

Algal study (Non- diatoms algae) in Al-Salhia River with nine new records to Iraqi algal flora

Ebtehal M.Jaffer

Department of Ecology, College of Science, University of Basrah.

Corresponding author: ebtehal_alasade@yahoo.com

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Abstract:

The present study was carried out in Al-Salhia river within shatt Al-Arab in (5) stations from March 2014 - February 2015 to contribute the knowledge of freshwater algae in Iraq. A total of 66 taxa of phytoplankton were identified during the studying period to 4 divisions, 5 classes, 8 orders, 15 families and 35 genera among them 9 species are new recorders to Iraqi flora, chlorophyta with 38 species (57.6%), cyanophyta with 20 species (30.3%), euglenophyta with 5 species (7.6%) and pyrrophyta with 3 species (4.5%), among them 9 species and 7 genera are new records to Iraqi flora: *Ankistrodesmus bibraianus*, *Dictyosphaerium tetrachotomum*, *Monoraphidium arcuatum*, *Monoraphidium contortum*, *Monoraphidium griffithii*, *Scenedesmus bicaudatus*, *Chroococcus thermalis*, *Cylindropermopsis taveriae* and *Komvophoron minutum*

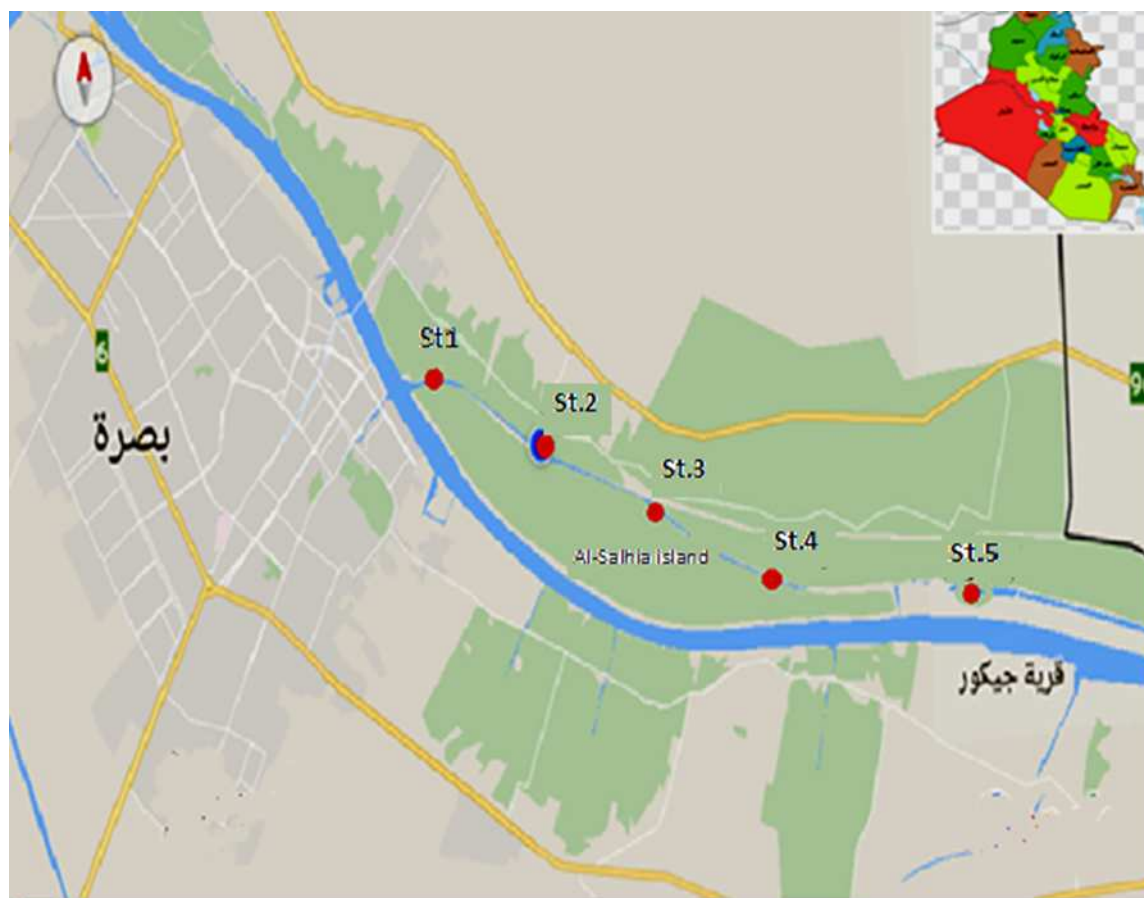
Keywords; Al-Salhia river, phytoplankton, new recorded, non diatoms algae, small Shatt Al-Arab

Introduction: Algae nourishment are self and photosynthetic green plant living as forms, most of algae possess the two phytoplanktonic and benthic phase lifetime [1]. Phytoplankton, regarded as the basic component of an aquatic food chain, the main autochthonous primary producers and oxygen resource, the benthic algae have

essential roles in preliminary production, stabilizing sediment, nutrient cycles, and transport of energy between sediment and water column [2, 3]. Ecological and limnological factors are mainly vital for formative the increase of phytoplankton in rivers than in lakes, live mass of phytoplankton in lakes associated the great quantity of nutrients where as in the rivers they are linked aquatic ecosystem [4]. In Iraq there are a huge number works have done in algal community abundance and distribution and seasonal variation in various aqueous system [5;6;7;8;9;10;11]. Algal species composition was basic characteristic for many researches in Iraq [12;13;14;15;16;17]. Work some researchers to collect different dispersed pamphlet of algae in Iraq in checklist such as [18] that 1296 taxa were integrated, where as [19] 1900 species were scheduled, [20] that 2312 taxa were incorporated in adding to that a checklist was available by [21] included 722 algal kind only in Diyala River. Recently about 2647 algal taxa which reported by [22]. A study of [23] which describe a few (non diatom) epiphytic algae in Al-hawizah marsh south of Iraq, [24] studied distribution algae in Baghdad after collect sample from various area. Fifteen new species register by [25] at upon section of Euphrates river and add [26] thirty-eight new records for algal species of Iraq's marshes. Many researchers have carried out researches on aquatic ecology and environment phytoplankton such as [27;28;29]

Materials and Methods:

Al-salhia river also called (small Shatt Al-Arab) is branched of Shatt Al-Arab which is located to the south of it, at the opposite side of the Khurh river and span southwardly to meet with shatt Al-Arab again near Abu Al-khaseb and surrounds the Al-Salhia island , which lies south east of the Basrah city. The length Al-Salhia river about 12 Km , width 40 m , depth 3-5 m (Figure 1) . The recent study was implemented from March 2014 to February 2015 . Phytoplankton was collect from the different sites with Phytoplankton net mesh of 20 μ m and reserved by Formalin solution (4%) , or loughle's solution (classification of the Phytoplankton pinpointed by dependence on (30 -47)). Identifications of algae were used by microscope digital Camera(SCMOS03000KPA) to describe the diameter, long and width of examined taxon. All the identified algae were arranged alphabetically following Prescott [30]. The classification references were listed next to each taxon.



Result and Discussion:

It is obviously show from(table 1, figure 2) that a total of sixty six algal species were collected from five different collection sites of Al-Salhia river of March 2014 - February 2015. These belonged to chlorophyta , cyanophyta , euglenophyta and pyrophyta. Chlorophyta presented the largest species number (57.6 % of the total), followed by cyanophyta (30.3 %) , euglenophyta (7.6 %) and pyrophyta (4.5 %) . In this study sixty six species (list 1) of phytoplankton were identified and nine of ,it first once recorded in Iraq. These species belonged to thirty five genera

eight orders ,fifteen families five classes and four divisions. All these species is non diatomic phytoplankton .

Division	Classes	Orders	Families	Genera	Species	%
Chlorophyta	1	2	7	19	38	57.6
Cyanophyta	1	2	4	10	20	30.3
Euglenophyta	1	1	1	3	5	7.6
pyrrophyta	2	3	3	3	3	4.5

Taba (1): Total number of recorded algal species with their percentage % during the studies period .

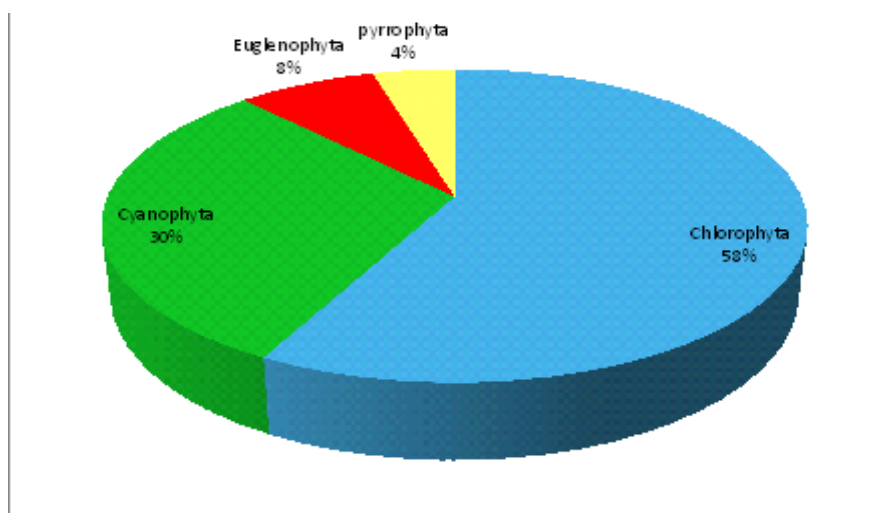


Figure 2 : The percentage of phytoplankton taxa during this study

: List (1):Algae (non-diatom species) recorded during the studied period

Division (1): Chlorophyta

Class: Chlorophyceae

Order1: volvocales

Family (1): Chlamydomonadacea

Genus: Carteria

Species: Carteria cordiformis (Carter) Diesing

Genus: Chlamydomonas

Species:Chlamydomonas angulosa Dill

Species: Chlamydomonas globosa Snow

Family(2):volvocaceae

Genus: pandorina

Species:pandorina morum (Muell.)Bory

Genus: Volvox

.Species:Volvox aureus Ehr

.Species:Volvox globator Linn

Order(2): chlorococcales

Family(1):chlorococcaceae

Genus: Chlorococcum

Species:Chlorococcum humicolo (Näegeli) Rabenhorst

Genus: Golenkinia

Species:Golenkinia paucispina West & West

.Species:Golenkinia radiata Chodat, J

Family(2) : Hydrodictyaceae

Genus: Pediastrum

Species: Pediastrum boryanum (Turp.) Meneghinii

Family(3) : Coelastraceae

Genus: Coelastrum

Species: Coelastrum asteroieds De Notaris

Species: Coelastrum microporum Nügelii

Family(4):oocystiaceae

GENUS:Ankisodesmus

.Species:Ankistrodesmus bibraianus (Reinsch) Korshikov*

Genus: Chlorella

.Species:Chlorella vulgaris Beijerinck, Bot. Ztg

Genus: Dictyosphaerium

Species:Dictyosphaerium tetrachotomum Printz *

Genus: Kirchneriella

Species:Kirchneriella elongate G.M. Smith

.Species:Kirchneriella microscopica Nyg

Species:Kirchneriella obesa (W. West) Schmidle

Genus: Monoraphidium

Species: Monoraphidium arcuatum (Korshikov) Hindák*

.Species: Monoraphidium contortum (Thur.) Komárk.-Legn*

.Species: Monoraphidium griffithii (Berk.) Komárk.-Legn*

Genus: oocystis

Species: Oocystis borgei snow

Species: Oocystis lacustris Chodat

Genus: schoederia

Species: Schoederia setigera

Genus: Tetraëdron

Species: Tetraëdron minimum (A. Braun) hansgig

.Species: Tetraëdron muticum (A. Braun) Hans

Family(5) : Scenedesmaceae

Genus: Actinastrum

Species: Actinastrum hantzschii Lagerheim

Genus: :Crucigenia

Species: Crucigenia lauterbornii Schmidle

Species: Crucigenia tetrapedia (Kirchner) W. West & G.S. West

Genus: Scenedesmus

Species: Scenedesmus acuminatus (Lagerhheim) Chodat

Species: Scenedesmus arcuatus (Lemmermann) Lemmermann

Species: Scenedesmus bicaudatus Dedusenko*

Species: Scenedesmus bijuga (Turp.) Lagerheim

Species: Scenedesmu bijuga (Turpin) Lagerheim var. alternans (Reinsch) Hansgig

Species: Scenedesmus dimorphus (Turpin) Kützing

Species: Scenedesmus perforatus Lemmermann

(.Species: Scenedesmus quadricauda var. quadrispina (Chod

Species: Scenedesmus quadricauda var westii G.M. Smith

Division: Euglenophyta

Class: Euglenophyceae

Order: Euglenales

Family: Euglenaceae

Genus: Euglena

.Species:Euglena polymorpha Dang

.Species:Euglena sanguinea Ehr

Species:Euglena spirogyra Ehr. var. spirogyra

Genus: Lepocinclis

Species:Lepocinclis ovum (Ehrenb.) Lemmerm

Genus: Phacus

Species:Phacus curvicauda Svirenk

Division(3):-pyrophyta

Class(1):cryptophyceae

Order: Cryptomonadales

Family: Cryptomonadaceae

Genus:cryptomonas

Species:Cryptomonas erosa Ehrenb

Class(2) :dinophyceae

Order1:gymnodiniales

Family: :gymnodiniaceae

Genus:Gymnodinium

Species:Gymnodinium fuscum (Ehrenb.) stein

Order(2): Peridinales

Family: Peridiniaceae

Genus: Peridinium

Species:Peridinium gatunense Nygaard

Division(4):- Cyanophyta

Class : Cyanophyceae

Order(1) : Chroococcales

Family1:chroococcaceae

Genus: Chroococcus

Species:Chroococcus thermalis (Maneghini) Nageli*

Genus: Microcystis

Species: Microcystis aeruginosa Kützing

Genus: Merismopedia

Species: Merismopedia elegans A. Braun in Kützing

Species: Merismopedia punctata Meyen

Order2: Hormogonales

Family1: Nostocaceae

Genus: Anabaena

Species: Anabaena cf -flos-aquae (Lyngb.) De Brebisson

Genus: Anabaenopsis

. Species: Anabaenopsis circular (G.S. West) Wołoszyńska y

. Species: Anabaenopsis elenkinii V.V

Genus: Cylindrospermopsis

Species: Cylindrospermopsis taveriae Komárek*

Family2: Borziaceae

Genus: Komvophoron

(Species: Komvophoron constrictum (Szafer

(Species: Komvophoron minutum (Skuja*

Family3: Oscillatoriaceae

Genus: Lyngbya

Species: Lyngbya martensiana Meneghini

Genus: : Oscillatoria

Species: Oscillatoria anguina Bory

Species: Oscillatoria curviceps Agardh

Species: Oscillatoria limosa (Roth) Agradh

Species: Oscillatoria princeps Vaucher

Species: Oscillatoria splendida Greville

Species: Oscillatoria tenuis Agardh

Species: Oscillatoria cf. vizagapatensis Rao

Genus: Spirulina

Species: Spirulina gigantea Schmidle

Species: *Spirulina meneghiniana* Zanardini

Division (1): Chlorophyta

(*Carteria cordiformis* (Carter) Diesing (Pl.1, Fig.1

Cells cordiform, vaster in the front terminus, has 4 flagellates, chloroplast a cup shape. cells 13 μm in diameter, 14.4 μm long. ([30] 73, Pl.1, Figs.20

(*Chlamydomonas angulosa* Dill (Pl.1, Fig.2

Cells broadly cylindric to ovoid, often truncated anteriorly and with a prominent papilla. The flagella as long as or slightly longer than the cell body. Chloroplast, parietal cup with a large angular pyrenoid in the base, pigment spot anterior and lateral. cells 12-14 μm in diameter, 16-18 μm long. ([30] 70, Pl.1, Figs.3

(*Chlamydomonas globosa* Snow (Pl.1, Fig. 3

Cells broadly ovoid to globose, inclosed in a hyaline, anterior papilla absent; gelatinous sheath, 1 contractile vacuole in the anterior end of cell. Chloroplast a dense, cup shape with a basal pyrenoid; pigment-spot lens-shaped. cells 4-8 μm in diameter, 10-17 μm long. ([30] 71, Pl. 1, Figs. 8, 9

(*pandorina morum* (Muell.)Bory (Pl.1, Fig. 4

Colony usually distinctly ovate as much as 220 μm in diameter, cells pyriform, crowded, usually (16 in number, 10-15 μm in diameter, 12-17 μm long. ([30]75, Pl.1, Figs.23

(Pl.1, Fig. 5 *Volvox aureus* Ehr.

Spherical colonies of 500-3200 ellipsoidal cells, 4.5-6.2 μm in diameter, dioecious, in mature coenobia, 2 or more daughter colonies are present. as many as 21 eggs are formed in female colonies; half of the cells in male coenobia develop antherozoid bundles, zygote 38-62 μm in diameter, with a smooth wall. ([30]78, Pl.2, Figs.4

(Pl.1, Fig. 6 *Volvox globator* Linn.

Ovate or spherical, gelatinous colonies containing as many as 17,000 pyriform or ovoid cells 2-3.8 μm in diameter, coenobium commonly containing 4-7 daughter colonies; sexual colony with 11-17 or up to 40, eggs, each inclosed by a wide gelatinous sheath. zygote 45-54 μm in diameter, with thick walls exteriorly decorated with wart like, blunt spines and verrucae. ([30]78, Pl.2, Figs.5

(*Chlorococcum humicola* (Näegeli) Rabenhorst (Pl.1, Fig. 7

Cells solitary or number of cells crowded together to form a stratum, spherical. Chloroplast a hollow sphere with a single pyrenoid. Cells 30 μm in diameter. ([31]59, Pl.1, Figs.2

(*Golenkinia paucispina* West & West (Pl.1, Fig.8

Cells solitary spherical cells, with a few short setae arising from all sides of the cell wall, Chloroplast cup shaped with 1 pyrenoid. Cells 16-17.5 μm in diameter; setae about 15 μm long. ([30]213, Pl.45, Fig. 2, [32] 287, Pl.2, Figs.38

(*Golenkinia radiata* Chodat, J. (Pl. 2, Fig. 9

Cells solitary, spherical 5.4-9 μm diam.; chloroplast cup shaped, with one pyrenoid cell wall with numerous

straight spines arranged irregularly, 7.1-11 μm long. ([31]60, Pl.1, Figs. 5); [33]220, Pl. 3, Figs. 36).

(*Pediastrum boryanum* (Turp.) Meneghinii (Pl. 2, Fig. 10

Colony entire; cells 6-sided with granular or smooth walls, peripheral cells with outer margins extended into 2 blunt-tipped processes; cells 10 µm in diameter, 12-16 µm long; 16-celled (colony, 49µm wide, 54.6 µm long. ([30] 222, Pl. 47, Fig.9 , Pl. 48, Figs 1, 3

(*Coelastrum asteroides* De Notaris (Pl. , 2 , Fig. 11

Spherical cenobios of 8-16 ovate cells, slightly wedge-shaped and joined together directly by its walls. Parietal chloroplast with a pyrenoid, cell diameter: 8.3-10 µm. [34]409 , Fig.2, c ; [36]84,Pl.2 .(,Fig.28

(*Coelastrum microporum* Nügelii (Pl., 2, Fig. 12

Coenobium spherical ,consisted of 10- sheathed ovoid cells , with the narrow end out wardly direction ;cells inter linked by very short ,scarcely discernible gelatinous processes , leaving small intercellular space ; cells 11 µm in diameter including the sheath ; colony 15.2 µm in diameter. [30] (230 , Pl. 53. Fig. 3;[31]61, Pl. 1, Fig. 220;[35]343, Pl.2, Fig. 44

(*Ankistrodesmus bibrainus* (Reinsch) Korshikov, (Pl., 2 ,Fig. 13*

Colonies of 4-16 cells, cells lunated or semicircular, convex side oriented to the center of colony; gradually narrowing to the apex,3.8 -5.2 µm diam., 8-11 µm distance between apices; parietal .(chloroplast, without pyrenoid. ([33]218, Pl. 3 , Figs. 25

(Species:*Chlorella vulgaris* Beijerinck, Bot. Ztg. (Pl.2, Fig.14

Cells spherical, solitary or possibly forming cells small aggregates, spherical; smooth cell wall, 4-7.2 µm diam.; chloroplast cup shaped, with one pyrenoid. ([36]82, Pl. 1 ,Figs.15;[33]218 ,Pl.3 ,Fig. (23

(*Dictyosphaerium tetrachotomum* Printz (Pl.2, Fig. 15*

spherical colonies to Irregular, and even ellipticals. Elliptical to oval cells located at from the longitudinal axis of each cell, in the end of fine hyaline pedicels. Chloroplast Parietal coupled with a (pyrenoid. Cells18 µm long,8 µm broad. [34]415 ,Figs.4,H ;[35]343 ,Pl.2 ,Fig. 39

(Species:*Kirchneriella elongate* G.M. Smith (Pl.2, Fig. 16

Colony composed of 16 elongate cylindrical , spirally twisted cells, having rounded apices ,one parietal chloroplast , without pyrenoid.cells 3 µm in diameter, 16-25 µm long .([30]258, Pl. 58 (,Figs.1;[35]346 ,Pl.2, Fig. 62

Species:*Kirchneriella microscopica* Nyg. (Pl.3, Fig. 17)

Colony with 4-8 lunar cells, apices rounded;

Chloroplast parietal, without pyrenoid.Distance between the apices of the apices of cells 1-1.5 µm, long (2.8 µm, diameter 0.5-1 µm.([32]287 ,Pl.3 ,Fig. 41

(*Kirchneriella obesa* (W. West) Schmidle (Pl.3, Fig. 18

Colonies with 8-64 cells, lunated, flattened, with the outer side markedly convex and the inner concave side, poles rounded or slightly attenuated; arranged Irregularly, mucilage not very evident. Chloroplast with 1 pyrenoid, cells 5.8-14 µm long; 5.8-6 µm in diameter.([36]82, Pl. 2 (,Figs.19;[35]346 ,Pl.2 ,Fig. 63

(*Monoraphidium arcuatum* (Korshikov) Hindák (Pl.3, Fig. 19*

Cells solitary, arcuated, apices acuminate, ,2-3 µm in diameter, as much as 130 µm long; (parietal chloroplast, without pyrenoid .([33]219, Pl. 3 ,Figs. 29;[47]88 ,Pl.1 ,Fig. 13a,b

(*Monoraphidium contortum* (Thur.) Komárk.-Legn. , (Pl.3, Fig. 20*

Synonym:*Ankistrodesmus contortus*

Cells solitary , helicoidal, fusiform-elongated, 1 -2 μm in diameter , 13.5 -33 μm distance between apices ; parietal chloroplast, without pyrenoid.([33]219, Pl. 3 ,Figs. 30;[32]287 ,Pl.3 ,Fig. 45)

(*Monoraphidium griffithii* (Berk.) Komárk.-Legn., (Pl.3, Fig.21

Synonym:*Closterium griffithii*

Cells solitary, straight , fusiform-elongated, 60.5-67 μm long, 1.5 -2.2 μm diam.; parietal (chloroplast,without pyrenoid.([33]219, Pl. 3 ,Figs.31;[35]346 ,Pl.2 ,Fig.60

(Pl.3, Fig.22) *Oocystis borgei* snow

One cell or groups of 2-8 cells , oviform or elliptic cell, cinctured by the old wall of mother cell, chloroplast either 1 or 4 parietal plaques . cells 10.2 μm in diameter, 12.8 μm long .([37]609, pl. 1 (,figs.10

(Pl.3, Fig.23) *Oocystis lacustris* Chodat

Elliptical-oval cells, poles rounded smoothly and without thickenings. Chloroplast parietal (1-2), with a pyrenoid. maternal wall *globosa*.cells 11.5-12 μm long ,6-10 μm in diameter.([37]609, Pl. .(1,Figs.11;[34]413 ,Fig.3, H;[36],Pl.2,Fig. 20-22

((Pl.3, Fig.24 *Schoederia setigera*

Elongated- spindle cells, straight or slightly curved, 22-60.5 μm long, 3-6 μm in diameter,with extended poles in long and fine spines. Parietal chloroplast with 1 pyrenoid.([37]609, Pl. (1,Figs.11;[34]413,Fig. 4, A

(*Tetraëdron minimum* (A. Braun) hansgig (Pl.4, Fig.25

Flattened cells, lone front view square, with rounded angles and edges concave; soft cell wall. (cells 7.1 μm in diameter. ([38] 101, Pl.5, Fig. 124; [30] 267, Pl.60, Figs. 12-15

(*Tetraëdron muticum* (A. Braun) Hans. (Pl.4, Fig.26

Cells small, , triangular ,flat, the angles without spines or furcations; sides of the cells emarginate or slightly curved; cells 11.5 μm in diameter.([30] 267, Pl. 60, Figs. 16, 17; [39] 234, Pl. 1, Figs. .(13,14

(*Actinastrum hantzschii* Lagerheim (Pl.4, Fig.27

Fusiform or cylindrical form strait toward the top, gather in slimy or compound colonies from 4 or 8 with the length pivot of the cell radiancy of center . cells 3- 5.2 μm in diameter, 16-20 μm long . (([35] 344, Pl. 2, Figs. 47; [30]281,pl.64,fig.10,11

(Pl. 4, Fig.28) *Crucigenia lauterbornii* Schmidle

Colony consisting of 4 subspherical cells arranged in 2 opposite pairs about a large square space bounded by the flat ,Inner walls of the cells ; cella in contact only at their inner corners; cells 4– 9 μm (in diameter, 8 – 13 μm long .([30]284, Pl.65, Fig. 11

(*Crucigenia tetrapedia* (Kirchner) W.West & G.S.West (Pl.4, Fig.29

cells flat, quadratic ,crucified; arranged about amminute central space,triangular cells, outer margins of 4 straight cells;Single parietal chloroplast with 1 pyrenoid. cells 4.3– 8.9 μm in diameter.([31], 61, Pl. 1, .(Figs. 21;[36]84,Pl.2,Fig.30

(*Scenedesmus acuminatus* (Lagerhheim) Chodat (Pl.4, Fig.30

Colonies curved of 4-8 (usually 4) fusiform cells with sharp pointed ends. Interior cells forming a flat plate and the other cells lunate and at an angle to the plane of the interior cells; rarely, all the cells in the same plane. Cell wall smooth and without teeth or spines. Cells 18-22 μm long, wide 10-15 μm . ([31] 62, Pl. 1, Figs. 23; [30] 275, Pl. 62, Fig. 16

(Pl. 4, Fig. 31) *Scenedesmus arcuatus* (Lemmermann) Lemmermann

Cells are angularly oblong to ovoid. Colony 8 celled which are arranged in two linear series. Cell wall smooth. Cells are 8.7 μm – 14 μm long and 3.5 μm – 7.5 μm wide. ([40] 77, PL. I, Fig. 6, PL. II, Fig. 23).

(*Scenedesmus bicaudatus* Dedusenko (Pl. 4, Fig. 32*

Synonym: *Scenedesmus quadricauda* var. *bicaudata*

Colony 4 celled set in a linear series, long spine there in one pole of terminal cell, spine of one terminal cell appear opposite angle to the other terminal cell; cells 9 μm long and 4 μm broad with 6 μm (long spine. ([40] 79, Pl. 1, Figs. 3, PL. II, Fig. 20 ; [35] 354, Pl. 2, Fig. 51

(*Scenedesmus bijuga* (Turp.) Lagerheim (Pl. 5, Fig. 33

Colony consisting of 4-8 cells, ovate or oblong, single flat sequence, none teeth or spine, cells 4-8 μm in diameter, 10-15 μm long. ([30] 276, Pl. 63, Figs. 2, 7

(*Scenedesmus bijuga* (Turpin) Lagerheim var. *alternans* (Reinsch) Hansgirg (Pl. 5, Fig. 34

Colony 8 celled set in an alternating series, cell ovoid or ellipsoidal with rounded ends. Cells are 10.1– 15 μm long and 4.7 – 7 μm wide. ([40] 80, PL. I, Fig. 8, PL. II, Fig. 25; [30] 277, Pl. 63, Figs. 3, 4

(*Scenedesmus dimorphus* (Turpin) Kützing (Pl. 5, fig. 35

Colony composed of 4- 8 fusiform cells arranged in a single or alternating series, outer cells are lunate with pointed apices, inner cells with straight, sharp apices; cells 4–7 μm in diameter, 16-20 μm long. ([30] 277, Pl. 63, Figs. 8, 9

(*Scenedesmus perforatus* Lemmermann (Pl. 5, Fig. 36

Colony 4 celled arranged in linear series, inner cell with concave side, outer cell with convex side, lenticular perforations present between two adjacent cells, long spine present at the pole of terminal cells; cell 20 μm long and 5 – 9 μm broad; length of spine 7 μm . ([30] 279, Pl. 46, Figs. 24, 25; [40] 77, Pl. 2, Fig. 32, 33

(*Scenedesmus quadricauda* var. *quadrispina* (Chod.) (Pl. 5, Fig. 37

Colonies usually 2-4 cells, ovoidal and about twice as long as wide. Poles of terminal cells with single short curved spine. Cells long 16 μm , breadth 7 μm ; length of spine 4 μm . ([30] 280, Pl. 63, Figs. 21; [40] 81, PL. I, Fig. 4, PL. II, Fig. 21; [35] 345, Pl. 2, Fig. 55

(*Scenedesmus quadricauda* var. *westii* G.M. Smith (Pl. 5, Fig. 38

Colony consisting of 4-8 ovate cells, 6.2 μm in diameter, 18 μm long and have strongly reflexed short spines. ([30] 281, Pl. 64, Figs. 7

(*Euglena polymorpha* Dang. (Pl. 5, Fig. 39

Cell fusiform, pellicle flexible, striae delicate, spiral 88-90 μm long, 23-25 μm broad, chloroplasts (numerous, disc-shaped, margin irregular; 1 pyrenoid present. ([41] 131, Pl. 2, Figs. 17

((Pl. 5, Fig. 40 *Euglena sanguinea* Ehr.

Cell broadly fusiform to spindle shaped, pellicle spiral striated; chloroplasts numerous, with (deeply incised lobate margins; 49-120µm long, 27-35 µm broad. ([41]131, Pl.2, Figs.19,20

(Pl.6, Fig.41) *Euglena spirogyra* Ehr. var. *spirogyra*

Cell cylindrical, pellicle yellowish 100-150 µm long, 10-20 µm broad; tail piece 10-12µm long, (chloroplasts numerous, small disc, paramylon grains 2. ([41]132, Pl.2, Figs.23

(Pl.6, Fig.42) *Lepocinclis ovum* (Ehrenb.) Lemmerm

Cells elliptic, posterior end attenuated in a conical caudal process; pellicule with helicoidal stripes; many discoid chloroplasts, two annular, lateral paramylon grains, 22 µm long, 12 µm diam. ([33]225, Pl.5, Figs.72 ;[32]295,Pl.5, Fig. 104

Phacus curvicauda Svirenk (Pl.6, Fig.43)

Cells broadly ovoid in outline, anterior end broadly rounded, slightly spiral in the posterior part, which is extended into a caudus that curves obliquely to the left; periplast longitudinally finely striated (or smooth); paramylon bodies 2 large discs; chloroplast numerous ovoid bodies; cells 24 µm (in diameter, 36 µm long. ([33]225, Pl.5, Figs.72 ;[32]295,Pl.5, Fig. 104

(*Cryptomonas erosa* Ehrenb (Pl.6, Fig.44

Cell broadly ovate or ellipsoid, the left margin arcuate and more convex than the right, apex almost evenly bilobed, the gullet broad, extending about 0.5 or less the length of the cell; cells 9-14 µm (in diameter, 15-32 µm long. [30]442, Pl.95, figs.39;[32]298,Pl.7, Fig. ,128;129

(*Gymnodinium fuscum* (Ehrenb.) Stein (Pl.6, Fig.45

Cells ovoid, large, epicone like dome and hypocone as broad as the epicone, narrowed posteriorly to form an inverted cone with a slightly produced tip; transverse groove slightly spiral; the longitudinal furrow extending about half way into the hypocone, but scarcely at all into the epicone. (cells 50-65 µm in diameter 90-100µm long. [30]426, Pl.89, Figs.23

(*Peridinium gatunense* Nygaard (Pl.6, Fig.46

Cells elliptic to globose, with angulations in the marginal sutures; the poles broadly rounded; transverse channel spiral with a wide border, unequally dividing the cell into a greater epicone and a shorter hypocone; the longitudinal channel extending wide, striated sutures between them, epitheca with 13 plates; hypotheca with large antapicals and 5 postequatorial plates cells 50-82 µm in (diameter, 30-75 µm long. [30]433, Pl.90, Figs.25,26

(*Chroococcus thermalis* (Maneghini) Nageli (Pl.6, Fig.47*

.Synonym: *Chroococcus turgidus* var. *thermalis* (Maneghini) Rab. Ex Han

Cells round, hemispherical, blue green with granular content, cell arrangement typical chroococcoid, cell diameter 9 µm; colony of 2, 3 or 4 cells with colorless indistinct mucilage. [42]258, (Pl.1, Fig.H

(*Microcystis aeruginosa* Kützing (Pl.6, Fig.48

An spherical, ovate or irregularly lobed and clathrate colony of several spherical cells which are much busier with distinct hyaline colonial mucilage; cell 3-3.5 µm in diameter; spherical generally (with gas vacuoles and highly granular. ([43]139,Pl.2, Fig.b,c;[30] 456, Pl.102, Fig. 1-4

(*Merismopedia elegans* A. Braun in Kützing (Pl.7, Fig.49

Cell widely oval or elliptic, 7.5-12.5 μm long, 4-7.5 μm wide, unicellular-colonial, mucilage more or less firm, more or less densely arranged in perpendicular rows. ([45]56, Pl.1, Figs. 11,12 .; [43]140, Pl.2, Fig. f

(*Merismopedia punctata* Meyen (Pl.7, Fig.50

Colonial tabular, mucilage more or less firm, cells spherical or subspherical ,more or less loosely arranged in regular rows, , 3-4 μm in diameter 8-12 long .([45]57, Pl.1, Figs. 15,16 .; [43]141, Pl.2, Fig. g

(Pl.7, Fig.51) *Anabaena cf -flos-aquae*(Lyngb.)De Brebisson

Trichomes very flexuoux and contorted , some times coiled in an irregular spiral fashion ; either solitary or entangled in a twisted mass cells spherical to sup cylindric ; 4.5 – 8 μm in diameter , 6-12 μm long ; heterocysts globose or some what depressed at the poles ; 7.2 – 9 μm in diameter , 6 – (10 μm long .([30]515, Pl.116, Fig.7

((Pl.7, Fig.52 *Anabaenopsis circular* (G.S.West) Wołoszyńska y

Trichomes spiral or circular, short, solitary, slightly arched. Cells cylindrical and usually slightly arched, heterochromes Spherical to oval, are usually arranged two by two at each end of the filament. Akinetes oval, are arranged in half of the trichomes, separated from the heterocysts. Diameter cellular of 4-6 μm and length of 4.5-9.5 μm diameter of trichom 10-52 μm .([45]61, Pl.3, Figs. 1,2)

((Pl.7, Fig.53 *Anabaenopsis elenkinii* V.V.

Trichome : circular, short and solitary, cylindrical cells with extremities rounded, contain spherical terminal heterocytes with 4-6 μm in diameter. Akinetes broadly ovoid, 8-10.5 μm in diameter. ([45]61, Pl.3, Figs.3,4; [30]520, Pl.131, Fig.4

(Pl.7, Fig.54) *Cylindrospermopsis taveriae* Komárek*

solitary trichomes in circular, spirals or more or less irregular. Cylindrical or slightly barrel cells, small, tapering apical cells and usually slightly narrower and round at the apex. The heterocyste is slightly elongated, conical, curved, and rounded at apex. Cell diameter 1.53 μm and 3 μm long. ([45]63, Pl.3, Figs.11,12

(*Komvophoron constrictum* (Szafer) (Pl.7, Fig.55

Trichomes in a straight line, 5-6 μm wide, not attenuated towards the end, constricted at the cross-walls, cells 2-4 μm wide, slightly thin at the middle, apical cells rounded. ([43] 145, Pl.3, Fig.c ; [48]19 , .(Pl. 333 Fig. 462

((Pl.7, Fig.56 *Komvophoron minutum* (Skuja) *

Trichomes straight or solitary, slightly curved, constricted; cells longer than broad, 4.5-7 μm long, 3.1 -4 μm wide; apical cell attenuated, not capitated; cell content blue-green, (homogeneous. Length of the trichome of 38-100 μm . ([33]217, Pl. 2 , Fig. 14

(*Lyngbya martensiana* Meneghini (Pl.7, Fig.57

Filaments solitary, straight, 8.0-13 μm wide; sheaths hyaline, thick, colorless to yellowish, lamellate; trichomes not attenuated, not constricted at the granulated cross-walls, 5.5-9.7 μm wide; cells 0.2- 0.5 times longer than wide, 2.0-4.0 μm long; cell content blue-green; apical cell rounded. ([46]335, Pl.2, Fig.18

(*Oscillatoria anguina* Bory (Pl.7, Fig.58

Trichomes solitary, curved, straight and gradually tightening at the apex, not constricted at the granulated cross-walls, 6 -9.3 μm wide; cells 0.4-0.5 times longer than wide, 1.2 -3.1 μm long; .(apical cell capitate or rounded, with a thick outer cell wall.([46]335, Pl. 2, Figs.19,20

(*Oscillatoria curviceps* Agardh (Pl.8, Fig 59

Trichomes solitary, curved, straight and gradually tightening at the apex, not constricted at their granulated cross-walls, 9.0-16.0 μm wide; cells 0.1-0.4 times longer than wide, 1.7-3 μm long; cell content blue green; apical cell capitate or rounded, with thick outercell wall.([46]335, Pl. 2, .(Figs.21

(*Oscillatoria limosa* (Roth) Agradh (Pl.8, Fig.60

Trichomes straight 12-17 μm broad, cells 3-4 μm long with mostly finely granular not constricted at the granulated cross-walls, not attenuated at the ends, apical cells flat-rounded or rounded with slightly thickened outer cell wall, without calyptra. ([43]142,Pl.3, Fig.d,e;[44] 206, Pl. 1-42, Fig. (11

(*Oscillatoria princeps* Vaucher (Pl.8, Fig.61

Trichomes straight, apical cells rounded , with thickened cell wall , not constricted at cross-walls,20-24 μm wide. Cells always shorter than wide, 3-5 μm long. Apical cells rounded , with (thickened cell wall. [43]142,pl.3, fig.g;[46]336,Pl.2,Fig. 23

(*Oscillatoria splendida* Greville (Pl. 8 Fig.62

Trichomes solitary, straight or curved,tapering for a long distance to a fine hair at the apex. Apical cell conical and capitate . cells 2-3 μm in diameter, 8.5 – 13.1 μm long , not constricted at the cross walls . [30]491,Pl.110, Fig.5-7)

(*Oscillatoria tenuis* Agardh (Pl.8, Fig.63

Trichomes solitary, straight or fl exuous,a pical cell rounded. not attenuated, not (or only slightly) constricted at the granulated or ungranulated cross-walls, 6.75-11.5 μm wide; cells up to 0.2- (0.74 times longer than wide, 1.6-3 μm long. [44] 222 Pl. 42, Fig. 15;[46]336,Pl.2,Fig. 24

(*Oscillatoria cf. vizagapatensis* Rao (Pl.8, Fig.64

Trichomes straight, not constricted at the cross walls, slightly attenuated at the ends, cells2.5-3 (μm long, 7-11 μm wide, apical cells rounded-conical, without calyptras.([43]142,Pl.3, Fig.j

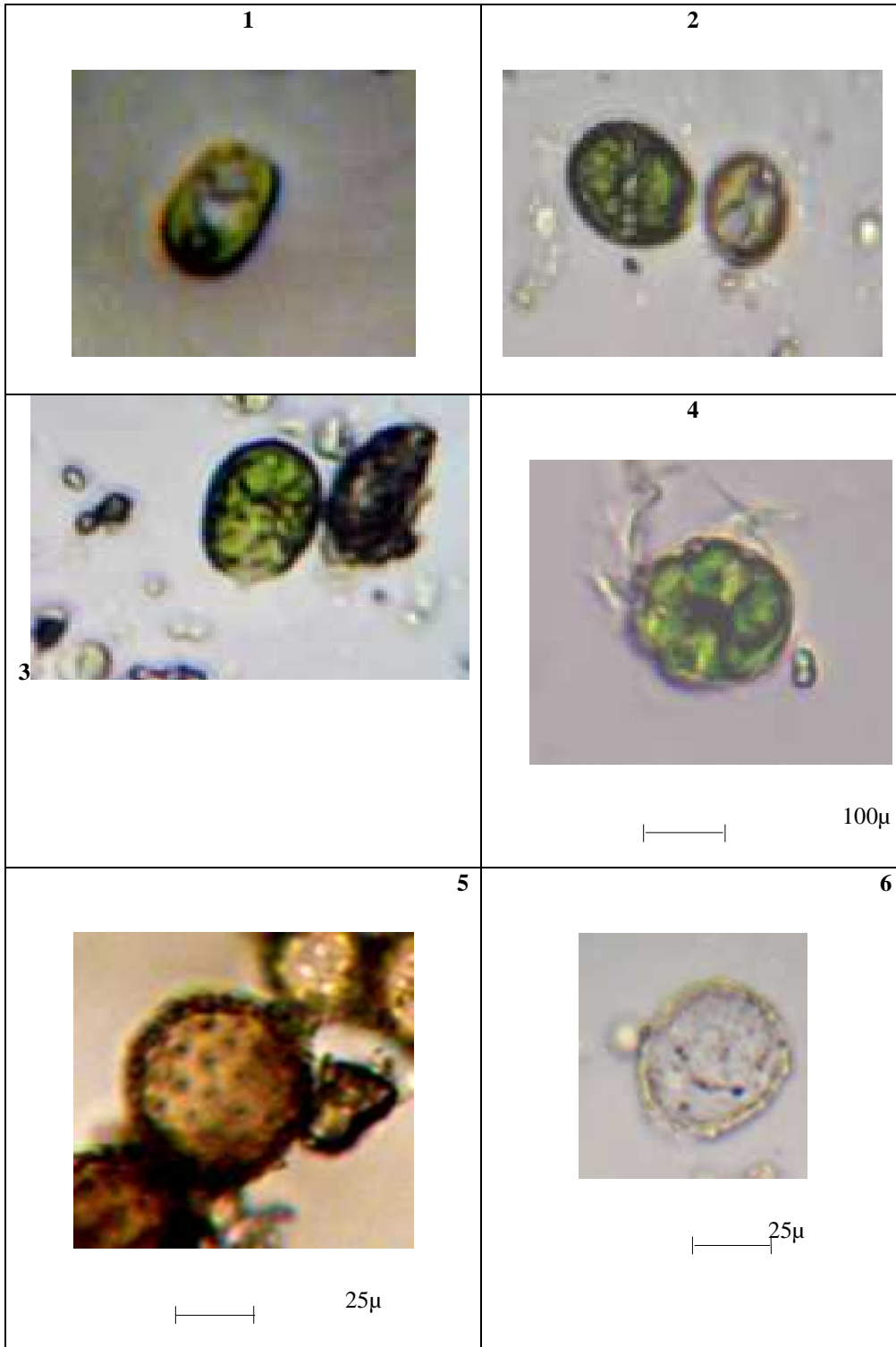
(*Spirulina gigantea* Schimidle (Pl.8, Fig.65

Trichome 44 μm long, breadth 3 μm , deep blue green, regularly spirally coiled, at the end conical .(attenuated, spirals 12-16 μm .([43]144,Pl.5, Fig. j

(*Spirulina meneghiniana* Zanardini (Pl.8, Fig.66

Trichomes 2 μm wide, with special pore and hole patterns in the cell walls, nearly irregularly loosely

screw-like twisting, 3-5 μm wid .([43]144, Pl.5, Fig. k).



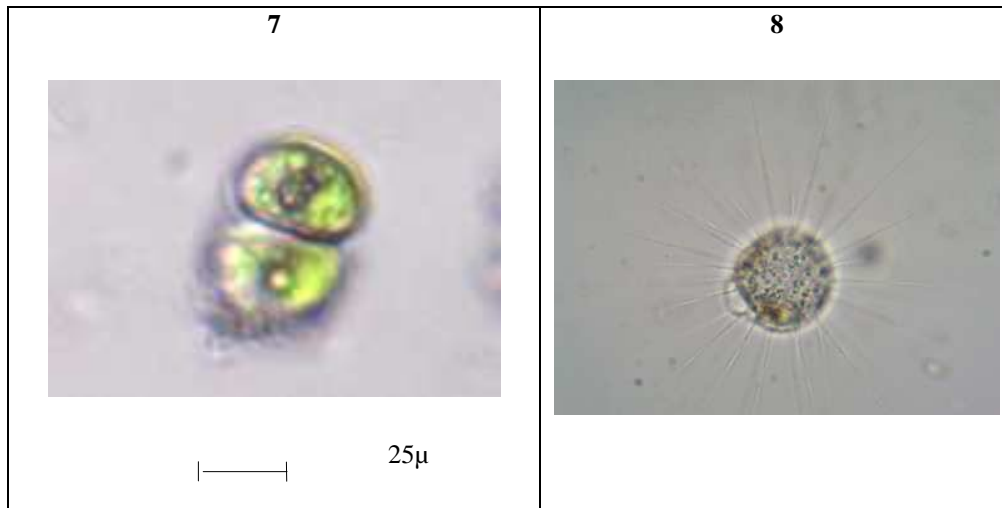
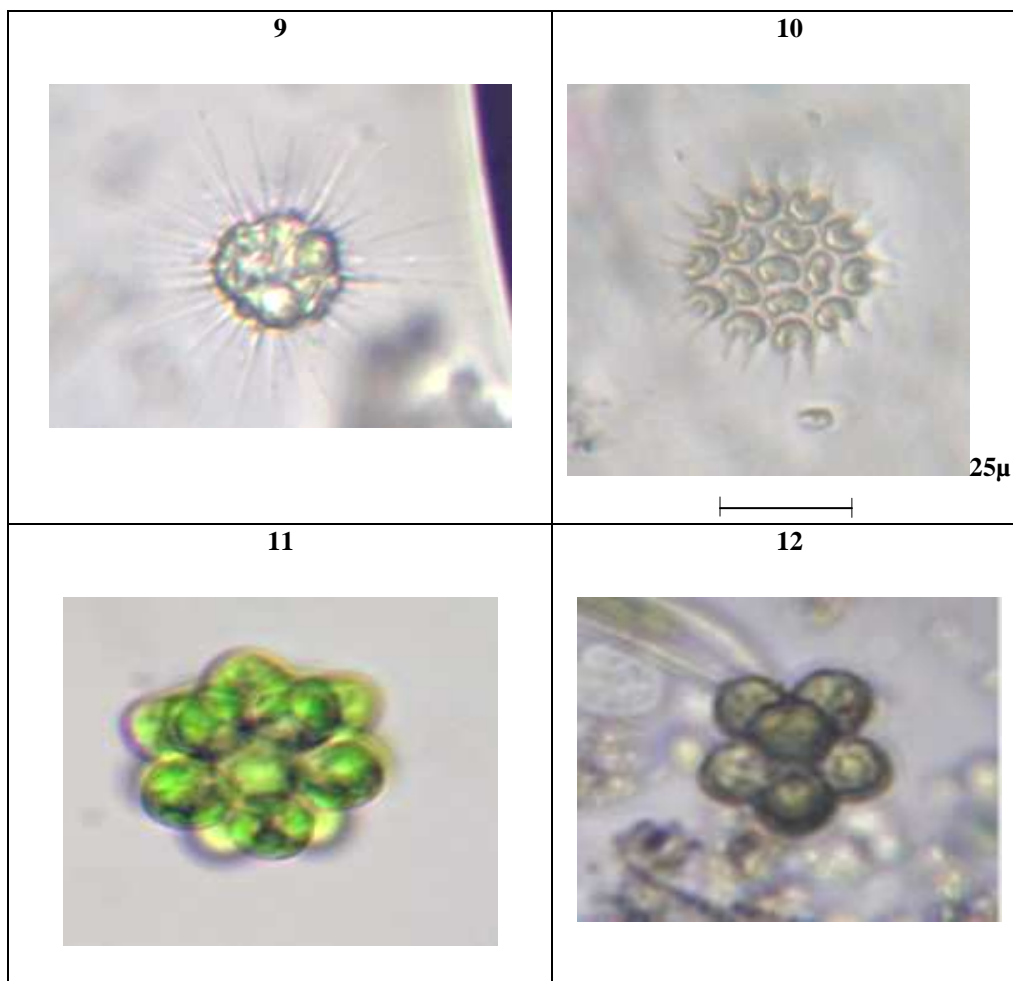


Plate 1: 1 *Carteria cordiformis*(Carter) Diesing,2- *Chlamydomonas angulosa* Dill ,3- *Chlamydomonas globosa* Snow,4- *pandorina morum* (Muell.)Bory ,5 -*Volvox aureus* Ehr.6- *Volvox globator* Linn. ,7- *Chlorococcum humicola*(Näegeli) Rabenhorst ,8- *Golenkinia paucispina* West & West 10μ



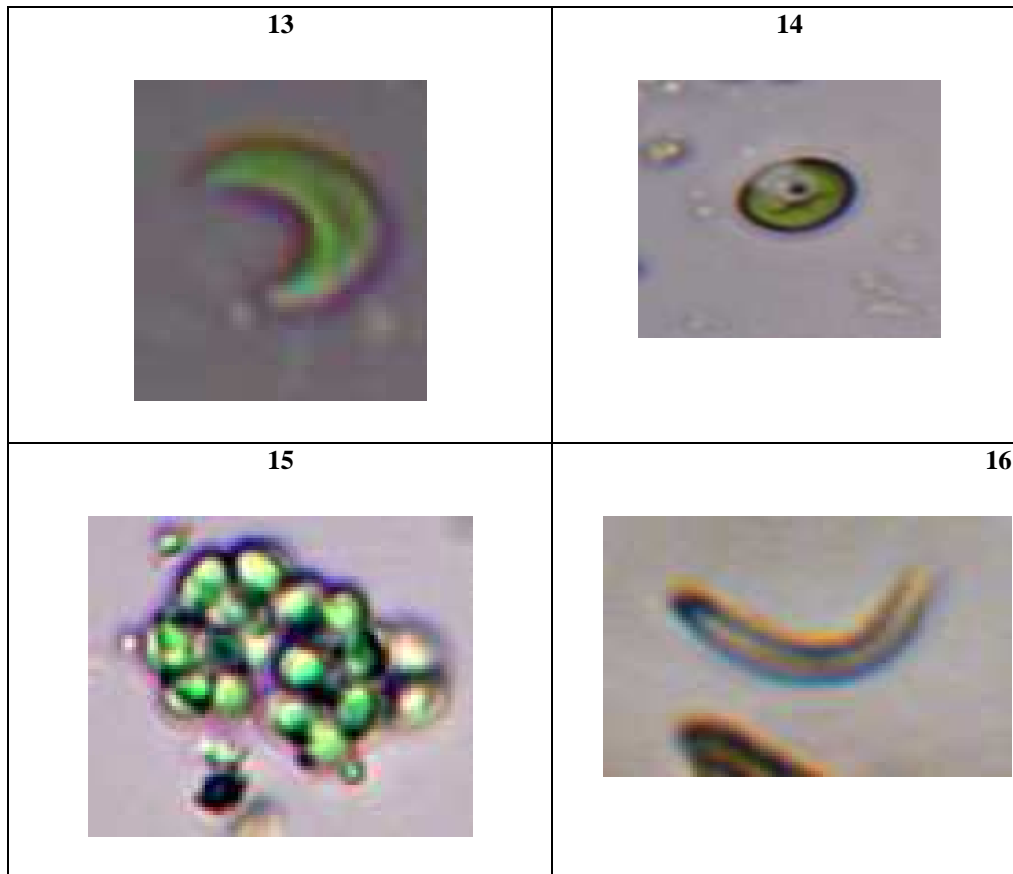
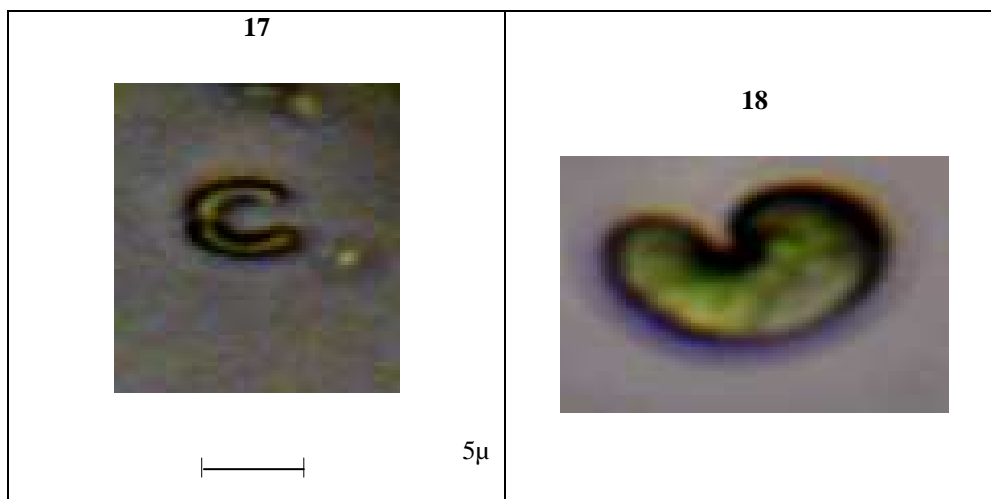
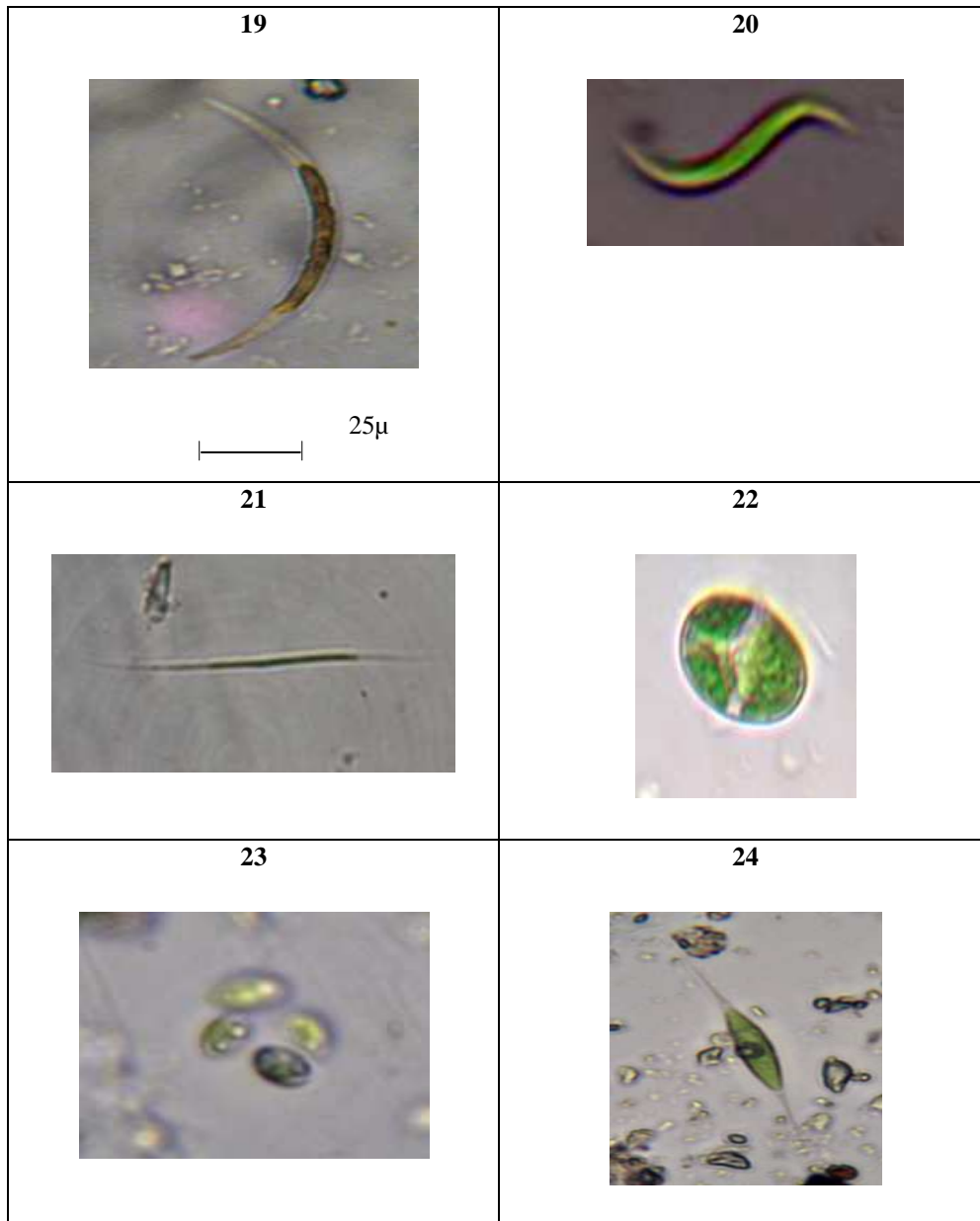


Plate2: 9- *Golenkinia radiata* Chodat, J. ,10-: *Pediastrum boryanum*(Turp.) Meneghini,11- *Coelastrum asterioides* De Notaris ,12-*Coelastrum microporum* Nügeli, 13- *Ankistrodesmus bibrainus*(Reinsch) Korshikov ,14- *Chlorella vulgaris* Beijerinck, Bot. Ztg. , 15- *Dictyosphaerium tetrachotomum* Printz,16- *Kirchneriella elongate* G.M. Smith, 10 μ





:Plate3

17- *Kirchneriella microscopica* Nyg., 18- *Kirchneriella obesa* (W. West) Schmidle 19- *Monoraphidium arcuatum* (Korshikov) Hindák, 20- *Monoraphidium contortum* (Thur.) Komark

Legn., 21- *Monoraphidium griffithii* (Berk.) Komark-Legn., 22- *Oocystis borgei* snow, 23- *Oocystis lacustris* Chodat 24- *Schoederia setigera*

20µ

& 10µ

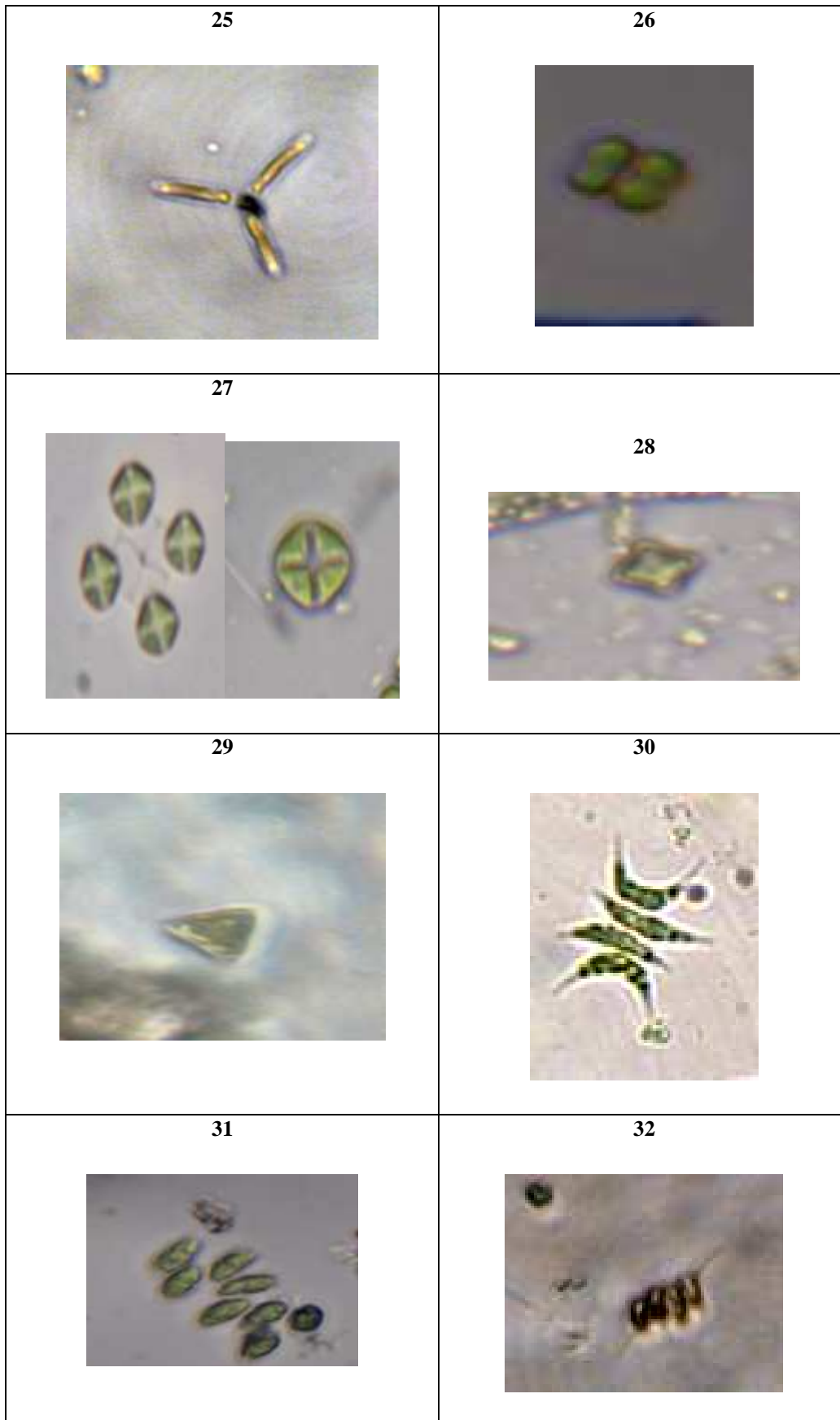
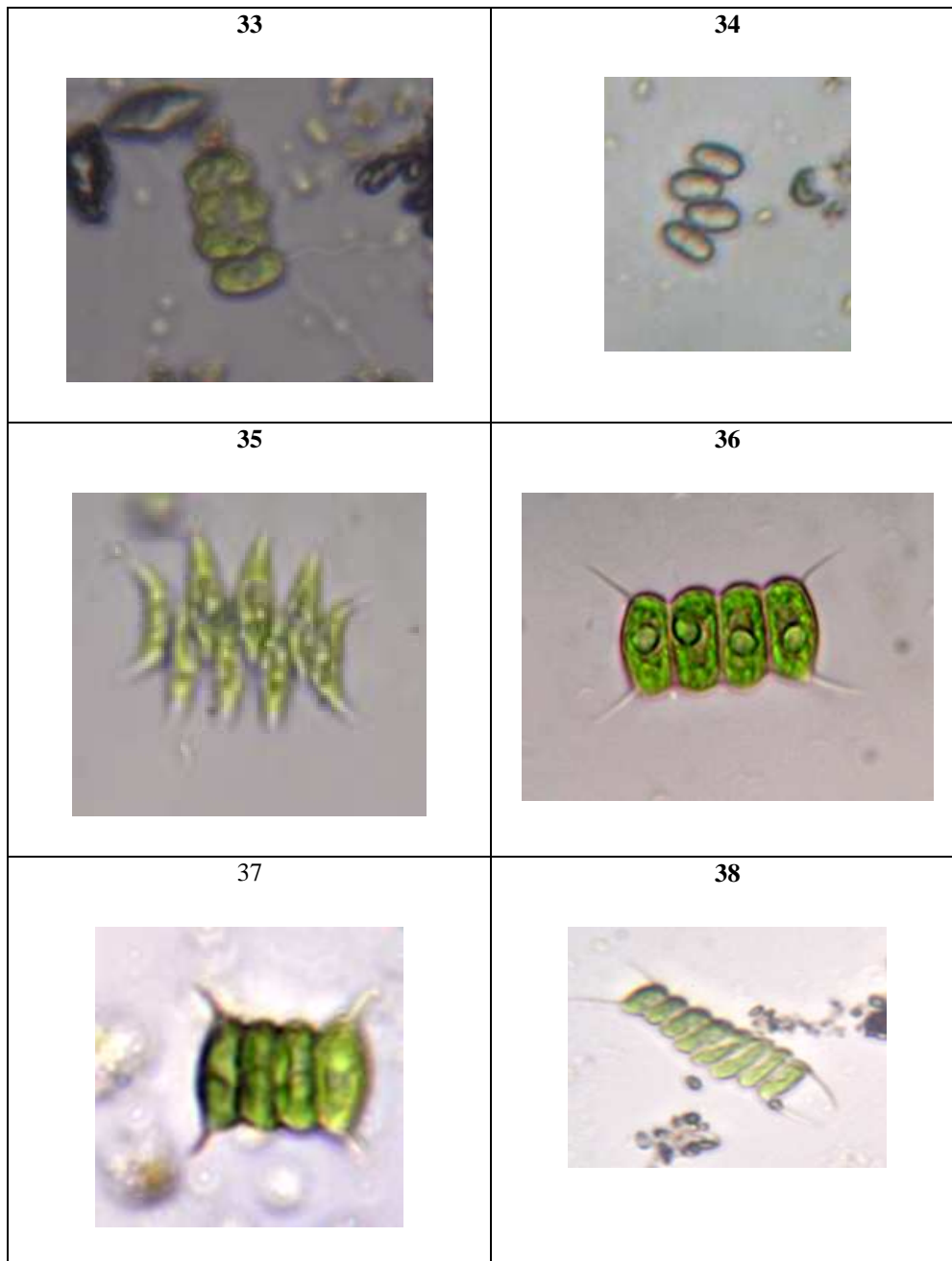


Plate4: 25- Actinastrum hantzschii Lagerheim,26- Crucigenia lauterbornii Schmidle,27- Crucigenia tetrapedia(Kirchner) W.West & G.S.West , 28- Tetraëdron minimum (A. Braun) hansgig,29-

Tetraëdron muticum (A. Braun) Hans,30- Scenedesmus acuminatus Lagerhheim) Chodat ,31-
Scenedesmus arcuatu(Lemmermann) Lemmermann s,32- Scenedesmus bicaudatus Dedusenko
10µ



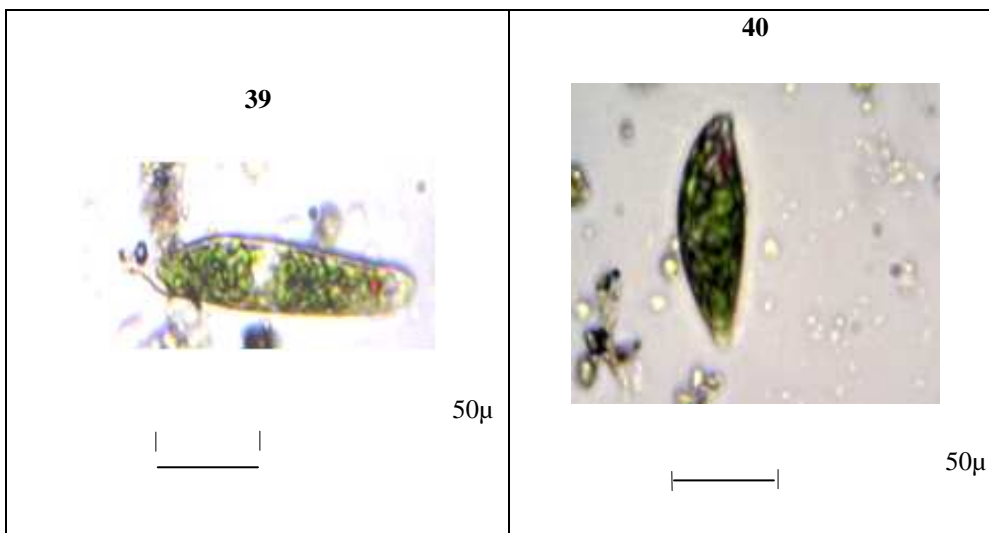
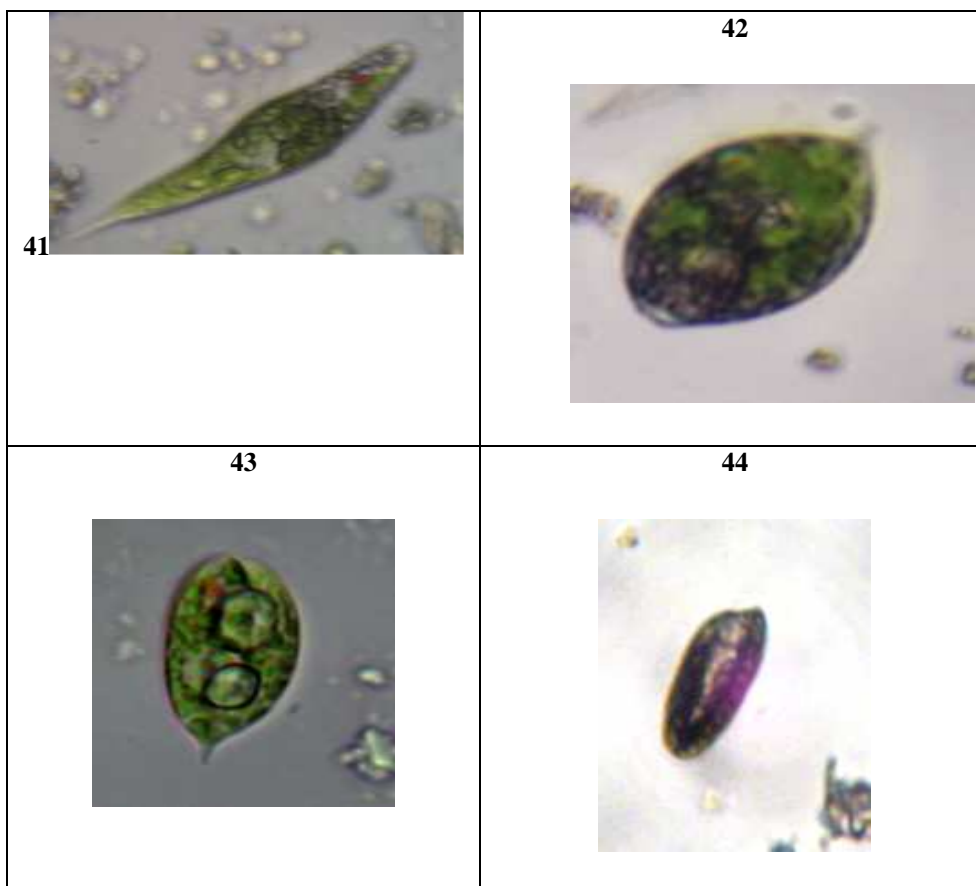


Plate 5: 33- Scenedesmus bijuga(Turp.) Lagerheim ,34 Scenedesmu bijuga (Turpin) Lagerheim var. alternans (Reinsch) Hansgirg ,35- Scenedesmus dimorphus(Turpin) Kützing ,36- Scenedesmus perforates Lemmermann,37- Scenedesmus quadricauda var. quadrispina(Chod.) ,38- Scenedesmus quadricauda var westii G.M. Smith ,39- Euglena polymorpha Dang.,40- Euglena sanguinea Ehr. 10μ



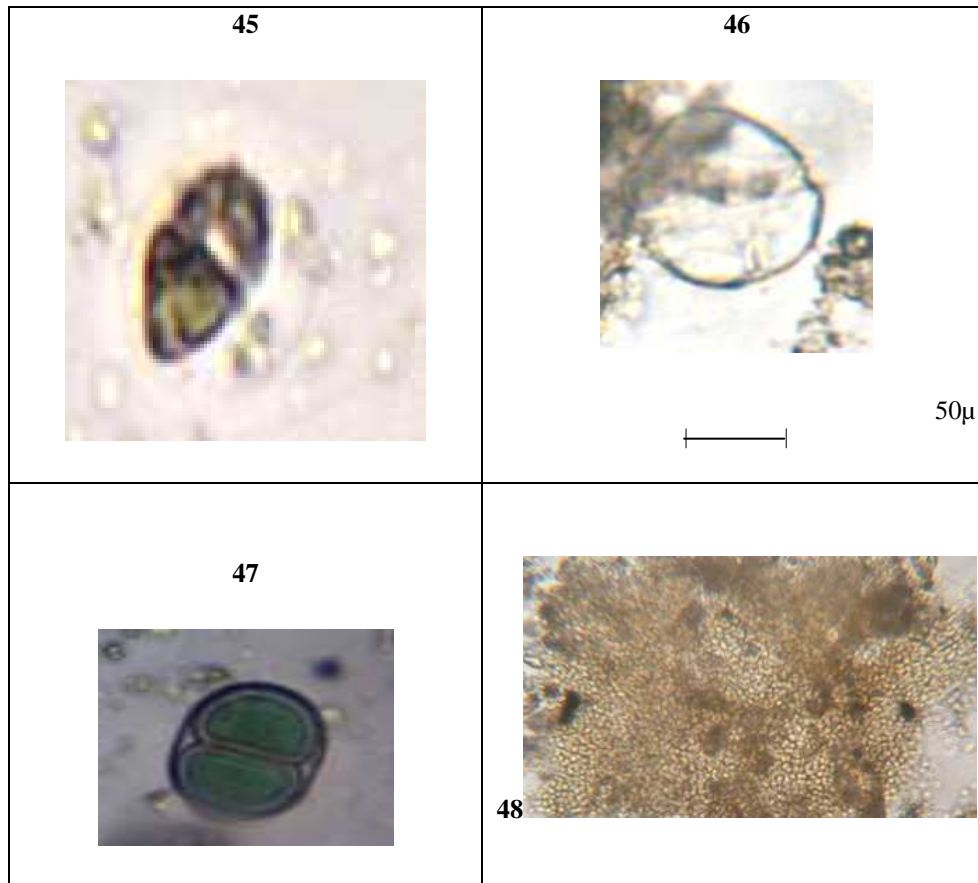
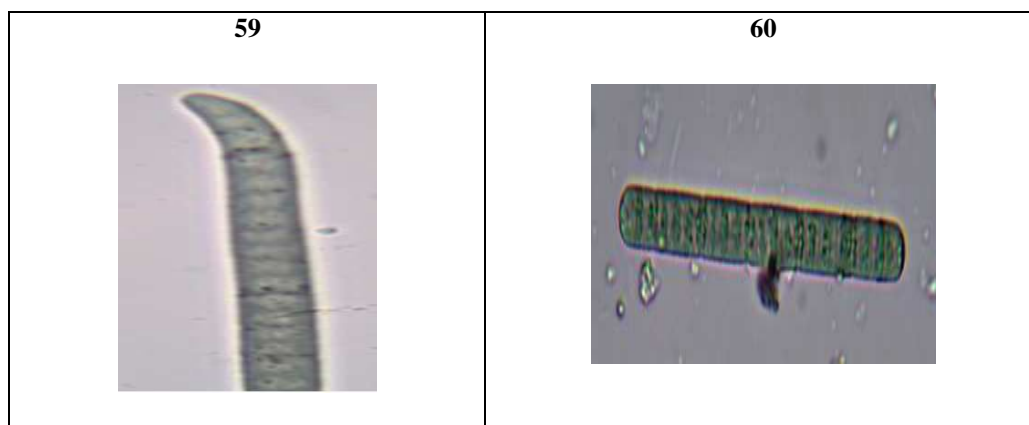


Plate 6 : 41- *Euglena spirogyra* Ehr. var. *spirogyra*,42- *Lepocinclis ovum*(Ehrenb.) Lemmerm,43- *Phacus curvicauda* Svirenk,44- *Cryptomonas erosa* Ehrenb,45- *Gymnodinium fuscum*(Ehrenb.) Stein,46- *Peridinium gatunense* Nygaard,47- *Chroococcus thermalis*(Maneghini) Nageli ,48- *Microcystis aeruginosa* Kützing

10μ 25μ



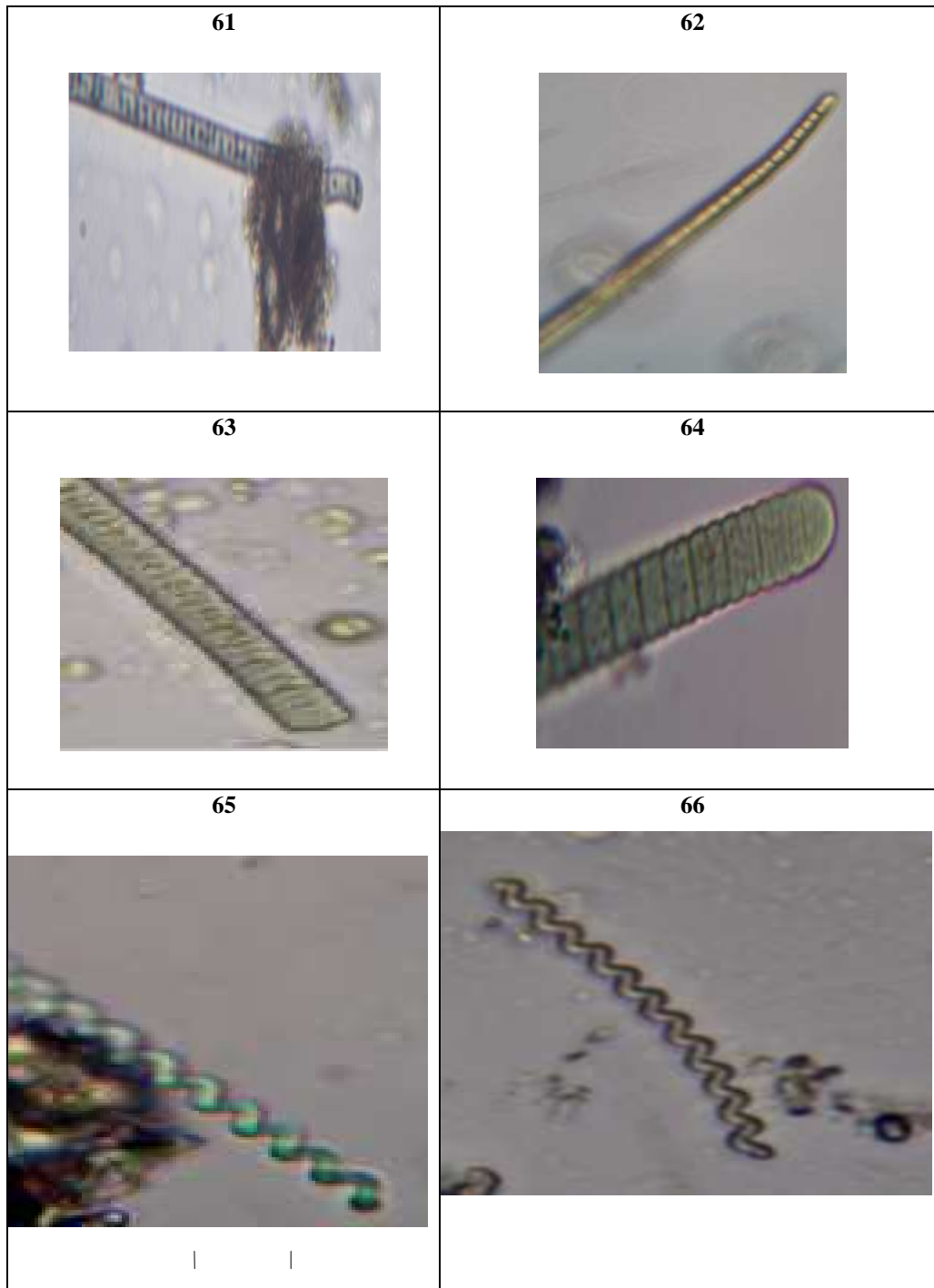


Plate8: 59- *Oscillatoria curviceps* Agardh,60- *Oscillatoria limosa* (Roth) Agradh 61- *Oscillatoria princeps* Vaucher s,62- *Oscillatoria splendid* Greville,63- *Oscillatoria tenuis* Agardh,64- *Oscillatoria vizagapatensis* Rao, 65- *Spirulina gigantean* Schimidle,66- *Spirulina meneghiniana* Zanardini 10µ

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