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West Bengal, India

सत्यमेव जयते

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Author: **Pratibha Gupta**

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FOREWORD

Algae are autotrophic organisms found in diverse habitats, including freshwater, marine and terrestrial environments. The epiphytic algae, typically grows on the surfaces of plants or submerged / moist objects, etc. Most of the work has been done on fresh and marine water algae and not much attention paid to work on epiphytic or bark algae.

Globally, the work done on epiphytic / bark algae is still in very nascent stage. Very less number of publications are available, and are fragmentary. Hence, exploration of epiphytic / bark algae of India is urgently required for detailed scientific studies. Thus, the scope of exploration work of this area is demanding. The AJC Bose Indian Botanic Garden offers a unique habitat for a wide variety of epiphytic algal species, which remain undocumented. Keeping this in view, the author studied epiphytic cyanoprokaryotes and algae of AJCBIBG, Howrah and in this backdrop; the idea for the book *"Epiphytic Algae of A.J.C. Bose Indian Botanic Garden"* was conceived.

The Botanical Survey of India, the premier taxonomic organization under the Ministry of Environment, Forest and Climate Change (MoEF&CC), is dedicated to the exploration and documentation of India's plant diversity. Taxonomic study of algae is very tough task as they are mostly microscopic with wide range of diversity in their morphological characteristics, which require keen observation through sophisticated research microscope and skill. Acharya Jagadish Chandra Bose Indian Botanic Garden (AJCBIBG), Howrah spread in 273 acres on the west bank of the river Ganga (Hooghly). The author has taken painstakingly the task with great zeal and enthusiastically tried to survey the whole AJC Bose Indian Botanic Garden, Howrah, W.B. During the study, altogether 117 species identified belonging to different classes and photomicrographs of each species were taken and presented in this book.

The author has tried to present the factual Algal profile of epiphytic Algae of AJCBIBG, Howrah, West Bengal in a very comprehensive way along with details of location and field photographs as they have not been reported earlier. This book will be an asset for Students, Teachers, Researchers, Scientists and others interested in this field of study.

(Nameeta Prasad)

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Nature Protects if She is Protected

आज़ादी का अमृत महोत्सव

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The publication of this book could not have been possible but for the ungrudging efforts put by Publication Section of BSI. It is therefore only fair that their contribution do not remain unacknowledged. I thank to all my colleagues of Botanical Survey of India who directly or indirectly co-operated me during this project.

Last but not the least, I express my sincere thanks to all those whosoever directly and or indirectly support since inception till completion of this project.

Author

INTRODUCTION

Indian Botanic Garden, Howrah established in 1787 by Col. Robert Kyd under East India Complany's patronage, the Company Bagan presently known as Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah which spread in 273 acres on the west bank of the river Ganga (Hooghly) depicted in Fig. 1. Geographically it is located at 22°35'N latitude and 88°21'E longitude at the elevation of 4.6m above the sea level.

Fig.1. Base Map of Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah

India, scientifically knowing about the plants with developing concept of taxonomy started in 1793 by Dr. William Roxburgh while working in the 'Company Garden', Shibpur, Howrah where as in 1890, Sir George King laid the foundation stone of the Botanical Survey of India (BSI) for taxonomic studies of plants. After that BSI established different regional centres in India and units in Howrah/Kolkata.

The garden is the real repository of more than 12,000 trees, shrubs and climbers representing over 1,400 species together with a large number of wild and cultivated herbs. Among them this garden is mainly well known for Great Banyan Tree, *Lodoicea maldivica* (J.E. Gmel.) Pres. situated in Large Palm House of the Garden, its native and exotic palms collection collected from South - East Asia and planted in an octagonal metalled enclosure. Apart from this, Mangroves, Mango Belt, Mahogany, etc. found in the Garden. This Garden played very important role in the economic development of the country by introducing,

improving and distributing large number of economic plants such as Tea, Rubber, Jute, Cinchona, Mahogany, Sugarcane, etc.

Algae are photosynthetic organisms that convert solar energy into chemical energy by using sunlight, carbon dioxide, water and minerals that can be utilized by humans and other organisms. Algae are unicellular to multi-cellular with diverse morphological characteristics. It generally ranged from <0.2 to 200µm belong to Class Cyanophyceae, Xanthophyceae, Chrysophyceae, Bacillariophyceae, Euglenophyceae, Chlorophyceae, Dinophyceae (Fritsch, 1935, 1945). After that some other classes were introduced like Conjugatophyceae (Zygnematophyceae), Ulvophyceae, Trebouxiophyceae, Coleochaetophyceae, Coscinodiscophyceae, Phaeothamniophyceae. Algae occurs even in wide range of habitats and have been distributed all over land and water system often in such as environments where there is no other vegetation possibly due to their adaptive capability to extreme adverse environmental conditions with respect to different environmental factors, availability of nutrients, etc. Their occurrence even in wide range of ecologically stress conditions and extreme habitats proves that they are very tolerant. It occurs in fresh-water ecosystem like lakes, ponds, rivers, wetland, etc. and marine water system like salt marshes and pans, estuaries, brackish waters and ocean. Besides, it also occur on rocks, snow and in cold lakes, thermal springs, acid bogs, alkaline as well as fertile and desert soil, in sub-aerial habitats like tree trunks (bark), epiphytic on aquatic and other plants growing in congenial habitat, benthic, rhizosphere and all other objects which remain moisten and get solar light from any angle even for a short span of time there algae grow. As algae is autotrophic organism and interest has increased tremendously mainly due to mounting evidence of their direct practical use as it has wide beneficial properties and helps in maintenance of soil, nitrogen fertility, reduce soil erosion, added in daily diet, produce medicines, etc. They are also considered as pollution and water quality indicator and has been recognised for its vital role in preventing global warming and keeping environment balanced due to production of an alternate source of energy i.e. bio-fuel to replace fossil fuel. Some forms are high in protein contents, vitamin and amino acids. These super living organisms represent the most concentrated, healthiest and power packed food on the earth.

Most of the work has been done on fresh and marine water algae and not much attention paid to work on epiphytic or bark algae. Globally, the work done on epiphytic / bark algae is still in very nascent stage. Very less number of publications, which are fragmentary. Hence, exploration of epiphytic / bark algae of India is also in dire need for detailed scientific studies. Thus, the scope of exploration work of this area is demanding. Keeping this in view studies were initiated on epiphytic cyanoprokaryotes and algae of AJC Bose Indian Botanic Garden, Howrah.

REVIEW OF LITERATURE

The term "algae" merely refers to any aquatic organisms capable of photosynthesis and so applies to several groups which photosynthesize and manufacture their own food except a few forms of Cyanobacteria which get sufficient supply of energy in the form of glucose. Taxonomically, algae are classified into 11 Classes pertaining to Cyanophyceae, Xanthophyceae, Cryptophyceae, Chrysophyceae, Dinophyceae, Bacillariophyceae, Euglenophyceae, Chlorophyceae, Chloromonodineae, Phaeophyceae and Rhodophyceae (Fritsch, 1935, 1945). After that some other classes were introduced like Conjugatophyceae (Zygnematophyceae), Ulvophyceae, Trebouxiophyceae, Coleochaetophyceae, Coscinodiscophyceae, Phaeothamniophyceae, etc. The species belonging to such Classes varies from unicellular to multi-cellular, filamentous and or in colonies, free-floating to such species which remain attached to the substratum and size-wise it range from <0.2 µm to more than 200 cm. Whereas, the microalgae (Anand, 1998; Goudar and Hegde, 2009; Kanungo *et al*., 2009; Kavitha *et al*., 2009; Misra *et al*., 2009; Nandan *et al*., 2009; Parameswaran, 2009; Patil and Chaugule, 2009a, b; Perumal and Anand, 2009; Srinivasan *et al*., 2009 and Yadav and Singh, 2009) varies from unicellular to multi-cellular, filamentous and or in colonies, size-wise it range from <0.2 µm to 200µm among which mostly recorded free-floating as well as colonies belongs to the Class Cyanophyceae, Xanthophyceae, Chrysophyceae, Bacillariophyceae, Euglenophyceae and Chlorophyceae. Algae appears to be a self-consciously reprieve of preserving and holding up its populace and regenerates to lay foundation of life on earth by forming original organic matter.

The first primitive form of life called as prokaryotes may have been emerged / originated during 3.5 billion years ago whereas, blue-green algae performing photosynthesis originated during 3.0 billion years ago (Cassidy, 2009). It has been uniquely positioned in evolutionary hierarchy of earliest living world, predominantly even during Precambrian era (Schopf, 1975, 1994, 1996). The ancient cyanobacteria likely produce much of oxygen in the Earth's atmosphere, as they dominantly metabolise and fix carbon in the form of sugars by using carbon dioxide. Increase in concentration of oxygen on the earth crust, recorded during 2.4 billion years ago considered as an architect of earth's atmosphere as they are “nature’s first and foundational mother and father for causing photosynthesis”, entail to form pure ecological niche on our planet and precisely stands as founder of the aquatic food-chain. As per findings, they have been distributed all over land and water system (Sengar *et al*., 1985; Bongale, 1986; Reddy *et al*., 1986; Chatterjee *et al*., 1990; Anand and Subramanian, 1994; Anand and Hopper, 1995; Rao and Premila, 1996; Hegde and Sujata, 1997; Nandi and Rout, 2000; Ahmed, 2001; Tewari, 2002; Dwivedi *et al*., 2005 and Choudhary *et al*., 2010) often in such as environments where there is no other vegetation possibly due to their adaptive capability to extreme adverse environmental conditions with respect to different environmental factors like temperature as it has been recorded at around 60 ˚C (Thomas and Gonzalves, 1965a, b, c, d, e, f, g and Vasishta, 1968), pH (Prasad *et al*., 1978), salinity, availability of nutrients, pollution load (Palmer, 1980; Kant, 1983; Sengar and Sharma, 1987;

Tripathi, 1989; Shaji and Patel, 1991, 1992; Suthar and Prasad, 1992; Kohli *et al*., 1994; Sinha, 2001 and Gupta and Shukla, 2002), etc. Algae (Fritsch, 1907, 1929; Biswas, 1932, 1934; Gonzalves and Joshi, 1943a, b; Raju, 1963; Goyal, 1964; Ahmad, 1967; Khan, 1970, 1972, 1985; Roy and Gupta, 1973; Grover and Pandhol, 1975; Nasar and Munshi, 1976; Pandhol and Grover, 1976; Bose and Bose, 1977; Sarma and Kanta, 1978; Sarma *et al*., 1979; Sinha and Srivastava, 1980; Goyal, 1982; Pandey, 1982; Pandey and Pandey, 1982; Trivedy, 1982; Somashekar, 1983, 1984; Pal and Santra, 1984; Nandan and Patel, 1985; Saha, 1985; Sengar *et al*., 1985; Mahajan, 1987; Mam *et al*., 1987; Pal and Santra, 1987; Hegde and Malammanavar, 1989; Shakuntala, 1990; Singh and Bongale, 1990; Tripathi *et al*., 1990; Mahajan, 1991; Prasad and Srivastava, 1992; Habib and Chaturvedi, 1993; Srivastava, 1993; Kohli *et al*., 1994; Habib, 1994a, b; Chaturvedi and Habib, 1995; Srivastava, 1997; Viswanathan, 1997; Kant and Gupta, 1998; Pandey *et al*., 1998; Dwivedi *et al*., 2000; Maya *et al*., 2000; Nandi and Rout, 2000; Tiwari *et al*., 2001; Samantaray *et al*., 2002; Shukla and Shukla, 2002; Kumar and Suseela, 2004; Seth *et al*., 2005; Brodie and Lewis, 2007 and Khare and Suseela, 2007) occur even in a wide range of ecologically stress conditions and extreme habitats proves that they are very tolerant and thus placed in an unique group of micro-organism. It occurs in fresh-water (Smith, 1938; Bharadwaja, 1963; Bharati and Bongale, 1975a; Prasad and Srivastava, 1986; Mahajan and Mahajan, 1990; Bajpai, *et al*., 1994 and Misra, *et al*., 2009) and marine water system, on rocks (Fritsch, 1950; Bharati and Kadam, 1987 and Adhikary and Satapathy, 1996), snow and even in cold lakes underneath 5 m of ice pack (Nautiyal, *et al*., 1997) as well as in thermal springs (Copeland, 1936; Yoneda, 1942a, b; Thomas and Gonzalves, 1965a, b, c, d, e, f, g; Patel, 1974 and Hazarika and Gogoi, 1985), acid bogs and alkaline soils (Prasad and Srivastava, 1968), fertile and desert soils (Holsinger, 1935; Gonzalves and Gangla, 1949; Pandey, 1965; Prasad and Srivastava, 1968; Bharati and Bongale, 1975b; Bongale and Bharati, 1980, 1984; Goyal *et al.,* 1984; Bongale, 1986, 1987a, b, c; Angadi, 1990; Shakuntala, 1990; Suseela and Goyal, 1994; Singh *et al.,* 1995 and Singh and Srivastava, 2002) and even a depth of 1 m (39.37 inches) or more, in sub-aerial habitats like tree trunks (Brühl and Biswas, 1924; Edwards, 1968; Cox and Hightower, 1972; Wylie and Schlichting, 1973; Kamat and Harankhedkar, 1976; Raven *et al.,* 1981; Hänninen, 1993; Dickison, 2000 and Gupta, 2008), moist walls (Chadha and Pandey, 1982 and Satapathy and Adhikary, 1993) and all other objects which remain moisten and get solar light from any angle even for a short span of time. However, along with studies on evolutionary trend taken place at different stages, environmental changes and geographic distribution of all organism received special attention after technological development including software based enumeration and identification techniques tend to use them as primary scientific tool as indicator of clean and polluted water (Kant, 1983; Somashekar and Ramaswamy, 1983; Tripathi, 1989 and Suthar and Prasad, 1992), molecular level studies (Bryant, 1994; Wilmotte, 1994; Turner, 1997; Komárek, 2006 and Siegesmund *et al.,* 2008) and collation of generated qualitative and quantitative data and presentation made possible for present day Scientists to carry out their scientific studies in wide range of environmental conditions and habitat like drinking water sources including tanks (Maya *et al.,* 2000), reservoirs (Chatterjee and Choudhury, 1980 and Suthar and Prasad, 1992) and filter units

(Brühl and Biswas, 1922), sewage (Rana, 1977; Somashekar and Ramaswamy, 1983; Palaria, 1985; Somashekar, 1985; Shukla *et al.,* 1989; Mishra and Saksena, 1990; Sarojini, 1996; Parameswaran, 2009; Shashirekha *et al.,* 2009), domestic and industrial effluents (Gupta, 1991 and Shaji and Patel, 1995), subterranean, epiphytic on aquatic and other plants growing in moist and suitable habitat (Brühl and Biswas, 1924; Gunale and Balakrishnan, 1983 and Madhusoodanan and Dominic, 1996a), benthic, rhizosphere (Nandan and Borse, 2001 and Karthikeyan *et al.,* 2009) and other areas which were not studied earlier in detail now recorded them to their greater satisfaction.

The systematic account of fresh water algae was enumerated by several Phycologists important among them are Ghose (1923), Prasad and Srivastava (1968), Bharati and Bongale (1975a), Sarma and Khan (1980), Gupta and Sen (1987), Sabata and Nayer (1992), Gupta (2018), Dhanalakshmi and Pandiyan (2021), Choubisa and Dubey (2022) and Venkateshappa and Krishna (2022). Algal diversity of Glen stream near summer hill region studied by Kumar et al. (2025). Quantitative, qualitative and periodical occurrence of algal flora in sewage ponds is well described by Shukla *et al.* (1989) whereas Deka and Bordoloi (1991) made qualitative assessment of blue-green algae growing in rice fields in Assam. Species diversity in phytoplankton communities in a few freshwater bodies, mines and extreme environment were studied in detail by Goel *et al.* (1988), Srivastava (1993), Ojha and Sharma (1994), Krishnamurthy and Reddy (1996), Sanilkumar and Thomas (2006), Goudar and Hegde (2009), Srinivasan *et al.* (2009), Yadav and Singh (2009), Shiddamallayya and Mathad (2009) and Perumal and Anand (2009).

After exploration of different species from natural condition and existing potent properties in individual species tempted the Phycologists to learn more and more about their life-cycle existing and used them as instrumental tool by isolating them in the laboratory simulating environmental conditions and using various combination of micro and macronutrient as source of nutrients. Studies on qualitative and quantitative distribution of sand culture algae of river Ganga at Kanpur was carried out by Gupta and Shukla (1994) and Tewari (2002) whereas cyanobacterial forms were grown in pure culture media by Anand (1979) and Rippka *et al.* (1979). The acid-tolerant cyanobacterial forms growing in low land paddy fields of Kerala were isolation and characterized by Madhusoodanan and Dominic (1996b).

In nature, a group of same and or other group of organisms live together in the same environment and form a large group depending upon common interests, purposes, reason, etc. Sen (2001) studied association and succession of blue-green algae at different growth stages of rice crop due to rate of fixation of atmospheric nitrogen result high productive rate. Palmer (1980) published a book on Algae and water pollution: The Identification, significance and control of algae in water supplies and in polluted water whereas Kumar and Krishna (2003) and Gupta and Husain (2007) carried out studies on Cyanobacterial toxins: occurrence, properties, biological significance, monitoring and management. Gupta (2012) published a book Algae of India: A Checklist of Cyanoprokaryota.

The epiphytic algal flora of pneumatophores of *Avicennia marina* L. of Karachi area has been described by Tanaka and Shameel (1992), Saifullah and Taj (1995) and Saifullah *et al*., (2003). Studies on epiphytic algae on pneumatophores of mangrove *Avicennia marina* L. was reported by Bhat and Sivakumar (2014). Satpati *et al*., (2013) studied abundance and seasonal variation of green algal genera from Indian Sundarbans mangrove forest. Ambika and Krishnamurthy (2016) studied documentation of corticolous algae.

Studies carried on above areas by various authors but study of algae on various parts of the trees, pneumatophores, etc. are still in very nascent stage. So, attempt has been made to study the taxonomic enumeration and diversity of cyanoprokaryotes and algae on tree trunk, soil, stones / boulder / pebble lying around the plants, pneumatophores, etc.

MATERIAL AND METHODS

Epiphytic cyanoprokaryotes and algal samples were collected from plants of different divisions of Acharya Jagdish Chandra Bose Indian Botanic Garden, Howrah.

Samples from different level of tree trunk like upper, middle and lower portion, petiole, flower, pneumatophores, etc. were collected depending upon the availability of cyanoprokaryotes and algae in different parts of the tree as well as from the historical building and monuments by gently scraping the green, bluish-greenish, yellowish-green and rust colour algal patches with scalpel and forceps in screw cap sampling vials of Tarsons (size 25X50mm & 25X75mm) and brought to the laboratory. Then added double distilled water to make the volume 10 ml in each vial and preserved the specimens by adding 2 - 4 drops of 4% Formalin for studies.

Samples from soil and pebble / boulder / stone lying around the tree, were collected by scraping the algal growth with scalpel and forceps in 15 ml screw cap glass Borosil specimen vial and brought to the laboratory. Further, added double distilled water to make the volume 10 ml in each vial and preserved specimens by adding 2 - 4 drops of 4% Formalin.

All specimens collected from nature (various part of the tree, soil and pebbles / boulders / stones, pneumatophores, building, etc.) were observed under Leica DM 2500 Microscope (4x, 10x, 20x, 40x, 63x and 100x magnification) using Leica **QWin V 3.2 Image Processing and Analysis Software and Leica Application Suit V4 Software**. The specimens of varying morphological and structural characteristic, shape and size of cell(s), colonies, filaments, trichomes, heterocysts, sheath, protoplasm and striae, etc. were studied in detail. Photomicrographs were taken by using Leica DFC 500 digital camera with annotation for documentation.

The specimens were identified consulting standard monographs, books, proceedings like Geitler (1932), Tiffany and Britton (1952), Desikachary (1959), Prescott (1982), Starmach (1985),Kant and Gupta (1998), Komárek and Anagnostidis (1998, 2005), Bertalot and Genkal (1999), Kristiansen and Preisig (2007), Karmmer and Bertalot (2008a, b) and Guiry (2024).

All specimens in screw cap sampling vials with proper labelling are properly maintained in the Section, Botanical Survey of India, MOEF & CC, Government of India, CNH Building, Botanic Garden, Howrah.

Compilation of Generated Data and Reporting :

The generated data tabulated and graphs were prepared. In the text, authority name are cited as described in Authors of Plant Names by Brummitt and Powell (1992), books in accordance with Stafleu and Cowan (1976, 1979, 1981, 1983, 1985, 1986, 1988) and supplements as described by Stafleu and Mennege (1992, 1993, 1995, 1997, 1998, 2000), Journals, Periodicals with Botanical content as described by Bridson (2004 a, b).

GREAT BANYAN TREE

The Great Banyan Tree (GBT) is an outstanding living legend of the AJC Bose Indian Botanic Garden and it acts as an Iconic structure of the Garden. It is one of the star attractions not only for Indian visitors but also for foreign delegates. GBT finds mention in "Guinness Book of the World Records" for its massive canopy. Famous among the local public by the names like „Walhing" and Immortal" tree, it is certainly one of the largest living entity in the world. In comparison with garden exhibits of exotic plants like Palms, Bamboos, Cacti and Succulents, etc., GBT draws maximum visitors throughout the year. Botanically known as *Ficus bengalensis* L. belongs to family Moraceae. This tree is a native of India. The fruit is a small fig, red in colour when ripe and it is not edible. It is over 270 years old and in terms of area of spread known to be the largest tree. There is no clear history of the tree as to the time of planting, etc. but it is mentioned in the travel books of the nineteenth century as existing on a phoenix tree (date palm), when Col. Robert Kyd initiated this garden in the year 1787. GBT was damaged by two great cyclones of 1864 and 1867 during which, some of its main branches got damaged exposing it to the attack of a hard fungus. In 1925, it main trunk measuring 16 m in girth had to be removed after it was infected by wood rotten fungi. With its large number of aerial roots which drops from its branches and runs vertically to the ground and look like so many trunks, the GBT appears more like a miniature forest than an individual tree. Thus as the branches grow longer horizontally, they are not only supported by a series of pillar like prop roots but are also provided with nourishment. These aerial roots are initially passed through the bamboo channels and hastened by care and trained to take a particular position in the ground finally providing maximum support to the growing horizontal branches. It is interesting to note that, despite the absence of main trunk, the tree still maintains perfect vigor and vitality. Present area occupied by the tree is about 18918 sq. m. The present crown of the tree has a circumference of 486 m. and the highest branch raise to 24.5 m. The total number of aerial roots as on date is 4033 reaching down to the ground as prop roots. Thus GBT is standing tall and as senior most citizen of the garden thereby enhancing the beauty and serenity of the area.

Knowledge on diversity and distribution of epiphytic cyanoprokaryotes and algae are still lags behind those of freshwater and marine environments. Hence, attempt made to evaluate the same.

Photo 1 - 4. Algal patches on Great Banyan Tree - *Ficus bengalensis* L.

Photo 5 – 7. Algal patches on Great Banyan Tree - *Ficus bengalensis* L.

Photo 8 - 10. Cyanoprokaryotes, Trentepohlia and other Algae respectively on Great Banyan Tree - *Ficus bengalensis* L.

Photo 11. Close-up of green algal patches on middle region of tree trunk of Great Banyan Tree - *Ficus bengalensis* L.

Photo 12. Close-up of bluish-greenish algal patches on middle region of tree trunk of Great Banyan Tree - *Ficus bengalensis* L.

Photo 13. Close-up of green algal patches on lower region of tree trunk of Great Banyan Tree - *Ficus bengalensis* L.

Photo 14. Collection of sample from middle region of tree trunk of Great Banyan Tree - *Ficus bengalensis* L.

Occurrence of cyanoprokaryotes and algae recorded from *Ficus bengalensis* L. (Great Banyan Tree) in AJCBIBG, Howrah have been presented in Table 1, Fig. 1 and new records from India in Table 2 and Fig. 2. Taxonomic enumeration of identified cyanoprokaryotes and algae belongs to various classes are described here along with their details including nomenclature.

Table 1. Epiphytic Cyanoprokaryotes and Algae recorded from *Ficus bengalensis* L. (Great Banyan Tree) in AJCBIBG

S. No	Class	Order	Family	Genera	species	Var.
1	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Chroococcaceae	Chroococcus	membraninus	
2		Chroococcales	Chroococcaceae	Gloeocapsopsis	crepidinum	
3		Chroococcales	Entophysalidaceae	Chlorogloea	gentilis	
4		Chroococcales	Chroococcaceae	Cyanosarcina	burmensis	
5		Chroococcales	Microcystaceae	Gloeocapsa	decorticans	
6		Chroococcales	Microcystaceae	Gloeocapsa	novacekii	
7		Synechococcales	Merismopediaceae	Limnococcus	limneticus	
8		Synechococcales	Chamaesiphonaceae	Chamaesiphon	polonicus	
9		Nostocales	Scytonemataceae	Scytonema	ocellatum	
10	Chlorophyceae	Sphaeropleales	Sphaeropleaceae	Sphaeroplea	wilmanii	
11		Sphaeropleales	Selenastraceae	Ankistrodesmus	gracilis	
12	Ulvophyceae	Trentepohliales	Trentepohliaceae	Trentepohlia	abietina	
13		Trentepohliales	Trentepohliaceae	Trentepohlia	aurea	
14		Trentepohliales	Trentepohliaceae	Trentepohlia	rigidula	
15	Chrysophyceae	Chromulinales	Chrysocapsaceae	Phaeaster	pascheri	
16		Chromulinales	Chromulinaceae	Spumella	beauchampii	
17	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	acanthostoma	
18		Euglenales	Euglenaceae	Trachelomonas	hispida	Crenuletocollis
19		Euglenales	Euglenaceae	Trachelomonas	pulchella	
20	Dinophyceae	Peridiniales	Peridiniaceae	Peridinium	cinctum	

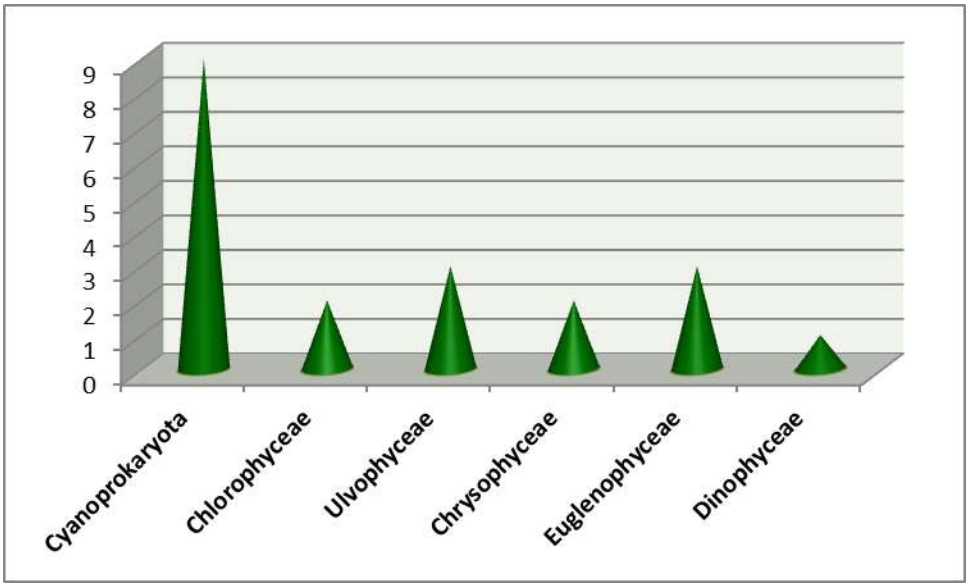

Fig. 1 Number of Cyanoprokaryotes and Algae Recorded from Different Classes

Taxonomic Enumeration of Cyanoprokaryotes and Algae

Cyanophyceae
Chroococcales
Chroococcaceae
Chroococcus Nägeli

Chroococcus membraninus (Meneghi.) Nägeli, Neue Denkschr. Allg. Schweiz. Ges. Gesammten Naturwiss. 10(7): 46. 1849; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 296, f. 390. 1998. *Pleurococcus membraninus* Meneghi., Mem. Reale Accad. Sci. Torino, ser. 2, 5(Cl): 34, t. 4: figs. 1 - 2. 1842.

Colonies mucilagenus, flat, leathery, colourless with irregularly arranged numerous cells or single or with groups of 2 - 4 cells in clusters, cells spherical or hemispherical, with wide, more or less spherical individual envelops, pale blue-green or blue-green, usually with finely granular content.

Dimension : Cells 7.0 µm - 14.51 µm in diameter.

Environment : Freshwater subaerophytic species.

Gloeocapsopsis Geitler ex Komárek

Gloeocapsopsis crepidinum (Thuret) Geitler ex Komárek, Bull. Natl. Sci. Mus. Tokyo, Ser. B (Bot.), 19: 24. 1993; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1):

275, f. 361 f. 1998. *Protococcus crepidinum* Thuret, Mém. Soc. Imp. Sci. Nat. Cherbourg 2: 388, 1854.

Cells more or less spherical with thin colourless and sometimes diffluent envelop, not lamellate, outer envelope hyaline, cell contents pale blue-green or greyish, usually homogeneous.

Dimension : Cells 2.6 µm - 7.06 µm in diameter.

Environment : Freshwater and Terrestrial species.

Cyanosarcina L.Kovácik

Cyanosarcina burmensis (Skuja) Kovácik, Arch. Hydrobiol. Suppl. 80 (Algol. Stud. 50 - 53): 176, 1988; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 315, f. 420. 1998. *Myxosarcina burmensis* Skuja, Nova Acta R. Soc. Upsal., ser. 4, 14(5): 21, t. I: fig. 12. 1949.

Cells more or less angular or with rounded corners, often arranged in transverse and vertical series, pale blue-green or olivaceous, homogeneous, or finely granular; individual sheaths thin, mucilaginous, hyaline; propagation by the division of the colony.

Dimension : 3.0 - 6.5 µm in diameter.

Environment : Freshwater species.

Entophysalidaceae

Chlorogloea Wille

Chlorogloea gentilis Skuja, Nova Acta R. Soc. Sc. Upsal., Ser. 4, 16(3): 44, t. 5, f. 3 – 5. 1964. Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 331, f. 436. 1998.

Colonies subspherical or slightly lobate with numerous densely packed cells, indistinctly radially arranged in marginal parts without visible gelatinous envelops; cells spherical, globose or subspherical, sometimes polygonal rounded with thin homogeneous, scarcely visible individual envelops; cell content olive-green or blue-green, homogeneous or with granules.

Dimension : Cells 4.1 µm - 6.0 µm in diameter.

Environment : Freshwater species.

Microcystaceae

Gloeocapsa Kütz.

Gloeocapsa decorticans (A.Braun) P.G.Richt., Nyt. Mag. Naturvidensk. 62: 186, 1925; Desikachary, Cyanophyta 114, t. 24, f. 9. 1959. *Chroococcus decorticans* A.Braun, Betracht. Erschein. Verjüng 194, 1850.

Cells spherical or sometimes oval, blue-green, single or up to 2 - 4 together; sheath colourless, thick, distinctly lamellated.

Dimension : Cells without sheath 6.2 - 8.0 µm in diameter.

Environment : Terrestrial.

Gloeocapsa novacekii Komárek & Anagn., Presilia 67: 19, figs. 1 - 7. 1995; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 252, f. 328. 1998.

Colonies gelatinous, granular, dirty or blackish brown, composed of subcolonies; mucilaginous envelops wide, finely granular; cells spherical or wide oval, pale olive-green, blue-green or yellowish.

Dimension : Cells 3.5 - 5.51 µm in diameter.

Environment : Aerophytic species.

Synechococcales
Merismopediaceae

Limnococcus (Komárek & Anagn.) Komárková, Jezberová, O.Komárek & Zapomelová
Limnococcus limneticus (Lemmerm.) Komárková, Jezberová, O.Komárek & Zapomelová, Hydrobiologia 639: 79, 2010. *Chroococcus limneticus* Lemmerm. Bot. Centralbl. 76, 153, 1898.

Cells spherical or hemispherical, greyish blue-green, bright blue-green, olive-green or yellowish, with finely granular protoplast.

Dimension : Cells 5.56 µm - 7.25 µm in diameter.

Environment : Freshwater species.

Chamaesiphonaceae
Chamaesiphon A.Braun

Chamaesiphon polonicus (Rostafinski) Hansg., Osterr. Bot. 2. 37: 100, 1887; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 392, f. 511. 1998. *Sphaerogonium polonicum* Rostafinski, Rozpk. I Spraw Wydz. Mat.-Przyr. Akad. Umiej (Kraków) 10: 299, 305, t. 5, figs. 8 - 17. 1883.

Cells almost spherical, later ellipsoidal or oval, longer than wide, rarely pear-shaped, ovoid or shortly cylindrical, with pale content, yellowish pale olive-green or greyish green, usually with 1 or sometimes more, more or less large prominent granules; exocytes 1 - 2 (4), solitary or sometimes in very short irregular rows, remaining attached to the mother cell.

Dimension : Cells 10.09 µm - 16.5 µm in diameter and 15.0 µm - 24.25 µm in length.

Environment : Freshwater species.

Nostocales
Scytonemataceae
Scytonema C.Agardh ex Bornet & Flahault

Scytonema ocellatum Lyngbye ex Bornet & Flahault, Ann. Sci. Nat. Bot. Ser. 7, 5: 87(key), 95, 1886; Desikachary, Cyanophyta 467, t. 92, f. 3. 1959.

Filament intricate, false branched and false branches short, not agglutinated; sheath firm, brownish; trichome olive-green, not torulose; cells shorter than broad or quadrate; heterocysts subquadrate, yellowish.

Dimension: Filaments 10.0 - 16.5 µm broad; trichome 8.4 - 9.4 µm broad; heterocysts 8. 5 - 11.2 µ broad.

Environment : Terrestrial species.

Chlorophyceae
Sphaeropleales
Sphaeropleaceae
Sphaeroplea C.Agardh

Sphaeroplea wilmanii Fritsch & Rich, Trans. Roy. Soc. S. Afr. 18: 38, Fig. 8 H - R, 1929 (as *'wilmani'*). K.R. Ramanathan, Ulotrichales 167, t. 47, f. B & t 50, E1 – E2. 1964.

Cells with chloroplasts annular, numerous often rather more delicate, wall firmer and thicker; oospore commonly single, rarely double, more or less spherical, developing number of primary membranes which are shed successively, mature membrane thick and provided with a few broad and blunt solid processes and system of coarse irregular ridges that show no definite relation to the processes.

Dimension : Oospore 20.03 µm - 25.91 µm in diameter.

Environment : Freshwater species.

Chlorophyceae
Sphaeropleales
Selenastraceae
Ankistrodesmus (Reinsch) Korshikov

Ankistrodesmus gracilis (Reinsch) Korshikov, Protococcineae: 305, figs. 267 a-c. 1953. *Selenastrum gracile* Reinsch Algenfl. Franken: 65, pl. IV: fig. III. 1866.

Cells more or less arcuate, cells arranged with their conves walls apposed; pyrenoid lacking.

Dimension : Cells 1.6 µm – 2.54 µm in diameter and 13.21 µm – 15.02 µm long.

Environment : Freshwater species.

Chlorophyta
Ulvophyceae
Trentepohliales
Trentepohliaceae
Trentepohlia C.Martius

Trentepohlia abietina (Flotow ex Kütz.) Hansg., Prodr. Alg. Bohmen 1: 86, 1886; *Chroolepus abietinus* Flotow ex Kütz., Phyc. Germ. 228, 1845.

Thallus consisted of erect axes, branched, arising from a limited system of prostrate axes; cells of erect axes were cylindrical or slightly swollen, cells of the prostrate parts were globular or elliptical, sometimes, the septa between adjacent cells showed great variation in thickness; whereas some septa much thicker than the adjacent lateral walls; cell walls ornamented by thin spiral strands; apical cells bore frequently a pectic cap; gametangia borne on the erect axes in lateral or apical position, at maturity globular.

Dimension : Cells of the prostrate parts 9.65 µm -10.24 µm in diameter and 18.06 µm – 24.97 µm long.

Environment : Terrestrial species.

Habitat Notes : Common at sites with cool, humid conditions, particularly in forests. GBT is also like a mini forest. Very rarely found on the rocks.

Trentepohlia aurea (Linnaeus) C.Martius, Fl. Crypt. Erlang.: 351, 1817. Byssus aurea Linnaeus, Sp. Pl. 1168, 1753; Prescott, Algae of the Western Great Lakes Area 133, t. 67, f. 6 - 9. 1982.

Thallus rusty brown or golden coloured, sometimes yellow in shaded areas; filaments branching variously according to habitat, sometimes sparingly, sometimes repeatedly branched; cells somewhat inflated below, but mostly cylindrical in the branches, but slightly reduced in diameter toward the apices; walls either smooth or externally tubercular; gametangia globular, lateral on the branches or terminal; sporangia usually terminal on curved cells, about the same size as the gametangia.

Dimension : Cells in main axis 7.03 µm - 11.54 µm in diameter. Gametangia 17.05 µm – 26.09 µm in diameter.

Environment : Terrestrial species.

Habitat Notes : Most frequently found on rocks, both calcareous and siliceous, at sites with cool, humid conditions; it may also be found on old concrete walls, tree bark, wood, mosses and wet soil.

Trentepohlia rigidula (J.Müller) Hariot, J. Bot. 3: 403, 1889; G.G. Satpati & R. Pal, J. Algal Biomass Utln. 7(4): 18 – 23, figs. 1 - 4. 2016. *Coenogonium igidulum* J.Müller, Flora 65: 490, 1882.

Thallus forms compact crusts of filaments on tree bark and varied from orange to yellowish-red in colour; uniseriate filaments showed prostrate and an erect portion; vegetative cells are arranged in uniseriate chain and sporangia borne on the stalk or superimposed on the vegetative cells, vegetative cells are elliptical, barrel shaped, two cells divided by a strong constriction or septum; cell wall thick and sometimes rough; sporangium varied from globular, orbicular or dome shaped, with 15-30 µm diameter, sporangia globose,

sometimes oval and larger than the vegetative cells, generally formed on the filament in apical, intercalary or in lateral position.

Dimension : Vegetative cells 6.0 -19.33 µm in diameter and 12.86 µm - 22.16 µm in length.

Environment : Aerophytic species.

Habitat : Polymorphic species widely distributed in tropical and subtropical regions, usually found on tree bark but also on rocks, cement walls and artificial substrata.

Chrysophyceae
Chromulinales
Chrysocapsaceae
Phaeaster Scherffel

Phaeaster pascheri Scherffel, Arch. Protistenk, 57, 344, t. 15, figs. 21 - 23, text f. 2. 1927 (as *'Paschеrii'*). K. Starmach, Chrysophyceae und Haptophyceae 1: 123, f. 251d, 263. 1985.

Elliptical organism with a single flagellum of similar length bearing the two rows of lateral appendages typical of the Chrysophyceae; thin membranes of the cells; cell surface overlying the chloroplast is covered by thin elliptical scales, cells globular.

Dimension : Cells 5.8 µm - 7.88 µm in diameter.

Environment : Freshwater species.

Chrysophyceae
Chromulinales
Chromulinaceae
Spumella Cienkowsky

Spumella beauchampii (Hovasse) P.C.Silva, Taxon 9: 22, 1960; K. Starmach, Chrysophyceae und Haptophyceae 1: 193, f. 393. 1985; K. Starmach, Chrysophyceae und Haptophyceae 1: 193, f. 393. 1985. *Oikomonas beauchampii* Hovasse, Arch. Zool. Expert. Et Gén. 83: 47, figs 1. 1943 (as *'beauchampi'*).

Cells solitary, spherical to ellipsoid or sometimes oval and may become amoeboid with loss of flagella; Instead of a chloroplast there is a small leucoplast; Protoplast also contains 1-2 contractile vacuoles, one or several chrysolaminaran vacuoles, food vacuoles and sometimes numerous trichocyst-like bodies (mucocysts, discobolocysts) just under the cell surface.

Dimension : Cells 15.0 µm - 17.09 µm in diameter.

Environment : Aerophytic species.

Euglenophyceae
Euglenales

Euglenaceae
Colacioideae
Trachelomonas Ehrenb.

Trachelomonas acanthostoma A.C.Stokes, Proc. Amer. Philos. Soc. 24, 246, 1887; Prescott, Algae of the Western Great Lakes Area 410, t. 85, f. 3. 1982.

Test subglobose or more or less ovoid; wall densely punctate, sometimes with very minute spiny projections about the flagellum aperture, with low collar.

Dimension : Test 19. 89 µm - 21.5 µm in diameter.

Environment : Freshwater species.

Trachelomonas hispida var. **crenuletocollis** (W.M. Maskell) E. J. Lemmerm., Krypt Fl. Mark Brandenburg 3: 526, 1910; Prescott, Algae of the Western Great Lakes Area 414, t. 83, f. 31. 1982.

Test ovoid, flagellum aperture in a short collar with a coarsely toothed margin; wall punctate and unevenly beset with short sharp spines.

Dimension : Test 18.65 µm - 26.23 µm in diameter.

Environment : Freshwater species.

Trachelomonas pulchella Drezepolski, Rozpri I Wiad. Muz. Dzieduszyekich 7, 16, t. I, f. 25. 1923; Prescott, Algae of the Western Great Lakes Area 416, t. 83, f. 28. 1982.

Test oval to ovoid, small; flagellum aperture with a short ring like collar; wall uniformly beset with blunt, wart-like roughenings.

Dimension : Test 10.03 µm - 12.6 µm in diameter.

Environment : Freshwater species.

Dinophyceae
Peridiniales
Peridiniaceae
Peridinium Ehrenb.

Peridinium cinctum (O.F.Müller) Ehrenb., Abh. Königl. Akad. Wiss. Berlin, Phys. KI 74: 1832; J. Popovsky & L.A. Pfiester, *Dinophyceae* (Dinoflagellida) 168, f. 172(b). 1990. *Vorticella cincta* O.F.Müller, Verm. Terr. et Fluv. 1(1): 105, 1773.

Cells spherical elongated and oval and dorsiventrally flattened, cingulum spirals to the left and sometimes flanged, flanged sulcus extends into 1/3 of the epitheca and to the antapex in the hypotheca; epitheca with its irregularly arranged plates is larger than the hypotheca; right antapical plate larger than the left arranged ribs; chloroplast parietal and numerous.

Dimension : 71.02 µm - 79.98 µm in diameter.

Environment : Freshwater species.

Table 2. New Records from India of Epiphytic Cyanoprokaryotes and Algae from Great Banyan Tree - *Ficus bengalensis* L.

S. No.	Class	Order	Family	Genera	species
1	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Entophysalidaceae	Chlorogloea	gentilis
2	,,	Chroococcales	Microcystaceae	Gloeocapsa	novacekii
3	Chlorophyceae	Sphaeropleales	Sphaeropleaceae	Sphaeroplea	wilmanii
4	Chrysophyceae	Chromulinales	Chrysocapsaceae	Phaeaster	pascheri
5	,,	Chromulinales	Chromulinaceae	Spumella	beauchampii
6	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	pulchella

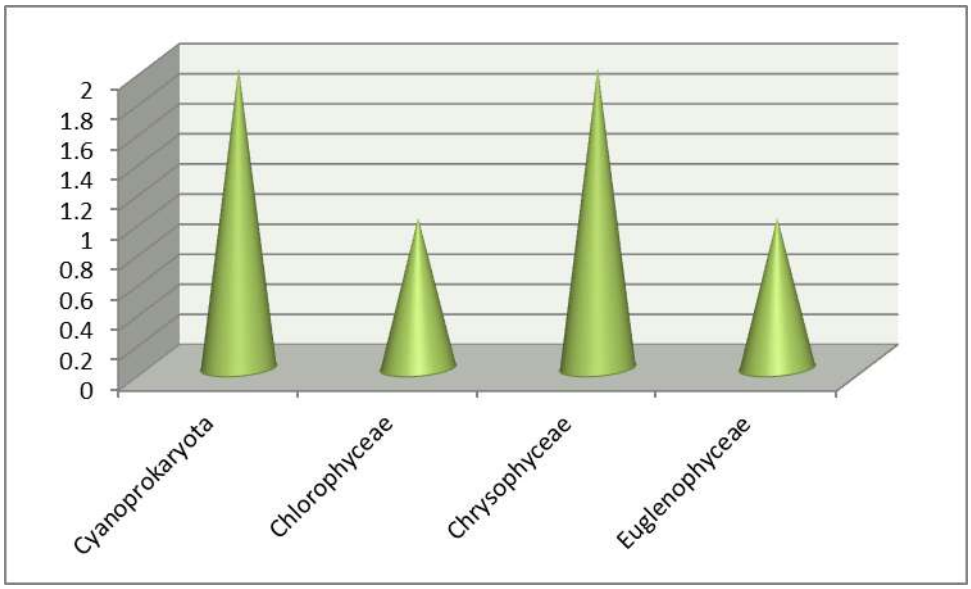

Fig 2. New Records from India of Epiphytic Cyanoprokaryotes and Algae recorded from Great Banyan Tree - *Ficus bengalensis* L. of AJCBIBG

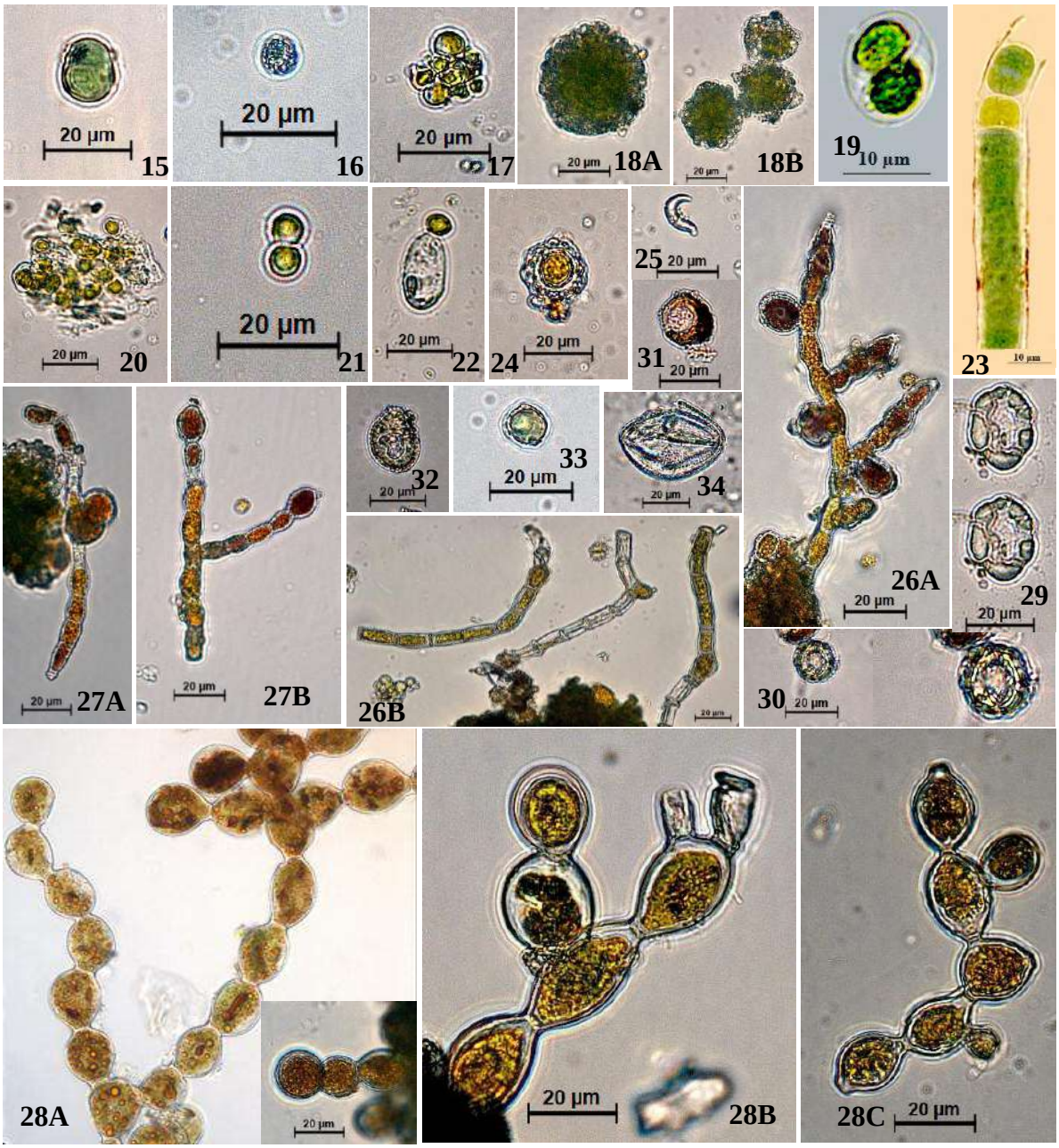

Photo 15. *Chroococcus membraninus* (Meneghi.) Nägeli, 16. *Gloeocapsopsis crepidinum* (Thuret) Geitler, 17. *Cyanosarcina burmensis* (Skuja) Kovácik, 18A & B. *Chlorogloea gentilis* Skuja, 19. *Gloeocapsa decorticans* (A.Braun) P.G.Richt, 20. *Gloeocapsa novacekii* Komárek & Anagn., 21. *Limnococcus limneticus* (Lemmerm.) Komárková, Jezberová, O.Komárek & Zapomelová, 22. *Chamaesiphon polonicus* (Rostafinski) Hansg., 23. *Scytonema ocellatum* Lyngb. ex Bornet & Flahault, 24. *Sphaeroplea wilmanii* Fritsch & Rich, 25. *Ankistrodesmus gracilis* (Reinsch) Korshikov Hansg., 26A & B. *Trentepohlia abietina* (Flotow ex Kütz.) Hansg., 27A & B. *Trentepohlia aurea* (Linnaeus) C.Martius, 28 A, B & C. *Trentepohlia rigidula* (J.Müller) Hariot, 29. *Phaeaster pascheri* Scherffel, 30. *Spumella beauchampii* (Hovasse) P.C.Silva, 31. *Trachelomonas acanthostoma* A.C.Stokes, 32. *Trachelomonas hispida* var. *Crenuletocollis* (W.M. Maskell) E. J. Lemmerm., 33. *Trachelomonas pulchella* Drezepolski and 34. *Peridinium cinctum* (O.F.Müller) Ehrenb.

DOUBLE COCONUT

Acharya Jagadish Chandra Bose Indian Botanic Garden is well known for its native and exotic palms collection collected from South - East Asia and planted in an octagonal metalled enclosure i.e. Large Palm House (Photo - 1). At the centre of the enclosure a very interesting rare giant palm listed in RED DATA Book i.e. *Lodoicea maldivica* (J.E.Gmel.) Pres. with gigantic leaves was planted in 1894 and thus now it attains its age 125 years (Photo 2). To create a natural condition of the tropical rain forest within the enclosure, diverse species of palms, ferns and shade loving plants / climbers bringing from different geographical areas have been planted time to time. This plant belongs to the family Arecaceae and is endemic only to two small islands, namely, Praslin and Curieus among the chain of 115 islands in Seychelles. This plant is commonly known as "Double Coconut" because its seeds i.e. the coconuts have two lobes, resembling two coconuts fused together. The live full mature seed in the whole plant kingdom is largest and heaviest (as recorded up to 30 kg). In this garden it flowered for the first time during 2006 after attaining its age 112 years since its plantation and thus it recorded as a female tree. Keeping in view for conservation of this precious tree in this enclosure, the microclimatic condition created helped this plant in its survival and has also thrive other forms on it.

In general, the microclimatic conditions on and around tree provide congenial environment for the growth of diverse plant forms among which different cyanoprokaryotes and algal forms also come into existence on different parts of the tree trunk which is with bark like rudiments of the leaf scar providing suitable substratum for growth of cyanoprokaryotes and algae. In general, those algae occur on bark are widely called as „Epiphloeophytes". Keeping in view of knowing diversity and taxonomic enumeration of cyanoprokaryotes and algae attempt made to evaluate the same with their significance.

Photo 1. Satellite Imagery of the Acharya Jagadish Chandra Bose Indian Botanic Garden Showing Sampling Site and in Inset Front View of Large Palm House

Photo 2. A rare giant palm i.e. *Lodoicea maldivica* (J.E.Gmel.) Pres. with gigantic leaves listed in RED DATA Book which was planted in the garden in 1894.

Photo 3. Close-up of bluish-greenish patches of Cyanoprokaryotes on middle region of tree trunk of *Lodoicea maldivica* (J.E.Gmel.) Pres. - Double Coconut.

Photo 4. Close-up of greenish patches of Algae on lower region of tree trunk of *Lodoicea maldivica* (J.E.Gmel.) Pres. - Double Coconut.

Photo 5 & 6. Close-up of upper region and flower of *Lodoicea maldivica* (J.E.Gmel.) Pres. - Double Coconut.
Photo 7, 8, 9 & 10. Collection of sample from upper, middle and lower region of *Lodoicea maldivica* (J.E.Gmel.) Pres. - Double Coconut.

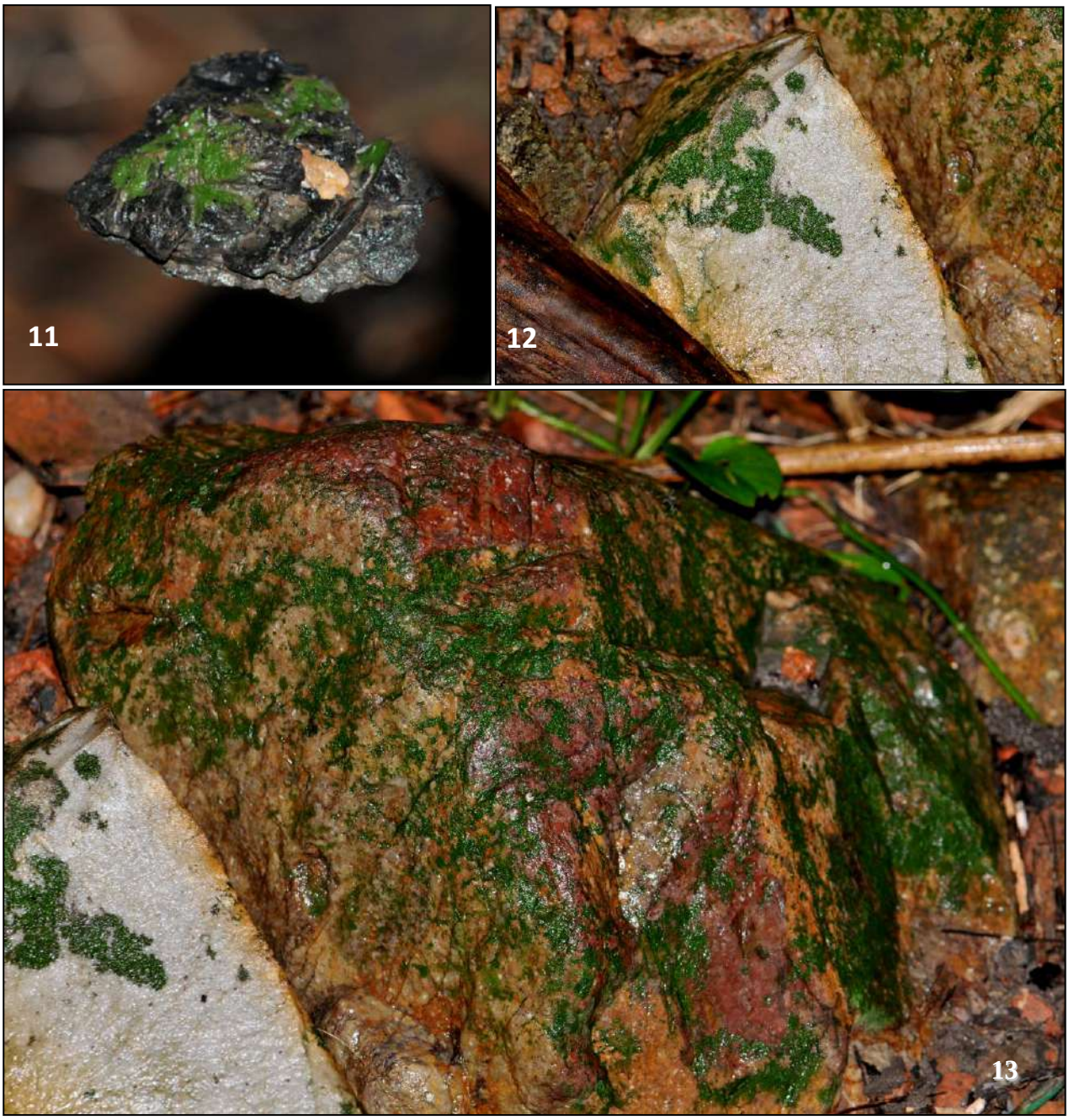

Photo 11, 12 & 13. Algal patches on Pebble, Boulders and Stone respectively

Occurrence of cyanoprokaryotes and algae recorded from *Lodoicea maldivica* (J.E.Gmel.) Pres. (Double Coconut) and on soil and pebbles / boulders / stones around aforesaid tree in the AJCBIBG, Howrah have been presented in Table 1, Fig. 1 and new records from India in Table 2 and Fig. 2. Taxonomic enumeration of identified microalgae belongs to various classes are described here along with their details including nomenclature.

Table 1. Distribution of Cyanoprokaryotes and Algae recorded from on and around *Lodoicea maldivica* (J.E.Gmel.) Pres. (Double Coconut) in AJCBIBG, Howrah

S. No	Class	Order	Family	Genus	species	subsp	var.
1.	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Chroococcaceae	Chroococcus	minutus	-	-
2.		,,	,,	Gloeocapsa	decorticans	-	-
3.		Nostocales	Oscillatoriaceae	Oscillatoria	lacustris	-	-
4.		,,	,,	,,	limosa	-	-
5.		,,	,,	,,	perornata	-	-
6.		,,	,,	,,	pseudogeminata	-	unigranulata
7.		,,	,,	,,	tenuis	-	-
8.		,,	,,	Phormidium	calcicola	-	-
9.		,,	,,	,,	mucicola	-	-
10.		,,	,,	,,	purpurascens	-	-
11.		,,	,,	,,	retzii	-	-
12.		,,	,,	,,	tenue	-	-
13.		,,	,,	Lyngbya	aerugineo-coerulea	-	-
14.		,,	,,	,,	contorta	-	-
15.		,,	,,	,,	dendrobia	-	-
16.		,,	,,	,,	majuscula	-	chakiaense
17.		,,	,,	,,	martensiana	-	-
18.		,,	,,	,,	mesotricha	-	-
19.		,,	Scytonemataceae	Scytonema	guyanense	-	minus
20.		,,	,,	,,	ocellatum	-	-
21.		,,	,,	,,	pseudopunctatum	-	-
22.	Xanthophyceae	Heterococcales	Pleurochloridaceae	Meringosphaera	spinosa	-	-
23.		,,	,,	Monallantus	brevicylindrus	-	-
24.	Chrysophyceae	Phaeothamniales	Phaeothamniaceae	Apistonema	expansum	-	-
25.		Synurales	Synuraceae	Synura	splendida	-	-

26.	Bacillariophyceae	Thalassiosirales	Stephanodiscaceae	Cyclotella	trichonidea	-	-
27.		Melosirales	Melosiraceae	Melosira	italica	-	-
28.		Fragilariales	Fragilariaceae	Diatoma	hyemalis	-	-
29.		,,	,,	,,	vulgare	-	-
30.		,,	,,	Fragilaria	construens	-	-
31.		,,	,,	,,	pinnata	-	-
32.		,,	,,	,,	,,	-	lancettula
33.		Naviculales	Diploneidaceae	Diploneis	ovalis	arctica	-
34.		,,	Naviculaceae	Navicula	slesvicensis	-	-
35.		,,	Pinnulariaceae	Pinnularia	curticostata	-	-
36.		,,	,,	,,	humilis	-	-
37.		Mastogloiales	Mastogloiaceae	Mastogloia	smithii	-	-
38.	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	pulcherrima	-	-
39.		,,	,,	,,	volvocina	-	compressa
40.	Chlorophyceae	Volvocales	Volvocaceae	Pandorina	mora	-	-
41.		Chaetophorales	Protococcaceae	Protococcus	viridis	-	-
42.		Chlorococcales	Chlorococcaceae	Chlorococcum	humicola	-	-
43.		,,	Oocystaceae	Chlorella	ellipsoidea	-	-
44.		,,	,,	,,	vulgaris	-	-
45.		,,	,,	Treubaria	setigera	-	-
46.		,,	Scenedesmaceae	Crucigenia	quadrata	-	-
47.		,,	,,	,,	rectangularis	-	-

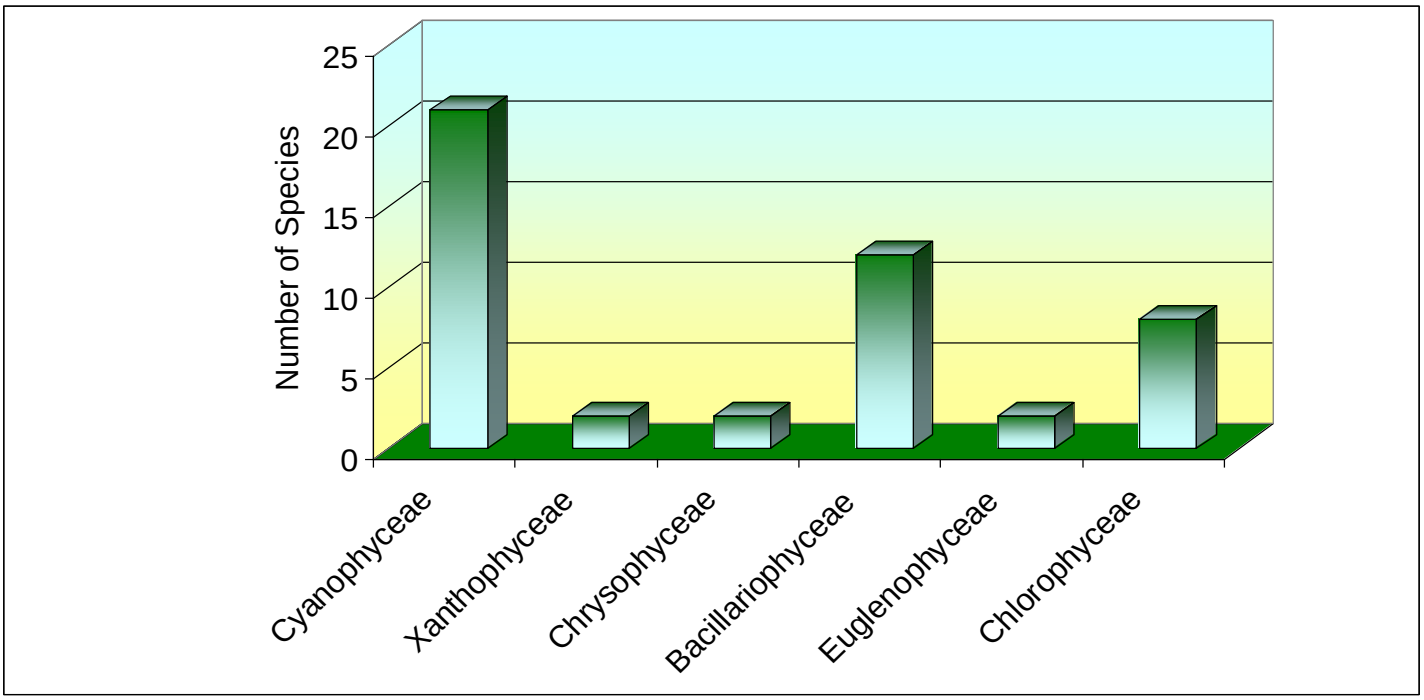

Fig. 1 Number of Cyanoprokaryotes and Algae Recorded from Different Classes

Taxonomic Enumeration of Cyanoprokaryotes and Algae

Cyanophyceae J.H.Schaffn.
Chroococcales Wettst.
Chroococcaceae Nägeli
Chroococcus Nägeli

Chroococcus minutus (Kütz.) Nägeli, Gatt. einzell. Alg. 46, 1849; Desikachary, Cyanophyta 103, t. 24, f. 4 & t. 26, f. 4, 15. 1959. *Protococcus minutus* Kütz., Phycol. general. 168, 1843.

Cells spherical or oblong, single or in groups of 2 - 4, light blue-green; sheath not lamellated, colourless.

Dimension: Cells with sheath 5.0 - 12.0 µ in diameter and without sheath 4.0 - 10.0 µ in diameter; colonies 8.0 - 12.0 µ in diameter.

Distribution: On upper part of the tree trunk.

Environment : Freshwater species.

Gloeocapsa Kütz.

Gloeocapsa decorticans (A.Braun) P.G.Richt., Nyt. Mag. Naturvidensk. 62: 186, 1925; Desikachary, Cyanophyta 114, t. 24, f. 9. 1959. *Chroococcus decorticans* A.Braun, Betracht. Erschein. Verjüng 194, 1850.

Cells spherical or sometimes oval, blue-green, single or up to 2 - 4 together; sheath colourless, thick, distinctly lamellated.

Dimension: Cells without sheath 6.2 - 8.0 µ in diameter.

Distribution: From middle part of the tree trunk.

Environment : Terrestrial species.

Nostocales Geitler
Oscillatoriaceae Kirchn.
Oscillatoria Vaucher

Oscillatoria lacustris (Kleb.) Geitler, in Pascher's Süsswasserflora 12: 362, 1925; Prescott, Algae of the Western Great Lakes Area 488, t. 109, f. 15. 1982. Vasishta, Phykos 7: 203, 1968. *Trichodesmium lacustre* Kleb.**,** Forschungsber. Biol. Stat. Plön 3: 13, 1895; Flora 80: 271, t. 4, f. 31 - 33. 1895.

Trichome straight, lying parallel, not tapering at the apices, apical cell broadly rounded without calyptra; cells compressed globose or barrel shaped, sometimes semiquadrate cell contents with pseudovacuoles.

Dimension: Trichome 3.5 - 6.0 µ broad and cells 2.7 - 4.3 µ long.

Distribution: On middle part of the tree trunk.

Environment : Freshwater species.

Oscillatoria limosa C.Agardh ex Gomont, C.Agardhi, Disp. alg. suec., 35, 1812; Desikachary, Cyanophyta 206, t. 42, f. 11. 1959.

Trichome more or less straight, dull blue-green, brown or olive - green, not constricted at the cross-walls, or only slightly constricted, cross-walls frequently granulated; end cell flatly rounded with slightly thickened membrane.

Dimension: Trichome 6.0 - 14.0 µ broad and cells 2.0 - 5.0 µ long.

Distribution: On middle part of the tree trunk and in soil.

Environment : Freshwater species.

Oscillatoria perornata Skuja, Nova Acta Regiae Soc. Sci. Upsal. ser. 4, 14: 47, t. 8, f. 7 - 9. 1949; Desikachary, Cyanophyta 205, t. 41, f. 8 - 9, 14. 1959. *Planktothrix perornata* (Skuja) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 416, 1988.

Trichomes erect and flexuous, apices briefly attenuated, well constricted at the cross-walls, single; cells commonly 1/2 - 1/5 as long as broad, finely granular, septa granulated, end cell humilis depressed hemispherical, calyptra absent.

Dimension: Trichome 8.5 - 14.0 µ broad and cells 1.8 - 4.2 µ long.

Distribution: On lower part of the tree trunk.

Environment : Freshwater species.

Oscillatoria pseudogeminata var. **unigranulata** Biswas, J. Fed. Malay States Mus. 14: 409,

t. 9, f. 7. 1929; Desikachary, Cyanophyta 229, t. 39, f. 19 & t. 41, f. 17. 1959. *Jaaginema unigranulatum* (Biswas) Anagn., Preslia 73: 363, 2001.

Trichome straight or somewhat curved, not constricted at the cross-walls, not attenuated at the apices, obtusely rounded or truncate, not capitate; cell distinct, sometimes with one granule situated at the centre of the partition walls on either side, cell contents finely uniformly granular, blue-green.

Dimension: Trichome 1.9 - 2.8 µ broad and cells 2.5 - 4.7 µ in length.

Distribution: On middle part of the tree trunk.

Environment : Freshwater species.

Oscillatoria tenuis C.Agardh ex Gomont, Ann. Sci. Nat. Bot., ser. 7, 16: 220, t. 7, f. 2 - 3. 1892; Desikachary, Cyanophyta 222, t. 42, f. 15. 1959.

Phormidium limosum (Dillwyn) P.C.Silva, Univ. Calif. Pub. Bot., 79: 52, 1996. *Conferva limosa* Dillwyn, Brit. Conferv., fasc. 2, t. 20. 1802.

Trichome almost straight, very slightly constricted at the cross-walls, sometimes bent at the ends; cells mostly granulated; end cell more or less with thickened outer membrane.

Dimension: Trichome 4.0 - 10.0 µ broad and cells 2.6 - 5.0 µ long.

Distribution: On lower part of the tree trunk.

Environment : Freshwater species.

Phormidium Kütz.

Phormidium calcicola N.L.Gardner, Mem. New York Bot. Gard., 7: 44, t. 9, f. 87. 1927; Desikachary, Cyanophyta 267, t. 43, f. 4 - 5. 1959.

Sheath colourless, unlamellated; trichome not constricted at the cross-walls, not attenuated; cells quadratic or slightly longer than broad or shorter, blue-green; end cell truncated rounded.

Dimension: Trichome 5.8 - 6.2 µ broad.

Distribution: On the upper part of the tree trunk.

Environment : Freshwater species.

Phormidium mucicola Hub-pest. & Naumann, Ber. Deutsch. Bot. Ges., 47: 86, f. 1 - 6. 1929; Desikachary, Cyanophyta 254, t. 15, f. 13. 1959.

Filament short; sheath very thin; trichome not attenuated at the ends, more or less constricted at the cross-walls; end cell almost rounded, seldom slightly conical, calyptra absent; contents granulated.

Dimension: Trichome 1.3 - 2.0 µ broad.

Distribution: On middle part of the tree trunk.

Environment : Freshwater species.

Phormidium purpurascens (Kütz.) Gomont, J. Bot. 4: 355, 1890; Desikachary, Cyanophyta 262, t. 44, f. 4 & t. 45, f. 1 - 4. 1959. *Leptothrix purpurascens* Kütz., Bot. Zeitung 5(13): 220, 1847. *Leptolyngbya purpurascens* (Gomont ex Gomont) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 392, 1988.

Trichome entangled, not constricted at the cross-walls, end not attenuated; sheath more or less diffluent; cells nearly quadrate, cross-walls marked by two granules on either side; end cell rounded, calyptra absent.

Dimension: Filament 3.0 - 4.7 µ broad and cells 2.9 - 5.4 µ long.

Distribution: On lower part of the tree trunk.

Environment : Freshwater species.

Phormidium retzii (C.Agardh) Kütz. ex Gomont, Ann. Sci. Nat. Bot. ser. 7, 15: 175, 1892; Desikachary, Cyanophyta 268, t. 44, f. 13, 15. 1959. *Oscillatoria retzii* C.Agardh, Disp. alg. suec. 4: 36, 1812.

Thallus compact, penicillate or branched tufts, attached at the base; filaments more or less straight, mostly unconstricted at the cross-walls, or seldom torulose, not attenuated at the ends, not capitate, straight, dull blue-green; sheath thin, firm or mostly diffluent; septa not granulated; end cells truncated with a thickened outer membrane, calyptra absent.

Dimension: Trichome 5.5 - 11.8 µ broad and cells 3.6 - 7.9 µ long.

Distribution: On the middle part of the tree trunk.

Environment : Freshwater species.

Phormidium tenue (Menegh.) Gomont, Monogr. Oscill. 169, t. 4, f. 23 - 25. 1892; Desikachary, Cyanophyta 259, t. 43, f. 13 - 15 & t. 44, f. 7 - 9. 1959. *Anabaena tenuis* Menegh., Consp. algol. Eugan. 8, 1837.

Leptolyngbya tenuis (Gomont) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 393, 1988.

Trichome straight or slightly bent, densely entangled, slightly constricted at the cross-walls, attenuated at the ends, pale blue-green; sheath thin, diffluent; cells up to 3 times longer than broad, septa not granulated; end cell acute-conical, calyptra absent.

Dimension: Trichome 1.0 - 2.0 µ broad and cells 2.5 - 5.3 µ long.

Distribution: On lower part of the tree trunk.

Environment : Freshwater and Terrestrial species.

Lyngbya C.Agardh ex Gomont

Lyngbya aerugineo-coerulea (Kütz.) Gomont, Monogr. Oscill. 146, t. 4, f. 1 - 3. 1892; Desikachary, Cyanophyta 315, t. 48, f. 9. 1959. *Phormidium aerugineo-coeruleum* (Gomont) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 407, 1988.

Filament single or more rarely forming a dull blue-green expanded thallus, flexuous, fragile; sheath thin, firm, not lamellated; trichome not constricted at the cross-walls, sometimes granulated, apex of the trichome very occasionally capitate; cells blue-green; end

cell flattened, conical or rotund, with outer membrane.

Dimension: Trichome 3.0 - 4.0 µ broad and 3.2 - 4.9 µ long.

Distribution: From middle part of the tree trunk.

Environment : Freshwater species.

Lyngbya contorta Lemmerm., Forschungsber. Biol. Stat. Plön 6: 202, t. 5, f. 10 - 13. 1898; Desikachary, Cyanophyta 290, t. 48, f. 5 & t. 50, f. 5, 9. 1959. *Planktolyngbya contorta* (Lemmerm.) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 394, 1988.

Filament single, regularly spirally coiled, with delicate, nearly circular coils; sheath narrow; colourless; cells granulated, end cell rounded.

Dimension: Cells 1.0 - 2.0 µ broad and 3 - 4.5 µ long.

Distribution: On middle part of the tree trunk and from the stone around tree.

Environment : Brackish and Freshwater species.

Lyngbya dendrobia Brühl & Biswas, J. Dept. Sci. Calcutta Univ. 5: 8, t. 3, f. 15a - d. 1923; Desikachary, Cyanophyta 302, t. 50, f. 3, 10 & t. 55, f. 2 - 4. 1959. *Porphyrosiphon dendrobius* (Brühl & Biswas) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 409, 1988.

Filament long and flexible; closely interwoven, sheath usually thin, smooth, hyaline, usually colourless; cells uniformly granular; dissepiments conspicuous, not marked by granules.

Dimension: Trichome 2.2 - 10.0 µ broad and cells 1.0 - 4.5 µ long.

Distribution: On middle part of the tree trunk.

Environment : Aerophytic species.

Lyngbya majuscula var. **chakiaense** C.B.Rao, Proc. Indian Acad. Sci., B. 3: 174, f. 3E - F. 1936; Dasikachary, Cyanophyta 314, t. 51, f. 1. 1959.

Trichome blue-green, brownish green; not constricted at the cross-walls, not attenuated at the ends, cross-walls not granulated; end cell round, calyptra absent.

Dimension: Cells 6.0 - 10.5 µ broad and 1.8 - 3.0 µ.

Distribution: On lower part of the tree trunk.

Environment : Freshwater and Marine species.

Lyngbya martensiana Menegh. ex Gomont, Ann. Sci. Nat. Bot., ser. 7, 16: 145, 1892; Desikachary, Cyanophyta 318, t. 52, f. 6 & t. 51, f. 2. 1959.

Thallus caespitose, blue-green, filament more or less flexible; sheath colourless, thick; trichome not constricted at the cross-walls and cross-walls sometime granulated, apices not attenuated; end cell rounded, without calyptra.

Dimension: Trichome 6.0 - 10.0 µ broad and cells 1.0 - 3.3 µ long.

Distribution: On middle part of the tree trunk.

Environment : Ubiquitous species.

Lyngbya mesotricha Skuja, Nova Acta Regiae Soc. Sci. Upsal. ser. 4, 14(15): 54, t. 9, f. 1 - 7. 1949; Desikachary, Cyanophyta 282, t. 50, f. 1 - 2. 1959. *Heteroleibleinia mesotricha* (Skuja) Anagn. & Komárek, Arch. Hydrobiol., Suppl. 80: 434, 1988.

Filament more or less curved, fixed to the substratum by the basal portion; growing together caespitose and fasciculate; sheath thin to moderately broad, firm, colourless; trichome ends not attenuated, not constricted at the cross-walls, cross-walls marked with one or two large granules on either side; cells contents pale blue-green; homogeneous; apical cell round or rounded conical, no calyptra.

Dimension: Trichome 2.0 - 3.0 µ broad and cells 4.0 - 7.0 µ long.

Distribution: On middle part of the tree trunk.

Environment : Freshwater and Marine species.

Scytonemataceae Rabenh.

Scytonema C.Agardh ex Bornet & Flahault

Scytonema guyanense var. **minus** N.L.Gardner, Mem. New York Bot. Gard. 7: 79, 1927; Desikachary, Cyanophyta 471, t. 87, f. 3. 1959.

Filament forming a thin, floccose stratum; sheath slightly lamellose, lamellae not divergent; cells cylindrical, or slightly torulose at the apices, quadrate or less at the apices of the trichome, 2 - 4 times as long as the diameter at the older parts, homogeneous or with a few refringent granules.

Dimension: Filament 12 - 18 µ broad; trichome up to 13.0 µ broad.

Distribution: On middle part of the tree trunk.

Environment : Terrestrial species.

Scytonema ocellatum Lyngb. ex Bornet & Flahault, Ann. Sci. Nat. Bot., ser. 7, 5: 95, 1888; Desikachary, Cyanophyta 467, t. 92, f. 3. 1959.

Filament intricate, false branched and false branches short, not agglutinated; sheath firm, brownish; trichome olive-green, not torulose; cells shorter than broad or quadrate; heterocysts subquadrate, yellowish.

Dimension: Filaments 10.0 - 16.5 µ broad; trichome 8.4 - 9.4 µ broad; heterocysts 8. 5 - 11.2 µ broad.

Distribution: On middle part of the tree trunk.

Environment : Terrestrial species.

Scytonema pseudopunctatum Skuja, Nova Acta Regiae Soc. Sci. Upsal. ser. 4, 14(5): 38, t. 6, f. 1 - 9. 1949; Desikachary, Cyanophyta 469, t. 96, f. 1 - 6. 1959.

Thallus attached to the substratum, not attenuated, olivaceous to blackish.; filaments partly prostrate, more or less densely intertwined, false branched, rarely solitary or geminate; sheath moderately thick, with parallel lamellation, close, colourless or yellow or yellowish brown, anterior portion smooth, posterior portion finely and densely granulated; trichome

commonly constricted at the cross-walls, slightly constricted at meristematic region; cells usually iso-diametric or in parts, cell contents homogeneous sparsely granulated; heterocysts cylindrical with rounded ends, frequently lightly constricted in the middle region or discoid or rounded quadrate; propagation by hormogones.

Dimension: Filaments 11.0 - 18.0 µ broad; sheath 4.0 - 6.0 µ thick; trichomes 6.0 - 16.0 µ broad; heterocysts 8.0 - 11.0 µ.

Distribution: On upper part of the tree trunk.

Environment : Freshwater and Terrestrial species.

Chlorophyceae Wille
Volvocales Oltm.
Volvocaceae Ehrenb.
Pandorina Bory

Pandorina mora (F.Muell.) Bory, Encyl. Méth. Hist. Nat. Zooph. 521, 1825; Prescott, Algae of the Western Great Lakes Area 75, t. 1, f. 23. 1982. (morum). *Volvox morum* F.Mull., Anim. Infus. 20, t. 3, f. 14 - 16. 1786.

Colony usually distinctly ovate; cells pyriform, crowded, usually 16 in number.

Dimension: Cells 5.5 - 12.0 µ in diameter.

Distribution: On stone around tree.

Environment : Freshwater species.

Chaetophorales Wille
Protococcaceae
Protococcus C.Agardh

Protococcus viridis C.Agardh, Syst. Alg. 13, 1824; Prescott, Algae of the Western Great Lakes Area 127, t. 10, f. 5 – 7. 1982.

Desmococcus olivaceus (Pers. Ex Ach.) J.R.Laundon, Taxon 34: 672, 1985. *Lepraria olivacea* Pers.ex Ach., Lich. Univers. 666, 1810.

Unicellular or in indefinite clusters, cells globose or angular from mutual compression; chloroplast a dense lobed parietal plate sometimes covering most of the cell wall.

Dimension: Cells 4.0 - 12.0 µ in diameter.

Distribution: From flower.

Environment : Freshwater species.

Chlorococcales Pascher
Chlorococcaceae V.H.Blackman & Tansley
Chlorococcum Menegh.

Chlorococcum humicola (Nägeli) Rabenh., Fl. eur. alg. 3: 58, 1868; Tiffany & Britton, The

Algae of Illinois 102, t. 29, f. 277 - 278. 1952. *Cystococcus humicola* Nägeli, Fl. eur. alg. 85, t. 3, f. E. 1849.

Chlorococcum infusionum (Schrank) Meneg., Monogr. nostoch. ital., 27,1842.

Cells solitary or in aggregates, forming thin coatings on moist places.

Dimension: Cells 3.0 - 26.0 µ in diameter.

Distribution: On stone around tree and lower part of the tree trunk.

Environment : Freshwater and Terrestrial species.

Oocystaceae Bohlin

Chlorella Beij.

Chlorella ellipsoidea Gerneck, Beih. Bot. Centralbl. 21: 250, t. 11, f. 45 - 46. 1907; Prescott, Algae of the Western Great Lakes Area 236, t. 53, f. 11 - 12. 1982.

Cells ellipsoidal, sometimes unsymmetrical; chloroplast a folded plate over part of the cell wall.

Dimension: Cells 7.0 - 8.0 µ in diameter and 9.0 - 11.2 µ long.

Distribution: On lower part of the tree trunk.

Environment : Freshwater and Terrestrial species.

Chlorella vulgaris Beij., Bot. Zeitung 48: 758, t. 7, f. 2. 1890; Tiffany & Britton, The Algae of Illinois 114, t. 29, f. 280. 1952.

Cells solitary or aggregated into small groups, spherical or globose or ellipsoidal, forming 2 - 8 autospore; cell walls smooth, chloroplast single and parietal, pyrenoid single and covered with starch envelope.

Dimension: Cells 5.0 - 10.0 µ in diameter.

Distribution: Lower part of the tree trunk; stone around the tree, leaf scar; flower.

Environment : Freshwater and Terrestrial species.

Treubaria C.Bernard

Treubaria setigera (W.Archer) G.M.Sm., Fresh.-w. alg. 499, 1933; Prescott, Algae of the Western Great Lakes Area 242, t. 51, f. 8. 1982 (setigerum). *Tetrapedia setigera* W.Archer, Quart. J. Microscop. Sci., 12: 365, t. 21, f. 14 - 17. 1872.

Cells triangular and flattened in surface view, the angles broadly rounded and then produced to form a long tapering spine; chloroplast a parietal plate, covering the cell wall.

Dimension: cells 7.0 - 9.0 µ in diameter and spines 12.0 - 15.0 µ long.

Distribution: On upper part of the tree trunk.

Environment : Freshwater species.

Scenedesmaceae Oltm.
Crucigenia Morren

Crucigenia quadrata Morren, Ann. Sci. Nat. Bot. 426, t. 15, f. 1 - 5. 1830; Prescott, Algae of the Western Great Lakes Area 285, t. 65, f. 10. 1982.

Colony consisting of a circular plate of 4 triangular cells, cruciately arranged about a small central space, the outer free wall of the cells broadly convex, the lateral walls adjoined throughout their length with neighbouring cells and converging toward the center of the colony; walls sometimes with knob-like projections; chloroplasts parietal disc, as many as 4 in a cell; pyrenoids not always present; cells multiple quadrate colonies formed by the close arrangement of the component quartets.

Dimension: Cells 2.5 - 6.0 µ in diameter and 3.0 - 4.2 µ long.

Distribution: On upper part of the tree trunk.

Environment : Freshwater species.

Crucigenia rectangularis (Nägeli) Gay, Rech. Alg. Vert. 116, t. 15, f. 151. 1891; S.Kant & P.Gupta, Algal flora of Ladakh 92, t. 22 f. 16 & t. 92, f. 6. 1998.

Colony with a small open space at centre; cells regularly arranged in quarters or in multiple of quarters, ovoid to ellipsoid.

Dimension: Cells 3.4 - 7.0 µ broad and 4.0 - 7.0 µ long.

Distribution: On upper part of the tree trunk.

Environment : Freshwater and Marine species.

Xanthophyceae Allorge ex F.E.Fritsch
Heterococcales
Pleurochloridaceae Pascher
Meringosphaera (Lohmann) Pascher

Meringosphaera spinosa Prescott, Prescott, P.C.Silva & W.E.Wade, Hydrobiologia 2: 87, t. 87, f. 8 - 9. 1949; Prescott, Algae of the Western Great Lakes Area 352, t. 95, f. 21 - 22. 1982.

Cells spherical, wall sparsely beset with relatively long, fine, tapering spines; chromatophores numerous ovate, parietal disc

Dimension: Cells 7.7 - 12.0 µ in diameter.

Distribution: On lower part of the tree trunk.

Environment : Freshwater species.

Monallantus Pascher

Monallantus brevicylindrus Pascher, in Rabenh. Krypto.-Fl. Deutschl. 2, 11: 422, f. 289 - 290. 1939; Prescott, Algae of the Western Great Lakes Area 352, t. 95, f. 24. 1982.

Cells cylindric, amoeboid, ellipsoid, with 1 or 2 chromatophores.

Dimension: Cells 6.0 - 8.0 µ in diameter and 9.0 - 13.0 µ long.

Distribution: On upper part of the tree trunk.

Environment : Freshwater species.

Euglenophyceae Schoen.
Euglenales Bütschli
Euglenaceae H.J.Carter
Trachelomonas Ehrenb.

Trachelomonas pulcherrima Playfair, Proc. Linn. Soc. New South Wales 40: 13, t. 1, f. 32 - 33. 1915; Prescott, Algae of the Western Great Lakes Area 416, t. 83, f. 22 - 23. 1982. *Trachelomonas oblonga* var. *pulcherrima* (Playfair) Popova, Opred. Presnovodn Vodorosl. SSSR 7: 68, 1955.

Test elliptic or subcylindric-elliptic; flagellum aperture without a collar; wall yellow-brown, smooth.

Dimension: Test 5.0 - 14.0 µ in diameter and 6.5 - 20.0 µ long.

Distribution: From soil around the tree.

Environment : Freshwater species.

Trachelomonas volvocina var. **compressa** Drezep., Kosmos Lvov 50: 224, f. 2. 1925; Prescott, Algae of the Western Great Lakes Area 419, t. 83, f. 2 - 3. 1982.

Test depressed - globose or spheroidal; flagellum aperture surrounded by a thickening of the smooth wall

Dimension: Test up to 18.3 µ in diameter and 20.2 µ long.

Distribution: Upper part of the tree trunk.

Environment : Freshwater species.

Chrysophyceae Pascher
Phaeothamniales
Phaeothamniaceae Hansg.
Apistonema Pascher

Apistonema expansum Geitler, Osterr. Bot. Z. 118: 21, f. 2. 1970; Starmach, Chrysophyceae and Haptophyceae 1: 380, f. 796a. 1985.

Barrel-shaped cells with wall and 1 - 2 chloroplasts, arranged in branched filaments.

Dimension: 4.7 - 9.0 µ broad and 7.8 - 12.0 µ long.

Distribution: From Leaf petiole.

Environment : Freshwater species.

Synurales R.A.Andersen
Synuraceae Lemmerm.
Synura Ehrenb.

Synura splendida Korshikov, Arch. Protistenk. 95: 27, f. 2. 1942; J.Kristiansen & R.Preisig, Chrysophyte and Haptophyte Algae 2: 113, t. 36a - c, f. 72, 78b. 2007.

Cells more or less cylindrical with very conspicuous spines; Cysts pyriform, with lateral thickenings; scales large, body scales have a continuous upturned edge and long, straight spine with a blunt, spine base has short radiating ribs, rear scales are smaller, spineless.

Dimension: Cells 19.2 - 45.0 µ; Scales about 7.5 µ; body scales up to 10.0 µ.

Distribution: Soil around the tree.

Environment : Freshwater species.

Bacillariophyceae Haeckel
Thalassiosirales
Stephanodiscaceae
Cyclotella (Kütz.) Bréb.

Cyclotella trichonidea Econ.-Amilli, Nova Hedwigia 31: 468, f. 1 - 20. 1979; Karmmer & Lange-Bert., Bacillariophyceae 52, t. 50, f. 12. 2008.

Valves circular to oval, on the outer region of valve face and continuing to the valve edge without a break, Central area with few warts and granules.

Dimension: Cells 9.0 - 13.1 µm in diameter; striae 13 - 14 in 10 µ.

Distribution: On stone around tree.

Environment : Freshwater species.

Melosirales R.M.Crawford
Melosiraceae Kütz.
Melosira C.Agardh

Melosira italica (Ehrenb.) Kütz., Bacillarien 55, 1844; Tiffany & Britton, The Algae of Illinois 221, t. 59, f. 668. 1952. *Gaillionella italica* Ehrenb. Infus. 171, 1838. *Aulacoseira italica* (Ehrenb.) Simonsen, Bacillaria 2: 60, 1979.

Sulcus shallow; valves with teeth and punctate; girdles punctate, striations slightly spiral, sometimes wavy and intersecting.

Dimension: Cells 6.0 - 20.0 µ broad and 8.0 - 28.0 µ long; striae 11 - 18 in 10 µ.

Distribution: Middle part of the tree trunk.

Environment : Freshwater species.

Fragilariales P.C.Silva

Fragilariaceae Grev.

Diatoma Bory

Diatoma hyemalis (Roth) Heib., Consp. Diat. Dan., 58. 1863; Karmmer & Lange-Bert., Bacillariophyceae 99, t. 97: 6 - 10 & t. 98, f. 1 - 6, 2008. *Conferva hyemalis* Roth, Tent. Fl. Germ. 3: 506, 1800.

Cells rectangularly tubular in girdle view, bilaterally symmetric; autospores formed within the cells.

Dimension: Cells 8.0 - 10.5 µ broad and 30 - 60 µ long; striae 7 - 8 in 10µ.

Distribution: Lower and upper part of the tree trunk.

Environment : Freshwater species.

Diatoma vulgare Bory, Rev. Gen. 461, 1824; Tiffany & Britton, The Algae of Illinois 230, t. 61, f. 686, 687. 1952. (vulgaris).

Cells delicate intercalary bands; valves sometimes elliptic-lanceolate; transverse striations.

Dimension: Cells 10.0 - 13.0 broad and 30.0 - 55.0 µ long; striae 8 - 16 in 10 µ.

Distribution: Lower part of the tree trunk.

Environment : Freshwater species.

Fragilaria Lyngbye

Fragilaria construens (Ehrenb.) Grunow, Verh. K. Zool.-Bot. Ges. Wien. 12: 371. 1862; Tiffany & Britton, The Algae of Illinois 232, t. 62, f. 696. 1952. *Staurosira construens* Ehrenb. Ber. K. Akad. Wiss. Berlin, Physik. KI. 424, 1843.

Cells solitary or sometimes united in to compact chains; valves greatly expanded medianly, with lance-like pseudoraphe; transverse striations very slightly radial.

Dimension: Cells 6.0 - 12.0 µ broad and 10.0 - 40.2 µ, striae 14 - 15 in 10 µ.

Distribution: Upper part of the tree trunk, soil around the tree & bryophyte near tree.

Environment : Freshwater species.

Fragilaria pinnata Ehrenb., Abh. K. Akad. Wiss. Berlin Physik. KI. 415, t. 3, f. 6, 8. 1843; Tiffany & Britton, The Algae of Illinois 234, t. 62, f. 700. 1952. *Staurosirella pinnata* (Ehrenb.) D.M.Williams & Round, Diat. Res. 2: 274, 1987.

Cells united into flat chains; valves broadly to slightly narrowly elliptical, transverse striations prominent, almost rib-like, sometimes radial.

Dimension: Cells 4.0 - 8.0 µ broad and 10.0 - 40.0 µ long; striae 10.0 - 12.0 in 10 µ.

Distribution: Lower part of the tree trunk.

Environment : Freshwater and Marine species.

Fragilaria pinnata var. **lancettula** (Schum.) Hust., A.Schmidt´s Atlas Diatom.-Kunde. expl. t. 297, f. 51, 59 - 64. 1913; Tiffany & Britton, The Algae of Illinois 234, t. 62, f. 701. 1952. *Fragilaria lancettula* Schum., Schriften Königl. Phys.-Ökon. Ges. Königsberg. 8(Abh.): 52, t. 1, f. 4. 1867.

Cells lanceolate in valve view, with more or less beaked and pointed poles, transverse striation almost 9 - 11 in 10 µ but not much clear in our sample.

Dimension: Cells 2.0 - 5.5 µ broad and 5.0 - 25.0 µ long.

Distribution: From soil culture.

Environment : Freshwater species.

Naviculales Bessey
Diploneidaceae D.G.Mann
Diploneis Ehrenb. ex Cleve

Diploneis ovalis subsp. **arctica** Lange-Bert. & Genkal, Iconographia Diatomologica, 43, t. 43, 1 - 3, 1999.

Cells solitary, valve usually elliptic with large roundly quadrate central nodule.

Dimension: Cells 5.2 -10.0 µ broad and about 12.3 µ long; costae 9 - 12 in 10 µ.

Distribution: On stone around tree.

Environment : Freshwater species.

Naviculaceae Kütz
Navicula Bory

Navicula slesvicensis Grunow, Lange - Bert. & Sergei I. Genkal, Iconographia Diatomologica 132, f. 9 - 11. 1999.

Valve linear, lanceolate or elliptical, end rounded, raphe straight present in both valves; valve surface striated.

Dimension: Cells 4.2 - 4.8 µ broad and 15.3 µ long; striae about 14 in 10 µ.

Distribution: On stone around tree.

Environment : Brackish and Freshwater species.

Pinnulariaceae D.G.Mann
Pinnularia Ehrenb.

Pinnularia curticostata Krammer & Lange-Bert., Lange- Bert. & Genkal, Iconographia Diatomologica 6: 84, t. 52b, f. 1 - 3. 1999.

Cells solitary, valve linear-elliptic, gradually tapering to obtuse; transverse striations, slightly radiate in the middle, convergent at the poles.

Dimension: 5.0 - 8.6 µ broad and 20.0 - 30.8 µ long; striae 7 - 9 in 10 µ.

Distribution: Lower part of the tree trunk.

Environment : Freshwater species.

Pinnularia humilis Krammer & Lange-Bert., Lange- Bert. & Genkal, Iconographia Diatomologica 6: 84, t. 52b, f. 8 - 14. 1999.

Cells solitary, symmetric, rounded at the ends, rectangular in girdle view; valve linear-elliptic, margin somewhat convex; transverse striation slightly radiate.

Dimension: Cells 6.0 - 10.2 µ broad and 20.0 - 39.6 µ long; striae 9 - 12 in 10 µ.

Distribution: Lower part of the tree trunk.

Environment : Freshwater species.

Mastogloiales D.G.Mann
Mastogloiaceae Mereschk.
Mastogloia Thwaites ex W.Sm.

Mastogloia smithii Thwaites ex W.Sm., Syn. Brit. Diat. II: 65, t. LIV, f. 341. 1856; Tiffany & Britton, The Algae of Illinois 250, t. 68, f. 792. 1952.

Valves elliptic-lanceolate, with transverse striations, slightly radial, axial area narrow and linear, raphe straight; rectangular to quadrate chambers of internal septa.

Dimension: Cells 4.0 - 12.0 µ broad and 19.0 - 45.0 µ; septa 6 - 8 in 10 µ.

Distribution: On lower part of the tree trunk.

Environment : Freshwater species.

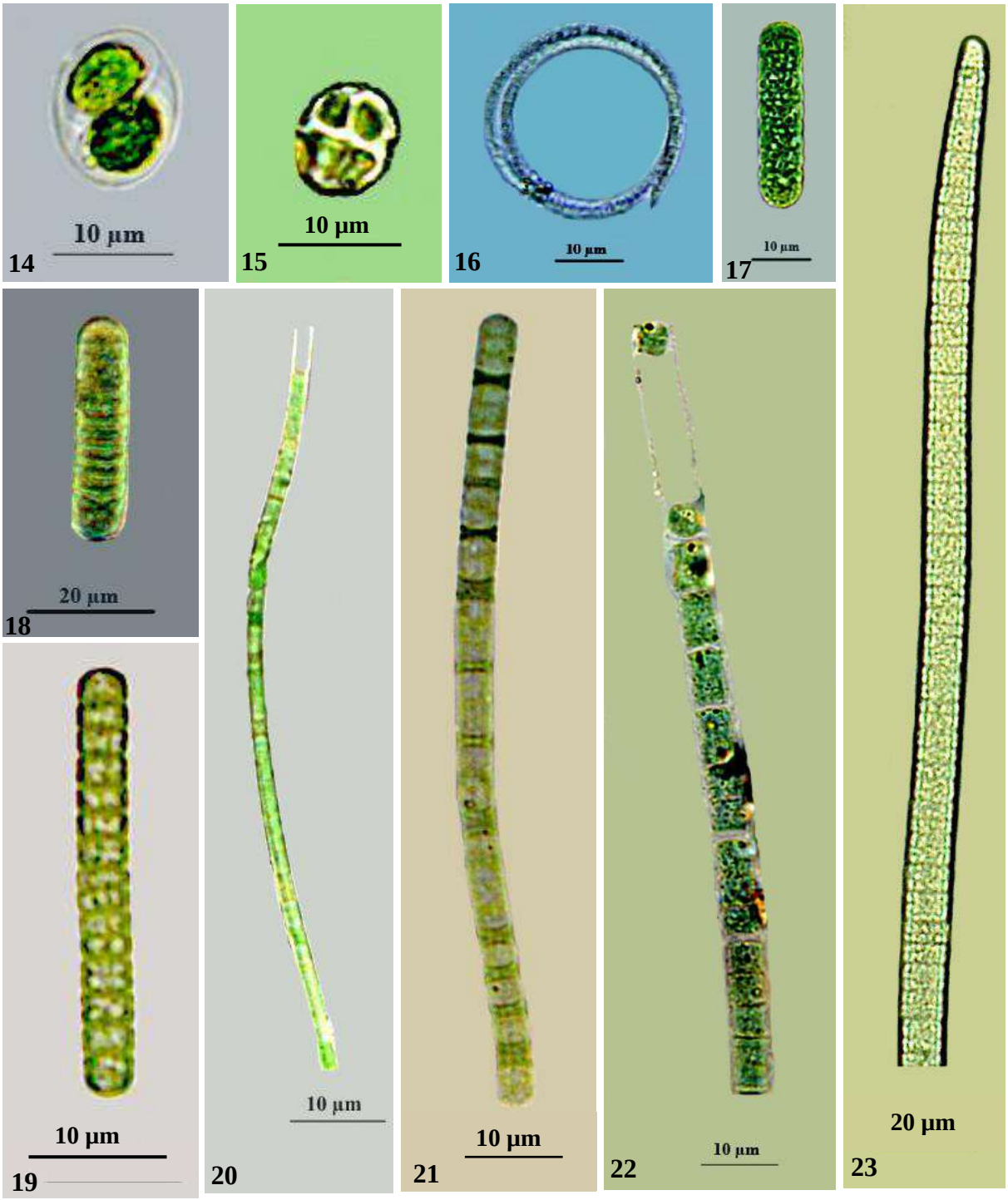

Photo 14. *Gloeocapsa decorticans* (A.Braun) P.G.Richt.
Photo 15. *Chroococcus minutus* (Kütz.) Nägeli
Photo 16. *Lyngbya contorta* Lemmerm.
Photo 17. *Oscillatoria perornata* Skuja
Photo 18. *Lyngbya majuscula* var. *chakiaense* C.B.Rao
Photo 19. *Oscillatoria lacustris* (Kleb.) Geitler
Photo 20. *Phormidium mucicola* Hub-pest. & Naumann
Photo 21. *Oscillatoria pseudogeminata* var. *unigranulata* Biswas
Photo 22. *Phormidium purpurascens* (Kütz.) Gomont and
Photo 23. *Oscillatoria tenuis* C.Agardh ex Gomont

Photo 24. *Phormidium calcicola* N.L.Gardner
Photo 25. *Lyngbya aerugineo-coerulea* (Kütz.) Gomont
Photo 26. *Lyngbya martensiana* Menegh. ex Gomont and
Photo 27. *Lyngbya mesotricha* Skuja

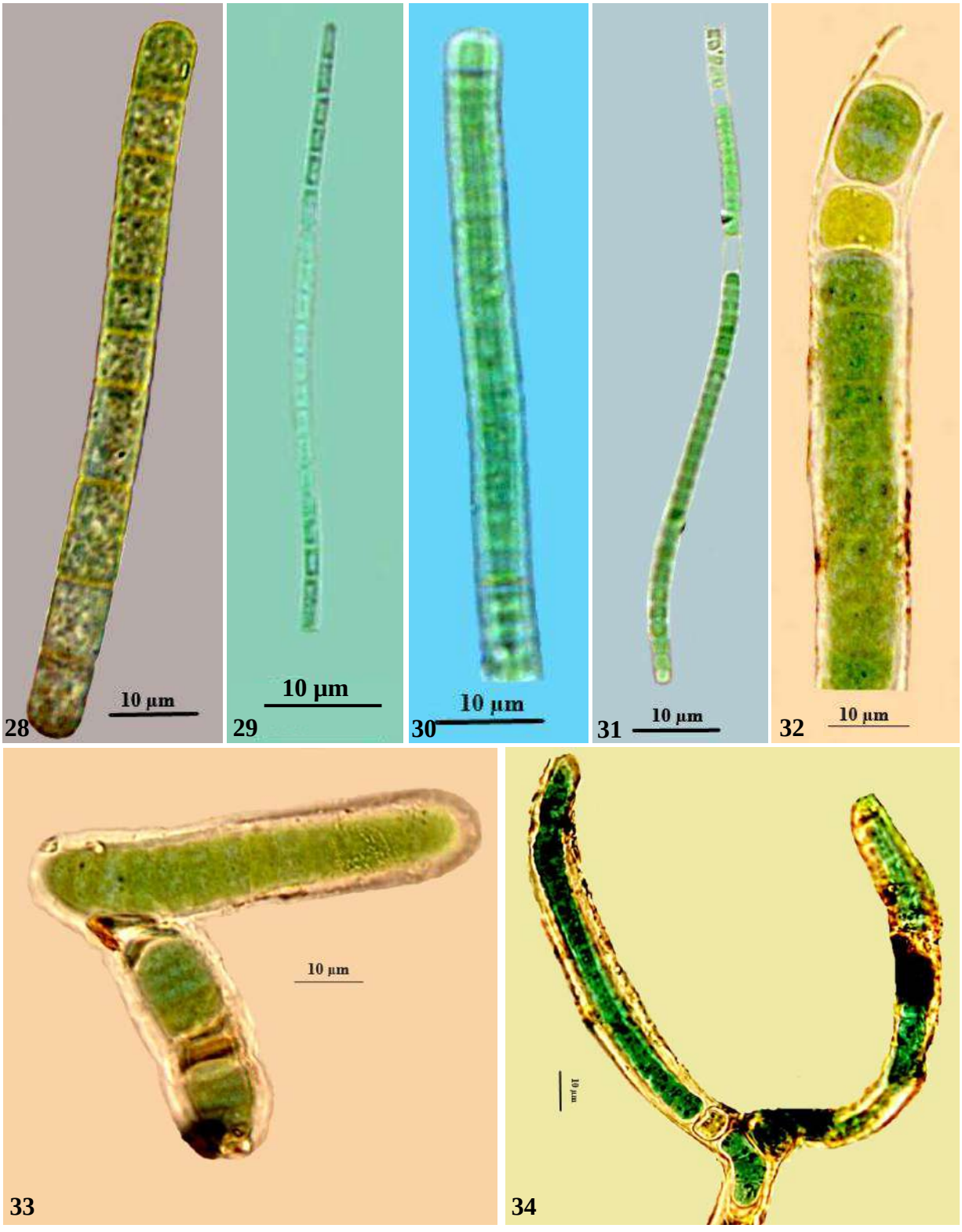

Photo 28. *Phormidium retzii* (C.Agardh) Kütz. ex Gomont
Photo 29. *Phormidium tenue* (Menegh.) Gomont
Photo 30. *Oscillatoria limosa* C.Agardh ex Gomont
Photo 31. *Lyngbya dendrobia* Brühl & Biswas
Photo 32. *Scytonema ocellatum* Lyngb. ex Bornet & Flahault
Photo 33. *Scytonema guyanense* var. *minus* N.L.Gardner and
Photo 34. *Scytonema pseudopunctatum* Skuja

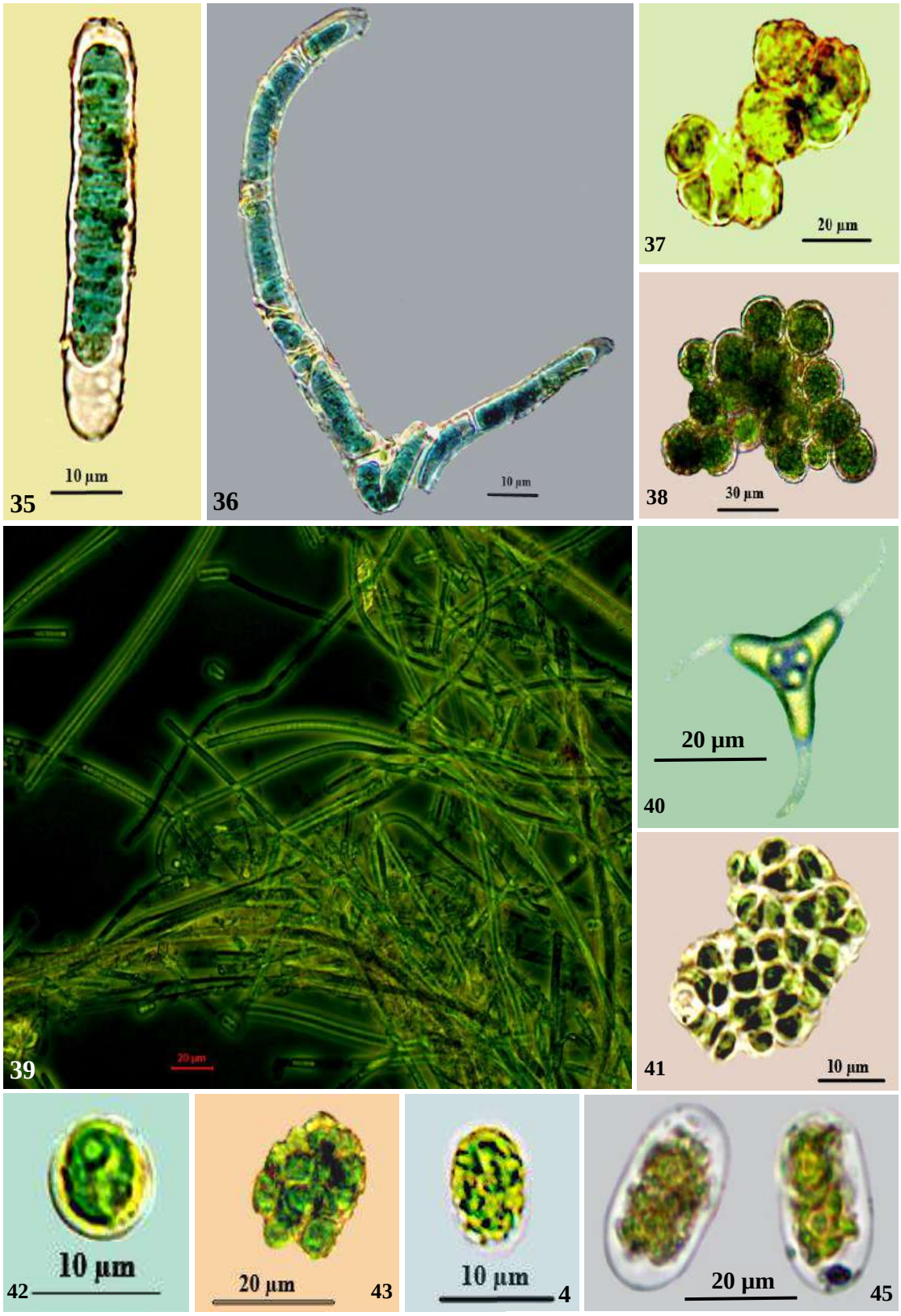

Photo 35 & 36. *Scytonema pseudopunctatum* Skuja
Photo 37. *Protococcus viridis* C.Agardh
Photo 38. *Chlorococcum humicola* (Nägeli) Rabenh.
Photo 39. *Lyngbya aerugineo-coerulea* (Kütz.) Gomont
Photo 40. *Treubaria setigera* (W.Archer)
Photo 41. *Crucigenia rectangularis* (Nägeli) Gay
Photo 42. *Chlorella vulgaris* Beij.
Photo 43. *Pandorina mora* (F.Muell.) Bory
Photo 44. *Chlorella ellipsoidea* Gerneck and
Photo 45. *Monallantus brevicylindrus* Pascher

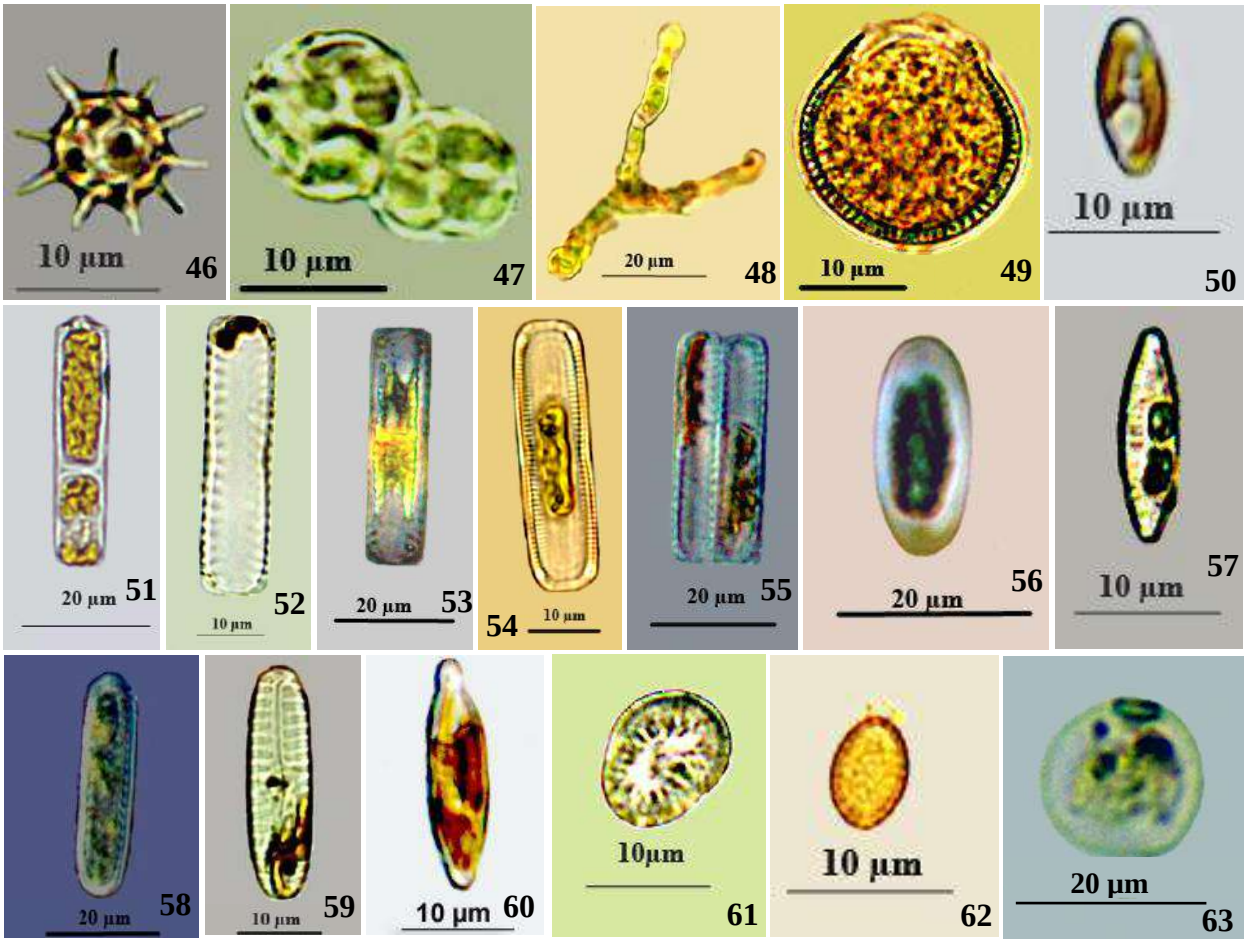

Photo 46. *Meringosphaera spinosa* Prescott
Photo 47. *Crucigenia quadrata* Morren
Photo 48. *Apistonema expansum* Geitler
Photo 49. *Synura splendida* Korshikov
Photo 50. *Fragilaria pinnata* var. *lancettula* (Schum.) Hust.
Photo 51. *Melosira italica* (Ehrenb.) Kütz.
Photo 52. *Diatoma hyemalis* (Roth) Heib
Photo 53. *Diatoma vulgare* Bory
Photo 54. *Fragilaria construens* (Ehrenb.) Grunow
Photo 55. *Fragilaria pinnata* Ehrenb.
Photo 56. *Diploneis ovalis* subsp. *arctica* Lange-Bert. & Genkal
Photo 57. Navicula slesvicensis Grunow
Photo 58. *Pinnularia humilis* Krammer & Lange-Bert.
Photo 59. *Pinnularia curticostata* Krammer & Lange-Bert.
Photo 60. *Mastogloia smithii* Thwaites ex W.Sm.
Photo 61. *Cyclotella trichonidea* Econ.-Amilli
Photo 62. *Trachelomonas pulcherrima* Playfair and
Photo 63. *Trachelomonas volvocina* var. *compressa* Drezep.

Table 2: New Records from India of Epiphytic Algae recorded from *Lodoicea maldivica* (J.E.Gmel.) Pres. (Double Coconut) in AJCBIBG, Howrah

S. No	Class	Order	Family	Genera	species	Variety
1	Xanthophyceae	Heterococcales	Pleurochloridaceae	Monallantus	brevicylindrus	
2	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	volvocina	compressa
3	Chrysophyceae	Phaeothamniales	Phaeothamniaceae	Apistonema	expansum	
4	Chrysophyceae	Synurales	Synuraceae	Synura	splendida	

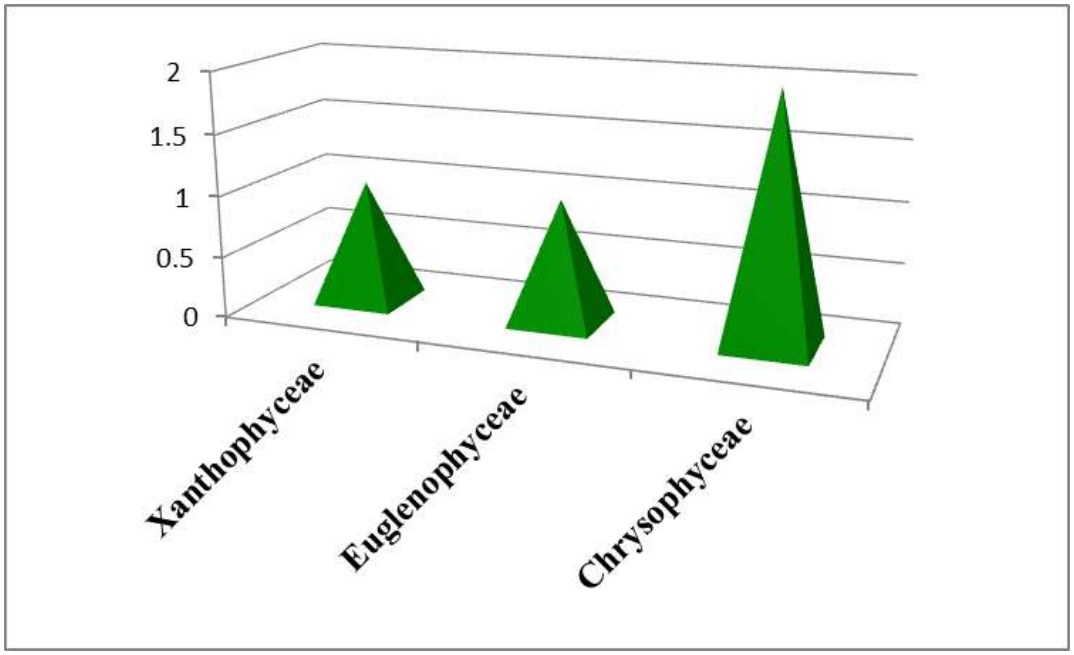

Fig 2. New Records from India of Epiphytic Algae recorded from *Lodoicea maldivica* (J.E.Gmel.) Pres. (Double Coconut) in AJCBIBG, Howrah

MANGROVES

Mangroves represent specialised halophytic vegetation. Halophytes occur either on sea shores or salty khadar (ravines) of rivers. Mangroves flourish well in swampy, waterlogged sandy sea shores and deltas of certain rivers. Mangrove plants face most harsh and unfavourable conditions of the habitat and confront certain problems like poor anchorage due to marshy sandy soil, physiological dryness due to water logging and extremely salty soil solution, heavy winds, and poor soil aeration. Mangroves show marvellous adaptations to survive in above adversities like stilt like prop roots, which fix the plant in marshy soil and provide extra support and respiration is difficulty in water logged soils, which become poor in oxygen. For this reason all mangrove (halophytes) have strongly developed respiratory roots called pneumatores for efficient aeration. These roots are negatively geotropic i.e. stand erect in air. Some species show an extraordinary phenomenon of Vivipary i.e. germination of seed inside the fruit which it is still attached to the parent plant. The embryo plant while still attached to the parent is nourished by the parent plant, grows into more or less developed plant without undergoing any rest period.

Mangroves are extremely important to the ecosystems in which they inhabit. Physically, they serve as a buffer between marine and terrestrial communities. Mangrove thickets improve water quality by filtering pollutants and trapping sediments from the land. Ecologically, they provide habitat for a diverse array of terrestrial organisms, and many species rely exclusively on mangroves as their breeding, spawning and hatching grounds. Because of their high salt tolerance, mangroves are often among the first species to colonize mud and sandbanks flooded by seawater. Several species are listed as vulnerable or endangered on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species.

Six species of Mangroves are available in different localion of Acharya Jagadish Chandra Bose Indian Botanic Garden, Howrah viz. *Taxodium distichum* (L.) Rich. (near Sadir Lake), *Heritiera littoralis* Aiton (near cafeteria), H. macrophylla (Wall.) Kuntze (near Large Palm House), Excoecaria agallocha L. (near Store Building), *Bruguiera gymnorhiza* (L.) Lam. (Charak udyan) *and* Kandelia candel (L.) Druce (Charak udyan). Out of six species of mangroves cyanoprocaryotes and algal species are observed on *Taxodium distichum* (L.) Rich.

Taxodium distichum (L.) Rich. is a deciduous conifer in the family Cupressaceae commonly called bald cypress. It is a long-lived, pyramidal conifer (cone-bearing tree) which grows 50-70' tall (less frequently to 125'). It is native to southern swamps, bayous and rivers, primarily being found in coastal areas from Maryland to Texas and in the lower Mississippi River valley to as far north as the southeast corner of Missouri. In the South, it is a familiar sight growing directly in swampy water, often in large strands, with its branches heavily draped with Spanish moss. In cultivation, however, it grows very well in drier, upland soils. This tree adapts to a wide range of soil types, whether wet, dry, or swampy. Trunks are buttressed (flared or fluted) at the base, and when growing in water, often develop distinctive,

knobby root growths ("knees"- pneumatophores) which protrude above the water surface around the tree. The bald cypress is an easy fall cleanup. It has a large taproot and is slightly salt tolerant. The heavy, straight-grained, rot-resistant wood has been used for a variety of purposes including barrels, railroad ties, shingles, etc.

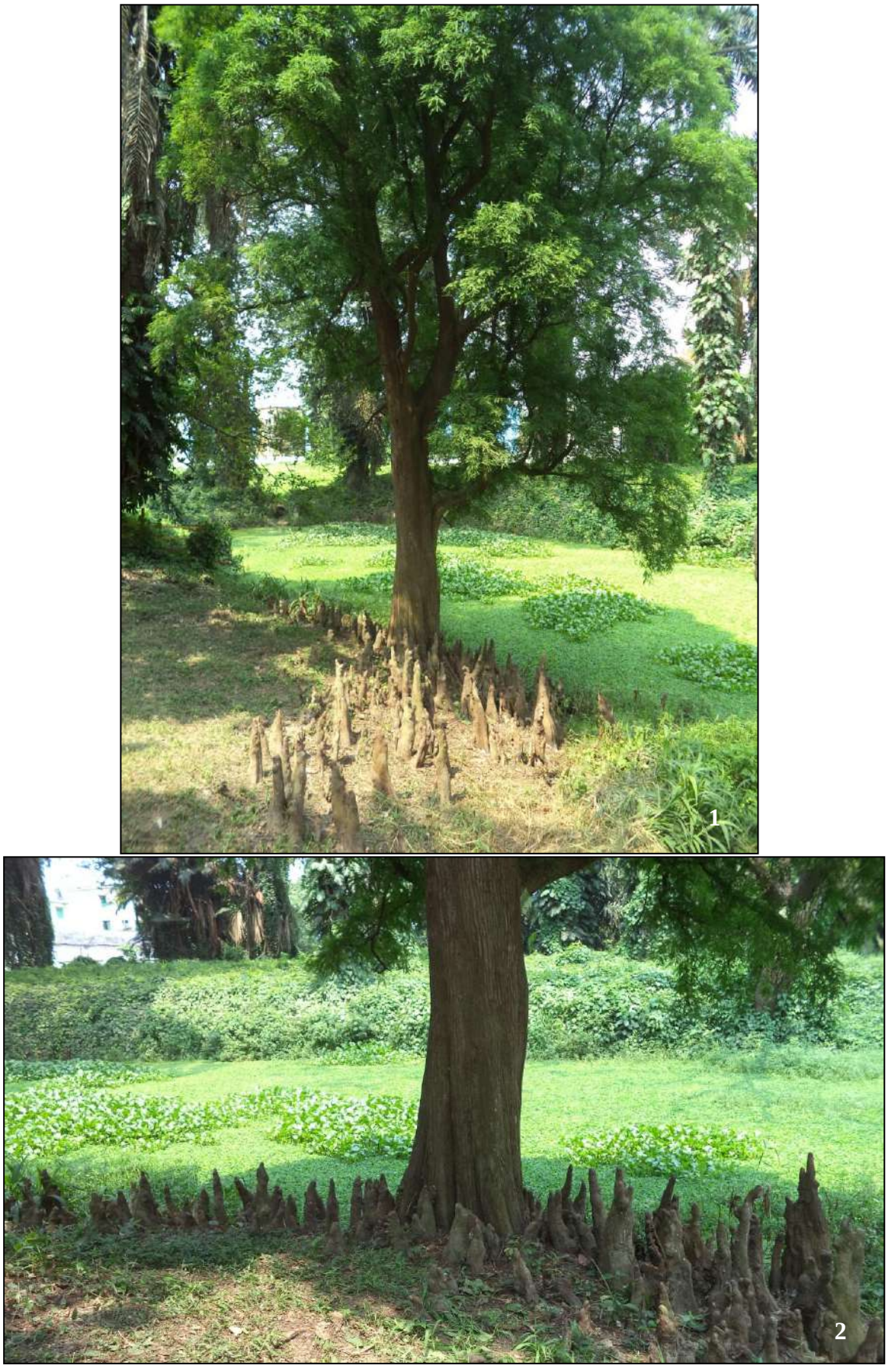

Photo 1 & 2. *Taxodium distichum* (L.) Rich. near Sadir Lake of AJC Bose Indian Botanic Garden, Howrah

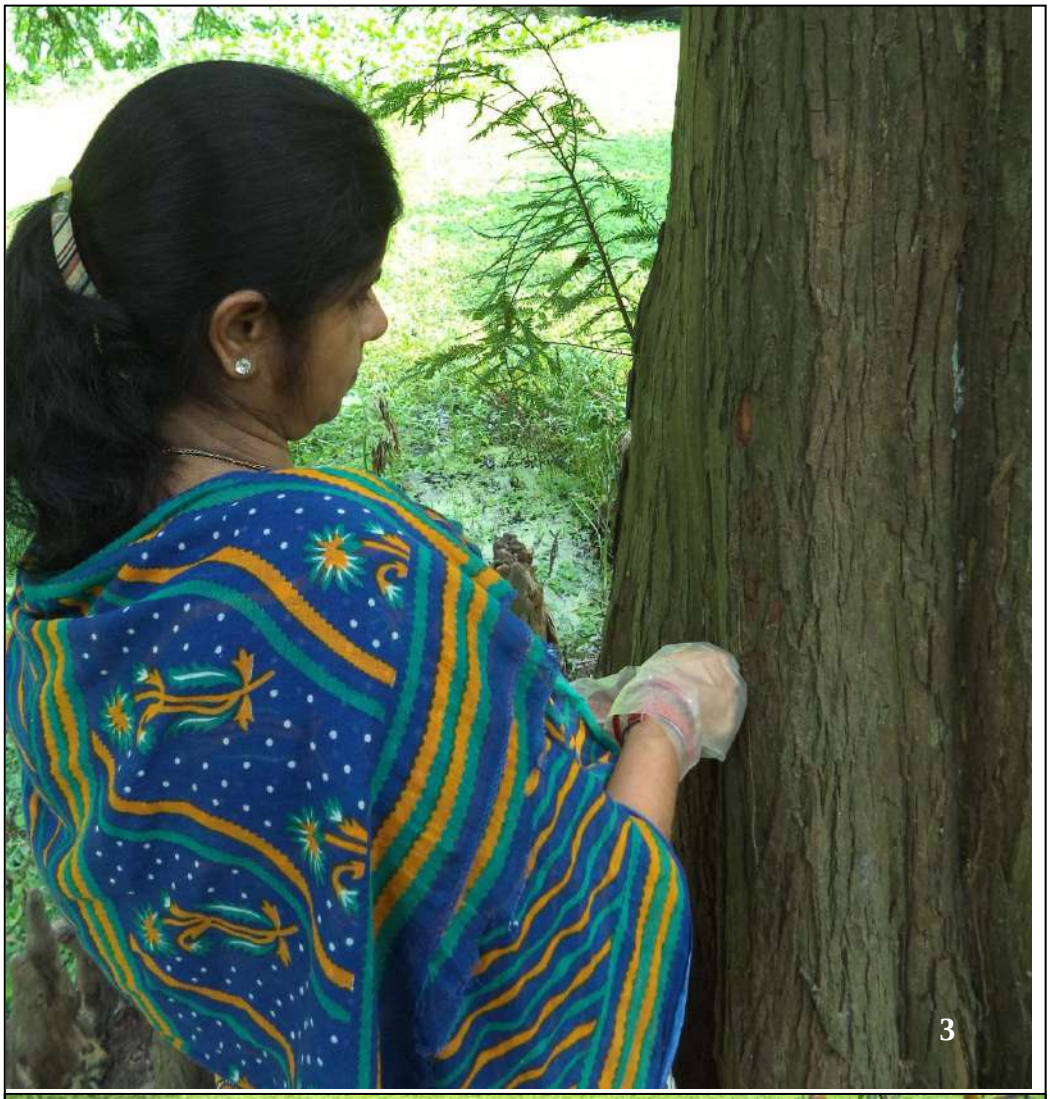

Photo 3 & 4. Collection of sample from main plant and from "knees"- pneumatophores of *Taxodium distichum* (L.) Rich. near Sadir Lake of AJC Bose Indian Botanic Garden, Howrah

Photo 5, 6 & 7. Close-up bluish-greenish, yellowish greenish and greenish algal patches on main tree trunk and on "knees"- pneumatophores of *Taxodium distichum* (L.) Rich.

Photo 8 & 9. Close-up view of algal patches on "knees"-pneumatophores of *Taxodium distichum* (L.) Rich.

Photo 10 & 11. Close-up view of algal patches on "knees"- pneumatophores of *Taxodium distichum* (L.) Rich.

Occurrence of cyanoprokaryotes and algae recorded from *Taxodium distichum* (L.) Rich. in the AJCBIBG, Howrah have been presented in Table 1 and Fig. 1 and new records from India in Table 2 and Fig. 2. Taxonomic enumeration of identified cyanoprokaryotes and algae belongs to various classes are described here along with their details including nomenclature.

S.No	Class	order	Family	Genera	species	Var.	Forms
1	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Chroococcaceae	Chroococcus	minor		
2		Chroococcales	Chroococcaceae	Gloeocapsopsis	dvorakii		
3		Chroococcales	Chroococcaceae	Dactylococcopsis	fascicularis		indica
4		Chroococcales	Aphanothecaceae	Myxobaktron	salinum		
5		Chroococcales	Microcystaceae	Gloeocapsa	*deusta*		
6		Synechococcales	Coelosphaeriaceae	Woronichinia	tenera		
7		Synechococcales	Merismopediaceae	Synechocystis	septentrionalis		
8		Pleurocapsales	Hyellaceae	Pleurocapsa	concharum		
9		Oscillatoriales	Microcoleaceae	Planktothrix	suspense		
10	Chlorophyceae	Chlamydomonadales	Chlorococcaceae	Chlorococcum	infusionum		
11		Chlamydomonadales	Tetrasporaceae	Fottiella	lamellosa		
12		Chlamydomonadales	Haematococcaceae	Haematococcus	lacustris		
13	Conjugatophyceae (Zygnematophyceae)	Desmidiales	Desmidiaceae	Staurastrum	gracile		
14	Trebouxiophyceae	Chlorellales	Chlorellaceae	Gloeotila	subconstricta		
15		Prasiolales	Prasiolaceae	Desmococcus	olivaceus		
16	Coleochaetophyceae	Coleochaetales	Coleochaetaceae	Coleochaete	orbicularis		
17	Bacillariophyceae	Naviculales	Naviculaceae	Navicula	subadnata		
18		Naviculales	Naviculaceae	Gyrosigma	scalproides	eximia	
19		Bacillariales	Bacillariaceae	Nitzschia	alpina		
20		Fragilariales	Fragilariaceae	Fragilaria	capucina	vaucheriae	

21		Cocconeidales	Achnanthidiaceae	Psammothidium	pseudoswazii		
22		Cymbellales	Gomphonemataceae	Geissleria	schoenfeldii		
23	Coscinodiscophyceae	Aulacoseirales	Aulacoseiraceae	Aulacoseira	granulata		
24	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	pulcherrima	minor	
25		Euglenales	Euglenaceae	Trachelomonas	volvocina		
26		Euglenales	Phacaceae	Phacus	acuminatus		
27	Xanthophyceae	Mischococcales	Pleurochloridaceae	Trachychloron	depauperatum		

Table 1: Occurrence of Epiphytic Cyanoprocaryotes and Algae recorded from Mangrove - *Taxodium distichum* (L.) Rich.

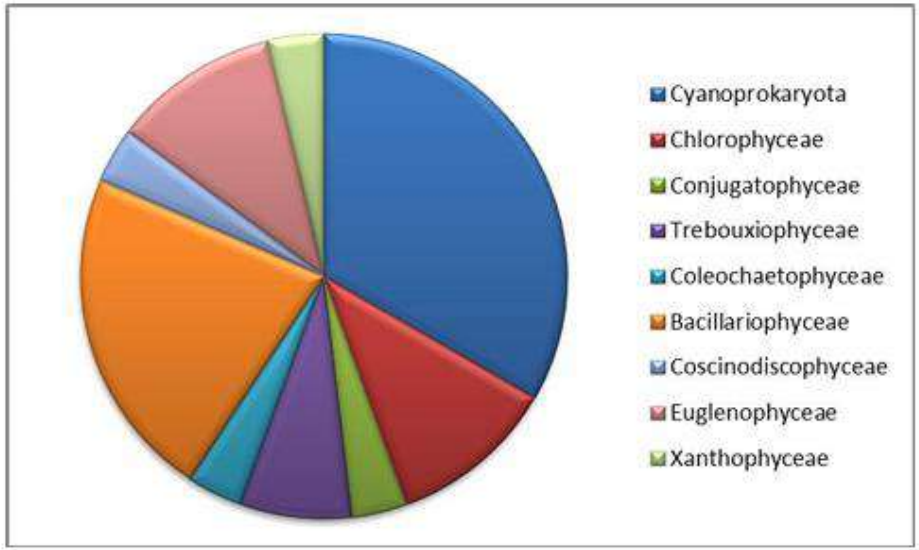

Fig. 1 Epiphytic Algae Recorded from different Classes

Taxonomic Enumeration of Cyanoprokaryotes and Algae

Cyanophyceae
Chroococcales
Chroococcaceae

Chroococcus Nägeli

Chroococcus minor (Kütz.) Nägeli, Neue Denkschr. Allg. Schweiz. Ges. Gesammten Naturwiss. 10(7): 46. 1849. Desikachary, Cyanophyta 105, t. 24, f. 1. 1959. *Protococcus minor* Kütz., Phycol. Germ.: 144. 1845.

Thallus more or less slimy-gelatinous, dirty blue-green or olive green; cells spherical, singly or in pairs, seldom 4 or 8; sheath colourless, very thin, hardly visible.

Dimension : Cells 2.7 - 3.5 µm in diameter.

Environment : Freshwater and Marine species.

Gloeocapsopsis Geitler ex Komárek

Gloeocapsopsis dvorakii (Novácek) Komárek & Anagn. ex Komárek, Bull. Natl. Sci. Mus. Tokyo, Ser. B (Bot.), 19: 24. 1993. Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 277, f. 363g. 1998. *Gloeocapsa dvorakii* Nováček Zpravy Kom. Prir. Moravy a Slezka, Oddel. Bot. 7: 1. 1929.

Cells solitary or in groups of cells with simple, narrow gelatinous envelops, generally aggregate into colonies; colonies irregular, forming rusty, red-orange or dirty brownish-blackish spots on the stony substrate, crustaceous, thin many celled; cells irregularly spherical or oval, irregular and polygonal in outline with rounded ends or pear shaped, pale blue-green with more or less homogeneous content, sometimes with several scarcely distributed granules; envelopes colouration very variable, sometimes indistinctly layered, never much widened, usually with very thin, delimited distinct sheath on the outer surface.

Dimension : Cells 3.0 - 7.1 µm in diameter.

Environment : Aerophytic species.

Dactylococcopsis Hansg.

Dactylococcopsis fascicularis f. **indica** Desikachary, Cyanophyta 158, 617, t. 29, f. 16. 1959.

Cells maximum up to 50 cells, bent or arcuate, taperting toward ends.

Dimension : Cells 0.6 - 1.3 µm in diameter and 42.4 - 49.3 µm in length.

Environment : Freshwater and Marine species.

Aphanothecaceae

Myxobaktron W. Schmidle

Myxobaktron salinum A.E.Walsby & Hindák , Arch. Hydrobiol. Suppl. 94 (Algol. Stud. 66): 4, t. 2: 1. 1992; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 103, f. 104. 1998.

Solitary cells without mucilage or sometimes with very fine narrow individual gelatinous layer, straight or slightly arcuate, serveral times longer than wide, fusiform, gradually tapering to the ends and pointed or pointed rounded ; cell content, blue-green, olive-green ; cell division transverse, perpendicular to the longitudinal axis, in the same plane in successive generations, in two or sometimes more or less isomorphic daughter cells soon sperating from one another.

Dimension : Cells 2.2 - 6.0 µm in diameter and 24.0 - 35.5 µm long.

Environment : Brackish species.

Microcystaceae

Gloeocapsa Kütz**.**

Gloeocapsa deusta (Menegh.) Kütz., Sp alg., 224, 1849; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 256, f. 334. 1998. *Coccochloris deusta* Menegh., Atti Riun. Sci. Ital. 2: 173, 1841.

Colonies flat, granular, composed of many small, irregular rounded subcolonies; these subcolonies with 1-2-4-more cells, lamellate, not very wide, firm, delimited, envelops; outer layer sometimes brown; cells more or less spherical or slightly elongate, blue-green.

Dimension : Cells 2.3 - 5.5 µm in diameter.

Environment : Marine and Terrestrial species.

Synechococcales
Coelosphaeriaceae

Woronichinia A.A.Elenkin

Woronichinia tenera (Skuja) Komárek & Hindák, Arch. Hydrobiol. Suppl. 80 (Algol. Stud. 50-53): 216. 1988; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 215, f. 280. 1998 *Gomphosphaeria* tenera Skuja Nova Acta R. Soc. Upsal., ser. 4, 18(3): 41, pl. IV: figs. 10-17. 1964.

Colonies small, more or less irregularly spherical, oval or lobate, 8 - 100 celled, sometimes compound in the center more or less hollow, surrounded by a very delicate, hyaline, scarcely visible, mucilaginous envelope; cells jointed to the ends of thick, but very fine stalks, more or less densely packed in the peripheral layers; cells more or less spherical or after division widely spherical obovate, with blue-green or rarely olivaceous, homogeneous content, without granules.

Dimension : Colony 9.4 - 12.5 µm in diameter; cells 2.1 - 2.5 µm in diameter

Environment : Freshwater species.

Merismopediaceae

Synechocystis C. Sauvageau

Synechocystis septentrionalis Skuja, Nova Acta R. Soc. Sci. Upsal., Ser. 4, 16(3): 48, t. 5, figs. 1 - 5. 1956. Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 145, f. 165a. 1998.

Cells spherical or widely elliptical, after division more or less hemispherical and pale blue-green with solitary granules with thin fine diffluent individual envelop.

Dimension : Cells 6.7 - 7.5 µm in diameter

Environment : Freshwater species.

Cyanophyceae
Pleurocapsales
Hyellaceae
Pleurocapsa Thuret

Pleurocapsa concharum Hansg., SitzBer K. Bo. onm. Ces. Wiss., Math.,-Naturw. Cl. 2, 90, t. 3, figs. 11 - 15. 1890. Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 465, f. 617. 1998.

Colonies of composed of aggregates of short creeping pseudo filaments, sometimes pseudo dichotomously divaricate uni or multiseriate; cells of different shape and size, barrel-shaped or irregular rounded with pale blue-green or olive-green content; sheath colourless; both intercalary and terminal cells able to divide into baeocystes.

Dimension : Cells 3.0 - 7.0 µm in diameter.

Environment : Freshwater species.

Oscillatoriales
Microcoleaceae
Planktothrix (Gomont) Anagn. & Komárek

Planktothrix suspense (E.G. Pringsheim) Anagn. & Komárek, Arch. Hydrobiol. Suppl. 80 (Algol. Stud. 50-53): 416, 1988; Komárek & Anagn., Cyanoprokaryota Part 2: Oscillatoriales19(2): 358, f. 498. 2005. *Oscillatoria agardhii* var. *suspense* E.G. Pringsheim, Arch. Mikrobiol. 50: 402, figs 1a-f, 2. 1965.

Trichome solitary, slightly curved, blue-green, yellow green or olive green, cylindrical, strait or slightly curved, not or sometimes constricted at the end; cells nearly isodiametric or somewhat longer or shorter than wide; apical cells mostly longer than broad, hemispherical up to rounded-conical, sometimes calyptrate.

Dimension : Cells 2.8 - 3.7 µm in diameter and 3.2 to 5.3 µm long.

Environment : Freshwater species.

Chlorophyceae
Chlamydomonadales

Chlorococcaceae

Chlorococcum (Schrank) Meneghini

Chlorococcum infusionum (Schrank) Menegh., Monogr. Nostoch. Ital. 27, t. 2, f. 3. 1842. *Lepra infusionum* Schrank, Ann. Bot. 9: 4, 1794.

Cells spherical, solitary or in small aggregates, variable in size.

Dimension : Cells 5.0 - 15. 11 µm in diameter.

Environment : Freshwater and Terrestrial species.

Chlamydomonadales

Tetrasporaceae

Fottiella Ettl

Fottiella lamellosa (Prescott) Ettl, Preslia 27: 39, 183, 1955. *Tetraspora lamellosa* Prescott, Farlowia 1: 348, t. 1, f. 3. 1944.

Thallus irregularly lobed, cells spherical, sheath distinct; pseudocilia very fine and 20 - 30 times fine, chloroplast a dense parietal plate covering almost the central wall.

Species differs from others by possession of distinct lamellate cell sheaths and the long pseudocilia.

Dimension : Cells 9.0 - 10.5 µm in diameter.

Environment : Freshwater species.

Haematococcaceae

Haematococcus C.Agardh

Haematococcus lacustris (Girod-Chantrans) Rostafinski, Mém. Soc. Natl. Sc. Nat. Cherbourg 19: 140, 1875. Prescott, Algae of the Western Great Lakes Area 80, t. 03, figs. 4 - 5. 1982. *Volvox lacustris* Girod-Chantrans, Rech. Chem. Et Micro. 54, t. 8: figs. 17, 17', 17". 1802.

Cells more or less ellipsoid or ovoid, chloroplast apparently cup-shaped, sometimes appear axial and usually masked by haematochrome, cells variable in diameter.

Dimension : Cell 12.0 - 20.5 µm in diameter.

Environment : Freshwater species.

Charophyta

Conjugatophyceae (Zygnematophyceae)

Desmidiales

Desmidiaceae

Staurastrum Meyen ex Ralfs

Staurastrum gracile Ralfs ex Ralfs, Brit. Desmid. 136, t. 22, f. 2. 1848. Tiffany & Britton, The Algae of Illinois 199, t. 55, f. 613. 1952.

Cell length often greater than the width, excluding the processes, constricted, sinus with an acute apex and opening widely, isthmus narrow; semi cells broadly triangular to more or less cup shaped, dorsal margin slightly concave to convex with a row of small emarginated verrucae, below which sometimes a short row of granules; angles continued in processes of variable length slightly alternated, horizontal or sometimes slightly converging, ventral view triangular the sides slightly concave and angles continued in straight processes; cell wall with intra marginal row of pairs of granules and sometimes with short rows of granules at right angles to the sides of cell, center without ornamentation, processes with transverse rings of granules and terminating in 3 or 4 small spines; chromatophore axial, with two laminate blades extending to each angle or a short distance into processes; pyrenoid single, central; zygote spherical, with numerous spines broad at the base and terminating in widely bifurcate apices.

Dimension : Cells 23.5 to 28.9 µm in diameter and 30 - 40 µm long; isthmus 6.9 - 7.8 µm wide.

Environment : Freshwater species.

Trebouxiophyceae
Chlorellales
Chlorellaceae
Gloeotila Kütz.

Gloeotila subconstricta (G.S.West) Printz, Hydrobiologia 24: 50, 1964. *Ulothrix subconstricta* G.S.West, J. Bot. 53: 82, text f. 6. 2015.

Filament composed of slightly inflated cells, moderately constricted at the cross-walls and sometimes inclosed in a gelatinous sheath; chloroplast parietal plate extending through about 2/3 of the median region of the cell, sometimes with a pyrenoid.

Dimension : Cells 5.0 - 7.7 µm in diameter and 12.1 - 15.5 µm long.

Environment : Freshwater species.

Prasiolales
Prasiolaceae
Desmococcus F.Brand

Desmococcus olivaceus (Persoon ex Acharius) J.R. Laundon, Taxon 34: 672. 1985. *Lepraria olivacea* Persoon ex Acharius**,** Lich. Univers.: 666. 1810.

Unicellular or in sometimes indefinite clusters, cells globose or angular from mutual compression and sometimes, organized to form simple filament.

Dimension : Cells 7.0 to 8.5 µm in diameter.

Environment : Aeroterrestrial, Terrestrial species and Chasmoendolithic.

Coleochaetophyceae
Coleochaetales

Coleochaetaceae

Coleochaete Bréb.

Coleochaete orbicularis Pringsheim, Jahrb. Wiss. Bot. 2: 35, t. 1, f. 5, t. 3, figs. 6 - 7; t. 6, figs. 1 - 2. 1860; Prescott, Algae of the Western Great Lakes Area 129, t. 18, f. 3. 1982.

Thallus forming a regular, circular , monostromatic disc of branching filaments radiating from a common center and adjoined laterally; cells quadrangular; oogonia ovoid or subglobose.

Dimension : Cells 6.7 - 12.0 µm in diameter.

Environment : Freshwater species.

Bacillariophyceae

Naviculales

Naviculaceae

Navicula Bory

Navicula subadnata Hustedt, Ber. Deutsch. Bot. Ges. 60: 69, figs. 6 - 8. 1942. Krammer & Lange-Bertalot, 1986, pág. 202, Fig. 78: 21-25).

Valve elíptical-lanceolate, rostrate; valve surface striated; stríae radial.

Dimension : Cells 5.0 - 8.1 µm in diameter and 10.0 - 23.0 µm long; striae 18 - 20 in 10 µm.

Environment : Freshwater species

Gyrosigma Hassall

Gyrosigma scalproides var. **eximia** (Thwaites) cleve, K. Svenska Vet. Akad. Handl., ser. 4, 26(2): 118. 1894; B.N. Prasad and M.N. Srivastava, *Fresh water Algal Flora of Andaman and Nicobar Islands*. 1: 241, t. 31, f. 8. 1992.

Valve solitary, linear sigmoid with attenuated rounded ends, raphe thin median, curved, central nodules turned in opposite directions; axial area narrow, linear central area large, elliptical; valve surface striated, transverse striae fine sense, lineate, parallel throughout the valve, longitudinal striations very faint, loose and seen with difficulty.

Dimension : Cells 6.5 - 7.5 µm in diameter and 22.0 - 40.0 µm long; transverse striae 28 - 30 µm in 10.0 µm.

Environment : Marine species

Bacillariales

Bacillariaceae

Nitzschia Hassal

Nitzschia alpina Hustedt, Int. Rev. Hydrobiol. U. Hydrogr. 43: 232, figs. 60 – 65. 1943; K. Krammer & H.Lange-Bertalot Part 2: Bacillariophyceae (2)2: 101, figs. 6 - 7. 1997

Valves are linear to lanceolate, with bluntly rounded to somewhat rostrate apices; Fibulae distinct, equidistant and the central nodule absent; areolae indistinct.

Dimension : Cells 3.5 - 6.1 µm in diameter and 14.0 - 39.8 µm long; fibulae 10 -14 in 10 µm and striae 21 - 24 in 10 µm.

Environment : Freshwater species

Bacillariophyceae
Fragilariales
Fragilariaceae
Fragilaria Lyngbye

Fragilaria capucina var. **vaucheriae** (Kütz.) Lange-Bertalot, Nova Hedwigia 33: 747, 1980, *Exilaria vaucheriae* Kütz., Alg.aq. dulc. Germ. 3: 3, 1833.

Valves linear to lanceolate in shape with rostrate to subcapitate ends; axial area is narrow and linear with a distinct border; central area is a unilateral fascia and not visibly thickened often, indistinct or rudimentary striae can be resolved.

Dimension : Cells 5.0 – 6.9 µm in diameter and 16.7 – 18.4 µm long; striae 9 – 13 in 10 µm.

Environment : This is a marine and freshwater species.

Cocconeidales
Achnanthidiaceae
Psammothidium L. Bukhtiyarova & Round

Psammothidium pseudoswazii (J.R.Carter) L.Bukhtiyarova & Round, Diatom Research 11: 20, figs. 70 - 71. 1996 (as *'pseudoswazi'*); Krammer & Lange-Bertalot, Bacillariophyceae 41, f. 2(4): 1-7, 1991. *Achnanthes pseudoswazii* J.R.Carter 201, t. 1: f. 5. 1963.

Valves linear with capitate ends, length/breadth ratio 3 - 4; areolae rounded; striae at apices parallel or slightly convergent in contrast to other species in this section, broken at the mantle, mantle areolae slightly elongate; raphe sternum narrow linear, central area expanded to margin, involving 7 - 8 striae. Central raphe pores simple, slightly curved to one side, terminal fissures simple, long, but not extending onto the mantle and curving to the secondary side; Raphe less valve sternum linear, narrow, central area asymmetric involving 3 striae one side, 2-3 on other side.

Dimension : Cells 3.0 -5.8 µm in diameter and 18.2 µm long and striae 30.0 - 32.0 in 10 µm.

Environment : Freshwater species.

Cymbellales
Gomphonemataceae
Geissleria Lange-Bertalot

Geissleria schoenfeldii (Hustedt) H. Lange-Bertalot & D. Metzeltin, Iconogr. Diatomol. 2: 67, t. 123, figs. 5 - 6; t. 124, figs. 1 - 4. 1996. *Navicula schoenfeldii* ('schönfeldii') Hustedt, in Pascher**,** Süssw.-Fl. 10, 2. Aufl.: 301, fig. 520. 1930.

The valves elliptical with broadly rounded to slightly rostrate apices; terminal striae divided into discrete punctae.

Dimension : Cells 4.0 - 7.9 µm in diameter and up to 21.4 µm in length; striae 12 - 14 in 10 µm.

Environment : Freshwater species

Coscinodiscophyceae
Aulacoseirales
Aulacoseiraceae
Aulacoseira Thwaites

Aulacoseira granulata (Ehrenb.) Simonsen, Bacillaria 2: 58, 1979. *Gaillonella granulata* Ehrenb., Ber. K. Akad. Wiss. Berlin, Physik. KI. 415, 1843.

Sulcus shallow but acute; valves with short marginal teeth and large scattered indistinct punctae; girdles coarsely punctate, striations parallel and straight.

Dimension : Cells 5.2 - 8.6 µm in diameter and 5.2 - 15.0 µm long.

Environment : Freshwater and Epilithic species.

Euglenophyceae
Euglenales
Euglenaceae
Trachelomonas Ehrenb.

Trachelomonas pulcherrima var. **minor** Playfair, Pro. Linn. Soc. N.S.W. 40: 14, t. 1, figs. 37 - 38. 1915. Prescott, Algae of the Western Great Lakes Area 416, t. 83, f. 24 - 25. 1982.

Test oval or elliptic; flagellum opening without a collar; wall brown, smooth.

Dimension : Test 5.3 - 7.7 µm in diameter and 7.2 - 12.5 µm long.

Environment : Freshwater species.

Trachelomonas volvocina (Ehrenb.) Ehrenb., Abh. K. Akad. Wiss. Berlin, Physik. KI. 315, 1834; Prescott, Algae of the Western Great Lakes Area 419, t. 83, figs. 7 - 8. 1982. *Microglena volvocina* Ehrenb. Abh. K. Akad. Wiss. Berlin Phys. KI. 64, t 1, f. 2. 1832.

Test globose; flagellum aperture without a collar; wall yellowish, sometimes colourless, smooth.

Dimension : Test 12.45 - 16.5 µm in diameter.

Environment : Freshwater species.

Phacaceae
Phacus Dujardin

Phacus acuminatus Stokes, Amer. Month Micr. J. 6: 183, f. 1. 1885. Prescott, Algae of the Western Great Lakes Area 396, t. 88, f. 4. 1982.

Cells sub orbicular in outline, broadly rounded posteriorly, with a short, blunt apiculation; peri plast longitudinally striated; paramylon bodies 1 - 2 ring like discs.

Dimension : Cells 14.6 - 20.2 µm in diameter and 16.7 - 23.0 µm long.

Environment : Freshwater species.

Xanthophyceae
Mischococcales
Pleurochloridaceae
Trachychloron Pascher

Trachychloron depauperatum Pascher, Rabenhorst's Krypt. Fl. Dautsch 1, 2. Aufl. 11: 507, f. 357. 1938; Prescott, Algae of the Western Great Lakes Area 355, t. 95, figs. 43 - 44. 1982.

Cells ovate or broadly ellipsoid, with broadly rounded poles; wall sculptured, making very close serrations at the wall margin; 1 chromatophore, vase-shaped or ring-like making a parietal fold within the cell wall.

Dimension : Cells 8.0 - 9.0 µm in diameter and 8.0 - 11.5 µm long.

Environment : Freshwater species.

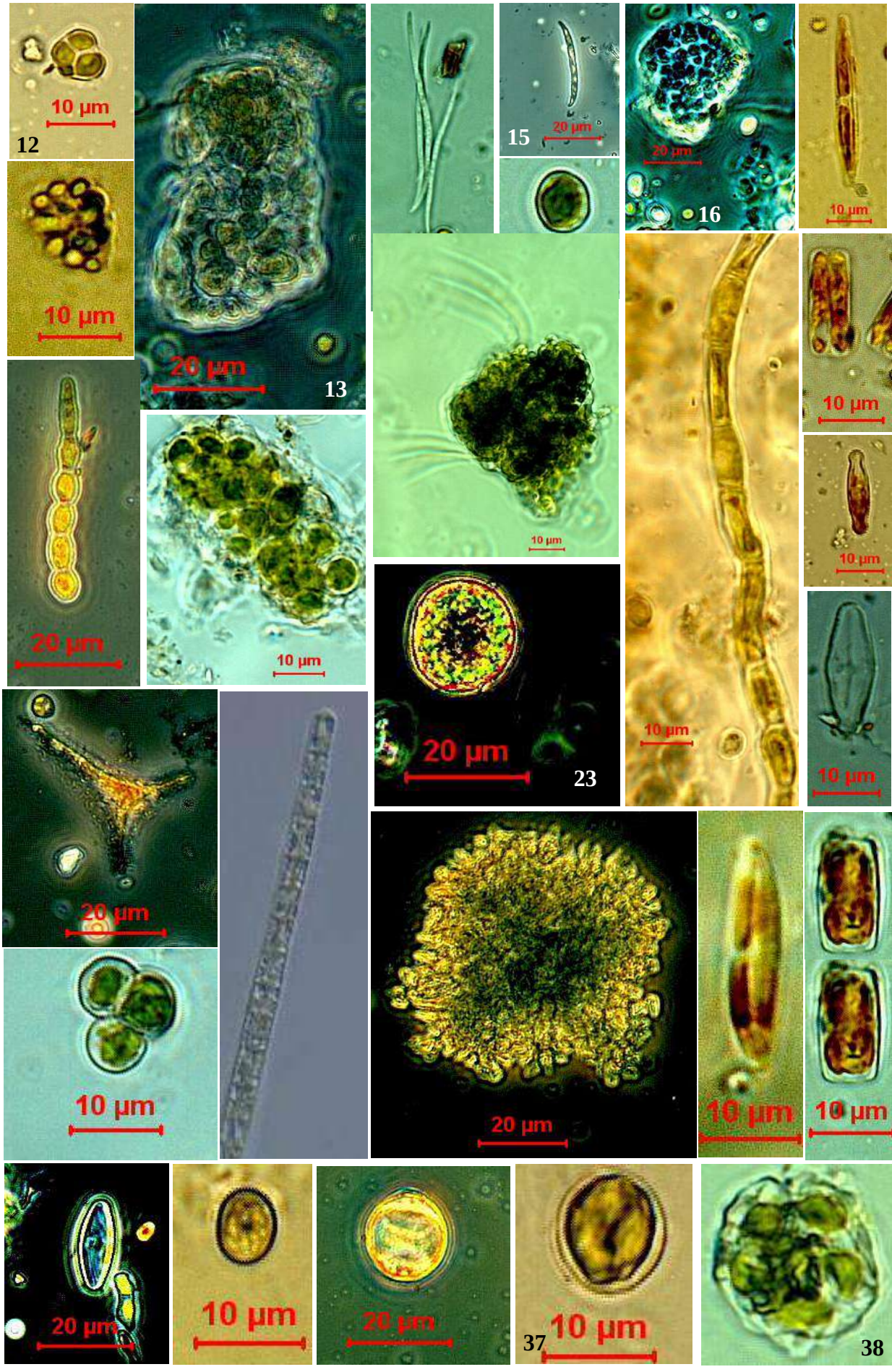
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Photo 12. *Chroococcus minor* (Kütz.) Nägeli

Photo 13. *Gloeocapsopsis dvorakii* (Novácek) Komárek & Anagn.

Photo 14. *Dactylococcopsis fascicularis* f. *indica* Desikachary

Photo 15. *Myxobaktron salinum* A.E.Walsby & Hindák

Photo 16. *Gloeocapsa deusta* (Menegh.) Kütz.

Photo 17. *Woronichinia tenera* (Skuja) Komárek & Hindák

Photo 18. *Synechocystis septentrionalis* Skuja

Photo19. *Pleurocapsa concharum* Hansg.

Photo 20. *Planktothrix suspense* (E.G. Pringsheim) Anagn. & Komárek

Photo 21. *Chlorococcum infusionum* (Schrank) Menegh.

Photo 22. *Fottiella lamellosa* (Prescott) Ettl

Photo 23. *Haematococcus lacustris* (Girod-Chantrans) Rostafinski

Photo 24. *Staurastrum gracile* Ralfs ex Ralfs

Photo 25. *Gloeotila subconstricta* (G.S.West) Printz

Photo 26. *Desmococcus olivaceus* (Persoon ex Acharius) J.R. Laundon

Photo 27. *Coleochaete orbicularis* Pringsheim

Photo 28. *Navicula subadnata* Hustedt

Photo 29. *Gyrosigma scalproides* var. *eximia* (Thwaites) cleve

Photo 30. *Nitzschia alpina* Hustedt

Photo 31. *Fragilaria capucina* var. *vaucheriae* (Kütz.) Lange-Bertalot

Photo 32. *Psammothidium pseudoswazii* (J.R.Carter) L.Bukhtiyarova & Round

Photo 33. *Geissleria schoenfeldii* (Hustedt) H. Lange-Bertalot & D. Metzeltin

Photo 34. *Aulacoseira granulata* (Ehrenb.) Simonsen

Photo 35. *Trachelomonas pulcherrima* var. *minor* Playfair

Photo 36. *Trachelomonas volvocina* (Ehrenb.) Ehrenb.

Photo 37. *Trachychloron depauperatum* Pascher and

Photo 38. *Phacus acuminatus* Stokes

Table 2. New Records from India of Epiphytic Cyanoprocaryotes and Algae from *Taxodium distichum* (L.) Rich.

S. No.	Class	Order	Family	Genera	species
1	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Chroococcaceae	Gloeocapsopsis	dvorakii
2		Chroococcales	Aphanothecaceae	Myxobaktron	salinum
3		Chroococcales	Microcystaceae	Gloeocapsa	deusta
4		Synechococcales	Coelosphaeriaceae	Woronichinia	tenera
5		Synechococcales	Merismopediaceae	Synechocystis	septentrionalis
6	Bacillariophyceae	Cocconeidales	Achnanthidiaceae	Psammothidium	pseudoswazii
7		Cymbellales	Gomphonemataceae	Geissleria	schoenfeldii
8	Xanthophyceae	Mischococcales	Pleurochloridaceae	Trachychloron	depauperatum

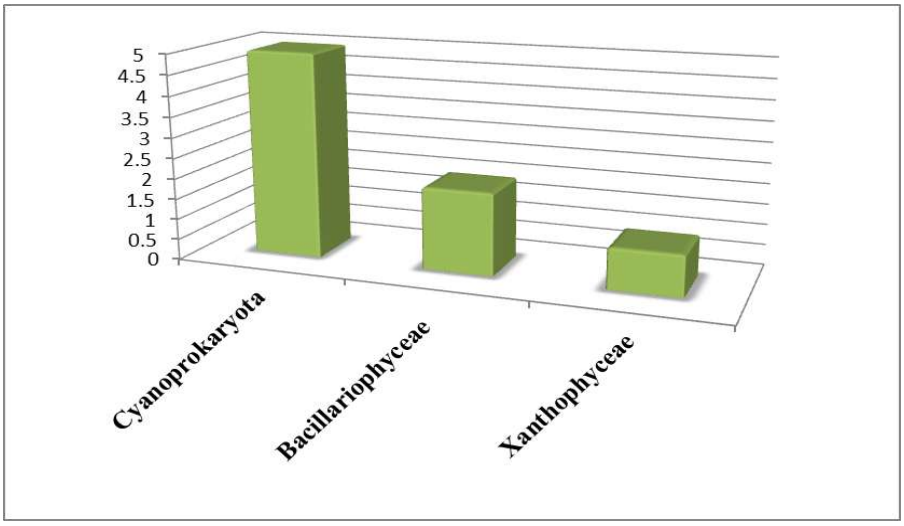


Fig 2. New Records from India of Epiphytic Cyanoprokaryotes and Algae recorded from *Taxodium distichum* (L.) Rich. in AJCBIBG, Howrah.

MANGO BELT

Mangifera indica L. is native to India but is widely grown as a fruit tree in tropical and subtropical zones. It is cultivated tree. It persists in abandoned fields grows as a tree to about 20 meters in height. The leaves arranged alternately and are up to 25 cm in length and 10 cm wide. The leaves are glabrous with an acute leaf apex and an entire margin. The actinomorphic flowers are arranged in panicles.

Three species of Mango are present in Acharya Jagadish Chandra Bose Indian Botanic Garden Howrah namely *Mangifera andamanica* King, *Mangifera caloneura* Kütz. and *Mangifera indica* L. belongs to family *Anacardiaceae*. *Mangifera andamanica* King is present in Division No. 1 and 22. *Mangifera caloneura* Kütz. in Division No. 1. However, *Mangifera indica* L. found in Division No. 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 17, 19, 21, 22, 23, 24 and 25. *Mangifera indica* L. belt mainly mango tree found in Division No. 7 and 19 in AJCBIBG.

Microclimatic conditions in the Garden provide congenial environment for growth of different algal forms on tree trunk. Keeping in view of knowing diversity and taxonomic enumeration of algae and their association on above mentioned tree have yet not been studied. Hence, attempt made to evaluation the same.

Photo 1 & 2. Close-up of algal patches on tree trunk of *Manaifera indica* L.

Occurrence of algae recorded from *Mangifera indica* L. in the AJCBIBG, Howrah have been presented in Table 1 and Fig. 1. Taxonomic enumeration of identified algae belongs to various classes are described here along with their details including nomenclature.

Table 1. Epiphytic Algae recorded from *Mangifera indica* L. in AJCBIBG, Howrah

S. No.	Class	Order	Family	Genera	species
1	Chlorophyceae	Chlamydomonadales	Chlorococcaceae	Chlorococcum	infusionum
2		Sphaeropleales	Microsporaceae	Microspora	loefgrenii
3	Ulvophyceae	Trentepohliales	Trentepohliaceae	Trentepohlia	aurea
4		Trentepohliales	Trentepohliaceae	Trentepohlia	rigidula
5	Coscinodiscophyceae	Aulacoseirales	Aulacoseiraceae	Aulacoseira	distans
6	Xanthophyceae	Vaucheriales	Vaucheriaceae	Vaucheria	undulata
7	Euglenophyceae	Euglenales	Euglenaceae	Trachelomonas	volvocina
8	Dinophyceae	Tovelliales	Tovelliaceae	Opisthoaulax	woloszynskae

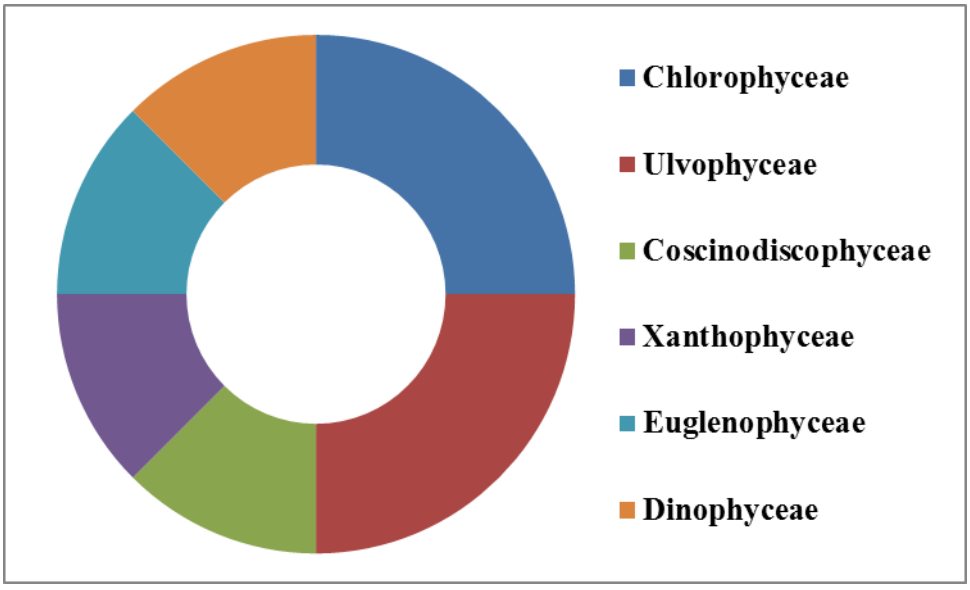


Fig. **1** Epiphytic Algae recorded from *Mangifera indica* L.

Taxonomic Enumeration of Algae

Chlorophyceae
Chlamydomonadales
Chlorococcaceae
Chlorococcum (Schrank) Meneghini

Chlorococcum infusionum (Schrank) Menegh., Monogr. Nostoch. Ital. 27, t. 2, f. 3. 1842. *Lepra infusionum* Schrank, Ann. Bot. 9: 4, 1794.

Cells spherical, solitary or in small aggregates, variable in size.

Dimension : Cells 12.0 - 15. 11 µm in diameter.

Environment : Freshwater/terrestrial species.

Chlorophyceae
Sphaeropleales
Microsporaceae
Microspora Thuret

Microspora loefgrenii (Nordstedt) Lagerheim, Flora 72: 208, 1887; Prescott, Algae of the Western Great Lakes Area 107, t. 8, f. 2. 1982. *Conferva loefgrenii* Nordstedt in Wittrock & Nordstedt, Bot. Not. 55, 1882, Hadwigia 21: 105, 1882.

Wall thick, section evident in the mid region of the cell; cells short cylindric, rectangular mostly little longer than broad, sometimes as long as broad; chloroplast a loose net converting nearly all of the cell wall.

Dimension : 20.0 - 24.64 µm in diameter and 20.0 - 23.99 µm long.

Environment : Freshwater species.

Ulvophyceae
Trentepohliales

Trentepohliaceae
Trentepohlia C.Martius

Trentepohlia aurea (Linnaeus) C.Martius, Fl. Crypt. Erlang. 351, 1817; Prescott, Algae of the Western Great Lakes Area 133, t. 67, figs. 6 - 9. 1982. *Byssus aurea* Linnaeus Sp. Pl.: 1168. 1753.

Thallus rusty brown or golden colour, sometimes yellow in shaded area; filaments branching variously according to habitat, sometimes sparingly, sometimes repeatedly branched; cells somewhat inflated below but mostly cylindrical in the branches, but slightly reduced in diameter towards the apices; walls either smooth or externally tubercular; gametangia globular, lateral on the branches or terminal; sporangia usually terminal on curved cells; about the same size as the gametangia.

Dimension : Vegetative cells 10 . 9 - 12.06 µm in diameter.

Environment : Terrestrial species.

Habitat : Most frequently found on rocks, both calcareous and siliceous, at sites with cool, humid conditions; also found on old concrete walls, tree bark, wood, mosses and wet soil.

Trentepohlia rigidula (J.Müller) Hariot, J. B. 3: 403, 1889. *Coenogonium rigidulum* J.Müller, Flora 65 : 490, 1882.

Thallus forms compact crusts of filaments on tree bark and varied from orange to yellowish-red in colour; uniseriate filaments showed prostrate and an erect portion; vegetative cells are arranged in uniseriate chain and sporangia borne on the stalk or superimposed on the vegetative cells, vegetative cells are elliptical, barrel shaped, two cells divided by a strong constriction or septum; cell wall thick and sometimes rough; sporangium varied from globular, orbicular or dome shaped, with 15-30 µm diameter, sporangia globose, sometimes oval and larger than the vegetative cells, generally formed on the filament in apical, intercalary or in lateral position.

Dimension : Vegetative cells 6.0 -12.0 µm in diameter and 12.86 - 15.0 µm in length.

Environment : Aerophytic species.

Habitat : Polymorphic species widely distributed in tropical and subtropical regions, usually found on tree bark but also on rocks, cement walls and artificial substrata.

Coscinodiscophyceae
Aulacoseirales
Aulacoseiraceae
Aulacoseira Thwaites

Aulacoseira distans (Ehrenb.) Simonsen, Bacillaria 2: 57, 1979. *Gaillonella distans* Ehrenb., Ber. K. Akad, Wiss. Berlin 56, 1836.

Distinctive heterovalvy, the “separation valves” that have no spines; areolae over the whole of the valve face; spines on the mantle edge are usually positioned between rows of areolae on the mantle, in more or less straight rows; and a deep, thick ringleist with numerous rimoportulae against its inner side; cells found in short chains.

Dimension : 8.0 - 11.41 µm in diameter and 18.9 - 19.9 µm long.

Environment : Freshwater species.

Xanthophyceae
Vaucheriales
Vaucheriaceae
Vaucheria A.P.de Candolle

Vaucheria undulata C.C.Jao, Sinensia 7: 741, t. 3, figs. 12 -13, 1936, A. Rieth, Xanthophyceae 2 Teil, 4: 88, f. 35j. 1980.

Vegetative filaments undulate; monoecious; main filament bearing at the tip one or sometimes two oogonia and a curved antheridium; oogonium more or less ovoid and curved at one side, bending downwards, oospore completely filling the oogonium (in this material only oospore visible).

Dimension : Oospore 10.5 - 16. 78 µm in diameter.

Environment : Freshwater and Terrestrial species.

Euglenophyceae
Euglenales

Euglenaceae

Trachelomonas Ehrenb.

Trachelomonas volvocina (Ehrenb.) Ehrenb., Abh. K. Akad. Wiss. Berlin, Physik. KI. 315, 1834; Prescott, Algae of the Western Great Lakes Area 419, t. 83, figs. 7 - 8. 1982. *Microglena volvocina* Ehrenb. Abh. K. Akad. Wiss. Berlin Phys. KI. 64, t 1, f. 2. 1832.

Test globose; flagellum aperture without a collar; wall yellowish, sometimes colourless, smooth.

Dimension : Test 12.45 - 16.5 µm in diameter.

Environment : Freshwater species.

Dinophyceae

Tovelliales

Tovelliaceae

Opisthoaulax Calado

Opisthoaulax woloszynskae (J. Schiller) A.J. Calado, Phycologia 50: 647, 2011. *Massartia woloszynskae* J.Schiller, Rabenhorst's Krypt.-Fl. Dautschl. 2 Aufl. 10 (3 Abt.) 1: 442, 270 a-c. 1933.

Cells ovoid and flattened dorsiventrally; epicone helmet-shaped and greater and wider than the nearly rounded hypocone; sulcus deep, extending nearly from the apex to the antapex; chloroplast lacking

Dimension : Cells 9.0 - 10.71 µm in diameter and 12.5 - 14.0 µm in long.

Environment : Freshwater species.

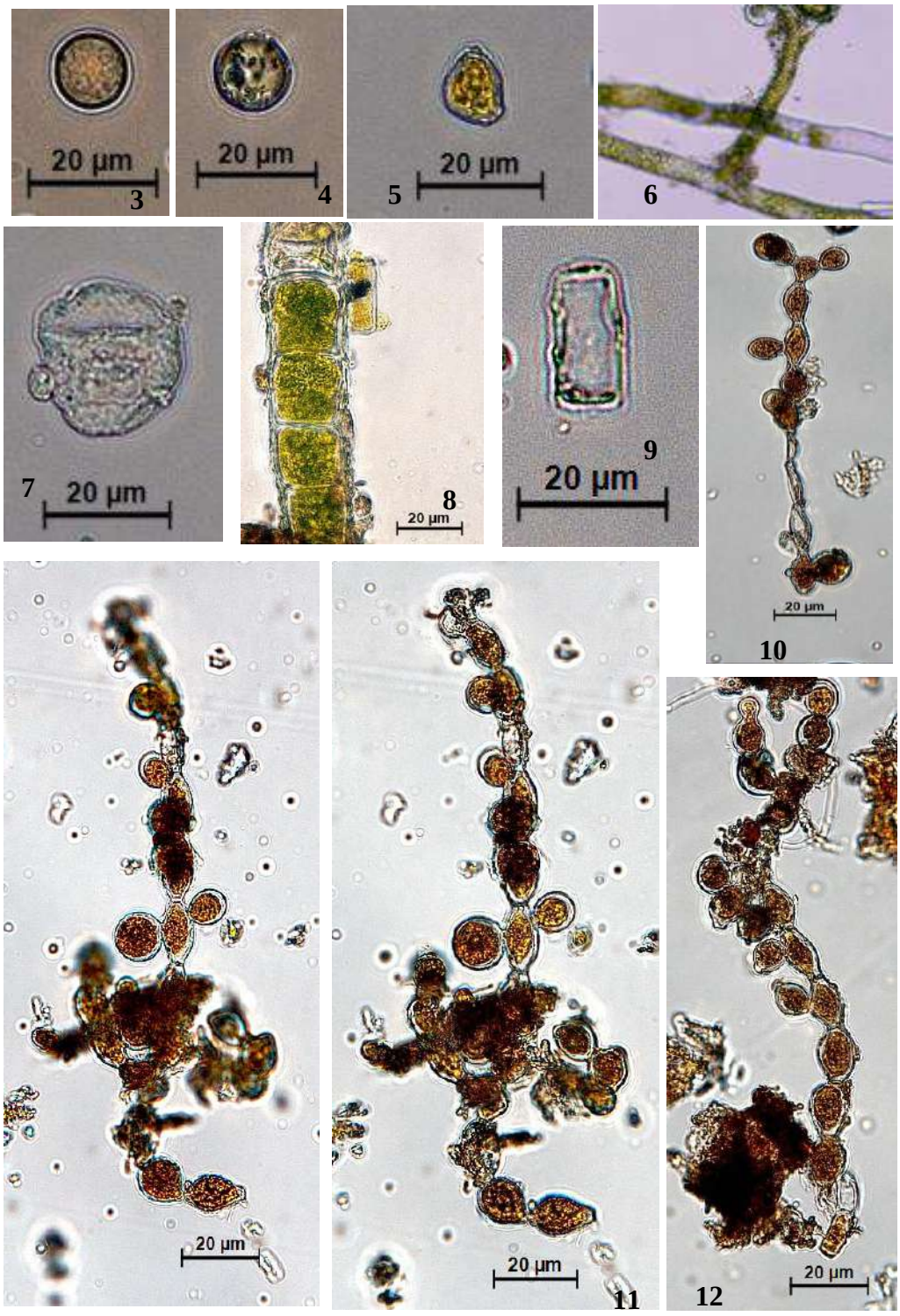


Photo 3. *Chlorococcum infusionum* (Schrank) Meneghini, 4. *Trachelomonas volvocina* (Ehrenb.) Ehrenb., 5 & 6 *Vaucheria undulata* C.C.Jao, 7. *Opisthoaulax woloszynskae* (J. Schiller) A.J. Calado, 8. *Microspora loefgrenii* (Nordstedt) Lagerheim, 9. *Aulacoseira distans* (Ehrenb.) Simonsen, 10 & 11. *Trentepohlia aurea* (Linnaeus) C.Martius and 20. *Trentepohlia aurea* (Linnaeus) C.Martius

ROXBURGH BUILDING

The Roxburgh Building in Acharya Jagadish Chandra Bose Indian Botanic Garden Howrah is more than 200 years old structure. Dr. William Roxburgh, was appointed as the first salaried superintendent of the Garden in 1793. He laid the foundation of modern plant taxonomy (post Linnean) in India by establishing a large Herbarium (the present day Central National Herbarium CAL) during his tenure (1793 - 1814) and is rightly known as the 'Father of Indian Botany. Many of the advances to the original gardens were brought about during botanist William Roxburgh's tenure as its Superintendent. He brought in plants from all over the country and created a vast herbarium on the premises. He worked extensively on a variety of plants and had published multiple works on Indian Botany. Not only did, he have the distinction of naming numerous species, but many species were also even named in his honour by his collaborators and admirers. Today, the Botanical Garden's extensive collection of dried plant specimens numbers over 2,500,000 items from around the globe perused within its premises. William Roxburgh left behind a large collection of coloured Icons, more than 2500 original colour paintings of Indian plants using vegetable dyes, a large number of manuscripts, which are preserved in the archives of the Central National Herbarium, Botanical Survey of India, Howrah.

Proposal from University of Sussex to restore an 18th century Roxburgh building where the "father of Indian botany", William Roxburgh, lived - might save the heritage structure. Abandoned since the 70s, the Roxburgh House in Botanic Garden with its impressive portico and wooden spiral staircase is slowly giving in to the vagaries of nature and time. Right beside the Roxburgh House is the herbarium that the Scottish surgeon-cum-botanist had built for his collection of plant specimen, along with detailed coloured drawings by Indians. An architectural marvel, the herbarium, which was built on an elevated structure with arched foundations to let the waters of the Hooghly flow through during high tide, is crumbling. The Asia Scotland Trust with help from the Centre of World Environmental History (CWEH) at the Sussex University has stepped in to preserve the Scottish-India heritage link and discussed possibility with BSI of restoring William Roxburgh's house in the garden for use as an interdisciplinary climate and environmental history research centre or an interpretation centre for the Botanic Garden by Director of CWEH. The house of Roxburgh in the AJC Bose Indian Botanic Garden is architecturally superb building though currently in a very dilapidated state. Roxburgh, an important botanist, is a significant figure for the natural history of both Britain and India. Preservation of his house is critical to the preservation of the story of Indian Botany and also to the architectural heritage preservation movement in India. There is now a Central National Herbarium but the "house and old herbarium building are superb examples of period architecture".
Conservation architect James Simpson has already gone through a report on and measured drawings of the house and the herbarium. This knowledge we can revive this important effort and build.

Cyanobacteria and algae develop on the building surfaces which may form more complex consortia (biofilms). The colonisation of structures by such organisms is in

constructional or aesthetic point of view. Algae as organisms that combine water cause physical corrosion of such materials via penetrating into the porous systems of building materials and contribute to the formation of micro-fissures. Under higher moistures, microalgae increase their volumes and erode the surrounding material by swelling pressure. Along with the impurities from the atmosphere (dust particles, microorganisms, etc.) they form a mucous bio-layer of the material surface that further supports the retention of water. In addition, algae may also participate in the formation of a crust as they produce the so-called extracellular polymer substances (EPS). These substances significantly affect the physicochemical properties of materials like building stone and support the bacterial growth and activity leading to the release of inorganic substances useful for organisms in the same environment.

The investigations of the microorganisms on the surface of Roxburgh building have shown that microorganisms thrive, particularly cyanoprokaryotes, algae, etc. that form biofilms and crusts on the surfaces.

Photo 1. Roxburgh Building

Photo 2 & 3 Algal patches on Roxburgh Building

Photo 4 & 5. Algal patches on the Roxburgh Building

Photo 6. Close-up of green algal patches on Roxburgh Building

Photo 7.Close-up of greenish yellowish algal patches on Roxburgh Building

Photo 8. Close-up of algal patches on Roxburgh Building

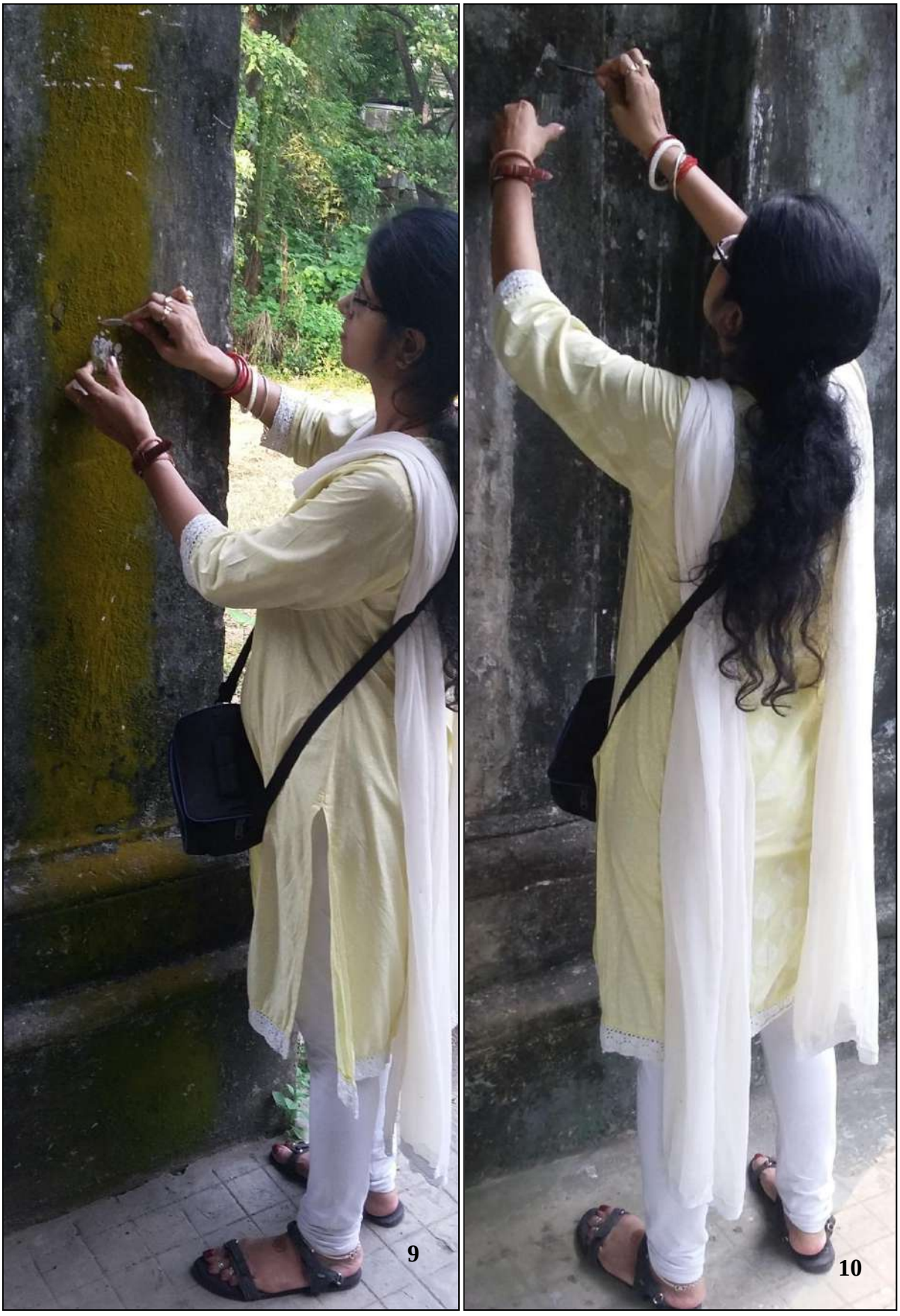


Photo 9 & 10. Collection of samples from the wall Roxburgh Building

Occurrence of cyanoprokaryotes and algae recorded from Roxburgh Building in AJCBIBG, Howrah have been depicted in Table 1, Fig. 1 and new records from India in Table 2.

Taxonomic enumeration of identified species belongs to various classes are described here along with their details including nomenclature.

Table 1. Epiphytic Cyanoprokaryotes and Algae recorded from Roxburgh Building of AJCBIBG.

S.No	Class	Order	Family	Genera	species	var
1	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Chroococcaceae	Chroococcus	minor	
2		Chroococcales	Chroococcaceae	Chroococcus	minutus	
3		Chroococcales	Chroococcaceae	Cyanosarcina	parthenonensis	
4		Chroococcales	Chroococcaceae	Gloeocapsopsis	crepidinum	
5		Chroococcales	Chroococcaceae	Gloeocapsopsis	pleurocapsoides	
6		Chroococcales	Entophysalidaceae	Entophysalis	deusta	
7		Chroococcales	Microcystaceae	Gloeocapsa	aeruginosa	
8		Chroococcales	Microcystaceae	Gloeocapsa	novacekii	
9		Chroococcales	Microcystaceae	Gloeocapsa	violacea	
10		Synechococcales	Merismopediaceae	Aphanocapsa	thermalis	
11		Nostocales	Rivulariaceae	Calothrix	brevissima	
12		Nostocales	Scytonemataceae	Scytonema	pseudopunctatum	
13	Ulvophyceae	Trentepohliales	Trentepohliaceae	Trentepohlia	rigidula	
14	Conjugatophyceae (Zygnematophyceae)	Desmidiales	Peniaceae	Penium	margaritaceum	
15	Phaeothamniophyceae	Phaeothamniales	Phaeothamniaceae	Phaeothamnion	confervicola	
16	Bacillariophyceae	Bacillariales	Bacillariaceae	Hantzschia	amphioxys	capitata

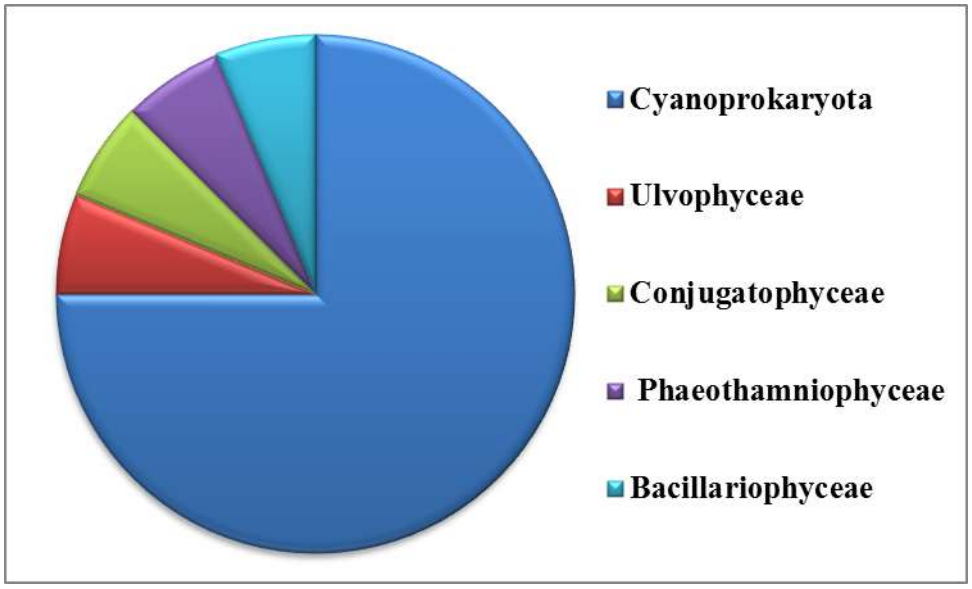


Fig. 1 Number of Epiphytic Cyanoprokaryotes and Algae recorded from Roxburgh Building

Taxonomic Enumeration of Cyanoprokaryotes and Algae

Cyanophyceae
Chroococcales
Chroococcaceae
Chroococcus Nägeli

Chroococcus minor (Kütz.)Nägeli, Neue Denkschr. Allg. Schweiz. Ges. Gesammten Naturwiss. 10[7]: 46. 1849; Desikachary, Cyanophyta 105, t. 24, f. 1. 1959. *Protococcus minor* Kützing**,** Phycol. Germ.: 144. 1845.

Thallus slimy gelatinous, dirty blue-green or olive green in colour; cells more or less spherical, single or in pairs, sometimes 4 or 8; sheath colourless, very thin, hardly visible.

Dimension : Cells 3.0 - 4.5 µm in diameter.

Environment : Freshwater and Marine species.

Habitat Notes : Generally found in wide range of freshwater environments, but especially shallow ponds and slow-flowing streams with submerged macrophytes.

Chroococcus minutus (Kütz.) Nägeli, Neue Denkschr. Allg. Schweiz. Ges. Gesammten Naturwiss, 10(7): 46, 1849. *Protococcus minutus* Kütz., Phycol. General. 168, 1843.

Microscopic colonies gelatinous or slimy, colourless, dirty olive-green or brownish; cells solitary or in 2 - 4 celled groups or sometimes 8 cells, rarely in multicellular, irregular slimy clusters; colonial slime wide, indistinctly lamellate or homogeneous, refractive, colourless or yellowish to orange-yellowish; cells spherical or hemispherical, cells and their small group (2 - 4 celled) surrounded by individual colourless, indistinctly and concentrically lamellate

envelops, cells green, olive-green, rarely yellowish content; cell division usually irregular in different oblique planes.

Dimension : Cells 4.47 - 5.59 µm in diameter; with sheath 7.6 - 12.75 µm in diameter.

Environment : Aerophytic, Epilithic and Freshwater species.

Cyanosarcina L.Kovácik

Cyanosarcina parthenonensis Anagn., in Anagnostidis & Pantazidou, Hydrobiol. Suppl. 92(Algol. Stud. 64): 144, f. 24. 1991; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 312, f. 415. 1998.

Thallus olive-green, consisting of 2 - 16 or more celled colonies, later compound and multicellular in more or less cubic, dense, packet-like aggregates, with thin colourless and structure less, mucilaginous envelope; cells spherical after division sub globose or sub spherical, olive-green, yellow-green rarely olive-brown, finely granulate protoplasts.

Dimension : Colony 35.68 µm in diameter and cells 4.61 - 5.9 µm in diameter.

Environment : Terrestrial species.

Gloeocapsopsis Geitler ex Komárek

Gloeocapsopsis crepidinum (Thuret) Geitler ex Komárek, Bull. Natl. Sci. Mus. Tokyo, ser. B(Bot.), 19: 24, 1993; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 275, f. 361. 1998. *Protococcus crepidinum* Thuret, Mém. Soc. Imp. Sci. Nat. Cherbourg 2: 388, 1854.

Colonies large, gelatinous, irregular, dirty greenish; cells irregular spherical with thin colourless and sometimes diffluent envelope; envelope yellowish green or yellowish brown near the colonial surface, not lamellate; outer envelope hyaline; cell content pale blue-green usually homogeneous.

Dimension : Cells 3.05 - 4.01 µm in diameter.

Environment : Freshwater, Halophilic, Epilithic and Terrestrial species.

Gloeocapsopsis pleurocapsoides (Novácek) Komárek & Anagn. ex Komárek, Bull. Natl. Sci. Mus. Tokyo, ser. B(Bot.) 19: 24, 1993; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 277, f. 362. 1998. *Gloeocapsa pleurocapsoides* Novácek, Mohelno, Arch. Svazu Ochr. Přír. a Domov. Zemi Moravskoslezské 3a: 93, 133, t.1: figs. 2, 6, 7; t. 3(lower half): figs. 1-12; t. 5, f. 7. 1934.

Colonies microscopic, irregular, composed of aggregations of solitary, ensheathed cells or their groups, crustaceous, dark olive-green, brownish or blackish-brown, gelatinous or flat, squamulous; cells sub-spherical, more or less oval, elliptical, irregularly rounded or of irregular outline, usually composed of sub-colonies, with greyish blue-green, pale olive-green

or blue-green, homogeneous or finely granular content, with differentiated chromato and centroplasm, sometimes with small granules; envelop narrow, copying the cells, usually more or less lamellated, firm, not diffluent, yellowish inside more intensely, outer lightly coloured; resting cells more or less spherical, irregular, yellow-brownish or brown.

Dimension : Cells 2.24 - 7.51 - 12.0 µm in diameter.

Environment : Aerophytic species.

Entophysalidaceae
Entophysalis Kütz.

Entophysalis deusta (Meneghi.) F.E. Drouet & W.A. Daily, Lloydia 11: 79. 1948. *Coccochloris deusta* Meneghi., Atti Riun. Sci. Ital. 2: 173, 1841.

Colonies flat, granular, dirty yellow-brown composed of many small, irregular rounded sub-colonies; these sub-colonies with 1 -2 - 4 more cells with lamellate, not very wide, firm, delimited, yellow-brown; cells more or less spherical or slightly elongate, pale blue-green; mucilaginous envelop colourless to brown, lamellate, with distinct outer brown layer.

Dimension : Cells 4.2 - 4.52 µm in diameter.

Environment : Marine and subaerophytic, Epilithic species.

Microcystaceae
Gloeocapsa Kütz.

Gloeocapsa aeruginosa Kütz., Phycol. General. 174, 1843; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 239, f. 310. 1998.

Colonies granular or gelatinous, sometimes forming amorphous mass, blue-green or greyish olive-green, composed of almost spherical, many celled sub-colonies; mucilaginous envelopes colourless, delimited, more or less inflated; cells small, spherical, blue-green.

Dimension : Cells 2.0 - 3.1 µm in diameter and 4.1 - 7.9 µm in diameter with sheath.

Environment : Aerophytic and Freshwater species.

Gloeocapsa novacekii Komárek & Anagn., Presilia 67: 19, figs. 1 - 7. 1995; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 252, f. 328. 1998.

Colonies gelatinous, granular, dirty or blackish brown, composed of subcolonies; mucilaginous envelops wide, finely granular; cells spherical or wide oval, pale olive-green, blue-green or yellowish.

Dimension : Cells 3.5 - 5.51 µm in diameter.

Environment : Aerophytic species.

Eponomy : Species ad honorem Dr. Frantisek Novácek nominata.

Gloeocapsa violacea Kütz., Tab. Phyc. 1: 25, t. 36, f. 9. 1847.

Colonies granular, blue-green, blackish; sub colonies usually 2 - 4 celled, rarely with more cells jointed together with wider outer colourless or bluish to very intensely coloured, usually not or slightly striated sheath layers; cells blue-green.

Dimension : Cells 4.5 - 5.71 µm in diameter.

Environment : Aerophytic species.

Synechococcales
Merismopediaceae
Aphanocapsa Nägeli

Aphanocapsa thermalis Brügger, Jahresber. Naturf. Ges. Graubündens, ser. 2, 8: 244, 1863; Komárek & Anagn., Cyanoprokaryota Part 1: Chroococcales 19(1): 156, f. 187. 1998.

Colonies mucilaginous, irregular, formless with homogeneous colourless mucilage, usually with densely packed cells, they touch one to another, blue-green; cells spherical or slightly oval, bright blue-green, sometimes with individual fine, diffluent mucilaginous envelope especially in peripheral parts of colonies.

Dimension : Cells 3.56 - 4.39 µm in diameter.

Environment : Freshwater and sub-aerophytic species.

Nostocales
Rivulariaceae
Calothrix C.Agardh ex Bornet & Flahault

Calothrix brevissima G.S.West, J. Linn. Soc., London Botany 38: 180, t. 10, f. 8. 1907; Desikachary, Cyanophyta 533, t. 114, f. 1. 1959.

Filament epiphytic, short, not or very little, very little attenuated, sheath firm, very close to the trichome, thin, nearly cylindrical, colourless; trichome short slightly attenuated with rounded end cells, not constricted at the cross-walls, olive green; cells at the base nearly as long as broad; heterocysts basal, single, more or less rounded, hemispherical or sub-spherical.

Dimension : Filament 4.03 - 7.51 µm in diameter.

Environment : Epiphytic and Freshwater species.

Scytonemataceae
Scytonema C.Agardh ex Bornet & Flahault

Scytonema pseudopunctatum Skuja, Nova Acta R. Soc. Sci. Upsal, Ser. 414(5): 38, t. 4, figs. 1 - 9. 1949; Desikachary, Cyanophyta 469, t. 96, f. 3. 1959.

Thallus pulvinate, attached to the substratum, not attenuated, olivaceous to slightly blackish; filament partly prostrate, mostly erect, more or less densely intertwined, false branched, rarely solitary or geminate, generally short; sheath moderately thick, with parallel lamellation, close, colourless or yellow or yellowish brown; trichome mostly constricted at the cross-walls, slightly constricted at meristematic region; cells isodiametric or in parts, cell content pale olivaceous; homogeneous or sparsely granulated; heterocysts cylindrical with rounded ends, frequently lightly constricted in the middle region or discoid or rounded quadrate, yellowish membrane; propagation by hormogones and hormocysts formed from the apices.

Dimension : Filament 14.02 - 17.0 µm in diameter; trichome 10.5 - 16.04 µm in diameter; heterocysts 15.0 - 16.01 µm in diameter.

Environment : Terrestrial species.

Ulvophyceae
Trentepohliales
Trentepohliaceae
Trentepohlia C.Martius

Trentepohlia rigidula (J.Müller) Hariot, J. Bot. 3: 403, 1889. *Coenogonium igidulum* J.Müller, Flora 65: 490, 1882.

Thallus forms compact crusts of filaments on tree bark and varied from orange to yellowish-red in colour; uniseriate filaments showed prostrate and an erect portion; vegetative cells are arranged in uniseriate chain and sporangia borne on the stalk or superimposed on the vegetative cells, vegetative cells are elliptical, barrel shaped, two cells divided by a strong constriction or septum; cell wall thick and sometimes rough; sporangium varied from globular, orbicular or dome shaped, with 15-30 µm diameter, sporangia globose, sometimes oval and larger than the vegetative cells, generally formed on the filament in apical, intercalary or in lateral position.

Dimension : Vegetative cells 6.0 -12.0 µm in diameter and 12.86 - 15.0 µm in length.

Environment : Aerophytic species.

Habitat : Polymorphic species widely distributed in tropical and subtropical regions, usually found on tree bark but also on rocks, cement walls and artificial substrata.

Charophyta
Conjugatophyceae (Zygnematophyceae)
Desmidiales
Peniaceae

Penium Bréb ex Ralfs

Penium margaritaceum Bréb., Brit. Desmid 149, t. 25, f. 1; t.33, f. 3. 1848; Tiffany & Britton, The Algae of Illinois 176, t. 51, f. 540. 1952.

Cells cylindric or subfusiform, very slightly attached to the truncately rounded apices; cell-wall brown with longitudinal rows of minute granules; chromatophores axial, with about 10 longitudinal ridges; pyrenoids numerous, in a median series.

Dimension : Cells 8.90 - 12.8 µm in diameter.

Environment : Freshwater species.

Ochrophyta
Phaeothamniophyceae
Phaeothamniales
Phaeothamniaceae
Phaeothamnion Lagerheim.

Phaeothamnion confervicola Lagerheim., in Wittrock & Nordstedt, Bot. Not. 124, 1884 (as*'confervicolum'*); S. Kant and P. Gupta, Algal Flora of Ladakh 141 & 263, t. 68, f. 7. 1998.

Thallus forms branched filaments; Cells cylindrical barrel-shaped to sub-ovoid jointed end to end in branched filament with a conspicuous central axis and sub-erect lateral branches prominent hemispherical cell without chromatophores attaches the plant to the substratum, mostly grows epiphytic.

Dimension : Cells 10.4 - 13.52 µm in diameter and 18.8 - 19.2 µm long.

Environment : Epiphytic and Freshwater species.

Bacillariophyceae
Bacillariales
Bacillariaceae
Hantzschia Grunow

Hantzschia amphioxys var. **capitata** Zimmermann, Brotéria Bot. 16: 88, t. 2, f. 8. 1918; B.N. Prasad & M.N. Srivastava, Algal Flora of Andaman and Nicobar Island Vol. 1: 313.

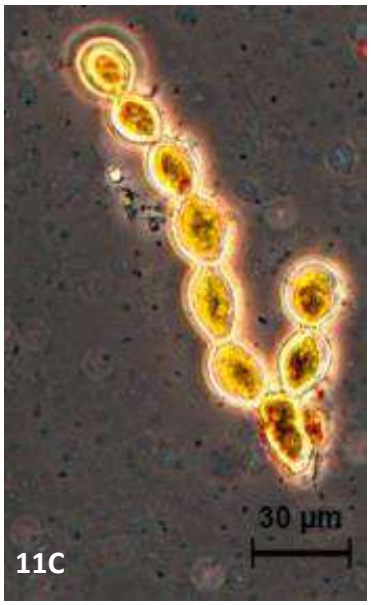
Valves narrowly linear-lanceolate, dorsal side convex, ventral side slightly concave with distinct deep median depression; ends slightly attenuated, constricted rounded-capitate; keel punctae distinct, thick, slightly elongated median two set apart, central nodule prominent; striae fine, lineate, parallel, throughout the valve.

Dimension : Length 41.0 - 42.34 µm and 7.0 - 8.74 µm in diameter; keel punctae 7 - 8 µm; striae 22.0 - 24.0 in 10 µm.

Environment : Freshwater and Terrestrial specie

11A


11B



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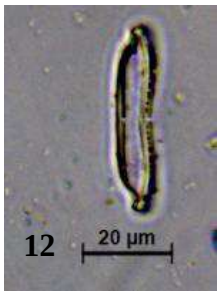

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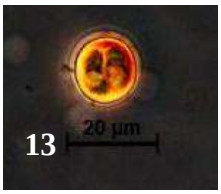

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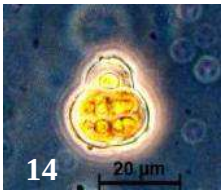

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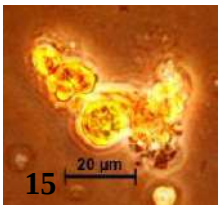

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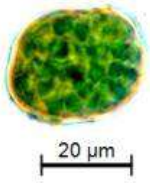

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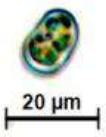

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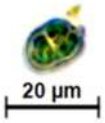

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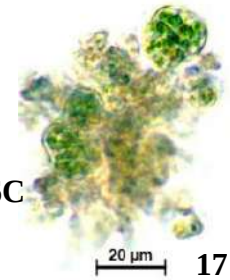

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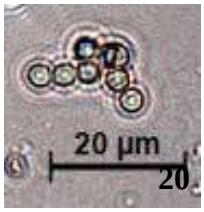

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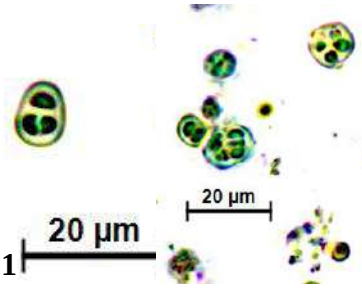

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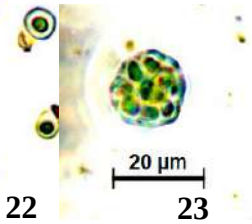

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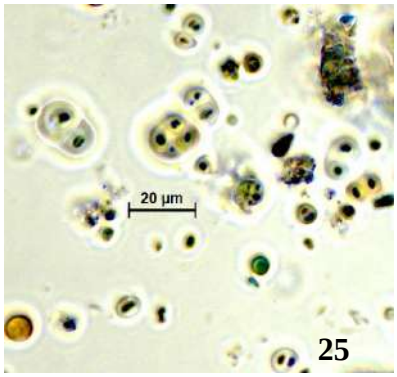

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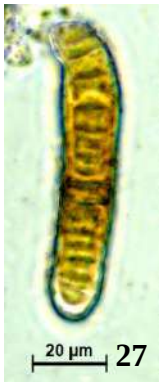

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Photo 11. *Trentepohlia rigidula* (J.Müller) Hariot

Photo 12 *Hantzschia amphioxys* var. *capitata* Zimmermann

Photo 13. *Gloeocapsa violacea* Kütz.

Photo 14. *Gloeocapsa novacekii* Komárek & Anagn.

Photo 15. *Entophysalis deusta* (Meneghi.) F.E. Drouet & W.A. Daily

Photo 16. A, B, C, 13. *Gloeocapsopsis pleurocapsoides* (Novácek) Komárek & Anagn. ex Komárek

Photo 17. *Gloeocapsopsis crepidinum* (Thuret) Geitler ex Komárek

Photo 18. *Cyanosarcina parthenonensis* Anagn.

Photo 19. *Penium margaritaceum* Bréb.

Photo 20. *Aphanocapsa thermalis* Brügger

Photo 21. *Chroococcus minor* (Kütz.)Nägeli

Photo *2*2. *Gloeocapsa aeruginosa* Kütz.

Photo 23. *Chroococcus minutus* (Kütz.) Nägeli

Photo 24. *Phaeothamnion confervicola* Lagerheim.

Photo 25. *Gloeocapsa violacea* Kütz.

Photo 26. *Calothrix brevissima* G.S.West and

Photo 27. *Scytonema pseudopunctatum* Skuja

Table 2. New Records from India of Cyanoprokaryotes recorded from Roxburgh Building

S. No.	Class	Order	Family	species
1	Cyanophyceae/ Cyanobacteria/ Cyanoprokaryota	Chroococcales	Microcystaceae	*Gloeocapsa novacekii* Komárek & Anagn.
2	,,	Chroococcales	Entophysalidaceae	*Entophysalis deusta* (Meneghi.) F.E.Drouet & W.A.Daily

DISCUSSION

During study 117 epiphytic cyanoprokaryotes and algal species were recorded from different Plant species like Great Banyan Tree - *Ficus bengalensis* L. (19), Mangrove - *Taxodium distichum* (L.) Rich. (27), Double Coconut - *Lodoicea maldivica* (J.E. Gmel.)Pres. (47), Mango Belt - *Mangifera indica* L. (08) and also from Roxbourg Building (16) of AJC Bose Indian Botanic Garden, Howrah. Out of 117 epiphytic cyanoprokaryotes and algal species, 12 species commonly observed on different plants so altogether 105 epiphytic species were recorded. Cyanoprokaryotes - *Scytonema ocellatum* Lyngbye ex Bornet & Flahault commonly observed on Great Banyan Tree and *Lodoicea maldivica* (J.E. Gmel.) Pres. No common species observed in between Mangrove - *Taxodium distichum* (L.) Rich., Great Banyan Tree, *Lodoicea maldivica* (J.E. Gmel.)Pres. *Trentepohlia aurea* (Linnaeus) C.Martius and *Trentepohlia rigidula* (J.Müller) Hariot observed from both Great Banyan Tree and Mango belt of *Mangifera indica* L. However, *Trentepohlia rigidula* (J.Müller) Hariot also recorded from Roxburgh Building of AJCBIBG. *Chlorococcum infusionum* (Schrank) Menegh. and *Trachelomonas volvocina* (Ehrenb.) Ehrenb. Commonly observed from Mangrove - *Taxodium distichum* (L.) Rich. and from Mango Belt. *Chroococcus minor* (Kütz.)Nägeli and *Scytonema pseudopunctatum* Skuja commonly observed from *Lodoicea maldivica* (J.E. Gmel.) Pres. and from Roxburgh Building. *Gloeocapsopsis crepidinum* (Thuret) Geitler ex Komárek and *Gloeocapsa novacekii* Komárek & Anagn. also observed from Great Banyan Tree and from Roxburgh Building.

It is very interesting to observe that out of 105 species belonging to different classes of algae 19 species recorded as *new to the science of India*. Out of 19 species recorded, from Great Banyan Tree 06 species reported for the first time from India of 04 classes Cyanoprokaryotes (02) - *Chlorogloea gentilis* Skuja, *Gloeocapsa novacekii* Komárek & Anagn., Chlorophyceae (01) - *Sphaeroplea wilmanii* Fritsch & Rich, Chrysophyceae (02) - *Phaeaster pascheri* Scherffel, *Spumella beauchampii* (Hovasse) P.C.Silva, Euglenophyceae (01) - *Trachelomonas pulchella* Drezepolski,

Out of 27 species recorded from Mangrove, 08 species reported for the first time from India from three classes viz. Cyanoprokaryotes (05) - *Gloeocapsopsis dvorakii* (Novácek) Komárek & Anagn. ex Komárek, *Myxobaktron salinum* A.E.Walsby & Hindák, *Gloeocapsa deusta* (Menegh.) Kütz., *Woronichinia tenera* (Skuja) Komárek & Hindák, *Synechocystis septentrionalis* Skuja, Bacillariophyceae (02) - *Psammothidium pseudoswazii* (J.R.Carter) L.Bukhtiyarova & Round, *Geissleria schoenfeldii* (Hustedt) H. Lange-Bertalot & D. Metzeltin and Xanthophyceae (01) - *Trachychloron depauperatum* Pascher. However, no new records recorded from Mango Belt.

While studying vertical profile of algae (Class-wise) on *Lodoicea maldivica* (J.E. Gmel.) Pres. tree trunk at upper, middle and lower portion out of 47 species recorded, 04 species of different classes Xanthophyceae (1) *Monallantus brevicylindrus* Pascher, Euglenophyceae (1) *Trachelomonas volvocina* var. *compressa* Drezep., Coccolithophyceae (1) *Apistonema expansum* Geitler and Synurophyceae (1) *Synura splendida* Korshikov. reported for the first time from India.

Out of 16 species observed from Roxburgh Building two species of Cyanoprokaryotes viz. *Entophysalis deusta* (Meneghi.) F.E. Drouet & W.A. Daily and *Gloeocapsa novacekii* Komárek & Anagn. recorded as new record from India.

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