

## Sexual reproduction in *Cylindrocystis brebissonii* (Ralfs) De Bary (Charophyta: Conjugatophyceae: Desmidiaceae) in nature

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**Abstract** – Complete sequence of sexual reproduction in *Cylindrocystis brebissonii* (Ralfs) De Bary was observed for the first time in a natural population from Sikkim, Eastern Himalayas. The observations are supported by microphotographs.

**Conjugation / Desmid / Eastern Himalaya**

### INTRODUCTION

Sexual reproduction in Conjugatophyceae occurs by the process of conjugation and it is frequently observed in certain genera of Zygnemataceae like *Spirogyra*, *Zygnema*, *Mougeotia*, *Sirogonium* (Fritsch, 1935; Smith, 1950; Graham *et al.*, 2009), in the members of Mesotaeniaceae like *Cylindrocystis*, *Mesotaenium* (Brook, 1981) and in the members of Desmidiaceae like *Cosmarium*, *Closterium* etc. Although its occurrence in temperate countries (Brook, 1981; Wehr *et al.*, 2015) has not been observed very frequently in nature, the condition is reverse in tropical countries like India (Turner, 1892; Bharati, 1971; Hegde, 1981, 1984, 1987; Hegde & Bharati, 1980, 1983; Panikkar & Krishnan, 2005, 2006, 2007). The Indian workers observed zygospore formation in nature in genera like *Cosmarium*, *Bambusina*, *Hyalotheca*, *Micrasterias*, *Xanthidium* and have been induced by many workers all over the globe (Cook, 1963; Biebel, 1964, 1975; Brandhan, 1964; Biebel & Reid, 1965; Teixeira, 1974; Dubois-Tylski, 1972, 1973; Dubois-Tylski & Lacoste, 1970; Lippert, 1967; Pickett-Heaps & Fowke, 1971; Blackburn & Tyler, 1980, 1981, 1987; Tijlickjan & Rayburn, 1985). In most of the natural populations in India zygospore formation have been observed very frequently, the culture studies depicted different stages of sexual reproduction more properly. Biebel (1975) observed various stages of sexual reproduction in *Cylindrocystis brebissonii* (Ralfs) De Bary in culture. He described the sequences of zygospore formation in this taxon. Although reports of sexual reproduction in the naturally occurring populations of *Cylindrocystis* (Kaufmann, 1914) and in culture (Pringsheim, 1918; Biebel, 1973) are not uncommon,

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complete sequence of sexual reproduction has not been documented till now. The present authors have observed a natural population of *Cylindrocystis brebissonii* (Ralfs) De Bary where all the sequences of sexual reproduction have been recorded and documented in detail.

## COLLECTION & STUDY SITES

While collecting different algal specimens from different regions of Eastern Himalaya, authors collected this specimen (DD-625) on 02 May 2015 from a marshy area near Gangtok, East district of Sikkim, India (27°20'30"N 88°37'10"E and an altitude about 1,663m) where the alga was growing in a shady place. pH of the collection spot was found slight acidic, nearly 6.5, temperature of the water was 17°C and air about 21.5°C. The collecting site was occupied by several semi-aquatic weeds i.e. *Campylopus*, *Pogonia* etc. and forming a soggy condition beside a walkway into the forest. Canopy of *Cryptomeria* of the forest made environment shady and moist thus creating an optimum situation for micro-algal reproduction. Several samples were collected in small polythene packets from this site to acquire all the possible specimens grew there and preserved instantly in 4% formalin solution or Lugol's iodine. After bring these specimens in the laboratory and examined under Olympus compound light microscope, one of these samples contain the different sexual stages of *Cylindrocystis brebissonii* (Ralfs) De Bary. Identification of the desmid taxa was done with the help of several monographs (West & G.S. West, 1904; Krieger, 1937; Prescott *et al.*, 1972 & Lenzenweger, 2003). Camera-lucida drawings were made for different stages of zygospore formation and micro-photographs were taken with Carl Zeiss Axiostar plus research microscope with Nikon SLR model (D60) digital camera attachment system. The original specimen is stored in the algae herbarium, Department of Botany, The University of Burdwan (BURD).

## OBSERVATIONS

### Taxonomic identification and characters of the taxa:

Kingdom: Plantae  
Subkingdom: Viridiplantae  
Infrakingdom: Streptophyta  
Phylum: Charophyta  
Class: Conjugatophyceae (Zygnematophyceae)  
Order: Zygnematales  
Family: Mesotaeniaceae  
Genus: *Cylindrocystis*

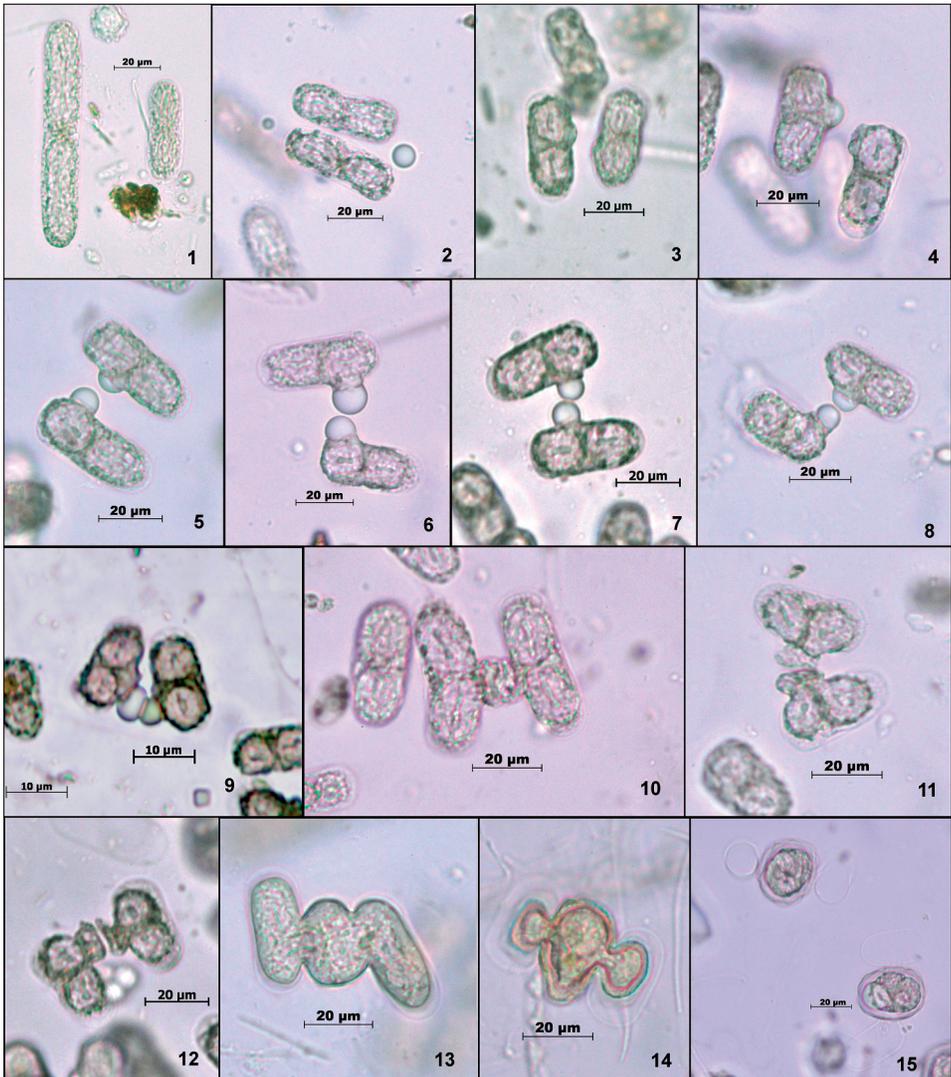
*Cylindrocystis brebissonii* (Ralfs) De Bary

## Figs 1-15

(West & G.S. West, 1904, p. 58, pl. 4, f. 23-32, pl. 5, f. 10; Krieger, 1937, p. 207, pl. 6, f. 4-7; Prescott *et al.*, 1972, p. 20, pl. 2, f. 1-5; Lenzenweger, 2003, p. 32, pl. 9, f. 3-6)

Cells medium sized, 2-3 times longer than broad, cylindrical; apex broadly rounded; lateral walls straight, parallel; chloroplast axial, pyrenoid central and large, one in each semicells; cell wall smooth. Length: 31-99  $\mu\text{m}$ , Breadth: 17-19  $\mu\text{m}$ .

The collected sample was occupied with various stages of life cycle of *Cylindrocystis*. The sample shows a wide range of thallus structures from 31  $\mu\text{m}$  to near about 99  $\mu\text{m}$  as cell length (Fig. 1). But it is important that the mating cells



Figs 1-15. Subsequent stages of sexual reproduction of *C. brebissonii* (Ralfs) De Bary.

were always of dimension. Desmids show gametangiogamy and therefore the mating cells behave nearly same gametangia. Figure 2 shows two cells of *Cylindrocystis* lying parallel 1<sup>st</sup> step in the sexual reproduction of the alga. Since flagellar stage is lacking some kind of chemo-tactic movement is involved for the attracting of potential pairing of cells. Figure 3 shows initiation of small papilla from the middle of the cells facing the opposite unit. Figure 4 depicts the clear indication of the conjugation tube breaking the cell wall. Simultaneously, conjugation tube enlarges (Fig. 5) and gradually emerges out to each other (Fig. 6). Then they touch each other to a specific point (Figs 7 & 8) and their point of contact dissolves (Fig. 9). After the pathway becomes established, the protoplasmic content passes toward the conjugation tube (Figs 10 & 11) and deposited in it (Fig. 12). Figure 13 shows obvious contact of aflagellate isogametes which move from the parent cell in the conjugation tube and fuse therein. Cellular protoplast detached out from the parent cell wall also found demarcated at this stage. No specialized order regarding the release of protoplast was found. Protoplasts from the conjugating members pass simultaneously to the conjugating tube after the point of contact get dissolved. Isogametes fuse to form zygospore acquiring a common thick cell wall (Fig 14). A complete and mature zygospore (Fig. 15) is sub-circular structure with thick cell wall devoid of any ornamentations and leaving the parent cell wall remnants nearby.

Conjugation style can be considered asynchronous as it is a natural collection and individuals were found to possess all the successive stages of sexual reproduction. In culture sexual reproduction still not achieved.

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