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# Taxonomy And Ecology Of Bacillariophyceae In The River Krishna, Andhra Pradesh, India

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**Abstract:** The present study reveals the taxonomy and ecology of diatom communities in the river Krishna, Hamsaladeevi, near Koduru village, Krishna district, Andhra Pradesh. Algae and water samples were collected in 5 locations during winter season (December 2018). In the present investigation a total number of 36 diatom species belonging to 10 genera were recorded. Among these Achnanthus brevipes, Pleurosigma spp., Gyrosigma accuminatum, Navicula cuspidate, Nitzschia tryblionella and Surirella fastuosa were the most abundant species.

**Keywords:** Taxonomy, Ecology, Algae and Krishna River.

**Introduction:**

Diatoms are recognized worldwide as one of the most fitting organic components for water quality assessment, due to their constant presence along the aquatic system and also because they give a quick response to environmental changes (Misra et al, 2005). There are currently over 260 genera of living diatoms with over 100,000 species (Anand and Kant, 1976). Diatoms are so ecologically important that they are used for monitoring environmental conditions of waters. Diatoms have been used in a number of countries as indicators of river pollution (Misra et al, 2007). The investigations in river diatoms are scanty due to practical difficulties in the survey and sampling of flowing water. A diatom community is a popular tool for monitoring environmental conditions, commonly used in studies of water quality (Round et al, 1990). According to diatoms develop faster when they grow on rocks or hard surfaces, in general cobbles, boulders and pebbles are used in the sampling of these epilithic diatoms. The sensitivity of diatom communities has led them to be used as indicators of environmental conditions, such as water quality and habitat conditions in river systems and stream (Venkatachalapathy and Karthikeyan, 2013).

Several investigators have been studied Diatom taxonomy such as Anand and Kant (1976), Anand and Sharma (1998), Biswas (1939), Desikachary (1952,1954,1954a,1954b,1962), Krishnamurthy (1954), Foged (1981), Gandhi et al (1960,1961,1962,1967), Hustedt (1931,1939 and 1957), Suxena and

Venkataswarlu (1970), Kamat and Agarwal (1975), Tarar and Bodhke (1998), Seth et al, (2006) and Shukla et al. (2009).

**Material and Methods:**

The Krishna River originates in the Western Ghats near Mahabaleshwar at an elevation of about 1,300 metres, in the state of Maharashtra in central India. It is one of the longest rivers in India. The Krishna River is around 1,400 km in length. The river Krishna enters Bay of Bengal at Hamsaladeevi near Koduru Andhra Pradesh on the east coast.

**Sample collection:** 250 ml of surface water samples collected near Koduru in 5 different locations during winter season and 4-5 uniform pebbles coated with brown or green scum were collected from the respective sampling stations in a wide mouthed bottle with clean forceps. The scraped sample materials were preserved in 4% formaldehyde solution and the final volume of the sample was reduced to 50 ml by sedimentation. This concentrated material was used for frequency measurement and species identification (Blum, 1957).
Images were captured with Cat Scope CSU 2000 L Binocular research microscope fitted with Cat Com digital camera photomicrographic system.

**Results and Discussion:**

**Description of the species:**

**PLATE – 1**

1. **Delphineis minutissima (Hustedt.) Simonsen (Plate 1, Fig. 1)**
   Basionym: Rhaphoneis minutissima Hustedt.
   Hustedt, 1939: page, 599, figs. 14 - 15; Simonsen, 1987: 252, pl. 374, figs 10 - 16; Ferrario et al. 2003: 126, fig. 3 j, k
   **Description:** Delphineis minutissima length is 4 - 12.5, width 3.4 - 8.45, Striae 13 - 20 in 10 µm, areolae 14 - 20 in 10 µm. Cells solitary. Valves suborbicular, rhombicelliptical to elliptical-lanceolate, with rounded apices to slightly produced rounded apices. Valve face flat and smooth, valve mantle oblique and shallow, with a single row of areolae roughly of the same size and evenly spaced. Striae uniseriate, almost straight or slightly curved, perpendicular to radiate, no consistently aligned across the sternum. Areolae subrectangular, occluded by rotae placed near the inside of the valve. Submarginal row of areolae is continuous around the apices of the valve face. Externally, an irregular row of minute granules located between the areolae of the mantle and the submarginal row of areolae, encircles the valve surface.

2. **Rhaphoneis amphiceros (Ehrenberg) (Plate 1, Fig. 2 & 3 )**
   Ehrenberg, 1844, p.364; Grunow, 1880, pl. 36, fig. 20, 21; Cleve, p.499.Andrews, 1975; 204 - 205, pl. 1, figs. 9 - 12; Hasle and Syvertsen, 1996: 252, pl. 52.
   **Description:** Valves circular to broadly elliptical-lanceolate with +/- strongly drawn out, protracted, quite sharply rounded apices. 20 to nearly 100 µ long, 18 – 25 µ wide. Transapical rows of areolae about 6 – 7 in 10 µ, strongly radial in small individuals perpendicular to the middle line in longer individuals where rows are radial only near the ends. Areolae round, in fairly regular straight longitudinal rows. Pseudoraphe very narrow lanceolate

**Ecology:** Widely distributed and polymorphic species. The variations here theoretically belong in the evolution of the generations.

3. **Achnanthus interrupta Hustedt. (Plate 1, Fig. 4 )**

**Description:** Valves elliptic to elliptic-lanceolate with rounded ends. Valves 12 - 15.5 µm in length and 3.5 - 5 µm in breadth. Raphe valve: Raphe straight; terminal fissures curved on the same side; axial area lanceolate with a small central area. Striae parallel at the center, slightly radiate and convergent at the ends. Striae, 19 - 28 in 10 µm.

**Ecology:** It occurs in fresh and brackish waters with moderate to high conductivity and β-mesosaprobous condition.

4. **Achnanthus brevipes (Agardh) var. intermedia Kutz. (Plate 1, Fig. 5 & 6 )**

**Skvortzow 1930, p. 254; Peterson 1930, p. 35**

**Description:** Cells occur in short filaments, supported on a short stipe; frustules linear-elliptic, with rounded ends, slightly constricted towards the middle; arcuate in girdle view; Valves 30 - 115 µm in length and 12 - 36 µm in breadth. Valve surface punctate in transverse and longitudinal rows; pseudoraphe eccentric on upper valve; raphe supported by a stout costa dilated at central nodule to form a transverse stauros. Striae 7 - 10 in 10 µm.

**Ecology:** Fresh water and brackish water. It prefers high conductivity water.

**PLATE - 2**

5. **Diploneis crabro (Ehren) var. Pandura (Breb) Cl. (Plate 2, Fig. 7 )**
Schmidt 1875, pl. 11, fig. 21, 22; 1881, pl. 69, fig. 9; Hustedt, 2007, page. 524, fig. 1034.
**Description:** Longitudinal canals with an outer row of poroid pits, which sometimes occupy the entire width of the canals, and an inner row of pores, which is interrupted near the middle chambers. Corresponds fully with the species and is differentiated from it essentially by the completely absent or only very narrow depressions. Valves linear with more or less strongly drawn in sides, blunt to wedge-shaped rounded ends and tongue shaped.

**Ecology:** The species distributed common on most ocean coasts.

6. **Diploneis splendid (Greg) Cleve (Plate 2, Fig. 8 )**
Hustedt 1985, p. 596, f. a - c; Cleve 1894, p. 87.

**Description:** Valves linear elliptical in outline with more or less strongly constricted sides and tongue-shaped valve halves. 50 - 220 µm long, 20 - 50 µm wide at the widest part and 15 - 30 µm wide at the middle. Central nodule relatively large, roundish quadratic in outline, horns robust, parallel, longitudinal canals fairly wide, nearly linear, usually slightly retracted at the

middle, their outer margins enclosing a space of about 1/3 or more of the valve width. Transapical ribs robust, 5 - 8 in µm, radial crossed by more or less numerous slightly curved bent longitudinal ribs standing further apart than the transapical ribs and usually interrupted at the middle.

**Ecology:** Salt water form distributed and common in saline waters of the interior, as well as on brackish water.

7. **Diploneis interrupta var. heeri (Plate 2, Fig. 9 )**
Venkataraman 1939, p. 323, f. 82; Suxena 1950, p. 59; Iyengar and Venkatraman 1951, pp. 158, 173, 174, 180; Foged 1959, p. 48.

**Description:** Valves linear elliptical in outline with deeply constricted sides and elliptical valve halves and with bluntly rounded ends about 30-80 µm long, 12-27 µm wide at the greatest width, 7 - 15 µm wide at the constriction. Longitudinal canals therefore displaced far to the outside. Includes small forms 20-35 µm long 9-15 µm wide at greatest width 6-10 µm wide at the middle. Transapical ribs very robust, strongly radial within the valve halves, 8-12 in 10 µm. Chambers undivided without discernible pores on the inside, outer walls homogenous the middle chambers absent or only rudimentarily developed. Longitudinal canals with an outer row of poroids, inner wall without pores.

**Ecology:** Salt water form distributed and common in saline waters of the interior, as well as on ocean coasts with more or less saline waters.

8. **Diploneis divergens (Schmidt A) cleve. (Plate 2, Fig. 10 )**
Schmidt, Atl. Pl.12, fig. 50

**Description:** Valves linear with more or less strongly constricted, in extreme cases almost parallel sides, elliptical - tongue - shaped valve halves and bluntly rounded ends about 32 - 80 µm long 16 - 26 µm wide at the widest part, 12 -23 µm wide at the middle. Transapical ribs robust, radial, 11 – 13 in 10 µm, crossed by irregularly wavy, delicate, longitudinal, ribs standing somewhat removed from each other. Chambers therefore divided repeatedly, subchambers transapically elongated, open in the inside, outer walls apparently homogenous.

**Ecology:** Species is very abundant in saline waters.

9. **Diploneis nitescens (Greg) Cleve (Plate 2, Fig. 11 )**
Gregory , 1857, p.15, pl. 1, fig. 16; Donkin, 1871, pl.1, fig. 7; Grunow, 1860, p.525, pl.3, fig.17.

**Description:** Valves rhombic-elliptical, elliptical with blunt, sometimes slightly wedge-shaped, rounded ends, 24 - 100 µm long, 14 - 36 µm wide. Central nodule moderately large, roundish-quadratic to apically-elliptical in outline; horns weakly developed, not sharply delimited toward the raphe furrows, parallel longitudinal canals very wide, half lanceolate, their outer margins enclosing a space of about ½ the valve width and more. 6 – 9 in 10 µm, chambers undivided, open on the inside, the outer walls distinctly poroid.

A double row of small areolae stand between each two ribs. Longitudinal canals with continuations of the transapical ribs, which are interrupted near the outer margin of the canals, therefore appearing especially long lateral “teeth” of the horns, outer walls of the longitudinal canals apparently homogenous or only very delicately poroid, inner side without discernible structure.

**Ecology:** Distributed on all coastal areas.

**10. Actinoptycus senarius (Ehrenb) Ehrenb (Plate 2, Fig. 12 )**

**Description:** The segments are covered with coarse areolation. Chloroplasts plate-like or irregular. Cells 20–80 µm in diameter. Markings on valve surface divided into (usually) six segments that are alternately raised or level giving an alternating light and dark appearance.

**Ecology:** It is a cosmopolitan marine, coastal and estuarine species common at most times of the year.

**11. Surirella fastuosa (Ehren.) (Plate 2, Fig. 13 )**

Ehrenberg 1854, pp. 126, 132; Skvortzow 1932, p.338.

**Description:** Frustules in girdle view slightly wedge-shaped and linear. Valves linearly elliptical, with broadly rounded heteropolar apices. Valves 146-291 µm in length and 56-94 µm in breadth. Costae broad, parallel centrally to radiate apically, 1-1.5 in 10 µm. Striae of similar orientation, finely punctate, 22-27 in 10 µm. Pseudoraphe broad, not intruded by costae. The valve face appears to be V-shaped based on the observable groove-like nature of the longitudinal axis.

**Ecology:** Epilithic species in freshwater.

**12. Surirella fastuosa var. robusta (Ehren.) (Plate 2, Fig. 14 )**

**Description:** Cella with heteropol apical axis wedge shaped girdle band side. Valves egg-shaped to elliptical with bluntly rounded ends, 150 to almost 400 µm long, 50-150 µm wide. Wings strongly developed wing projection distinct, win canals 7-15 in µm, as a rule somewhat narrower then the windows. Ribs robust reaching the middle line or liberating a more or less wide lanceolate middle field. Valve surfaces depressed between the middle field and the wing margin. Cell wall distinctly transapically punctuate-striated.

**Ecology:** Surirella robusta is especially distributed and not rare in bottom mud of the larger lakes.

**Plate - 3**

**13 Gyrosigma balticum (Ehr.) Rabh. (Plate 3, Fig. 15 & 19 )**

Iyengar and Venkatraman 1951, p. 158, 173,174,175,180; Gonzalves and Gandhi 1953, p. 240, f. 64; Gandhi 1961a, p. 499.

**Description:** Valves broad linear, slightly bent into a weak S-shape, obliquely rounded at the apices, 200-400µm long 20-40 µm wide. Raphe with "swung" branches, as a result of which they lie somewhat eccentrically, central area small, oriented diagonally to the midlle line. Transverse and longitudinal striae of equal prominence, 11-16 in 10µm, transepical striae perpendicular to the middle line.

**Ecology:** Widely distributed in salt water and common on all coasts, here and there in this area in salt works (Salzuflen, Kraske). But in general, rarely occurring in the interior.

14. **Gyrosigma accuminatum (Kutz.) Cl. (Plate 3, Fig. 20 )**

Sarode and Kamat 1979, p. 30, f. 28; 1983a, p. 282, pl. 4, f. 48; 1984, p. 66, pl. 7, f. 145; Somasekhar 1983, p. 82.

**Description:** Valves bent into S-shape, generally lanceolate, gradually narrowed from the middle toward the bluntly rounded apices, 100-200 µm long 15-20µm wide. Raphe lying in the middle line of the valve and correspondingly S-shaped. Transverse and longitudinal striae standing the sanme distance apart, about 18 in 10 µm, transverse striae perpendicular to the middle line.

**Ecology:** Distributed throughout the entire area and common in waters of all types var. gallica and var. Brebissoii prefer slightly brackish water. And are found therefore in salt woprks and other saline places in the interior

15. **Gyrosigma attenuatum (Kutz.) Rabh. (Plate 3, Fig. 21 )**

Hustedt 1922, p. 124; Mills 1934 XI, p. 826; Cleve-Euler 1952, p. 12; Van Lan 1971, IV, p.1998.

**Description:** Valves slightly bent into weak S-shape, lanceolate, gradually decreasing in width from the middle toward the ends, bluntly rounded at the spices, 150-240µm long, 23-26µm wide. Raphe in the middle line of the valve, slightly S-shaped. Transapical striae perpendicular to the middle line, 14-16 in 10 µm, longitudinal striae distinctly coarser, 10-12 in 10µm

**Ecology:** Fresh water form very widely distributed and common in standing and flowing waters of the entire area.

16. **Gyrosigma scalproides (Rabh.) Cleve (Plate 3, Fig. 22 )**

Gonzalves and Gandhi 1953, p. 241, f. 66; Foged 1959, p. 49; 1971, p. 294, pl. 9, f. 6; Gandhi 1961a, p. 499; Sarode and Kamat 1984, p. 68, pl. 7, f. 150.

**Description:** Valves linear scarcely narrowed toward the apices, slightly bent into S-shape bluntly and more or less diagonally rounded at the ends, 25-70– long 5.5-10 µm wide. Raphe central, slightly S-shaped. Transverse striae somewhat radial at the middle part of the valve,

otherwise perpendicular to the middle line. 22-24 in 10 µm. Longitudinal striae much more delicate, about 28-30 in 10 µm

**Ecology:** Distributed and not rare throughout the entire area in ditches, ponds and lakes the variety found especially in slightly brackish water of the coastal area.

**Plate - 4**

**17. Pleurosigma rhombeum (Grun in cl. Grun) (Plate 4, Fig. 23 )**

**Description:** Frustules slightly sigmoid and linear that gradually tapers to obtusely round symmetrical ends. Valves 70 - 145 µm in length and 12 - 15 µm in breadth. The axial area and raphe sigmoid or slightly undulate. The longitudinal straie finer than the transverse striae and curve outward to the sides of the central area. Transverse striae, 18 - 20 in 10 µm and 20 - 22 longitudinal straie in 10 µm.

**Ecology:** Freshwater to slightly brackish water and prefers relatively high electrolyte content waters.

**18. Pleurosigma directum Grun in cl. and Grun (Plate 4, Fig. 24 )**

**Description:** Valves slightly sigmoid, lanceolate or linearly lanceolate with strongly attenuated, narrow, rounded obtuse apices. Valve surface flat; valves 75 - 118 µm in length and 12 - 16 µm in breadth. Axial area and raphe slightly sigmoid; slightly eccentric towards the poles.

**Ecology:** Fresh and brackish waters species

**19. Gyrosigma strigilie (W. Sm) Nach. Cleve (Plate 4, Fig. 25 )**

Hustedt 1985, p.782, f. 332.

**Description:** Valves lanceolate, rapidly narrowed from the middle toward the sharply rounded ends, bent into a fairly strong S-shape, 250 - 360 µm long, 27 - 35 µm wide. Raphe with slightly “swung” branches, partly somewhat eccentric, central area more or less diagonally oriented. Transverse striae perpendicular to the middle line, 11 - 14 in 10 µm.

**Ecology:** Fresh water form, very widely distributed and common in standing and flowing waters entire area.

**20. Pleurosigma Grun in cl. and Grun (Plate 4, Fig. 26 )**

Grun 1860, p. 561, pl. 4, f. 6; West and West 1902, p. 207.

**Description:** Valves large, elongated sigmoid and sigmoid raphe. Striae arranged in transverse and oblique rows. Areolae loculate and occluded by a rica. The areolae open externally by a slit, the foramen. The internal areola opening either single or subdivided by a siliceous bar.

**Ecology:** Fresh water form, very widely distributed and common in standing and flowing waters entire area.

**Plate - 5**

**21. Navicula cuspidate Kutz (Plate 5, Fig. 27 )**

Hustedt 1922, p. 131; Suxena 1950, p. 68; Hirano 1963, p. 11; 1955, p. 36, pl. 6, f. 40; 1966a, p. 26; Sarode and Kamat 1980b, p. 198; 1983a, p. 298, pl. 7, f. 81; 1984, p. 107, pl. 12, f. 258.

**Description:** Valves 58.8 - 68 m long and 18 - 20 m broad, elliptic-lanceolate with constricted, shortly rcastrate.sub truncate ends, Raphe thin and straight with central pores hook-like, Axial area very narrow, linear ; central area scarcely formed Striae transverse 14 - 16 in 10 m, mostly perpendicular to the middle line, longitudinal striae very fine, almost indistinct, about 26 - 28 in 10 m. A few pustules observed in the collection, differed from the type in being more elliptical-lanceolate with constricted, shortly prostate. Sub truncate ends.

**22. Navicula digitoradia (Gregory) Ralfs (Plate 5, Fig. 28)**

Hustedt 1922, p. 134; Iyengar and Venkataraman 1951, pp. 158, 173, 174, 176, 181; Foged 1959, p. 60; Van Lan 1975, V, p. 2514.

**Description:** Valves broadly elliptical, usually ± linearelliptic, ends wedge-shaped, broadly rounded 25 - 60 µm long, 8 - 9.5 µm broad. Raphe weakly lateral with somewhat distant, distinct central pores, terminal fissures appearing very close to the poles and running over onto the mantle, thus appearing short in valve view. Axial area moderately narrow, becoming lanceolate in the middle, central area ± asymmetric rhombic. Striae fairly strongly radiate, convergent at the ends, strongly convergent in long individuals, single, short striae alternating with longer striae in the middle, 10-11/10 µm,

**Ecology:** Occur in freshwaters and brackish water. Alkalibiontic (exclusively occurring at pH > 7) and tolerant to heavy pollution.

**23. Navicula gracilis Ehrenb. (Plate 5, Fig. 29 )**

Suxena 1950, p. 68; Hirano 1964, p. 192, pl. 5, f. 9; 1973, p. 113, pl. 2, f. 14; Pandey and Pandey 1980a, p. 156, f. 12.

**Description:** Valves linear-lanceolate, usually linear towards the middle and narrowed distally, ends wedge-shaped and obtusely rounded. Valve 26 - 74µm in length, 5 - 12 µm in breadth. Raphe filiform. Axial area very narrow, central area rectangular, expanded transversely to a little over half the valve width, slightly asymmetric due to the irregular shortening of 2 - 3 striae on either side. Striae weakly radiate, becoming parallel, then weakly convergent at the ends, Striae, 8 - 14 in 10 µm with lineate pores.

**Ecology:** Occur in freshwater and marine habitats. Alkaliphilous (mainly occurring at pH > 7), polytrophic and β-mesosaprobous.

**24. Navicula distans (Sm.) Ralfs. (Plate 5, Fig. 30 )**

**Description:** Valves elliptical with broad rounded apices; valves 11-15 µm in length and 4-7 µm in breadth. Raphe straight and filiform; median ends of the raphe somewhat distant from each other. Axial area very linear. Striae interrupted by lateral sterna on one or two sides of axial area. Striae parallel at the center and slightly convergent at the ends; 16-18 striae in 10 µm.

**Ecology :** Epipelic in freshwater and brackish water and tolerant to moderate to high pollutions.

**25. Navicula compressicauda A.S. Bm Comber (Plate 5, Fig. 31 )**

**Description:**Valves broadly lanceolate, sometimes slightly wider on one side than the other, apices broadly protracted and bluntly rounded, 28–59 µm in length, 11–20 µm in breadth.

**Ecology:** Freshwater (to slightly brackish water) and prefers meso- to eutrophic waters.

**26. Navicula retusa var. cancellata (Donk.) Ross (Plate 5, Fig. 32 )**

**Description:** Valves broadly linear or linear-lanceolate; ends broadly rostrate; valves 22-24 µm in length and 6-9 µm in breadth. Axial area narrow. Raphe straight; proximal ends closed, rounded, distal ends hooked. Central area small, circular. Striae 12-15 in 10 µm.

**Ecology:** It occurs in fresh and brackish waters; alkaliphilous (mainly occurring at pH > 7) and β-mesosaprobous.

**Plate - 6**

**27. Nitzschia socialis Greg. (Plate 6, Fig. 33 )**

**Description:** Valves broadly elliptical to elliptically lanceolate, valves 11 - 35 µm in length and 3 - 9 µm in breadth. Striae finely punctuate, more or less discontinuous in the middle, 15 - 21 in 10 µm.

**Ecology:** Fresh and brackish waters.

**28. Nitzschia sigmoidea (E.) W. Smith (Plate 1, Fig. 34 )**

**Description:** Cells more or less bent into S-shape in girdle view, otherwise linear with parallel margins and rounded corners. Valves long canoe-shaped, narrow lanceolate in somewhat rotated position with narrowed wedge shaped ends, 160 - 500 µm long, 8 - 14 µm wide. Keel slightly eccentric, keel punctae 5 - 7 in 10 µm. Striae distinct, 23 - 26 in 10 µm. The separation of the more coarsely striated individuals as var.amoricana (Kutz.) Grun. is not justified, the width of the girdle band side which was emphasized by Grunow likewise as a differential characteristic is eaningless, since it represents only a growth condition.

**Ecology:** Widely distributed and common.

**29. Nitzschia recta Hantz. (Plate 1, Fig. 35 )**

**Description:** Cells linear with parallel sides in girdle view somewhat narrowed, wedge shaped toward the ends, flately trimmed on the spices, middle not constricted. Valves typically linear, without constrictions, with narrowed, wedge shaped, quite sharpely rounded ends, 60 - 130 µm long, 5 - 7 µm wide, keel narroe not retratche, keel punctae robust, 5 - 9 in 10 µm, the two middle punctae not standing for apart. Transapical striae very delicate, hardly discernible, nearly 40 in 10 µm.

**Ecology:** Widely distributed and common in fresh water, easily distinguishable by the form and structure.

**30. Nitzschia tryblionella var. Genuina (Grun) (Plate 1, Fig. 36 )**

Hustedt 1922, p. 145; Gandhi 1961a, p. 475, pl. 2 (124), fs. 26 - 27, p. 502; Suxena 1983, p. 94, pl. 7, f. 152; Venkateswarlu 1983, p. 38, pl. 5, f. 75.

**Description:** Valves linear-elliptic with cuneate to subrostrate or even apiculate apices; often slightly constricted centrally. Valves 14 - 51 µm in length and 10 - 15 µm in breadth. Raphe system fibulate, strongly eccentric, 8-12 fibulae in 10 µm. Striae, dense to widely placed, 33 - 36 in 10 µm. Transapical ribs 10 - 13 in 10 µm.

**Ecology:** It occurs in freshwater and uncommon in slightly brackish water.

**31. Nitzschia tryblionella var. ambigua (Grun) (Plate 1, Fig. 37 )**

Suxena 1950, p. 72; Foged 1959, p. 81; 1976, p. 43, pl. 20, f. 7; Hirano 1966a, p. 35, pl. 3, f. 23; Compere 1981, p. 28; 1983, p. 149.

**Description:** Valves linear-elliptic with cuneate to subrostrate or even apiculate apices; often slightly constricted centrally. Valves 14 - 51 µm in length and 10 - 15 µm in breadth. Raphe system fibulate, strongly eccentric, 8 - 12 fibulae in 10 µm. Striae, dense to widely placed, 33 - 36 in 10 µm. Transapical ribs 10 - 13 in 10 µm.

**Ecology:** It occurs in freshwater and uncommon in slightly brackish water.

**32. Nitzschia Antarctica okuno (Plate 1, Fig. 38 )**

**Description:** Valves 70 - 148 µm in length and 3 - 7 µm in breadth. Striae transverse, appearing as simple lines. Striae, 18 - 24 in 10 µm. Raphe system fibulate, central.

**Ecology:** The species is recorded from marine, brackish and freshwater habitats. Epipelic, loosely associated with the benthic, or planktonic; in inland waters, most often found in brackish or saline habitats but there are a number of records from freshwater habitats as well.

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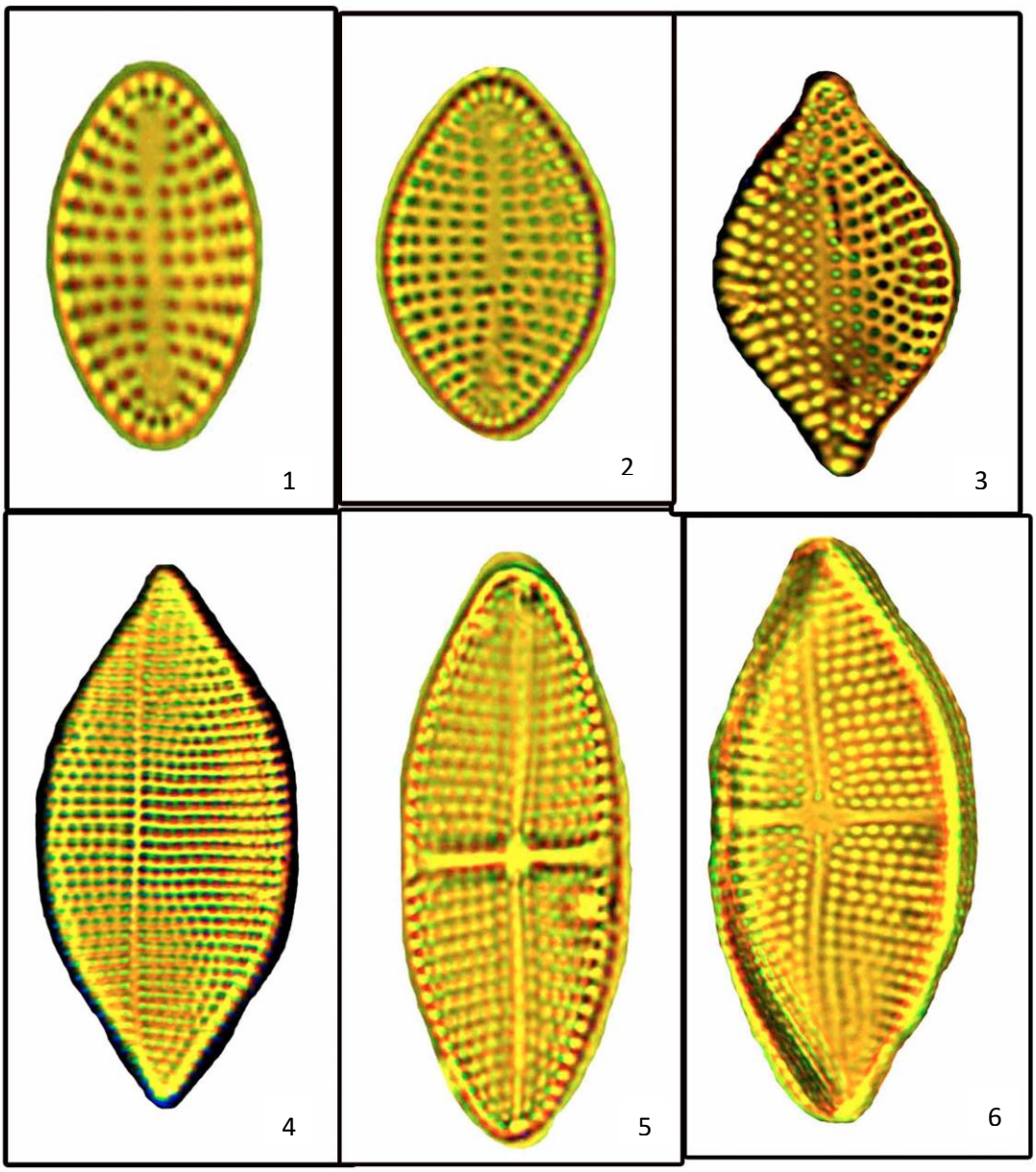
**Plate - 1**



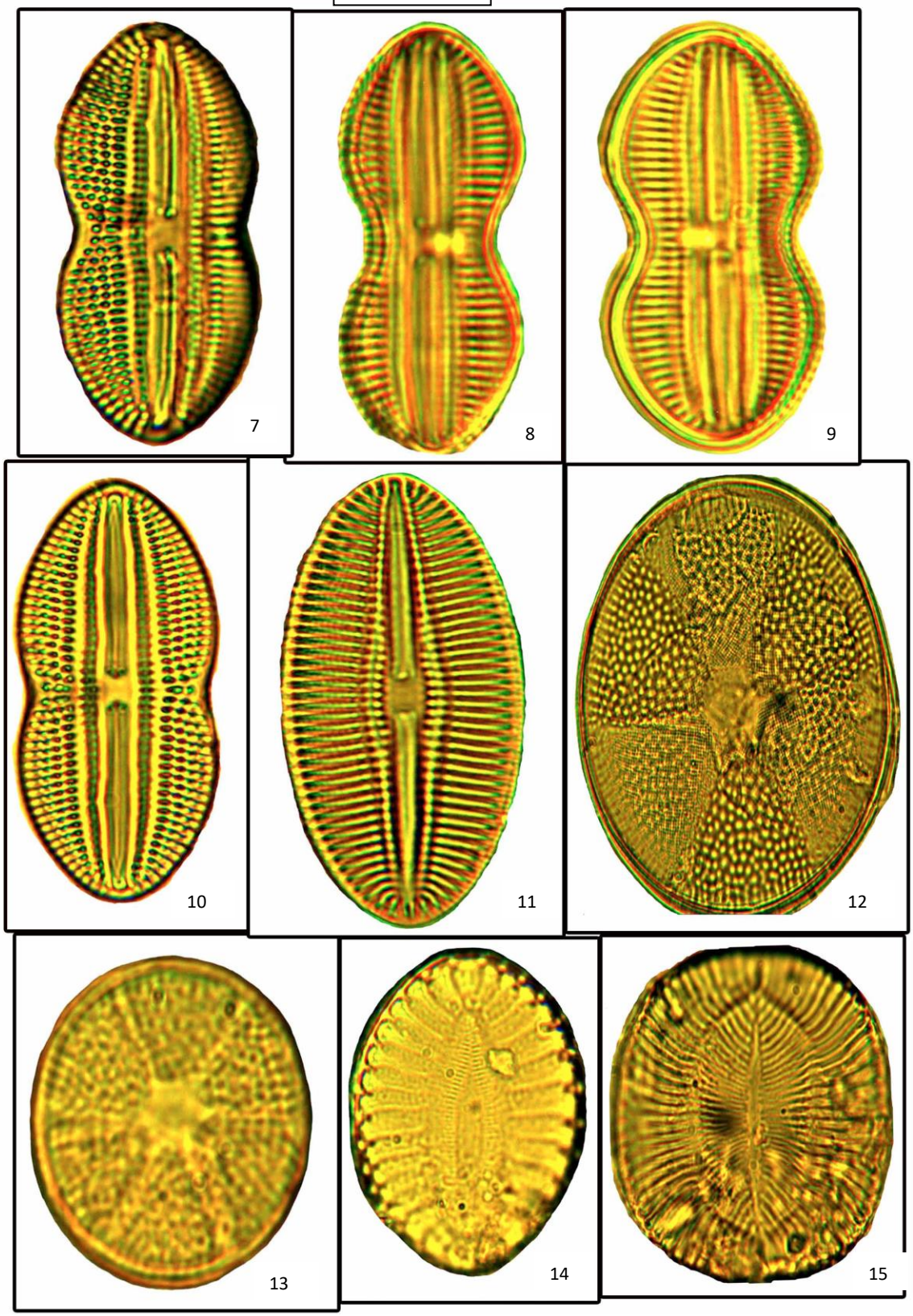

1. Delphineis minutissima (Hustedt.)

2, 3. Rhaphoneis amphiceros (Ehrenberg)

*4.* Achnanthus interrupta Hustedt

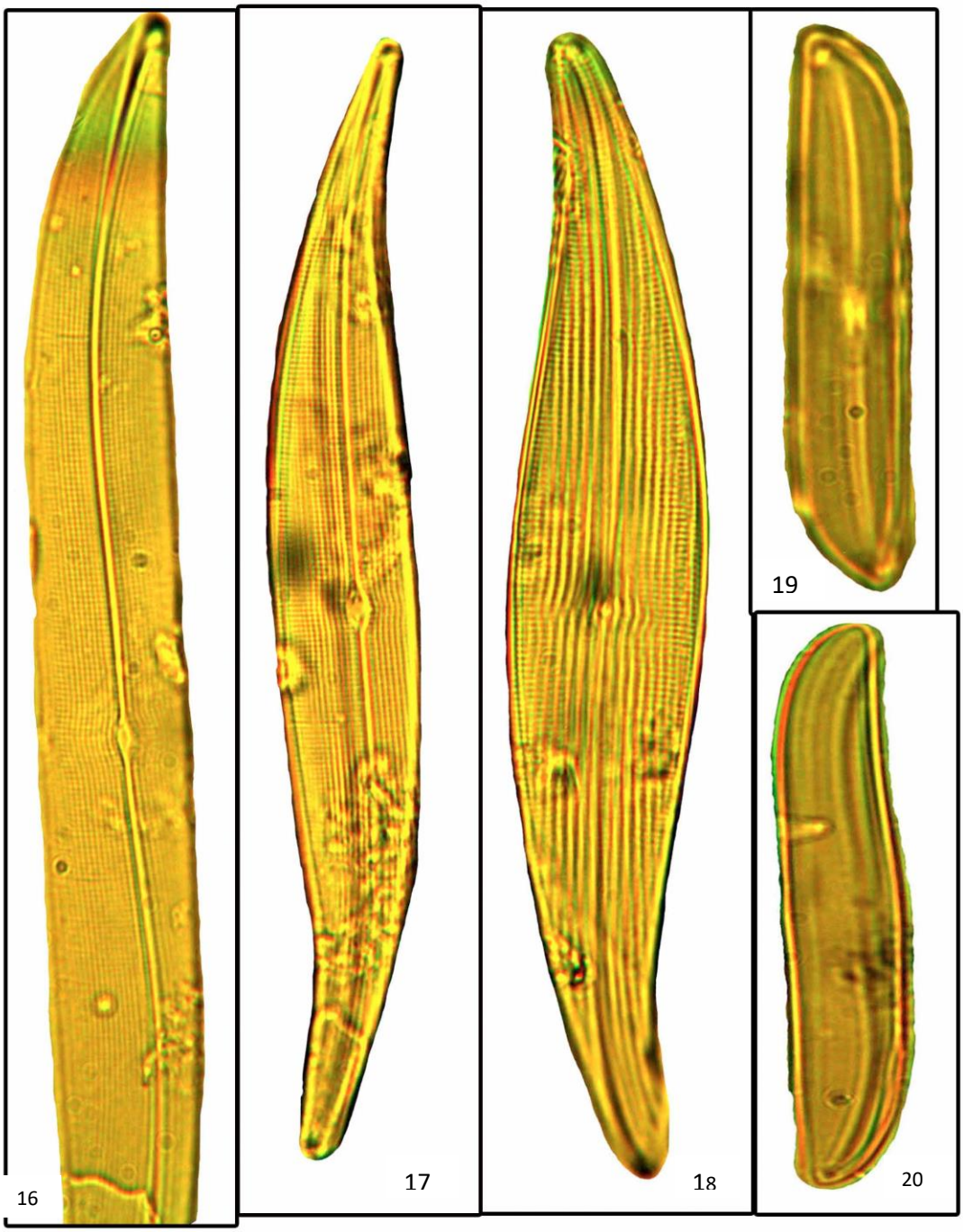
5, 6. Achnanthus brevipes var. intermedia

**Plate - 2**




7. Deploneis crabro (Ehren) var. Pandura (Breb) Cl. 8. Deploneis splendida (Greg) cleve
9. Deploneis interrupta var. heeri 10. Deploneis divergens (Schmidt A) cleve.
11. Deploneis nitescens (Greg) Cleve 12, 13. Actinoptycus senarius (Ehrenb)
14. Surirella fastuosa (Ehren.) 15. Surirella fastuosa var. robusta (Ehren.)

**Plate - 3**




16. Gyrosigma balticum (E.) cl. Nach W. Smith
17. Gyrosigma accuminatum (Kz.) cl.
18. Gyrosigma altenuatum (Kz.) cl.
19. Gyrosigma scalproides (Rabh.) Cleve
20. Gyrosigma balticum (Ehren) Rabench

**Plate - 4**

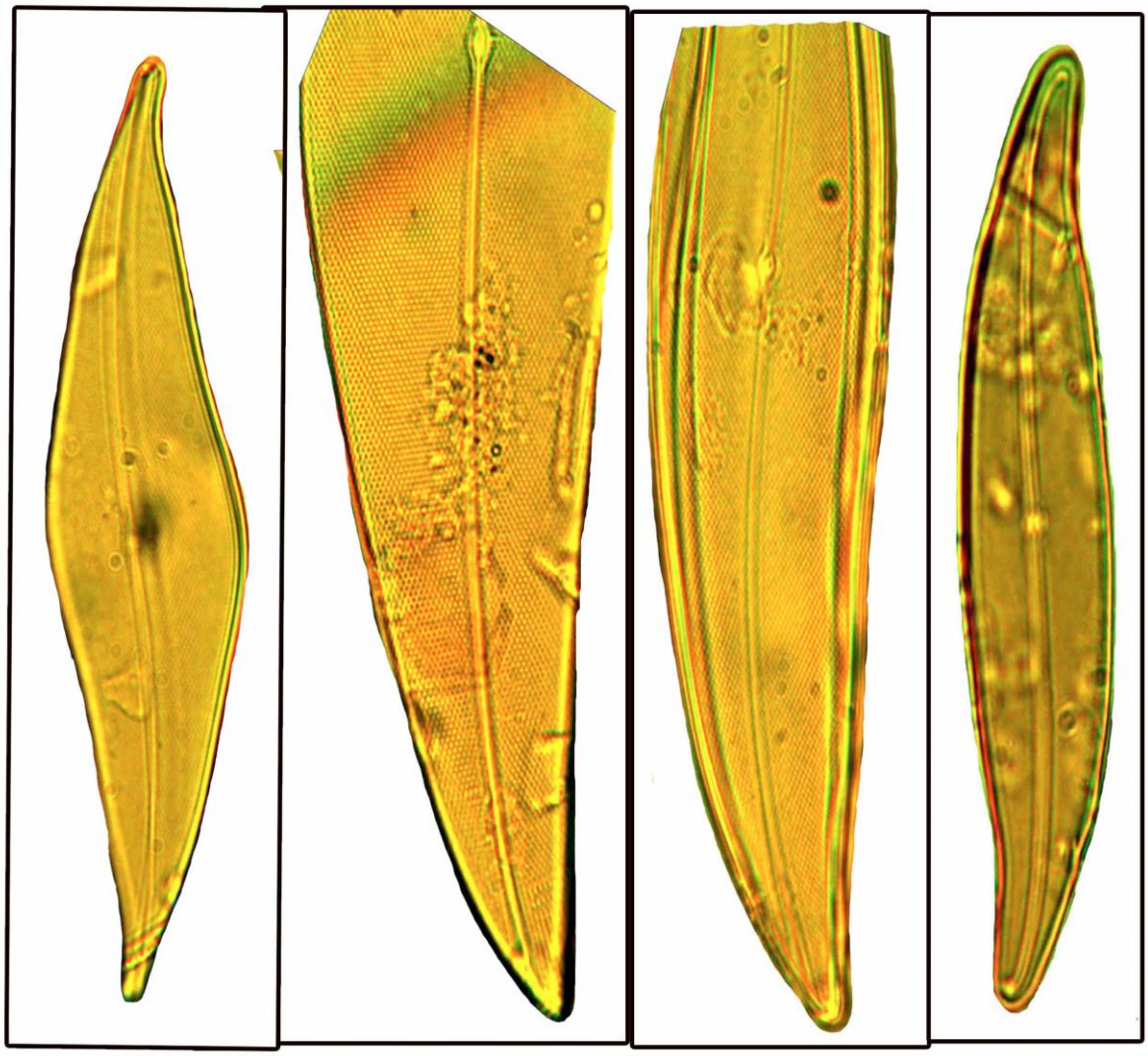
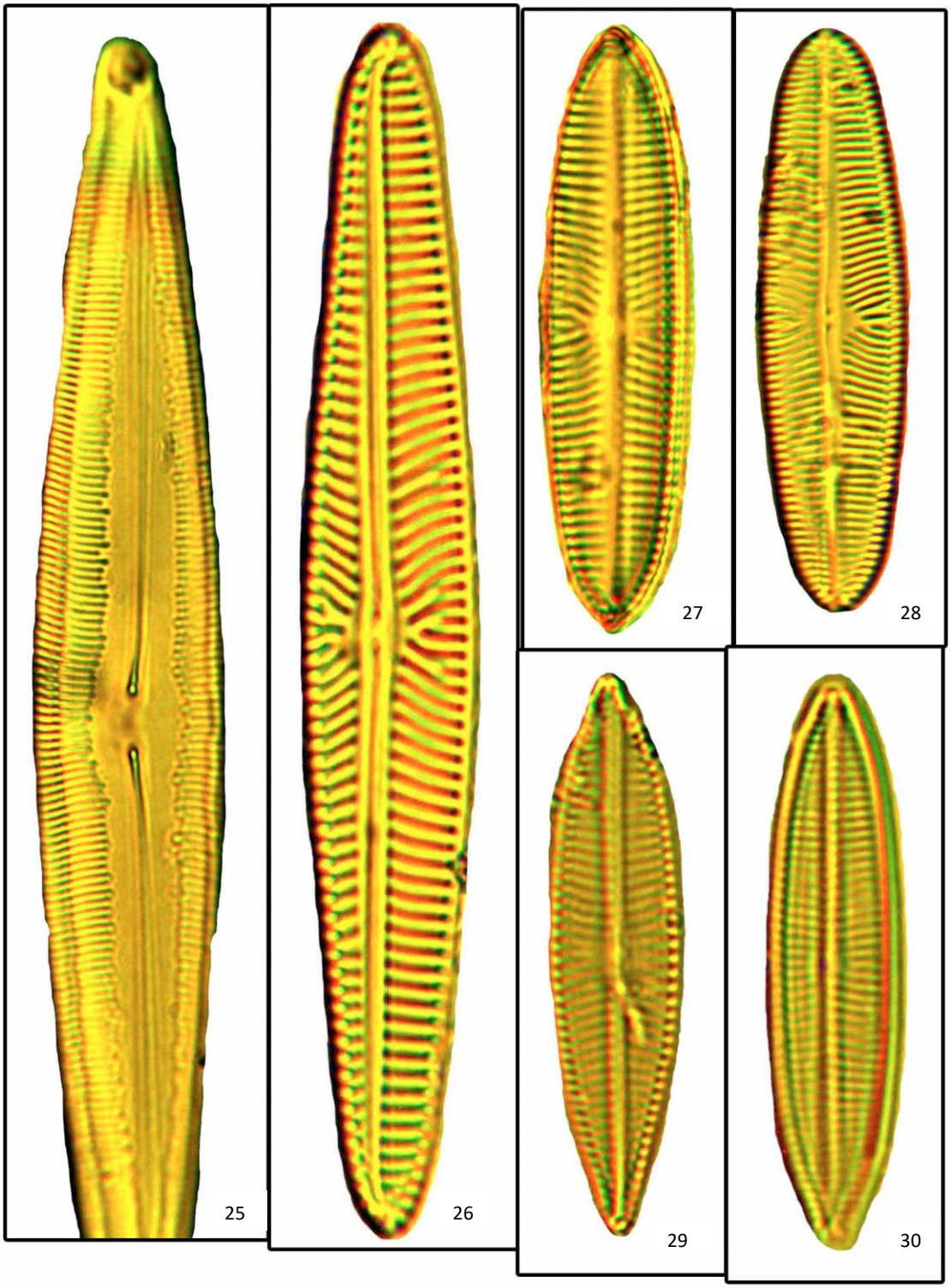


**Plate - 5**




25. Navicula cuspidata Kutz

26. Navicula digitoradia (Gregory) Ralfs

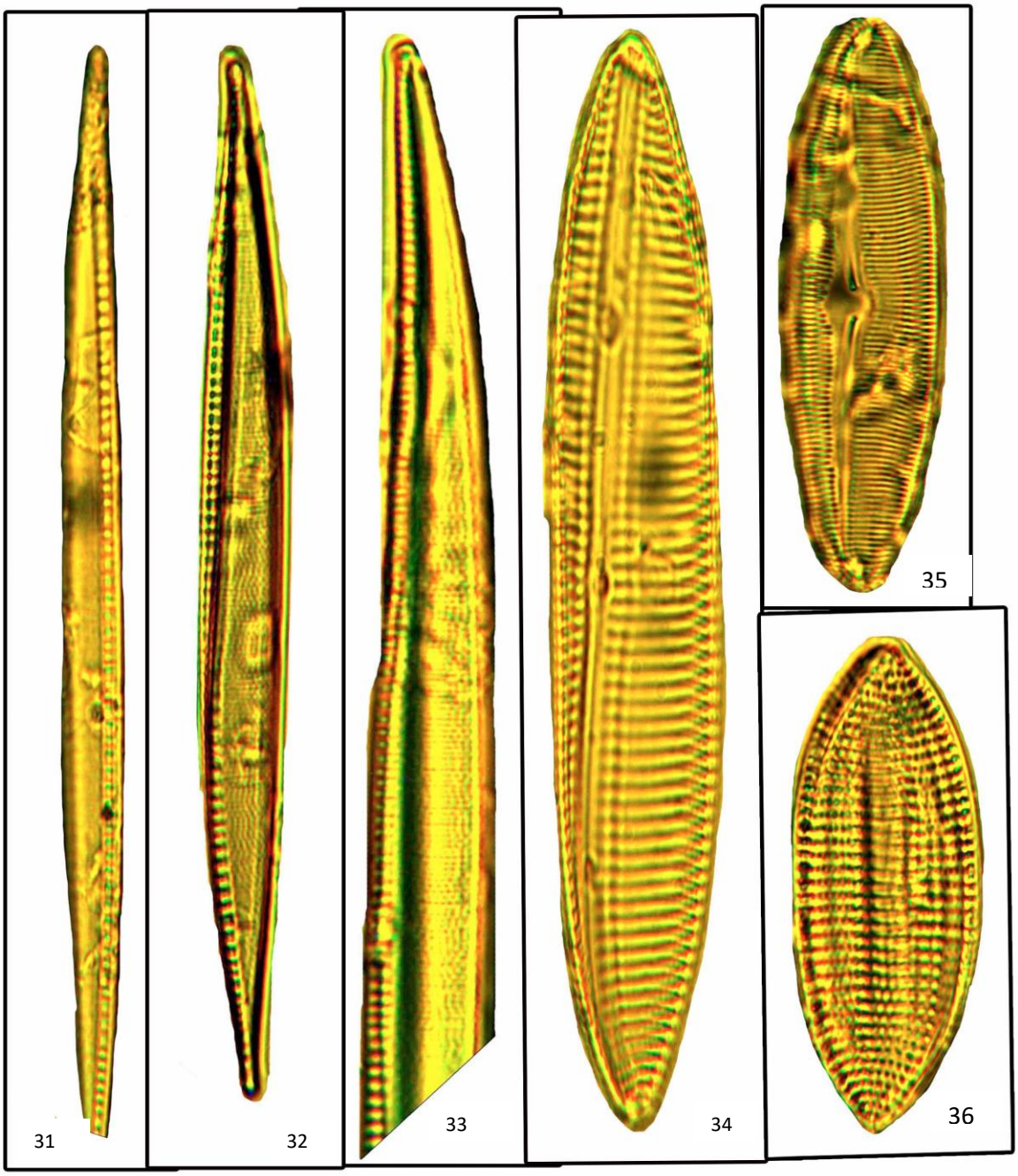
27. Navicula gracilis Ehrenb.

28. Navicula distans (Sm.) Ralfs.

29. Navicula compressicauda A.S. Bm Comber

30. Navicula retusa var. cancellata (Donk.) Ross

**Plate - 6**




31. Nitzschia socialis Greg.
32. Nitzschia sigmoidea (E.)W.sm.
33. Nitzschia recta Hantz.
34. Nitzschia tryblionella var. genuina (Grun)
35. Nitzschia tryblionella var. ambigua (Grun)
36. Nitzschia antarctica okuno