



## TAXONOMICAL ENUMERATION OF UNICELLULAR AND COLONIAL CYANOBACTERIAL TAXA FROM DISTRICT NASHIK (MH), INDIA

**Kiran Prakash Patil (Behere), Udaya Ganesh Basarkar**

\*Dept. of Botany, G.E.Society's, H.P.T./R.Y.K. Science college, Nashik

Email : [padmakarpathankar@gmail.com](mailto:padmakarpathankar@gmail.com)

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### ABSTRACT:

The Myxophyceae or Cyanobacteria is unique group of organisms having C- phycocyanin and C phycoerythrin pigments, it reflect blue green colour. So this characteristics group of organism is commonly called as blue green algae. The members of the unicellular and colonial are representing primitive habits. Such primitive members are representing family Chroococcaceae. Thus the Chroococcaceae are spherical, ovoid or cylindrical in structure, occurs singly or to form colonies with a slimy matrix. Family Chroococcaceae are non heterocystous cyanobacteria. The present work deals with the taxonomy of micro algae of the family Chroococcaceae in the fresh water reservoirs of various localities of Nashik. In present investigation family Chroococcaceae is represented by 13genera, 57 species *Glaucocystis duplex*, *G. nostochinearum* and *Gloeochaete wittrockiana* are rare and little known taxa of the family Chroococcaceae. Among these *Glaucocystis duplex*, *G. nostochinearum* are new to Maharashtra. The alga *Gloeochaete wittrockiana* appear new report for India. Rests are first time explored from this region. This enriches the algal flora of Nashik.

**Key words:** - Taxonomy, Blue green algae, Chroococcaceae, Microalgae, Nashik.

### INTRODUCTION:

Blue-green algae or Cyanobacteria are a unique group of the plant world. Blue-green algae occupy an anomalous position in the biological world. They are global in occurrence and are most ancient of the lower organisms thriving right from the pre-Cambrian times and have successfully established today in almost every kind of habitats on this planet. They are probably the oldest and toughest life forms which dominated life in oceans. These micro- organisms have played a major role in phylogeny and evolution of plant kingdom.

These simple prokaryotic plants are one of the most important primary producers of organic matter and thus play a major role as a basic part of the living community

Chroococcales are non heterocystous cyanobacteria. Members of order Chroococcales are spherical, ovoid or cylindrical in structure,

occurs singly or to form colonies with a slimy matrix. Chroococcales are non heterocystous cyanobacteria. Chroococcales plays an important role in nitrogen fixation. These are the good source of secondary metabolites eg. *Microcystin*.

The present investigation is taken to explore the fresh water algal flora of Nashik district during the period 2009-2013. The study area is Nashik city proper and its environs about 50-60 km. away from Nashik city. Nashik is situated in the Western Maharashtra. Nashik, lying between 19° 33' and 20° 53' north latitude and 73° 16' and 73° 6' east longitude, with an area of 13100.06 sq. km. The district Nashik is of rhomboidal in shape, with a length of 173.80 km from south-west to north-east and extreme breadth from north to south of 140 km. The average annual maximum temperature at Nashik is 32.2°C, and the minimum 16.1°C.

## MATERIALS AND METHODS:

Sample of foam, submerged decaying wood and submerged decaying leaves were collected from various localities along major streams and water reservoirs from Ahmednagar district (Maharashtra state). The survey was undertaken for two years during 2013-2015. The sample analysis was done by the following methods:

1) Wood analysis:-Submerged woody debris was collected and placed in polythene bags from various streams, rivers and lakes. Samples were transported to the laboratory. Collections contaminated by sediments or fouling organisms were washed with tap water. Specimens were observed for sporulating structures (Ascomata and conidia). After initial observations, samples were placed in plastic boxes and after one week periodically examined for the presence of fungal fruiting bodies.

2) Leaf litter analysis: -Submerged leaves were collected from sampling sites and brought to the laboratory in polythene bags. They were washed in tap water and finally in distilled water. They were cut into small bits and incubated, separated in Petri dishes containing distilled water at laboratory temp. (25-30°C). The water was replaced in Petri dishes once in three days to minimize the growth of bacteria and other aquatic organisms (algae, animal etc.). The leaf bits were screened under microscope at 72 hour intervals for 60 days to detect the water borne fungi appearing on margin and petiole of the leaves.

3) Foam analysis:-Foam samples were collected in wide mouthed plastic bottles and kept for 24 hours to enable the foam to dissolve. It was preserved by adding FAA to yield 5% foam solution. Then samples were scanned under high power of a microscope using 10x or 15x eyepieces for the presence of conidia of Hyphomycetes.

The slides were made permanent by using double cover glass method (Volkmann-Kohlmeyer and

Kohlmeyer, 1996). The measurement of various parts of fungi were taken and used in the identification and classification of different species. Reports of fungi from India and Maharashtra state were confirmed with the help of Bilgrami et al. (1979, 1981, 1991), Sridhar et al. (1992), Sarbhoy et al. (1975, 1986, 1996), Jamaluddin et al. (2004), Borse et al. (2014), Patil and Borse (2015) and other relevant literature.

The study is based on field, laboratory work and literature surveys. Collection were made with help of phytoplankton net and manually. Algal samples were preserved in 4% formalin. For the detailed studies of algae, Photomicrography has been done under Labmade electric microscope with digital camera.

### 2.1. COLLECTION OF ALGAL SAMPLES:

The Algae are collected by hand or with a knife, forceps etc. including part or entire substrates. They are also collected from stones in fast flowing water, aquatic plants, on dam walls and from any floating objects. Algae are also obtained by simply squeezing bryophytes and other aquatics. The phytoplanktons are collected by using a fine mesh phytoplankton net, with 25-30 $\mu$  pores. Sufficient quantity of sample is concentrated by simply scooping a jar through the water for several times.

### 2.2 STORAGE AND PRESERVATION OF SAMPLES:

The algal samples are collected in bottles, jars or plastic bags of different sizes with some water from the collection sites. After collection the containers are kept open. Algae can be kept alive for short periods for one or two days in open petri dishes, in a cool place with reduced light for their continuous growth and further observations.

For long term storage samples are preserved in preservative solutions, dried or as permanent microscope mounts. Samples are preserved in commercial formations like 4 % formalin and FAA.

The observations are based on living materials which are essential for its identification. The simplest method is to prepare a cavity glass slide by placing a drop of sample on to the slide with cover slip carefully over it and avoiding any air bubbles and observing the specimen under lower magnification of microscope. Observations are made more sequentially at under 4 x, 10x, 40x, 100 x magnification. India ink is also used to observe the flagella of motile organisms.

### 2.3 MEASUREMENTS:

The measurements of the specimens are taken and used for its identification and subsequent classification. The metric units' cm, mm, and  $\mu$  are utilized. .

### 2.4 ILLUSTRATIONS:

All the drawings are drawn with the help of Mirror- type and Prism type - Focus CLM-8 S.no.4647 Camera Lucida at the stage level using 10x, 40x 45x, 100x, objectives and 6x, 10x eye-pieces. The measurements were made by ocular and 45x, 100x objectives. Sketches were drawn on plain paper with the help of Rotering pen using black water proof India ink. The thickness of each sketch was maintained uniform.

### 2.5 MICROPHOTOGRAPHS:

The microphotographs are taken by camera by using "Lobo"- Trinocular microscope unit. Sony Cyber Shot DSC-W80 camera is used for all microphotographs.

### 2.6 IDENTIFICATION:

The identification of algae was done by using standard monographs and research papers.

## III TAXONOMICAL ENUMERATION

Division	Cyanophyta
Class	Cyanophyceae
Order	Chroococcales
Family	Chroococcaceae

### Genus-*Microcystis* Lemmermann, 1907:

Desikachary, 1959: 82.

Cells spherical or elongated many in spherical ellipsoidal or irregularly overlapping or net-like colony, free-swimming, often with attached

daughter colonies. Cells in homogeneous colourless, often difficult, mucilage, individual envelopes absent. Cells arranged very densely.

### *Microcystis aeruginosa* (Kützing), 1846:

Pl. -3, F.-3

Desikachary- 1959; 93: Pl. - 17, Fig.-1; Pl.-18, Fig. - 6, 10.

= *Clathrocystis aeruginosa* (Kützing.) Henfrey, J. Roy, 1907.

= *Anacystis cyanea* (Kützing) Drouet and Daily Rev, 1956.

= *Micraloa aeruginosa* Kützing, 1833.

= *Diplocystis aeruginosa* (Kützing) Trevisan, 1848.

= *Clathrocystis aeruginosa* (Kützing) Henfrey, 1856.

Colonies young rounded, slightly longer than broad, solid, mature irregular shape with distinct hyaline colonial mucilage, marginal envelope, diffluent, cells  $2.64\mu$  in dia., spherical with gas-vacuoles.

Habitat- Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009),

Pimpalgaon Bhor (14/09/2010), Karanjwan Dam (15/10/2009), KashyapiDam (28/10/2010), Anandwali (14/11/2011), Ghodegaon (18/08/2011), Ozar (27/02/2012), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012).

Distribution- Maharashtra (Schmidle, 1900b; Dixit, 1936; Gonzalves and Joshi, 1943a; Kamat, 1963; 1968; 1974; 1975; Mahajan and Mahajan, 1990; Patil, 2000; Talekar and Jadhav, 2009; Bhosale and Dhumal 2012), West Bengal (Biswas, 1927, 1942; Banerji, 1936; Das and Adhikary, 2012), Uttar Pradesh (Bharadwaja, 1935), Andhra Pradesh (Ghousuddin, 1936), Orissa (Rao, 1938b), Kerala (Parukutty, 1940) Delhi (Rao, 1940), Tamilnadu (Ganapathi, 1940; Kavitha and Balasingh, 2007), Karnataka (Gonzalves and Kamat, 1958; Tiwari, 1975), MadhyaPradesh (Agarkar, 1967).

***Microcystis aeruginosa* var. *major* (Wittrock)**

**G. M. Smith:** Pl.-3, F.-2

Desikachary- 1959; 94: Pl.-17, Fig.-2.

Colonies clathrate, broken to filaments, young colony rounded, slightly longer than broad, solid, with distinct hyaline colonial mucilage, marginal envelope diffluent. Cells are larger in size than the typical type. Cells 5.5 -6.6 $\mu$  in dia., spherical with gas-vacuoles. It seems a first report of the alga from this locality and Maharashtra.

Habitat- Rajurgaon (4/6/2011), Tapovan (22/06/2012).

Distribution - Tamilnadu (Mayakkannam, 2010), Romania (Caraus, 2002), Pakistan (Mahar *et al.* 2007).

***Microcystis flos-aquae* (Wittrock) Kirchner, 1898:** Pl.-3, F.-4

Desikachary- 1959; 94: Pl.-17, 18, Fig. -11.

= *Microcystis aeruginosa flos-aquae* (wittr.) Elenkin, 1938.

= *Anacystis cyana* (kutz.) 1952.

= *Microcystis prasina* (Wittrock) Lemmermann 1904.

= *Microcystis aeruginosa* f. *flos-aquae* (Wittrock) Elenkin 1938.

Colonies spherical, elongate shape, not much longer than broad with indistinct colonial mucilage, 128.7-132 $\mu$  dia., 165 $\mu$  long, margins of colony mucilage, diffluent. Cells spherical, 3.3 $\mu$  dia., with gas-vacuoles and closely arranged.

Habitat-Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Pimpalgaon Bhor (14/09/2010), Sinnar (21/10/2011), Gangapur Farm (25/01/2012), Dindori (30/02/2012), Trimbak (01/11/2012).

Distribution- Ceylon (Crow, 1923), Assam (Bruhl and Biswas, 1926), Uttar Pradesh (Bharadwaja, 1935), West Bengal (Banerji, 1936; Biswas, 1942), Andhra Pradesh, Orissa (Rao, 1938; 1938b), Delhi, Bihar (Rao, 1939), Tamilnadu (Fremy, 1942; Ganapathi, 1940a; 1943; Mayakkannam, 2010), Burma (Skuja, 1949)

Maharashtra (Dixit, 1936; Gonzalves and Joshi, 1946; Patil, 2000; Bhosale and Dhupal, 2012).

***Microcystis marginata* (Meneghini) Kützing, 1846** Pl.-3, F.-1

Desikachary- 1959; 87: Pl.-17, Fig. - 3, 5.

= *Micraloa aeruginosa* Kützing, 1833.

= *Anacystis marginata* Mnegh., 1837.

= *Palmella cyanea* Kützing, 1843.

= *Diplocystis aeruginosa* (Kützing) Trevisan, 1848.

= *Polycystis aeruginosa* (Kützing) Kützing, 1849.

= *Clathrocystis aeruginosa* (Kützing) Henfrey, 1856.

= *Microcystis aeruginosa f.marginata* (Menegh.) Elenkin, 1938.

= *Anacystis cyanea* (Kützing) F.E.Drouet and W.A. Daily, 1952.

Colony ellipsoidal, ovoid, irregularly flattened, more or less lenticular, simple. Colony with thick multilayer envelope, distinct margin, refractive, 6.6-8.25 $\mu$  thick. Colony 171.6 $\mu$  in length, 26 $\mu$  in width. Cells spherical 4.95 -6.6 $\mu$  dia., 8.25 $\mu$  long, closely arranged, with gas-vacuoles.

Habitat- Karanjwan Dam (15/10/2009), Kashyapi Dam (28/10/2010), Rajurgaon (4/6/2011), Tapovan (22/06/2012).

Distribution- Ceylon (Crow, 1923; 1923b), West Bengal (Bruhl and Biswas, 1923; Banerji, 1936; Biswas, 1942), Tamilnadu (Ganapathi, 1940a), Punjab (Sarma and Kanta, 1978; Mayakkannam, 2010), Gujarat (Mahajan, 1983; Vasavda and Vaidya, 1983; Vaidya and Thakare, 1989), Maharashtra (Patil, 2000), Madhya Pradesh (Mishra, 2007; Chaudhary *et al.*, 2009).

New South Wales (Day *et al.* 1995), Romania (Caraus 2002), China (Hu and Wei 2006), Arkansas (Smith 2010).

***Microcystis protocystis* W.B.Crow, 1923:** Pl.-3, F.-5

Desikachary- 1959; 93, 91: Pl. - 20, Fig. - 4.

= *Microcystis aeruginosa f. protocystis* (crow) Elenkin. 1938.

= *Anacystis cyanea* (kutz.) Drouet and Daily 1952.

Colony spherical, cells spherical, arranged loosely, 3.3 $\mu$  in dia., mucilaginous sheath diffuent, and a margin of colonial mucilage is highly diffuent, aggregation of cells in a various ways.

Habitat- Ghodegaon (18/08/2011), Ozar (27/2/2012).

Distribution- Ceylon (Crow, 1923; 1923b), Tamil Nadu (Ganapathi, 1941), West Bengal (Banerji, 1936), Uttar Pradesh (Gupta, 1956), Maharashtra (Nandan *et. al.*, 2009; Bhosale and Dhupal 2012). Brazil (Werner 2010), Queensland (Bostock and Holland 2010), New Zealand (Broady and Mexican 2012).

***Microcystis robusta* (Clark) Nygaard, 1925:**

Pl.-3, F.-6, 7

Desikachary- 1959; 85: Pl.-17, Fig.-7to10.

Colonies free floating, light green colour, rounded shape with distinct mucilage later irregularly elongate with diffuent mucilage envelop. Cells spherical initially cells are arranged closely, laterally it becomes loose. Cells 9.9 $\mu$  length, 6.6 $\mu$  broad, spherical, without gas-vacuole thick wall.

Habitat- Planktonic in standing water Sinner (21/10/2011), KTHM Boat club (25/02/2012).

Distribution- Maharashtra (Patil, 2000; Patil and Jaiswal, 2009; Nandan *et. al.*, 2009; More *et. al.*, 2009; Mahajan and Mahajan, 1990), Madhya Pradesh (Mishra, 2007), West Bengal (Biswas, 1927; Banerji, 1936), Tamilnadu and Bengal (Ganapathi, 1940a; 1949a; Mayakkannam, 2010), Gujarat (Vaidya and Thaker, 1989).

**Genus – *Chroococcus* Nageli, 1849:**

Desikachary- 1959; 98.

Cells mostly spherical, ellipsoidal, cylindrical, rarely spindle shaped, single or forming colonies; membrane thick, mucilaginous, often lamellated, with an overall formation of amorphous mucilaginous masses; colony shapeless, spherical, ellipsoidal, tubular or hemispherical.

***Chroococcus limneticus* Lemm., 1898d:**

Pl. -2, F.-3

Desikachary-1959; 107: Pl. - 26, Fig- 2.

A free floating spherical or oval colony consist 4-32 spherical or sub spherical cells. Cells bright blue-green, without sheath 6-12  $\mu$  dia., with sheath 8-14  $\mu$  dia. individual sheath distinct or diffuent, Colonial mucilage broad, unlamellated and hyaline.

Habitat-Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Peint-Surgana (12/08/2009), PimpriTrimbak (18/09/2009), Pimpalgaon Bhor (14/09/2010), Botanical garden (14/11/2011), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012), Ghodegaon (18/08/2011), Ozarkhed Dam (30/3/2012).

Distribution- Maharashtra (More *et. al.*, 2009; Chowadhary *et. al.*, 2009; Bhosale and Dhupal, 2012), West Bengal (Das and Adhikary, 2012), Pakistan (Singh, 1933).

***Chroococcus macrococcus* (Kützing) Rabenhorst, 1865:**

Pl.-2, F.-7

Desikachary- 1959; 101: Pl.-27, Fig-3, 9, 10.

Thallus mucilaginous, single celled or a small colony of 2-4 broad, yellowish brown, more or less dilated. Cells spherical, without sheath 26.4-33  $\mu$  dia., with sheath 37.95-39.6  $\mu$  dia. Sheath thick, distinct colures with parallel lamellated.

Habitat- Vani (12/03/2009), Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Pimpalgaon Bhor (14/09/2010), Dugaon (12/08/2011), Anandwali (14/11/2011), Ghodegaon (18/08/2011), Ozarkhed Dam (30/03/2012), Kumbharwadi (28/07/2012).

Distribution-Gujarat (Vasavda and Vaidya, 1983; Vaidya and Thaker, 1989), Maharashtra (Mahajan, and Mahajan, 1990; Patil and Deore, 2000; Patil and Jaiswal, 2009; Nandan *et. al.*, 2009; Chaudhary *et.al.*, 2009). Pakistan (Singh, 1933), Hawaiian Islands (Sherwood, 2004), New Zealand (Broady and Merican, 2012).

***Chroococcus minor* (Kützing) Nägeli, 1849:**

Pl.-2, F.-1

Desikachary- 1959; 105: Pl.-24, Fig.-1.

=*Protococcus minor* Kützing 1845.

=*Pleurococcus minor* (Kützing) Rabenhorst 1863.  
Thallus slimy-gelatinous, blue-green, cells spherical, 3.3 $\mu$  in dia., without sheath. Colony of 4-8 cells Sheath colorless, very thin. Colony of 8 cells 11.55-13.2 $\mu$  in dia., 16.5 $\mu$  long

Habitat- Peint-Surgana (12/08/2009), PimpriTrimbak (18/09/2009), Nandgaon Dam (15/10/2010), Botanical garden (14/11/2011), Ghodegaon (18/08/2011), Ozarkhed Dam (30/3/2012), Makhmalabad (5/9/2012), Gangapur dam (15/10/2010;15/02/2011; 23/03/2011).

Distribution- Karnataka (Gonzalves and Kamat, 1958), Punjab (Vasishta, 1963; Sarma and Kanta, 1978, Anon, 2012), Gujarat (Thomas and Gonzalves, 1965; Mahajan, 1983), Himachal Pradesh (Prasad and Srivastav, 1965;1986; Vashishta, 1968), Rajasthan (Gupta and Kumar, 1968; Gupta, 1972), Maharashtra (Vasishta, 1968, 1975; Barhate and Tarar, 1982; Mahajan and Mahajan, 1990, Patil and Deore, 2000; Gore and Sanap,2009; Patil and Jaiswal,2009; Nandan *et. al.*, 2009; Chaudhary *et al.*,2009), Uttar Pradesh (Kumar, 1970; Pal and Yadav, 1974; Singh, 1974; Bendre and Kumar,1975; Gupta and Pandey, 1979; Prasad and Mehrotra, 1979, 1980, Pandey , 1982), West Bengal (Das and Adhikary, 2012).

***Chroococcus minutus* (Kützing) Nägeli, 1849:**

Pl.-2, F.-6, 10

Desikachary-1959; 103: Pl.-24, Fig- 4: Pl.-26, Fig. - 4, 15.

= *Protococcus minutus* Kützing 1843.

= *Gloeocapsa minuta* (Kützing) Hollerbach 1938.

= *Chroococcus virescens* Hantzschii, 1865.

Cells spherical or oblong, colony of 4-16, blue-green, with sheath 13.2-14.5  $\mu$  in dia., and without sheath 8.25-9  $\mu$  dia. Colony of four cells, 19.8-20 $\mu$  in dia.23.1-23.5 $\mu$  long, sheath not lamellated, colorless.

Habitat- Vani (12/03/2009), Waghera Dam (04/04/09), Pimpalgaon Bhor (14/09/10),

Niphad (10/06/2009), Salher (11/07/2009), Nandgaon Dam (15/10/10), Gangapur dam (15/10/2010;15/02/2011), Dugaon (12/08/2011), NandurMadhameshwar (29/02/12), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012), Ozarkhed Dam (30/03/2012), Planktonic in a lake at Kumbharwadi (28/07/2012), Makhmalabad (05/09/2012).

Distribution-Uttar Pradesh(Rao, 1937b; Singh,1939a; Mitra, 1951, Pandey, 1965; Pal and Yadav, 1974; Singh, 1974; Bendre and Kumar, 1975; Prasad and Mehrotra, 1979, 1980), Tamilnadu (Fremy, 1942; Kavitha and Balasingh, 2007) West Bengal (Bruhl and Biswas, 1925; Banerji, 1936), Karnataka (Gonzalves and Kamat, 1958), Maharashtra (Kamat, 1962, 1963, 1974, 1975, Mahajan and Mahajan, 1990; Patil and Deore, 2000; Jadhav and Chavan, 2009; Patil and Jaiswal, 2009; Talekar and Jadhav, 2009; Bhosale and Dhumal, 2012; Sarma, Swarnkanta and Sunita, 1979), Gujarat (Gupta, 1964; Vasavda and Vaidya, 1983; Mahajan, 1983) Rajasthan (Gupta, 1972; Yadav and Bharadwaja, 1979; Srivastava and Nigam, 1980), Jammu and Kashmir (Anand, 1979,1980), Himachal Pradesh (Prasad and Srivastav, 1965), Madhya Pradesh (Mishra, 2007), Punjab (Anon 2012).

***Chroococcus tenax* (Kirchner) Hieronymus, 1892:**

Pl.-2, F.-

2, 8

Desikachary- 1959; 103: Pl.-26, Fig-7, 16.

= *Chroococcus turgidus* var. *tenax* Kirchner 1878.  
Two celled colony, 23.1 $\mu$  in dia., 23.1 $\mu$  long, blue-green or olive green, without sheath 16.5 $\mu$  dia. with sheath21.5 $\mu$  in dia.9.9 $\mu$ long. Sheath colorless very thick, not lamellated.

Habitat- Waghad Dam (10/05/2009), Darana Dam Back Water (23/11/2011), KTHM Boat club (22/07/2012).

Distribution- Tamilnadu (Ganapathi, 1940a; Samuel *et al.*,2012), Karnataka (Gonzalves And Kamat, 1958), Rajasthan (Gupta and Kumar,

1968), Maharashtra (Kamat, 1968; Ashtekar and Kamat, 1980; Mahajan and Mahajan, 1990; Patil and Deore, 2000; Nandan *et al.*, 2009; Chaudhary *et al.*, 2009), Gujarat (Vasavda and Vaidya, 1983), Spain (Alvarez-Cobelas and Gallard, 1988), Israel (Vinogradova *et al.*, 2000), Pakistan (Husna *et al.*, 2005, Leghari *et al.*, 2005), China (Hu and Wei, 2006), Romania (Caraus, 2012).

*Chroococcus turgidus* (Kützing) Nägeli, 1849:

Pl.-2, F.-13

Desikachary- 1959; 102: Pl. - 26, Fig. - 6.

= *Protococcus turgidus* Kützing 1846.

= *Gloeocapsa turgida* (Kützing) Hollerbach, 1938.

= *Trochiscia dimidiata* Kützing 1834.

= *Chroococcus dimidiatus* (Kützing) Nägeli, 1849.

= *Anacystis dimidiata* (Kützing) Drouet and Daily, 1952.

Free floating colony consist single or 2-4 spherical cells. Colony with wide, hyaline and distinct parallel laminated sheath. Cells blue-green or yellowish with individual sheath. Cells without sheath 11.55 -14.85 $\mu$  in dia, with sheath 26.4-33 $\mu$  dia. Cells without sheath 15.85-19.4 $\mu$  long, with sheath 19.8-23.43 $\mu$  long. Sheath colourless, distinctly parallel lamellated. Two celled colonies, 33 $\mu$  in dia., 44.55 $\mu$  long, four celled colony, 33 $\mu$  in dia., and 47.87 $\mu$  long.

Habitat-Vani (12/03/2009), Peint-Surgana (12/08/09), Pimpri-Trimbak (18/09/09), Nandgaon Dam (15/10/10),

Dugaon (12/08/11), Gangapur dam (15/2/11), Botanical garden (14/11/2011), Planktonic, Kumbharwadi (22/04/2010; 1/2/2011; 15/2010/10; 27/7/2012),

Makhmalabad (5/9/2012).

Distribution - Maharashtra (Schmidle, 1900b; Gonzalves and Joshi, 1946; Kamat, 1968, 1974, 1975, Ashtekar and Kamat, 1979; Mahajan and Mahajan, 1988, 1990, Patil and Deore, 2000; Nandan *et al.*, 2009; More *et al.*, 2009; Bhosale and Dhumal, 2012), Biswas, 1925; Banerji, 1936), Andhra Pradesh (Ghousuddin, 1936; Rao,

1938a), Uttar Pradesh (Rao, 1937b), Rajasthan (Gupta and Kumar, 1968), Madhya Pradesh (Subramanian, 1972; Mishra, 2007), Jammu and Kashmir (Anand, 1979), Karnataka (Bongale and Bharti, 1980a), Gujarat (Vasavda and Vaidya, 1983; Mahajan, 1988; Vaidya and Thaker, 1989).

***Chroococcus turgidus* var. *maximus* Nygaard, 1926:**

Pl.-2, F.-9, 11

Desikachary- 1959; 102: Pl.-24, Fig.-2; Pl.-26, Fig.-8.

Cells in colony of 2-4, 42.9- 51.15 $\mu$ , in dia. and 49.5- 66 $\mu$  long. Cells 21.45 - 24.75 $\mu$  in dia. Blue-green, sheath colourless 3.3 $\mu$  dia., much lamellated in the inner portions.

Habitat - Someshwar (18/2/2012).

Distribution- Maharashtra (Nandan *et al.*, 2009; Chaudhary *et al.*, 2009; Kamat and Ashtekar, 1979). Sweden (Skuja 1948), New Zealand (Chapman, 1956), Mozambique (Silva, Basson and Moe, 1996).

***Chroococcus turgidus* var. *solitarius* Ghose, 1927:**

Desikachary- 1959; 102: Pl.-26, Fig. - 14.

Cells single globose, dark blue-green, with sheath 13.2 $\mu$  dia, without sheath 9.9 $\mu$  dia., sheath thick, colourless, lamellated.

Habitat- Gangapur dam (15/02/2011).

Distribution- Maharashtra (Deore, 1978; Barhate and Tarar, 1983), Uttar Pradesh (Pandey, 1982).

**Genus- *Gloeocapsa* Kuetzing, 1843:**

Desikachary- 1959; 111.

Unicellular-colonial thallus, irregular aggregations, or large, gelatinous, amorphous colonies composed of 2-8 groups of spherical cells, enclosed in concentric, layered and limited mucilaginous envelopes, wide and concentrically lamellated, reddish, bluish, orange or yellowish colored. Individual sheaths of cell lamellated or unlamellated, cells in large colonies with secondary colonies, arranged irregularly.

***Gloeocapsa aeruginosa* Kützing, 1843:**

Pl.-1,

F.-19

Desikachary - 1959:115.

Thallus mucilaginous, cells spherical, blue green, 2-3.3 $\mu$  broad, with colourless sheath 4.8  $\mu$  broad, four cell colony 16.5 $\mu$  in dia. spherical, sheath slightly lamellated.

Habitat-Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Peint-Surgana (12/08/2009), PimpriTrimbak (18/09/2009), Pimpalgaon Bhor (14/09/2010), Nandgaon Dam (15/10/2010), Gangapur dam (01/02/11), Botanical garden (14/11/2011), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012).

Distribution- Orissa (Biswas, 1924), Hyderabad (Ghousuddin, 1936), Bengal (Biswas, 1925; 1942), Maharashtra (Nandan, *et. al.*, 2009), Punjab (Anon 2012).

***Gloeocapsa altrata* (Turp.) Kutz.**

Pl.-1, F.-11, 20

Desikachary, 1959; 116: Pl. - 24, Fig-8.

Thallus mucilaginous, blackish green .Two celled colony 9.9 $\mu$  in dia., 11.5 $\mu$  length. Cells without sheath 4.5-4.95 $\mu$  dia., with sheath 9.9 $\mu$ in dia., pale blue-green. Sheath colorless, thick and unlamellated.

Habitat - Dugaon (12/02/2009), Vani (12/03/2009), Waghera Dam (04/04/2009), Pimpalgaon Bhor (14/09/2010), Niphad (10/06/2009), Salher (11/07/2009), Anandwali (14/11/2011), Kumbharwadi (28/7/2012).

Distribution- N. India (Turner, 1892), Uttar Pradesh (Bharadwaja, 1936), West Bengal (Banerji, 1936), Maharashtra (Dixit, 1936; Mahajan and Mahajan 1990; Patil, 2000; Gore and Sanap, 2009), West Bengal (Banerji, 1936), Tamilnadu (Tiwari, 1975), Gujarat (Vasavda and Vaidya, 1985), Burma (Ghose, 1927 b).

***Gloeocapsa decorticans* (A. Braun) Richter, 1925:**

Pl.-1, F.-15

Desikachary 1959; 114: Pl.-24, Fig.-09.

= *Chroococcus decorticans* A. Braun 1850.

Cells spherical, blue-green, single or 2-4 in group. Single cells without sheath 6.6 $\mu$  in dia. and with sheath 13.2-16.83 $\mu$  in dia. Two celled colony cells with Sheath 16.5 $\mu$  broad, 12-23.1 $\mu$  long, sheath colourless, thick distinctly lamellated, 1.65-4.95 $\mu$  broad.

Habitat-Nandgaon Dam (15/10/2010), Gangapur dam (01/02/2011), Benze Farm (18/8/2011), Ghodegaon (18/08/2011), Ozarkhed (30/03/2012).

Distribution- Uttar Pradesh (Mitra, 1951), Maharashtra (Patil and Jaiswal, 2009; Nandan *et. al.*, 2009; Chaudhary *et al.*, 2009), Punjab (Anon 2012).

Spain (Noguerol-Seoaneand Rifón-Lastra1999), Romania (Caraus 2002; 2012), Turkey (Taskin *et al.* 2008).

***Gloeocapsa gelatinosa* Kützing, 1843:**

Pl.-1; F.-9, 10, 12, 13.

Desikachary 1959:114; Pl.-27, Fig.-6.

Colonies of 2 -4 cells, small size 9.9 -23.1 $\mu$  in dia., may aggregated .Cells without sheath about 1.65 $\mu$  and with sheath 4.2-8 $\mu$  dia., blue- green. Sheath colorless, thin, when old it is lamellated. Specimen is smaller than the type specimen describing by Kützing.

Habitat - Dugaon (12/02/2009), Vani (12/03/2009), Nandgaon Dam (15/10/2010), Gangapur dam (01/02/2011).

Distribution - Maharashtra (Nandan *et. al.*, 2009), Tamilnadu (Tiwari, 1972, 1975; Anand, 1989; Mayakkannam, 2010), Karnataka (Bongale and Bharti, 1980; Somashekhar, 1983), Gujarat (Vidya and Thakare, 1989.) Mauritius (Silva and Pienaar 2000), Israel (Vinogradova *et al.* 2000), Pakistan (Husna 2005), China (Hu and Wei 2006).

***Gloeocapsa kuetzingiana* Nägeli, 1849:**

Pl.-1, F.-16

Desikachary 1959; 118:Pl.-23, Fig.-4; Pl.-24, Fig.-12.



Thallus thin, soft, brownish or blackish; cells densely aggregated in colonies up to 150 $\mu$  dia. Cells without sheath 3.6 $\mu$  dia., with sheath 4.95 $\mu$  dia., blue-green. Sheath yellow without lamellated.

Habitat- Vani (12/03/2009), Gangapur dam (01/02/2011), Dugaon (12/08/2011), Benze Farm (18/8/2011).

Distribution- Gujarat (Vasavda and Vaidya, 1983; Vaidya and Thaker, 1989), Maharashtra (Mahajan and Mahajan, 1990; Patil and Deore, 2000; Chaudhary *et al.*, 2009).

***Gloeocapsa nigrescens* Nägeli, 1857:**

Pl. -6, F.-7.

Desikachary -1959; 117:Pl.-24, Fig.-15, 17.

Thallus with many individuals aggregated to form thin, blackish gelatinous masses of spherical cells. Cells without sheath 3.3-6.8 $\mu$  in dia. and with sheath 12-13.5 $\mu$  dia. Colonies spherical 9.9-30-125 $\mu$  in dia. Sheath broad, slightly lamellated, light purple or hyaline. Colony observed at Gangapur dam site is smaller in size than the Nagelli's type.

Habitat - Gangapur dam (15/02/2011).

Distribution – Gujarat (Vaidya and Upadhyaya, 1968; Vasavda and Vaidya, 1983), Uttar Pradesh (Prasad and Mehrotra, 1978), Maharashtra (Deore, 1978; Patil and Deore, 2000), Tamilnadu (Samuel *et al.*, 2012), Punjab (Anon 2012).

Burma (Skuja, 1949).

***Gloeocapsa polydermatica* Kützing, 1846:**

Pl.-1, F.-14, 17

Desikachary 1959; 114: Pl.-25, Fig.-1.

Thallus mucilaginous, compact, 2 cell colony 3.9 $\mu$  dia. and 13 $\mu$  length. Cells spherical, without sheath 3.25-5.2 $\mu$  dia. -3.45-3.9 $\mu$  long, blue-green, sheath colourless thick, very distinctly and many times lamellated, 1.65-3.3 $\mu$  broad.

Habitat - Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Pimpalgaon Bhor (14/09/2010), Nandgaon Dam (15/10/2010), Gangapur dam (01/02/2011), Peint Surgana (12/08/2009), Pimpri-Trimbak

(18/09/2009), Botanical garden (14/11/2011), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012).

Distribution – Maharashtra (Patil and Deore, 2000; 2002; Nandan *et al.*, 2009; More *et al.*, 2009; Chaudhary *et al.*, 2009).

Pakistan (Ghose, 1919; Husna et al 2005), Dawna hills (Carter, 1926), Britain (Whitton et al. 2003), Hawaiian Islands (Sherwood 2004), China (Hu and Wei 2006).

***Gloeocapsa quaternata* Brébisson ex Kützing,**

**1846:** Pl.-1, F.-18

Desikachary- 1959; 120: Pl.-20, Fig. - 9.

Thallus pale green, brownish, expanded. Cells without sheath 2.4- 4.95 $\mu$  dia., with sheath 6.6 $\mu$  in dia., blue-green. Sheath not distinct rarely lamellated, red in colour. Cells single, 2-4 in colonies, colonies (6.6)9.7-19.2  $\mu$  in dia.9.9 $\mu$  length.

Habitat - On moist sub aerial soil of Gangapur dam (01/02/2011).

Distribution - Orissa (Bruhl and Biswas, 1922a), West Bengal (Biswas, 1925; Banerji, 1936), Maharashtra (Patil and Deore, 2000; 2002; Chaudhary *et al.*, 2009).

Pakistan (Ghose, 1924), Hawaiian Islands (Sherwood 2004), China (Hu and Wei 2006), Mexico (Ramírez, Hernández-Mariné and Roldán 2009), New Zealand (Broady and Merican 2012).

**Genus-*Gloeothece* Nägeli, 1849:**

Thallus unicellular-colonial, aggregations of small colonies, enclosed by concentrically lamellated mucilaginous sheath. Sheath colourless, yellow-brownish, bluish, dark blue or reddish. Cells oval, or rod-like, pale grayish blue, blue-green or olive-green, irregularly arranged, with granular content and several prominent granules.

***Gloeothece fusco-lutea* Nägeli, 1849:**

Pl.-2, F.-18

Desikachary -1959; 125: Pl.-25, Fig.-5

Cells oblong, cylindrical, enclosed in amorphous mucilage with individual thick sheath, yellow or red, lamellated. Cells without sheath 4.95-5.5 $\mu$  broad, 6.6 $\mu$  long, cells with envelop 11.55 $\mu$  broad, 11.88 $\mu$  long, mostly 4-8 rarely 16-3 together.

Habitat- Waghera Dam (04/04/2009), Pimpalgaon Bhor (14/09/2010), Nandgaon Dam (15/10/2010), Gangapur dam (01/02/2011), Anandwali (14/11/2011), Kumbharwadi (28/07/2012).

Distribution- Tamilnadu (Freymy, 1942), Maharashtra (Deore, 1978; Chaudhary *et al.*, 2009), Gujarat (Vasavda and Vaidya, 1983).

Florida (Taylor, 1928), Hawaiian Islands (Sherwood, 2004), China (Hu and Wei, 2006).

***Gloeothece membranacea* (Rabenhorst)**

**Bornet, 1892:** Pl.-2, F.-4, 15

Desikachary-1959; 128:

Thallus expanded, leathery, gelatinous, and olive-green. Colony spherical or rectangular, free floating 16 cell colony 28.05-29 $\mu$  dia., 28.5-29.5 $\mu$  length, 2 cell colony 14.25-15 $\mu$  broad, 19.8-20 $\mu$  long, cells without sheath 4.95-5.2 $\mu$  broad, 8.25-9.9 $\mu$  long, with sheath 9.9 $\mu$  broad, 13.2 $\mu$  long, blue-green. Sheath colorless or light pink colour, distinct parallel lamellated.

Habitat- Dugaon (12/02/2009), Vani (12/03/2009), Kadva River (15/02/2011), Ghodegaon (18/08/2011), Ozarkhed Dam (30/03/2012), Kumbharwadi (28/07/2012), Makhmalabad (05/09/2012).

Distribution - Tamilnadu (Freymy, 1942), Maharashtra (Kamat, 1963; Mahajan and Mahajan, 1990), Gujrat (Vasavda and Vaidya, 1983), Punjab (Anon, 2012).

China (Hu and Wei, 2006), Queensland (Bostock and Holland, 2010).

***Gloeothece palea* (Kützing) Rabenh. 1865:**

Pl.-2, F.-12

Desikachary, 1959:127:

=*Gloeocapsa palea* Kützing, 1843.

Thallus mucilaginous, aquatic, blue-green. Cells long cylindrical, without sheath

3.79 $\mu$  broad, with sheath 13.2 $\mu$  broad, 9.9 $\mu$  long, blue-green, individual mucilaginous sheaths yellowish, with distinct lamellation. Many cells are embedded in a common irregular envelop. The type described by Desikachary is without lamellated sheath but in our form it is having a distinct lamellated sheath, such lamellated sheath is also observed by Skuja (1949), who described the same species with partly lamellated sheaths.

Habitat-Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Pimpalgaon Bhor (14/09/2010), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012), Makhmalabad (05/09/2012).

Distribution - Maharashtra (Kamat, 1966; Ashtekar and Kamat, 1979).

Mozambique (Silva, Basson and Moe, 1996), Spain (Alvarez-Cobelas and Gallardo, 1988, Calvo, Barbara and Cremades, 1999, Calvo and Barbara *et al.*, 2005), Israel (Vinogradova *et al.*, 2000), Romania (Caraus, 2002; 2012), Mexico (Ramirez, Hernandez-Marine and Roldan, 2009), Germany (Tauscher, 2011), New Zealand (Broody and Merican, 2012).

***Gloeothece rupestris* (Lyngbye) Bornet in Wittrock and Nordstedt, 1880:**

Desikachary- 1959; 127: Pl.-25, Fig.-4

PP.-1, F.-2

=*Palmella rupestris* Lyngbye 1819.

=*Coccolchloris stagnina* f. *rupestris* (Lyngbye) Drouet and Daily

=*Gloeothece rupestris* var. *maxima* West 1892.

=*Gloeothece rupestris* f. *maxima* (West) Hollerbach 1938.

Colony of 2-4 cells aggregate together, 3 - 4 small colonies are present in a large colony attached submerged. Cells cylindrical, without sheath 3.7-9.5 $\mu$  broad, with sheath 13.2-16.5 $\mu$  broad, 6.6-13.2 $\mu$  long. Colony oval, subglobose, 18.15 $\mu$  dia., 23.1 -33 $\mu$  long. Sheath colorless or yellow colour

with distinct parallel lamellated or without lamellated.

Habitat- Nandgaon Dam(15/10/10),Gangapur dam (01/02/11),Ghodegaon (18/08/11), Ozarkhed (30/03/2012)

Chandasi (05/09/2012),Makhmalabad (5/09/2012).

Distribution- Uttar Pradesh (Pandey, 1982), Maharashtra (Barhate and Tarar, 1983; Bhosale and Dhumal, 2012), Tamilnadu (Mahendrapurumal and Anand, 2009; Mayakkannam, 2010), Punjab (Anon, 2012).

***Gloethece rupestris* (Lyngb.) Bornet var. *maxima* West, 1892:** Pl.-2, F.-16, 17

Desikachary- 1959; 127:

Colony of 2-4 cells aggregate together, 3-4 small colonies present in a large colony attached submerged. Cells cylindrical or rod shape with rounded ends, 5.7-7.4 $\mu$  broad and 13.2-14.5 $\mu$  long, with large granules, mucilage sheath thick, cells without sheath 5.5-7.4 $\mu$  broad- 6.6-8.2 $\mu$  long.

Habitat- Botanical garden (14/11/2011), Ozarkhed dam (30/03/2012).

Distribution - Burma (Skuja, 1949), Maharashtra (Barhate and Tarar, 1983; Patil, 2000).

***Gloethece samoensis* Wille, 1913:**

PP.-1,

F.-8

Desikachary – 1959; 128: Pl.-23, Fig.-03

Cells circular, attached to other algae. Colonies round. Cells bluish green, without sheath 3.3-4.95 $\mu$  broad, 3.3- 6.6 $\mu$  long, with sheath 11.55 $\mu$  broad 4.95- 8.25 $\mu$  long, sheath 3.3 $\mu$  dia., hyaline. Colony 9.9-29.7 $\mu$  dia., 13.2 $\mu$  long mostly 2-4 in a common sheath, colorless, yellow or violet colour, unlamellated or distinctly lamellated.

Habitat-Peint-Surgana (12/08/09), Pimpri-Trimbak (18/09/09), Nandgaon Dam (15/10/10), Gangapur dam (1/02/11; 15/02/2011), Botanical garden (14/11/2011),

Ozarkhed (30/03/2012), Kumbharwadi (28/07/2012), Makhmalabad (5/09/2012).

Distribution - Tamil nadu( Desikachary, 1959),Punjab (Vasishta, 1961),Gujarat (Thomas and Gonzalves,1965e; Vasavda and Vaidya,1983), Maharashtra (Thomas and Gonzalves,1965; Kamat, 1975; Deore, 1978; Mahajan and Mahajan, 1990; Nandan, *et al.*,2009; Chaudhary *et al.*, 2009), Uttar Pradesh (Pal, 1975; Bendre and Kumar, 1975), Karnataka (Bongale and Bharati, 1980), West Bengal (Das and Santra,1982), Spain (Asencio and Aboal 1997), Israel (Vinogradova *et al.* 2000), Brazil (Werner 2010).

***Gloethece samoensis* Wille var. *major* Wille, 1915:** Pl.-2, F.-5, 14

Desikachary -1959; 128:

Cells without sheath 3.3-6.6 $\mu$  broad and 4.95-6.6 (7.2-8.25)  $\mu$  long. Cell with sheath 13.2-16.5 $\mu$  dia., and 18.15 $\mu$  long. The Kumbharwadi form is slightly bigger in dimension than Madras form. Cells without sheath.-6.6  $\mu$  broad, with sheath 6.6-10.5  $\mu$  broad and 6.2-9.2 $\mu$  long, sheath hyaline.

Habitat - Gangapur dam (25/3/2011), Kumbharwadi (28/07/2012)

Distribution- Uttar Pradesh (Pandey, 1982), Maharashtra (Barhate and Tarar, 1983), West Bengal (Maity and Santra, 1985), Tamilnadu (Mayakkannam, 2010; Anand, 1989).

**Genus –*Aphanocapsa* Nageli, 1849:**

Desikachary- 1959; 130.

Colonies many-celled, irregular, microscopic, planktonic, gelatinous, with irregularly, loosely or densely distributed cells. Mucilage colorless, diffluent or limited rarely yellowish, brownish or bluish. Cells many loosely arranged, forming a formless gelatinous mass. Cells with a thin gelatinized individual sheaths .Cells spherical, hemispherical, pale grayish blue or blue-green, rarely bright blue-green or olive-green.

***Aphanocapsa banaresensis* Bharadwaja, 1935:**

Pl. -5, F.-3

Desikachary-1959; 133: Pl. -22, Fig. -8.

Colony bigger spherical, hollow, hyaline, dark blue green color, up to 19.8- 49.5 $\mu$  in dia. Cells spherical, numerous, embedded in distinct mucilaginous sheath, (3.3) 4 -6.2 $\mu$  in dia. Cells are arranged in four together. Sheath thick, unstratified, hyaline, closely adpressed to the cells, up to 1 $\mu$  thick.

Habitat- Dugaon(12/02/2009), Vani (12/03/2009), Submerged aquatic Waghad Dam (10/05/2009), KTHM Boat Club (22/07/2012), Darana Dam Back Water (15/12/2011), in a stagnant pond Nandur Madhameshwar (29/02/2012).

Distribution- Gujarat (Vaidya and Patel, 1971), Punjab (Sarma, Swarnkanta and Sunita, 1979; Vaidya and Thaker, 1989), Maharashtra (Mahajan and Mahajan, 1990; Patil and Deore, 2000; Nandan *et. al.*, 2009; More *et. al.*, 2009), Rajasthan (Jain and Srivastava, 2012).

***Aphanocapsa biformis* A. Braun, 1876:**

Pl. -5, F.-2

Desikachary - 1959; 134: Pl.-21, Fig.-3, 4.

Thallus bluish green, planktonic, colony spherical or irregular shape, 2, 4 cells grouped together, embedded in mucilage, 4.95- 23.1 $\mu$  to 49.5 -115.5 $\mu$  in dia. Cells spherical or oval with thick wall and distinct sheath, cell with sheath 9.9 $\mu$ , without sheath 6.6-6.93 $\mu$  in dia.

Habitat- Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Pimpalgaon Bhor (14/09/10), Nandgaon Dam (15/10/10), Gangapur dam (22/03/2011), Anandwali (14/11/2011), NandurMadhameshwar (29/02/2012), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012).

Distribution- Kerala (Parukutty, 1940) Maharashtra (Kamat, 1961-62; Patil and Deore, 2000; Patil and Jaiswal, 2009; Nandan *et. al.*, 2009; More *et. al.*, 2009; Chaudhary *et al.*, 2009),

Rajasthan (Gupta and Kumar, 1968), Gujarat (Vaidya and Patel, 1971; Vasavda and Vaidya, 1983; Vaidya and Thaker, 1989).

***Aphanocapsa elachista* W.et G.S. West, 1894:**

Pl. -5, F.-12

Desikachary-1959; 132: Pl.-21, Fig.-5.

= *Microcystis pulverea* f. *elachista* (West and G.S.West) Elenkin 1938.

= *Microcystis elachista* (West and G.S.West) Compère 1967.

= *Aphanocapsa elachista* f. *conferta* West and G.S.West 1912.

= *Aphanocapsa elachista* var. *planctonica* G.M.Smith 1920.

= *Microcystis pulverea* f. *conferta* (West and G.S.West) Elenkin 1938.

= *Aphanocapsa conferta* (West and G.S.West) Komárková-Legnerová and Cronberg 1994.

= *Aphanocapsa planctonica* (G.M.Smith) Komárek and Anagnostidis 1995

Colony small, spherical or ellipsoidal, 14.85-19.8 $\mu$  dia., mucilage thin, colorless homogeneous, diffluent, cells compactly, rarely loosely arranged 1-2-4 in numbers, cell with sheath 3.3 $\mu$  in dia., 1.65 $\mu$  rarely 2 $\mu$  broad, blue-green. The specimen is smaller than the type specimen described by Desikachary (1959).

Habitat- Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher(11/07/2009), Pimpalgaon Bhor (14/09/2010), Gangapur Farm (25/01/12), Nandur Madhameshwar (29/02/2012), Dindori Toll Naka (30/02/2012), Rajurgaon Stone Mine (09/03/2012).

Distribution - Tamilnadu (Ganapathi, 1940), Karnataka (Gonzalves and Kamat 1958). Maharashtra (Ashtekar and Kamat, 1980; Barhate and Tarar, 1983; Nandan *et. al.*, 2009), Gujarat (Vasavda and Vaidya, 1983; Mahajan, 1983; Vaidya and Thaker, 1989), Punjab (Anon 2012), Rajasthan (Jain and Srivastav, 2012).

***Aphanocapsa grevillei* (Berkeley) Rabenhorst, 1865:**

Pl.-5, F.-10

Desikachary 1959; 134: Pl.-21, Fig.-9.

= *Coccochloris grevillei* Hassall 1845.  
= *Aphanocapsa grevillei* (Berkeley) Rabenhorst 1865.

= *Microcystis grevillei* (Hassall) Elenkin 1938.  
= *Microcystis grevillei* (Berkeley) Elenkin 1938.

Thallus gelatinous, spherical or hemispherical, light blue-green, colony irregular, or big spherical shape, planktonic, 19.7-62.7 $\mu$  dia., sheath colourless, mucilaginous, thick 3.3  $\mu$  in dia.. Colony consist number of rounded cells, arranged compactly, cells in a group of four, 9.9-66 $\mu$  long, 13.2-46.2 $\mu$  dia.. Cells spherical (1.65)3.3-4.95 $\mu$  dia., contents finely granular, individual envelopes not distinct.

Habitat- Waghad Dam (10/05/2009), Nandgaon Dam (15/10/2010), Gangapur dam (15/2/2011), Benze Farm (18/8/2011), Darana Dam (4/6/2011), KTHM Boat club (22/07/2012), Nandur Madhameshwar (29/2/2012), Ghodegaon (18/08/2011), Planktonic in pond at Ozarkhed (30/3/2012).

Distribution- West Bengal (Bruhl and Biswas, 1932; Biswas, 1925; 1942; Das and Adhikary, 2012), Andhra Pradesh (Ghousuddin, 1936), Uttar Pradesh (Rao, 1937b), Karnataka (Gonzalves and Kamat, 1958; Tiwari, 1975) Maharashtra (Kamat, 1961-62, 1963, 1975; Mahajan and Mahajan, 1988, 1990; Patil and Deore, 2000; More *et. al.*, 2009; Chaudhary *et al.*, 2009; Gore and Sanap, 2009), Rajasthan (Gupta and Kumar, 1968; Jain and Srivastav, 2012), Madhya Pradesh (Tiwari, 1975; Mishra, 2007), Tamilnadu (Tiwari, 1975), Punjab (Sarma, Swarnkanta and Sunita, 1979), Gujarat (Vasavda and Vaidya, 1983, Vaidya and Thaker, 1989).

***Aphanocapsa koordersi* Strom, 1923:**

Pl. -5, F.-11

Desikachary- 1959; 132: Pl.-23, Fig.-1.

Colony irregular in shape, dull green to blue-green, 33 $\mu$  in dia. Cells spherical, loosely arranged or in groups of four 2.2-2.8 $\mu$  in dia.

Habitat- Vani (12/03/2009), Nandgaon Dam (15/10/10), Gangapur dam (5/4/2011), Dugaon (12/08/2011).

Distribution- Uttar Pradesh (Rao, 1937b), West Bengal (Biswas, 1942), Madhya Pradesh (Agarkar, 1967), Gujarat (Kamat, 1967; Vasavda and Vaidya, 1983; Mahajan, 1983; Vaidya and Thaker, 1989), Punjab (Sarma *et. al.* 1979), Maharashtra (Ashtekar and Kamat, 1980; Mahajan and Mahajan, 1990; Patil and Deore, 2000; More *et. al.*, 2009), Rajasthan (Jain and Srivastav, 2012).

***Aphanocapsa montana* Cramer, 1862:**

Pl-4, F.-8, 9

Desikachary- 1959; 135: Pl.-20, Fig.-8.

Fresh water, colony spherical or irregular, large with distinct margin, attached or free floating, 33 $\mu$  dia., cells are compactly arrange, dark blue green colour, 1.65-3.96 $\mu$  in dia., spherical, light blue-green or yellowish, single or in pairs, sheath mucilage colorless, diffluent.

Habitat- Karanjwan Dam (15/10/2009), Kashyapi Dam (28/10/2010), on submerged aquatic plants in Ghodegaon (18/08/2011), Trimbakeshwar (21/01/2012), Ozarkhed Dam (30/2/2012), Chandasi (5/9/2012).

Distribution- Uttar Pradesh (Randhawa, 1936), West Bengal (Banerji, 1936), Maharashtra (Kamat, 1963; Deore, 1978; Mahajan and Mahajan, 1889, 1990; More *et. al.*, 2009; Chowdhary *et al.*, 2009), Rajasthan (Jain, Jain and Srivastava, 2012).

***Aphanocapsa muscicola* (Meneghini) Wille, 1919:**

Pl. -5, F.-

7, 9.

Desikachary-1959; 135: Pl. - 21, Fig.-7

= *Coccochloris muscicola* Meneghini 1843.

= *Microcystis muscicola* (Meneghini) Elenkin 1938.

= *Aphanocapsa naegelii* Richter 1884.

= *Aphanocapsa minima* Migula 1933.

= *Microcystis montigena* Hoffmann 1986.

Colony microscopic, irregular, 23.1-132 $\mu$  in dia., adhering to filaments of *Lyngbya*. Cells spherical, 1.65-2.4 $\mu$  in dia., blue-green, 2-4 together, daughter cells often together in a common mucilage envelope, mucilage thick, colorless or blue.

Habitat- Gangapur dam (01/02/2011; 15/11/2011).

Distribution- Tamilnadu (Mayakkannam, 2010), Karnataka (Bongale and Bharati, 1980b).

***Aphanocapsa pulchra* (Kützing) Rabenhorst, 1865:**

Pl.-5, F.-5

Desikachary-1959; 132: Pl. - 21, Fig. - 2.

Thallus gelatinous homogeneous, blue-green, tuberculate, free floating, in early stage colony small and spherical, at maturity irregular and large distinct margin, 46.2 $\mu$  dia. Cells spherical 2.9 - 4.95 $\mu$  dia., loosely arranged, single or paired, dark blue green or pale blue-green. Individual sheath of cells indistinct and colourless.

Habitat- Dugaon (12/02/2009), Vani (12/03/2009), Kumbharwadi (28/07/2012), Makhmalabad (05/09/2012), Chandasi (05/09/2012).

Distribution- Uttar Pradesh, Andhra Pradesh, Orissa (Rao, 1928b, 1937b, 1938, 1938b), Karnataka (Gonzalves and Kamat, 1958; Tiwari, 1975), Madhya Pradesh, Tamilnadu (Tiwari, 1975), Gujarat (Kamat, 1967), Maharashtra (Barhate and Tarar, 1981; Vasavda and Vaidya, 1983; Mahajan, 1983; Vaidya and Thaker, 1989; Patil and Deore, 2000; Nandan *et al.*, 2009; Talekar and Jadhav, 2009; Chowadhary *et al.*, 2009), Punjab (Anon 2012), Rajasthan (Jain and Srivastav, 2012).

***Aphanocapsa roeseana* De Berry, 1870:**

PP-5, F.-4

Desikachary, 1959; 131:

Thallus broad, colony irregularly lobed, brownish green to blue-green, 66.66 $\mu$  in dia., cells 3.3 - 4.95 $\mu$  dia., nearly oval, pale blue green, mucilage sheath homogeneous.

Habitat- Nandgaon Dam (15/10/2010), Gangapur dam (15/02/2011), Peint-Surgana (12/08/2009), PimpriTrimbak (18/09/2009), Botanical garden (14/11/2011).

Distribution- Tamilnadu (Fremy, 1942), Uttaranchal (Gupta, 2005), Maharashtra (Chowadhary *et al.*, 2009), Rajasthan (Jain and Srivastava, 2012),

**Genus-*Aphanothece* Nägeli, 1849:**

Desikachary- 1959; 140:

Cells ovate, ellipsoidal or rod-like, straight or slightly curved, with rounded ends, irregularly, scarcely or densely arranged in the colony. Colonies many-celled, micro- or macroscopic mucilaginous, irregularly spherical or irregular, greenish, bluish, brownish or reddish colored; colonial slime diffluent or limited, usually without structure, colorless. Cells without own mucilaginous envelopes or concentrically lamellated mucilaginous envelopes. Cells pale grayish blue-green, pale to bright blue-green or reddish colour.

***Aphanothece castegnei* (Breb.) Rabenh, 1865:**

Pl. -4, F.-1, 2

Desikachary- 1959; 140: Pl. - 21, Fig. - 8.

Thallus gelatinous, colony irregular or spherical, small colonies grouped together, Each colony has 4-6 or 8-10 cells, (8.25) 26.4 -29.7-33 $\mu$  dia. and 39.6 $\mu$  long. Cells arranged in concentric layers without any definite shape, slimy, blue-green or brown; cells ellipsoidal to cylindrical, 2.44-3.3 $\mu$  broad, 3.3-6.6 $\mu$  long, mostly densely arranged, without individual sheath blue-green, sheath yellowish or red in colour.

Habitat- Waghera Dam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Pimpalgaon Bhor (14/09/2010), forming a scum on surface of ponds near Nandgaon Dam(15/10/2010), Gangapur dam (1/02/2011; 15/02/2011), Nandur Madhameshwar (27/02/12), Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012), Ghodegaon (18/08/2011), Ozarkhed Dam (3/03/2012).

Distribution- Tamilnadu (Fremy, 1942), Maharashtra (Gonzalves and Joshi, 1942a, 1943a, Kamat 1963, 1974, 1975, Tiwari, 1975; Ashtekar and Kamat, 1979; Patil and Deore, 2000; More *et. al.*, 2009), Karnataka (Gonzalves and Kamat, 1958), Gujarat (Kamat, 1967; Mahajan, 1983, Vasavda and Vaidya, 1983, Vaidya and Thaker, 1989), Punjab (Sarma *et. al.*, 1979), Rajasthan (Jain, Jain and Srivastav, 2012).

***Aphanothece clathrata* West and G.S. West, 1906:**

Pl.-4, F.-3

Desikachary- 1959; 137: Pl. - 22, Fig. - 2.

= *Aphanothece gracilis* Schiller 1954.

Colonies microscopic, small, planktonic, irregular, clathrate, with colorless homogenous mucilage, circular, 6.5 $\mu$  dia. and 9.1 $\mu$  length. Cell 0.65-0.9 $\mu$  broad, 1.3-1.98(3.5-5.7)  $\mu$  long, cylindrical, straight, capsule or rod shape, numerous. Cells are arranging loosely, pale blue-green.

The given specimen described here is alike as the type specimen described by Desikachary except it is larger in size.

Habitat- Dugaon (12/02/2009), Vani (12/03/2009), Nandgaon Dam (15/10/2010), Gangapur dam (15/02/2011; 25/3/2011), Rajurgaon stone mine (09/03/2012), Ozarkhed (30/03/2012), Kumbharwadi (28/07/2012).

Distribution- Maharashtra (Patil and Deore, 2000; 2002), Tamilnadu (Mayakkannam, 2010; Mahendraperumal and Anand, 2009).

***Aphanothece conferta* Richter, 1892:**

Pl.-4, F.-6

Desikachary, 1959; 140:

Free floating, thallus gelatinous, membranous, small size. Cells more or less compactly arranged. Cells single or mostly in rows, rod or spherical shape with rounded ends, pale blue-green, 2.8-3.3 $\mu$  dia., 4.1-6.6 $\mu$  long, sheath diffluent, colorless.

Habitat- NandurMadhameshwar (29/02/2012).

Distribution - Maharashtra (Gonzalves and Gangla, 1949; Ashtekar and Kamat, 1980; Patil and Deore, 2000; Talekar and Jadhav, 2009; Chaudhary *et al.*, 2009), Gujarat (Vaidya and Thaker, 1989), Rajasthan (Jain, *et. al.*, 2012).

***Aphanothece microscopica* Nägeli, 1849:**

PP.-1, F.-10

Desikachary, 1959; 142: Pl. - 22, Fig. - 4, 5, 9.

In the beginning thallus small, gelatinous and rounded later on irregular size large up to 313.5-505 $\mu$  in dia., 771.4 $\mu$  length. Colony large submerged. Cells oval oblong cylindrical, elongated, (3.79) 4.95-6.6 $\mu$  broad, 6.6-8.25 $\mu$  long, mucilaginous sheath is distinct, some cells have distinct individual sheath, blue-green, free-floating.

The alga resembles closely to Rao's (1938a) observations. The cells 4-5 $\mu$  broad and 6-9.5 $\mu$  long.

Habitat- Waghad Dam (10/05/2009), Nandgaon Dam (15/10/2010), Gangapur dam (5/04/2011), Free-floating, Darana Dam Back Water (23/11/2011), Ghodegaon (18/08/2011), Ozar (27/2/2012) NandurMadhameshwar (29/02/2012), KTHM Boat club (22/07/12), Kumbharwadi (28/07/2012), Makhmalabad (5/9/2012).

Distribution- Maharashtra (Schmidle, 1900b; Kamat, 1963, 1974, 1975; Patil and Deore, 2000; Nandan *et. al.*, 2009; Chaudhary *et al.*, 2009; Bhosale *et al.*, 2012), Uttar Pradesh, Orissa (Rao, 1936, 1938b), Tamilnadu (Rao, 1938a; Fremy, 1942), Gujarat (Kamat, 1967, Mahajan, 1983, Vasavda and Vaidya, 1983, Vaidya and Thakare, 1989), Rajasthan (Vaidya and Patel, 1968), Madhya Pradesh (Prasad, Srivastava and Khanna, 1986; Mishra, 2007), Rajasthan (Jain, *et. al.*, 2012).

***Aphanothece naegelii* Wartmann, 1861:**

Pl.-4, F.-7

Desikachary, 1959; 141: Pl.- 22, Fig.-7.

Thallus gelatinous, yellowish colour, soft, blue green. Colony large, irregular or circular shape, 56.1-66 $\mu$  dia., 359.7 $\mu$  long. Cells oblong, cylindrical, elliptical, present in a group of four, 4.95-6.6 $\mu$  in dia., (3.3-6.6) 8.25-9.9 $\mu$  in length, sheath distinct in peripheral part of the thallus, laminated, diffuent to the inner part. Cyanophyceean granules are distinct at periphery of the cell.

Habitat- Waghad Dam(10/05/2009), Nandgaon Dam (15/10/2010), Gangapur dam (15/02/2011), Darana Dam Back Water (15/11/2011), KTHM Boat Club (22/07/2012), Kumbharwadi (28/07/2012), Makhmalabad (5/09/2012).

Distribution-Bengal (Banerji, 1936a), Uttar Pradesh, Andhra, Orissa, Bihar, (Rao, 1936, 1938a, 1938b, 1939), Maharashtra (Gonzalves and Joshi, 1946; Kamat, 1963, 1974, Ashtekar and Kamat, 1979, Tiwari, 1975; Schmidle, 1990b; Patil and Deore, 2000; Chaudhary *et al.*, 2009), Gujarat (Kamat, 1967; Vaidya and Thaker, 1989), Punjab (Sarma, *et al.*, 1979), Rajasthan (Jain, *et al.*, 2012).

***Aphanothece nidulans* Richter in Wittrock and Nordstedt, 1884:**

PP.-

1, I.-3

Desikachary- 1959; 138: Pl.-22, Fig.-1.

= *Aphanothece saxicola* f. *nidulans* (Richter) Elenkin 1938.

Thallus irregularly expanded, with other algae, plankton forms, colony small ovate or spherical covered by a mucilage. Mucilage sheath diffuent, colourless or yellow to brownish yellow. Cells blue green, short cylindrical, broadly rounded at apices, straight or slightly bent, numerous, 1-1.65 $\mu$  in dia., 3.3-3.5 $\mu$  in length, densely arranged in a colony.

Habitat-Vani (12/03/2009), Niphad (10/06/2009), Salher (11/07/2009), Dugaon (12/08/2011) Gangapur Farm (25/01/2012), Dindori Toll Naka (30/02/2012), Kumbharwadi (28/07/2012), Makhmalabad (05/09/2012) .

Distribution - Maharashtra (Deore, 1978; Jadhav and Chavan, 2009; More *et al.*, 2009; Chaudhary *et al.*, 2009), Tamilnadu (Ganapathi, 1940a), Ceylon (Holsinger, 1954).

***Aphanothece pallida* (Kützing) Rabenhorst, 1863:**

Pl.-5, F.-1,6

Desikachary, 1959; 140: Pl. - 22, Fig. - 3.

=*Microcystis pallida* Lemm, 1907

Thallus 4-6 mm in dia., gelatinous, soft, blue-green or brownish. Cells oblong, elliptical, 3.5-5 $\mu$  broad, 5-8 $\mu$  long, olive- green. Sheath distinct in peripheral region of the thallus, lamellated, diffuent to the inner part.

The taxon resembles to the type (Desikachary, 1959).

Habitat- Waghad Dam (10/05/2009), Gangapur dam (22/04/2010; 15/10/2010), Planktonic in stagnant water of Darana Dam back water (23/11/2011), KTHM Boat club (22/07/2012).

Distribution- Maharashtra (Schmidle, 1900b; Gonzalves and Joshi, 1946; Kamat, 1963, 1974, 1975; Mahajan and Mahajan, 1988, 1989, 1990, Pingale and Deshmukh 2009), Uttar Pradesh (Rao, 1936, Pandey and Chaturvedi, 1978), West Bengal (Banerji, 1936a), Andhra Pradesh, Orissa, Bihar (Rao, 1938a, 1938b, 1939, 1982), Karnataka (Gonzalves and Kamat, 1958), MadhyaPradesh (Agarkar, 1967; Subrahmanyam, 1972), Punjab (Sarma, *et al.*, 1979), Gujarat (Mahajan, 1983).

***Aphanothece saxicola* Nägeli, 1849:**

Pl. - 5 , F.-8

Desikachary, 1959; 138:Pl.-22, Fig.-11.

= *Aphanothece subachroa* Hansgirg 1892.

Thallus mucilaginous, yellowish; colony large, spherical, with other algae, 16.5 $\mu$  in dia..Cells cylindrical, loosely arranged in a common mucilaginous sheath, 1.65(2.31)-2.64 $\mu$  dia., 3.3-4.95 $\mu$  length, single or in pairs, pale blue-green. Habitat-Gangapur dam (15/02/2011), Benze Farm (18/8/2011), Planktonic in Ghodegaon (18/08/2011), Ozarkhed Dam (3/03/2012).



Distribution- Uttar Pradesh (Rao, 1936; Mitra, 1951), Tamilnadu (Freymy, 1942), Maharashtra (Kamat, 1963; Deore, 1978; Ashtekar and Kamat, 1979; Mahajan and Mahajan 1983; Barhate and Tarar, 1983; Patil and Deore, 2000; Jadhav and Chavan, 2009; Talekar and Jadhav, 2009), Gujarat (Mahajan, 1983; Vaidya and Thaker, 1989).

***Aphanothece stagnina* (Sprengel) A. Braun in Rabenhorst, 1863:**

PP.-1,I-4

Desikachary, 1959; 137: Pl.-21, Fig.-10.

= *Coccolochloris stagnina* Sprengel 1807.

= *Aphanothece prasina* A. Braun 1863.

= *Aphanothece piscinalis* Rabenhorst 1865.

= *Aphanothece mooreana* (Harvey) Lagerheim 1883.

= *Aphanothece tuberculata* (Areschoug) Forti 1907.

Thallus gelatinous, cells are compactly arranged in an ovate or spherical shape colony. Colonies dark blue green, 29.7- 66.5 $\mu$ . In dia., 33-72.1 (132)  $\mu$  long. Cells oblong, ovoid, short cylindrical, 3.3- 6.6 $\mu$  broad, 6.6-9.9 $\mu$  long. Cells are arranged, densely in the peripheral region of the colony and sparsely in the inside of the colony, without individual envelopes, homogeneous mucilage. It is attached to *Microspora*, aquatic plant or free floating.

Habitat- Nandgaon Dam (15/10/2010), Gangapur dam (12/02/2011), Benze Farm (18/8/2011), Ozarkhed dam (30/03/2012), Kumbharwadi (28/07/2012), Darana dam (15/08/2012), Makhmalabad (5/09/2012), Chandasi (5/09/2012).

Distribution - Uttar Pradesh (Singh, 1939), West Bengal (Banerji, 1936), Kerala (Parukutty, 1940), Tamilnadu (Freymy, 1942; Tiwari, 1975), Gujarat (Kamat, 1967; Mahajan, 1983), Rajasthan (Gupta and Kumar, 1968; Jain, et al., 2012), Karnataka (Tiwari, 1975), Punjab (Sarma, et al., 1979), Maharashtra (Ashtekar and Kamat, 1980; Mahajan and Mahajan, 1989, 1990;

Patil and Deore, 2000; More et al., 2009; Chaudhary et al., 2009), Punjab (Anon 2012).

**Genus – *Synechococcus* Nageli, 1849:**

Desikachary -1981; 143.

Cells solitary or aggregated into a group but without common mucilage or with a very thin and narrow sheath. Cells oblong, cylindrical, ellipsoidal, erect, rarely curved or sigmoid, blue-green, olive-green, bright blue-green or pinkish.

***Synechococcus aeruginosus* Nägeli, 1849:**

Pl. -6, F.-4

Desikachary -1959; 143: Pl.-25, Fig-6, 12.

= *Synechococcus fuscus* Zeller, 1873.

Cells oblong to cylindrical, poles broadly rounded, solitary or in pairs, blue green colour, 6.6 $\mu$  broad, 9.9  $\mu$  long, solitary or in pairs. Rare in occurrence.

Habitat- Ozarkhed Dam (3./03/2012).

Distribution- Maharashtra (More et al., 2009; Chaudhary. et al., 2009). Tamilnadu (Kavita and Balasingh 2007).

***Synechococcus cedrorum* Sauvageau, 1892:**

Pl.-6, F.-1, 2, 6

Desikachary -1959:144.

Colony large, irregular consist many cells, mucilage envelope absent or very thin and narrow, Cells single or two together, elongate, oblong ellipsoidal and finely rounded, 2.64 - 4.95 $\mu$  broad, 3.3-10 $\mu$  long, blue-green.

Habitat- Dugaon (12/02/2009), Vani (12/03/2009), Waghad Dam (10/05/2009), Karanjwan Dam (15/10/2009), Kashyapi Dam (28/10/2010), Nandgaon Dam (15/10/2010), Gangapur dam (15/2/2011), Benze Farm (18/8/2011), Nandur Madhameshwar (29/2/12), Kumbharwadi Gangapur (28/07/2012), KTHM Boat club (22/07/2012), Darana Dam (15/08/2012), Makhmalabad (5/09/2012).

Distribution-Tamilnadu (Mitra, 1951), Karnataka (Somasekhkar, 1983), Maharashtra (Barhate and Tarar, 1983), Rajasthan (Jain, et al., 2012).

Romania (Caraus 2002), South Australia (Day *et al.* 1995).

***Synechococcus elongatus* Nägeli, 1849:**

Pl. -6, F.-3, 5

Desikachary-1959; 143: Pl.-25, Fig.-7, 8.

= *Protococcus elongatus* Nägeli 1849.

=*Synechococcus racemosus* Wolle 1881.

=*Synechococcus geitleri* De Toni 1936.

=*Synechococcus parvulus* Nägeli 1948.

Cells cylindrical, elongated, 1.4-2.2 $\mu$  broad, solitary or 2-4 cells together, contents homogeneous and dark or light blue-green.

Habitat-Vani (12/03/2009), Dugaon (12/08/2011), Puddle near Dental College, Pachavati (22/06/2012).

Distribution- Kerala (Parukutty, 1940), Rajasthan (Gupta and Kumar, 1968; Gupta, 1972), Gujarat (Vasavda and Vaidya, 1983), Maharashtra (Mahajan and Mahajan, 1990, Patil and Deore, 2000; Nandan *et al.*, 2009), Madhya Pradesh (Yadav and Singh, 2009).

**Genus- *Synechocystis* Sauvageau, 1892:**

Desikachary -1959; 144.

Unicellular or aggregated to form colony, without distinguishable common mucilage envelopes. Colony spherical or oval. Cells pale blue-green, olive-green, bright green or pink, spherical.

***Synechocystis aquatilis* Sauvageau, 1892:**

PP.1-.I.-9

Desikachary -1959; 144: Pl.-25, Fig-9.

Planktonic, colony irregular 198 $\mu$  length, 132 $\mu$  dia., cells circular globular or in pairs, 3.3 $\mu$  dia., pale blue green.

The present specimen is smaller than the type specimens describe by Desikachary, Delhi and Banaras form. The Banaras form is 5.6-6.5 $\mu$  dia. (Rao, 1937b), and Delhi form is 4-6.5 $\mu$  in dia. (Rao, 1940).

Habitat- Botanical Garden HPT College campus, Nashik (14/11/2011).

Distribution- Maharashtra (Barhate and Tarar, 1983; More *et al.*, 2009), Gujarat (Vaidya and

Thaker, 1989), Rajasthan (Jain, *et al.*, 2012), Tamilnadu (Mayakkannam, 2010).

**Genus- *Merismopedia* Meyen, 1839:**

Desikachary-1959; 150.

Thallus colonial ,free floating, table-like, flat or slightly waved, cells in one plane, in rows or perpendicular one to another square or rectangular colonies with 4-16, or several hundreds of cells (up to 4000).Mucilaginous envelope hyaline, homogeneous. Cells spherical or oval hemispherical, with homogeneous content.

***Merismopedia elegans* A. Braun ex Kützing, 1849:**

Pl.-1,

F.-5

Desikachary- 1959; 156: Pl.-29, Fig. - 9.

Colony irregularly quadrangular, ranging from 16-4000 celled. Colonies small to big, light blue in colour, 128 celled colonies contain 8 rows, each rows consist 16 cells, 70.95 $\mu$  long and 45.54 $\mu$  in dia. Cells spherical or oblong, more or less closely arranged, 4.95 $\mu$  broad, and 3.63 $\mu$  long.

Habitat-Vani(12/03/2009), Karanjwan Dam (15/10/2009),; (15/10/2010), Kashyapi Dam (28/10/10), Dugaon(12/08/11),Gangapur dam(22/09/11),Trimbakeshwar (21/01/2012). Distribution- Orissa (Carter, 1926), West Bengal (Banerji, 1936), Hyderabad (Ghousuddin, 1936, 1949), Karnataka (Biswas, 1994, 1998), Maharashtra (Nandan *et.al.* 2009; Bhosale and Dhumal, 2012), Rajasthan (Jain and Srivastava, 2012).

***Merismopedia glauca* (Ehrenberg) Kützing, 1845:**

Pl. -1,

F.-4

Desikachary- 1959; 155: Pl.-29, Fig. - 5.

= *Gonium glaucum* Ehrenberg 1838.

= *Merismopedia aeruginea* Brébisson 1849.

= *Merismopedia nova* Wood 1872.

Colony 16-64 ovate or hemispherical cells, regularly arranged in a quadrangular colony, 30-45 $\mu$  dia., Cells closely arranged 3.3 $\mu$  broad, pale

blue-green, cell content homogenous. Very common in soft water, scattered among the other algae.

Habitat- Waghad Dam (10/5/2009), Rajurgaon (26/1/2011), Darana Dam (04/6/2011), KTHMBoat Club (22/7/2012) BenzeFarm(18/8/2011), Ghodegaon(18/8/2011), Ozarkhed (30/03/2012).

Distribution- West Bengal (Banerji, 1936, Das and Adhikary, 2012), Tamilnadu (Ganapathi, 1940), Uttar Pradesh (Gupta, 1956; Singh, 1959; Ahmad, 1967, 1972; Pandey and Pandey, 1982), Punjab (Vasishta, 1961), North India (Turner, 1892), Maharashtra (Thomas and Gonzalves, 1965d; Kamat, 1963c, 1968a, 1974, 1975; Gore and Sanap, 2009; Nandan *et. al.*, 2009; More *et. al.*, 2009; Bhosale and Dhumal, 2012), Gujarat (Thomas and Gonzalves, 1965e; Vasavda and Vaidya, 1983; Mahajan, 1983), Bihar (Rao, 1939; Lolorya and Mitra, 1974a), Karnataka (Somashekar and Ramaswami, 1982; Bongale and Bharati, 1980a), Rajasthan (Jain, Jain and Srivastav, 2012). Jammu and Kashmir (Subba Raju, 1963; Anand, 1979), Andhra-Pradesh (Venkateshwarlu, 1976), Nepal (Ghimire *et al.*, 2012)

***Merismopedia minima* Beck, 1897:**

Pl.-1, F.- 2

Desikachary-1959; 154: Pl.- 29, Fig.-11.

Thallus colonial, free floating, table-like, four to many in small colonies. Cells pale blue-green, circular. Colony 16 cells, 6.6 $\mu$  long and 4.95 $\mu$  dia., cells 1.5 $\mu$  in dia.

Habitat-WagheraDam (04/04/2009), Niphad (10/06/2009), Salher (11/07/2009), Karanjwan Dam (15/10/2009), Pimpalgaon Bhor (14/09/2010), Kashyapi Dam (28/10/2010), Ghodegaon (18/8/2011), Gangapur Farm (25/1/2012), Rajurgaon stone mine(9/03/2012), Dindori (30/03/2012), Ozarkhed Dam(30/03/2013), Tapovan (22/6/2012).

Distribution –UttarPradesh, Andhra Pradesh (Rao, 1936; 1938), Maharashtra (Kamat, 1961-

62; Mahajan and Mahajan, 1990; Patil and Nandan, 1994; Patil and Deore, 2000; Nandan *et. al.*, 2009; More *et. al.*, 2009), Jammu and Kashmir (Anand, 1979), Gujarat (Vaidya and Thaker, 1989), Tamilnadu (Kavitha and Balasingh, 2007).

***Merismopedia punctata* Meyen, 1839:**

Pl. -1, F.-3

Desikachary-1959; 155: Pl.-23, 29, Fig.-5, 6.

= *Merismopedia kuetzingii* Nageli 1849.

= *Merismopedia convoluta* f. *minor* Wille 1922.

= *Merismopedia haumanii* Kufferath 1942.

A rectangular colony of small, 4-64-128 cells, about 28.05-60 $\mu$  broad. Cells spherical or ovoid, squarish in shape, loosely arranged 2.5-3.5 $\mu$  broad, 2.2- 2.64 $\mu$  long, pale blue green. 32 celled colony 11.55 $\mu$  in dia., 21.94 $\mu$  long; cell 2.8 $\mu$  in dia., 3.3 $\mu$  long. Planktonic in stagnant and flowing waters or among other algae.

Habitat- Waghad Dam (10/05/2009), KaranjwanDam (15/10/2009), KashyapiDam (28/10/2010), Kadva river (15/02/2011), Darana Dam (04/06/2011), Benze Farm (18/8/2011), Trimbakeshwar(21/1/12), Rajurgaon(26/1/2012), NandurMadhameshwar (29/02/2012), Rajurgaon stone mine (9/3/2012), Gangapur Farm(25/1/2012), Dindori (30/03/2012), Ozarkhed (30/03/2012), KTHM Boat club (22/07/2012).

Distribution -Tamilnadu (Ganapathi, 1940a; Desikachary, 1959), Punjab (Singh, 1941; Vasishta, 1965; Sarma and Kanta, 1978, Anon 2012), Karnataka (Gonzalves and Kamat, 1958; Bharati and Bongale, 1975), Gujarat (Gupte, 1964; Thomas and Gonzalves, 1965e; Kamat, 1967a; Vaidya and Thaker, 1989), Delhi (Rao, 1940), Maharashtra (Vasishta, 1968; Kamat, 1968, 1974, 1975; Marathe and Chaudhary 1976, Ashtekar and Kamat, 1979; More *et. al.*, 2009; Bhosale and Dhumal 2012), Jammu and Kashmir (Subba- Raju, 1963; Mir and Suri, 1975; Anand, 1979), Rajasthan (Kamat, 1967; Yadav and Bharadwaja, 1979; Jain, *et. al.*,

2012), Haryana (Vasishta, 1968), Himachal Pradesh (Kamat, 1968a), Uttar Pradesh (Venkattaraman, 1957; Suxena, 1960; Ahmad, 1967; Pandey, 1969; Kumar, 1970, Kamat, 1973a; Gupta and Roy, 1975), West Bengal (Vasishta, 1968).

***Merismopedia tenuissima* Lemmermann, 1898d.**

Pl.-1, F.-1

Desikachary-1959; 154: Pl- 29, Fig.-7; Pl- 30, Fig.-8, 9.

A small rectangular plate of 16 cells, closely packed in mucilaginous sheath. 16 cell colonies, (5.94) 8.2 -9.57 dia. and 6.93-9.9-14.02 $\mu$  lengths. Cells minute, pale blue-green, subspherical, 1.65 $\mu$  broad, 0.9-2.4-3.3 $\mu$  long individual cells may with distinct mucilaginous envelopes.

Habitat- Dugaon(12/02/2009), Vani (12/03/2009), Karanjwan Dam (15/10/2009), Kashyapi Dam (28/10/2010), Trimbakeshwar (21/01/2012), Rajurgaon Stone Mine (09/03/2012).

Distribution- Uttar Pradesh (Rao, 1973b; Pal and Yadav, 1974; Bendre and Kumar, 75), Andhra Pradesh, Orissa (Rao, 1938a,38b), Delhi (Rao, 1940), Karnataka (Ashtekar and Kamat, 1980; Mahajan and Mahajan, 1990; Jadhav and Chavan, 2009), Rajasthan (Srivastava and Nigam, 1980a; Trivedi, 1982; Jain and Srivastav, 2012), Jammu and Kashmir (Anand, 1980), Gujarat (Mahajan, 1998; Vasavda and Vaidya, 1983, Vaidya and Thakur, 1989), Maharashtra (Nandan *et. al.*, 2009; Talekar and Jadhav, 2009; Bhosale and Dhumal, 2012.)

**Genus- *Coelosphaerium* Nägeli, 1849:**

Desikachary- 1959; 146.

Colonial thallus, spherical, globular, ovate or irregular, planktonic. Cells spherical or hemispherical, mainly distant from one another, in a single peripheral layer, producing a hollow sac situated. Densely at peripherally in old colonies than in young ones, with or without individual envelopes around cells. Colonial

mucilage homogeneous or heterogeneous and colorless.

***Coelosphaerium kuetszingianum* Nägeli, 1849:**

Pl. -1, F.-7

Desikachary –1959; 148:Pl.-28, Fig- 7, 8.

= *Coelocystis kuetszingiana* Nägeli 1849.

Planktonic, spherical or ovate colony with thin mucilage envelope, 31.35-59.4-62.7 $\mu$  broad. Cells arranged at same distance from one another, in a single peripheral layer. Cells spherical or subspherical, light blue green colour, 2.25-5 $\mu$  broad.

Habitat- Niphad (10/06/2009), Salher (11/07/2009), Nandgaon Dam (15/10/2010), Gangapur dam (15/2/2011; 22/3/2011), Makhmalabad (5/9/2012).

Distribution- Uttaranchal (Gupta, 2005), Maharashtra (Mahajan and Nandan, 2009; Bhosale and Dhumal 2012), Tamilnadu (Mahendrapurumal and Anand, 2009; Mayakkannam, 2011

***Coelosphaerium naegelianum* Unger, 1854:**

Pl. -1, F.-8

Desikachary-1959; 147: Pl.-28, Fig- 9, 16.

Free floating, spherical or ellipsoidal, reniform or irregularly shaped colony, 42.9 $\mu$  dia., with broad radial mucilage stalks clearly visible at the disintegrated stage of colony. Cells oval or ellipsoidal, closely arranged, with gas vacuoles, dark reddish brown or black granular cells giving opaque appearance, 3.3 $\mu$  broad, 4.95 $\mu$  long.

Habitat- Gangapur dam (25/3/2011).

Distribution- Maharashtra (Gonzalves and Joshi, 1943b), Tamilnadu (Mayakkannam, 2010), Karnataka (Somashekar, 1984).

**Genus- *Gomphosphaeria* Kützing, 1836:**

Desikachary- 1959; 148:

A globose or ovate colony of pyriform, cordate, ellipsoidal, globose, spherical cells in groups of four or 2 - 8, with or without envelopes, individual sheath indistinct. Colony hollow, blue-green, olive-green or yellowish in colour.

***Gomphosphaeria aponina* Kützing, 1836:**

PP.-7 ,I-5

Desikachary- 1959; 148: Pl-28, Fig.-1-3.

Colony consists of pyriform or cordate cells, 4.95-5.61 $\mu$  long and 3.3-6.6 $\mu$  broad, blue-green, olive-green or yellowish with a distinct mucilaginous envelope, placed at the ends of regularly dichotomously branched radial mucilaginous stalks. Colonies (16.5)26.4-39.6 $\mu$  in dia.

Habitat-Gangapur dam (01/02/2011).

Distribution - Tamilnadu (Biswas 1924; Ganapathi, 1940a; Mayakkannam, 2010)

Maharashtra (Ashtekar and Kamat, 1979; Bhosale and Dhumal, 2012).

**Genus- *Glaucocystis* Itzigsohn, 1854:**

Philipose -1967; 187.

Cells alike *Oocystis*, colonies of solitary or 2-8 cells enclosed within the mother cell wall. Cells oblong, spherical, free floating, ellipsoidal and with a radiating chromatophore, each have two deeply lobed blue-green plastids called cyanelles. So controversy in their systematic position of the alga. Fritsch (1935), Korshikov (1953) and Fott (1959) consider as the colourless member of oocystaceae living in a symbiotic relation with the blue green algae. Other group Smith (1950) and Prescott (1951) considered blue green algae are more important so include it under the Myxophyceae.

***Glaucocystis duplex* Prescott, 1944:**

PP.-1,I.-6

Prescott- 1951; 474: Pl.-108, Fig.-1.

Colony of 04 cells. Cells spherical, enclosed within enlarged spherical mother cell wall. Two stellate masses of chromatophores, with short vermiform blue green protoplast radiating from different points. Four cell colony 69.3 $\mu$  in dia., cells 23.1 $\mu$  in dia. Rare in occurrence. It seems a first report of the alga from this locality and Maharashtra.

Habitat- Makhmalabad (5/09/2012).

Distribution- Tamilnadu (Chandra *et. al.*, 2003), Spain (Alvarez Cobelas and Gallardo 1986).

***Glaucocystis nostochinearum* Itzigsohn in Rabenhorst, 1868:**

PP.-

1,I.-7

Philipose-1967; 187: 188, Fig.-101.

= *Glaucocystis geitleri* Pringsheim, 1964.

Colonies of 2-8 cells enclosed within the mother cell wall. Cells oblong-ellipsoidal and with a radiating chromatophores. Colony 59.4 $\mu$  in dia. and 59.4 $\mu$  long. Cells 33 $\mu$  17.5 $\mu$  in dia.

Habitat-Gangapur dam (15/2/2011).

Distribution-Tamilnadu (Chandra *et. al.*, 2003), Uttaranchal (Gupta, 2005).

**Genus- *Gloeochaete* Lagerheim, 1883:**

Prescott-1951; 475.

Unicellular or colonial colorless thallus, colony of 2, 4, 6 cells embedded in the colourless matrix, epiphytic on the filamentous algae. Cells are round, usually containing four blue-green chloroplasts; each internal cell/chloroplast emits one or two long gelatinous hairs. Cells are fully laden with the chloroplast so difficult to observe the endophytic cells. *Gloeochaete* actually endophytic cyanobacteria within the cells of colourless member of tetrasporaceae, which grow as epiphytic on the other filamentous algae.

***Gloeochaete wittrockiana* Lagerheim, 1883:**

PP.-7,I.-1

Smith - 1950; 565: Pg. - 565, Fig. - 474.

=*Gloeochaete bicornis* Kirchner 1888

= *Schrammia barbata* P.-A.Dangeard 1889.

Colorless colony of 2, 4, 6 cells, epiphytic. Each cell endophytized by ovate, blue green protoplasts, which forms cup shape body within the host cell, provided with a long setae. Cells are embedded in a colourless mucilaginous matrix. Colony 26.4 $\mu$  dia., 39.6 $\mu$  length. Cell 9.9 $\mu$  dia., setae 200-250 $\mu$  long. Epiphytic on the filamentous algae as *Oedogonium*, *Zygnema* or on submerged plants. Anomalous organism, symbiotic association of colorless member blue green entophytes. It is rare in occurrence and seems to be a new report to India.

Habitat- Makhmalabad (5/09/2012).

Distribution- Spain (Alvarez Cobelas and Gallardo 1986), Britain (Moestrup 2002, Whitton *et al.* 2003), Romania (Caraus 2002, Caraus 2012).

## RESULT & DISCUSSION:

The family Chroococcaceae having 13 genera, 57 species. The genera like *Microcystis*, *Chroococcus*, *Gloeocapsa*, *Gloeotheca*, *Aphanothece*, *Aphanocapsa*, *Synechococcus*, *Synechocystis*, *Merismopedia*, *Coelosphaerium*, *Gomphosphaeria*, *Glaucozystis* and *Gloeochaete* are predominately encountered. The alga *Microcystis* forms dark blue green coloured scum in most of the water bodies and represented by *M. aeruginosa*, *M. flos-aquae*, *M. marginata*, *M. protocystis* and *M. robusta*. The genus *Chroococcus* is represented by 06 species namely *C. limneticus*, *C. minor*, *C. tenax*, *C. minutus*, *C. micrococcus* and *C. turgidus* enclosed within mucilaginous sheaths. The members of *Gloeocapsa* also form large mucilaginous colonies of spherical cells and the common species are: *G. kuetzingiana*, *G. aeruginosa*, *G. gelatinosa*, and *G. polydermatica*. The genus *Gloeotheca* with *G. membranacea*, *G. palea*, and *G. rupestris* are common whereas *G. fusco-lutea* is rare. The genera *Aphanocapsa* and *Aphanothece* having equal distribution with 09 species each. The taxa *Aphanocapsa banaresensis*, *A. grevillei*, *A. montana*, *A. biformis* and *A. pulchra* are common. Another genus *Aphanothece* having some rare species, viz. *A. clathrata*, *A. microscopica* and *A. naegeliı*. The genus *Synechococcus* having 03 species: *S. aeruginosus*, *S. cedrorum* and *S. elongatus*. Another genus *Synechocystis* is monospecific with *Synechocystis aquatilis* collected from HPT college campus and is rare taxon. Flat colonies of *Merismopedia* are represented by 05 species: *M. elegans*, *M. glauca*, *M. minima*, *M. punctata* and *M. tenuissima*.

## CONCLUSIONS:

Very few genera of family Chroococcaceae are somewhat rare and little known including *Coelosphaerium* with its two species *C. kuetzingianum* and *C. naegelianum*. Other species viz. *Glaucozystis nostochinearum* *G. duplex*, *Gomphosphaeria aponina* and *Gloeochaete wittrockiana* are very rare.

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- Web Sites.** Algae Base-  
<http://www.algaebase.org/search/species>

### PLATE-1

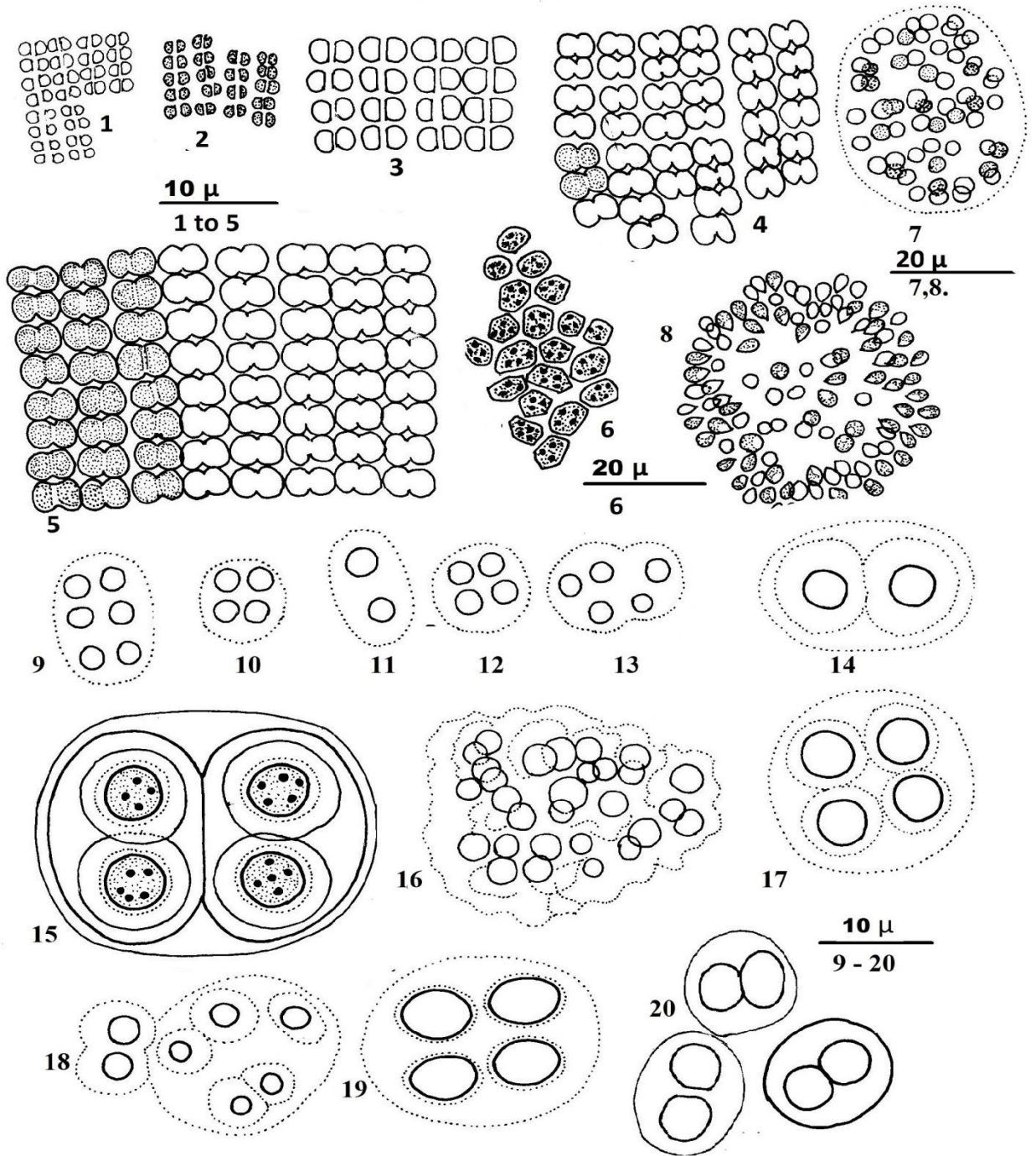


PLATE-2

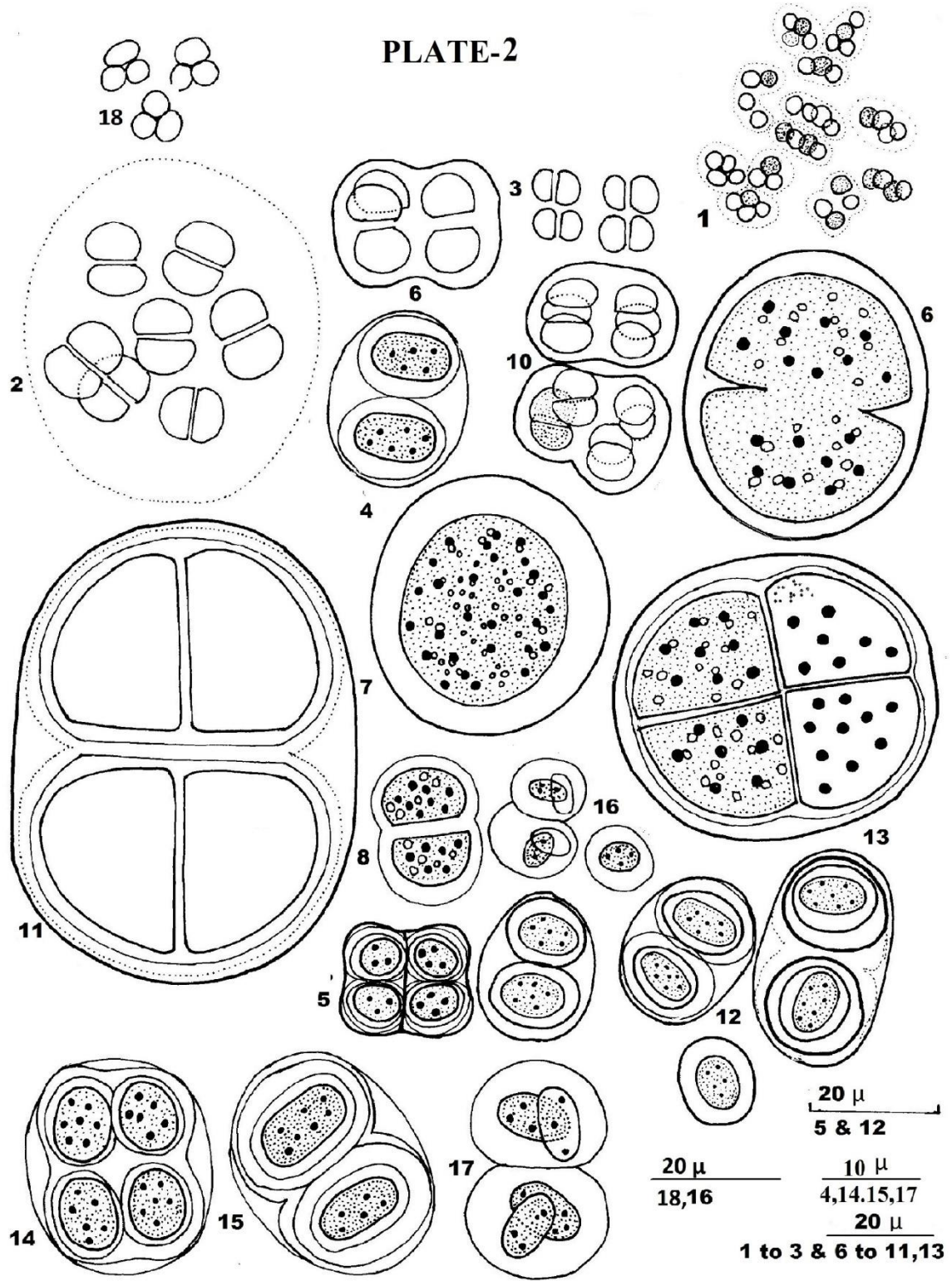
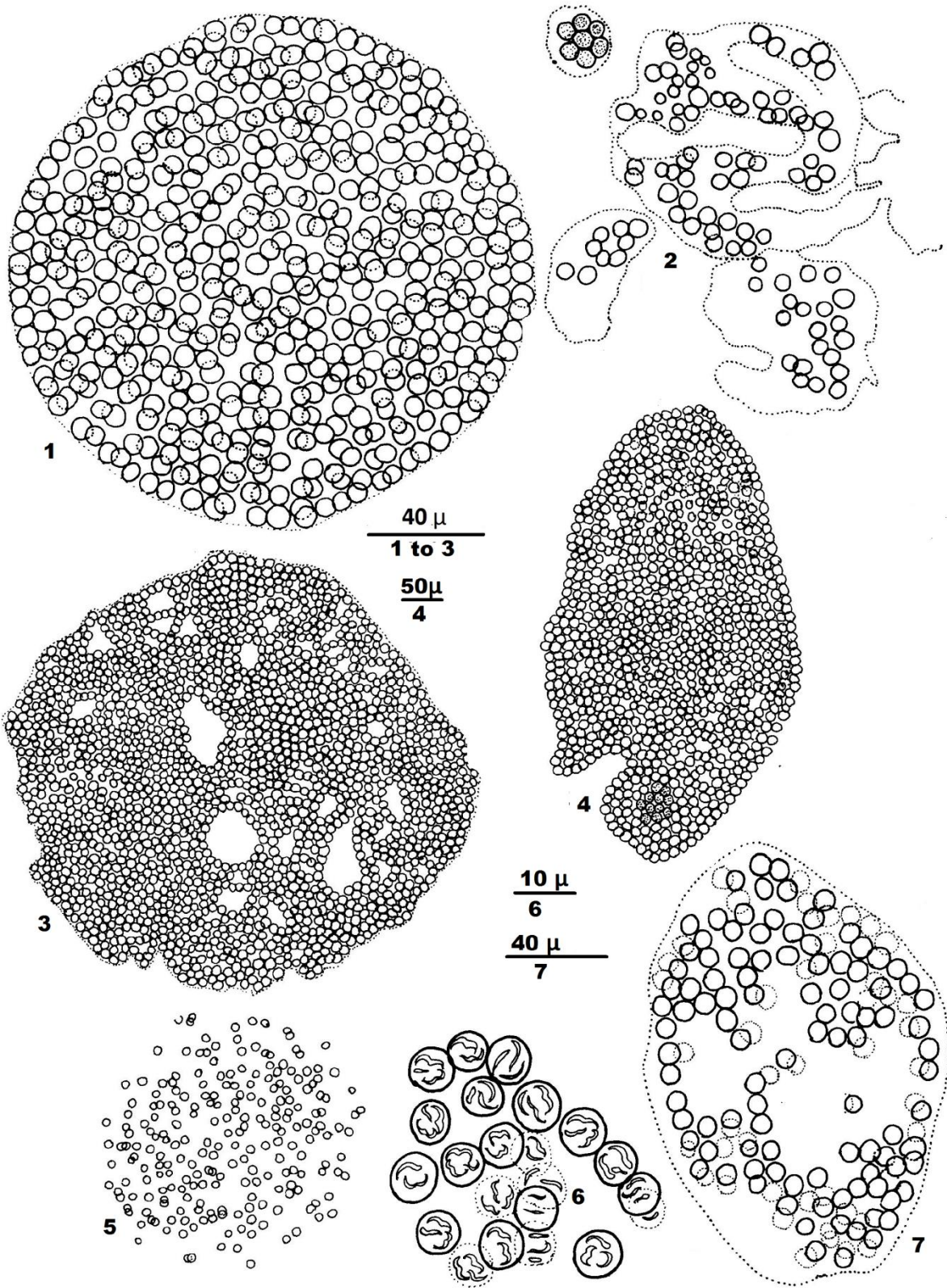


PLATE-3



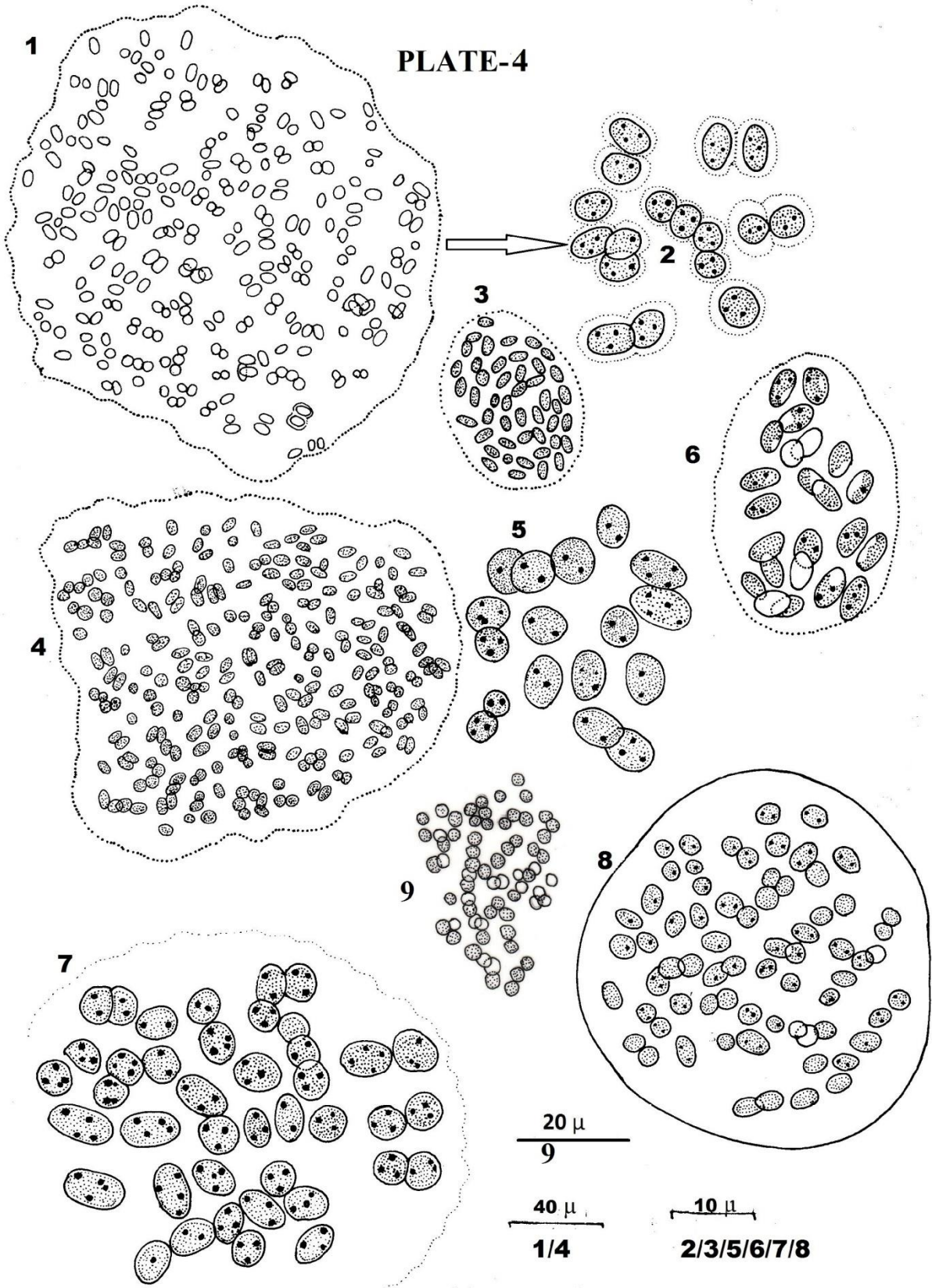


PLATE- 5

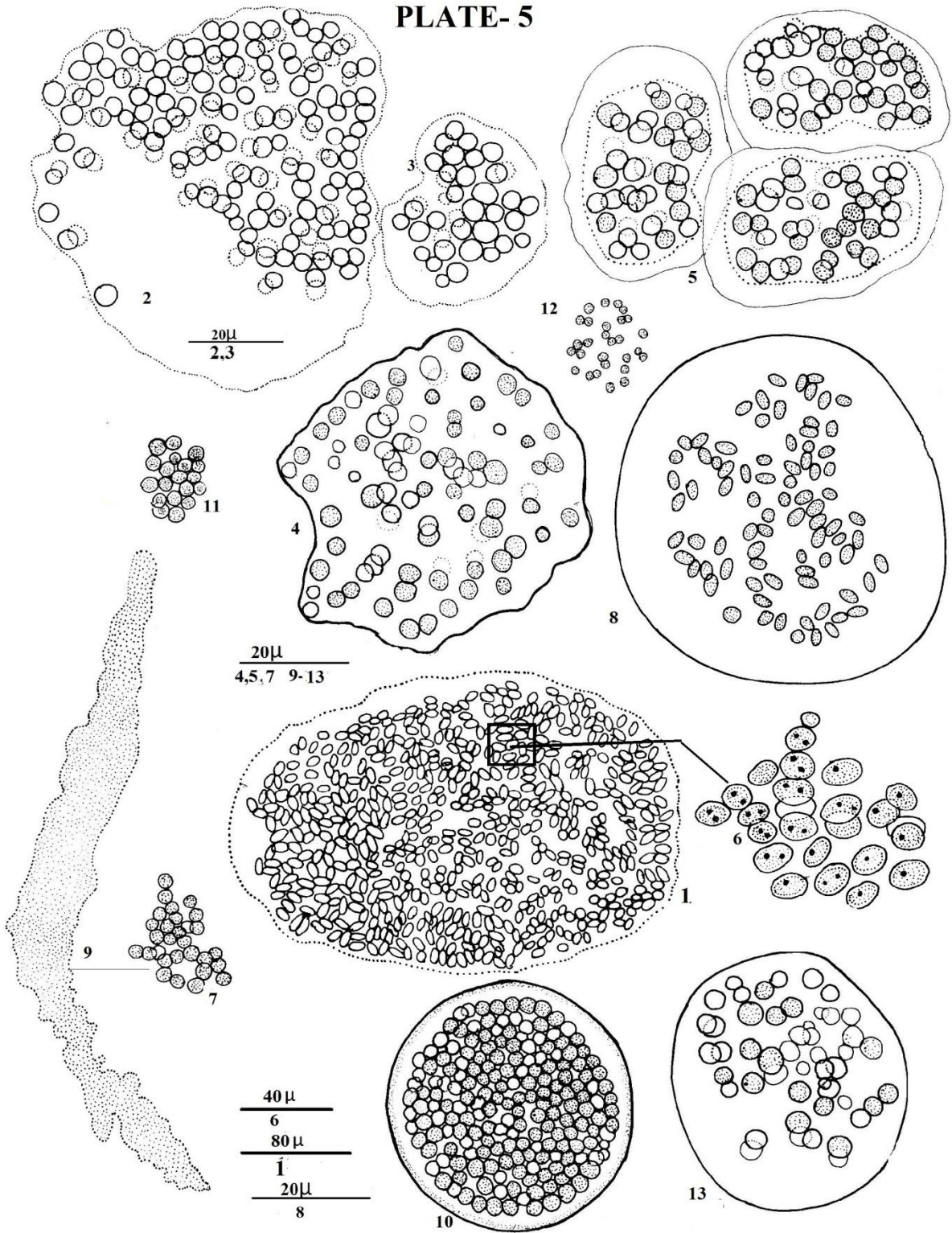
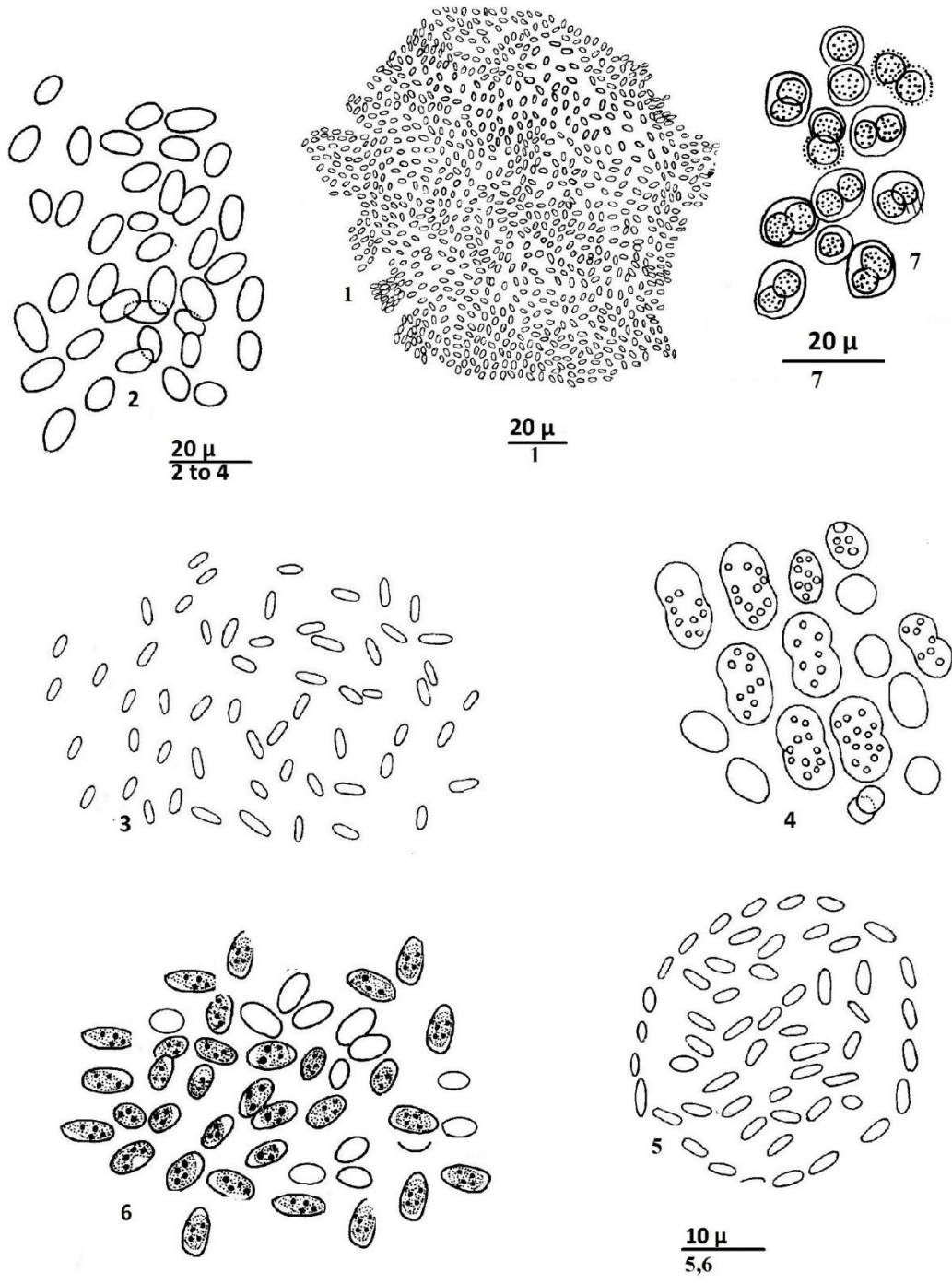
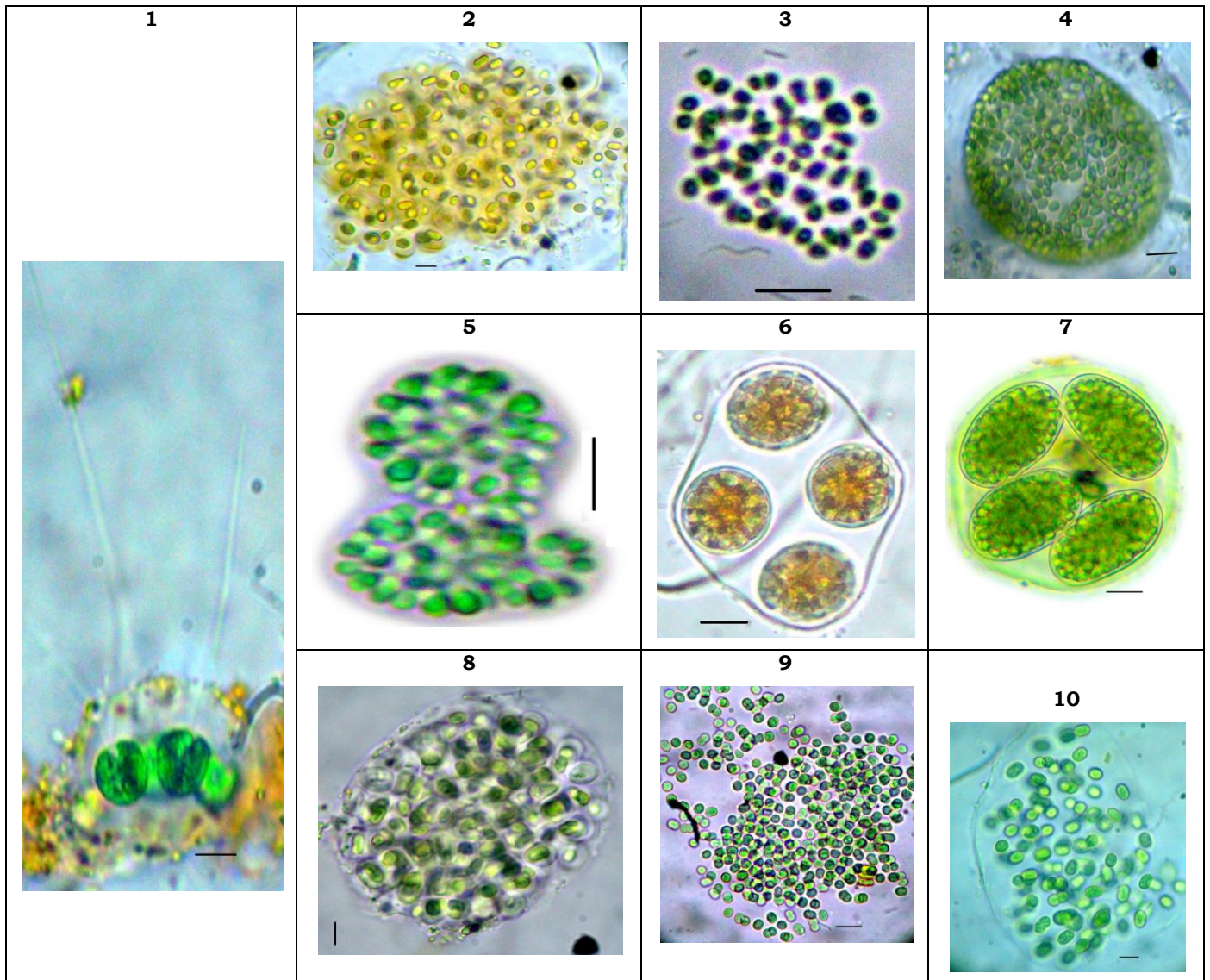




PLATE - 6



Photoplate -1



**PHOTO PLATE-1**

Image- 1 *Gloeochaete wittrockiana* Lagerheim Image 2 *Gloeothece rupestris* (Lyngbye) Bornet. Image 3  
*Aphanothece nidulans* Richter in Wittrock and Nordstedt Image 4 *Aphanothece stagnina* (Sprengel) A.  
 Braun in Rabenhorst Image- 5 *Gomphosphaeria aponina* Kützing Image- 6 *Glaucocystis duplex* Prescott  
 Image- 7 *Glaucocystis nostochinearum* Itzigsohn in Rabenhorst  
 Image 8 *Gloeothece samoensis* Wille. Image- 9 *Synechocystis aquatilis* Sauvageau Image- 10  
*Aphanothece microscopica* Nägeli

PLATE – 1

Fig. 1 *Merismopedia tenuissima* Lemm, Fig. 2 *Merismopedi minima* Beak. Fig. 3 *Merismopedia*  
*punctata* Meyen. Fig. 4 *Merismopedia glauca* (Ehrenb.) Nag. Fig. 5 *Merismopedia elegans* A.Br.,  
 Fig. 6 *Myxosarcina burmensis* Skuja. Fig. 7 *Coelosphaerium kuetzingianum* Nag. Fig. 8  
*Coelosphaerium naegelianum* Unger. Fig. 9, 10, 12, 13 *Gloeocapsa gelatinosa* Kuetz. Fig. 11, 20. *Gloeocapsa*

*altrata* (Turnip) Kuetz. Fig.14, 17. *Gloeocapsa polydermatica* Kuetz. Fig.15 *Gloeocapsa decorticans* (A.Br.)Richter. Fig. 16 *Gloeocapsa kuetzingiana* Nageli. Fig.18 *Gloeocapsa quaternata* (Breb) Kuetz. Fig.19 *Gloeocapsa aeruginosa* (Carm.)Kuetz.

PLATE-2

Fig. 1 *Chroococcus minor* (Kuetzing)Nägeli Fig. 2 , 8 *Chroococcus tenax* (Kirchner) Hieronymus Fig. 3 *Chroococcus limneticus* Lemm. Fig. 6 , 10 *Chroococcus minutus* (Kützing) Nägeli Fig. 7 *Chroococcus micrococcus* (Kuetzing) Rabenh. Fig. 9 , 11 *Chroococcus turgidus* (Kuetzing)Nägeli var. *maximus* Nygaard. Fig. 12 *Gloeothece palea* (Kuetzing) Rabenh. Fig. 13 *Chroococcus turgidus* (Kuetzing) Fig. 5,14 *Gloeothece samoensis* Wille var. *major* Wille Fig. 4 , 15 *Gloeothece membranacea* (Rabenhorst) Bornet. Fig. 16,17 *Gloeothece rupestris* (Lyngb.)Born var. *maxima* West, W. Fig. 18 *Gloeothece fuscolutea* Nägeli.

PLATE – 3

Fig. 1 *Microcystis marginata* (Menegh) Kuetz. Fig. 2 *Microcystis aeruginosa* var. *major* (Wittrock) G.M.Smith. Fig. 3 *Microcystis aeruginosa* Kuetzing. Fig. 4 *Microcystis flos-aquae* (wittr) Kuetzing . Fig. 5 *Microcystis protocystis* Crow. Fig. 6,7. *Microcystis robusta* (Clark) Nygaard.

PLATE – 4

Fig. 1, 2. *Aphanothece castegeni* (Breb) Rabenh . Fig. 3. *Aphanothece clathrata* W.et G. S. West. Fig. 4, 5 . *Aphanothece microscopica* Nag. Fig. 6. *Aphanothece conferta* Richter. Fig. 7. *Aphanothece naegeli* Wartm. Fig. 8,9. *Aphanocapsa montana* Cramer.

PLATE - 5

Fig.1, 6 *Aphanothece pallida* (Kutz.)Rabenh. Fig. 2 *Aphanocapsa biformis* A.Braun. Fig. 3 *Aphanocapsa banaresensis* Bharadwaja. Fig. 4 *Aphanocapsa roeseana* DeBery. Fig. 5 *Aphanocapsa pulchra* (Kuetzing) Rabenh. Fig.7, 9 *Aphanocapsa muscicola* (Menegh.)Wille. Fig. 8 *Aphanothece saxicola* Nageli. Fig. 10 *Aphanocapsa grevillei* (Hass) Rabenh. Fig. 11 *Aphanocapsa koordersi* Strom. Fig. 12 *Aphanocapsa elachista* W.et G. S. West. Fig. 13 *Aphanocapsa* Sp.

PLATE - 6

Fig. 1, 2, 6 *Synechococcus cedrorum* Sauvageau Fig. 3,5 *Synechococcus elongatus* (Nageli) Nägeli. Fig. 4 *Synechococcus aeruginosus* Nägeli. Fig. 7 *Gloeocapsa nigrescens* Nägeli.