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ON THE MORPHOLOGY OF A RARE COCCOID CYANOPROCARYOTE, *CHAMAECALYX SWIRENKOI*, CHROOCOCCALES FROM INDIA

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Chamaecalyx (Komárek and Anagnostidis 1986) has been described in detail for the first time from freshwater cemented tanks of Allahabad, India. Studies based on the material collected from many cemented water tanks continuously for two years, revealed that, its growth was most common in those tanks which were located in shady places. This genus is distinguished on the basis of first horizontal division of sessile cells and formation of exocytes from the upper cell. Various stages of exocyte formation and proliferation of stalk cells are recorded. Occasionally repeated transverse divisions of a parent cell may result into a linear row of cells which look similar to the stages of the genus *Stichosiphon* or due to repeated divisions throughout the cell, the appearance of stalk cell is obscured and then it becomes quite comparable to the genus *Cyanocystis*.

Key Words: Coccoid, Cyanoprocaryote, Exocyte, *Chamaecalyx swirenkoi*, Taxonomy.

In total 95 genera and about 600 species of coccoid Cyanoprocaryotes are known at global level (Komárek and Anagnostidis 1998). Our recent survey of Indian coccoid forms revealed the record of 33 and 326 taxa from various habitats (Tiwari *et al.* 2007, 2009). The genus *Chamaecalyx* Komárek and Anagnostidis (1986) is a member of Chamaesiphonaceae of the order Chroococcales and it was known earlier by different names viz. *Dermocarpa* (Geitler (1932, 1967), Desikachary (1959), Starmach (1966), Bourrelly (1970, 1985), Hindak (1983), *Dermocarpella* (Feldmann and Feldmann (1953), Ardre (1960, 1969), and *Cyanocystis* (Hallfors and Munsterhjelm (1982). Komárek and Anagnostidis (1986) segregated the genus *Chamaecalyx* on the basis of its specific pattern of first horizontal division of sessile cells. This division results into the upper cell that produces exocytes and the lower cell that acts as a stalk. Characteristic features of the genus *Chamaecalyx* include: Cells solitary or in groups attached to the substrate by the narrow base or by pad, heteropolar elongate more or less club-shaped, always enveloped by a thin or thick, firm, colourless sheath (pseudovagina). Sheath opens at the apex before the exocyte liberation. Cell content is homogeneous, usually pale blue-green, olive-green or reddish. Many marine and a few freshwater species are known. Cell division begins by the transverse binary fission, in which the first division plane is always at right angle to the longer (vertical) axis; later the upper (distal) cell of the original mother cell divides successively or simultaneously, while the basal (proximal) part mostly remains undivided. Divisions in various planes in upper cell result into small daughter cells called exocytes (earlier known as exospors), which were liberated by the gelatinization of apical end. The genus *Chamaecalyx* is mostly known from marine habitats and not frequently recorded. From India, only two species viz. *Chamaecalyx clavatus* (Setchell & Gardner) Komárek & Anagnostidis and *C. leibleiniae* (Reinsch) Komárek & Anagnostidis have been described as the species of the genus *Dermocarpa* (Desikachary 1959). In the present communication a third species viz. *Chamaecalyx swirenkoi* (Sirsov) Komárek & Anagnostidis is described in detail for the first time from India.

MATERIAL AND METHODS

The specimens of the *Chamaecalyx swirenkoi*

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were collected from six cemented tanks of Allahabad situated with in the radius 5 km., during July 2009 to June 2011. It was growing in epiphytic small clusters on the surface of filaments of *Cladophora* and other aquatic weeds viz. *Hydrilla* and *Vallisneria* of the tank. The organism was studied from repeated collection of material from natural habitats.

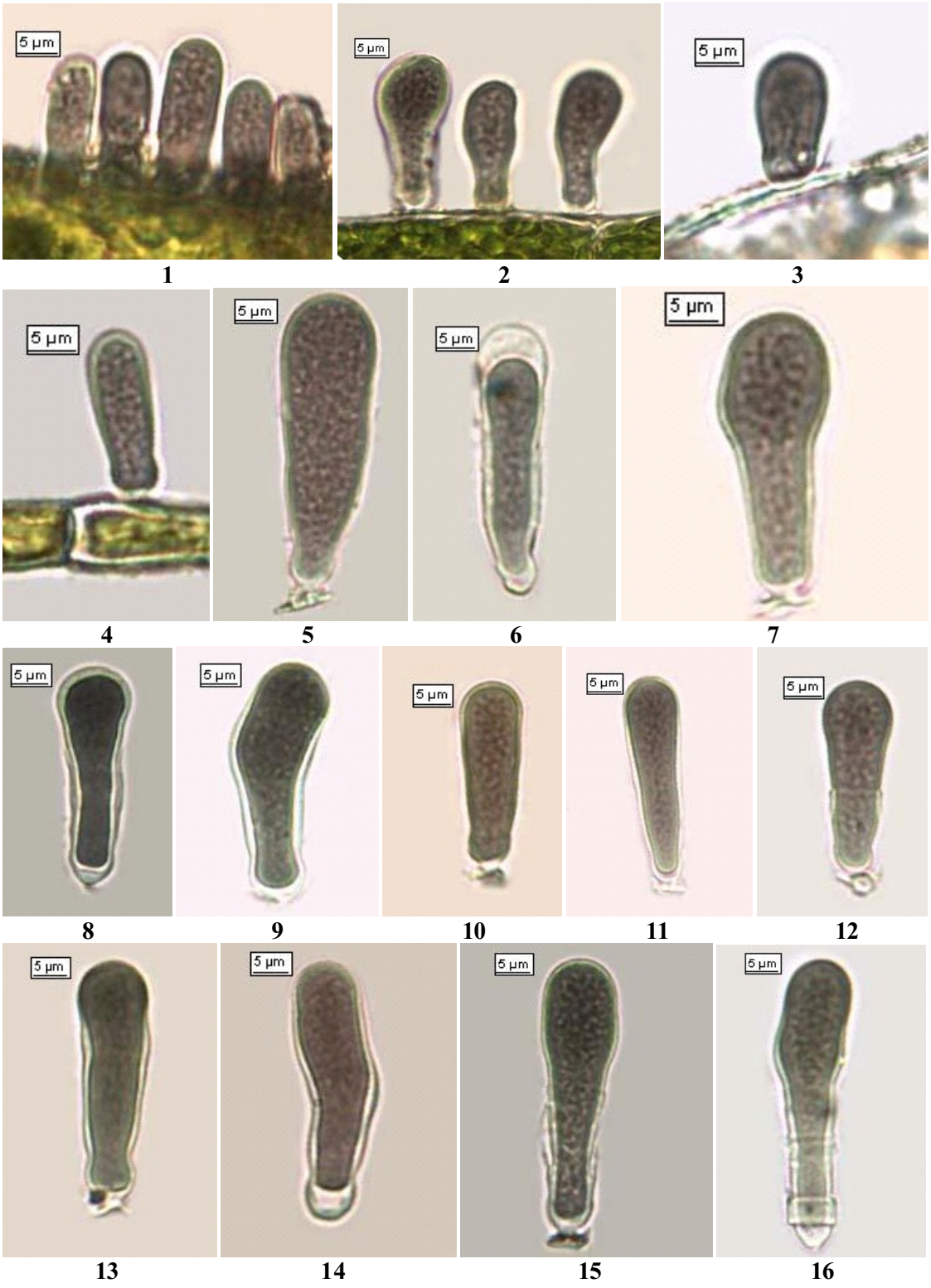
OBSERVATIONS

Ecology: Our frequent collections of algae all around the year for decades from numerous open and exposed aquatic habitats revealed extremely rare occurrence of chamaesiphonalean forms like *Chamaecalyx* and *Stichosiphon*. But recent collections made from six cemented tanks located in shaddy places of Allahabad revealed frequent occurrence of these forms in all the tanks. It has ecological implications and because of its growth in shaddy localities it is adapted to develop more of phycobilins. Therefore specimens did not show bright blue-green appearance. On the other hand, due to poor nutrient condition of the cemented tanks the cells did not show prominent and coarse granulations of reserved materials at any stage of growth cycle. Further, different demographic stages of vegetative, reproductive and perennating cycles were not clearly demarcated informs growing in tanks of shaddy places.

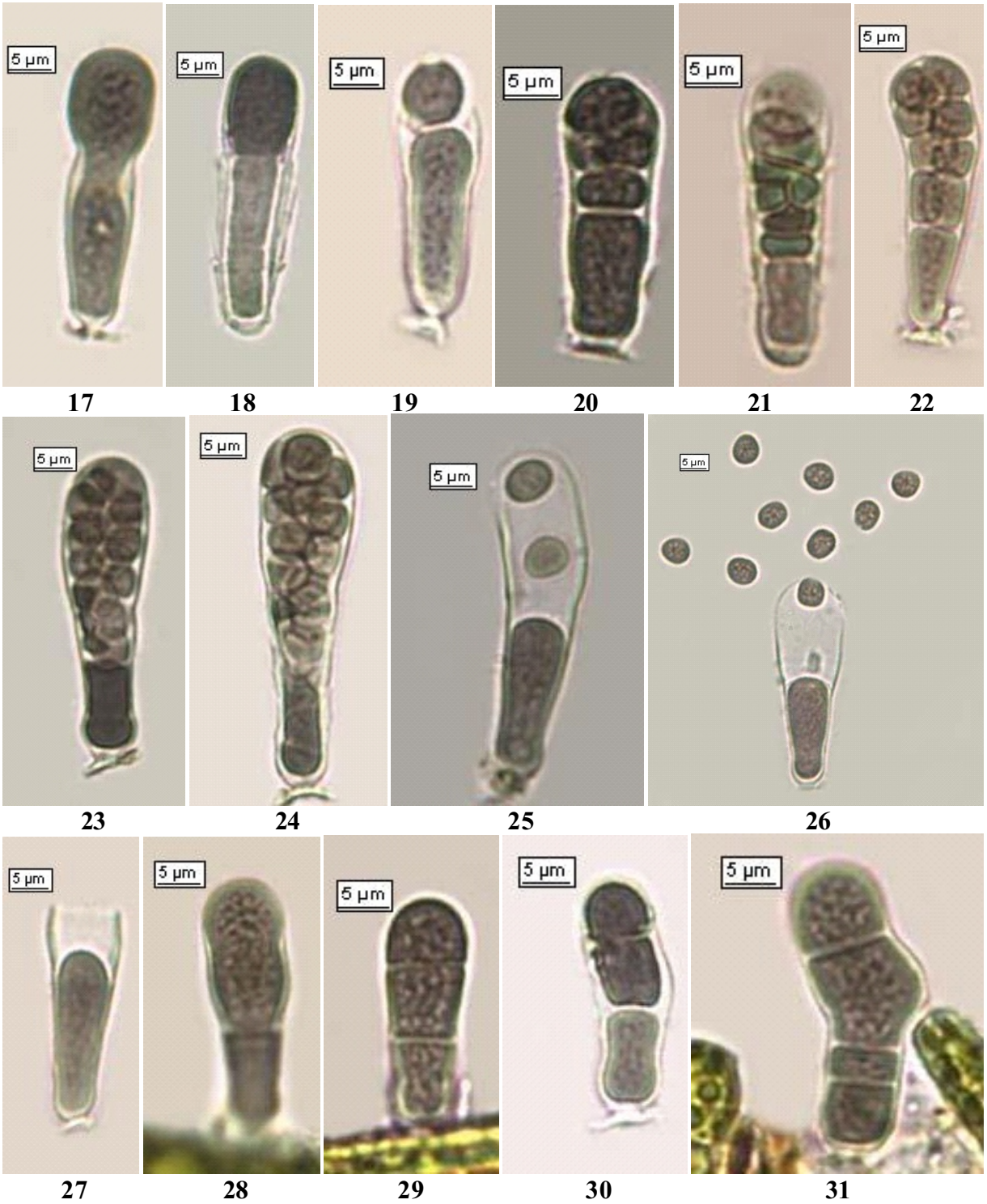
Description: Heteropolar cells in single or several grouped together were found attached on the surface of aquatic algae or weeds (Figs. 1-4). Cells were club-shaped, straight or bent and broadly rounded at the apex. The cells were surrounded by thick and gelatinous sheath (pseudovagina) and attached at the base by an extension of sheath or small pad-like structure. The cells were having gradually tapering and wavy or undulating lateral walls. Cells measured 8-14 µm in diameter at apical and broader end and 20-53 µm in length. The content of cells appeared finely granulated and more-dense at apical end. The cells appeared as violet, bluish, dark grey or dirty blue-green in colour (Figs. 5-16).

Vegetative cells and reproductive cells were found growing mixed together. The reproducing cells divided first by a transverse division to form a small basal stalk cell and upper large and swollen cell (Figs. 17 and 18). The upper cell divided by several successive or simultaneous divisions in various planes to produce 5-15 spherical or oval exocytes of 3-5 µm in diameter (Figs. 20-24). Exocytes are liberated by the gelatinization of apical end. Occasionally most of the content of the club-shaped cells is used up in the formation of exocytes and only a small and inconspicuous basal part remains and such stages may come closer to the genus *Cyanocystis* (Fig. 24). In rare cases only a single exocyte is constricted in the same way as it happens in the genus *Chamaesiphon* (Fig. 19). Rarely successive divisions in one plane may result into a row of 3 or 4 cells and such stages relate this organism with *Stichosiphon*, characteristic of the genus (Figs. 28-31). Frequently after liberation of exocytes the basal part may proliferate and grow into the shape of the original mother cell again and the content may divide and liberate the exocytes in the same way and this cycle may be repeated one to three times as indicated by annular thickenings and telescoping of sheath (pseudovagina, Figs. 15, 16 and 27).

Taxonomic Discussion: The genus *Chamaecalyx* represents a transition from exocyte producing *Chamaesiphon* and *Stichosiphon* (*Chamaesphenaceae*) to baeocyte producing *Cyanocytis* (*Dermocarpellaceae*). The present organism showed cells similar to *Chamaesiphon* in showing basal stalk, single row of exocytes similar to *Stichosiphon* and multiple rows of exocytes similar to *Cyanocytis*. *Chamaecalyx*



Figures. 1-31.*Chamaecalyx swirenkoi* Komárek & Anagnostidis
Figures. 1-4. Cells attached on the filament of *Cladophora*. **Figures. 5-14.** Showing different shapes and colonies of vegetative cells. **Figures. 15 and 16.** Cells showing circular thickenings in the basal part of cells formed due to proliferation of sheath.



Figures. 17 and 18. Cells showing distinct basal stalk cell and dense apical ends. **Figures. 19.** Cells showing formation of single exocyte as found in *Chamaesiphon*. **Figures. 20-23.** Typical stages of formation of 5-15 exocytes in the upper part of cells. **Figures. 24.** Cells where most of the content is transformed into exocytes and the basal stalk cell is inconspicuous. **Figures. 25 and 26.** Showing liberation of exocytes by dissolution sheath at the apical end. **Figures. 27.** Cells showing proliferation of basal stalk cell. **Figures. 28-31.** Showing presence of a series of cross walls in one plane and resulting into uniseriate row of cells comparable to *Stichosiphon*.

is known to have 11 species from all over the world and most of them are marine except *C. chamaesiphonoides* (Geitler) Komárek and Anagnostidis (1986) and *C. swirenkoi* (Sirsov) Komárek & Anagnostidis (1986) which are known from freshwater habitats. The organism under present study is quite comparable to the latter one in occurrence, cell shape and measurements. It is also comparable with *C. clavatus* (Setch & hard) Komárek & Anagnostidis described by Desikachary (1959 p.175) from fresh water habitats of India and it appears that his specimens may actually belong to *C. swirenkoi*.

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