

## MORPHOLOGY AND TAXONOMY OF CHLOROCOCCALES IN FISH PONDS AT CHILLIA DIST. THATTA SINDH PAKISTAN

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### Abstract

The present work concern with a systematic enumeration of the 36 algal forms belonging to 8 genera, 36 species and 20 varieties of the order Chlorococcales, collected in fish ponds at Chillia, dist. Thatta. Sindh, Pakistan.

### Introduction

Inspite of the fact that Chlorococcales are important order of the Chlorophyceae (Khatum Islam & Tahmida 1966; Patel & George 1967; Patel & Rao 1975; Srivastva and Dwiredi 1983, Kumar et al. 1986, Pandy and Gangwer 1986) and that algae belonging to this order are primary producers and used as herbivores like zooplankton and fishes (Prescott 1960) the fresh water Chlorococcales have not received much attention. The algal flora of this region is still unexplored and only few species have been reported and references are quite limited are (Siddiqui & Faridi 1964 and Aizaz & Farooqi 1972).

The present study concern with the taxonomical suty of Chlorococcales reported for the first time in fish ponds at Chillia dist Thatta.

### Material and Method

Collections were made by squeezing aquatic plants and by flowing four litters of water through plankton net. Specimen were brought to the laboratory and were studied fresh and also after preservation in 4% formalin. The genera described below are mainly arranged and identified according to Prescott (1951) and Philipose (1967). The drawings are original and were drawn with the help of Camera lucida.

### Genus *Characium* A. Brawn in Kuetzing

Cells variously shaped, spindle shaped or ovoid, fusiform or cylindrical, attached to a substrate (submerged plants, large algae, microfauna) by a stipe and often with a basal attaching disc; rarely sessile; chloroplast 1 or several parietal plates, which some times become diffuse; paranooids 1 to several. The cells are mostly uninucleate. Biflagellate zoospores. formed 2-128 in a cell, escape through and an apical or lateral pore, food reserve in a form of starch.

Recorded 3 species:

1. *C. limneticum* Lemmermann
2. *C. obtusum* A.Braun
3. *C. ornithocephalum* A. Braun

#### 1. *Characium limneticum* (Lemm)

Forest H.S. f.101, p.97, 1954; Prescott, Alg. of the Gt. West. Lake Area, pl.45, f.18, p.217., 1951.

Pl. 1      Fig 1

Cells are long and cylindrical with a long pointed apex and stipe. chloroplast parietal 25-83  $\mu$  long and 3-7  $\mu$  (5  $\mu$ ) wide.

#### 2. *Characium obtusum* A.Braun

Alg. Unicell 39, pl. 3f. E: 1-9, 1855, Printz, Vidensk. Selsk. skrift. 1, Mat - Nat. K1 1913(6): 38, pl. 2, f.26, 1914; Braunthaller in Pascher (ed) Sussw - fl.5: 82, f.33, 1925; Yamagishi, Gen. Educ. Rev. Coll. Agri. Vet Med., Nihon Univ. 5: 21, pl. 1, f.22, 1969.

Prescott, Alg. of the Gt. West lake area, Pl.45, f.20, p.217, 1951; Yamagishi & Akiyama (eds) Photomicrog. of the Fresh-w Alg. 8: 5, 1988.

Pl. 1      Fig 2

Cell solitary, epiphytic, oblong-ovoid; anterior end rounded with a thickened plug at the apex, basal ends tapering into a short stout stripe, with a basal disc; chloroplast of single, parietal plate like with one to several pyrenoids; cells 8-12  $\mu$  (7.5  $\mu$ ) in diameter, 13-33  $\mu$  (22.5) long.

#### 3. *Characium ornithocephalum* A.Braun.

Thompson R.N. Fresh W. Alg. of E.Kanas. The Univ. of Kanas Sc. Bull. Vol. XXV No.1, Pl. VI, f.9, p.30, 1938.; Prescott, Alg. of the Gt. West. Lake Area, p.218, pl. 46, f. 14, 1951.

## Pl. 1 Fig 3

Cells broadly and unsymmetrically ellipsoidal, convex on one side, nearly straight on the other, abruptly narrowed anteriorly to form a sharp apiculation, the cells body set at an angle and curved away from a long stipe with a basal attaching disc; chloroplast laminate, parietal with conspicuous pyrroids; cells 25-33  $\mu$  long, without stipe.

Habitat: One submerged plants especially filamentous algae.

Genus *Pediastrum* Meyen

Colony disc like, entire, perforate or clathrate, free floating, consisting of from 2-128, coenocytes arranged in a layer, coenocyte in thickness; reproduction by planogonidia and probably by planogametes; planogonidia extruded in a gelatinous vesicle and after a brief period of motility apposing themselves in the same position as the mature coenocytes of the colony.

Recorded 8 species 5 varieties.

1. *P. argentiniense* Bourrelly & Tell var. *argentiniense*
2. *P. boryanum* (Turp) Menegh *boryanum*.
3. *P. boryanum* var. *longicorne* Racib
4. *P. clathratum* (Schroeter) Lemm. var. *duodenarium*
5. *P. duplex* Turp Menegh
6. *P. duplex* var. *regulosum* Raciborski
7. *P. duplex* Meyen var. *reticulatum* Lager
8. *P. tetras* (Ehreberg) Ralpf var. *tetras*.
9. *P. tetras* (Eherb) Ralph.

1. *Pediastrum argentiniense* Bourrelly & Tell var. *argentiniense*

In Tell, Rev. Alg. N.S. 14:43, Pl. 3, f.15, 1979, Komarek, Nova Hedwigia 37: pl.14, f. 8a-c, 1983;  
Yamagishi & akiyama (eds) Photomicrg. Fresh-w. Alg. 8: 56, 1988.

Pl. 1 Fig 4.

Colonies free floating circular to ovoid or slightly irregular of 16 to 64 cells, with small lenticular perforations with the cells; basal part of the marginal cells quadrate, with two low triangular processes formed by a broad V shaped depressions at the outer sides; the lateral sides of neighboring cells almost joined together except a lenticular pore, cell 9-24  $\mu$  in diameter 12-20  $\mu$  long.

2. *Pediastrum boryanum* (Turp) Menrgh var. *boryanum*

Meneghini, Syn. Desmid linnaea, 14:210, 1840; Thompson, Fresh-w. Alg. of E. Kansas, The Univ. of Kansas Sc. Bull. Vol. XXV, Pl. VI f. 1, 1938; Prescott, Alg. of Caspian Sea, pl. 69, 1968.

Pl. 1      Fig 5

Colony entire, cells united to form a coenobium of one cell layer in thickness, without any perforations or space between cells. The coenobia may contain 4 - 128 cells. The peripheral cells have two blunt tipped projections, inner cells 5-6 sided with smooth or granular walls; cells upto 14  $\mu$  in diameter and 21  $\mu$  long.

Hab. Occurs as an and tychoplankton of many lakes and ponds.

3. *Pediastrum boryanum* var. *longicorne* Racib.

Raciborski, Acad. Umieji. w. Krakowie, 20: 13, 1889; Thompson, Fresh-w. Alg. of E. Kansas, The Univ. of Kansas Sc. Bull. Vol XXV, No.1, Pl. VI, f.19, 1938; Tiffany & Britton, Alg. of Illinois, pl. 30, f. 297, p.97, 1952; Prescott, Alg. of the Great West, lake Area, pl.47, f.10, p.222, 1951; Forest, Hand Book of Alg. f.111, p.102, 1954.

Pl. 1      Fig 6

Coenobium of eight or more cells, up to 40  $\mu$  in diameter with horns at the ends of the process 12 - 30 (12  $\mu$ ) long. Peripheral cells with outer margins extended into larger processes than in the typical plant; apices of the swollen euplankton.

4. *Pediastrum clathratum* (Schroeter) Lemm var. *duodenarium*

Thompson, Fresh-w. Alg. of E. Kansas, the Univ. of Kansas Sc. Bull. Vol. XXV, No.1, Pl.VIII, f.4, p.32, 1938.

Pl. 1      Fig 7

Colonies circular 16 -17 celled, with 5 cells in the middle with perforations and the remainder forming a ring about them; basal parts of the marginal cells

obtrapezoid, inner three sides nearly straight, outer sides with a single, long horn like process; having triangular base inner cells 5 sided, with nearly straight sides.

This species resembles *P. simplex* var. *echinulatum* but it differs; the colony is 12 celled, cell walls are without spines, it contain 5 inner cells. Thompson var. *radians*, in centre of the coenobium with one large opening, so that the coenobium is merely a ring of marginal cells. This species contains cells in the centre.

#### 5. *Pediastrum duplex* (Turp) Menegh

Gronbald Cont. to the knowledge of the Fresh-w. Alg. of Italy, Soc. Sc. Fennica Comentionate, Biologia XXII. 4f. 194 & p.75. 1958.

Pl. 1 Fig 8

Cells 7 - 30  $\mu$  in diameter, with smooth or granulate walls, outer half of the marginal cells ending in short spines, coenobia 4-256 cells usually compact.

#### 6. *Pediastrum duplex*. var. *regulosum* Raciborski.

Raciborski 1889, Akad. Umieji W. Kiakowie, 20:24; Poshkin & Makarva, Plank. Alg. of Caspian sea, pl. 69, f.6 -9, p.232, 1968; Prescott, Alg. of the Wt. Gt Lake Area, pl.49.f.3, 1951.

Pl. 1 Fig 9

Colony ovoid, entire except for lense shaped openings between peripheral and inner cells; walls irregularly crenate, granular; cells 15.

Habitat: Common as euplankter in ponds and lakes..

#### 7. *Pediastrum duplex* Meyen var. *reticulatum* Lager

Lagerheim, Oefv.k.Sr.Vet. Acc. Forhandl., 39, 2; 56; 1892; Thompson, Fresh-w Alg. of East, Kansas, Univ. of Kansas Sc Bull. VolXXV, No.1, pl. VII, f.16, p.31, 1938; Tiffany & Britton, Alg. of Illinois, pl.30, f.295, p.96 - 112, 1952.

Pl. 1 Fig 10

Colony 8-16 celled, the cell almost H shaped, perforations very large marginal cells 12-18  $\mu$  in diameter.

Hab. Widely distributed; euplanktonic.

#### 8. *Pediastrum tetras* (Ehreb) Ralph.

West. Trans, Linn. Soc. Lond. Bot., V. P. 81, pl. x. f. 39; 1895.

## Pl. 2 Fig.11.

The specimen closely resemble the form of West except for slight difference in the shape of incision between the cells. This same form is recorded by Smith as var. *tetraodon* (Corda) Hansg. Which is not in agreement with the diagnosis of Hansgirg (Prodr. Algenfl. Boehmen, i, 1888, p.112) or Brunthaller (op.cit., p.103) where the marginal cells as described as "viersitzig".

9. *Pediastrum tetras* (Ehreberg) Ralph var. *tetras*

Ann. Mag. Nat. Hist. 1, 14: 469, pl.12, f.4, 1844; Brunthaller in Pascher (ed), Sussw-fl. 5:103, f.64 a-c, 1915; Thompson, Fresh-w Alg of E.Kansas, The Univ. of Kansas Sc. Bull. Vol.XXV, No.1, pl. VI, f.17, 17, p.32, 1938; Prescott, Alg of the Gt. West. Lake Area, pl. 50, f.3-6, p.227, 1951; Tiffany & Britton, The Alg. of Illinois, pl. 30, f.293, p.97, 1952; Forest, Hand book of Alg. f.1116, p.104, 1954; Komarek & Fott, Elster & Ohle (eds) Binnengew 16 (7, 1) 301, pl.91, f. 5a-f 1983. Yamagishi & Akiyama (eds) Photomicrog. Fresh-w Alg. 5: 61, 1986.

## Pl. 2 Fig 12

Colonies free floating rectangular to nearly circular; of 4, 8 rarely 16 or 32 cells, without perforations, basal part triangular or trapezoid; with two triangular processes formed by deep incision; outer sides of the processes slightly or deeply concave; inner cells five to seven angled, with a deep linear incision and 4-6 straight sides; cell wall smooth; colonies 12- 74  $\mu$  (45  $\mu$ ) in diameter, marginal cells 5-18 in diameter, 4-18  $\mu$  long; inner cells 4-16  $\mu$  in diameter, 4-14  $\mu$  long.

Habitat: Common as plankton in ponds and lakes.

Genus *Oocystis* Naegeli in A.Brown.

Unicellular or in colonies of 2-16 individuals enclosed by the persistent and much swollen mothercell wall of the previous generation; several successive generations of cells sometimes inclosed within old membrane; cells ovoid, ovoid-ellipsoid, or rarely cylindrical, with rounded poles which may be smooth or furnished of various shapes, ovoid discs, irregular star shaped plates or reticular; 1 paranoïd in each chloroplast (Sometimes wanting)

1. *Oocystis pusila* (Hansgirg)

Ges.d. Wiss. Maths. Nat. Kl. Prag. p.9 1890; Prescott, Alg of the Gt. West. Lake Area. pl. 51, f.15, pl.54, f. 4-5, p.246, 1951, Siddiqui & Faridi, Biologia, Vol.10, No.2, f.38, p.59, 1964.

## Pl. 2 Fig 13

A colony of 4 ovate cells enclosed by the enlarged mother cell wall; poles of the cells broadly rounded, without modern thickenings; chloroplast 1 or 2 parietal plates, pyrenoids some time present; cells 3 -7.  $\mu$  in diameter 6-16 ( $\mu$ (9 $\mu$ ) long.

Hab. Uncommon but found in several lakes and fresh water ponds.

Genus *Ankistrodesmus* Corda 1938, p.196

Cells acicular, crescent shaped or narrowly fusiform; solitary or clustered in fascicles, sometimes straight, usually curved and often twisted about one another; without a gelatinous envelope. chloroplast a thin, parietal plate covering most of the cell wall; pyrenoids present or absent.

Recorded 5 species and 2 varieties.

1. *A. braunii* (Naegeli) Lemm. Var. *braunii*
2. *A. convolutus* Corda.
3. *A. falcatus* (Corda) Ralfs var. *falcatus*.
4. *A. falcatus* var. *tumidus* (West & West)
5. *A. falcatus* var. *stipitatus* (Chod) Lemm.

1. *Ankistrodesmus braunii* (Naegeli) Lemm. var. *braunii*.

Arch. Hydrobiol. 4: 168, 1908.

= Syn. *Ankistrodesmus braunii* (Naegeli) Collins, Tuft, coll. Stud. 3 : 78, 1912; *A. braunii* (Naegeli) Brunthaler in Pascher (ed) *sussw.fl.* : 189, f. 290, 1915; Yamagishi et al., Gen. Educ. Rev. Coll. Agri. Vet. Med. Nihon Univ., 18:15, 1982; *Monoraphidium braunii* (Naegeli) Legnerova in Fott (ed) Stud. Phycol. 100, 1969; Tanaka, Jap. Phycol. 29:273, 1981; *Raphidium braunii* Nageli in Kuetzing, spec. Alg. 891, 1849.

Pl. 2      Fig. 14

Cells free floating, cylindrical fusiform, tapering to pointed or bluntly rounded ends, straight or slightly curved, solitary or in pairs, rarely 3-4 together for some times after division, without a colonial envelope; chloroplast a single, parietal plate like, with a paranooid; cells 4-8 (7.5  $\mu$ ) in diameter, 30-50 (50  $\mu$ ) long.

Hab. Tycho plankton.

2. *Ankistrodesmus convolutus* Corda 1839.

Prescott, Alg. of the Gt. West. Lake Area, pl.55, f.3, p.253, 1951.

Pl. 2 Fig 15

Solitary or in groups of 2-4 cells, fusiform in shape, twisted and sigmoid; apices sharply pointed in opposite directions; cells 3-4.5  $\mu$  in diameter, 15-25  $\mu$  long.

Hab. Common as tychoplankton in fresh water lakes and ponds.

3. *Ankistrodesmus falcatus* (Corda) Ralfs var. *falcatus*.

Brit. Decm. 180, 1848; Brunthaller in Pascher (ed). *sussw. fl.* 5: 188, f.283, 1951; Prescott, Alg. of Gt. West. Lake Area, pl. 56, f.5-6, 1951; Philipose, Chlorococcales 211, f.121a e1967; Hirose & Yamagishi (ed) Ill, Jap. Fresh-w Alg. 351, pl. 116, f.9, 1977;

= Syn *Micrasterias falcata* Corda, Alma Carlsbad 121, pl. 2f, 29, 1835; Yamagishi & Akiyama (eds) Photomicrag. Freshw. Alg. 3:2, 1985.

Pl. 2 Fig 16

Cells free floating, needle shaped, tapering to the sub-acute ends, slightly twisted or curved, rarely solitary, usually clustered parallel or readily adjoining in 4 or 32 cells with each middle part of the cells, not enclosed with conical envelope; chloroplast a single parietal plate like usually with pyrenoid cells 1.5 -6 $\mu$  (3  $\mu$ ) in diameter 25-100  $\mu$  (30  $\mu$ ). long.

4. *Ankistrodesmus falcatus* var. *stipitatus* (Corda) Lemm. 1908, p176.

Prescott, Alg. of the Great West. Lake Area, pl. 56, f.14, 15, p. 254, 1951.

Pl. 2 Fig.17

Cells lunate, rarely almost straight, attached at one pole to the filamentous algae, usually gregarious forming clusters of 2-8 cells, 3-4  $\mu$  (3  $\mu$ ) in diameter, 20-30  $\mu$  (30  $\mu$ ) long.

Hab. Plankton in lakes and ponds.

5. *Ankistrodesmus falcatus* var. *tumidus* (West & West) G.S. West 1904.

Prescott, Alg. of the Great Western Lake Area, Pl. 56, f.9., p.224, 1951.

Pl. 2 Fig 18

Cells lunate or fusiform, the ventral margins decidedly tumid in the mid region. 2-3  $\mu$  in diameter, 30-40  $\mu$  long.

Genus *Selenastrum* Reinsch, p.64

A colony of 4- 16 lunate or sickle-shape cells with acute apices, the dorsal or convex walls adjacent; not enclosed by a gelatinous envelopem chloroplast, parietal, lying along the convex wall, usually with one pyrenoid.

Recorded 2 species.

1. *S. gracile* Reinsch var *gracile*
2. *S. westii* G. M. Smith

1. *Selenastrum gracile* Reinsch var. *gracile*

Algfl. mitt. Theil. Franken 65, pl. 4, f. 3q-b, 1867; Smith, Bull. Wisc. Geol. Nat. Hist. Surv. 57(1): 133, pl.31, f.5, 1920; Philipose, Chlorococcales f.128, p.219, 1967;

= Syn. *Ankistradesums gracile* (Reinsch) Korchikoff, Protococcine 305, 1953; Forest, a hand book of Alg. f.156, p.122, 1954; Thompson, Fresh-w Alg Kansas; Univ. Kansas Sci. Bull Vol. XXV, No.1, pl.VIII, f.1, p.35, 1938; and Islamic Studies on the phytoplankton of Dacca Dist, pl. 3, f. 8, p.243, 1970; Prescott, Alg of the Gt.West Lake Area, pl.57, f.11, p.256, 195. Tiffany & Britton, the Alg. of Illinois, f.326, p.117, 1952; Yamagishi & Akiyama(eds) Photmicrog. Fresh-w.Alg.2:69, 1984.

Pl. 2 Fig 19

Colonies free floating of 4, 8, 16, 32 or more cells; cells joined in a large irregular shaped colony, cells lunate to sickle shaped, narrow in proportion to length; with sharply pointed ends; chloroplast a single laminate, parietal with a pyrenoid; cells 3- 5  $\mu$  broad and 19-28  $\mu$  long.

Hab. Tychoplankton of lakes and ponds.

2. *Selenastrum westii* G.M. Smith.

Smith, Bull wisc. Geol. Nat. Hist. Surv. 57(1) : 133, pl. 31, 1920; Forest, A hand book of Alg. f.158, p.123 1954; Prescott, Alg of the Wt Gt Lake Area, pl.57, f.10, p.257, 1951.

Pl. 2 Fig. 20

Colonies small composed of 2-8 slender, lunate or arcuate (but not sickle shaped) cells; arranged with three convex wall supposed; cells curved only to about half circular; poles pointed; pynoids lacking; 1.5,-2.5  $\mu$  (3  $\mu$ ) broad; 15-18  $\mu$  long.

Smith observed that this species had been confused with *Scenedesmus acuminatus* (Lag) Chod.

Hab. Rare; in euplankton.

Genus *Kirchneriella* Schmidle 1893, p.83.

Cells arcuate or crescent shaped, uninucleate with parietal chromatophores and usually one pyrenoid, loosely aggregated without apparent order in a large gelatinous mass; asexual reproduction by division into 4 or 8 daughter cells.

Recorded 2 species.

1. *K. lunaris* (Krichner) Moeblus var. *lunaris*.
2. *K. microscopica* Naggad var. *microscopica*

1. *Kirchneriella lunaris* (Krichner) Moeblus var. *lunaris*.

Abh. Senckenb. Naturf. Ges 18: 331, 1894; Chodat, Mat. Fl. Crypt. Suisse 1 pl. 3, Alg. Ven. Suisse, 202, f.121- 1-6, 1902; Smith, Bull. Wisc. Geo. Nat Hist. Surv. 57(1): 141, pl.34, f. 4, 1920; Prescott, Alg. of the Gt. West Lake Area, pl.58, f.2, p.258, 1951; Tiffany & Britton, the Alg. of Illinois, pl.31, f.308, p.116, 1952; Forest, Hand Book of Alg. 1. 140, p.115, 1954; Hirose & Yamagishi (eds) Ill, Jap. Fresh-w. Alg. 347, pl. 114, f.1, 1977; Komarek & Fott in Elester & Ohle (eds) Binnengew 16(7.1): pl. 187, f.3, 669, 1983; Yamagishi & Akiyama (eds): Photomicrog. Fresh-w. Alg. 10:38, 1989.

= *Raphidium convolutum* (Corda) Rabenhorst var. *lunare* Krichner, Krypt. Scheislen, II(1), Alg. 114, 1878;

Pl. 2      Fig 21.

Colonies free floating of 4,8 or 32 cells, enclosed by a hyaline, gelatinous envelope; cells flattened, strongly curved crescent shaped, tapering to pointed, some times slightly blunted ends; outer cells roundly convex; inner sides concave and broadly V or u shaped, ends some time almost touching, chloroplast a single, with a pyrenoid; cells 3-8  $\mu$  (6  $\mu$ ) in diameter and 6-15  $\mu$  (12  $\mu$ ) long.

Hab. Common in the plankton of lakes and ponds.

2. *Kirchneriella microscopica* Nagaard var. *microscopica*

Dansk. Plank. 52, f.40, 1945; Nagaard, Tavlerne Dansk Plateplankaton II, f.42, 1976; Komarek & Fott in Elester & Ohle (eds) Binnengew. 16(7.1): pl.183, f.7, 662, 1983; Yamagishi, Gen. Educ. Rev. Coll. Agr. & Vet. Med. Nihon Univ. 24: 75, f.2, 37, 1988; Yamagishi & Akiyama (eds) Photomicrog. Fresh-w. Alg. 9:49, 1989.

## Pl. 3 Fig 22

Colonies free floating of many cells, associated irregularly in a very soft, watery gelatinous envelope; cells small cylindrical crescently to circularly curved, without narrowed or rounded end; chloroplast usually filling the entire cell, without pyrenoid; cells 1-2  $\mu$  (1.5  $\mu$ ) in diameter, 4-7  $\mu$  (6  $\mu$ ) long, distance between apices 3-5  $\mu$  (1-4  $\mu$ ).

Rare; in plankton of lakes & ponds.

Genus *Tetraëdron* Kuetzing 1845, p.129

Cells solitary and unattached; of various shapes; triangular and flat, pyramidal polyhedral; the angles entire, with or without spines of variously lobed to form dichotomous or trichotomous spine tipped process; chloroplasts one to many parietal discs or plates; pyrenoids usually present.

Recorded 6 species and 3 varieties.

1. *T. hastatum* (Reisch) Hansgirg
  2. *T. muticum* (A. Braun)
  3. *T. regulare* var. *granulata* Prescott.
  4. *T. trigonum* var. *gracile* (Reinsch)
  5. *T. trigonum* (Naegeli) Hansgirg var. *minor* Reinsch
  6. *T. tumidulum* (Reinsch) Hansgirg
  7. *T. quadratum* (Reinsch) Mansgrig.
1. *Tetraëdron hastatum* (Reisch) Hansgirg

*Hedwigia* 27: 132, 1888; Smith, Bull. Wisc. Geol. Nat Hist. Surv. 57(1): 121, pl.25, fl. 18, 1920; Prescott, Alg. of the Gt. West. Lake Area, pl. 59, f.18, p.25, 1951, Yamagishi et al, Gen. Educ. Rev. Coll. Agr. & Vet. Med. Nihon Univ., 18: 25, pl.1, f.14, 1982.

= Syn. *Polydrium hastatum* Reinsch, Notorisia 3: 507, 1888.; Yamagishi & Akiyama (eds): Photomicrog. Fresh-w. Alg. 288, 1984.

## Pl. 3 Fig 23

Cells solitary free floating pyramidal, the angles extended into narrow processes which are tipped with 2 or 3 short spines at each apex, the margins concave. Cells 8 - 10  $\mu$  in diameter, processes 10 - 14  $\mu$  long.

Hab. Rare; in plankton.

## 2. *Tetraëdon muticum* (A Braun) Hansgirg

Islam, Studies on phytoplankton of Dacca dist. order chlorococcales Jour. of Asiatic. Soc. of Pak. Vol. XV, No.3, P 227-271, 1970.

Pl. 3 Fig 24

Cells small, flat triangular, the angles without spines or furcations; sides of the cell emarginate or slightly convex; cells 6 - 18  $\mu$  (15  $\mu$ ) in diameter.

Hab. A common species in many habitat but because of its size it is easily overlooked in rich tychoplanktonic collections.

## 3. *Tetraëdron regulare* var. *granulata* Prescott.

Prescott, Alg. Gt. West lake Area, pl. 61, f.2-3 p.269. 1951.

Pl. 3 Fig 25

Cells large, rather regular pyramidal, the lobes broad and stout with a single short spine which may reduced to a mere papilla; cells 14-24  $\mu$  (16.5  $\mu$ ) in diameter.

Hab. Plankton in lakes and ponds.

## 4. *Tetraëdron trigonum* var. *gracile* (Reinsch)

Sylog. Alg. 1:598, 1889; Smith, Bull. Wisc. Geol. Nat. Hist. Surv. 57(1):117, pl.24,f.5-9 1920  
Prescott, Alg. of the Gt West. Lake Area, pl.61, f.14-16, p.270, 1951; Forest, Hand book of Alg. f.166, p.127, 1954.

Pl. 3 Fig. 26

Cells flat triangular, some what narrower and more protruded than in the typical plant, some what curved, tapering acutely and ending in a spine; cells 25-50  $\mu$  in diameter ending in spine

Hab. Euplankton.

5. *Tetraedron trigonum* (Naegeli) Hansgirg var. *minor* Reinsch

Thompson, Fresh-w. Alg. E. Kansas, The Univ. of Kansas Sc. Bull Vol. XXV, N.1, pl. VIII, f.9, 1932.

Pl. 3      Fig 2

Cells triangular the sides indented and attenuating at the apices into sharp spines 10- 14  $\mu$  (22  $\mu$  ) wide.

Hab. Euplankter.

6. *Tetraedron umidulum* (Reinsch) Hansgirg

Hedwigia 28: 18, 1889; Brunthaller in Pascher (ed). süssw. - fl.5: 148, f.157, 1914; Philipose, Chlorococcales 139, f.54 c, 1967; Smith, Trans Amer. Micros. Soc. 45: 173, pl.6, f. 24-27, 1926.

= Syn. *Polyederium tumidulum* Reinch Notorisia 3: 506, 1888;

Prescott, Alg. of Gt. West. Lake Area, pl 61, f.17-18, p.270, 1951; Yamagishi & Akiyama (eds.) Potomicrog. Fresh-w. Alg. 2: 91, 1989.

Pl. 3      Fig 28

Cells solitary, free floating, pyramidal; sides concave, rarely straight or slightly convex; angles round or truncate, without spines; cell wall smooth; cells 30-53  $\mu$  (27  $\mu$ ) in diameter.

Hab. Plankter in lakes and ponds.

7. *Tetraedron quadratum* (Reinsch) Hansgirg

Prescott, Alg. of Wt. Great lake Area, pl. 46, f.21-21a, p.268, 1951.

Pl. 3      Fig 29

Cells quadangular in front view, the lateral margins straight with sharp angles which are furnished with sharp spine; membrane 2 layered, cells 17-34  $\mu$  (25  $\mu$  ) in diameter.

Genus *Scenedesmus* Meyen 1829 p.774

Colony of 2, 4, 8, 32 ovoid, fusiform crescent shaped or oblong cells lying side by side in single series or in a double row with the cells alternating; cell wall smooth or with spines, teeth and ridges, chloroplast a parietal plate covering most of the cell wall and often showing a median lateral notch; 1 pyrenoid.

Recorded 8 species.

1. *S. acuminatus* (Lagerh) Chodat var. *acuminatus*.
2. *S. armatus* (Choo) Smith
3. *S. bijugatus* (Turp) Lagerheim var. *bijugatus*
4. *S. dimorphus* (Turp) Kuetzing
5. *S. incrassatulus* var. *monoae* Smith
6. *S. obliquus* (Turp) Kuetzing
7. *S. opoliensis* (Richter)

1. *Scenedesmus acuminatus* (Lagerh) Chodat var. *acuminatus*

Chodat, Mater. Fl. Cryptog. Suisse, 1,3: 211, f.88, 1902; Prescott, Alg. of the Gt. West. Lake Area, pl.62, f.16, p.275, 1951; Reinhardt in Koroshikov, All. Soviet Union Inst. of Sc. of Fresh-w. Alg. Ukr. Uni. of Soy. Res. V:380, 1953; Tiffany & Britton, The Alg. of Illinois, p.35, f.368, 1954; Forest, Hand Book of Alg. f.179, p.136, 1952.

Pl. 3      Fig. 30

Cells 4 rarely 8 arranged in single row, slightly tapered with pointed ends, outer cells curved, sharp or fine pointed outward, internal cells straight; convex walls adjoining inwardly, 3-7  $\mu$  (4  $\mu$ ) in diameter and 30-40  $\mu$  (32  $\mu$ ) long.

2. *Scenedesmus armatus* (Choo) Smith 1916a.

Prescott, Alg. of the Gt. West. Lake Area, pl. 62, f.13-14, p.276, 1951; Forest, Hand book of Alg., f.183, p.137, 1954; Tiffany & Britton, The Alg. of Illinois, pl. 35, f.353, p.122, 1954.

Pl. 3      Fig. 31

Cells oblong or elliptic, but with ends broadly rounded; terminal cells with a single, usually curved or unevenly bent spine at each pole cells 5-8 (7.5  $\mu$ ) in diameter, 9-15  $\mu$  long.

Hab. Widely distributes and common in lakes and ponds.

3. *Scenedesmus bijugatus* (Turp) Lagerheim var. *bijugatus*

Lagerheim, Nuova Natalsia, 4: 158, 1893; Thompson, Fresh-w. Alg. of E.Kansas, The Univ. Kansas Sc. Bull. Vol. XXV, No.1, pl. VIII, f.14, p.37, 1938; Prescott, Alg. of the Gt. West. Lake Area, pl.63, f.2 & 7, 276, 1951; Tiffany & Britton, Alg. of Illinois, pl. 35, f. 371, p.123, 1952;

Forest, Hand Book of Alg. f. 183, p.137 1854; Poshkin & Makarov, Plank. Alg. of Caspian sea, pl. 76, f.17, 1968.

Pl. 3 Fig 32.

Coenobium of 4-8 cells in a single row; cells oval to oblong or ellipsoidal with broadly rounded ends, without teeth or spines; cells 4-8  $\mu$  (7.5  $\mu$ ) in diameter, 8-16(15  $\mu$ ) long.

Hab. Widely distributed; often appearing as a prominent component of littoral plankton.

#### 4. *Scenedesmus dimorphus* (Turp) Kuetzing 1833b.

Prescott, Alg. of the Gt. West. Lake Area, pl. 63, f.9, p.277, 1951, Tiffany & Britton, The Alg. of Illinois, pl. 35, f.370, p.123, 1952; Forest, Hand Book of Alg. f. 188, p.139, 1954; Islam, Tahmida, studies on the phytoplankton of Dacca. Dist, Four the Assist. Soc of Pak., Vol.XV, No.3, pl.5, 162-168, p.254 1970.

Pl. 3 Fig 33

Colony composed of 4 - 8 fusiform cells without spines or ridges arranged in single or attenuate series. Central cells straight or curved slightly outward, outer cells curved considerably out ward even lunate or sickle shaped. Cells 3-67  $\mu$  in diameter, 16-22  $\mu$  long.

Orthocelluarl variety - all cells with straight axis, all four cells in single series.

#### 5. *Scenedesmus incrassatulus* var. *mononae* Smith 1916 a.p. 440

Prescott, Alg. of The Gt. West. Lake Area, pl.63, f.13, p.278, 1951

Pl. 3 Fig 34.

Colony composed of 2, 4 fusiform, subacute cells arranged either in 1 or 2 series. A variety differing from the typical by its smaller, more slender cells, 4.4 - 5 $\mu$  (6  $\mu$ ) in diameter 11-12  $\mu$  (18  $\mu$ ) long.

(In a typical colony, median cells slightly curved; outer cells definitely curved, with the walls strongly concave; cells 5-8  $\mu$  in diameter, 17-24  $\mu$  long).

#### 6. *Scenedesmus obliquus* (Turp) Kuetzing 1833b, p.609

Prescott, Alg. of the Gt. West. Lake Area, pl. 63, f.17, p.279, 1951 Thompson, Fresh-w. Alg. of E. Kansas, The Univ. of Kansas Bull. Vol.XXV, No.1, pl. VIII, f.12, p.37, 1938; Tiffany & Britton, The Alg. of Illinois, pl.35, f. 369, p.123, 1952; Forest, Hand Book of Alg. p.140, f.190, 1954; & Tahmida Islam Studies on the phytoplankton of Dacca District four of the Asiat. Soc of Pak, Vol. XV, No.3, Pl.5,6, 180-184, p.256, 1970.

Pl. 3                      Fig 35.

Colony composed of 2 -8 (usually 4) fusiform cells arranged in series, with more abruptly tapering ends (apiculate). Cells are generally shorter than those of *S.dimorphus*. Outer cells of the colony straight or curved outward. Cells 4- 6  $\mu$  (4.5  $\mu$ ) in diameter and 10-21  $\mu$  (12  $\mu$ ) long.

Hab. Common in still waters.

#### 7. *Scenedesmus opoliensis* (Richter)

Tiffany & Britton, The Alg. of Illinois, pl. 35, f.355, p.127, 1952.

Pl. 3                      Fig 36

Cells fusiform, with long spines at either end of the outside cells of the colony (generally 4 celled). Cells 6-8  $\mu$  (7.5  $\mu$ ) in diameter and 14-26  $\mu$  (22.5  $\mu$ ) long. The combination of spines and fusiform cells identifies the species immediately.

Hab. Widely distributed, common in lakes and ponds.

#### 8. *Scenedesmus quadricauda* var. *westii* Smith 1916 a, p.48.

Prescott, Alg. of the Gt. West Lake Area, pl. 64, f.7-9, p.281, 1951, Forest, Hand Book of Alg. f. 195, p. 142, 1954; Tiffany & Britton, The Alg. of Illinois, pl.35, f.358, p.122, 1952.

Pl. 3                      Fig. 37

Colony composed of 4 - 8 ovate cells ; cells somewhat narrower than typical plants in proportion, spines very slender and strongly curved. Cells 16 -22  $\mu$  (22.5 $\mu$ ) long.

Hab. Rare, but found in the plankton of great variety of lakes and ponds.

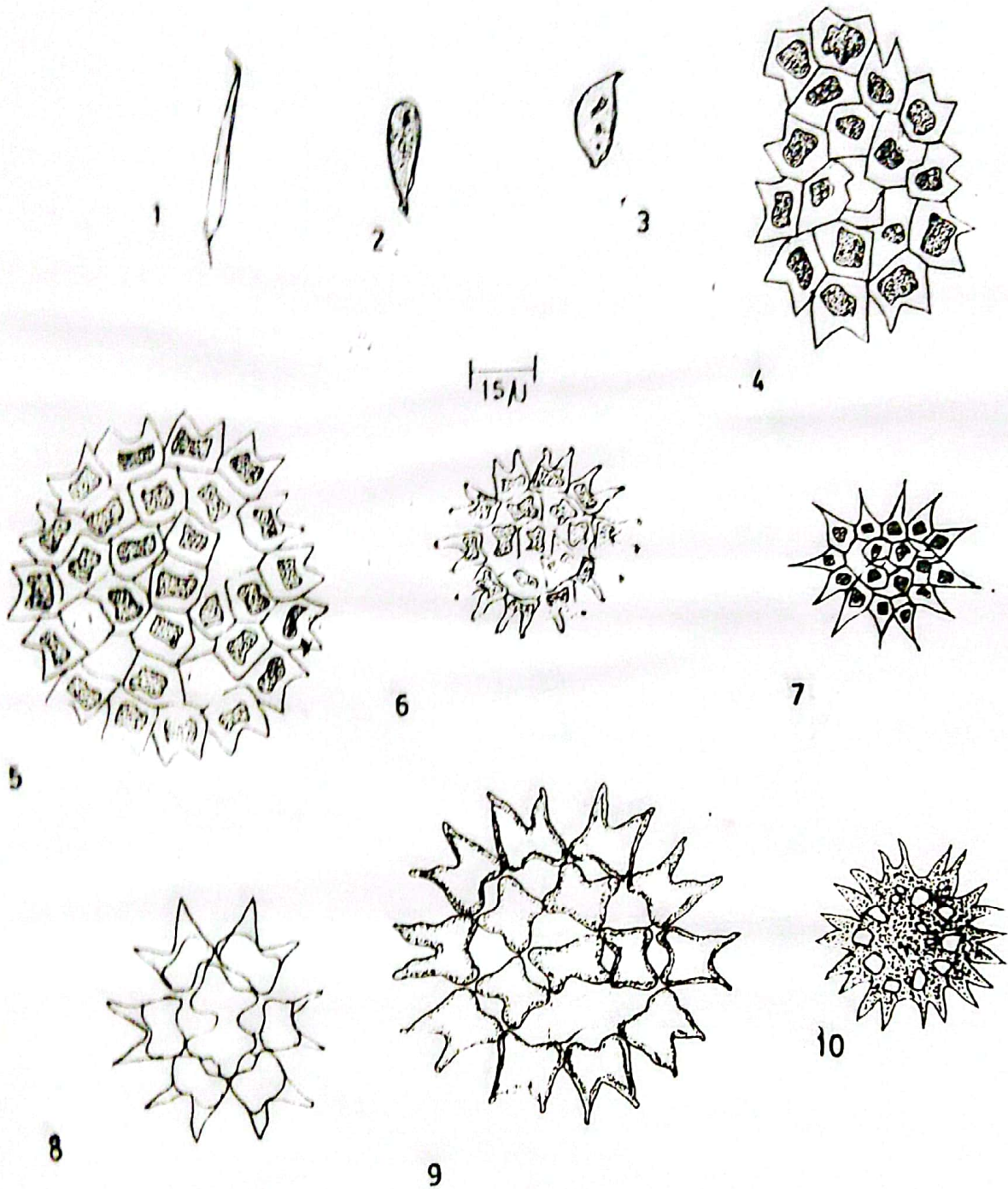


Plate - 1

1. *Characium Limneticum*
2. *C. oblusum*
3. *C. ornithocephalum*
4. *Pediastrum argentiniense*
5. *P. boryanum*

6. *Pedistrum boryanum* var. *longicorne*
7. *P. Clathratum* var. *duodenarium*
8. *P. duplex*
9. *P. duplex* var. *regulosum*
10. *P. duplex* var. *reticulatum*

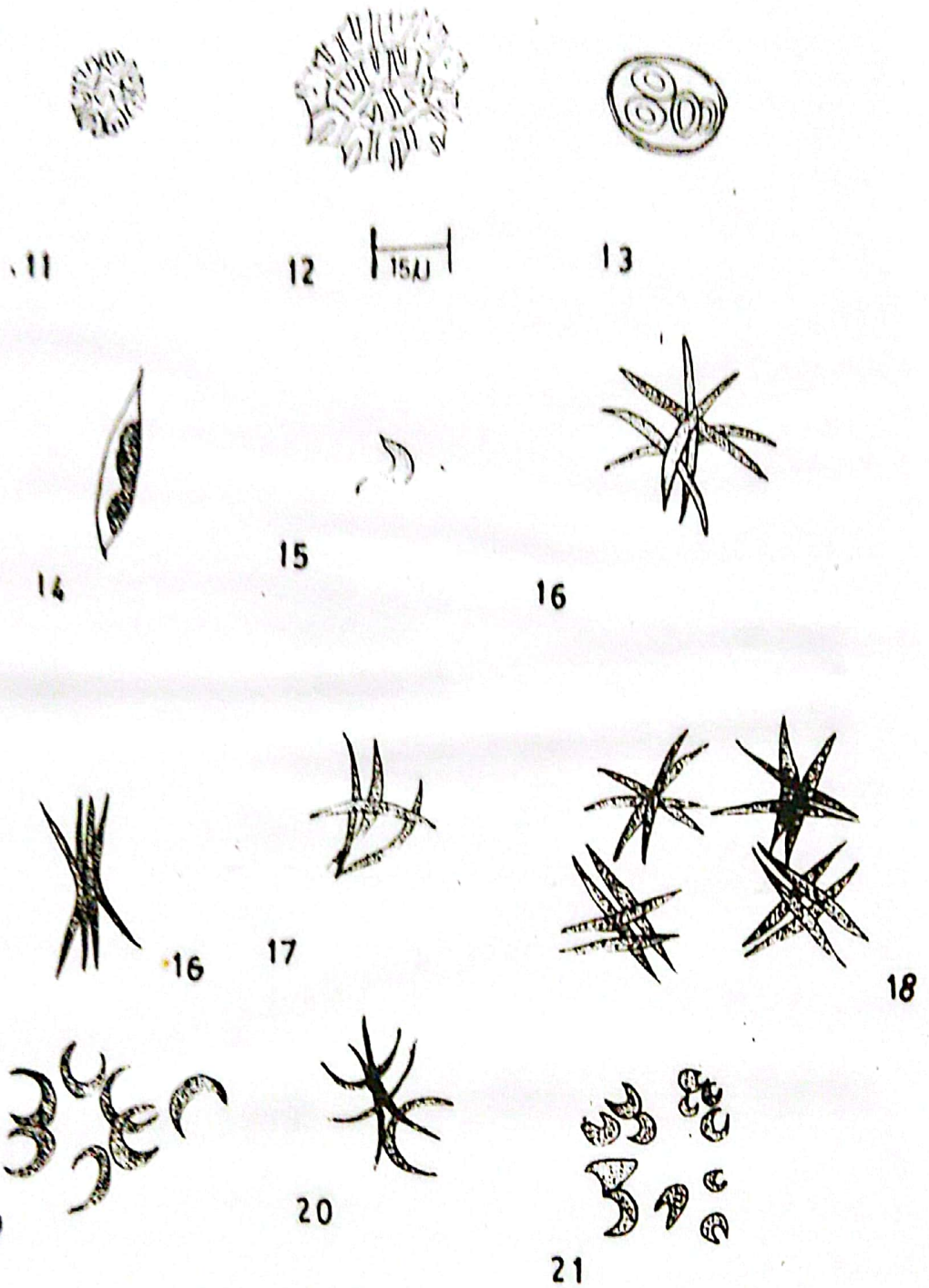


Plate - 2

- |   |   |
|---|---|
| 11. <i>Pediastrum tetras</i> var. <i>tetras</i>       | 16. <i>Ankistrodesmus falcatus</i> var. <i>falcatus</i> |
| 12. <i>P. tetras</i>                                  | 17. <i>A. falcatus</i> var. <i>stipitatus</i>           |
| 13. <i>Oocystis pusilla</i>                           | 18. <i>A. falcatus</i> var. <i>tumidus</i>              |
| 14. <i>Ankistrodesmus braunii</i> var. <i>braunii</i> | 19. <i>Selenastrum gracile</i> var. <i>gracile</i>      |
| 15. <i>A. convolutus</i>                              | 20. <i>S. westii</i>                                    |
|   | 21. <i>Kirchneriella lunaris</i> var. <i>lunaris</i>    |

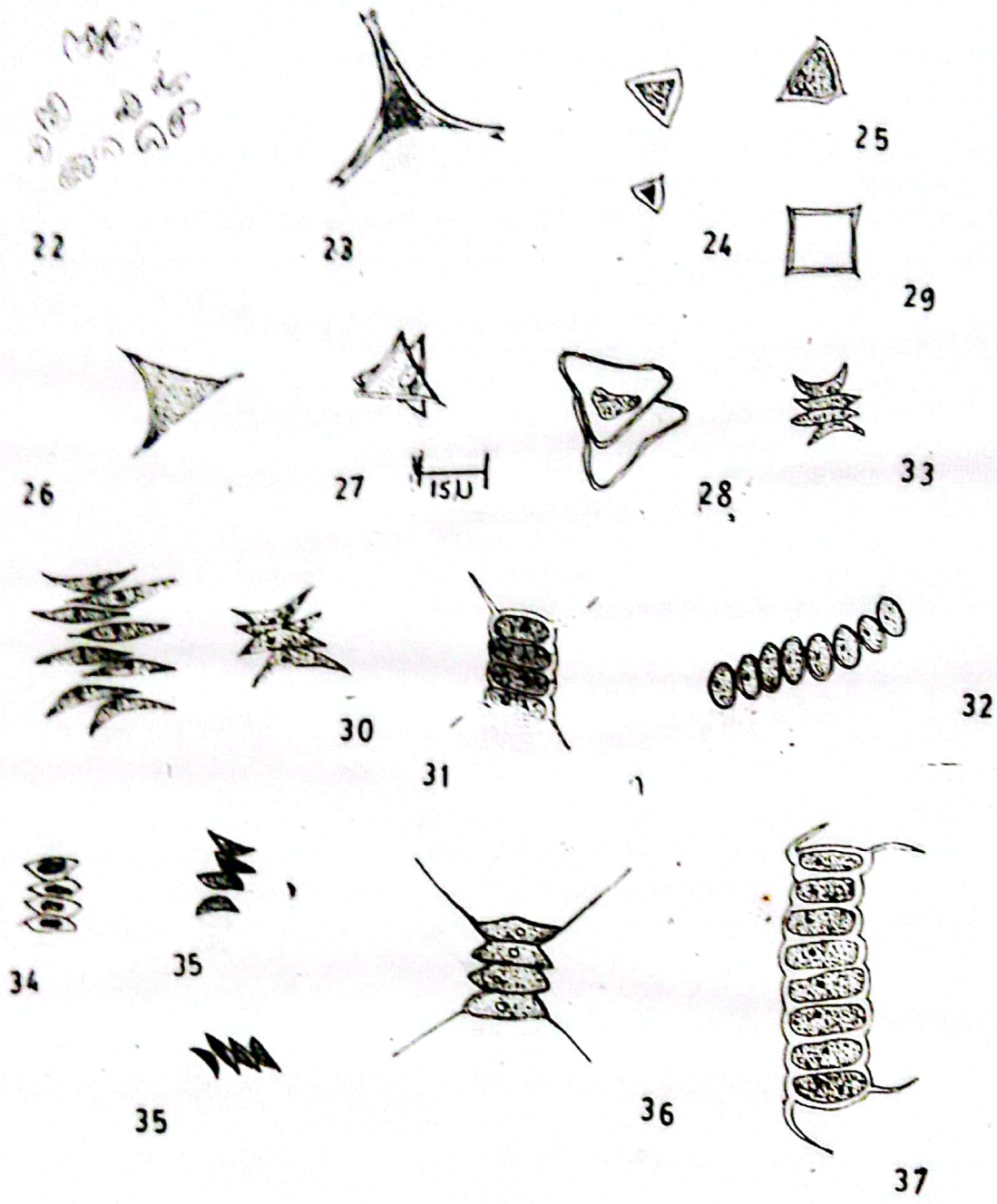


Plate - 3

- |   |   |
|---|---|
| 22. <i>Kirchneriella microscopica</i><br>var. <i>microscopica</i> | 30. <i>Scenedesmus acuminatus</i><br>var. <i>acuminatus</i> |
| 23. <i>Tetroedron hastatum</i>                                    | 31. <i>S. armatus</i>                                       |
| 24. <i>T. muticum</i>   | 32. <i>S. bijugatus</i> var. <i>bijugatus</i>               |
| 25. <i>T. regulare</i> var. <i>granulata</i>                      | 33. <i>S. dimorphus</i>                                     |
| 26. <i>T. trigonum</i> var. <i>gracile</i>                        | 34. <i>S. incrassatulus</i> var. <i>mononae</i>             |
| 27. <i>T. trigonum</i> var. <i>monor</i>                          | 35. <i>S. obliquus</i>                                      |
| 28. <i>T. tumidulum</i>   | 36. <i>S. opiliensis</i>                                    |
| 29. <i>T. quadratum</i>   | 37. <i>S. quadricauda</i> var. <i>westii</i>                |

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