

## TAXONOMIC STUDY OF SOME DIATOMS FROM MIANWALI DISTRICT, PAKISTAN

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### Abstract

Thirteen species of pennate diatoms were collected and taxonomically investigated from various freshwater habitats in Daud Khel, Mianwali District of the Punjab Province of Pakistan during December 1986 and January 1987. The taxa *Cymbella incerta* Grunow, *Hannaea arcus* (Ehrenberg) Patrick and *Pinnularia biceps* Gregory have been described for the first time from Pakistan.

### Introduction

A survey was undertaken to collect algae from different freshwater reservoirs of Mianwali District, Punjab Province, Pakistan. They were preserved and later on some specimens are brought to the research Lab. at Karachi for investigation. Species belonging to the phyla Chlorophycota, Cyanophycota and Volvophycota (Masud-ul-Hasan *et al.*, 2009, 2010a, b) have been investigated and taxonomically described. This is a continuation of this research program, where taxonomy of species of the phylum Bacillariophycota is being presented.

### Materials and Methods

The materials were collected from various freshwater habitats in Daud Khel, Mianwali District of the Punjab Province of Pakistan during December 1986 and January 1987. Methods involved in the collection, microscopic examination and drawing preparation were the same as described previously (Masud-ul-Hasan *et al.*, 2009). The collected specimens were identified up to species level with the help of authentic literature (*lit. cit.* against each species). The voucher specimens are kept in the research laboratory of Phycology, Department of Botany, GC University of Lahore.

1. Valve up to 8  $\mu\text{m}$  broad ..... *C. incerta* (1)  
Valve more than 8  $\mu\text{m}$  broad ..... *C. ventricosa* (2)

### 1. *C. incerta* Grunow in Cleve et Möller 1878: 96

**Reference:** Cleve & Möller, 1878: 96.

**General characters:** Valve broadly lanceolate, striae radiate; length 32-33  $\mu\text{m}$  and width 7-8  $\mu\text{m}$  (Fig. 1).

**Locality:** Daud Khel: Jinnah Barrage, Kala Bagh (26-12-1986).

**Geographical distribution:** Europe and Afghanistan.

**Remarks:** The specimens were collected during winter. This is the first report of its occurrence from Pakistan.

### Results and Discussion

Taxonomic enumeration of the collected specimens revealed the presence of 13 species of unicellular and colonial diatoms of the order Bacillariales (class Bacillariophyceae, phylum Bacillariophycota; *vide* Shameel, 2001, 2008, 2012). The descriptions of various taxa have been presented as follows.

**Family Cymbellaceae Greville, 1833: 409:** Valve longitudinally asymmetrical is due to the fact that one side of a valve is convex and the other side is less convex and straight. Frustules are symmetrical in all other planes, valve consists of only striae. In girdle view, frustules are symmetrical in both axes. There is single large chromatophore within a cell. Following genus of this family was collected.

***Cymbella* C.A. Agardh 1830: 1:** Frustules asymmetrical, solitary or in colonies, free-floating or epiphytic, sessile or borne on stalk or enclosed in gelatinous tube; girdle straight or nearly sub-rectangular; valve sublunate, attenuated from the middle towards the obtuse ends; striae punctate, radiate, delicate or coarse; raphe arched, eccentric with central and polar nodules; axial area narrow or broad, slightly dilated in the middle; terminal fissures straight or curved towards the dorsal margin, chromatophores one or more, plate like. Its two species have been collected, which may be distinguished as follows:

### 2. *C. ventricosa* C. A. Agardh 1830

**References:** Cleve, 1894: 168; Østrup, 1908: 265; Hustedt, 1930: 359; Gandhi, 1955: 326, 1956: 204, 1958: 260, 1960: 102; Salim & Khan, 1960: 50; Starmach, 1964: 444; Cholnoky, 1970: 12; Sultana *et al.*, 1991: 70; Leghari & Sultana, 1993: 15; Ertan & Moirkoynlu, 1998: 244; Jahangir *et al.*, 2000: 1967; Leghari & Leghari, 2002: 183; Leghari MK *et al.*, 2002: 78; Leghari SM *et al.*, 2002a: 129; Leghari MK *et al.*, 2004: 41; Tariq-Ali *et al.*, 2006a: 166.

**General characters:** Valve lunate, with dorsal side convex and ventral side straight or slightly gibbous in the

middle; ends obtuse; raphe straight; axial area indistinct, narrow; length 42-43  $\mu\text{m}$  and width 11-12  $\mu\text{m}$ ; striae punctate, radiate, 13-14 within 10  $\mu\text{m}$  (Fig. 2).

**Locality:** Daud Khel: Jinnah Barrage, Kala Bagh (26-12-1986).

**Geographical distribution:** Pakistan: Peshawar; Afghanistan: Nuristan, Pushuki, Kabul River; Maimana; Poland; Faeröes (Denmark).

- |   |                    |
|---|--------------------|
| 1. Frustules rectangular .....          | 2                  |
| Frustules otherwise .....               | 3                  |
| 2. Chromatophore single, laminate ..... | <i>Anomoeoneis</i> |
| Chromatophores vary in shape .....      | <i>Fragilaria</i>  |
| 3. Valves arched .....                  | <i>Hannaea</i>     |
| Valves with broad sternum .....         | <i>Tabularia</i>   |

***Anomoeoneis* Pfitzer 1871: 78:** Frustules rectangular, linear; valve elliptical to lanceolate; ends rostrate, capitate; raphe straight, axial area narrow, striae transverse; delicate with wavy blank longitudinal space on the valve-face, chromatophore single, laminate with pyrenoids. Only following species was identified in the present collection.

### 3. *A. sphaerophora* (Kützing) Pfitzer 1871: 77

**References:** Cleve, 1895: 6; Gonzalves & Gandhi, 1953: 262; Gandhi, 1958: 496; Salim & Khan, 1960: 32; Starmach, 1964: 279; Gerloff & Lüdemann, 1966: 107; Cholnoky, 1970: 8; Nizamuddin, 1984: 26; Leghari & Sultana, 1993: 15; Leghari MK *et al.*, 1995: 12; Tariq-Ali *et al.*, 2008b: 132; Ghazala & Arifa, 2011: 16.

**General characters:** Valve elliptic-lanceolate, ends rounded; raphe clear, striae indistinct, length 73-75  $\mu\text{m}$  and breadth 18-19  $\mu\text{m}$  (Fig. 3).

**Locality:** Daud Khel: Jinnah Barrage, Kala Bagh (6-1-1987).

**Geographical distribution:** Pakistan: Peshawar; Afghanistan; Libya; Poland.

**Remarks:** The specimens were obtained during winter.

***Hannaea* R. M. Patrick in R. Patrick et C.W. Reimer 1966: 131:** Valves arched, poles capitate to rostrate; valve with central ventral swelling, faint (ghost) striae near central swelling, **Araphid**-valves are linear and arched. One or two rimoportulae occur on each valve, located near the valve ends. The ventral (concave) side of the valve has a central swelling. Faint or ghost striae are often present near the center of the valve. It grows attached in tufted colonies to benthic surfaces. Only following species was collected:

**Remarks:** This species has also collected together with *C. incerta* during winter.

**Family Fragilariaceae Greville, 1833: 402:** Frustules solitary or in colonies, sometimes epiphytic; truncate apices with elongated girdle; valve straight linear or lanceolate; ends attenuated or capitate. Each valve is transversely striate or punctate. Girdles may overlap each other or separated by one to several intercalary bands; chromatophores one or two, plate like along the sides of the valves. Following four genera of this family have been collected, which may be distinguished as follows:

### 4. *H. arcus* (Ehrenberg) R. M. Patrick in R. M. Patrick et L. R. Freese 1961: 132

**Basionym:** *Navicula arcus* Ehrenberg 1836: 243.

**Homotypic Synonyms:** *Ceratoneis arcus* (Ehrenberg) Kützing 1844: 104, *Cymbella arcus* (Ehrenberg) Hassall 1845: 429, *Fragilaria arcus* (Ehrenberg) Cleve 1898: 9.

**Heterotypic Synonym:** *Synedra gibbosa* Ralfs in Pritchard 1861: 786.

**Reference:** Şahin 2001: 189.

**General characters:** Valve swollen on one side at central area; central area unilateral; valve length 68-70  $\mu\text{m}$  and width 6-7  $\mu\text{m}$  (Fig. 4).

**Locality:** Daud Khel: Thal Canal (4-1-1987).

**Geographical distribution:** Spain, China, Romania, Afghanistan and Myanmar.

**Remarks:** The species was collected during winter. This is the first report of its occurrence in Pakistan.

***Fragilaria* Lyngbye 1819: 182:** Frustules rectangular; valve lanceolate, oblong in general outline; without costae, pseudoraphe indistinct; chromatophores vary according to species. Only following species was collected:

### 5. *F. ulna* (Nitzsch 1817) Lange-Bertalot 1980: 745

**Basionym:** *Bacillaria ulna* Nitzsch 1817: 99.

**Synonym:** *Synedra ulna* (Nitzsch 1817) Ehrenberg 1837: 53.

**References:** West, 1904: 286; Østrup, 1908: 281; Gandhi, 1955: 309, 1956: 197, 1958: 250, 1959: 100; Salim & Khan, 1960: 19; Starmach, 1964: 166; Foerster &

Schlichting Jr., 1965: 491; Gerloff & Lüdemann, 1966: 107; Cholnoky, 1970: 37; Nizamuddin, 1984: 106; Inam *et al.*, 1986: 2; Sultana *et al.*, 1991: 70; Leghari MK *et al.*, 1995:12, 2004: 42; Jahangir *et al.*, 2000: 1967; Leghari & Leghari, 2002: 183; Leghari MK *et al.*, 2002: 79; Leghari SM *et al.*, 2005a: 40; Husna *et al.*, 2006: 161; Tariq-Ali *et al.*, 2008b: 132, Ghazala & Arifa, 2011: 22.

**General characters:** Frustules solitary, girdle robust, elongated with truncate apices; valve straight, linear to lanceolate; apices appreciably thinned and drawn out; median area blank; length 198-200  $\mu\text{m}$  and width 7-8  $\mu\text{m}$ ; striae punctate, 11-12 within 10  $\mu\text{m}$  (Fig. 5).

**Locality:** Daud Khel: Jinnah Barrage, Kala Bagh (6-1-1987).

**Geographical distribution:** India, Pakistan (Peshawar), Libya, Ontario (Canada), Poland and Faerøes (Denmark).

**Remarks:** The specimens were obtained during winter from stagnant water pool.

**Tabularia (F.T. Kützing) D. M. Williams et Round 1986: 320:** Valves with broad sternum, striae broad, shortened; apical pore field at each pole, rimoportula single on each valve; robust and "needle-like", with a broad sternum. The striae are relatively broad and composed of complex areolae. An apical porefield is present at each pole. Each valve possesses a single rimoportula, positioned near one pole. Only following species was collected.

**6. *T. fasciculata* (C. Agardh) D.M. Williams & Round 1986: 326**

**Basionym:** *Diatoma fasciculata* C. A. Agardh 1812 : 35.

**Homotypic Synonyms:** *Echinella fasciculata* (Agardh) Jurgens 1816, *Lyngbyea fasciculata* (C. Agardh) Sommerfelt 1826: 190, *Exilaria fascicula* (C. Agardh) Greville 1827, *E. fasciculata* Kützing 1833: 561, *Fragilaria fasciculata* (C. Agardh) Lange-Berlot 1980 : 750.

**Heterotypic Synonyms:** *Synedra fasciculata* (Agardh) Kützing, *Diatoma fasciculatum* Agardh 1812, *D. tabulatum* C. Agardh 1832: 50, *D. tabulata* C. A. Agardh 1832: 50, *Synedra affinis* Kützing 1844: 68, *S. tabulata* (C. Agardh) Kützing 1844: 68, *S. tabulata* var. *fasciculata* (C. Agardh) Hustedt 1932, *S. tabulata* var. *affinis* (Kützing) Cleve-Euler 1953: 71, *Fragilaria tabulata* (C. Agardh) Lange-Berlot 1981, *Tabularia tabulata* (C. Agardh) Snoeijs 1992: 343, *T. affinis* (Kützing) P. Snoeijs 1992: 343.

**References:** Giffen, 1963: 254, 1966: 287, 1970: 96 ; Starmach, 1964: 175 ; Gerloff & Lüdemann, 1966: 107; Cholnoky, 1970: 36; Nizamuddin, 1984: 103; Daudpota & Leghari, 1993: 122 ; Jahngir *et al.*, 2000: 1967 ; Leghari & Leghari, 2002: 183; Leghari MK *et al.*, 2004: 42; Husna *et al.*, 2006: 161; Tariq-Ali *et al.*, 2008b: 134 ; Ghazala & Arifa, 2011: 22.

**General characters:** Frustules solitary, narrow, lanceolate; pseudoraphe wide; length 128-130  $\mu\text{m}$  and breadth 6-7  $\mu\text{m}$ ; striae marginal and short wall, 10-11 within 10  $\mu\text{m}$  (Fig. 6).

**Locality:** Daud Khel: Cement Factory, Kala Bagh (20-12-1986).

**Geographical distribution:** India, Pakistan, Libya and Poland.

**Remarks:** The specimens were collected during winter.

**Family Gomphonemaceae Kützing 1844: 70, 82:** Frustules are longitudinal in symmetry in valve view but transversely asymmetrical; they are broader at one end. The dendroid colonial habit is sometimes given as a second character. Auxospores are formed. Only following genus of this family was found in the present collection.

**Gomphonema Ehrenberg 1832: 87:** Frustules solitary or in groups; sessile or borne in gelatinous stalks, girdle cuneate; valve lanceolate or clavate, sinuate towards the margin; ends obtuse or capitate; striae lineate or punctate, delicate or bead like; raphe straight with polar and central nodules; axial area narrow, inflexed in the middle, containing an isolated, unilateral puncta; chromatophores one or more, broadly lobed, extending over the entire valve face. Only following species was collected.

**7. *G. ghosea* Abdul-Majeed**

**References:** Inam *et al.*, 1986: 2; Sultana *et al.*, 1991: 70; Leghari & Sultana, 1993: 15; Leghari & Leghari, 2002: 183; Leghari MK *et al.*, 2004: 42; Tariq-Ali *et al.*, 2008c: 135, Zarina *et al.*, 2013: 347.

**General characters:** Frustules epiphytic, girdle straight, cuneate; valve clavate, attenuated towards the base, and gibbous towards the upper part; striae lineate or closely punctate, axial area narrow; chromatophores two, elongated with irregular lobes; length 41-43  $\mu\text{m}$  and breadth 10-11  $\mu\text{m}$ ; striae 10-12 within 10  $\mu\text{m}$  (Fig. 7).

**Locality:** Daud Khel: near factory area (1-1-1987).

**Geographical distribution:** India, Afghanistan and Pakistan.

**Remarks:** The specimens were obtained during winter.

**Family Nitzschiaceae:** Single, excentric, keel next to the lateral margin of valve and a raphe adjacent to small dot in the region of keel. The valves are symmetrical with respect to longitudinal axis. Frustules may be rectangular, auxospores are formed. The following, typical genus of this family has been collected:

**Nitzschia Hassall 1845: 435, nom. Cons:** Frustules solitary and free-floating or in groups; girdle straight, elongate or sigmoid with truncate ends; valve straight, linear or elliptical, attenuated to acute or subrostrate ends; keel (with raphe) of the two valves diagonally opposite;

carinal dot conspicuously present; striae transverse, punctate, coarse or fine; chromatoophores one or two, elongate, with irregular margins. The present collection included only following species.

#### 8. *N. angustata* (W. Smith) Grunow 1880: 70

**Basionym:** *Tryblionella angustata* W. Smith 1853: 36.

**Synonym:** *Homoeocladia angustata* (W. Smith) Kuntze 1898: 408.

**References:** Østrup, 1908: 284; Starmach, 1964: 504; Tariq-Ali *et al.*, 2006b: 152

**General characters:** Valve linear, lanceolate, swollen centrally towards the keel side; ends blunt; keel marginal,

1. Chromatophores elongated with irregular outline and lie on opposite sides of the girdle ..... *Gyrosigma*  
Chromatophores otherwise ..... *Pinnularia*

**Gyrosigma Hassall 1845: 435, nom. Cons:** Frustules solitary and free-floating, lanceolate; girdle straight and linear, oblong; valve convex, sigmoid, gradually attenuated towards acute or broadly rounded poles; striae in two delicate sets crossing one another at right angles; median line (raphe) with sigmoid curvature;

1. Valve up to 75 µm long ..... *G. scalproides* (10)  
Valve more than 75 µm long ..... *G. acuminatum* (11)

#### 9. *G. acuminatum* (Kützing) Rabenhorst 1853: 47

**Basionym:** *Frustulia acuminata* Kützing 1833: 555.

**Homotypic Synonyms:** *Sigmatella acuminata* (Kützing) Brébisson et Godey 1835, *Navicula acuminata* (Kützing) Kützing 1844: 102, *Pleurosigma acuminatum* (Kützing) W. Smith 1852: 9, *P. acuminatum* (Kützing) Grunow 1860: 561.

**Heterotypic Synonyms:** *Navicula spencerii* J. W. Bailey ex Quekett 1848: 440, *Pleurosigma spencerii* (J. W. Bailey ex Quekett) W. Smith 1852: 12, *Gyrosigma spencerii* (J. W. Bailey ex Quekett) Griffith et Henfrey 1856: 303, *G. spencerii* (W. Smith) Griffith et Henfrey 1856: 303, *Pleurosigma kuetzingii* Grunow 1860: 561, *P. gracilentum* Rabenhorst 1861, *P. spenceri* var. *kuetzingii* (Grunow) Grunow in Cleve et Grunow 1880: 59, *Scalptrum spenceri* (Quekett) Kuntze 1891: 919, *Gyrosigma kuetzingii* (Grunow) Cleve 1894: 115.

**References:** Gonzalves & Gandhi, 1953: 239; Salim & Khan, 1960: 38; Starmach, 1964: 412; Foerster & Schlichting Jr., 1965: 491; Nizamuddin, 1984: 60; Daudpota & Leghari, 1993: 122; Leghari & Leghari, 2002: 183; Tariq-Ali *et al.*, 2007: 1802.

**General characters:** Frustules solitary but occurring in large masses, valve sigmoid, gradually tapering from the middle towards obtuse ends; striae not distinct; median

carinal dots continued into striae; length 80-82 µm and breadth 8-10 µm; striae lineate, parallel, 12-13 within 10 µm (Fig. 8).

**Locality:** Daud Khel: PIDC Colony (20-12-1986).

**Geographical distribution:** Europe, Pamir, Tibet, Afghanistan, Tibet, Poland and Faeröes (Denmark).

**Remarks:** The specimens were collected during winter.

**Family Pinnulariaceae D. G. Mann:** Frustules solitary and free-floating; girdle linear, rectangular or broadly elliptical; valve linear or lanceolate, sublunate; raphe straight, arcuate, with central and polar nodules; striae transverse, punctate, parallel or radiate; chromatophores two or more with pyrenoids. In the present collection two genera were collected which may be distinguished as follows:

central and polar nodules present; chromatophores two or more, elongated with irregular outline and lie on opposite sides of the girdle. Its following two species were present in the collected material, which may be distinguished as follows:

line, central nodules and plastids clear; length 118-120 µm, breadth in the middle 14-16 µm and at the ends 3-4 µm (Fig. 9).

**Locality:** Daud Khel: Thal Canal (4-1-1987).

**Geographical distribution:** Afghanistan, India, Pakistan: (Peshawar), Libya, Canada (Ontario) and Poland.

**Remarks:** The specimens were obtained during winter.

#### 10. *G. scalproides* (Rabenhorst) Cleve 1894: 118

**Basionym:** *Pleurosigma scalproides* Rabenhorst 1861.

**Homotypic Synonyms:** *Gyrosigma spenceri* var. *scalproides* (Rabenhorst) H. Peragallo 1891: 23, *Scalptrum scalproides* (Rabenhorst) Kuntze 1891: 919.

**References:** Gonzalves & Gandhi, 1953: 241; Salim & Khan, 1960: 38; Starmach, 1964: 416; Jahangir *et al.*, 2000: 1967; Leghari & Leghari, 2002: 183; Leghari SM *et al.*, 2002b: 302, 2005c: 170; Leghari MK *et al.*, 2004: 42; Tariq-Ali *et al.*, 2007: 1802.

**General characters:** Frustules solitary, valve sigmoid, linear; ends rounded, striae dim; cell 73-75 µm in length and 10-11 µm in breadth; chromatophores two or more, elongated with irregular outline (Fig. 10).

**Locality:** Daud Khel: near factory area (1-1-1987).

**Geographical distribution:** Azad Kashmir, Pakistan; Peshawar; Poland.

**Remarks:** The specimens were collected during winter, attached with the leaves.

***Pinnularia* (Ehrenberg) Ehrenberg 1843: 45, nom.**

**Cons:** Frustules solitary and free-floating, girdle linear, rectangular; valve linear, sometimes gibbous in the middle; ends broadly obtuse; raphe straight and reflexuose, central and polar nodules expanded, axial area broad; terminal fissures straight or sigmoid; striae or costae coarse, parallel or radiate with internal openings; chromatophores two, with pyrenoids. Only following species was collected:

#### 11. *P. biceps* W. Gregory 1856: 8

**Homotypic Synonyms:** *Pinnularia interrupta* f. *biceps* (W. Gregory) Cleve 1895, *Navicula interrupta* f. *biceps* (Gregory) Fricke 1902, *Pinnularia interrupta* var. *biceps* (W. Gregory) F. Meister 1912, *Navicula interupta* var. *biceps* (Gregory) Prochazka 1923.

**Heterotypic Synonym:** *Navicula mesolepta* (W. Smith) Grunow 1860, *N. bicapitata* var. *crucifera* O'Meara 1875, *N. termes* (Ehrenberg) O'Meara 1875, *N. interrupta* (W. Smith) Schmidt 1876, *N. nivalis* var. *interrupta* (W. Smith) Héribaud 1893, *N. interrupta* var. *termes* (Ehrenberg) Prochazka 1923, *Pinnularia termes* Ehrenberg 1843, *P. interrupta* W. Smith 1853, *P. stauroptera* var. *interrupta* (W. Smith) Brun 1880, *P. bicapitata* var. *interrupta* (W. Smith) L. Dippel 1905, *P. gibba* var. *interrupta* (W. Smith) N. Woodhead et R. D. Tweed 1960

**Reference:** Ertan & Moirkoyunlu, 1998: 251.

**General characters:** Frustule free-floating; valve 28-29  $\mu\text{m}$  long and 7-8  $\mu\text{m}$  broad, and 10-11  $\mu\text{m}$  in breadth, gibbous in the middle, central and polar nodule expended (Fig. 11).

**Locality:** Daud Khel: near Jinnah Barrage, Kala Bagh (26-12-1986).

**Geographical distribution:** Europe and Turkey.

**Remarks:** This species was collected during winter from stagnant water. This is first report of its occurrence from Pakistan.

**Family Surirellaceae Kützing 1844: 32, 58:** Raphe is present on both margins of a valve. Costae are much more prominent near the margin of a valve than at the center. Frustules are quiet large. Girdle view is rectangular, sinuate. Chromatophores are single, auxospores are formed. Only following genus was collected:

***Surirella* Turpin 1828: 363:** Frustules solitary or free-floating, girdle sub-rectangular or cunate; valve linear, elliptical or ovate, ends rounded; sub-acute keel marginal,

containing a raphe; costae short, transverse, parallel, reaching the pseudoraphe; intercostal striae fine and delicate; pseudoraphe centrally placed, linear or lanceolate; chromatophores two, lying along the girdle and joined by a bridge like connection in the middle or split up into numerous irregularly rounded granules. The present collection included the following species.

#### 12. *S. ovalis* de Brébisson 1838: 17

**Synonyms:** *Surirya ovalis* (Brébisson) Pfizer 1871: 112, *Surirella ovata* var. *ovalis* (Brébisson) Kirchner 1878: 201.

**References:** West, 1904: 304; Østrup, 1908: 286; Salim & Khan, 1960: 63; Starmach, 1964: 554; Foerster & Schlichting Jr., 1965: 491; Giffen, 1970: 96; Nizamuddin, 1984:102; Ertan & Moirkoyunlu, 1998: 251; Şahin 2001: 189; Tariq-Ali et al., 2008: 2147.

**General characters:** Valve ovate; costae short, marginal, radiate; intercostal striae and pseudoraphe scarcely visible; length of frustule 50-51  $\mu\text{m}$  and breadth 29-30  $\mu\text{m}$ ; costae 5 within 10  $\mu\text{m}$  (Fig. 12).

**Locality:** Daud Khel: Railway Station, Kala Bagh (2-1-1987).

**Geographical distribution:** United States, Pakistan (Peshawar), Libya, Canada (Ontario), Poland and Denmark (Faeröes).

**Remarks:** The specimens were collected during winter.

**Family Epithemiaceae Grunow 1860:** Solitary frustules, rectangular; free-floating; girdles smooth with intercalary bands; linear or elliptical; valves elongate or lunate, curved, dorsally convex; striae delicate; raphe along the convex edge with polar and central nodules; single chromatophore with projections, elongate. In the present collection, only following genus was found.

**Rhopalodia O.F. Müller 1895: 57:** Frustules solitary or in group, free-floating; girdle linear or elliptical, broad in the middle with rounded poles; valve elongate or lunate, dorsal side convex, inflated in the middle, ends acute or incurved; costae transverse and well-marked, intervening one or two rows of delicate striae; raphe along the convex edge, situated in keel like portion with indistinct central and polar nodules; chromatophore one, elongate, irregularly lobed. Following species was found in the present collection.

#### 13. *R. gibba* (Ehrenberg 1832) Otto Müller 1895: 65

**Basionym:** *Naviculla gibba* Ehrenberg 1830: 64.

**Homotypic synonyms:** *Pinnularia gibba* (Ehrenberg) Ehrenberg 1843: 315, *Epithemia gibba* (Ehrenberg) Kützing 1844: 35, *Frustulia gibba* (Ehrenberg) Jenner 1845: 102, *Epithemia ventricosa* var. *gibba* (Ehrenberg) J. Schumann 1869: 86, *Cystopleura gibba* (Ehrenberg) Kuntze 1891: 891 *Schizonema gibbum* (Ehrenberg) Kuntze 1898: 553.

**Heterotypic synonyms:** *Navicula gibba* Ehrenberg 1832: 80, *Eumotia gibba* (Ehrenberg) Ehrenberg 1843.

**References:** Gandhi, 1956: 207, 1958: 503, 1961: 471; Salim & Khan, 1960: 54; Starmach, 1964: 487; Gerloff & Lüdemann, 1966: 108; Giffen, 1966: 284; Cholnoky, 1970: 33; Nizamuddin, 1984: 99; Leghari & Sultana, 1993: 16; Leghari *et al.*, 2002: 78; Leghari & Leghari, 2002: 183; Leghari MK *et al.*, 2004: 42; Tariq-Ali *et al.*, 2008d: 846.

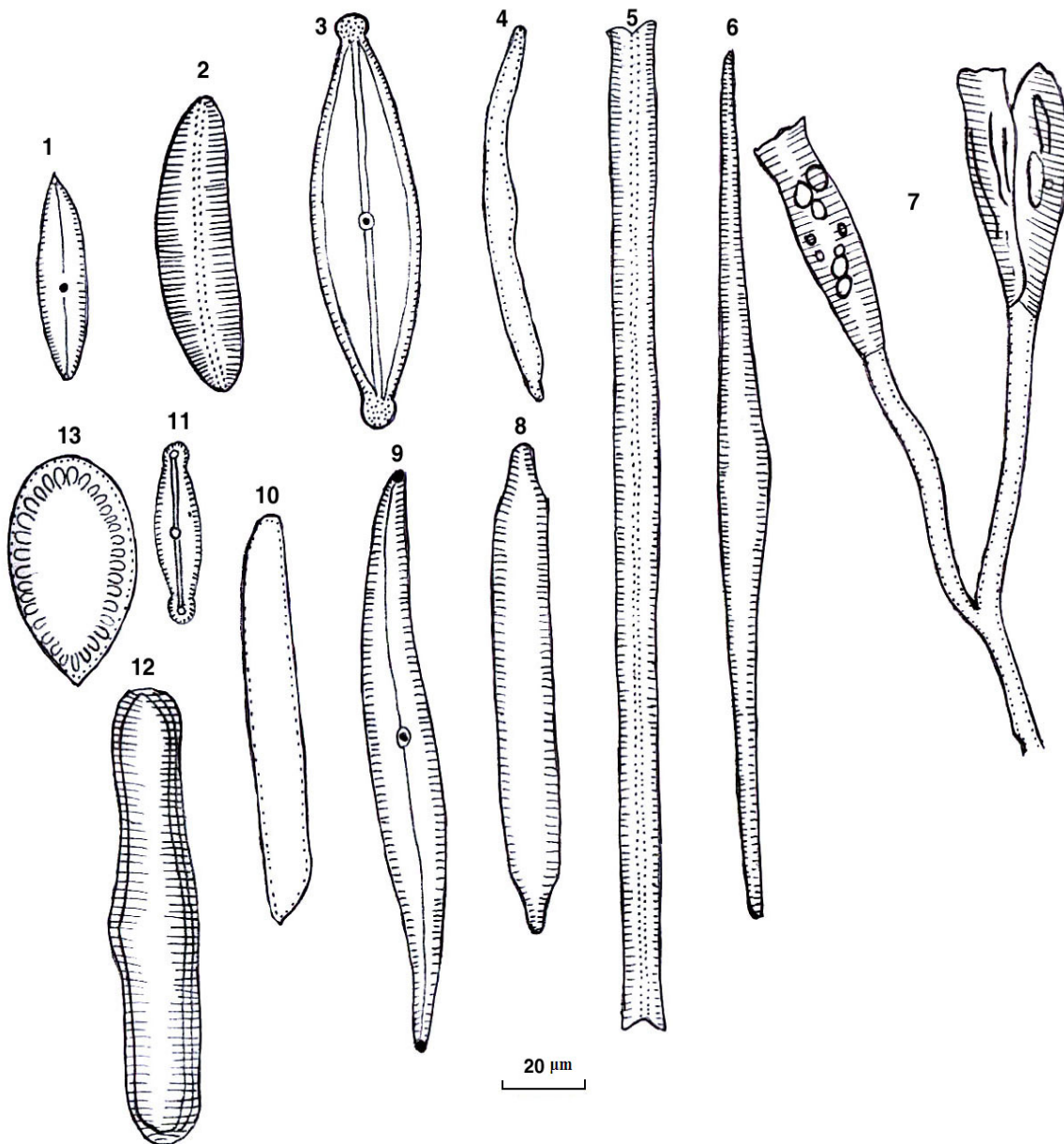
**General characters:** Frustules solitary or in groups, linear with medianly inflated sides narrowing towards the

broadly rounded ends; valve linear, dorsal side arcuate and ventral straight, but bent (or reflexed) at the ends, ends acute; costae transverse, 8 within 10  $\mu\text{m}$ ; cell-length 93-95  $\mu\text{m}$  and breadth 19-20  $\mu\text{m}$  (Fig. 13).

**Locality:** Daud Khel: Jinnah Barrage, Kala Bagh (26-12-1986).

**Geographical distribution:** Pakistan (Peshawar); Libya, Poland and other European countries.

**Remarks:** The specimens were obtained during winter from stagnant water.



Figs. 1-13. Diatoms from Mianwali District: 1. *Cymbella incerta*, 2. *C. ventricosa*, 3. *Anomooneis sphaerophora*, 4. *Hannaea arcus*, 5. *Fragillaria ulna*, 6. *Tabularia fasciculata*, 7. *Gomphonema ghosea*, 8. *Nitzschia angustata*, 9. *Gyrosigma acuminatum*, 10. *G. scalproides*, 11. *Pinnularia biceps*, 12. *Surirella ovalis*, 13. *Rhopalodia gibba*.

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