the area.

31. *Amphora veneta* Kütz.

HUSIEDI, 1930, 345, f. 631.

This species was found in varying to good number in samples from pools and ditches in whole of the area but more especially in masses of vegetable detritus.

32. *Anomoeoneis exilis* (Kütz.) CL.

HUSIEDI, 1930, 264, f. 429; 1927-1963, II, 751, f. 1114 a-c.

This species was found in varying number in samples from pools, puddles and ditches in the river bed formed in encrustations and wet mosses. Stray specimens also were recorded from other water holes along the way leading to base of the falls. REIMER has considered this species as *A. variabilis* (ROSS) REIMER (REIMER, 1961, 194, pl. 1, f. 7-8) with hesitation. However, the present author considers it according to HUSIEDI.

33. *Anomoeoneis exilis* f. *lanceolata* A. MAY.

HUSIEDI, 1927-1963, II, 752, f. 1114d; MAYER, 1919, 202, t. 7, f. 12-14 (= v. *lanceolata* MAY. also its form f. *subacuminata* MAY.); HUSIEDI, 1930, 264 (= v. *lanceolata* MAY.)

This diatom was found also in varying number along with the above type, inhabiting slimy detritus and wet mosses of pools and ditches. This author had considered this entity as *A. brachysira* (BRÉB.) GRUN. v. *lanceolata* (MAY) A. CL. (GANDHI, 1957, 45, f. 7) according to CLEVE-EUIER which was the only major work available to him at that time.

34. *Anomoeoneis seriens* (BRÉB.) CL. v. *brachysira* (BRÉB.) CL.

HUSIEDI, 1927-1963, II, 748, f. 1112e-h; 1930, 264, f. 427 [= v. *brachysira* (BRÉB.) HUSI.]; GANDHI, 1956, 199, 7-9 [= *A. seriens* v. *modesta* A. CL. and *A. brachysira* (BRÉB.) GRUN. v. *genuina* A. CL.]

This diatom was found in a good or varying number in samples from various wet places in the area but it seemed to prefer slimy detritus.

35. *Anomoeoneis sphaerophora* (KÜTZ.) PFII.

HUSIEDI, 1930, 262, f. 422; 1927-1963, II, 740, f. 1108a

This species was found rather occasionally in certain pools with much decaying masses of matter in the river bed

36. *Anomoeoneis styriaca* (GRUN.) HUSI.

HUSIEDI, 1930, 265, f. 432; 1927-1963, II, 754, f. 1116a-b

This species was found usually in a small number in various samples collected from water holes along the way down to the falls. It mostly occurred in slimy encrustations of rocks and detritus.

37. *Caloneis bacillum* (GRUN.) MERESCH.

HUSIEDI, 1930, 236, f. 360.

This species was found in varying number in almost all the samples collected from the area but more frequently in slimy encrustations of rock pools and detritus.

38. *Caloneis pulchra* MESSIK.

HUSIEDI, 1930, 235, f. 357

This species was usually found in a small number in samples derived from pool sediments, wet encrustations or mosses and liverworts.

39. *Caloneis pulchra* v. *interrupta* GANDHI (Fig. 93a)

GANDHI, 1959b, 101, pl. 9, f. 2:— Valves 39-45 μ long and 5.8-7 μ broad, with large central area reaching the sides. Striae about 18 in 10 μ , slightly radial but perpendicular to indistinctly convergent towards ends. In all other details agrees with the type described earlier.

This diatom was found usually in a small number in samples collected from wet mosses and liverworts mixed with wet encrustations of rock pools. Specimens collected from this area were usually smaller than those from Mugad and Dharwar area besides they seemed to possess somewhat broader central area, and lesser range of striae. However, these specimens compare very well with the original type.

40. *Caloneis silicula* (EHR.) CL.

HUSTEDI, 1930, 236, f. 362.

This species was found in varying number in samples from pools, puddles and ditches sometimes associated with wet mosses.

41. *Caloneis silicula* v. *gibberula* (KÜTZ.) GRUN.

HUSTEDI, 1930, 238, f. 365.

This diatom was mostly found in a small number, formed in encrustations of wet rocks, mosses and other matter.

42. *Caloneis silicula* v. *minuta* GRUN.

HUSTEDI, 1911, 282, pl. 2, f. 26; GANDHI, 1962, 134, pl. 1, f. 7.

This diatom was found usually in a small number along with the type occurring with wet mosses and vegetable detritus.

43. *Ceratoneis jogensis* sp. nov. (Fig. 26)

Valves 70-80 μ long and 6.4-6.6 μ broad, linear, scarcely or indistinctly bent in the middle with constricted very broadly produced rostrate or indistinctly capitate ends. Pseudoraphe narrow, linear; central area unilaterally reaching the side where it is slightly dilated, area about 6 μ broad. Striae about 9-9.5 in 10 μ , coarse, a few striae in the middle shortened.

Valvae 70-80 μ longae atque 6.4-6.6 μ latae, lineares, paululum vel indistincte arcuatae, apicibus constrictis, latissime productis aut indistincte capitatis. Pseudoraphe angusta, linearis; area centralis unilaterialis perveniens ad latus, aliquantum dilatata, area circiter 6 μ lata. Striae circiter 9-9.5 in 10 μ , crassae, pauci striae in medio aliquantum abbreviatae. Holotype slide no. MYS-JOG. 9:417.

This species seemingly compares *C. arcus* KÜTZ. v. *hattoriana* MEISF. (SKVORIZOV, 1937, 15, pl. 1, f. 38) in having straight valves, unilateral

central area with a slight bulge and rostrate apices. However, the present specimens differ in dimensions, broadly rostrate or indistinctly capitate apices, less density of striae in 10μ , besides much larger central area. Again, *C. arcus* v. *amphioxys* (RABH.) HUSI (HUSIEDI, 1930, 134, f. 123; SKVORIZOW, l.c. 15, pl. 2, f. 36; pl. 9, f. 13, 16) differs from the present forms in having clearly capitate ends and bent valves. These specimens further differ from *Fragilaria vaucheriae* (KÜTZ.) B. PEI v. *kamtchatica* B. PEI (PEIERSEN, 1946, 59, f. 5) in several respects. With these observations, therefore, it is felt here to consider them as a new species of *Ceratoneis*, as these valves seem to possess slightly dilated middle wall on the side of central area and faintly arcuate nature.

This species was found in a small number in samples from rock pools with vegetable detritus in the river bed below the cataract.

44. *Cocconeis placentula* EHR.

HUSIEDI, 1930, 189, f. 260.

This species was found usually in a very small number in samples from pools, puddles, ditches, wet mosses and encrustations on wet rocks in the area.

45. *Cocconeis placentula* v. *euglypta* (EHR.) CL.

HUSIEDI, 1930, 190, f. 261.

This entity was found frequently, sometimes gregariously in pools, puddles and various water holes with slimy matter. Stray specimens also were observed with wet mosses and waste materials.

46. *Cocconeis placentula* v. *lineata* (EHR.) CL.

HUSIEDI, 1930, 190, f. 262.

This diatom was seen rather in a small number in samples from pools and ditches in the river bed and wet encrustations on rocks.

47. *Cyclotella catenata* BRUN

HUSIEDI, 1930, 108, f. 83a-b.

This species was observed usually in a small number in samples from various wet situations but more especially from rock pools in sheltered places containing slimy sediments.

48. *Cyclotella glomerata* BACHMANN

HUSIEDI, 1930, 105, f. 81.

This species was frequently seen in samples from various water courses, streams from hilly inclines, water courses on road sides and the like often mixed up with pale brownish slimy matter. Sometimes it was gregarious.

49. *Cyclotella kützingiana* THW.

HUSIEDI, 1930, 98, f. 62

This species was found usually in a small number or as stray specimens in several samples collected from the area but it seemed to favour such bodies of water which contained slimy detritus.

50. *Cyclotella meneghiniana* KÜTZ.

HUSTEDT, 1930, 100, f. 67.

This species was frequently recorded in various collections from the area but it was gregarious in pools with much decaying matter

51. *Cyclotella meneghiniana* f. *binotata* GRUN.

GANDHI, 1958, 494, f. 4.

This diatom was found mostly in a small number in some samples from pools and ditches in the river bed along with the type.

52. *Cyclotella stelligera* CL. u. GRUN.

HUSIEDI, 1930, 100, f. 65.

This species was found in very good number in several pools and other bodies of water, but it was gregarious in slowly flowing water courses in fields and on road sides. A common diatom in the area.

53. *Cymbella amphicephala* NAEG.

HUSIEDI, 1930, 355, f. 651.

This species was found in varying number in several samples collected from the area but it was more commonly observed in samples of detritus and slimy matter.

54. *Cymbella aspera* (EHR.) CL.

HUSIEDT, 1930, 365, f. 680.

This species was found in varying number and sometimes gregariously in samples collected from pools and ditches in the river bed

below the cataract, often forming slimy encrustations on wet rocks with detritus. It was noted to be very stray in other samples.

55. *Cymbella bengalensis* GRUN

SCHMIDI, 1874-1959, t. 9, f. 12-13; t. 71, f. 79; t. 375, f. 2-3, 6

This species was found in good numbers in several samples collected from pools, puddles and ditches in the river bed. It occurred in slimy detritus, decaying vegetable matter and wet encrustations of rocks.

56. *Cymbella gracilis* (RABH.) CL. (Fig. 139)

CLEVE, 1894, I, 169; HUSIEDI, 1924, 579, t. 22, f. 12; - 1930, 359, f. 663; VAN DER WERFF en HUIJS, 1957-1963, pl. P.D. G XVIII 128; SCHMIDI, 1874-1959, Atlas Diat., t. 10, f. 36-37, 39-40 (= *Encyonema gracile* RABH.); VAN HEURCK, 1896, 151, pl. 28, f. 791 (= *E. gracile* RABH.): - Valves 26-32 μ long and 6.5-7 μ broad, asymmetrical, semi-lanceolate with dorsal side uniformly convex in a large arc, ventral side straight or incipiently concave to convex, ends slightly constricted, produced and rounded, somewhat acute. Raphe thin and straight, close to the ventral side with central pores bent towards dorsal side and terminal fissures distantly formed from ends and ventrally curved. Axial area very narrow, linear; central area only slightly formed, stigma not observed in the central area on dorsal side. Striae fine but distinct, about 10-12 in 10 μ , slightly radial throughout except at very ends where they tend to be convergent on ventral side.

This species was observed in varying number in samples from pools, ditches and wet encrustations of rocks and vegetable detritus. It was also noted with wet mosses and decaying vegetable matter. A number of specimens observed from the locality, they all tended to be smaller in dimensions - even smaller than the smallest recorded in the literature. In these small specimens, therefore, stigma in the central area on the dorsal side was not observed as defined in larger specimens (HUSIEDI, 1938, 428, t. 25, f. 15-16) by HUSIEDI and some other workers. However, the identity of these specimens is unmistakable on account of their shape and structure.

57. *Cymbella helvetica* Kütz. (Fig. 140)

KÜTZING, 1844, 79, t. 6, f. 13; CLEVE, 1894, I, 174; VAN HEURCK, 1896, 148, pl. 1, f. 43; HUSIEDI, 1930, 364, f. 678; SCHMIDI, 1874-1959, t. 10, f. 20 (= *C. balatonis* GRUN. a *slenderi* var ?); PANIOCSEK, 1902,

19, t. 1, f. 13 (= *C. helvetica* KÜTZ. v. *elongata* PANI.); MEISLER, 1912, 181, t. 30, f. 5 (= *C. helvetica* v. *major* MEISL.):— Valves 100–125 μ long and 20–25 μ broad, asymmetrical, semi-lanceolate, dorsal side convex but not in uniform arc, ventral side straight or weakly concave or sometimes very slightly convex with a median tumidity often quite evident, rarely slight, ends slightly reflexed towards dorsal side, constricted and produced rounded. Raphe thick, slightly medially oriented, arcuate with central pores in a large loop and terminal fissures somewhat distant from the ends, long bayonet-shaped curved dorsal-wards. Axial area narrow, linear-lanceolate following the curvature of the raphe; central area slightly dilated, elliptical in long axis. Striae 5–7 and 6–7 in the middle on dorsal and ventral sides respectively and becoming gradually closer towards ends up to 11 (7–11) in 10 μ , coarse, very clearly lineate, lineations 16–18 in 10 μ , striae radial to less radial towards ends where they become almost perpendicular to the middle line.

This species was mostly found in a small number in samples collected from large pools, ditches and wet encrustations of rocks in the river bed below the cataract. Stray specimens also were recorded from slimy sediments in some pools. The presently discovered specimens closely compare with *C. balatonis* GRUN. var. ? (slender variety) given in the Atlas Diat. t. 10, f. 20, in shape, apices, raphe, raphe fissures and the median gibbosity on the ventral side. They also more or less compare with *C. helvetica* KÜTZ. (KÜZING, 1844, HUSIEDI, 1930), *C. helvetica* v. *major* MEISL., *C. helvetica* v. *elongata* PANI., *C. helvetica* v. *vaszaryi* (PANI.) A. CL. (CLEVE-EULER, 1951–55, IV, 168, f. 1258e–k) and probably *C. cistula* (EHR.) HEMP. v. *hungarica* PANI. (PANTOCSEK, 1905, 40, t. 3, f. 40) ?, in general shape of the valves, raphe and apices.

CLEVE, considered *C. balatonis* GRUN. v. ? (slender variety) of Atlas Diat. t. 10, f. 20, as *C. helvetica* KÜTZ. (to which are included *C. laeve* NAEG., *C. scotica* SM. ?, and *C. gerstenbergeri* GRUN.) making mention of tumidity on the ventral side may be present in individuals (as the case indicated in KÜZING's original illustration) – and thus the present specimens seem to fit in completely. However, his recorded dimensions and the greater density of striae remain at variance (36–85 \times 10–15 μ , striae 9–11 in 10 μ , punctae 16 in 10 μ) from the present ones. Again, MEISLER considered the same Atlas Diat. t. 10, f. 20, as *C. helvetica* v. *major* (MEISLER l. c.) and indicated larger dimensions which conform here in all respects, but these entities have a new status! HUSIEDI (1930) by his extended observations recorded larger dimensions (40–160 \times 10–26 μ , stl. 8–11 and punctae 16–20 in 10 μ)

for the same, which tend to embrace in MEISIER's and the local specimens so far the dimensions are concerned but then nothing is indicated in his description and illustration regarding the presence of tumidity on the ventral side and fewer striae in the middle of the valves – the character which is defined by MEISIER for his specimens and in *C. balatonis* GRUN. by PANIOCSEK (1902) and also noted in present specimens. This PANIOCSEK's entity is CLEVE's *C. helvetica* var. ? *balatonis* GRUN., under the note of interrogation which is recognised by HUSIEDI (1930) confirmatively as a tumid form [*C. helvetica* v. *balatonis* (GRUN.) CL.].

PANIOCSEK, further recorded *C. helvetica* v. *elongata* PANI. (on the basis of larger dimensions) which compares in nature of striae and some other details *C. balatonis* GRUN. as illustrated by him except that it is a slimmer and larger form. This new entity of PANIOCSEK also compares with local specimens with one condition of reservation i.e., if it does not possess 6-7 striae in 10 μ , throughout – a point rendered mute by his extremely thin description. CLEVE-EULER's account of this diatom is not very helpful except that PANIOCSEK's *C. vaszaryi* PANI. (PANIOCSEK, 1902, 19, t. 1, f. 15) is treated by her as a var. *vaszaryi* of *C. helvetica*, under which HUSIEDI's *C. helvetica* and MEISIER's *C. helvetica* v. *major*, are included

What it follows from the above discussion: *C. helvetica* KÜTZ. represents some amount of variation in its outline, contour of the ventral side and the number of striae of which *C. balatonis* v. ? (slender variety) Atlas Diat. t. 10, f. 20; *C. gerstenbergeri* GRUN. (GRUNOW, 1865, 9, t. 1, f. 11); *C. helvetica* v. *major* MEISL.; and *C. helvetica* v. *elongata* PANI., are the manifestations representing slender valves as are recorded here also. These, the present author is inclined to consider them as *C. helvetica* KÜTZ. in accordance with CLEVE and KÜZING, and so the present specimens are treated

58. *Cymbella japonica* REICHEL

HUSIEDI, 1938, 419, t. 25, f. 20

This species was found also quite frequently in several samples collected from the area especially from pools, puddles, ditches and wet encrustations of rocks etc.

59. *Cymbella javanica* HUSI.

HUSIEDI, 1938, 424, t. 25, f. 1-3

This species was found quite frequently in samples from pools, puddles, ditches and wet rocks encrusted with slimy matter along with the above type.

60 *Cymbella pusilla* GRUN. (Fig. 141)

SCHMIDI, 1874-1959, Atlas Diat., t. 9, 36-37; CLEVE, 1894, I, 162; HUSIEDI, 1930, 354, f. 646; - 1938, 423, t. 24, f. 15: - Valves 40-46 μ long and 2-7.5 μ broad, asymmetrical, dorsal side convex in a smooth arc, ventral side straight or slightly convex, ends constricted, produced and bent towards ventral side somewhat acutely rounded. Raphe thin and straight with terminal fissures bent ventrally. Axial area narrow, linear; central area slightly dilated and elliptical in long axis. Striae 16-18 in the middle up to 20 in 10 μ towards ends, somewhat strongly radial in the middle and convergent at extreme ends, middle striae shortened and possibly alternate with longer ones.

This species was found in samples mostly collected from encrustation of wet rocks and decaying vegetable matter of pools and ditches. It occurred usually in a small number or as a stray specimen. HUSIEDER remarks that this species is generally available in waters which are brackish but it is not infrequent in chalk rich fresh-waters. Here, encrustations were found generally rich in calcium carbonate, hence its occurrence is noted.

61. *Cymbella radiosa* REICHEL (Figs. 174-175)

SCHMIDI, 1874-1959, Atlas Diat., t. 377, f. 8-10: - Valves 50-65 μ long and 13-15 μ broad, asymmetrical, rhomboid-lanceolate with dorsal side strongly convex and ventral side slightly convex with a slight median tumidity, ends unconstricted and obtusely rounded. Raphe thick, arcuate, with central pores shortly flexuose or complicated in the central nodule and terminal fissures abruptly reflexed towards dorsal side. Axial area fairly broad, linear-lanceolate; central area slightly dilated but inevident. Striae 8-9/9-10 in the middle on dorsal and ventral sides respectively and 9-10/9-11 towards ends in 10 μ , coarse, lineate, strongly radial as they approach ends.

This species was fairly represented in several samples collected from pools, ditches and other wet situations in the river bed. This species was previously considered by this author under *C. austriaca* GRUN. v. *subhomboidea* (OSL.) A. CL. (GANDHI, 1957, 16, f. 9) but by rechecking the same it is felt to refer it to *C. radiosa* REICHEL.

62. *Cymbella sagarensis* GANDHI

GANDHI, 1959, 322, f. 24-25.

This species was found in varying number but never gregariously in samples collected from pools, puddles, ditches and wet encrustations on rocks with or without Podostemads.

63. *Cymbella sagarensis* f. *gracilis* GANDHI

GANDHI, 1959, 323, f. 44.

This diatom was found mostly with the above type in small number.

64. *Cymbella turgida* (GREG.) CL.

HUSIEDI, 1930, 358, f. 660.

This species was found in varying number in almost all the samples collected from the area.

65. *Cymbella ventricosa* KÜRZ.

HUSIEDI, 1930, 359, f. 661.

This species was found in varying number in several samples collected from the region but it never occurred gregariously.

66. *Diploneis elliptica* (KÜRZ.) CL.

HUSIEDI, 1930, 250, f. 395; 1927-1963, 690, f. 1077a.

This species was found mostly in a small number in several samples collected from pools, puddles and ditches in the river bed and other water holes with wet mosses etc.

67. *Diploneis pseudovalis* HUSI (Fig. 54)

HUSIEDI, 1930, 253, f. 403; 1927-1963, II, 668, f. 1063c; CLEVE-EULER, 1951-55, III, 83, f. 654h [= *D. smithii* (BRÉB.) CL. v. *laevis* J. DANF.]:- Valves 20-28 μ long and 11-13 μ broad, linear-elliptical with broadly rounded smooth ends. Raphe thin between the raphe horns which are linear, terminal fissures slightly curved. Raphe horns in the central nodule not widened. Axial area linear-lanceolate, very narrow; central area fairly large, roundish-elliptical in long axis. Furrows or longitudinal canals narrow contiguous with raphe horns slightly away from the central nodule, linear and evidently bulged in the middle. Costae about 10-12-13 in 10 μ , becoming strongly radial towards apices, alternate with fine to very fine double rows of alternate punctae, punctae about 24-26 in 10 μ , rows of punctae about 20-22 in 10 μ .

This species was usually found in a small number in marginal detritus and sediments in pools, ditches and wet encrustations in the river bed. A number of specimens observed from the locality, some tended to show somewhat small central nodule and in others it was fairly large as illustrated by HUSIEDI. CLEVE-EULER, considered it as a variety of *D. smithii* (BRÉB.) CL.

68. *Diploneis smithii* (BRÉB.) CL. v. *pumila* (GRUN.) HUST

HUSIEDI, 1927-1963, II, 650, 1052d-e; LAVRENKO, 1951, 245, f. 137-4; HUSIEDI, 1930, 250, f. 394 [= *D. puella* (SCHUM.) CL.].

This diatom was found rather sparingly in samples collected from various wet places in the region. It occurred more especially in samples of detritus and sediments in pools and puddles of the river bed.

69 *Diploneis subocalis* CL (Figs. 55-56, 62-106, 108)

CLEVE, 1894, I, 96, pl. 1, f. 27; HUSIEDI, 1927-1963, II, 667, f. 1063a-b; VENKATARAMAN, 1939, 322, f. 74, pl. 17, f. 3-4; LAVRENKO, 1951, 247, f. 138-1:— Valves 12-77 μ long and 8-33 μ broad, elliptic-lanceolate, elliptic-linear-lanceolate, elliptical, broadly elliptical, narrowly elliptical or broadly elliptical-rhomboid and thus variable in shape with rounded ends. Raphe thin and straight with clear central pores, enclosed between ribs or horns which are usually slightly widened in the central nodule, terminal fissures slightly curved. Axial area very narrow, linear-lanceolate to slight extent; central area small or large, roundish-elliptical in long axis without any punctae. Furrows or longitudinal canals fairly broad, linear-lanceolate and contiguous with raphe horns slightly away from the central nodule as a rule, invariably clearly dilated in the middle, fine but clearly punctate zigzagly in continuation of intercostal alveoli, punctae extended variably depending upon the size of the specimen, generally 2-4 or more punctae in the transverse line. Costae about 6-14 in 10 μ , gradually becoming strongly radial from the middle towards ends, alternating with clear and double alternating rows of alveoli, alveoli number variable, 15-24 in 10 μ , average number being 15-17 in 10 μ , a table of dimensions is given hereunder as typically noted of several specimens:—

A table of typical dimensions noted for *Diploneis subovalis* C1

No	Length × Breadth in μ	Costae and rows of alveoli in 10 μ	No	Length × Breadth in μ	Costae and rows of alveoli in 10 μ
1.	12 × 8	13-14 /22-24	2	14.2 × 8	12-13
3.	14.2 × 9.5	12-13 /20-22	4	16.5 × 9.5	10-12
5	20.4 × 11.2	9-12 /18-20	6	20.5 × 11.2	9-11 /18-20
7	22.2 × 14.2	9-10 /16-18	8	23 × 11	10-12 /18-20
9.	23 × 16.5	8-9	10	24 × 15.7	7.5-8 /14-15
11	25.2 × 17	7-8 /16	12	26.6 × 13	12
13	26.7 × 17.2	7-8	14	26.9 × 17.3	7-8 /14-16
15.	28.3 × 18.8	7-8	16	28.3 × 16.2	7-8 /13-15
17.	29 × 18.7	9 /16-18	18	30 × 17.8	7-7.5/13
19	30 × 18.8	7-8	20	30.5 × 22	7-8
21	31 × 18.8	7-8	22	31 × 18.9	8-9 /15-17
23.	31.5 × 20.4	7-8 /17	24	35.5 × 22.2	7-8
25	36.5 × 22	7-8	26.	38 × 22.2	6.5-7.5/13-15
27.	39.5 × 22.2	7-8	28	39 × 23	7-8 /13-15
29.	39 × 20.5	7-8	30	41 × 20.4	7-8 /14-15
31	42 × 23	7-7.5/14-15	32	42.6 × 23.7	7-8.5/14-15
33	44.3 × 25.2	6.5-7 /14	34.	44.4 × 23.4	7
35.	44.2 × 25.2	7 /15	36	47.4 × 24.3	7-8 /14
37	48.4 × 25.5	7-8	38	49.5 × 25	7.5-8 /15-16
39.	50.4 × 23.6	7.5-8 /15-16	40	51.1 × 25.6	7-7.5
41.	52 × 26.7	6.5-7	42.	55 × 25.2	7-8 /15-16
43	57 × 26.7	7 /14-16	44	58.4 × 28.4	7-8 /15-16
45.	58.3 × 28.4	7.5-8 /14-16	46	58.8 × 27.8	7-7.5/14
47.	60 × 26.7	7-8	48.	60 × 26	7.5-8 /15-16
49	63.2 × 26.8	7.5-8 /15-16	50	62.5 × 30	7-8 /14-16
51	63.2 × 28.8	7-8 /14-15	52	63.2 × 30	6.5-7.5/14-15
53	67.5 × 30	7.5-9 /14-17	54	67.8 × 31.6	7 /14-15
55	68.9 × 31	7 /14	56.	70 × 32	6.5-7.5/13-15
*57.	71.5 × 32	6.5-7.5/13-15	58	71.5 × 33	7.5-8 /15-16
59.	72.5 × 31.5	7-8 /14-16	60	75.5 × 31.5	7-7.5/13-14
61	77 × 32	7-8 /13-14	*62.	77.8 × 33.33	6-7 /12
*63.	79 × 32.3	6.5-7 /13-14	*64.	80 × 29.7	7-9 /14-16
*65.	83.32 × 33.33	7-8 /12-14	*66	83.33 × 30	7 /14

* Entities differently considered at present

Of the species under consideration, there about 6-7 form deviations are noticed as illustrated (figure nos are given below), some of these at one or the other level stand intermediate between one or the other category as indicated in the following:—

- Category - I: Elliptical-lanceolate forms some of which compare with HUSTEDI's 1927-1963, II, f. 1051c, e:-
Fig nos 67, 80, 82, 83, 84?, 88?, 89, 91, 94, 95?, 96?, 97, 102, 105, 108.
- Category - II: Elliptic-linear-lanceolate forms related to the above category in part:-
Fig nos 55?, 60?, 64, 68, 70, 86?, 90?, 92, 97?, 98, 99, 100, 101, 102, 103, 104, 105?, 106?, 107?
- Category - III: Broadly elliptical forms comparable to HUSTEDI's I c fig 1051b, d, f:-
Fig nos 62, 63?, 66, 68?, 69, 70?, 71, 72?, 73, 74?, 75, 76, 77, 78, 81?, 90?, 100, 101?
paring VENKATARAMAN's 1939 photomicrographic
- Category - IV: Broadly elliptical-rhomboid forms more or less reproductions of *D. subovalis* CL. and CHOJNOKY's *D. natalensis* CHOI. in part:-
Fig nos 68, 69?, 72, 75?, 84, 88?, 93?, 94?, 95, 96.
- Category - V: Narrowly elliptical forms comparable to HUSTEDI's 1911 *D. smithii* and his 1927-1963 *D. subovalis*:-
Fig nos 55, 61, 63?, 64?, 65.
- Category - VI: Subrhombic forms separately considered but distantly related to FRENGUELLI's 1945 *D. argentina* FRENG :-
Fig nos 57, 58, 93?
- Category - VII: Linear-oblong-elliptical forms comparable to *D. smithii*, in the Atlas Diat. (specimen from Sölsvig) in part:-
Fig nos 59, 60, 61?, 98, 99, 100?, 101?, 105?, 106?, 107? etc (some of these are separately considered at present).
- Note: Figure nos marked "?" this, are interconnecting specimens.

A table of references where *D. smithii*, *D. subovalis* and related forms of *Diptoneis* are illustrated with dimensions and which compare with presently illustrated specimens etc.

Reference	<i>Diptoneis smithii</i>	<i>Diptoneis subovalis</i>	Figure nos. more or less comparable
CLEVE-EULER, 1951-55, III, 81, 654a-b and 654d-e v. <i>borealis</i> GRUN.	60-200 × 35-75; 4.5-7.5 65-120 × 25-45; 8-11/24	..	60, 69, 80, 91, 94 97-99, 100-106/81, 56
83, 654 654 A v. <i>perminuta</i>	..	12-38 × 8-20; 7-10 12-44 × 9-10; 15-16	82, 88, 89, 91, 92, 97 .. 62, 63, 66 ?
CLEVE, 1894, I, 96 96, pl. 1, f. 27	27-50 × 15-35; 7-11 ..	..	.. 69, 70, 81, 86, 99-101 etc.
CHOLNOKY, 1956, 65, f. 37 1957, 49, f. 59-60	<i>D. natalensis</i> CHOL. <i>D. tugetae</i> CHOL.* * (double rows of intercostal alveoli do not alternate as they do here)	45-60 × 30-33; 7-8 20-30 × 14-16; 7-9/13-14	66, 71, 87 etc. 75, 77, 79, 80 etc.
FRENGUELLI, 1923-24, III, 256, t. 9, f. 5 as v. <i>argentina</i> FRENG. 1926, 50, t. 5, f. 7 as v. <i>minor</i> 1945, 170, t. 8, f. 25	50-54 × 28-29; 6 <i>D. argentina</i> FRENG. (originally <i>D. subovalis</i> v. <i>argentina</i> FRENG.) ?	.. 59-93 × 30-45; 5.5-6 25-32 × 18-24; 6.5	75, 78, 81, 90, 99, 101 .. 62, 66, 69, 70, 71 etc.
FERGUSON-WOOD, 1959, 24, pl. 5, f. 71A	60-100	..	59, 60, 61 ? , 92, 100-106 ? 107

A table of references where *D. smithii*, *D. subovalis* and related forms of *Diptoneis* are illustrated with dimensions and which compare with presently illustrated specimens etc.

Reference	<i>Diptoneis smithii</i>	<i>Diptoneis subovalis</i>	Figure nos. more or less comparable
GANDHI, 1960 c, 562, f. 12	..	12.5-16 × 7.5-9; 12-13 = v. <i>permutata</i> A. C.	
GONZALVES et GANDHI, 1958, 254, f. 87	..	27-38 × 18-21.6; 8-10/16-18	as in VENKATARAMAN
f. 88	27-30 × 16.2; 9/18-20	..	as in HUSTEDT, 1930
HUSTEDT, 1911, 281, t. 2, f. 12	28 × 15 collected from moss turfs	..	62, 64, 66, 70, 73, 75, 77
1930, 253, f. 402	25-200 × 15-75; 4.5-11	..	79
1927-1963, II, 647, f. 1051	25-200 × 15-75; 5-12	..	57, 62, 66, 68, 78, 74, 84, 93, 97, 101, 102, 103, 105, 108
667, f. 1063 a-b	..	10-50 × 8-20; 10-12	64, 62, 65, 66, 86, 90, 93, 97, 102
JURIJ, 1957, 91, t. 24, f. 5 a-b	30-50 × 15-25; 8-9-10	..	77, 78, 81, 83, 92, 98, 101, 103
LAVRENKO, 1951, 245, f. 137-1 a-b	25-200 × 15-75; 4.5-11	..	68, 71, 83, 98-100, 101, 102-103, 108, 104-105, 57
p. 247, f. 138-1	..	10-50 × 8-20; 10-12/8	66, 73, 76, 77, 78, 81, 99-101
138-2 v. <i>baikatensis</i> SKV.	..	39 × 25; 9-10/5	above nos. in part

OKUNO, 1952, Atlas Jap. Diat.	pl. 3, f. 3	..	..	mostly as in VENKATARAMAN
OKUNO & KUROSAWA, 1959, 269, t. 2, f. 11	50-160×30-70; 7-8	..	..	68, 69, 72, 75, 78, 84, 87, 88, 93, 94, 95, 96 etc.
RICH, 1936, 241, pl. 11, f. I	..	..	32-40×16-25; 8-10	62, 68, 73, 75, 78
ROUND, 1964, p. 59, f. 51	..	..	..	as in CLEVE
SCHMIDT, 1874-1959, Atlas Diat. t. 7, f. 14-21	<i>D. smithii</i>	..	..	59, 60, 62, 88, 99-104, 108, 106, in part
SKVORTZOW, 1937a, 31, pl. 9, f. 1 v. <i>oblongella</i> SKV.	98-100×35-39; 6	..	..	57-59, 105, 107
1937b, 269, pl. 3, f. 1, <i>D. ovalis</i> , v. <i>bipunctata</i> SKV.	..	..	30×20; 8-9	73
1938a, 169, f. 1d	..	..	<i>D. subovalis</i>	61
1938b, 414, pl. 1, f. 27 v. <i>novae zealandae</i> SKV.	..	..	30×17; 5-6	66-68, 72, 75-76, 86, 90
VAN HEURCK, 1896, 197, pl. 4, f. 151 = f. 152 v. <i>scueltum</i>	90-100×---; 5 30×25; 8	..	..	as in HUSTEDT 75, 85, 87 etc.
VENKATARAMAN, 1939, 322, i. 74, pl. 17, f. 3-4	..	..	35-40×22-24; 8-10/18	67, 68, 73, 84, 85, 86, 87, 93, 94, 96

A very large number of specimens from a gregarious formation in a sample taken from encrustations of wet rocks in the river bed pool were critically examined (nearly 3000 specimens estimated) of which several illustrations are given at close dimensional levels. They reveal some variation in size, shape, length to breadth proportions, size of the central nodule, width of the furrow (long canal) and its median dilation with rows of punctae extended from the intercostal alveoli and the shape, while the structure in all closely follow one another and also the number of costae and their organisation – as is indicated in the table of dimensions given above and specimens illustrated. Another table is given with references of authors in which dimensions of *D. smithii*, *D. subovalis* and some structurally related species of *Diploneis* with their varieties and forms are compared, and available illustrations of these which closely correspond or overlap with local specimens as illustrated are indicated in a column of the said table.

From these tables – accounts and illustrations given by various workers, it would appear that *D. smithii* (BRÉB) CL. with its forms and varieties on one hand and *D. subovalis* CL. with its varieties and forms on the other, seem to merge with one another or very closely overlap with the result that it is almost impossible to separate these two entities. The maximum size ascribed to *D. subovalis*, is 50 μ (in the present collection larger specimens are found), up to this size level *D. smithii* and *D. subovalis*, compare very well in all respects except in respect of central nodule and longitudinal furrows or longcanals (HUSIEDI, 1930 and 1927-1963 in part) where the central nodule is indicated to be very small and furrows more or less broad, linear-lanceolate. But again, HUSIEDI's (1911 and 1927-1963 in part) *D. smithii*, can hardly be differentiated from *D. subovalis*, as they are shown to have large central nodule and medially distinctly bulged furrows ascribed for *D. subovalis*. More comparable conditions are found between larger *D. smithii* and *D. subovalis*, as depicted in the literature and to the latter the locally discovered larger specimens are added. HUSIEDI (1911) remarked under his *D. smithii*, "very variable species... collected from mosssturfs" (from fresh-water?) is hardly different than *D. subovalis*, as illustrated by him (1927-1963) and again this in turn compares his *D. smithii* (1927-1963 in part) except for the dimensions. Further, HUSIEDI's illustrations of *D. subovalis* do not indicate as large a central nodule as indicated by CLEVE (1894) in his New Zealand specimen collected from fresh-water. CLEVE's account of this, *D. subovalis* and its illustration, is not very helpful in some respects as it "stands on very thin verge" without dimensional range (perhaps single specimen being observed by him) and the central

nodule being unduly!! indicated dilated In his remarks it is merely stated "... resembles *D. ovalis* (HILSE) CL. in shape and central nodule but has the structure of *D. smithii*." Again, FRENGUELLI'S (1923-24) *D. smithii* v. *argentina* FRENG. (excellently illustrated) can scarcely be differentiated from *D. subovalis*. The photomicrograph of so called of *D. subovalis* given by VENKATARAMAN (1939) compares excellently with several specimens observed here and also with HUSIEDI'S *D. smithii* (1927-1963 in part). Some illustrations of *D. smithii*, given in the Atlas Diat. also more or less compare here, as well as those given by CLEVE-EULER, LAVRENKO and others indicated in the above table (LAVRENKO'S *D. subovalis* is also included here).

The author's close study of the present material as illustrated, indicates gradually enlarging differences in one or more directions noted in the specimens which tend to connect *D. smithii* and *D. subovalis* at one or the other level (derivatives included) differently recorded by different workers, - and thus the position of taxonomy of these two entities becomes so very absurd as to at what level these entities be circumscribed and especially when the transition is rather gradual. Dr. CHOLNOKY - an author's esteemed colleague in his personal communication writes, "the position regarding *D. smithii* and *D. subovalis* is really difficult. I do not think that the two taxa refer to the same species, though the overlapping of the two communities is certainly known to most of us. The position is made even more difficult by *D. subovalis* v. *argentina* FRENG. (? *D. smithii* v. *argentina* FRENG.). I have often recently found this variety in great numbers in my. . . so that I am uncertain what should be done? I must emphasize however, that the typical *D. smithii* of coastal water is quite distinct from *D. subovalis* (present author agrees here). *D. subovalis*, moreover, always occurs in fresh-water whereas *D. smithii* inhabits the marine littoral (HUSIEDI, 1911 loc. exception?)." The same trying circumstance is found here.

The present set of illustrations given by the author are from the material collected entirely from fresh-, crystal clear and potable water of pools in the river bed with encrusted rocks where the gregarious formation of *D. smithii* can hardly be expected. If however, any worker who might consider any of the presently given illustrations referable to *D. smithii*, then such worker must accept that *D. subovalis* does not exist at all. Again, those who agree with the author that the illustrations are representatives of *D. subovalis* - it would be a welcome thing but then they would have to weigh some of HUSIEDI'S (1911, 1927-1963) illustrations of *D. smithii* in main and a few others illustrating after him. At certain times, this author himself feels what

harm should accrue if *D. subovalis* is integrated with *D. smithii*, considering CLEVE's account based on a thin verge!! Again, there is no reason why any entity found in marine habitat cannot be found in fresh-water (in certain cases only) as some other taxa are known to be occurring in both the habitats. For example, *D. puella* (SCHUM.) CL. which is now considered as *D. smithii* v. *pumila* (GRUN.) HUSI occurs both in brackish and fresh-water habitats, again *D. smithii* recorded by HUSIEDI (1911) from moss-turfs, is the case in sight. In any way, the present author would be inclined to desist from venture to say these two taxa to be the same until he finds a very large number of *D. smithii* from marine or marine littorals which could be satisfactorily and assuredly compared with the present material. Of course, he knows *D. smithii* from marine and mangrove swamps which typically correspond HUSIEDI's (1930) illustrations.

Further, HUSIEDI (1927-1963) in remarks under *D. subovalis* CL. states that the double rows of alternating intercostal alveoli become in single rows towards the mid-axis especially in small forms. The present author finds this condition at a certain fixed focus in most of his specimens, but with the change of focus they resolve into double rows contrary to HUSIEDI's remarks. Here the smallest entity of 12μ size being observed. Again, VENKATARAMAN (1939) in his remarks states that costae are capitate or pin-headed towards the axial field (well exemplified by his good photomicrographs) and calls them for one of the items to identify *D. subovalis*, and one which is not recorded by CLEVE or HUSIEDI. The remark, here, is considered to be void, since such a feature occurs also in some other *Diploneis*. Infact, he should have taken more care to look at the illustration given by HUSIEDI (1927-1963) and some other workers. The fact regarding capitate look of the costae is that valve faces are sometimes more and other times less convex in this diatom with the result that under high magnifications, (1) when the marginal portion of the valve is in focus the axial part goes out and blurs hence the costae appear gradually thickened or "flared-up" and its termination ultimately gets capitate due to delimitation of intercostal rows of alveoli brought about by longitudinal canals (furrows) by their inner edge and inner chamber opening. Concomitantly, the double rows of alternating alveoli between the costae taper and towards axial part they become in single file as noted by HUSIEDI referred to above and by FERGUSSON-WOOD in case of his *D. smithii*. But, when the axial part of the valve is brought in the focus the marginal part goes out, blurs, looks compressed or the size is reduced accompanied by loss of capitate nature of costae towards the central axis, in certain cases the capitate nature

becomes reduced or dimmed. The double rows of alveoli become, clear in contrast to their appearance in single file.

70. *Diploneis subovalis* v. *jogensis* v. nov. (Figs. 57-58)

Valves 60-73.3 μ long and 26-33.3 μ broad, subrhomboid or subrhomboid-elliptical with broadly rounded ends. Raphe thin and straight enclosed between the horns, horns linear or sometimes very slightly widened in the central nodule, terminal fissures slightly curved. Axial area very narrow, lanceolate; central area slightly dilated, large, elliptical in long axis. Furrows lanceolate, $\frac{1}{3}$ - $\frac{1}{4}$ the width of the valves, distinctly dilated in the middle and apposed to the raphe at some distance from the central nodule. Costae about 6-8 in 10 μ , coarse, gradually becoming strongly radial towards ends, alternate with double rows of alternating alveoli, rows of alveoli about 13-16 in 10 μ , quite distinct, punctae continue zig-zagly across the furrows (extension of 3-5-6 punctae). In all other characters like the above type.

Valvae 60-73.3 μ longae atque 26-33.3 μ latae, subrhomboidea vel subrhomboidea-ellipticae, apicibus late rotundatis. Raphe tenuis et recta, includeri inter cornua, cornua lineares interdum aliquantum dilatata in noduli centralis; fissuris terminalibus paulum curvatis. Area axialis angustissima, lanceolata; area centralis aliquantum dilatata, magna et elliptica in axe longo. Sulci lanceolatae, $\frac{1}{3}$ - $\frac{1}{4}$ latitudinis valvae, distincte dilatata in medio, sulci affigeri cornu aliqui distantibus ab nodulus centralis. Costae circiter 6-8 in 10 μ , crassae, gradatim valde radiales ad apicem, inter duos cum duobus alternatum lineis alveolarum, lineis alveolarum circiter 13-16 in 10 μ , satis distincte; punctae trans extendere in ordo "anfractus viarum" versus sulci (porrectis punctae 3-5-6). In coeteres ut typus. Holotype slide no. MYS-JOG 7:415.

This diatom was found along with the above species but in a small number, noted as a conspicuous form with large dimensions and distinctly subrhomboid or subrhomboid elliptical shape. It has many features in common with *D. natalensis* CHOI. (CHOINOKY, 1956, 65, f. 37); *D. smithii* (BRÉB.) CL. (OKUNO et KUROSAWA, 1959, 269, 2, f. 11); *D. ovalis* (HILSE) CL. v. *bipunctata* SKV. (SKVORZOW, 1937b, 269, t. 3, f. 1); *D. smithii* v. *nipponica* SKV. (SKVORZOW, 1937, 71, t. 2, f. 9); and *D. subovalis* v. *major* FREN. (FRENGUELL, 1926, 50, t. 5, f. 8) of which mention is made in above tables (under *D. subovalis* CL.). While checking up these five references, it appears that *D. natalensis*, *D. smithii* (OKUNO et KUROSAWA) and *D. ovalis* v. *bipunctata* tend to represent the same entity but differ from present specimens in being broadly rhomboid with more dilated roundish central nodule. FRENQUELL'S *D. subobalis* v. *major*, appears more strongly rhomboid with

depressed sides between middle and ends, and therefore slightly differs from *D. natalensis*, *D. smithii*, and *D. ovalis* v. *nipponica* on one hand and present specimens on the other. Again, *D. smithii* v. *nipponica* Skv. differs from all the present forms slightly in shape and central nodule besides furrows. With these observations, therefore, it appears that present entity does not satisfactorily compare with any of the above named diatoms, hence it is considered as a new variety. It may however be emphasized that all these entities belong to *D. smithii* - *D. subovalis* complex.

71 *Diploneis subsmithii* sp. nov. (Figs. 59-61, 107?)

Valves 77-83 $3\ \mu$ long and 29.7-33.3 μ broad, large, linear-elliptical to oblong-linear-elliptical with rounded to slightly truncately rounded ends. Raphe thin and straight enclosed between the narrow linear horns and terminal fissures slightly curved. Axial area very narrow, linear or sublinear; central area small slightly widened and somewhat elliptical in long axis. Furrows very broad, linear or linear-lanceolate, about $\frac{1}{2}$ to $\frac{1}{3}$ the width of the valves, sometimes only indistinctly dilated in the middle and attached to the raphe horns almost from the central nodule. Costae about 6.5-8 in $10\ \mu$, coarse, gradually becoming strongly radial towards ends, alternate with double rows of alternating alveoli, rows of alveoli about 12-14 in $10\ \mu$, quite distinct, punctae continue zig-zagly across the furrows (extensions of punctae 5-7 in number). Costae terminate with capitate ends as in above types.

Valvae 77-83 $3\ \mu$ longae atque 29.7-33.3 μ latae, magna, lineari-ellipticae vel oblongo-lineari-ellipticae, apicibus rotundatis vel aliquantum truncatis-rotundatis. Raphe tenuis et recta includeri inter cornua, cornua lineares et angusta, fissuris terminalibus paulum curvatis. Area axialis angustissima, linearis vel sublinearis; area centralis parva, paulum dilatata et aliquantum elliptica in axe longo. Sulci latissima, linearis vel lineari-lanceolata prope $\frac{1}{2}$ - $\frac{1}{3}$ latitudinis valvae, interdum indistincte dilatata in medio, sulci affigeri cornu fere ab nodulus centralis. Costae circiter 6.5-8 in $10\ \mu$, crassae, gradatim valde radiales ad apicem, inter duos cum duobus alternatum lineis alveolarum, lineis alveolarum circiter 12-14 in $10\ \mu$, satis distincte; punctis trans extendere in ordo "anfractus viarum" versus sulci (porrectis punctae 5-7 in numero). Costae terminalibus capitatis ut typus. Holotype slide no. MYS-JOG 11:449.

This species was found along with above types usually in a small number and were conspicuous for their large dimensions. Isolated specimens also were found in certain pools in the river bed encrusting wet rocks. All of them were derived from very fresh-water.

The present specimens very closely compare with *D. smithii* (BRÉB.) Cl. as illustrated in the Atlas Diat. t. 7, f. 19 (from Sölsvig) and by

FERGUSON-WOOD (FERGUSON-WOOD, 1959, 24, pl 5, f. 71 a) in several respects but differs in having comparatively broad furrows almost $\frac{1}{2}$ the width of the valves. The illustration in the Atlas Diat further differs in having median dilation of furrows and widened raphe horns in the central nodule. Again, *D. smithii* illustrated by HUSIEDI (HUSIEDI, 1927-1963, II, 647, f. 1051) and LAVRENKO (LAVRENKO, 1951, 245, f. 137-1a) also very well compare in structural details, furrows, central and axial areas but they differ in having comparatively less broad furrows (only $\frac{1}{3}$ to $\frac{1}{5}$ the width of the valves) and more narrowly rounded ends, than noted in present specimens. In respect of broad furrows the present specimens compare with *D. nitescens* (GREG.) CL. (HUSIEDI, 1927-1963, II, 640, f. 1047), but differ in several respects. Moreover, the present specimens are collected from entirely fresh-water, hence it is felt here to designate them as a new taxon in light of the discussion made under *D. subovalis* CL., above

72. *Epithemia sorex* KÜTZ

HUSIEDI, 1930, 388, f. 736

This species was found rather sparingly in samples collected from pools, puddles and wet encrustations of rocks in the river bed and other places

73. *Epithemia zebra* (EHR) KÜTZ

HUSIEDI, 1930, 384, f. 729

This species was found in varying number in several samples collected from many wet situations in the area but it was never gregarious

74. *Epithemia zebra* v. *saxonica* (KÜTZ.) GRUN.

HUSIEDI, 1930, 385, f. 730

This diatom was found also in varying number in samples mostly derived from pools and ditches in the river bed with vegetable detritus. Stray specimens also were found in other wet places in the area

75. *Eunotia alpina* (NAEG.) HUST

HUSIEDI, 1930, 185, f. 252; 1927-1963, II, 304, f. 770

This species was found usually in a small number in several samples collected from the area

76. *Eunotia ambigua* sp. nov. (Fig. 27)

Valves 41-50 μ long and 7-7.2 μ broad, linear, slightly arcuate, dorsal side slightly convex, ventral side concave with straight part between two pseudonodule like formations, ends on the dorsal side constricted, broadly produced and truncately rounded. End nodules small and distinct. Striae 9-10 in the middle up to 12-13 in 10 μ towards ends, fairly coarse, irregularly set in the middle and indistinctly punctate

Valvae 41-50 μ longae atque 7-7.2 μ latae, lineares, aliquantum arcutae, pars dorsali aliquantum convexae, pars ventralis concava cum recta parte inter duos pseudonodules, apicibus constrictis ad partem dorsa, late productis, truncatis rotundatis. Noduli polares parvi sed distincti. Striae circiter 9-10 in medio tenus 12-13 in 10 μ ad apicem, crassae, irregulariter positae in medio et indistincte punctatis. Holotype slide no. MYS-JOG 11: 419.

This species compares *E. grunowi* Å. BERG v *limacida* A. CL. (CLEVE-EULER, 1951-55, II, 96; 421 a-d; BERG, 1939, 436, pl. 2, f. 73 = f. *alpha*) in general shape and structure with two pseudonodules on the ventral side. However, the present specimens differ in having constricted produced, truncately rounded ends, small dimensions, and proportionately greater breadth. Again, it resembles *E. pseudoparallela* Å. BERG (BERG, 1939, 438, pl. 2, f. 83 = f. *alpha*; CLEVE-EULER, 1951-55, II, 98, f. 424 a-b = v. *genuina* A. CL.), in the structure and somewhat in the outline but again the present specimens differ in proportionate dimensions, constricted and produced apices. While, looking at the illustrations given by CLEVE-EULER and BERG for forms and varieties of *E. grunowii* Å. BERG and *E. pseudoparallela* Å. BERG, it is hardly convincing to separate these two taxa and one after following the same lands into difficulty and comes out with all the more confusion. The present specimens do not otherwise satisfactorily compare with any other known types, hence they are considered as a new species.

This species was found in varying number in samples collected from pools, puddles and ditches in the river bed containing much detritus. Stray specimens also were seen in samples of wet encrustations of rocks and mosses.

77. *Eunotia cholnokyi* sp. nov. (Fig. 28, 160)

Frustules broadly rectangular in girdle view. Valves 48-59 μ long and 7.8-9 μ broad, linear, arcuate, dorsal side more or less convex

with a conspicuous broad sinus in the middle; ventral side concave but straight in the middle like a saucer, ends distinctly constricted and short but broadly truncately capitate rounded. Polar nodules small and distinct. Striae about 10-13 in 10μ , coarse, indistinctly punctate and very slightly closer towards ends.

Frustulae late rectangulares in aspectu zonali. Valvae 48-59 4μ longae atque 7.8-9 μ latae, lineares, arcuatae, parte dorsali plus minus convexa, in medio late sinuata; pars ventrali concava sed recta in medio, patella similibus, apicibus distincte constrictis, brevi sed late truncatis capitatis et rotundatis. Noduli polares parvi et distincti. Striae circiter 10-13 in 10μ , crassae, indistincte punctatae et paululum proximae positae ad apicem. Holotype slide no. MYS-JOG 8:416

This species seems to be related to *E. praerupta* EHR. (HUSIEDI, 1930, 174, f. 214) but differs from it and its varieties in having a clear sinus on the dorsal side and ends constricted, short but broadly capitate truncately rounded, ventral part saucer-shaped and the striae more or less uniformly set. Moreover, none of the specimens noted with crookedly truncate apices. Further, the present specimens do not satisfactorily compare with any of the known types, hence they are considered as a new species and named in honour of author's esteemed colleague Dr. CHOLNOKY.

This species was found mostly in small number in samples collected from pools and ditches in the river bed below the falls and wet encrustations of rocks and mosses in the area.

78. *Eunotia cholnokyi* v. *ventricosa* v. nov. (Fig 29)

Valves 44-64 μ long and 9-10 μ broad, linear, arcuate, dorsal side convex with a broader sinus than in the above type; ventral side concave but with a distinct gibbosity in the middle, ends constricted, short but truncately capitate rounded. Striae about 11-13 in 10μ , coarse, indistinctly punctate and somewhat closer towards ends. In all other characters like the above type.

Valvae 44-64 μ longae atque 9-10 μ latae, arcuatae, pars dorsalis convexa cum latior sinuata ut in typo, pars ventralis concava cum distincte uno gibboso in medio, apicibus distincte constrictis, brevi sed truncatis capitatis rotundatis. Striae 11-13 in 10μ , crassae, indistincte punctatae ad apicem paulum proxime positae. In coeteres ut typus. Holotype slide no. MYS-JOG 9:417

This diatom differs from the above type in having a tumidity on the ventral side and broader sinus in the middle of the dorsal side, hence it is considered as a new variety of *E. cholnokyi*.

This diatom was collected along with the above type from various pools and ditches in the river bed. Stray specimens also were found in encrustations of wet rocks and mosses.

79. *Eunotia grunowii* BERG v. *uplandica* A. Cl. (Fig. 30)

CLEVE-EULER, 1951-55, II, 97, f. 421 esp. 1-k; GANDHI, 1962b, 117, f. 4-7:—Valves 50-60 μ long and 8 μ broad, ends much produced, broadly rounded. Striae about 13-15 in 10 μ .

This diatom was recorded in a small number in samples collected from pools and ditches in the river bed occurring with vegetable detritus. Some specimens observed from this area seemed to have broadly produced rounded ends unlike those found from Ahmedabad having somewhat obliquely truncate rounded ends. However, the present specimen best compares with CLEVE-EULER'S f. 421-k. Further, this diatom seems to serve as a connecting link between *E. major* (W. SM.) RABH. (CLEVE-EULER, 1951-55, II, 119, f. 456) and some forms of *E. pectinalis* (KÜTZ.) RABH. etc.

80. *Eunotia jogensis* sp. nov. (Fig. 31)

Frustules elongated, robust and rectangular in girdle view. Valves 125-140 μ long and 13-14 μ broad, robust, slightly arcuate, linear with slightly narrowed, broadly produced rounded ends. Polar nodules distinct and somewhat nearer ends. Striae about 5-6 in the middle up to 7-8 in 10 μ towards ends, somewhat irregularly set.

Frustulae elongatae, robustae et rectangulares in aspectu zonali. Valvae 125-140 μ longae atque 13-14 μ latae, robustae, aliquantum arcuatae, lineares, apicibus leniter constrictis, late productis et rotundatis. Noduli polares distincti ac versus finem. Striae circiter 5-6 in medio tenus 7-8 in 10 μ ad apicem, crassae et aliquantum irregulariter positae. Holotype slide no. MYS-JOG 8:416

This species was found usually in a small number or as a stray specimen in samples collected from pools and large ditches in the river bed occurring with vegetable detritus and the like. Very stray specimens also were seen in wet encrustations of rocks with Podostemads. This diatom does not compare with any of the known types hence it is considered as new species. It is probably related to *E. pectinalis* (KÜTZ.) RABH. in coarseness of structure and general shape but otherwise differs in several respects.

81 *Eunotia lunaris* (EHR.) GRUN

HUSTEDT, 1930, 183, f. 249.

This species was found in varying number in samples from pools, puddles and ditches in the region often occurring with vegetable detritus and wet mosses

82. *Eunotia nehruui* sp. nov. (Fig. 32)

Frustules broadly rectangular in girdle view. Valves 45-50 μ long and 13 μ broad, slightly arcuate, robust, dorsal side convex, ventral side slightly concave, parallel with dorsal side with a subconical tumidity in the middle, ends on the dorsal side constricted, broadly capitate and rounded. Polar nodules small and distinct. Striae about 13-14 in 10 μ , coarse and clear, indistinctly punctate and somewhat irregularly set.

Frustulae late rectangulares in aspectu zonali. Valvae 45-50 μ longae atque 13 μ latae, aliquantum arcuatae, robustae, pars dorsi convexa, ventralis aliquantum concava parallela ad partem dorsi, subconi tumidi in medio, apicibus constrictis ad partem dorsi, late capitatis rotundatis. Noduli polares parvi et distincti. Striae circiter 13-14 in 10 μ , crassae et distinctae, indistincte punctatae et leniter irregulariter positae. Holotype slide no. MYS-JOG. 11:419

This species does not compare satisfactorily with any of the known types, hence it is considered as a new species. It is dedicated in honour of India's greatest national leader JAWAHARLAL NEHRU to commemorate his memory (departed on 27th May 1964 at 2 p.m.).

This diatom was found mostly in small number in samples from pools and ditches in the river bed below the falls and wet encrustation of rocks.

83. *Eunotia nodulosa* MEISL. (Fig. 161)

MEISLER, 1932, 35, t. 12, f. 88; CLEVE-EULER, 1951-55, II, 96, f. 421 i [= *E. grunowii* v. *nodulosa* (MEISL.) A. CL.]; GANDHI, 1957, 15, f. 5 [= *E. grunowii* v. *nodulosa* (MEISL.) A. CL.]:- Valves 36-39 μ long and 4.5 μ broad, slightly arcuate, dorsal side convex and almost parallel to the ventral side which is concave, ends somewhat abruptly narrowed on the dorsal side, well produced and somewhat obliquely truncate rounded. Polar nodules distant from the ends. Striae about 16 in 10 μ in the middle and closer towards ends up to 20 in 10 μ .

This species was found mostly in small number in samples from pools, puddles and ditches in the river bed mixed up with vegetable

detritus and other things. A few specimens also were seen in wet slimy encrustation of rocks. This diatom appeared to be delicate but conspicuous because of thin valves with beautifully narrowed ends. CLEVE-EULER, treated this entity under *E. grunowii* BERG without assigning any reasons. While checking up further references, her *E. sudetica* MÜLL. v. *incisa* (MAY.) A. CL. (l.c. p. 141, f. 447h-k) compares with her *E. grunowii* v. *nodulosa*, with less number of striae as stated but the illustration fails to support the statement. Again, the present specimens compare *E. sudetica* v. *emycephala* A. CL. (CLEVE-EULER, l.c. f. 447g) in shape and apices but differ in number of striae per 10μ . However, the present forms closely compare with MEISNER's photomicrographic illustration and hence they are so treated.

84. *Eunotia patrickii* sp. nov. (Fig. 33)

Frustules solitary, rectangular in girdle view. Valves $60-66.6\mu$ long and 9μ broad, linear, biarcuate, dorsal side slightly convex with a slight but distinct concavity in the middle, ventral side slightly concave but with a median tumidity, ends on the dorsal side clearly constricted, broadly capitate and rounded, apices somewhat thickened towards dorsal side. Polar nodules small towards ends. Striae about $11-12$ in 10μ , indistinctly punctate and slightly closely set towards ends.

Frustulae solitariae, in aspectu zonali rectangularis. Valvae $60-66.6\mu$ longae, atque 9μ latae, lineares, biarcuatae, pars dorsalis aliquantum convexa cum leniter sed clare concavis in medio, pars ventralis aliquantum concava sed tumida in medio, apicibus constrictis ad partem dorsalem, late capitatis et rotundatis, apicibus aliquantulum expansi versus dorsum. Noduli terminalibus parvi. Striae circiter $11-12$ in 10μ , indistincte punctatae et aliquantum proximae positae ad apice. Holotype slide no. MYS-JOG. 9:417

This species does not compare well with any of the known types, hence it is considered as a new species and named in honour of Dr. R. PATRICK of Philadelphia.

This diatom was found usually in a small number in samples collected from pools, ditches and wet encrustations of rocks in the river bed and sometimes with vegetable detritus.

85. *Eunotia pectinalis* (KÜTZ.) RABH. v. *curta* V. H.

CLEVE-EULER, 1951-55, II, 84, f. 409b-d.

This diatom was found in varying number in several samples collected from the area.

86. *Eunotia pectinalis* v. *gibbulosus* VENKAT.

VENKATARAMAN, 1939, 309, f. 22; GANDHI, 1959, 97, pl. 1, f. 8.

This diatom was found mostly as a stray specimen in some samples collected from pools and ditches in the river bed and wet encrustations of rocks.

87. *Eunotia pectinalis* v. *minor* (KÜTZ.) RABH.

HUSIEDI, 1930, 182, f. 238; 1927-1963, II, 298, f. 763 d-f

This diatom was found in varying number in samples collected from various wet situations in the area.

88. *Eunotia pectinalis* v. *neglecta* GANDHI (Fig. 34)

GANDHI, 1957b, 47, pl. 13, f. 3-5.

This diatom was usually found in a small number in samples collected from pools, puddles and ditches in the river bed occurring in form of slimy ribbons with vegetable detritus. Stray specimens also were seen in slimy matter encrusting rocks.

89. *Eunotia praeupta* EHR.

HUSIEDI, 1930, 174, f. 244; 1927-1963, II, 280, f. 747 A a-e.

This species was found usually in a very small number in samples from pools and ditches in the river bed occurring with slimy matter and detritus. Stray specimens also were found with wet mosses and liverworts bordering some water holes on way down to the falls.

90. *Eunotia subgibba* sp. nov. (Fig. 35)

Valves 41.8-50 μ long and 7-7.7 μ broad, linear, arcuate, dorsal side with three weak uniform gibbositities closely set, ventral side only slightly concave in a uniform arc, ends slightly constricted on the dorsal side, very much produced, broadly subcapitate and rounded. Polar nodules small near the ends. Striae about 11-13 in 10 μ , indistinctly punctate and closely set towards ends, middle striae slightly irregularly set.

Valvae 41.8-50 μ longae atque 7-7.7 μ latae, lineares, arcuatae, in parte dorsi paulum tribus protuberantis equidistantibus et proxime positis; latus ventrali paululum concavis in constans curvis, apicibus aliquantum constrictis ad partem dorsi valde productis, late subcapitatis rotundatis. Noduli polares parvi prope apicem. Striae 11-13 in 10 μ , indistincte punctatae, in

medio aliquantum irregulariter ad apicem proxime positae Holotype slide MYS-JOG. 7:415.

This entity only approximately compares with forms and varieties of *E. pectinalis* (Kütz.) RABH., having tumidities on the dorsal side. The illustrations given in the Atlas Diat., t. 274, f. 27; t. 289, f. 32, somewhat compare in outline of the present form but they look much slimmer with comparatively much narrower apices. It, otherwise, does not agree with any similar looking diatoms, hence it is considered as a new species.

This species was found in varying number in samples collected from pools, puddles and ditches in the region often associated with other diatoms in masses of vegetable detritus.

91. *Eunotia veneris* (Kütz.) MÜLL.

HUSTEDI, 1930, 182, f. 245; 1927-1963, II, 300, f. 766

This species was found in varying number in samples collected from various pools and ditches in the area. Stray specimens also were found in vegetable detritus and wet masses of liverworts.

92. *Fragilaria capucina* DESM.

HUSTEDI, 1930, 138, f. 126; 1927-1963, II, 144, f. 659a-c.

This species was found in fair number in samples collected from various pools containing much vegetable detritus and sediments.

93. *Fragilaria intermedia* GRUN.

HUSTEDI, 1930, 139, f. 130; 1927-1963, II, 152, f. 666

This species was frequently observed in various samples collected from the area, and also in wet encrustations of rocks in the river bed.

94. *Fragilaria rumpens* (Kütz.) CARL.

CLEVE-EULER, 1951-55, II, 41, f. 352a, aa [= v. *genuina* (V. H.) A. CL.]

This species was found in a good number in several samples collected from pools, puddles and other wet situations in the region.

95. *Fragilaria rumpens* v. *familiaris* (KÜTZ.) A. CL.

CLEVE-EULER, 1951-55, II, 42, f. 352c-e.

This diatom was found fairly frequently in samples collected from pools and ditches in the river bed and other places, often along with the above type.

96. *Fragilaria rumpens* v. *fragilarioides* (GRUN.) A. CL.

CLEVE-EULER, 1951-55, II, 42, f. 352b.

This diatom was found in varying number in samples collected from pools and wet encrustations of rocks and other places.

97. *Fragilaria rumpens* v. *meneghiniana* (GRUN.) nov. comb

HUSIEDI, 1930, 156, f. 178 (= *Synedra rumpens* KÜTZ. v. *meneghiniana* GRUN.).

This diatom was found in usually small number in samples collected from pools and ditches in the river bed. It was noted to occur in regular bands or ribbons of slimy nature, hence it is felt here to suggest a new combination.

98. *Fragilaria ungeriana* GRUN

GANDHI, 1962, 130, pl. 1, f. 1-2.

This species was found in varying number in samples mainly collected from pools and some large ditches in the river bed below the falls. It also occurred in samples of vegetable detritus and pool sediments.

99. *Frustulia saxonica* RABH

CLEVE-EULER, 1951-55, V, 8, f. 1327a-b (= v. *typica* A. CL.).

This species was found in varying number in several samples collected from pools, puddles and ditches in the river bed. It was also commonly seen in wet encrustations of rocks and clusters of mosses.

100. *Frustulia vulgaris* (THW.) DE TONI

HUSIEDI, 1930, 221, f. 327; 1927-1963, II, 730, f. 1100a.

This species was found in varying number in samples collected of slimy matter and detritus lying in pools, water courses and wet mosses.

101. *Frustulia vulgaris* v. *capitata* KRASSKE

HUSTEDI, 1930, 221, f. 328; 1927-1963, II, 731, f. 1100b

This diatom was found usually in a small number along with the above type mostly occurring with slimy matter and pool sediments etc.

102. *Frustulia vulgaris* v. *subcapitata* GANDHI

GANDHI, 1959c, 103, f. 28-29.

This diatom was found in varying number in samples collected from various bodies of water in the area but more commonly in slowly flowing water courses occurring there with light brown sediments and slimy matter. Stray specimens also were recorded from among wet clusters of mosses and liverworts

103. *Gomphonema augu* EHR

HUSTEDI, 1930, 372, f. 688.

This species was found in varying number in several samples collected from the area. It was often seen mixed up with vegetable detritus and other slimy matter etc.

104. *Gomphonema clavatoides* GANDHI

GANDHI, 1960b, 112, f. 88-89, 103.

This species was found in a small number in pools and ditches in the river bed and encrustations of wet rocks.

105. *Gomphonema clevei* FRICKE

SCHMIDI, 1874-1959, Atlas Diat., t. 234, f. 44-46; HUSTEDI, 1938, 441, t. 27, f. 15-18

This species was found commonly in several samples collected from the area. In certain samples from pool encrustations it was gregarious.

106. *Gomphonema clevei* f. *acuta* f. nov. (Figs. 142-144)

Valves 26-33 μ long and 4.4-5.5 μ broad, lanceolate-clavate with apex acutely rounded and base slightly constricted, broader than the apex, subcapitate rounded. Raphe thin and straight or slightly undulate. Axial area $\frac{1}{3}$ the width of the valves, narrowly lanceolate; central area not defined, isolated stigma present very close to the

raphe ends in the central nodule. Striae 14-16 in 10μ , slightly radial throughout, fine but distinct. In all other characters like the above type

Valvae 26-33 μ longae atque 4-5 μ latae, lanceolatae-clavatae, apice acutis rotundatis, basi aliquantum constrictis, latior quam apex, subcapitatis rotundatis. Raphe tenuis et recta vel undulata. Area axialis $\frac{1}{3}$ latitudinis valvae, tenui-lanceolatae; area centralis haud evoluta, stigmatate unico unilateralis posito ad raphe terminali in nodulo centrali. Striae circiter 14-16 in 10μ , ubique aliquantum radiales, tenuis sed distinctis. In coeteres ut typus. Holotype slide no. MYS-JOG 28:1653

This diatom was collected in varying number from pools, puddles and ditches in the river bed often occurring there in vegetable detritus and slimy matter. This diatom is considered as a new form of *G. clevei* as the apex in several specimens noted to be rather acute and base constricted, broad and slightly capitate

107. *Gomphonema clevei* v. *bipunctata* GANDHI

GANDHI, 1959, 326, f. 49.

This diatom was found usually in small number along with the above types

108. *Gomphonema clevei* v. *javanica* HUSI (Figs 145-146, 162)

HUSIEDI, 1938, 441, t. 27, f. 6-13.

Valves 22-35 μ long and 4.2-5.5 μ broad, narrowly lanceolate-clavate, indistinctly inflated in the middle or not, apex more or less broadly rounded, base attenuated and rounded. Raphe thin or thick, somewhat undulate or straight, ends in the central nodule somewhat closely set and terminal fissures short and curved. Axial area slightly less wide than in the type proper, about $\frac{1}{3}$ the width of the valves, lanceolate according to outline; central area not apparent, isolated stigma present, quite fine and set in the central nodule on one side. Striae about 14-16 in 10μ , fine but distinct and indistinctly punctate, slightly radial throughout

This diatom was found in a very good number in several samples collected from pools, ditches, wet encrustations of rocks, tufts of wet mosses etc. Several specimens observed of this diatom showed some variation in the outline, middle tumidity in some being present and in others absent, base comparatively broader in some cases, sometimes very slightly constricted subcapitate and the raphe straight or undulate. However, this variety is distinguished from the main type in its possession of comparatively narrower axial area.

109. *Gomphonema clevei* v. *undulata* v. nov. (Fig. 151)

Valves 33-40 μ long and 6.2-6.8 μ broad, lanceolate-clavate, sides triundulate, apex constricted and broadly produced and rounded, base constricted and truncately rounded capitata. Raphe thin and straight or sometimes slightly undulate, terminal fissures shortly curved. Axial area very broad, linear-lanceolate, almost $\frac{1}{3}$ the width of the valves; central area not defined; isolated stigma fine, set close to raphe ends in the central nodule. Striae about 15-16 in 10 μ , fine, slightly radial throughout and distinct. In all other characters like the type.

Valvae 33-40 μ longae atque 6.2-6.8 μ latae, lanceolatae clavatae, margines triundulatae, apice constrictis, late productis rotundatis, basi constrictis et truncatis capitatis. Raphe tenuis et recta interdum undulata, fissuris terminalibus brevi curvatis. Area axialis latissima, lineari-lanceolata; prope $\frac{1}{3}$ latitudinis valvae; area centralis haud evoluta; stigmati unico subtilis, unilaterialis positus ad raphe terminali in nodulo centrale. Striae circiter 15-16 in 10 μ , subtilis, ubique aliquantum radiales et distincte. In coeteris ut typus. Holotype slide no. MYS-JOG. 29:1655.

This diatom compares in shape and triundulate side with *G. helveticum* BRUN v. *tenuis* (FRICKE) HUSI. (HUSIEDI, 1930, 374, f. 711), *G.* - v. *undulatum* MAY. (MAYER, 1928, 123, t. 5, f. 4-5; CLEVE-EULER, 1951-55, IV, 181, f. 1273d) and *G. islandicum* ØST. (ØSIRUP, 1920, 21, t. 2, f. 28), but it differs from all in having broadly linear-lanceolate axial area, position of isolated stigma close to the raphe ends in the central nodule and other features. Again, the striae are more uniformly set than in the above quoted references. The present specimens except for the triundulate sides strongly conform to the structure and construction of *G. clevei*, hence they are considered as a new variety of the same.

This diatom was found mostly in small number but in several samples collected from the area, especially from pools etc. in the river bed and wet encrustations of rocks.

110. *Gomphonema gracile* EHR.

HUSIEDI, 1930, 376, f. 702.

This species was collected in varying number, rarely gregariously in several samples collected from the area. It generally occurred in large number with vegetable detritus.

111. *Gomphonema gracile* v. *aurita* (A. BRAUN) CI. (Fig. 148)

HUSIEDI, 1930, 376; SCHMIDT, 1874-1959, t. 236, f. 20-24 esp. f. 22-23.

This diatom was found also in varying number along with the above type.

112 *Gomphonema lanceolatum* EHR.

HUSIEDI, 1930, 376, f. 700

This species was found as a common diatom in whole of the region.

113. *Gomphonema lanceolatum* v. *insignis* (GREG.) CL.

HUSIEDI, 1930, 376, f. 701.

This diatom was found usually in a small number in many samples collected from pools, puddles and ditches in the river bed. It often occurred with slimy matter and detritus.

114 *Gomphonema parvulum* (KÜTZ.) GRUN.

HUSIEDI, 1930, 372, f. 713a

This species was found in varying number in all the samples collected from the area

115. *Gomphonema parvulum* v. *lagenula* (GRUN) HUSI

HUSIEDI, 1930, 373; 1949, 119, t. 11, f. 8-10

This diatom was found usually in a small number in many samples collected from the area, often occurring with the type.

116 *Gomphonema parvulum* v. *micropus* (KÜTZ) CL.

HUSIEDI, 1930, 373, f. 713c.

This diatom was found also in varying number along with the type.

117. *Gomphonema parvulum* v. *subelliptica* CL.

HUSIEDI, 1930, 373, f. 713b

This diatom was found in a small number in samples collected from pools and ditches in the area occurring there in slimy matter and other detritus.

118. *Gomphonema sphaerophorum* EHR

HUSIEDI, 1930, 372, f. 695.

This species was found in varying number in several samples collected from the area

119. *Gomphonema sphaerophorum* f. *jogensis* f. nov (Fig. 149)

Valves 30-40 μ long and 6-7 μ broad, lanceolate-clavate, shoulder towards apex somewhat angular, constricted and capitate rounded, base gradually narrowed, in between slightly concave and acutely rounded but not capitate. Raphe thin and straight, terminal fissures slightly curved. Axial area narrow, linear; central area slightly widened, unilateral with an isolated stigma on the opposite side. Striae about 12-13 in 10 μ , moderately radial and punctate, punctae indistinct. In all other characters like the above type.

Valvae 30-40 μ longae atque 6-7 μ latae, lanceolatae-clavatae, humeri ad apicem aliquantum angulares, apice constrictis, capitatis rotundatis, basi gradatim attenuata interdum leniter concava, acutis rotundatis haud capitatis. Raphe tenuis et recta, fissuris terminalibus paulum curvatis. Area axialis angusta, linearis; area centralis paulum unilaterialis dilatata, unico stigmatate in latere opposito. Striae circiter 12-13 in 10 μ , modice radiales et punctatae, punctis indistincte. In coeteres ut typus. Holotype slide no MYS. JOG 30:1656

This diatom compares very well with *G. sphaerophorum* EHR as illustrated in Atlas Diat., t. 239, f. 37-39 conforming with the description given here. CLEVE-EULER, also recorded similar looking diatoms under *G. sphaerophorum* (CLEVE-EULER, 1951-55, IV, 176, f. 1267a-b) but the base is indicated to be capitate, hence the present entity differs. HUSTEDI's illustration of *G. sphaerophorum* (HUSTEDI, 1930, 372, f. 695) shows non-angular shoulder towards apex besides capitate base, hence it differs. Moreover, many specimens observed of this diatom from the present locality, they all seem to have 12-13 striae in 10 μ . With these remarks, therefore, the present specimens are treated as a new form of *G. sphaerophorum* EHR.

This diatom was collected in varying number from pools and ditches in the river bed often occurring there in masses of vegetable detritus and in encrustations of wet rocks etc.

120. *Gomphonema subapicatum* FRIT. et RICH

FRITSCH et RICH, 1929, 109, f. 6A-D; GANDHI, 1960b, 108, f. 74-80

This species was found in varying number in practically all the samples collected from the area but it was never found to be gregarious.

121. *Gomphonema subtile* EHR.

HUSTEDI, 1930, 376, f. 709.

This species was found usually in small number in several samples collected from pools and ditches in the area often occurring with slimy matter and detritus.

122. *Gomphonema subtile* v. *malayensis* HUSI

HUSTEDI, 1942, 119, f. 258-260.

This diatom was found rather sparingly in samples collected from tufts of wet mosses and detritus of pools and puddles in the river bed.

123. *Gomphonema subventricosum* HUSI (Fig 163)

HUSTEDI, 1938, 440, t 27, f 25-26; GANDHI, 1962, 145, pl. 2, f. 34-35

This species was found in varying number in samples collected from pools and other wet places in the region. It often occurred with detritus and encrustations of rocks. The specimens recorded from this area seemed to be somewhat smaller and slimmer than those recorded from Lonavla. However, they all showed characteristic irregular setting of striae and other details.

124. *Hantzschia amphioxys* (EHR) GRUN.

HUSTEDI, 1930, 394, f. 747.

This species was found invariably in a small number but in most of the samples collected from the area.

125. *Hantzschia amphioxys* f. *capitata* O MÜLL.

HUSTEDI, 1930, 394, f. 748.

This diatom was found mostly as a stray specimen in many samples collected from the area.

126. *Hantzschia amphioxys* v. *densestriata* (FONI) A. CL.

CLEVE-EULER, 1951-55, V, 49, f. 1419n-p.

This diatom was collected in varying number from pools, puddles and ditches in region. It mostly occurred with vegetable detritus, pool sediments and wet encrustations of rocks.

127. *Hantzschia distincte-punctata* HUSI. (Figs. 164-167)

HUSIEDI, 1938, 462, t. 40, f. 4; SCHMIDI, 1874-1959, Atlas Diat., t. 329, f. 21-22; CHOLNOKY, 1955, 18, f. 19; - 1957b, 66, t. 3, f. 63; HUSIEDI, 1922, 167 (= *H. amphioxys* v. *distincte-punctata* HUSI): - Valves 50-58 μ long and 5.3-5.5 μ broad, slightly arcuate, linear to linear-lanceolate with strongly constricted, delicately produced, distinct small capitate ends. Keel very excentric, keel punctae 5.5-7 in 10 μ , quite coarse, somewhat regularly set, middle two clearly distantly set. Striae about 10-12 in 10 μ , very clearly and coarsely punctate (structure alveolar), punctae about 8-11 in 10 μ .

This species was found usually in a small number or in varying number in samples collected from pools, ditches and wet encrustations of rocks also in tufts of wet mosses. It appeared as a very conspicuous diatom with beautifully coarsely punctate structure. It also represented some variation in outline, curvature and end portion.

128. *Melosira distans* (EHR.) KÜTZ. v. *lirata* (EHR.) BEIHEGE
f. *lacustris* (GRUN.) BEIHEGE (Fig. 36)

HUSIEDI, 1930, 93, f. 57; - 1927-1963, I, 264, f. 111c; HUBER-PESIALOZZI, 1942, 391, f. 477o; CLEVE-EUIER, 1951-55, I, 23, f. 13i-1 [= *M. lirata* (EHR.) GRUN. v. *lacustris* GRUN.]: - Cells formed in cylindrical chains, 15-18 μ in diameter and semi-cells 8-10 μ in height, wall very coarse or thickened, inner line undulate or somewhat irregular, pseudo sulcus very distinct and sulcus deeply wedged, hals sharply marked, discs flattened with rounded corners. Individual cells connected with short spiny structures not evidently marked due to some thickening matter. Striae about 15-17 in 10 μ , slightly curved, somewhat finely punctate, punctae somewhat stretched in long axis.

This diatom was found usually in a small number in sediments of pools and ditches in the river bed. It also occurred in encrustations of wet rocks and water holes along the way down to the falls. Short chains were found with stiff coat of slimy matter.

129. *Melosira granulata* (EHR.) RALFS

HUSIEDI, 1930, 87, f. 44

This species was found usually in varying number in several samples collected from the area.

130. *Melosira granulata* v. *angustissima* MÜLL.

HUSIEDI, 1930, 88, f. 45.

This diatom was found in usually small number in most of the samples collected from the area. It was more commonly seen with vegetable detritus and pool sediments

131. *Melosira granulata* v. *muzzanensis* MEISL.

HUSIEDI, 1930, 88, f. 47.

This diatom was found rather in a small number in samples collected from some pools and ditches in the river bed and other wet places. It occurred with masses of vegetable matter and detritus.

132. *Melosira juergensii* C. A. AG

HUSIEDI, 1930, 84, f. 40.

This species was found usually in a small number in samples collected from pools and ditches in the river bed and some water courses in the area.

133. *Navicula bacillum* EHR. v. *jogensis* v. nov (Fig. 109)

Valves 45-66 μ long and 12-13.2 μ broad, sublinear, slight but distinctly inflated in the middle, ends weakly produced and broadly rounded or indistinctly subcapitate. Raphe thin and straight with central pores very distinct and closely set in a large bright central nodule and terminal fissures very conspicuously curved and bayonet-shaped in very distinct terminal nodule. Axial area fairly broad, linear, hyaline bordering the raphe; central area large elliptical in long axis, terminal areas very large and distinct. Striae about 15-17 in the middle up to 24 in 10 μ , towards ends, radial and curved throughout, finely punctate (lineate?) and becoming gradually closer towards ends delimited by very strong striae at ends.

Valvae 45-66 μ longae atque 12-13.2 μ latae, sublineares, leniter sed distincte inflatae in medio, apicibus paulum productis et late rotundatis vel indistincte subcapitatis. Raphe tenuis et recta, poris centralibus distinctissima et proxime positis in nodulo centrali, nodulum centralis magna et candida, fissuris terminalibus conspicuis gladius-similibus curvatis in distincti noduli terminales. Area axialis modice lata, linearis, hyalinum ad raphe; area centralis magna, elliptica in axe longo, area ad apicem amplissima et distincta. Striae circiter 15-17 in medio tenus 24 in 10 μ ad apicem, ubique radiales et curvatis, tenuissimae punctatae, gradatim proxime positae et delimitatae versus crasse striae in utroque apice. Holotype slide no MYS-JOG 12:420

This diatom agrees in all details and structural plan of *N. bacillum* EHR as described by HUSIEDI [HUSIEDI, 1930, 280, f. 465; 1927-1963, III, 113, 1248a-d (= f. *genuina*)] and others. However, the present specimens differ in shape, indistinctly constricted apices which are produced or subcapitate and number of striae in the middle part and towards ends differing in count. It is, therefore, considered as a new variety.

This diatom was found in a good number in several samples collected from pools and ditches in the river bed and also in wet encrustations of rocks and tufts of mosses etc.

134. *Navicula cari* EHR.

HUSIEDI, 1930, 299, f. 512

This species was found in varying number in samples collected from various bodies of water and wet clusters of mosses and encrustations.

135. *Navicula cari* v. *angusta* GRUN

GANDHI, 1958, 257, f. 13.

This diatom was found fairly frequently in several samples of algae collected from the area. It commonly occurred with wet mosses, flakes of liverworts and other encrustations of rocks in the river bed.

136. *Navicula cincta* (EHR) KÜTZ

HUSIEDI, 1930, 298, f. 510.

This species was recorded mostly as a stray diatom in several samples collected from the area.

137. *Navicula contenta* GRUN. f. *biceps* ARNOU (Fig. 110)

HUSIEDI, 1930, 277, f. 458c; 1927-1963, III, 209, f. 1328h-i:—Valves 9.5-13 μ long and 2 3/3.2-2.5/3.4 μ broad in the middle and at the broadest, linear with swollen broadly rounded ends. Raphe thin and straight with terminal fissures bent. Axial area very narrow, linear; central area very large, roundish or roundish-elliptical. Striae varying, 28-33 in 10 μ , very fine, hyaline, seen with difficulty but somewhat distinct towards mid-axis, almost perpendicular to the middle line and parallel or very indistinctly radial in the middle.

This diatom was found rather in a small number in samples collected from pools and wet encrustations of rocks in the river bed. It also

seemed to occur with wet clusters of mosses bordering water holes. It was noted to be a beautiful diatom with robust wall and faint structure.

138 *Navicula contenta* GRÜN. f. *parallela* PEIERSEN (Fig 141)

HUSIEDI, 1930, 277, f. 458b; 1927-1963, III, 209, f. 1328e-g: Valves 9-11.2 μ long and 2.8-3 μ broad, linear with almost parallel sides and broadly rounded ends. Raphe thin and straight with terminal fissures bent. Axial area very narrow; central area quite large, roundish or elliptical in long axis. Striae about 30 or more in 10 μ , hyaline, parallel or extremely less radial in the middle, at length perpendicular to the middle line.

This diatom was found mostly as a stray specimen along with the above type in samples collected from wet mosses, encrustations of rocks and other wet places in the area.

139. *Navicula cryptocephala* KÜTZ

HUSIEDI, 1930, 295, f. 496.

This species was found in varying number in samples collected from the area.

140. *Navicula cryptocephaloides* HUSI.

HUSIEDI, 1938, 261, t. 18, f. 1-2; SCHMIDT, 1874-1959, Atlas Diat. t. 403, f. 56-59.

This species was found fairly well in samples collected from pools and ditches in the river bed and also in encrustations of wet rocks.

141. *Navicula cuspidata* KÜTZ.

HUSIEDI, 1930, 268, f. 433; 1927-1963, III, 59, f. 1206a (= f. *genuina*)

This species was observed in varying number in several samples collected from the area, with and without craticular plates.

142. *Navicula cuspidata* v. *ambigua* (EHR.) CL.

HUSIEDI, 1930, 268, f. 434; 1927-1963, III, 62, f. 1206b.

This diatom was found somewhat more frequently than the above type in several samples collected from the area.

143. *Navicula dicephala* (EHR) W. SM

HUSIEDT, 1930, 302, f. 526.

This species was found fairly well in samples collected from pools and ditches in the river bed, often occurring with wet encrustations of rocks and detritus.

144. *Navicula dicephala* v. *sphaerophora* A. Cl

CLEVE-EUIER, 1951-55, III, 143, f. 792g-h

This diatom was found fairly frequently in several samples collected from the locality but particularly in masses of detritus and encrustations.

145. *Navicula fluens* HUSI.

HUSI, 1930, 285, f. 474

This species was collected in varying number in samples derived from pools and ditches in the river bed often occurring there with slimy encrustations and detritus.

146. *Navicula gothlandica* GRUN.

HUSIEDT, 1930, 296, f. 499

This species was found rather sparingly in samples collected from pools, ditches and slimy matter on vegetable detritus and rocks

147. *Navicula gracilis* EHR.

HUSIEDT, 1930, 299, f. 514

This species was found usually in a small number in samples collected of detritus and pool sediments. It also occurred in some encrustations of wet rocks.

148. *Navicula jogensis* sp. nov. (Figs 112-115)

Valves 56-66 μ long and 25-27.5 μ broad, broadly elliptical or elliptical-rhomboid with or without slightly constricted, broad, truncately rounded or rounded ends. Raphe thin and straight with central pores distinct and terminal fissures short but sharply curved towards extremity. Axial area narrow, linear or sublinear; central area large rounded or transversely elliptical without punctae or

stigma. Striae about 6.5-7 in the middle up to 8-11 in 10μ , towards ends, strongly radial throughout, clearly punctate, punctae about 16-18 in 10μ , in the middle some short and long striae present but they do not alternate

Valvae $56-66\mu$ longae atque $25-27.5\mu$ latae, late-ellipticae vel elliptico-rhomboidae, apicibus paulum vel haud constrictis, late truncatis rotundatis vel rotundatis Raphe tenuis et recta, poris centralibus distinctis et fissuris terminalibus brevi sed abrupte curvatis ad apicem Area axialis angusta, linearis vel sublinearis; area centralis magna, rotundata vel transapicali elliptica cum sine punctatis vel stigmatibus. Striae circiter 6.5-7 in medio tenus 8-11 in 10μ ad apicem, ubique radiales, clare punctatae, punctis circiter 16-18 in 10μ , in medio paucae striae longae et breves evolutae haud alternatae Holotype slide no. MYS-JOG. 30:1655

This species only slightly compares *N. ludloviana* A. S. as described and illustrated by CLEVE-EULER (CLEVE-EULER, 1951-55, III, 134, f. 769a-b = v *typica* A. CL.; CLEVE, 1895, II, 24; SCHMIDI, 1874-1959, Atlas Diat. t. 46, f. 15), in shape and the number of striae which are lineolately punctate and radial throughout. However, the specimens collected from this area are much smaller in dimensions, they are more rhomboid or elliptical rhomboid and the axial and central areas also somewhat differ from that in *N. ludloviana*. Moreover, the striae in middle region do not necessarily alternate with shorter ones. With these observations, therefore, the present specimens are considered as new species.

This species was collected usually in a small number from pools and ditches in the river bed, occurring there with wet encrustations on rocks, clusters of mosses and detritus.

149. *Navicula laterostrata* HUSI.

HUSIEDI, 1930, 301, f. 521.

This species was found in varying number in samples collected from various pools, puddles and ditches in the region. It also occurred in wet encrustations of rocks and vegetable detritus but in a small number

150. *Navicula mutica* KÜTZ.

HUSIEDI, 1930, 274, f. 453a.

This species was found in varying number in several samples collected from the area.

151 *Navicula mutica* v. *cohnii* (HILSE) GRUN.

HUSIEDI, 1930, 275, f. 453b.

This diatom was found usually in a small number in samples collected of detritus and slimy matter in water courses and pools in the river bed. It also occurred in wet encrustations of rocks and clusters of mosses.

152 *Navicula perotettii* GRUN.

HUSIEDI, 1927-1963, III, 56, f. 1205a-b; VENKATARAMAN, 1939, 325, f. 83, 88 (= *N. cuspidata* v. *conspicua* VENKAT.).

This species was noted as a stray specimen in some samples collected from the area.

153. *Navicula pupula* KÜTZ.

HUSIEDI, 1930, 281, f. 467a; 1927-1963, III, 120, 1254a-g.

This species was found as a common diatom in several samples collected from the area.

154. *Navicula pupula* f. *capitata* SKV. et MEYER

HUSIEDI, 1927-1963, III, 121, f. 1254i-m; 1930, 281, f. 467c (= v. *capitata* HUSI.).

This was found also as a common diatom in the area often occurring with masses of vegetable matter and detritus.

155 *Navicula pupula* f. *elliptica* HUSI.

HUSIEDI, 1927-1963, III, 121, f. 1254h; 1930, 282, f. 467d (= v. *elliptica*).

This diatom was found usually in small number in some samples collected from the area.

156 *Navicula pupula* f. *rectangularis* (GREG) GRUN.

HUSIEDI, 1927-1963, III, 121, f. 1254n-q; 1930, 281, f. 467b (= v. *rectangularis*).

This diatom was found rather sparingly in some samples collected from pools and ditches in the area.

157. *Navicula pusilla* W. SM. v *lanceolata* GRUN. (Figs. 116-119)

LAVRENKO, 1951, 333, f. 194-6; CLEVE-EULER, 1951-55, III, 113, f. 729d-f; DONKIN, 1874-73, I, 20, pl. 3, f. 6a-b (= *N. pusilla* W. SM.):—Valves 53.5–70.4 μ long and 22–26.5 μ broad, broadly lanceolate or lanceolate-elliptical with clearly constricted rostrate beaklike rounded ends. Raphe thin and straight with distinct central pores and terminal fissures clearly curved. Axial area narrow, linear; central area fairly large, more or less rounded. Striae about 11–15 in 10 μ , from the middle progressively closer towards ends, curved and strongly radial throughout, clearly punctate, punctae varying from 18 to 25 in 10 μ , in the middle long and short striae present mostly alternating.

This diatom very well compares the type described and illustrated by CLEVE-EULER and LAVRENKO in all the details except that number of striae stated to be only 11 in 10 μ (throughout?) by both these authors. While considering the illustrations given by CLEVE-EULER which entirely agree here, suggest that she seemed to have recorded 11 striae per 10 μ from the middle part only. The present specimens also agree well with those given by DONKIN under the main type. Again, the present specimens compare, *N. gandhi* MEISER (MEISER, 1932, 36, t. 12, f. 95), N. XI CLEVE (SCHMIDT, 1874-1959, t. 370, f. 13) and *N. pusilla* W. SM. (HENDEY, 1958, 66, pl. 3, f. 11) in shape, apices and organization of striae but differ in some or other respects. The central area in *N. gandhi* and N. XI CLEVE is comparatively very small and striae seem to have higher density per 10 μ than noted here. HENDEY's specimen appears to be proportionately broader and less lanceolate. This species was found mostly in a small number in samples collected from pools and ditches in the river bed.

158. *Navicula radiososa* KÜTZ.

HUSTEDI, 1930, 299, f. 513.

This species was collected in varying number from several wet places in the area.

159. *Navicula radiososa* v. *tenella* (BRÉB.) GRUN.

HUSTEDI, 1930, 299; GANDHI, 1955, 321, f. 21.

This diatom was found in varying number in samples collected from pools, puddles and ditches in the area. Stray specimens also were seen in wet encrustations of rocks and detritus.

160. *Neidium bisulcatum* (LAGSI.) CL.

HUSIEDI, 1930, 242, f. 374

This species was found usually in a small number in samples collected from various pools, puddles, ditches and water holes occurring in the area. It was also found with wet mosses and small liverworts.

161. *Neidium bisulcatum* f. *undulata* O. MÜLL.

HUSIEDI, 1930, 242, f. 375

This diatom was found in fair number in samples of wet mosses, encrustations of rocks and detritus from pools and some ditches

162. *Neidium gracile* HUSI.

HUSIEDI, 1938, 406, t. 16, f. 8-9.

This species was found usually in a small number in samples collected from pools, ditches, wet encrustations of rocks and tufts of mosses in the area close to the falls.

163. *Neidium grandis* GANDHI

GANDHI, 1959, 313, f. 8.

This species was found in varying number in several samples collected from pools and wet encrustations of rocks in the river bed. Stray specimens also were recorded with tufts of wet mosses around water holes.

164. *Neidium iridis* (EHR.) CL.

HUSIEDI, 1930, 245, f. 379; GANDHI, 1959, 311, f. 4

This species was found usually in a small number in samples derived from pools and ditches in the river bed. It also occurred with wet mosses and Podostemads mostly as a stray form.

165. *Neidium productum* (W. SM.) CL. v. *bombayensis* GONZAL
et GANDHI

GANDHI, 1959, 311, f. 5.

This diatom was found also in a small number in samples collected from pools and ditches in the river bed occurring there with encrustations and sediments.

166. *Nitzschia amphibia* GRUN.

HUSIEDI, 1930, 414, f. 793.

This species occurred as a common diatom in all the samples collected from the region, sometimes it was gregarious

167 *Nitzschia amphibia* v *acutiuscula* GRUN.

HUSIEDI, 1930, 414; CLEVE-EULER, 1951-55, V, 86, f. 1496f-i

This diatom was found in varying number along with the above type.

168. *Nitzschia frustulum* (KÜTZ.) GRUN

HUSIEDI, 1930, 414, f. 795.

This species was found in a good number in several samples collected from pools, puddles, ditches, wet soils and other things of detritus. It was sometimes gregarious.

169. *Nitzschia gracilis* HANIZ.

HUSIEDI, 1930, 416, f. 794

This species was collected in varying number from pools, ditches and slimy matter of water courses in the area.

170. *Nitzschia ignorata* KRASSKE (Fig. 176)

HUSIEDI, 1930, 422, f. 819a-b.

This species was seen in varying number in samples collected of detritus and slimy matter in pools and ditches.

171. *Nitzschia levidensis* (W. SM.) GRUN.HUSTEDT, 1957, 338; 1930, 399, f. 760 (= *N. tryblionella* HANFZ. v. *levidensis*)

This species was found in varying number in samples collected from pools, ditches and wet encrustations of rocks occurring there with vegetable detritus.

172. *Nitzschia linearis* W. SM.

HUSTEDT, 1930, 409, f. 784

This species was collected in varying number from various pools, water courses and large ditches with detritus.

173 *Nitzschia longirostris* HUST.

HUSTEDI, 1938, 490, t. 40, f. 8.

This species was found usually in a small number in samples collected from wet encrustations of rocks, pools and ditches in the river bed. Stray specimens also were seen with tufts of wet mosses.

174. *Nitzschia lorenziana* GRUN. v. *subtilis* GRUN.

HUSTEDI, 1930, 423, f. 820.

This diatom was collected mostly in small number from pools and ditches in the river bed often occurring there with vegetable detritus and other stuff.

175 *Nitzschia microcephala* GRUN.

HUSTEDI, 1930, 414, f. 791.

This species was collected in varying number and rarely gregariously (?) in samples collected from various wet situations in the area.

176. *Nitzschia obtusa* W. SM. v. *scalpelliformis* GRUN.

HUSTEDI, 1930, 422, f. 817b.

This diatom was found usually in a small number in samples collected from pools and ditches in the river bed and fields where it occurred with masses of vegetable matter and detritus.

177 *Nitzschia obtusa* v. *scalpelliformis* f. *parva* HUST. (Fig. 168)

SCHMIDI, 1874-1959, Atlas Diat., t. 336, f. 25-26.

This diatom was collected usually in a small number from various pools and ditches in the area.

178. *Nitzschia palea* (Kütz.) W. SM.

HUSTEDI, 1930, 416, f. 801.

This species occurred as a very frequent diatom in all the collections made from the area. It was sometimes gregarious.

179. *Nitzschia perminuta* GRUN.

HUSTEDI, 1957, 352; 1930, 415 (= *N. frustulum* v. *perminuta*).

This species was found in varying number in several samples collected from the area.

180. *Nitzschia recta* HANIZ.

HUSIEDI, 1930, 411, f 785

This species was collected usually in a small number from various pools and ditches in the river bed and sometimes from clusters of wet mosses.

181. *Nitzschia spiculoides* HUSI.

HUSIEDI, 1949, 151, t. 13, f 5-6; GANDHI, 1962c, 487, pl. 125, f 66.

This species was found in varying number in samples collected from various pools, ditches and wet encrustations in the river bed

182. *Nitzschia sublinearis* HUSI

HUSIEDI, 1930, 411, f 786.

This species was collected in varying number from pools and ditches in the area often occurring there with vegetable detritus and other matter.

183. *Nitzschia subrostrata* HUSI.

HUSIEDI, 1942, 137, f. 313-319; GANDHI, 1962c, 485, t 125, f 63.

This species was found in varying number with vegetable detritus and sediments of pools and ditches in the river bed.

184. *Nitzschia thermalis* KÜTZ. v. *minor* HILSE

HUSIEDI, 1930, 403, f 772.

This diatom was collected usually in a small number from pools and ditches in the river bed. It also occurred in wet encrustations of rocks and tufts of mosses growing around water holes in the area.

185. *Nitzschia tryblionella* HANIZ. v. *victoriae* GRUN.

HUSIEDI, 1930, 399, f 758

This diatom was mostly found with vegetable detritus and sediments of various pools, ditches and water courses in the area. Stray specimens also were seen with wet encrustations on rocks.

186. *Nitzschia woltereckii* HUSI

HUSIEDI, 1942, 135, f. 309-312; GANDHI, 1962c, 485, t. 125, f. 62.

This species was found mostly in a small number or as a stray form in some pools and large ditches in the river bed

187. *Pinnularia acrosphaeria* BRÉB.

HUSIEDI, 1930, 330, f. 610

This species was collected in varying number from various pools and ditches in the area. It often occurred with detritus and pool sediments.

188. *Pinnularia acrosphaeria* v. *minor* CL.

CLEVE-EULER, 1954-55, IV, 25, f. 1022d; GANDHI, 1956, 203, f. 16.

This diatom was collected in good number from various pools and ditches in the area.

189. *Pinnularia borealis* EHR v. *lonavensis* GANDHI (Fig. 127)

GANDHI, 1962, 143, t. 1, f. 25.

This diatom was found usually in a small number in samples collected from pools and ditches on the way down to the falls and the river bed, occurring there with mosses, detritus and other stuff.

190. *Pinnularia borealis* v. *undulata* HUSI. (Fig. 120)

HUSIEDI, 1938, 393; SCHMIDI, 1874-1959, Atlas Diat., t. 385, f. 27; FOGED, 1949, 24, t. 2, f. 12:— Valves 55.5-62 μ long and 40-41.2 μ broad, linear with slight but distinctly triundulate sides, ends cuneate, constricted, rostrate and truncately rounded. Raphe thin but coarse, weakly arcuate, central pores thick conspicuous and unilaterally inclined and terminal fissures thick shallowly curved and reflexed. Axial area narrow, linear; central area large roundish and somewhat enlarged on one side. Striae about 5 in 10 μ , thick, radial in the middle and slightly convergent towards ends, inter costal space almost as much as the thickness of the striae.

This diatom was found mostly in a very small number or as a stray specimen in samples collected from pools and ditches in the river bed below the cataract and it occurred there with wet encrustations on rocks, tufts of mosses and detritus.

191. *Pinnularia congolensis* (ZANON) CHOL. (Fig. 128)

CHOLNOKY, 1957, 80, t. 6, f. 256-261; ZANON, 1938, 641, f. 27 (= *P. borealis* EHR. v. *congolensis* ZANON); HUSIEDI, 1949, 105, t. 6, f. 7-8 (= *P. borealis* v. *congolensis*):— Valves 50.3-60 μ long and 8.4-9 μ broad, linear, sides parallel or very slightly concave, ends

cuneate or long cuneate, constricted rostrate, truncate or subtruncately rounded. Raphe thin, straight or slightly arcuate, central pores distinct and slightly unilaterally inclined and terminal fissures clearly curved. Axial area slightly narrow, linear; central area large roundish and often slightly unilaterally dilated. Striae about 5-5.5 in 10μ , very thick, fairly radial in the middle and slightly convergent towards ends.

This species was collected usually in a small number in samples of wet mosses, detritus, and encrustations on wet rocks in the river bed and water holes. These specimens are considered according to CHOLNOKY.

192. *Pinnularia divergens* W SM

HUSIEDI, 1930, 323, f. 589.

This species was seen in varying number in samples collected from various pools, and large ditches found in the area. It also occurred with wet mosses and encrustations on wet rocks in the river bed.

193. *Pinnularia divergens* v *americana* MEISER (Fig. 150)

MEISER, 1937, 263, t. 7, f. 3:- Valves 90-118 μ long and 16-19 μ broad, linear, slightly inflated in the middle with cuneately rounded ends. Raphe thin and somewhat undulate with central pores distinct and terminal fissures shallowly curved and thickened. Axial area fairly wide about $\frac{1}{4}$ - $\frac{1}{5}$ the width of the valve, linear; central area large rhomboid with conical thickenings projected into it from the walls. Striae about 8-9 in 10μ , thick, congested, strongly radial in the middle and convergent towards ends.

This diatom was found mostly in a small number in samples collected from pools and large ditches in the river bed where it occurred with detritus and encrustations. A number of specimens observed from this area they very well compare with that of MEISER except that they are proportionately less broad. Moreover, the local specimens seemed to have conical thickenings from the mid-walls projected into the central area but not indicated in MEISER's form. However, these deviations are considered to be of minor importance, hence this taxon is treated as such.

194. *Pinnularia dubiosa* sp. nov. (Fig. 151)

Valves 85-98 μ long and 11.5-12.4 μ broad, linear, slightly inflated in the middle with slightly swollen smoothly rounded ends. Raphe thin and straight with central pores unilaterally bent and closely set and terminal fissures broadly curved semi-circular. Axial area some-

what narrow, sublinear; central area very large, rhomboid and reaching the sides. Striae about 9-10 in 10μ , coarse, fairly radial in the middle and convergent towards ends, striae in the middle gradually shortened due to which large rhomboid central area is formed

Valvae $85-98\mu$ longae atque $11.5-12.4\mu$ latae, lineares, paulum inflata in medio, apicibus aliquantum dilatata et levis rotundatis. Raphe tenuis et recta, poris centralibus aliquantum unilateraliter inclinatis et proxime positus, fissuris terminalibus semi-circularis curvatis. Area axialis fere angusta, sublinearis; area centralis magnissima rhomboidea ad latera perveniens. Striae circiter 9-10 in 10μ , crassae, modice radiales in medio ac convergentes ad apicem, striae in median partem gradatim abbreviata propterea quod area centralis magna rhomboidea formantur. Holotype slide no. MYS-JOG. 7:415.

This species compares fairly closely *P. gibba* EHR v *sancta* GRUN. as accounted by MEISTER (MEISTER, 1932, 43, t. 17, f. 140) in shape, setting of striae, central and axial areas as indicated in his photomicrographic illustration, but the dimensions mentioned are much larger ($130 \times 16\mu$, str. 8) than is the case noted here. In his remarks it is stated that the said form is not securely identified after his having cited CLEVE's reference (CLEVE, 1895, II, 83) according to the same this diatom should be *P. stauoptera* GRUN. v. *sancta* GRUN. HUSTEDI gave entirely different illustration of *P. gibba* v. *sancta* GRUN. (HUSTEDI, 1938, 395, t. 20, f. 35) which conforms CLEVE's description. In this event, therefore, the present specimens as well as MEISTER's cannot be referred to *P. gibba* / *stauoptera* v. *sancta* GRUN. Again, the present specimens somewhat compare with *P. rivularis* HUSI. (HUSTEDI, 1936, 160, t. 5, f. 35; 1938, 393, t. 23, f. 3; Atlas Diat. t. 392, f. 1) in shape, size and the number of striae but the local specimens differ in having very large central area gradually widening in the middle with shortening of striae and raphe pores in the centre closely set. Moreover, the striae are more radial and convergent than are recorded for *P. rivularis* HUSI. GRUNOW recorded similar looking diatom as *Navicula stauoptera* GRUN. (= *Pinn*) (GRUNOW, 1884, 98, t. 1 A, f. 18) which is quite comparable here but differs in apices, and probably the same is considered by CLEVE-EULER as *P. stauoptera* v. *genuina* MAY. (CLEVE-EULER, 1951-55, IV, 66, f. 1091a-c, esp. 1091x) which is shown to have thick but simple raphe. In any way the present specimens do not compare satisfactorily. They further differ from *P. bogotensis* (GRUN.) CL. given by CLEVE-EULER (l.c. 44, f. 1058a-c) and others and also from *P. (gibba* var.?) *hyalina* HUSI. nov. var. (SCHMIDT, 1874-1959, Atlas Diat. t. 392, f. 17-18) although comparing in shape and contour. With these observations, therefore, the present

specimens are considered to be a new species. They evidently belong to *P. gibba* and *P. stauroptera* cycle.

This species was found in usually small number in samples collected from pools and large ditches in the river bed below the falls and some wet encrustations

195. *Pinnularia eburnea* (CARLSON) ZANON (Figs. 121-124, 129-130)

CHOLNOKY, 1959, 62, f. 331; - 1960, 108, t. 9, f. 324-331; ZANON, 1941, 49, t. 3, f. 16-18 (= *P. eburnea* ZANON)

This species was found in varying number in samples collected from pools, ditches and wet encrustations from the river bed. The present set of illustrations are given to further emphasize the range of variations found in this species in support of CHOLNOKY's observations

196. *Pinnularia gibba* EHR.

GANDHI, 1960b, 96, pl. 2, f. 46-47.

This species was found usually in a small number in samples collected from pools and ditches in the river bed mostly occurring there with vegetable detritus.

197. *Pinnularia graciloides* HUSI

HUSIEDI, 1938, 293, t. 22, f. 9-10; 1942, 82, f. 155-158

This species was found in varying number in samples collected from various wet situations in the area but more especially from pools and ditches in the river bed having much detritus.

198. *Pinnularia graciloides* v. *americana* (HUSI.) emend (Fig. 152)

SCHMIDI, 1874-1959, Atlas Diat. t. 392, f. 12-13, esp. 12 (= *P. gracilis* HUSI. v. *americana* HUSI.):— Valves 90.2-105.6 μ long and 13.2-14.3 μ broad, linear with or without very faint tumidity in the middle with broadly rounded ends with a faint tapering. Raphe thin undulate due to which subcomplex, with distinct central pores slightly unilaterally bent and terminal fissures long bayonet-shaped curved and thick. Axial area somewhat narrow, sublinear; central area large, roundish or elliptical in long axis and somewhat unilaterally enlarged. Striae about 10-11 in 10 μ , thick, appressedly set, strongly radial in the middle and very strongly convergent towards ends.

This diatom compares very well with the illustrations given in the Atlas Diat. which perhaps seemed to have not been described any-

where. Further, in the Atlas Diat. it is named as *P. gracilis* HUSI. v. *americana* HUSI., but HUSIENI already emended *P. gracilis* HUSI. to *P. graciloides* in his subsequent works, hence this taxon is treated here under the emended name with the diagnosis.

This diatom was found in varying to a small number in samples collected from pools, ditches and wet encrustations on rocks in the river bed. Stray specimens also were seen with clusters of wet mosses growing around water holes in the area.

199. *Pinnularia graciloides* v. *jogensis* v. nov. (Figs 131-132)

Valves 92.4-100 μ long and 14.3-15 μ broad, linear, distinctly triundulate, undulations equidistant, ends constricted, slightly narrowed than the valves, produced and cuneately rounded capitate. Raphe thin or very slightly thick subcomplex (?) with central pores distinct and slightly unilaterally inclined and terminal fissures thickened and very shallow curved. Axial area fairly wide about $\frac{1}{4}$ - $\frac{1}{5}$ the width of the valves, linear or sublinear; central area fairly large, rhomboid reaching the sides. Striae about 8-10 in 10 μ , coarse, strongly radial in the middle and convergent and somewhat closely set at the ends.

Valvae 92.4-100 μ longae atque 14.3-15 μ latae, lineares, distincte triundulatae, undae equidistantibus positae, apicibus constrictis, paulum angusta versus valvam, productis et cuneatis rotundatis et capitatis Raphe tenuis vel paululum crassa subcomplexa (?), poris centralibus distincta paulum unilaterialiter inclinatis, fissuris terminalibus crassa, paululum curvatis. Area axialis modice lata, circa $\frac{1}{4}$ - $\frac{1}{5}$ latitudinem valvae, linearis vel sublinearis; area centralis lata rhomboidea ad latera perveniens Striae circiter 8-10 in 10 μ , crassae, fortiter radiales in medio ac convergentes et proxime ad apicem. Holotype slide no. MYS-JOG 7:415, 28:1653

This diatom compares very favourably with *P. graciloides* HUSI. in general characteristics and its variety v. *krasskei* FREN. (FRENGUELLI, 1942, 141, t. 4, f. 27-28; KRASSKE, 1951, 651, t. 32, f. 14) in more distinct triundulate sides and linear shape. However, the present specimens differ from the same in having fewer striae, greater width and smaller central area. Moreover, the apices are narrower than the valves and sides more clearly undulate. With these observations, therefore, the present specimens are considered to be a new variety.

This diatom was found usually in a small number in samples collected from pools, ditches and wet encrustations on rocks in the river bed below the falls. Stray specimens also were seen with wet bryophytes growing around water holes on way below the cataract.

200. *Pinnularia interrupta* W. SM

HUSIEDI, 1930, 317, f. 573a-b; GANDHI, 1958, 259, f. 15

This diatom was found in smaller or larger number in all the samples collected from the area

201. *Pinnularia lata* (BRÉB.) W SM. v. *media* ZANON
(Figs 133-134, 169)

ZANON, 1938, 643, f. 25: - Valves 50-63 μ long and 15-19 μ broad, linear with broadly cuneate or subcuneate smooth rounded ends without any constrictions. Raphe slightly thick and straight with central pores distinct and unilaterally inclined and terminal fissures thick and shallowly curved or reflexed. Axial area narrow, linear about $\frac{1}{6}$ - $\frac{1}{7}$, the width of the valves; central area large elliptical, quadrate or roundish, often unilaterally widened. Striae about 4-5.5 in 10 μ , variable, very thick, slightly radial in the middle and a few convergent at the ends, inter costal space as much as the thickness of the striae or less.

This diatom was found usually in a small number in samples collected from pools and ditches in the river bed occurring there with vegetable detritus or slimy matter encrusting rocks. It also compares *P. lata* v. *minor* GRUN. (CLEVE-EULER, 1951-55, IV, 34, 1038n-o; MAYER, 1925, 78, f. 17) in general shape and structure but differs in size and apices. MAYER's illustration more favourably compares *P. lata* v. *thuringiaca* (RABH.) MAY

202 *Pinnularia lata* v. *thuringiaca* (RABH.) MAY.
(Figs. 125, 135-136, 170)

MAYER, 1917, 40, t. 4, f. 8; 1925, 78, f. 16; FRENGUELLI, 1942, 147, 3, f. 50-51; HUSIEDI, 1938, 394; CHOINOKY, 1956, 86, t. 5, f. 124; HUSIEDI, 1924, 569, t. 21, f. 12 (= *P. lata* BRÉB.); - 1930, 326, f. 596 [= *P. lata* f. *thuringiaca* (RABH.) MAY.]; CLEVE, 1895, II, 81 [*P. lata* v. *latestriata* (GREG.) CL.]; MEISIER, 1912, 157, t. 17, f. 2 [= *P. lata* v. *latestriata*, also v. *rabenhorstii* (GRUN.) CL.]; CLEVE-EULER, 1951-55, IV, 33, f. 1038j-k (= *P. lata* v. *latestriata*): - Valves 50-85.3 μ long and 12.5-17.7 μ broad, robust, linear with sides parallel and straight or very slightly concave in the middle, ends more or less abruptly short or long cuneate, smooth truncately rounded or slightly constricted, produced and truncately rounded. Raphe thin or slightly thick, straight or slightly arcuate with central pores thick and conspicuous,

unilaterally inclined and terminal fissures shallow curved, thick and curved or reflexed. Axial area narrow, linear or sublinear; central area roundish, quadrate or elliptical, large often unilaterally dilated. Striae about 4-5.5 in 10μ , very thick, slightly radial in the middle and convergent towards ends, intercostal space as wide as the thick striae or less

This diatom was found in varying number in samples collected from various pools, ditches, encrustations on wet rocks, sometimes with wet bryophytes growing around rock pools in the river bed below the cataract. A number of specimens observed from the area they tended to show some variations comparable to various references cited above. However, they all are structurally related and show inter-gradations.

203. *Pinnularia microstauron* (EHR.) CL.

HUSIEDT, 1930, 320, f. 582.

This species was found in varying number in samples collected from various pools ditches and other water holes in the area

204. *Pinnularia microstauron* v. *ambigua* MEISI.

HUSIEDT, 1930, 320; GANDHI, 1957c, 847, f. 8

This diatom was found in a small number in samples collected from pools and ditches in the river bed, occurring there with vegetable detritus

205. *Pinnularia paucicostis* sp. nov. (Fig. 137)

Valves 39-43 μ long and 7.8-8 μ broad, linear, sides feebly triundulate with cuneately rounded ends. Raphe coarse and simple with central pores unilaterally inclined and terminal fissures slightly curved. Axial area fairly wide, about $\frac{1}{6}$ the width of the valves, linear; central area somewhat dilated and elliptical in long axis. Striae about 6-6.5 in 10μ , thick, slightly radial in the middle and convergent towards ends, striae crossed by a narrow longitudinal clear band.

Valvae 39-43 μ longae atque 7.8-8 μ latae, lineares, marginibus leniter triundulatis, apicibus cuneatis rotundatis. Raphe crassa et simplex, poris centralibus unilateraliter inclinatis, fissuris terminalibus paulum curvatis. Area axialis modice lata prope $\frac{1}{6}$ latitudinem valvae, linearis; area centralis aliquantum dilatata et elliptica in axe longo. Striae circiter 6-6.5 in 10μ , crassae, fere radiales in medio ac convergentes ad ultimum apicem, clare

vittis longitudinalibus angustis decussata versus striae Holotype slide no MYS-JOG 8:416.

This diatom distantly looks like *P. congolensis* (ZANON) CHOL (CHOLNOKY, 1957, 80, t. 6, f. 256-261 esp. f. 260) in shape but differs in several respects and especially in having a clear longitudinal band across the striae. Moreover, there are no other diatoms known in the available literature to which these forms could be compared satisfactorily. It is, therefore, considered as a new species.

This species was found usually in a small number in samples collected from pools and ditches in the river bed containing much detritus and vegetable matter. It also occurred with wet encrustations of rocks below the cataract.

206. *Pinnularia sahyadrens* sp. nov. (Fig 153)

Valves 111-114 μ long and 16.6-17 μ broad, sublinear, in the middle very slightly widened and ends indistinctly tumid, constricted, produced and cuneately rounded. Raphe thin or slightly thick undulate subcomplex (?), central pores distinct and slightly unilaterally inclined and terminal fissures thick, distinct and bayonet-shaped. Axial area rather narrow, about $\frac{1}{6}$ the width of the valves, sublinear; central area slightly dilated and elliptical in long axis. Striae about 8-9 in 10 μ , very coarse, appressedly set, slightly radial in the middle but fairly convergent towards ends, longitudinal band not clearly seen.

Valvae 111-114 μ longae atque 16.6-17 μ latae, in medio inconspicuis inflatis, apicibus indistincte tumidis, constrictis, productis, cuneatis et rotundatis. Raphe tenuis vel aliquantum crassa undulata, subcomplexa (?), poris centralibus distincte et unilateraliter inclinatis, fissuris terminalibus crassa, distincte gladius similibus. Area axialis fere angusta prope $\frac{1}{6}$ latitudinem valvae, sublinearis; area centralis paulum dilatata et elliptica in axe longo. Striae circiter 8-9 in 10 μ , crassissima, congesticiae, paulum radiales in medio et plus convergentes ad apicem, vittis longitudinalibus indistincte. Holotype slide no MYS-JOG 8:416, 13:421.

This species seems to compare with *P. aquilonaris* HOHN et HELLERMAN (HOHN and HELLERMAN, 1963, 322, pl. 5, f. 24) in shape, faintly triundulate sides, apices and the number of striae per 10 μ , with a slight difference in dimensions. However, it differs in having narrow axial area, narrow subcomplex raphe, small central pores and bayonet-shaped terminal fissures. It does not agree with any other similar looking diatom, hence it is considered to be a new species.

This species was found usually in a very small number in samples collected from pools, wet encrustations of rocks and ditches in the river bed.

207 *Pinnularia stauoptera* (RABH) CL. v. *minuta* MAY
f. *medioconstricta* A. CL. (Fig 138)

CLEVE-EULER, 1951-55, IV, 68, f. 1091r-s:— Valves 48-56 μ long and 7-7.6 μ broad, linear, slight but distinctly concave in the middle, ends constricted and broadly rostrate rounded. Raphe thin and straight with central pores closely set and unilaterally bent and terminal fissures curved. Axial area narrow, sublinear; central area very large, rhomboid, reaching the sides. Striae about 8-10 in 10 μ , coarse, fairly radial in the middle and gradually abbreviated, at ends convergent.

This diatom compares very well with *P. stauoptera* v. *minuta* f. *medioconstricta* as described and illustrated by CLEVE-EULER, except that the central area in the local specimens appears to be large. A similar specimen is also recorded by FRIISCH as *Navicula* (*Pinnularia*) *interrupta* W. SM. f. *subbicapitata* FRIISCH (FRIISCH, 1918, 592, f. 40d) which compares very closely except in width of the valves and number of striae. The general dimensions mentioned by FRIISCH for his specimens are: length 51-66 μ , breadth 9-12 μ and striae 10-12 in 10 μ . Again, there appears an unnamed diatom in the Atlas Diat. t. 44, f. 52 (remarked as an uncertain entity) compares here in shape and structure but no other details are known regarding it. However, it is felt here to include this unnamed entity of the Atlas under the present consideration.

This diatom was found in good number in samples collected from pools and ditches in the river bed occurring there with vegetable detritus and slimy encrustations on wet rocks.

208 *Pinnularia subcapitata* GREG

HUSIEDT, 1930, 317, f. 571.

This species was collected in good number from various wet situations in the locality. It commonly occurred with slimy matter and detritus of pools and ditches.

209. *Pinnularia viridis* (NITZ.) EHR

HUSIEDT, 1930, 334, f. 617a.

This species was found in varying number sometimes gregariously in samples collected from various pools, puddles and ditches in the area. It also occurred with wet mosses and encrustations of rock pools. A frequent diatom.

210 *Pinnularia viridis* v. *curvifolpa* GANDHI

GANDHI, 1960, 86, f. 9.

This diatom was found usually in a small number in samples collected from pools and ditches in the river bed occurring there with detritus and encrustations.

211. *Pinnularia viridis* v. *intermedia* CL.

HUSIEDI, 1930, 335; GANDHI, 1957, 16, f. 8.

This diatom was found in varying number in several samples collected from the area.

212. *Rhopalodia gibba* (EHR) O. MÜLL.

HUSIEDI, 1930, 390, f. 740.

This species was found in varying number and rarely gregariously in samples collected from pools, puddles and ditches in the river bed. It also occurred in other samples but in a small number.

213 *Rhopalodia gibba* v. *ventricosa* (EHR) GRUN.

HUSIEDI, 1930, 391, f. 741.

This diatom was found usually in good number in several samples collected from the area.

214. *Rhopalodia gibberula* (EHR) O. MÜLL.

HUSIEDI, 1930, 391, f. 742.

This species was found usually in a small number in some samples collected from pools and ditches in the river bed occurring there with detritus.

215. *Rhopalodia parallela* (GRUN.) O. MÜLL.

HUSIEDI, 1930, 389, f. 739.

This species was found mostly in a small number in samples collected from pools and ditches in the river bed and clusters of wet mosses occurring there. This species had been considered by the author as *R. ingens* (FRICKE) MEISL. (GANDHI, 1957, 17, f. 11) after following CLEVE-EULER but by subsequent checking it appeared to be the said entity.

216. *Stauroneis anceps* EHR.

HUSTEDI, 1930, 256, f. 405; 1927-1963, II, 771, f. 1120a.

This species was found in varying number in several samples collected from pools, ditches and other wet places

217. *Stauroneis anceps* v. *hyalina* BRUN et PERAG (Fig 126)

SCHMIDT, 1874-1959, Atlas Diat., t. 242, f. 11; HUSTEDI, 1930, 256, f. 408?; 1927-1963, II, 773, f. 1120g? :- Valves 55-63.3 μ long and 10.5-11.2 μ broad, subelliptical-lanceolate with constricted, short capitate rounded ends, shoulders somewhat more widened than in f. *gracilis* (EHR.) CL. Raphe thin and straight, central pores distinct and terminal fissures shortly curved. Axial area very narrow, linear; central area narrowly rectangular and reaching the sides. Striae about 30 in 10 μ , fairly radial, very finely punctate

While checking up a number of reference concerning this diatom the following give closely comparable illustrations:-

KÜZING, 1844, 105, t. 29, f. 4, *S. anceps* EHR.,
29, f. 9, *S. birostris* EHR.,
30, f. 25, *S. amphicephala* KÜZ.;

SCHMIDT, 1874-1959, Atlas Diat., t. 242, f. 11, *S. anceps* v. *hyalina* BRUN et PERAG.;

VAN HEURCK, 1896, 160, pl. 1, f. 55, *S. anceps* EHR (35-50 μ , str. 20/10 μ);

SCHÖNFELDT, 1910, 113, f. 249, *S. anceps* EHR (24-80 \times 6-17 μ , str. 20-30/10 μ);

MEISNER, 1912, 124, t. 19, f. 4, *S. anceps* v. *elongata* CL. (43-60 \times 9-11 μ , str. 25-26/10 μ);

FRENGUELLI, 1923-24, I, 261, t. 2, f. 7-8, *S. anceps* v. *amphicephala* (KÜZ.) V. H. (48-64 \times 12-14 μ , str. 22-24/10 μ),
263, t. 2, f. 9-11, *S. anceps* v. *abnormis* FRENG (as above)?,
1926, I, 29, f. 20, *S. anceps* v. *amphicephala* v. *abnormis* (51-62 \times 12 μ , 20 str.);

CLEVE-EULER, 1951-55, III, 208, f. 943i, *S. anceps* v. *elongata* CL. (35-55 \times 6-9 μ , str. 26/10 μ);

VAN DER WERFF en HULS, 1957-1963, P. D. G. XVI 108, *S. anceps* EHR. (25-130 \times 6-18 μ , str. 20-30/10 μ).

From these references, FRENGUELLI'S v. *abnormis* is considered by the author himself in his subsequent paper to be v. *amphicephala*,

which in turn commented upon by HUSTEDI (1927-1963) to be retained as the type proper on account of coarser structure. In this suit, KÜTZING'S *S. amphicephala*, *S. anceps* and *S. birostris* and VAN HEURCK'S *S. anceps* as well as *S. anceps* v. *elongata* CL. by CLEVE, MEISIER and CLEVE-EULER are conveniently included. The illustrations given by SCHÖNFELDI and VAN DER WERFF en HUIS for *S. anceps*, fall somewhere between the type proper and its f. *gracilis* and v. *fossilis*; as is the case of present specimens which in turn fully compare *S. anceps* v. *hyalina* BRUN et PERAG. of the Atlas Diat. t 242, f. 11.

After having checked a number of references, this particular "Atlas Diat.," entity seems to have not been referred to except by HUSTEDI (1927-1963) rather too briefly "HEIDEN, l.c. f. 11," whereas his illustration shows non-capitate ends comparable to the "Atlas Diat., t 242, f. 12" v. *gracilis* EHR. remarked there "11 und 12 wurden von Herrn CLEVE bestimmt," but not accounted by him (HUSTEDI). This treatment left an undesirable gap!! CLEVE-EULER, although made no reference to these entities of the "Atlas Diat.," but mentioned in her short diagnosis for v. *hyalina* BRUN et PERAG. that... "ends produced to weakly capitate." Taking these clues in account and noting comparatively narrow rectangular central area and very fine structure, i.e. striae 30 in 10 μ , as specific character for v. *hyalina*, found also in the present specimens, hence they are so treated.

This diatom was found in varying number in samples collected from various pools and ditches in the river bed. It also occurred in wet encrustations of rocks and detritus.

218. *Stauroneis anceps* f. *linearis* (EHR.) RABH.

HUSTEDI, 1930, 256, f. 407 [= f. *linearis* (EHR.) CL.]; - 1927-1963, II, 772, f. 1120c

This diatom was usually found in a small number in samples collected from pools and ditches in the river bed along with the type.

219. *Stauroneis phoenicenteron* (NIIZ.) EHR.

HUSTEDI, 1927-1963, II, 766, f. 1118a (= f. *genuina*); 1930, 255 f. 404 (= *S. phoenicenteron* EHR.).

This species was found in varying number in several samples collected from the area.

220. *Stauroneis phoenicenteron* f. *producta* GANDHI

GANDHI, 1958, 252, f. 7; 1959c, 106, f. 38-40.

This diatom was found in varying number in samples collected from various pools and ditches in the region.

221. *Surirella apiculata* W. SM. (Fig 171)

SCHMIDT, 1874-1959, Atlas Diat., t. 23, f. 34; GANDHI, 1959c, 122, f. 87-88.

This species was found in a good number in several samples collected from the area but more especially from pools and ditches in the river bed. Stray specimens also were found among tufts of wet mosses.

222. *Surirella biseriata* BRÉB.

HUSIEDI, 1930, 432, f. 831.

This species was found usually in a small number in samples collected from pools and large ditches in the river bed occurring there with detritus, and sparingly in encrustations

223. *Surirella capronii* BRÉB

HUSIEDI, 1930, 440, f. 857.

This species was found in varying number in samples collected from pools and large ditches in the river bed below the cataract. Stray specimens also were seen with wet encrustations of rocks and slimy detritus.

224. *Surirella capronii* v. *obtusa* HUST. (Fig 177)

HUSIEDI, 1927, 170, f. 2; SKVORIZOW, 1929, 38, pl. 8, f. 10; HUBER-PESALOZZI, 1942, 514, f. 626:— Valves 200-220 μ long and 60-62 μ broad, heteropolar, long cuneately ovate with broadly rounded apex and acutely rounded base. Middle line faint and interrupted. Axial field slightly wide, linear-lanceolate with a strong spine on a large cushion towards apex and small spine on a narrow small cushion towards base. Marginal folds clear with distinct projections and large falcate windows. Costae about 16-18 in 100 μ , thick, linear, radial and becoming strongly curved towards apices.

This diatom was found usually in a small number in samples collected from pools and large ditches in the river bed below the falls

occurring there with detritus and sediments. Many specimens collected from the area they seemed to have somewhat more acutely rounded base whereas some specimens compared very well with illustrations given by HUSIEDI and HUBER-PESTALOZZI

225. *Suriella celebesiana* HUSI

HUSIEDI, 1942, 161, f. 403-406; HUBER-PESTALOZZI, 1942, 508, f. 617B; GANDHI, 1959, 327, f. 30.

This species was found usually in a small number in samples collected from pools and ditches in the river bed occurring there with detritus and slimy matter

226. *Suriella ceylonica* SKV. f. *minor* GANDHI (emend.)

GANDHI, 1959, 328, f. 31-32 (= *S. horrida* HUSI f. *minor* GANDHI).

This diatom was found mostly in small number in samples collected from pools and ditches in the river bed occurring there with detritus and slimy matter on rocks etc. While checking further references on this diatom it appears that SKVORIZOW described an entity *S. ceylonica* SKV. (SKVORIZOW, 1928-1932, 259, pl. 33, f. 19, 21-22) which closely compares in all the characters recorded for *S. horrida* (HUSIEDI, 1942, 157, f. 394-395; HUBER-PESTALOZZI, 1942, 506, f. 616A) except that HUSIEDI's specimens are slightly broader with number of costae recorded to be 13-20 in 100 μ , whereas SKVORIZOW recorded them to be 2-3 in 10 μ (i.e. 20-30 in 100 μ) which to this author seems to be a matter of error. HUSIEDI's illustrations are excellent but SKVORIZOW's are not well detailed. These two authors further stress that their entities also compare fairly with *S. rudis* HUST. (SCHMIDT, 1874-1959, Atlas Diat., t. 356, f. 5-6) is a point of importance as it suggests that probably both these authors observed the same species, except that SKVORIZOW perhaps through error recorded larger number of costae. With these observations, therefore, the present author is prompted to consider HUSIEDI's *S. horrida* to be *S. ceylonica* SKV., and the present specimens are treated under the modified name

227. *Suriella linearis* W. SM

HUSIEDI, 1930, 434, f. 837-838.

This species was found in varying number in samples collected from various pools and ditches in the area but more especially from the river bed.

228. *Surirella linearis* v. *constricta* (EHR.) GRUN.

HUSTEDI, 1930, 434, f. 839; GANDHI, 1957, 19, f. 16, 20.

This entity was found also in varying number in samples collected from pools and ditches occurring there with detritus, slimy matter on wet rocks, along with the type.

229. *Surirella robusta* EHR

HUSTEDI, 1930, 437, f. 850.

This diatom was found in varying to good number in several samples collected from pools and large ditches in the river bed. It occurred well in encrustations and detritus.

230. *Surirella shyamai* sp. nov (Fig 172)

Valves 125-160 μ long and 50-55 μ broad, robust, heteropolar, linear-elliptical with broadly rounded apex and broadly rounded base slightly narrower than the apex and indistinctly cuneate. Middle field narrow, linear with a median line interrupted and distinct beset with strong wedge-shaped spines at both ends, spines raised on the surface of the valve without cushions. Flap margin narrow but distinct with distinct projections, flap windows small and not very clearly marked. Costae about 19-22 in 100 μ , closer towards ends, very thick, linear in shape but slightly fluted and truncate towards the axial field, radial only towards ends, striae indistinct.

Valvae 125-160 μ longae atque 50-55 μ latae, robustae, heteropolares, lineari-ellipticae, apice late rotundatis, basi late rotundatis sed aliquantum contractus versus apicem, indistincte cuneatis. Area axialis angusta, linearis; linea mediam interrupta et distincta, spina valde cuneata premeri ad linem terminalis, spina editus ad superficies valva haud pulvinarum. Alae marginae angusta sed distincta, alae projectiones distinctae, fenestra parva et paulum manifesta. Costae circiter 19-22 in 100 μ , crassissima, linearis sed leniter dilatatae, truncatae ad aream axialem, proxime posite et radiales ad apicem, striae indistincte. Holotype slide no. MYS -JOG. 11:419.

This species was found in a good number in several pools and large ditches in the river bed occurring there with detritus and slimy sediments. It does not compare with any of the known *Surirella*, hence it is considered as a new species. It is named in secret memory of author's revered unlettered mother under whose benevolent care and inspiration he could untraditionally educate

231. *Surirella shyamii* f. *constricta* f. nov. (Figs. 173, 178-180)

Valves 130-160 μ long and 47-50 μ in the middle and 50-55 μ broad towards ends, robust, heteropolar, linear-elliptical, sides slightly concave, apex broadly rounded and base slightly narrower than apex, broadly cuneately rounded. Costae 16-18 in the middle up to 18-22 in 100 μ towards ends. In all other characters like the above type.

Valvae 130-160 μ longae atque 47-50 μ in medio ac 50-55 μ latae ad apicem, robustae, heteropolares, lineari-ellipticae, margines concavi, apice late rotundatis, basi aliquantum paululum brevior quem apex, cuneatis rotundatis. Costae 16-18 in medio tenus 18-22 in 100 μ ad apicem. In coeteres ut typus. Holotype slide no. MYS-JOG 27:1652.

This diatom was found somewhat in larger number than the above type in several samples collected from pools and large ditches in the river bed along with the type. This entity is distantly comparable in shape with *S. biseriata* BRÉB v. *celebesiana* HUSI. (HUSIEDI, 1942, 146, f. 362-364; HUBER-PESIAZZI, 1942, 497, f. 600B) and has middle line beset with terminal spines like in *S. debesi* HUSI. (SCHMIDI, 1874-1959, Atlas Diat., t. 356, f. 3) but otherwise differs in several characters.

232. *Surirella splendida* (EHR.) KÜTZ

HUSIEDI, 1957, 361; - 1930, 437, f. 851-852 [= *S. robusta* v. *splendida* (EHR.) V. H.]

This diatom was found usually in a small number in samples collected from pools and ditches in the river bed occurring there with detritus etc.

233. *Surirella subsalsa* W. SM.

VAN HEURCK, 1896, 370, pl. 31, f. 866; GANDHI, 1958, 263, f. 24.

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

234. *Surirella tenera* GREG.

HUSIEDI, 1930, 438, f. 853.

This species was found as a very common diatom in the area but it was more frequent in samples collected from the river bed.

235. *Surirella tenera* v. *nervosa* A. S.

HUSIEDI, 1930, 439, f. 854-855.

This diatom was found also very commonly along with the above type.

236. *Suriella tenuissima* HUST.

HUSTEDI, 1938, 504, t. 43, f. 8-10; GANDHI, 1962c, 489, t. 126, f. 72.

This species was found in varying number in samples collected from various pools and ditches in the area. It also occurred in slimy encrustations on rocks and tufts of wet mosses.

237. *Synedra acus* KÜTZ.

HUSTEDI, 1930, 155, f. 170; 1927-1963, II, 201, f. 693a.

This species was found in varying number in several samples collected from the area. It usually occurred with detritus and slimy matter.

238. *Synedra jogensis* sp. nov. (Fig. 37)

Frustules isolated and rectangular in girdle view. Valves 39-45 μ long and 8 μ broad, linear with acutely cuneate and weakly produced rounded ends. Pseudoraphe narrow, linear; central area unilaterally reaching the side about 5.6 μ broad. Striae about 10 in 10 μ , coarse, at ends slightly radial and somewhat closely set.

Frustulae solitariae ac rectangulares in aspectu zonali. Valvae 39-45 μ longae atque 8 μ latae, lineares, apicibus acutis cuneatis et paulum productis rotundatis. Pseudoraphe angusta, linearis; area centralis unilateralis perveniens ad latus, prope 5.6 μ lata. Striae circiter 10 in 10 μ , crassae, ad apice aliquantum radiales et proxime positae. Holotype slide no. MYS-JOG. 11:419.

This diatom compares *S. notata* KÜTZ. (MEISNER, 1912, 77, t. 8, f. 8) in shape, apices and the number of striae. However, it differs in having well marked central area reaching on one side and much smaller dimensions. It does not agree with any other species of *Synedra*, hence it is considered as a new entity.

This species was found usually in a small number in samples collected from various pools and large ditches in the river bed occurring there with detritus.

239. *Synedra ulna* (NITZ) EHR.

HUSTEDI, 1930, 151, f. 158-159; 1927-1963, II, 195, f. 691A, a-c

This species was found commonly in several samples collected from the area.

240. *Synedra ulna* v. *amphihynchus* (EHR.) GRUN.

HUSIEDI, 1930, 154, f. 167; 1927-1963, II, 200, f. 691 A, e

This diatom was found in varying number in samples collected from various wet situations in the area.

241. *Synedra ulna* v. *danica* (KÜIZ.) GRUN.

HUSIEDI, 1930, 154, f. 168; 1927-1963, II, 200, f. 691 A, f.

This diatom was found also in varying number in samples collected from various pools and ditches in the area.

242. *Synedra ulna* v. *oxyrhynchus* (KÜIZ.) V. H.

HUSIEDI, 1930, 152, f. 160; 1927-1963, II, 198, 691 B, q

This diatom was found rather sparingly in samples collected from some pools and ditches in the river bed.

243. *Synedra ulna* v. *subaequalis* GRUN.

FRIISCH et RICH, 1929, 96, f. 2A-F.

This diatom was found usually in a small number in various pools and ditches in the area.

The Analysis of Diatom Samples Collected from the Jog-Falls

While considering the analyses from the following Tables it seems that habitats containing larger quantities of detritus and encrustations together contain here the largest number of diatoms and this number both qualitatively (meaning number of species) and quantitatively (meaning number of specimens per species) decreases with the de-

(Continuation on p 183)

Key to the abbreviations and symbols used in the following table:-
 a = abundant; g = gregarious; vf = very frequent; f = frequent; lf = less frequent; s = stray; vs = very stray; r = rare; vr = very rare; vn = varying number; ⊕ = new record for India; ⊕⊕ = new taxon; * = tropical; ** = cosmopolitan; I = Indifferent; HP = Halophobous; HL = Halophilous; M = Mesohalobous; A = Alkaliphilous; AB = Alkalibiont; AA = Acidophilous; I. M. A. Haw. Ins. = Indo-Malayan Archipelago and Hawaii Islands; J. B. S. Isl = Java, Bali and Sumatra Islands; Fed. S. Mal. = Federated States of Malaya; Bom. Sal Isl = Bombay and Salsette Islands; + = recorded

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<i>Anomooneis</i>																
- <i>exilis</i> (KÜTZ.) CL.		VS	S	f	r	If	If	+	+	+	+			I/HP	I/AA	**
⊙ - <i>f. lanceolata</i> A. MAY.		If	S	If	r	If	If	+	+	+	+					
- <i>serians</i> (BREB.) CL. V.																
- <i>brachysura</i> (BREB.) CL.	VS	VN	S	VN	VS	S	S	+	+	+	+			HP	AA	**
- <i>sphaerophora</i> (KÜTZ.) PRIT.	S	S		If	S	VS	If	+	+	+	+		+	HL	A	**
- <i>styriaca</i> (GRUN.) HUST.		If		S		If	S	+						I	A	
<i>Caloneis</i>																
- <i>bacillum</i> (GRUN.) MERESCH.	If	S	S	If	f	If	If	+	+	+	+		+	I	A	**
- <i>pulchra</i> MESSIK.		VS		If	S	If	S									
- <i>v. interrupta</i> GANDHI		S		S	S	If	S	+	+	+	+					
- <i>silicula</i> (EHR.) CL.	If	S	f	f	If	f	VN	+	+	+	+	+		I	A	**
- <i>v. gibberula</i> (KÜTZ.) GRUN.	S	S		f	S	VN	S				+		+			
- <i>v. minuta</i> GRUN.	r	VT		S	S	S	S				+					
<i>Ceratonais</i>																
⊙⊙ - <i>jogensis</i> GANDHI		S		If		If	S	+								
<i>Cocconeis</i>																
- <i>placentula</i> EHR.	VT	S	S	If	S	S	If	+	+	+	+		+	I	A	**

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<i>Gomphonema</i>																
- <i>augur</i> EHR.	r	vt	s	lf	s	f	s				+		+	I	A	
- <i>clavatooides</i> GANDHI	s	vf	s	f	lf	f	s					+	+	I	A	*
- <i>clevei</i> FRICKE	s	s		g	lf	f	s		+							
⊕⊕ - <i>f. acuta</i> GANDHI	s	s		lf	s	lf	s					+				
- <i>V. bipunctata</i> GANDHI	s	s		s	s	lf	s		+							
⊕ - <i>V. javanica</i> HUST.	s	s		lf	lf	f	vs									
⊕⊕ - <i>V. undulata</i> GANDHI	vs	lf		lf	s	lf	s		+							
- <i>gracile</i> EHR.	lf	s	vs	f	lf	vn	s	+	+	+	+	+	+	I	I	**
- <i>V. aurita</i>																
(A. BRAUN) CL.	s			lf	s	s	vt				+		+			
- <i>lanceolatum</i> EHR.	lf	s	s	f	lf	lf	vn	+	+	+	+	+	+	I	A	**
- <i>V. insignis</i> (GREG.) CL.	r	r		lf	s	s	r	+	+	+	+	+	+	I	A	**
- <i>pareulum</i> (KÜTZ.) GRUN.	f	f	s	f	vn	f	vn	+	+	+	+	+	+	I	A	**
- <i>V. lagenula</i> (GRUN.) HUST.	lf	lf	s	lf	vn	s	s	+	+				+			
- <i>V. micropus</i>																
(KÜTZ.) CL.	s	s		lf	s	r	s		+	+	+	+	+	I	I	**
- <i>V. subelliptica</i> CL.	lf	s	s	lf	s	s	s									
- <i>sphaerophorum</i> EHR.	vf	s		lf	lf	lf	s						+			
⊕⊕ - <i>f. togensis</i> GANDHI				lf	s	s	s						+			
- <i>subpicatum</i>																
FRUIT. et RICH.	lf	r	s	f	f	f	s		?			+	+			
- <i>subtile</i> EHR.	vt	s		lf	vs	lf	s	+	+	+	+		+			
- <i>V. malayensis</i> HUST.	vs	vs		s	s	s	s	+					+			
- <i>subcentricosum</i> HUST.	vs	vs		lf	s	lf	s	+					+			

Table 1 (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
<i>f. biceps</i> ARNOTT		vs		lf		vn	s	+	+	+				I	I	**
- <i>f. parallela</i> B. PET.		s		lf		s	s	+	+	+				I	I	**
- <i>cryptocephala</i> KÜTZ.	lf	lf	s	f	lf	s	vn	+	+	+	+		+	I	A	**
- <i>cryptocephaloides</i> HUST.	vs	lf		lf	s	lf	vn		+							**
- <i>cuspidata</i> KÜTZ.	lf	s		lf	s	lf	s	+	+	+				I	A	**
- <i>v. ambigua</i> (EHR.) CL.	f	s	s	f	lf	f	vn	+	+	+				I	A	**
- <i>dicephala</i> (EHR.) W. SM.	s	s		lf	s	lf	s		+					I	A	**
- <i>v. sphaerophora</i> A. CL.	lf	lf	vt	lf	lf	f	vn			+						
- <i>fluens</i> HUST.	lf	lf		lf	s	lf	s							I	A	
- <i>gothlandica</i> GRUN.	vt	vt		lf	vs	s	s							I	A	
- <i>gracilis</i> EHR.	vs	s		lf	s	lf	s		+					M?		**
⊕ - <i>jogensis</i> GANDHI	vs	lf		lf	s	lf	s							I	A	
- <i>laterostrata</i> HUST.	vs	lf		lf	s	lf	s							I	A	
- <i>mutica</i> KÜTZ.	vn	s	vs	vn	s	vn	s	+	+	+			+	I	Λ/I	**
- <i>v. cohnii</i> (HULSE) GRUN.	s	s		vn	s	s	r	+	+	+				I	I	**
- <i>perotettii</i> GRUN.	vt	vs		s	s	s	s	+	+	+				I	I	**
- <i>pupula</i> KÜTZ.	f	lf	s	f	lf	f	vn	+	+	+				I	I	**
- <i>f. capitata</i> SKV. et MEYER	f	lf		f	lf	lf	vn	+	+	+				I	I	**
- <i>f. elliptica</i> HUST.	s	s		lf	s	lf	s							I	I	**
- <i>f. rectangularis</i> (GREG.) GRUN.	s	vs		s	s	s		+						I	I	**
⊕ - <i>pusilla</i> W. SM.		s		lf	s	lf	vs							I	I	**
- <i>v. lanceolata</i> GRUN.		s		lf	s	lf	vs							I	I	**

Table 4. (continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
- <i>gibberula</i> (EHR.)	vs	?		s		s	s	+	+	+	+		+	HL/M	A	**
O. MÜLL.		s		s	vt	s	s			+	+		+	i	I	**
- <i>paralicta</i> (GRUN.)				f	vn	If	s	+	+	+	+	+	+	I	I	**
O. MÜLL.				If	s	If	vn									
<i>Stauroneis</i>	If	If	s	f	vn	If	s	+	+	+	+	+	+	I	I	**
- <i>anceps</i> EHR.																
⊗ - <i>v. tyalina</i>							vn									
BRUN et PERAG.	s	s		If	s	If										
- <i>v. linearis</i> (EHR.)				s	s	vs		+	+	+	+		+			
RABH.	vs	s		s	s	vs										
- <i>phoenicenteron</i>																
(NITZ.) EHR.	vt	s	vs	If	s	.If	vs	+	+	+	+	+	+	I	I	**
- <i>l. producta</i> GANDHI	s	If	s	If	vn	vn	s			+	+	+	+			
<i>Survrella</i>																
- <i>apiculata</i> W. SM.	s	If	s	If	vn	If	s		+	+	+	+	+	I	A	**
- <i>biseriata</i> BRÉB.		s		s	s	vn	s	+	+	+	+	+	+	I	A	**
- <i>capronii</i> BRÉB.		If		If	s	If	vn	+	+	+	+	+	+	I	A	**
⊗ - <i>v. obtusa</i> HUST.		s		s	s	If	s	+	+	+	+	+	+			
- <i>celestiana</i> HUST.		s		s	vs	If	s	+				+				
- <i>ceylonica</i> SKV.																
<i>f. minor</i> GANDHI		s	s	If	s	s	s	+	+	+	+	+	+	I	A/I	**
- <i>linearis</i> W. SM.	vs	s	r	If	s	vn	s	+	+	+	+	+	+			**
- <i>v. constricta</i> (EHR.)				f	s	f	If	+	+	+	+	+	+	I	A	**
GRUN.		s		f	s	f	If	+	+	+	+	+	+	I/HP	I	**
- <i>robusta</i> EHR.		s		g	If	f	If	+	+	+	+	+	+			**
⊗⊗ - <i>shyamai</i> GANDHI		If		f	If	f	s	+	+	+	+	+	+			**
⊗⊗ - <i>f. constricta</i> GANDHI		f		f	If	f	r	+	+	+	+	+	+			**

- <i>splendida</i> (EHR.) KÜTZ.	s	If	VS	If	s	If	s	If	f	s	+	+	+	+	+	+	+	I	A/I	**
- <i>subsalsa</i> W. SM.	If	If	S	f	If	f	f	f	f	VS	+	+	+	+	+	+	+	I	A	**
- <i>tenera</i> GREG.	If	f	S	f	If	f	f	f	f	VS	+	+	+	+	+	+	+	I	A	**
- <i>V. nervosa</i> A. S.		If	VS	VS	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	A	**
- <i>tenuissima</i> HUST.		S	VS	If	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	A	**
<i>Synedra</i>																				
- <i>acus</i> KÜTZ.	If	If	S	f	If	f	f	f	f	VS	+	+	+	+	+	+	+	I	I	**
⊕⊕ - <i>jogensis</i> GANDHI	S	S	S	If	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	I	**
- <i>ulna</i> (NITZ.) EHR.	Vf	f	S	f	If	f	f	f	f	VS	+	+	+	+	+	+	+	I	A	**
- <i>V. amphirhynchus</i> (EHR.) GRUN.	S	If		If	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	A	**
- <i>V. danica</i> (KÜTZ.) GRUN.	S	S	VS	If	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	A	**
- <i>V. oxyrhynchus</i> (KÜTZ.) V. H.	VS	S	VS	S	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	A	**
- <i>V. subaequalis</i> GRUN.	Vf	S		S	If	If	If	If	If	VS	+	+	+	+	+	+	+	I	A	**
⊕	162	229	90	243	218	244	230	103	422	86	82	76	135	separately considered	6	100				
⊕⊕	27	25																		
11.11	10.28	percentages	66.66	93.82	37.03	100	89.71	99.47	94.25	42.40	50.21	35.40	33.74	31.27	55.55					2.47/ 41.12

Table 2

A table showing the analysis of genera of diatoms with number of taxa and their occurrence in the sample categories, percentage, order of dominance and the comparative values of the same from the neighbouring geographical regions according to Table 1

Name of the genus	No. of taxa	%	Sample categories with the number of taxa							Order of dominance	No. of present taxa recorded from the neighbouring geographical regions					New taxa	Remarks and new records	
			1	2	3	4	5	6	7		8	9	10	11	12			13
<i>Achnanthes</i>	27	11.07	13	26	7	27	20	27	24	II	10	10	9	6	2	9	3	8
<i>Amphora</i>	4	1.64	4	4	2	4	4	4	4		3	3	3	3	1	2		
<i>Anomoeoneis</i>	5	2.05	2	5	3	5	4	5	5		4	3	3	2	1	1		1
<i>Catoneis</i>	6	2.46	4	6	2	6	5	6	6		2	2	2	1	1	3	1	
<i>Ceratoneis</i>	1	0.41	1	1	1	1	1	1	1		2	3	3	1	1	3		
<i>Cocconeis</i>	3	1.23	3	2	2	3	3	3	3		3	2	2	3	2	4		
<i>Cyclotella</i>	6	2.46	6	4	4	6	5	5	6	VIII	3	2	2	3	2	4		2
<i>Cymbella</i>	13	5.33	8	11	7	13	13	13	13		5	7	5	5	8	5		
<i>Diptoneis</i>	6	2.46	4	3	2	6	6	6	6		2	2	1	1	2	2		
<i>Epithemia</i>	3	1.23	3	2	3	3	3	3	3		3	3	3	3	1	3		1
<i>Eunotia</i>	17	6.97	8	17	1	17	14	17	17	VI	2	2	2	4	3	6	7	
<i>Fragilaria</i>	7	2.87	6	7	3	7	7	7	6		3	5	2	2	2	6		
<i>Frustulia</i>	4	1.64	3	4	4	4	4	3	3	V	2	3	2	2	6	4	3	1
<i>Gomphonema</i>	21	8.61	19	19	8	21	21	21	20		7	10	7	9	6	14	8	1
<i>Hantzschia</i>	4	1.64	4	4	1	4	3	4	4		1	2	2	1	1	3		1
<i>Melosira</i>	5	2.05	4	4	1	5	5	5	4		2	2	1	1	2	4		1
<i>Navicula</i>	27	11.07	24	27	9	27	25	27	25	I	14	19	13	11	14	14	2	3
<i>Neidium</i>	6	2.46	2	6	1	6	6	6	6		2	3	1	1	4	4		
<i>Nitzschia</i>	21	8.61	20	21	5	21	19	21	21	IV	11	15	7	11	3	20	4	7
<i>Pinnularia</i>	25	10.25	8	25	12	25	24	25	25	III	8	8	7	8	8	11	4	
<i>Rhopalodia</i>	4	1.64	3	3	2	4	3	4	4		2	3	3	3	2	4		1
<i>Stauroneis</i>	5	2.05	5	5	3	5	5	5	4		2	2	2	3	3	3	2	1
<i>Surirella</i>	16	6.56	5	16	7	16	15	16	16	VII	11	9	8	8	9	9	2	1
<i>Synedra</i>	7	2.87	7	6	3	7	7	7	7		2	3	3	3	3	5	1	
Total 24	243	100	162	228	90	243	218	244	230	8	103	122	86	82	76	135	25	27

Table C. Halobion spectrum

Halobion category	No. of forms	% out of total bulk	% out of known total halobs
Mesohalobous	3	1.23	2.40
Meso./Halophilous	1	0.41	0.80
Halophilous	5	2.05	4.00
Halophilous/Indifferent	7	2.90	5.60
Indifferent	96	39.50	76.80
Indifferent/Halophobous	6	2.46	4.80
Halophobous	7	2.90	5.60
? unknown	118	48.56	—
Total	243	100.01	100.00
±		00.01	

Table D pH-spectrum

pH-category	No. of forms	% out of total bulk	% out of known total types
Alkaliphilous	63	25.93	51.22
Alkaliphilous/Indifferent	13	5.35	10.57
Indifferent	36	14.81	29.28
Indifferent/Acidophilous	2	0.82	1.62
Acidophilous	9	3.70	7.32
? unknown	120	49.39	—
Total	243	100.00	100.01
			— 0.01

creased amount of detritus as evinced from the sample categories, 4, 6, 7, 2, 5, 1 and 3 with number of taxa and their percentages, thus: 243 (100%), 241 (99.7%), 230 (94.25%), 228 (93.82%), 218 (81.71%), 162 (66.66%) and 90 (37.03%) respectively. Again, from among the sample categories another feature noticed is that samples containing mainly detritus are poorer in diatom content either qualitatively (7), quantitatively (1, 5, 7, 2) or both than those sample categories having detritus and encrustations mixed together (4 and 6) as is made out from the frequency Table 1. The samples of slimy matter and loose soil (3) with flowing water seemed to be the poorest in diatoms as a whole.

The halobion characteristics of the Diatomflora here found to represent the highest percentage of Indifferent-biota, i.e. 87.2% of

the total known halobs, such 109 individuals (here, I/HL, I and I/HP, are taken together as Indifferent), but out of the total bulk (all 243 entities) this percentage is only 44.86, a little lower than all such biotopes considered to be of unknown halobion status, i.e. 118 specimens. The (3) mesohalobs forming 2.4% or 1.23%, (6) halophils 4.8% or 2.46% and the (7) halophobs 5.6% or 2.9%, respectively both from known halobs and the total bulk considered alternatively conform with the expected results. The small percentage of mesohalobs and halophils occurring here may be attributed to the total salt concentration usually taking place in certain rock-pools with encrustations and detritus due to drying up process. The appearance of halophobs in samples mainly confine to tufts of mosses, liverworts, oozing streams from hill inclines or exposed wet rocks (subaerial habitats) where the pH-value tended to be from neutral to acidic side.

The pH-spectrum indicates the highest percentage of alkaliphils (63), 51.79% of the total known pH-biotopes but this percentage recedes only to 25.93% while considering the total bulk of 243 entities, i.e. a little over half the value obtained of the (120) unknown biotopes for their pH requirement. In the first instance the result thus obtained may be said as expected because most of the encrustation-samples from various pools etc. showed pH-value towards the alkaline side concurring with high calcium carbonate contamination, but the second instance points to insufficient information available. The pH-Indifferent group (51 entities) also appear to be significant (I/A, I and I/AA, taken together as Indifferent) making 41.47% or 20.98%, of known pH-biotopes and the total bulk of taxa respectively. These values suggest equable condition of water with regard to various chemical components. The acidophils generally have shown small percentage 7.32% or 3.7%, in harmony with conditions governing halophobs and well aerated habitats.

From the geographical distributional records only 6 or 2.47% typically tropical and 100 or 41.12% cosmopolitan entities are noted here of the total bulk, and 137 entities, i.e. 56.41% need assignment of geographical status, this includes 30 new taxa discovered from here and 11 others from a neighbouring locality - SAGAR (1959).

Again, while appreciating the distribution of locally available diatoms in the neighbouring geographical regions referred to earlier, approximately 103 or 42.4% in Indo-Malaya Archipelago and Hawaii Islands (HUSTEDI, 1942), 122 or 50.21% in Java, Bali and Sumatra Islands (HUSTEDI, 1936, 1938), 86 or 35.4% in Afghanistan (FOGED, 1959), 82 or 33.75% in the Federated States of Malaya and or Siam (PATRICK, 1936, and PROWSE, 1962) and 135 or 55.55% in Bombay

and Salsette Islands (GONZALVES et GANDHI, 1952-1954, GANDHI, 1960, 1962), are found in common. The cent percent or near about figures of comparison should never be excepted as a rule from such very different geographical areas as are hitherto taken into consideration. There are several reasons for this, but the chief among them are: (1) number of localities considered in an area, (2) type of localities, (3) extent of areas, (4) number of samples taken, (5) local conditions, in broadest sense, prevailing over there, (6) time of collection, and (7) the endemic elements present, etc. etc. plus the human factor. However, it is interesting to point out that the local flora (of Jog-Falls) compares favourably with that of Indonesian Islands, Indo-Malaya Archipelago and Hawaii Islands and Bombay-Salsette Islands, in as much as 40 to 56% of the elements are rather commonly found. The following Tables 3 and 4, are given to indicate the comparative aspects of number of genera, their component taxa, percentages and the order of dominance (the dominance considered here on the basis of 10 or more taxa contained in a genus) between the Jog-Falls and other neighbouring geographical regions:-

While considering the eight dominant genera that are found here and setting them in comparisons with those of the neighbouring geographical regions as shown in the above Table 4, the *Navicula* occupies the first place in all the regions, except in Bombay and Salsette Islands where it stands fourth in the order of dominance, is significant although its numerical and percentage values are considerably small, i.e. 27 taxa or 11.11% only as against 74 or 48.92% in Federated States of Malaya, 87 or 17.02% in Indo-Malaya Archipelago and Hawaii Islands, 96 or 20.95% in Afghanistan and 140 or 21.04% in Java, Bali and Sumatra Islands, respectively.

The second place taken here by *Achnanthes* (11.11%) equivalent to that of *Navicula*, finds fifth place in Federated States of Malaya (5.62%) and sixth in other regions, e.g. Indonesian Islands (4.74%), Bombay and Salsette Islands (4.77%), Indo-Malaya Archipelago (5.28%) and Afghanistan (5.67%). It is important to note that this genus here is also significant as it registers twice the percentage values than that are recorded in other areas and the number of taxa as it holds are comparable leaving out the case of Bombay and Salsette Islands.

Table 3

Name of the genus	Jog-Falls			Indo-Malaya Archipelago			Java, Bali Sumatra Isis.			Afghanistan			Federated States of Malaya and Siam			Bombay and Saisette Isis.		
	1			2			3			4			5			6		
	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order
<i>Achnanthes</i>	27	11.41	2	27	5.28	6	31	4.74	6	26	5.67	6	22	5.62	5	16	4.77	6
<i>Actinella</i>							1	0.15										
<i>Amphipleura</i>				2	0.39		1	0.15		1	0.22					2	0.59	
<i>Amphiprora</i>				1	0.20		1	0.15								4	1.18	
<i>Amphora</i>	4	1.65		9	1.76		9	1.38		13	2.84	9	11	2.81	10	4	1.18	
<i>Anomoconis</i>	5	2.06		7	1.37		8	1.22		6	1.30		4	1.02		2	0.59	
<i>Asterionella</i>				1	0.19		1	0.19		2	0.44							
<i>Attheya</i>				1	0.19		1	1.16		1	0.22		1	0.26		1	0.30	
<i>Bacillaria</i>				1	0.19		1	0.15		1	0.22							
<i>Biddulphia</i>				1	0.19		1	0.15										
<i>Catoneis</i>	6	2.46		8	1.57		15	2.30	12	42	2.62	10	3	0.77		3	0.90	
<i>Campylodiscus</i>				3	0.59		1	0.15		1	0.26		1	0.26		1	0.29	
<i>Ceratoneis</i>	1	0.41		1	0.19		1	0.16		2	0.44					1	0.30	
<i>Chaetoceros</i>													1	0.26				
<i>Cocconeis</i>	3	1.23		9	1.76		10	1.53	15	7	1.53		4	1.02		4	1.20	
<i>Coscinodiscus</i>				3	0.59		2	0.31					9	2.30		1	0.30	
<i>Cyclotella</i>	6	2.47		10	1.96	12	6	0.94		6	1.29		4	1.02		6	1.79	
<i>Cymatopleura</i>							1	0.15		3	0.65							
<i>Cymbella</i>	13	5.35	8	43	8.41	4	38	5.82	5	48	10.48	3	14	3.57	9	11	3.29	10

Table 3 (continued)

Name of the genus	Jog-Falls			Indo-Malaya Archipelago			Java, Bali Sumatra Isls.			Afghanistan			Federated States of Malaya and Siam			Bombay and Salsette Isls.		
	1			2			3			4			5			6		
	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order	Taxa	%	Order
<i>Rhizosolenia</i>				2	0.39													
<i>Rhoicosphenia</i>				1	0.19													
<i>Rhopalodia</i>	4	1.65		5	0.98		8	1.22								6	1.79	
<i>Stauroneis</i>	5	2.06		8	1.57		18	2.76	11							12	3.58	3
<i>Stenopterobia</i>				4	0.78		1	0.15										
<i>Stephanodiscus</i>				3	0.59		4	0.61										
<i>Surirella</i>	16	6.58	7	46	9.02	3	29	4.44	8									
<i>Synedra**</i>	7	2.88		15	2.94	40	24	3.67	9									
<i>Tabellaria</i>				2	0.39		1	0.15										
<i>Terpsinoe</i>				1	0.19		1	0.15										
<i>Thalassiostrra</i>				1	0.19		1	0.15										
<i>Tropidonets</i>				1	0.19		1	0.15										
Total	243	100		511	100		653	100			458	100		391	100		335	100

** some of these treated under *Fragilaria* and vice versa.

Table 4
The table showing the eight dominant genera in order of predominance occurring here and in the neighbouring geographical regions

Order of dominance Region	1	2	3	4	5	6	7	8	9
Jog-Falls	<i>Navicula</i>	<i>Achnanthes</i>	<i>Pinnularia</i>	<i>Nitzschia</i>	<i>Gomphonema</i>	<i>Eunotia</i>	<i>Survirella</i>	<i>Cymbella</i>	
Indo-Malaya	<i>Navicula</i>	<i>Nitzschia</i>	<i>Survirella</i>	<i>Cymbella</i>	<i>Pinnularia</i>	<i>Achnanthes</i>	<i>Eunotia</i>	<i>Gomphonema</i>	<i>Melostris</i>
Archipelago	<i>Navicula</i>	<i>Pinnularia</i>	<i>Nitzschia</i>	<i>Eunotia</i>	<i>Cymbella</i>	<i>Achnanthes</i>	<i>Gomphonema</i>	<i>Survirella</i>	<i>Synedra</i>
Java, Bali, Sumatra	<i>Navicula</i>	<i>Nitzschia</i>	<i>Cymbella</i>	<i>Gomphonema</i>	<i>Pinnularia</i>	<i>Achnanthes</i>	<i>Synedra</i>	<i>Fragilaria</i>	<i>Amphora</i>
Afghanistan	<i>Navicula</i>	<i>Pinnularia</i>	<i>Nitzschia</i>	<i>Eunotia</i>	<i>Achnanthes</i>	<i>Gomphonema</i>	<i>Stauroneis</i>	<i>Survirella</i>	<i>Cymbella</i>
Fed. States of Malaya	<i>Navicula</i>	<i>Pinnularia</i>	<i>Nitzschia</i>	<i>Navicula</i>	<i>Eunotia</i>	<i>Achnanthes</i>	<i>Survirella</i>	<i>Neidium</i>	<i>Stauroneis</i>
Bombay and Salsette	<i>Pinnularia</i>	<i>Nitzschia</i>	<i>Gomphonema</i>						

The *Pinnularia* (10.3%) occurs here in the third place but seems to be extremely important in Bombay and Salsette Islands (15.52%) by standing first in the series. It is also comparatively important in Java, Bali and Sumatra Islands 63-taxa or 9.64%, and Federated States of Malaya 49 or 12.52% by being there in second position, but recedes in importance in Indo-Malaya Archipelago, 39 or 7.64% and Afghanistan, 28 taxa or 6.12%, as it stands there in fifth rank. This genus, although assumes great importance in Bombay and Salsette Islands and Federated States of Malaya from the view of percentage values but numerically it is preceded by some margin in Java, Bali and Sumatra Islands.

The fourth place occupied here by *Nitzschia* (8.64%) is relatively much less important and prominent than in other regions. It is worthy to note its second place in Bombay and Salsette Islands (14.3%), Afghanistan (10.7%) and Indo-Malaya (9.98%), and third in Federated States of Malaya (10.23%) and Indonesian Islands (9.18%) is nearly compensated in Jog-Falls on the percentage basis excluding Bombay region. Numerically this area is poorer in species of *Nitzschia* as one-half to one-third the number that is found in other regions occur here.

Again, the *Gomphonema* (8.64%) equal in number to *Nitzschia* positioned here in the fifth place, assumes third place in Bombay and Salsette Islands (12.24%), fourth in Afghanistan (6.55%), sixth in Federated States of Malaya (4.6%), seventh in Indonesian Islands (4.59%) and receding to 8th place in Indo-Malaya Archipelago (4.51%) is interesting. It is quite important in Bombay and Salsette region both in numerical and percentage values than elsewhere, and to this, Jog-Falls stands next in its percentage.

The sixth position taken here by *Eunotia* (6.99%) is fourth in Java, Bali and Sumatra Islands (6.87%) and Federated States of Malaya (9.71%), fifth in Bombay and Salsette Islands (5.97%), seventh in Indo-Malaya Archipelago (4.9%) and but its recession to eleventh position in Afghanistan (2.18%) is to be noted. From the percentage point of view this genus is more important in the Federated States of Malaya but very poor in Afghanistan. However, it is numerically more important and better represented in Indonesian Islands and Federated States of Malaya respectively than in any other regions.

The *Surirella* (6.58%) in the seventh position here and also in Bombay region (4.78%), occupies third place in Indo-Malaya (9.03%) but eighth in Java, Bali and Sumatra Islands (4.44%) and Federated States of Malaya and Siam (4.6%), but strangely enough it registers no place at all in the panel of dominant genera in Afghanistan. From

the numerical values it is rather important in Indo-Malaya Archipelago and Hawaii Islands and half as much in Indonesian Islands.

The eighth and the last of the dominant genera found in Jog-Falls is *Cymbella* (5.35%) enjoys third place in Afghanistan (10.48%), fourth in Indo-Malaya (8.41%), fifth in Java, Bali and Sumatra Islands (5.81%), ninth in Federated States of Malaya (3.57%) and tenth in Bombay and Salsette Islands (3.29%). It is numerically important in Afghanistan (48 taxa), Malaya-Archipelago (43 taxa) and Indonesian Islands (38 taxa) where it occurs three times or more in number than here. The rest of the genera although have some rank in the order of their dominance in some regions but the present area sets limit to their being considered here in comparison.

From all these analytic considerations it emerges that so limited an area investigated yet it abounds in diatoms but concomitantly suggests all the greater need for extensive explorations to find out if some of the genera poorly represented in number of their constituents, e.g. *Navicula*, *Cymbella*, *Eunotia*, *Nitzschia* and *Pinnularia*, could rise to comparable numbers to those of other regions and also certain others hitherto remaining elusive, also occur.

SUMMARY

In order to summarize the results of the present investigation, it can be safely said that the Jog-Falls contains a wealth of diatoms and higher harvest is likely to be obtained with greater exploration of the region. This supposition is borne out by the fact that so limited an area, i.e. one square mile, taken into investigation here yet it could yield as many as 243 taxa representing twenty-four genera. Of these, twenty-seven are the new records for India, fifteen species, twelve varieties and three forms are considered to be new to the science.

As is indicated in the introduction, this account is based on 30-samples collected from various wet situations in the area. These are categorised under 7-groups. Of these, the diatom populations are qualitatively estimated for their frequency, pattern of distribution and dominance and the results are tabulated. In the tables it is also indicated regarding their distribution in the neighbouring geographical regions as well as their known Halobion, pH and geographical status. In another table, comparisons are drawn of various genera and their constituents which occur here and in the neighbouring geographical regions with their numerical and percentage values besides their positions in the order of dominance. From these, it is understood that: (1) in certain way local flora bears some affinity with that of Indonesian Islands, Indo-Malayan region and Bombay-Salsette Islands inasmuch as 40 to 56% of the elements are commonly found; (2) there are certain reasons which do not promote cent percent comparisons; and (3) there is a need for further extensive exploration of the area.

From the geographical point of view, this area seems to abound in cosmopolitan types and the tropical elements are rather meagrely noticeable as deduced from the known records

As evidenced from the Halobion and pH-spectra, the halobion feature of the local populations is strongly represented by Indifferent biotopes and the pH-spectrum suggests equable conditions of water (slightly alkaline to feebly acidic) as reflected by narrow margin of difference between the known Alkaliphils and pH-Indifferent biotopes. It is however, not attempted to assign any halobion, pH or the geographical status to unknown entities here as more studies are desirable to this end.

In the systematic part some comments are made on *Diploneis subovalis* Cl, and several illustrations are made from the local material of the same, and it is suggested desirable to re-evaluate *D. subovalis* and *D. smithii* (BRÉB) Cl and their forms and varieties

In the end it is hoped that some future worker might fill in lacunae circumstantially left out here to the further understanding of the Diatom-flora of this region.

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EXPLANATION OF PLATES 11 (1) - 19 (9)

Fig 1-2. *Achnanthes biasoletiana* (Kütz.) GRUN. v. *minuta* CL.; 3-5. *A. elata* (LEUD.-FOIT) GANDHI; 6-7 *A. - v. curvula* GANDHI; 8-10. *A. inflata* Kütz.; 11-12 *A. jogensis* sp. nov.; 13-14. *A. lanceolata* (BRÉB.) GRUN.; 15-21. *A. - v. dubia* GRUN.; 22-23 *A. - v. laterostrata* v. nov.; 24-25 *A. - v. rostrata* (ØSI.) HUIS; 26 *Ceratoneis jogensis* sp. nov.; 27 *Eunotia ambigua* sp. nov.; 28 *E. cholnokyi* sp. nov.; 29 *E. - v. ventricosa* v. nov.; 30. *E.*

grunovii BERG v *uplandica* A. CL.; 31. *E. jogensis* sp. nov.; 32. *E. nehruii* sp. nov.; 33. *E. patrickii* sp. nov.; 34. *E. pectinalis* (KÜTZ.) RABH. v. *neglecta* GANDHI; 35. *E. subgibba* sp. nov.; 36. *Melosira distans* (EHR.) KÜTZ. v. *lirata* (EHR.) BEIHGE f. *lacustris* (GRUN.) BEIHGE; 37. *Synedia jogensis* sp. nov.

Fig. 38-39. *Achnanthes inflata* v. *javanica* var. nov. 40-41. *A. lanceolata* (BRÉB.) GRUN.; 42-43. *A. -f. capitata* O. MÜLL.; 44-48. *A. -v. elegans* A. CL.; 49-51. *A. -v. rhomboidea* v. nov.; 52-53. *A. -v. rostrata* (ØST) HUSI.; 54. *Diploneis pseudovalis* HUSI.; 55-56. *D. subovalis* CI.; 57-58. *D. -v. jogensis* v. nov.; 59-61. *D. subsmithii* sp. nov.

Fig. 62-93. *Diploneis subovalis* CI.

Fig. 93a. *Caloneis pulchra* MESSIK v. *interrupta* GANDHI; 94-106. *Diploneis subovalis* CI.; 107. *D. subsmithii* sp. nov.?

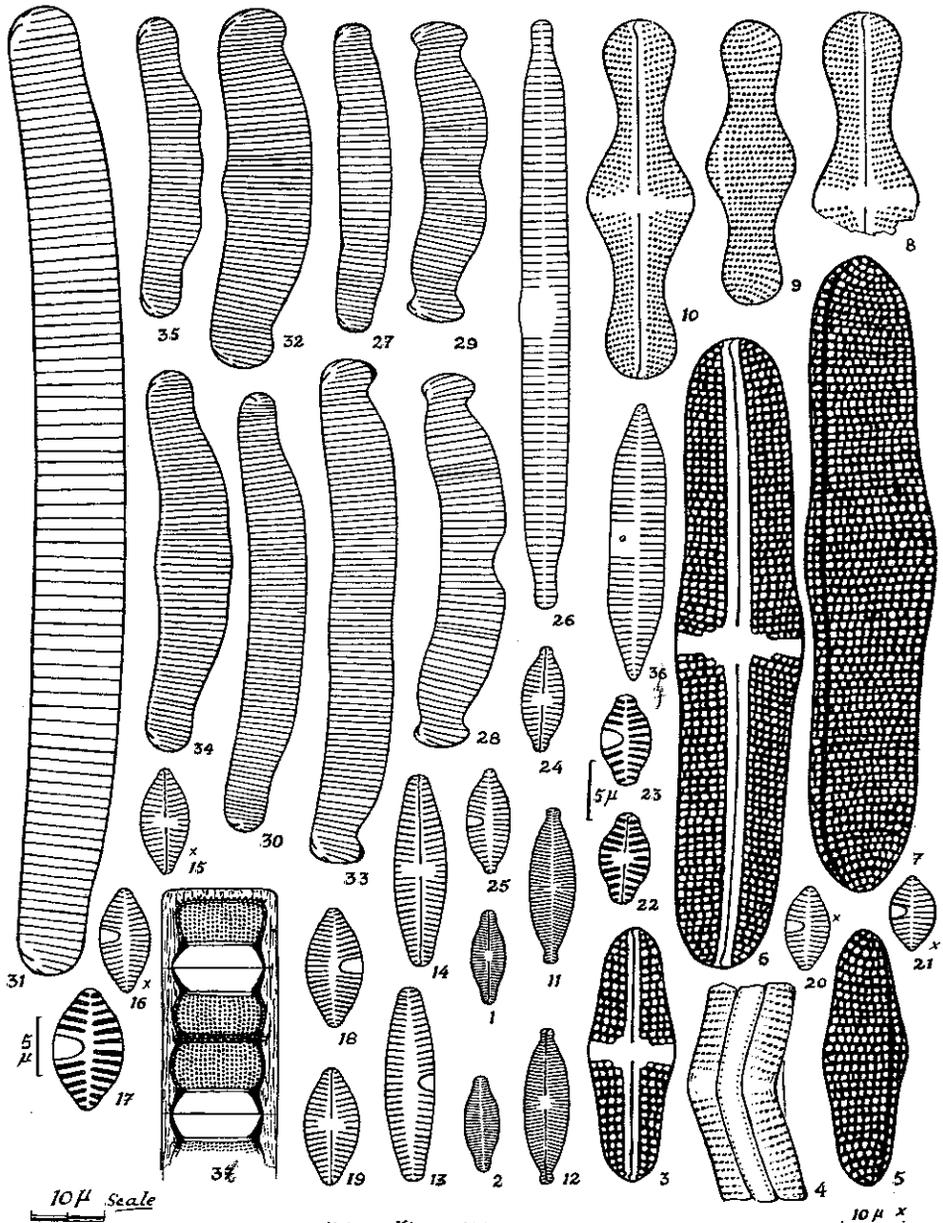
Fig. 108. *Diploneis subovalis* CI.; 109. *Navicula bacillum* EHR. v. *jogensis* v. nov.; 110. *N. contenta* GRUN. f. *biceps* ARNOI; 111. *N. -f. parallela* B. PEI.; 112-115. *N. jogensis* sp. nov.; 116-119. *N. pusilla* W. SM. v. *lanceolata* GRUN.; 120. *Pinnularia borealis* EHR. v. *undulata* HUSI.; 121-124. *P. eburnea* (CARLSON) ZANON; 125. *P. lata* (BRÉB.) W. SM. v. *thuringiaca* (RABH.) MAY.; 126. *Stauroneis anceps* EHR. v. *hyalina* BRUN et PERAG.

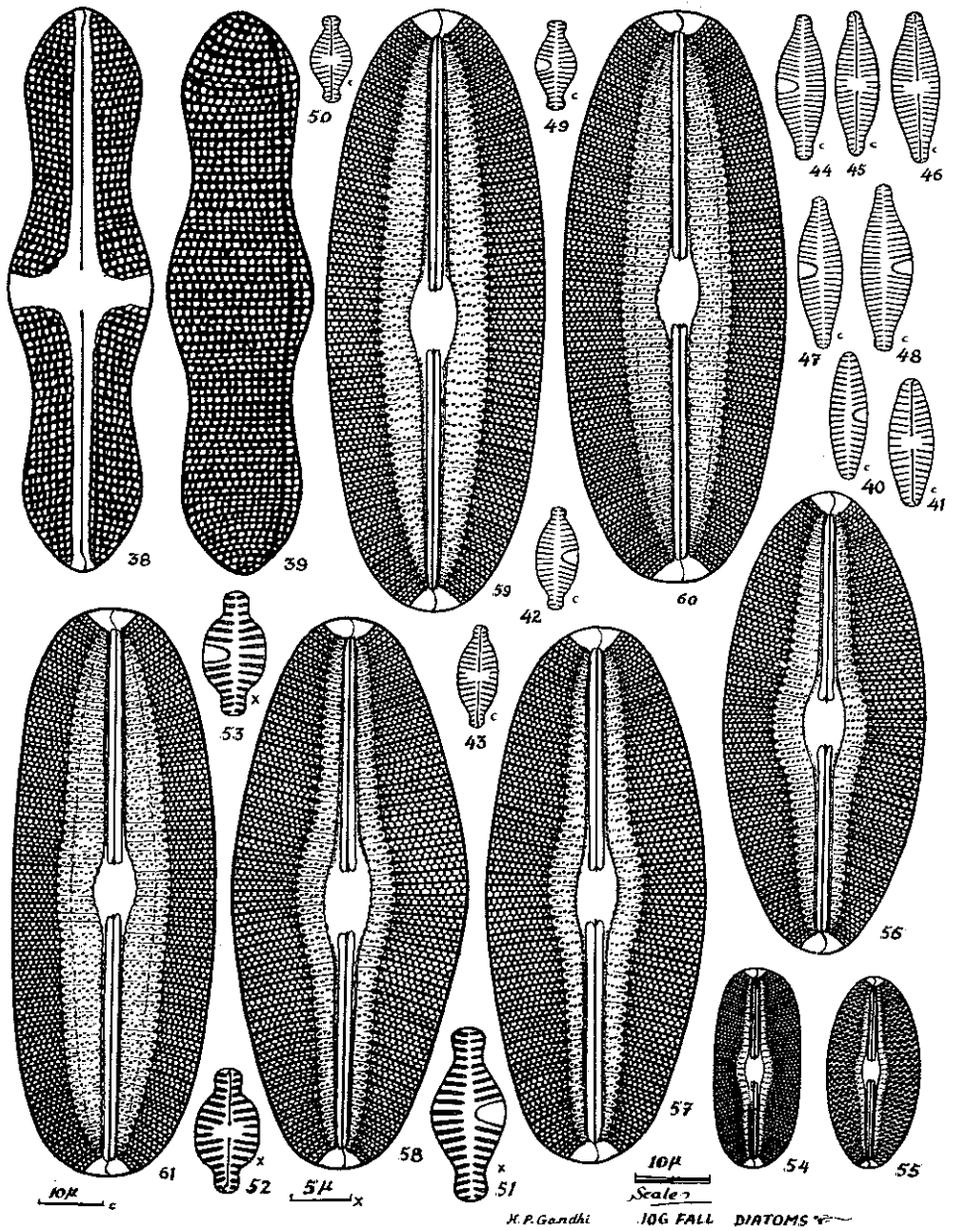
Fig. 127. *Pinnularia borealis* v. *lonavensis* GANDHI; 128. *P. congolensis* (ZANON) CHOI; 129-130. *P. eburnea* (CARL.) ZANON; 131-132. *P. graciloides* HUSI. v. *jogensis* v. nov.; 133-134. *P. lata* v. *media* ZANON; 135-136. *P. -v. thuringiaca* (RABH.) MAY.; 137. *P. paucicostis* sp. nov.; 138. *P. stauroptera* (RABH.) CI. v. *minuta* MAY. f. *mediocostricta* A. CI.

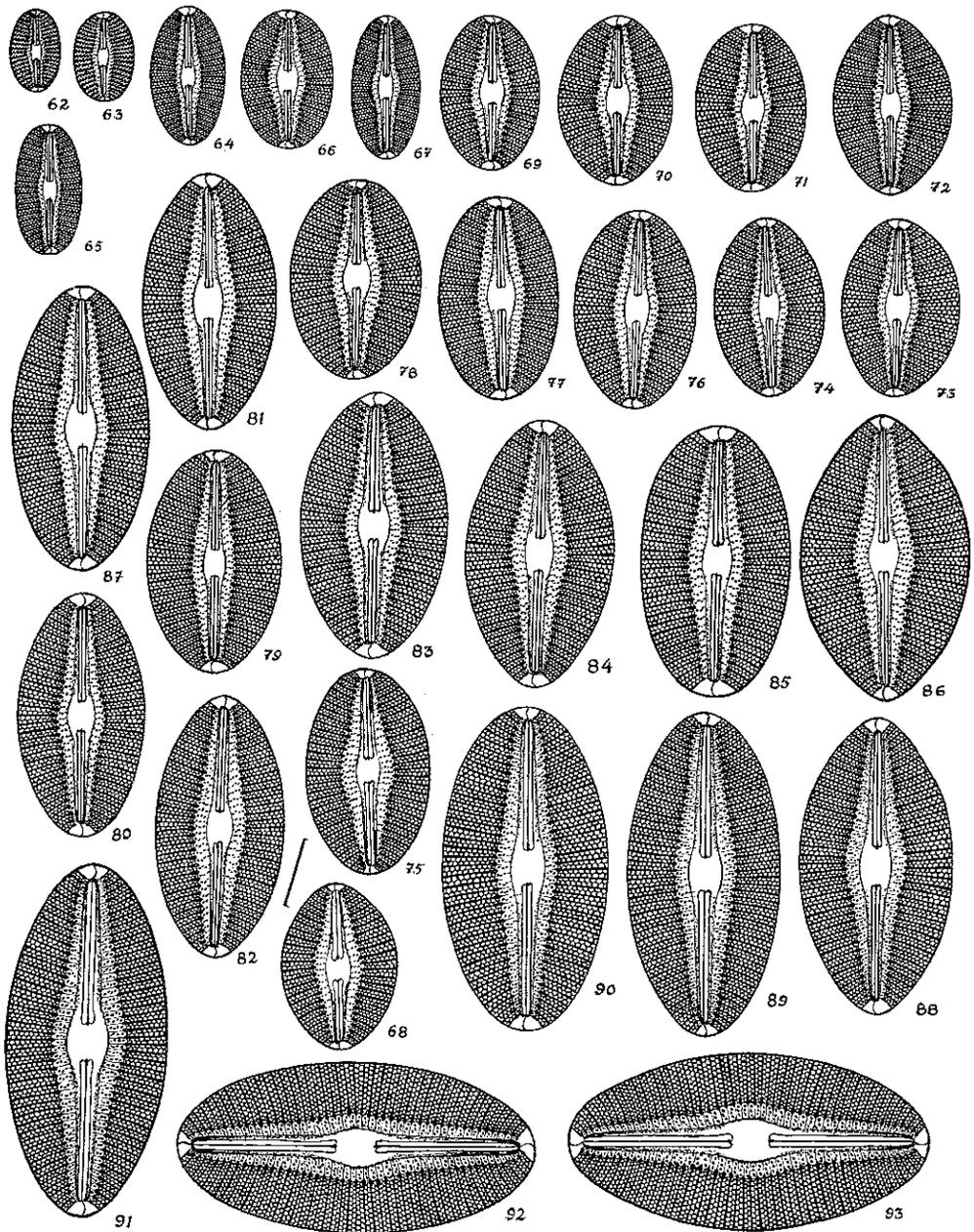
Fig. 139. *Cymbella gracilis* (RABH.) CI.; 140. *C. helvetica* KÜTZ.; 141. *C. pusilla* GRUN.; 142-144. *Gomphonema clevei* FRICKE f. *acuta* f. nov.; 145-146. *G. -v. javanica* HUSI.; 147. *G. -v. undulata* v. nov.; 148. *G. gracile* EHR. v. *aurita* (A. BRAUN) CI.; 149. *G. sphaerophorum* EHR. f. *jogensis* f. nov.; 150. *Pinnularia divergens* W. SM. v. *americana* MEISI; 151. *P. dubiosa* sp. nov.; 152. *P. graciloides* HUSI. v. *americana* (HUSI.) emend.; 153. *P. sahyadrens* sp. nov.

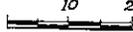
Fig. 154-155. *Achnanthes crenulata* GRUN.; 156-157. *A. -o. elliptica* GANDHI; 158-159. *A. elata* (LEUD-FORT.) GANDHI; 160. *Eunotia cholnokyi* sp. nov.; 161. *E. nodulosa* MEISI; 162. *Gomphonema clevei* v. *javanica* HUSI.; 163. *G. subventricosum* HUSI.; 164-167. *Hantzschia distincte-punctata* HUSI.; 168. *Nitzschia obtusa* W. SM. v. *scalpelliformis* GRUN. f. *parva* HUSI.; 169. *Pinnularia lata* v. *media* ZANON; 170. *P. -v. thuringiaca* (RABH.) MAY.; 171. *Swirella apiculata* W. SM.; 172. *S. shyamii* sp. nov.; 173. *S. -f. constricta* f. nov.

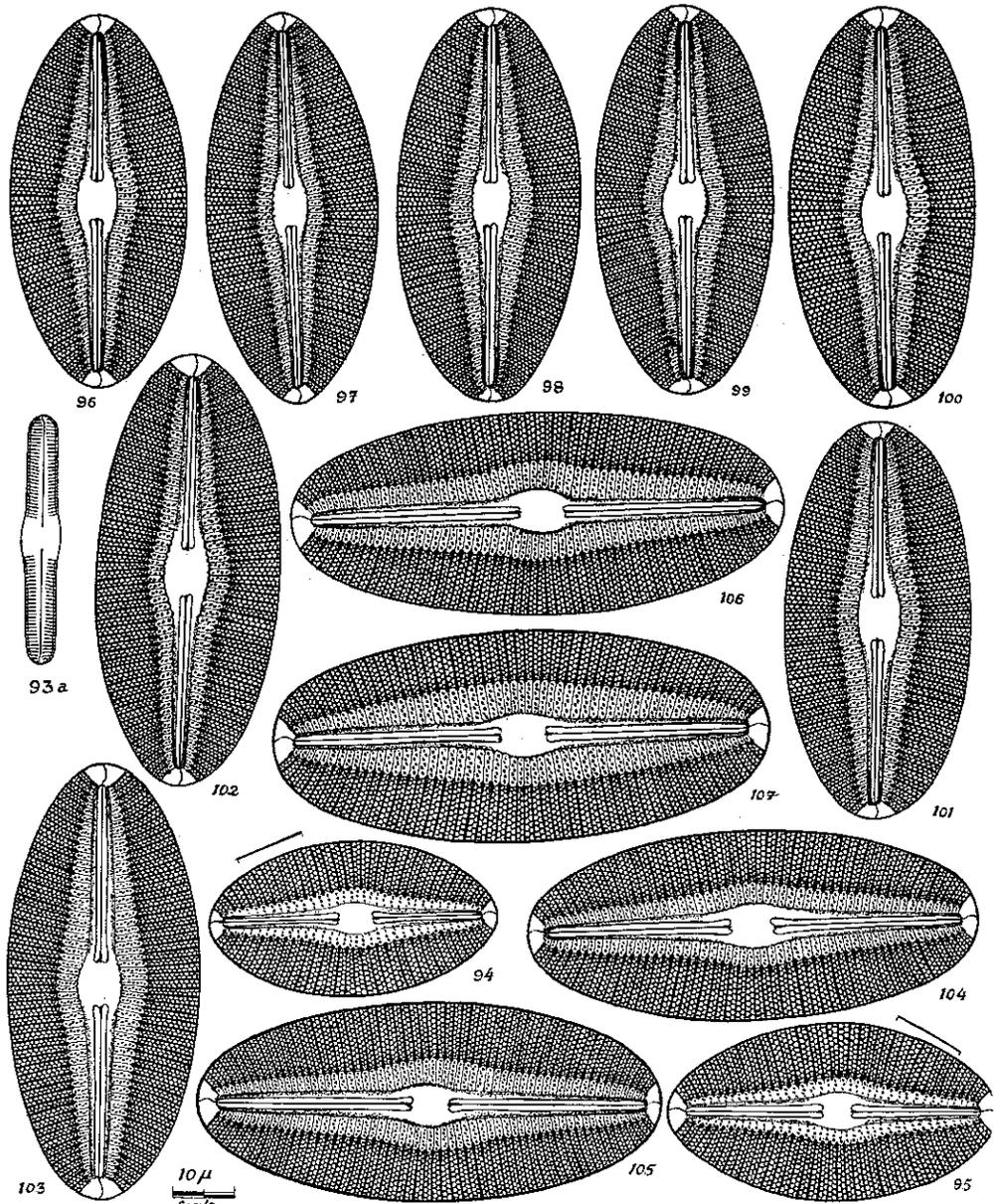
Fig. 174-175. *Cymbella radiosa* REICHEL; 176. *Nitzschia ignorata* KRASSKE; 177. *Swirella capronii* BRÉB. v. *obtusa* HUSI.; 178-180. *S. shyamii* f. *constricta* f. nov.



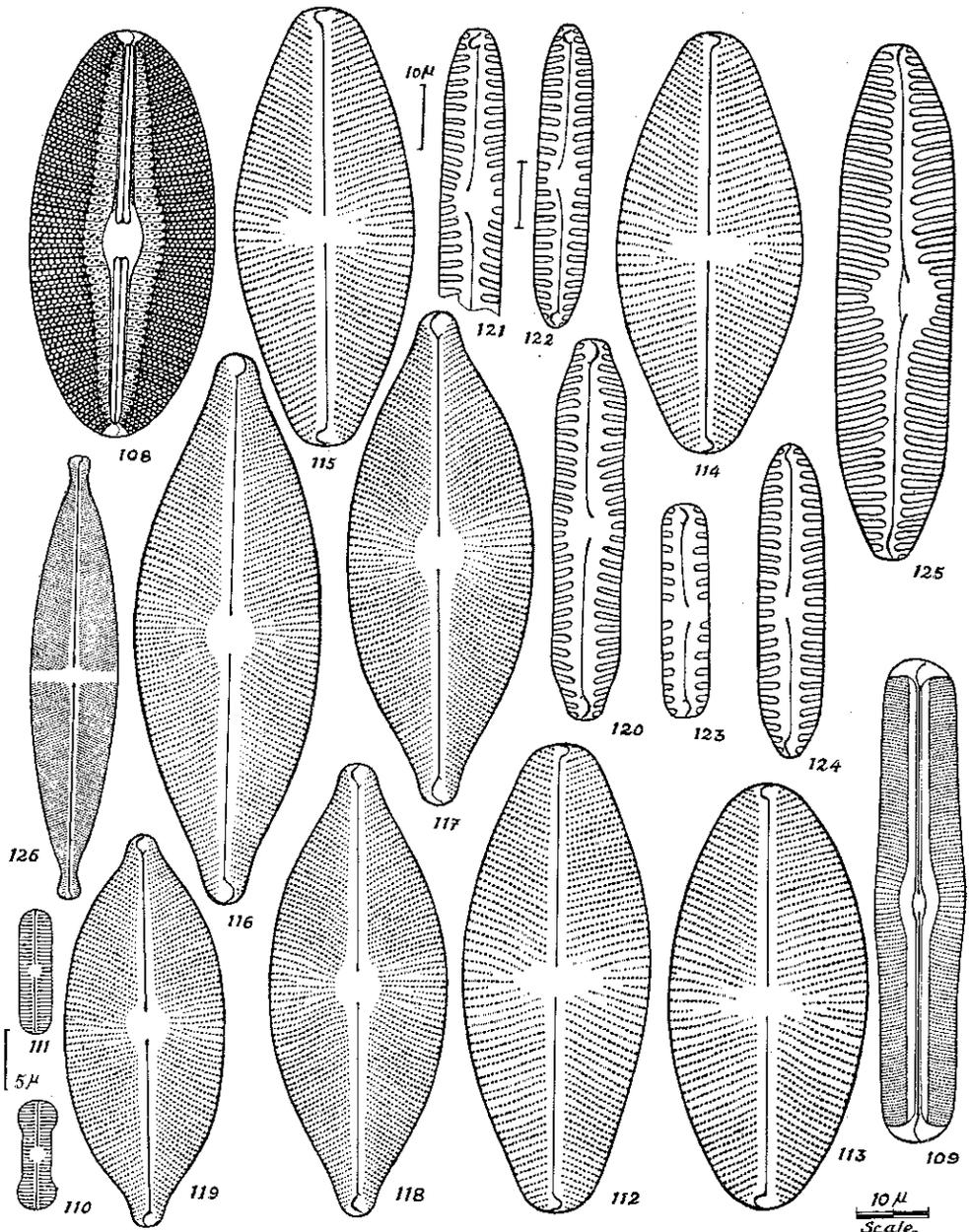




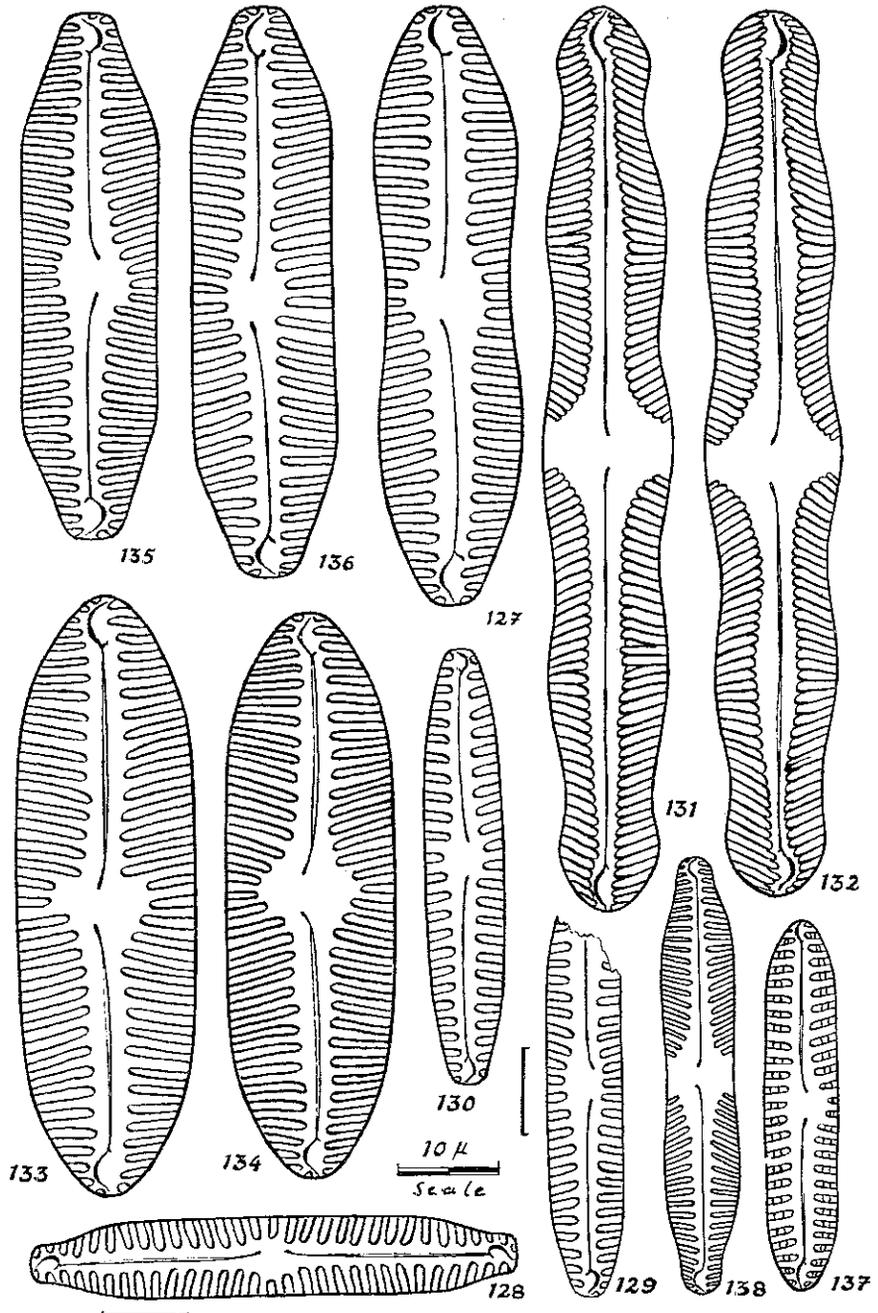
H. P. Gandhi - JOG FALL DIATOMS -  Scale



H. P. Gandhi - 106 FALL DIATOMS

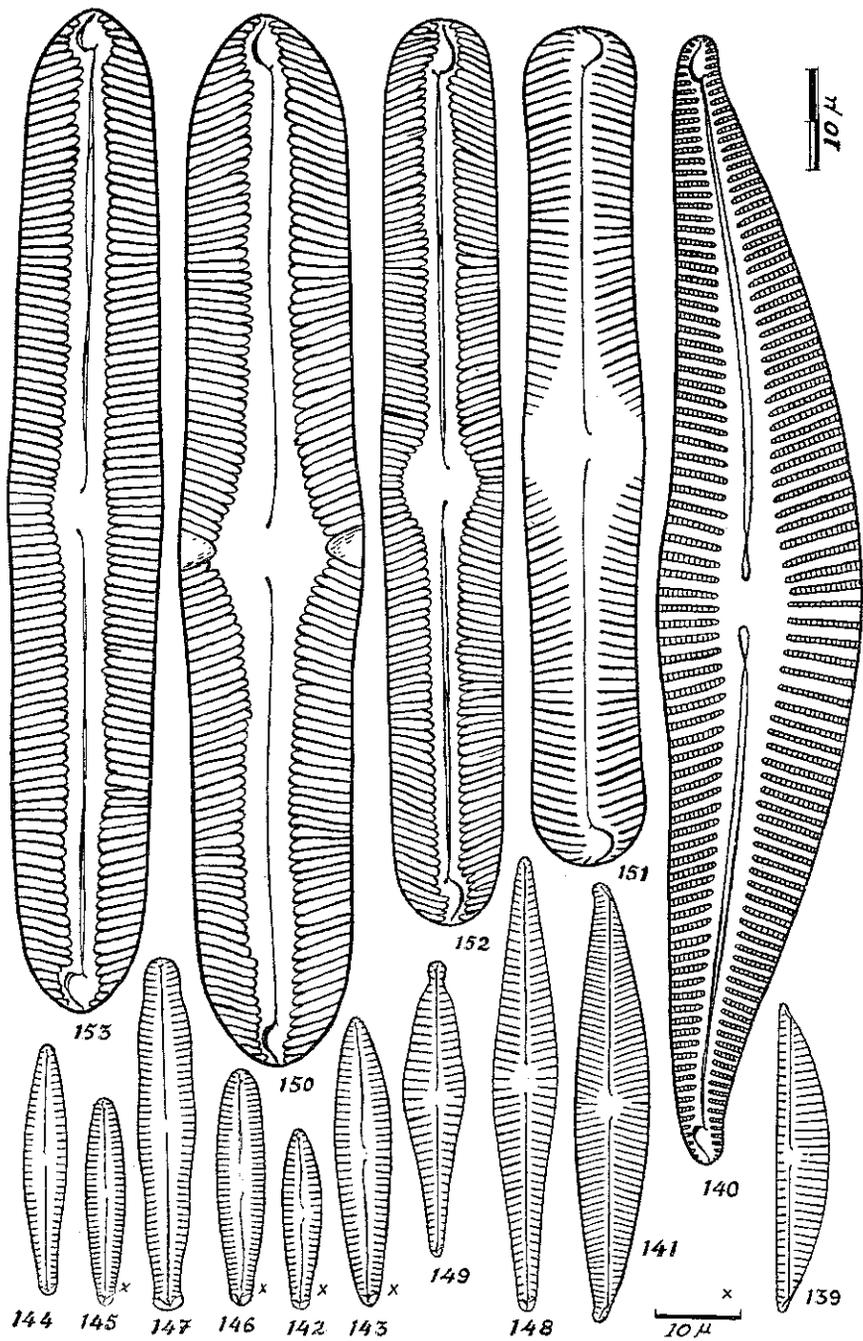


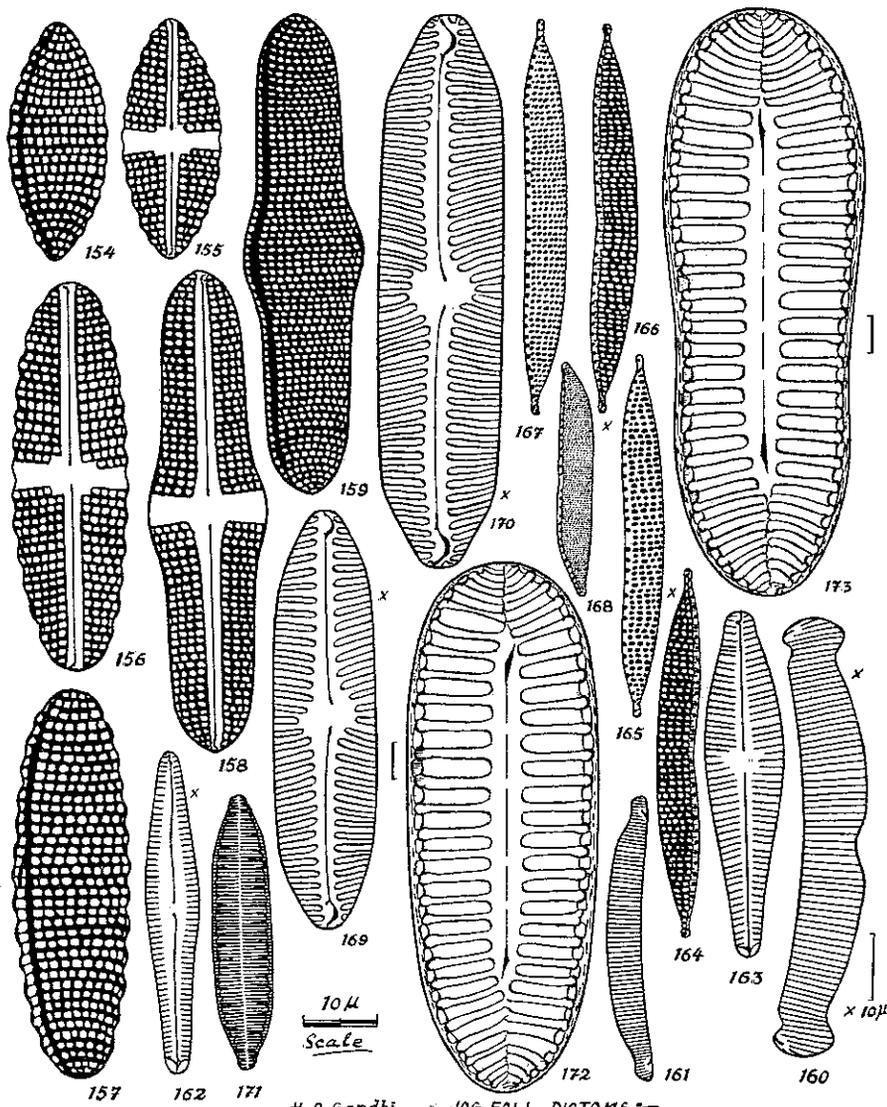
H. P. Gandhi - JOG FALL DIATOMS



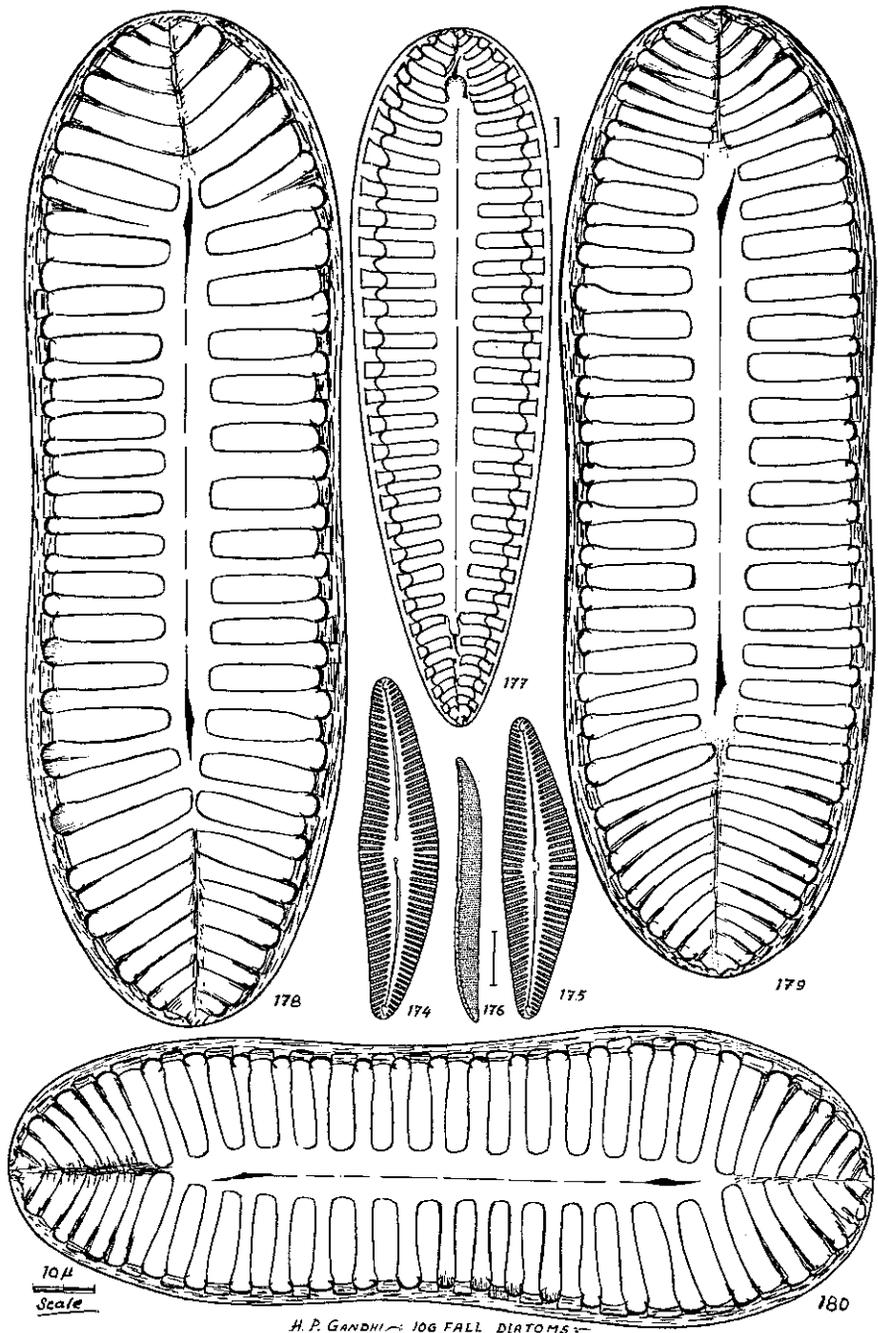
H. P. Gandhi - 106 FALL DIATOMS

K. P. Gandhi - 106 FALL DIATOMS -





H. P. Gandhi - JOG FALL DIATOMS :-



H. P. GANDHI: 106 FALL DIATOMS