



# A new species of the rare chrysophycean alga *Dermatochrysis* (Chrysocapsaceae, Chromulinales) from Eastern Himalayas, India

Sudipta Kumar DAS\*, Pritha BASU, Rajendra Kumar GUPTA

Cryptogamic Unit, Central National Herbarium, Botanical Survey of India, Howrah – 711103, West Bengal, India

\*Corresponding author's email: sudiptaalgae@gmail.com

(Manuscript received 13 February 2019; accepted 17 June 2019; online published 10 July 2019)

**ABSTRACT:** A new species of the rare chrysophycean genus *Dermatochrysis* Entwisle & R.A. Andersen is described from eastern Himalayas (Arunachal Pradesh, India). The comparative morphology of this taxon with allied species showed its uniqueness in thallus structure and cellular arrangements, thus is proposed as a new species, i.e. *Dermatochrysis himalayensis* S. K. Das, P. Basu & R. K. Gupta.

**KEY WORDS:** Arunachal Pradesh, Chrysophyta, *Dermatochrysis himalayensis*, Himalaya, India.

## INTRODUCTION

*Dermatochrysis* Entwisle & R.A. Andersen is a rare coccoid colonial chrysophycean genus (Chrysocapsaceae, Chromulinales) was described while circumscribing *Tetrasporopsis* (De Toni) Lemmerm. by Entwisle and Andersen (1990). It is a rare genus of Chrysophyta morphologically characterized by cells with distinct cell walls, embedded in sac-like mucilagenous colonies, monostromatic thallus and presence of contractile vacuoles. However, there were several contradictions and lack of adequate descriptions by several researchers time to time (Schmidle, 1902; Pascher, 1925; Bourrelly, 1957; Lund, 1960; Tschermak-Woess, 1980). Entwisle and Andersen (1990) elucidated its taxonomic status with extensive revisionary studies on the protologue and type materials of earlier described taxa along with their Australian collections. After thorough phenotypic observations, they segregated all the taxa having naked cells with contractile vacuoles under the genus *Dermatochrysis*, whereas those with cell wall and no contractile vacuoles were placed under *Tetrasporopsis* (Nicholls and Wujek, 2015). The former genus is represented by only three species so far (Guiry, 2019), *D. pelagica* (R.E. Norris) Entwisle & R.A. Andersen was recorded from coastal New Zealand, *D. pseudofenestrata* (J.W.G. Lund) Entwisle & R.A. Andersen from small freshwater pool in Lancashire and the type species *D. reticulata* (Meyer) Entwisle & R.A. Andersen from Lake Baikal, Russia.

The Eastern Himalayas include the north-eastern states and northern part of West Bengal along with central Nepal, Myanmar, Bhutan and south-east Tibet in China. Popularly, it was regarded as 'Cradle of flowering plants' by Takhtajan (1969), as it houses world's richest alpine flora, out of which one third are endemic to the region (Dhar, 2002). The unique climatic variation and a wide altitudinal range (from 300 m to 8000 m a.s.l.)

provide a suitable ambience for its rich biodiversity. Arunachal Pradesh is the north-eastern most state of India sharing its international border with Bhutan, Myanmar and China. Though this place has immense floristic wealth, the history of its phycological exploration is only few decades old (Reddy *et al.*, 1986; Singh *et al.*, 1997; Singh and Gupta, 2000; Gupta *et al.*, 2002; Das and Adhikary, 2012, 2014; Das *et al.*, 2014; Das, 2015, 2016), which were only restricted to some novel distributional records. Recently, Das *et al.* (2018) described three new freshwater diatoms species from the state. In the present study, a new chrysophycean species from this region, was described.

## MATERIALS AND METHODS

The alga was collected as a greenish mucilagenous mass (Fig. 1) attached to the rocks in the feeding stream of Sungester Tso (popularly called as 'Madhuri lake') in Tawang district of Arunachal Pradesh (27°43.325' N; 91°49.631' E; 3736 m a.s.l. altitude). It is believed that the lake was originated due to a blockage in the feeding stream caused by an earthquake during 1970's. The pristine lake and its adjoining area comes under Bhagajang High Altitude Wetland (HAW) complex, which is one among the major HAW complexes located near the Indo-China border of Tawang district of Arunachal Pradesh. Due to its unique beauty, the lake is one of the major tourist attractions of the state. The lake is fed by a shallow perennial stream, with boulders and small to medium sized rocks in the catchment area as well as in the base. Due to moderate water flow throughout the year (except peak monsoon), the stones get colonized with adhering mucilagenous algal populations.

The alga was preserved in 4% formalin solution with voucher number and deposited at the algal collection in Cryptogamic unit, Central National Herbarium, Howrah. The samples were also collected in a glass bottle with



**Fig. 1.** Natural habitat of *Dermatochrysis himalayensis*. **A.** Sungester Tso lake in Arunachal Pradesh; **B.** The shallow feeding stream to the lake; **C.** Occurrence of *Dermatochrysis himalayensis* as mucilaginous mass on stones.

**Table 1.** Comparative morphology of *Dermatochrysis himalayensis* with its closely look-alike taxa.

Morphological features	<i>Dermatochrysis himalayensis</i>	<i>Dermatochrysis pseudofenestrata</i>	<i>Phaeosphaera indica</i>
Thallus (matured colonies)	Cylindrical to irregular shape; sometimes interconnecting network-like appearance; up to 1 mm long and 0.3 mm wide	Irregular network; 1.5 mm long and 0.5 mm wide; with finger like outgrowths	Reticulate with short lateral lobes to long loops; up to 0.5 cm; without any mucilaginous outgrowth
Branching like appearance	linearly or palmately branched appearance	Absent	Absent
Vacuolar spaces in thallus	Present	Present	Present
Pattern in cellular arrangement	Randomly arranged; monostromatic; young colonies with rarely two or single layer of cells	Randomly arranged; monostromatic	Arranged in groups of 2, 4, 8 or more; young thallus with single row of centrally placed cells
Cell shape	Spherical to oval (4.5–6.9 µm diameter) or oblong-elliptical (8.7–12.4 µm long and 3.0–3.8 µm broad)	Spherical to oval (10 µm in diameter) to oblong (19 µm long and 14 µm broad)	Spherical; 6.7–11.7 µm in diameter
Cell wall	Absent	Absent	Present
Presence of stigma	Absent	Absent	Absent
Chloroplast	1, very rarely 2	1, very rarely 2	2–3, sometimes 4; parietal
Contractile vacuole	Present	Present	Absent
Habitat	Feeding stream to a lake	Small pool	Stream adjacent to paddy field
References	Present study	Lund, 1960; Entwisle and Andersen, 1990	Ramanathan, 1947

Bold’s Basal medium (Bischoff and Bold, 1963) for isolation into culture and maintained in culture racks in a temperature-controlled room at 25 ± 1 °C under continuous illumination with a light intensity of 2.55 µmole/m<sup>2</sup>/s which was equipped with day light fluorescent tubes. However, we failed in isolating the organism to culture with repeated trying. Light Microscopic observations and morphological descriptions were done under Nikon microscope Ni–11 fitted with Nikon Digital Camera DS–Ri1–U3 and operated by Nikon Imaging Software NIS–D+EDF. The holotype of the alga is deposited in Central National Herbarium, Howrah (CAL).

**TAXONOMIC TREATMENT**

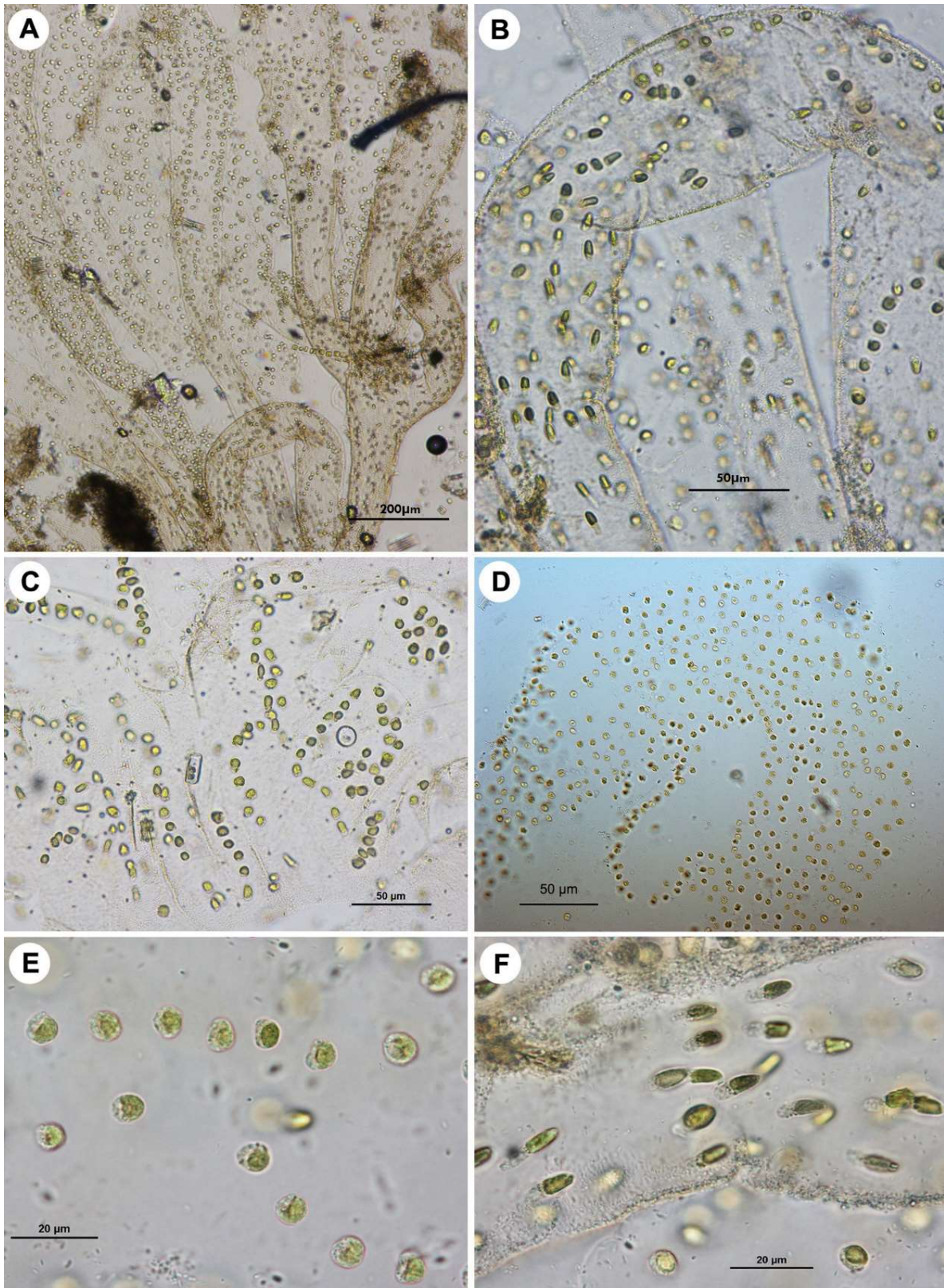
*Dermatochrysis himalayensis* S.K. Das, P. Basu & R.K. Gupta, *sp.nov.* **Fig. 2, 3**

**Type:** INDIA, Arunachal Pradesh, Tawang, Sungester Tso/Madhuri lake, 62849, 3736 m a.s.l.,

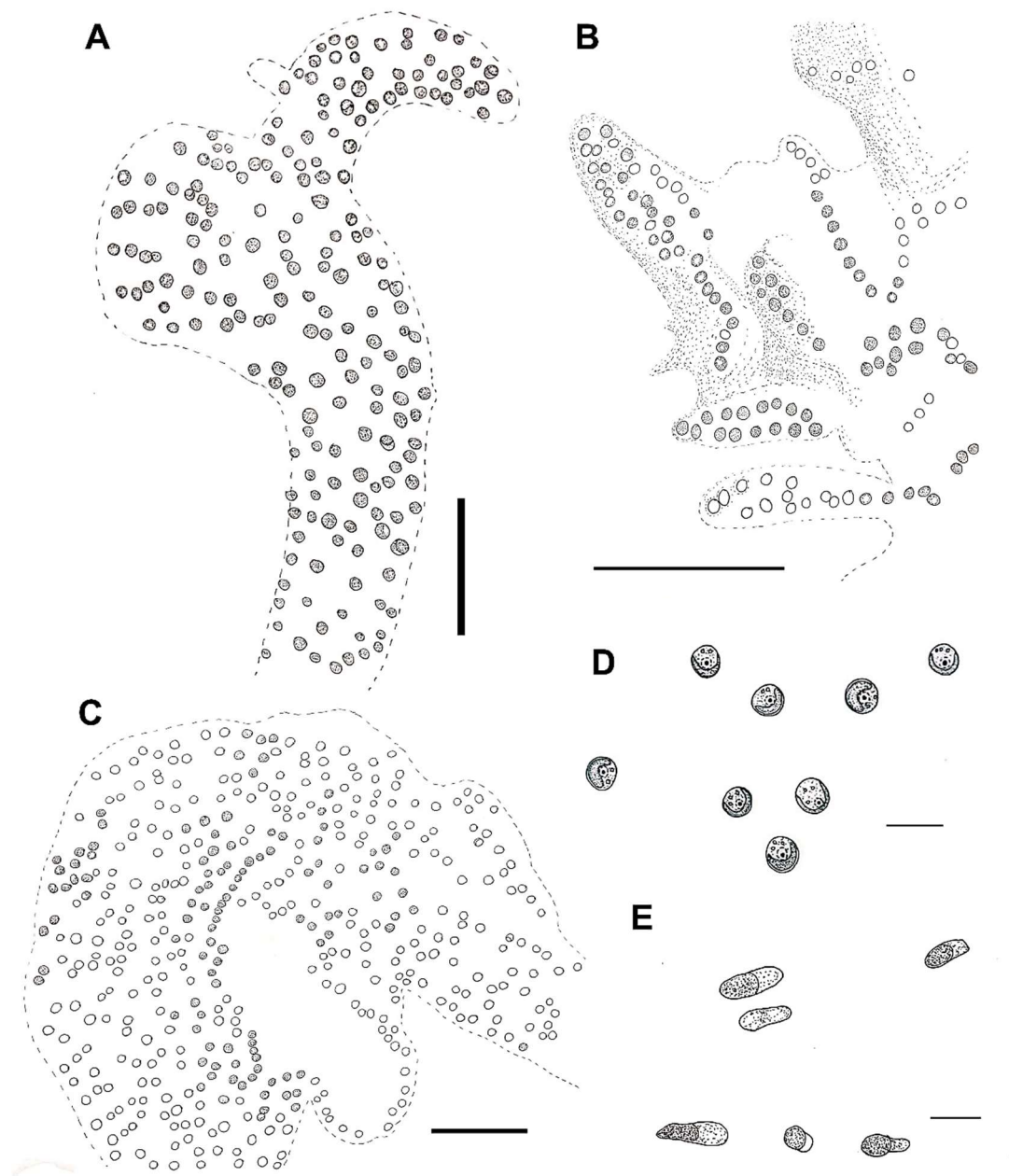
27°43.325' N and 91°49.631'E, S.K. Das, 12 March 2014, *Alg. 058* (Holotype CAL!.)

**Description:** Thallus was brownish green, thickly mucilaginous, up to 1 mm long and 0.3 mm wide. The mucilaginous colonies were cylindrical to irregular shape, having distinct linearly or palmately branched appearance, which were distinct near the point of adherence (Fig. 2A-B; 3A). However, no holdfast was observed. Sometimes interconnecting network-like appearance was also observed in the main branches with large vacuolar spaces within (Fig. 3C). Young colonies were thin, cylindrical with rounded tip and rarely two or single layer of cells (Fig. 2C-D; 3B). The gelatinous matrix have scattered cells (not so closely placed) arranged monostromatically. The widths of the main gelatinous branches were 58.3–116.8 µm and that of the finger-like projections were 22.7–34.2 µm. Cells were naked, irregularly spherical or oval, with 4.5–6.9 µm diameter or oblong-elliptical with 8.7–12.4 µm length and 3.0–3.8 µm breadth (Fig. 2E-F; 3D-E). Chloroplasts





**Fig. 2.** Light microscopic photographs of *Dermatochrysis himalayensis* sp. nov., **A-B.** Thallus structure showing branching appearance; **C.** Young colonies; **D.** Network-like colonies with large vacuolar spaces; **E-F.** Different shapes of cells. (Scale bar: Fig. 2A = 200 µm, B-D = 50 µm and E-F = 20 µm)



**Fig. 3.** Line drawings of *Dermatochrysis himalayensis* sp. nov., **A.** Thallus structure; **B.** Young colonies; **C.** Network-like colony showing vacuolar spaces; **D-E.** Different shapes of cells. (Scale bar: Fig. 3A-C = 50 μm and D-E = 20 μm)

were one or very rarely two, parietal. Stigma was absent. Contractile vacuoles present and their number varied from 2 to 3.

**Etymology:** The specific epithet is based on the name of the locality, the Himalayas.

**Ecology:** Occurred as greenish gelatinous bio-film on stones in the shallow water of the feeding stream to the lake. The pH of the habitat was 6.8 and temperature was 12.4 °C.

Absences of cell wall and stigma with presence of contractile vacuoles were the identifying features of the taxon under the genus *Dermatochrysis*. The overall morphological features of the species have resemblances to *Phaeosphaera indica* (Ramanathan) Bourrelly and *Dermatochrysis pseudofenestrata* (Table 1). *P. indica* was originally described by Ramanathan (1947) from India as a distinct genus and species, i.e. *Chrysodictyon indicum* Ramanathan. His description misinterpreted the



broken cell walls as cysts, which was later clarified (Lund, 1960). The most significant similarity of *D. himalayensis* with *P. indica* was the texture of young colonies, which were thin, cylindrical and single layer of cellular arrangement, but their placement was not exclusively central, with some parietal observations. Our species lacked any finger-like projections as observed in *D. pseudofenestrata* and also smaller cell size. *D. himalayensis* showed distinctness in thallus shape showing some prominent branching like appearance (lineate or palmate) and the shape of young thallus, which were not observed in any *Dermatochrysis* taxa. Due to these phenotypic peculiarities, the taxon can be considered as a new species, i.e. *Dermatochrysis himalyensis* S. K. Das, P. Basu & R. K. Gupta.

## ACKNOWLEDGMENTS

We are grateful to Director, Botanical Survey of India, Kolkata for providing laboratory facilities. We are also thankful to Dr. Lubomir Kovacik, Department of Botany, Comenius University in Bratislava, Slovakia and Ms. Marie Calátová, Centre for Algology, Institute of Botany, Czech Academy of Sciences for providing useful literatures. We also thank the authorities of Dept. of Environment & Forest, Arunachal Pradesh, for facilitating necessary permissions and helps during the field work.

## LITERATURE CITED

- Bischoff, H.W. and H.C. Bold.** 1963. Phycological Studies IV. Some soil algae from enchanted rock and related algal species. Univers. Texas Publ. no. **6318**: 1-95.
- Bourrelly, P.** 1957. Recherches sur les Chrysophycées. Morphologie, phylogénie, systématique. Thésis Présentées à la Faculté des Sciences de l'Université de Paris, Ser. A, no. 2704. no. d'ordinaire 3576, 417pp.
- Das, S.K.** 2015. Taxonomic study of the genus *Chamaesiphon* (Chroococcales: Cyanoprokaryota) reported from India with two new distributional records. Feddes Repert. **126**: 22-30.
- Das, S.K.** 2016. Floristic study of the algae under the ice covers in the alpine lakes of Arunachal Pradesh, India (Eastern Himalayas). Cryptogr. Biodivers. Assess. **1(1)**: 75-83.
- Das, S.K. and S.P. Adhikary.** 2012. Diversity of freshwater algae in Arunachal Pradesh and their distribution in different altitudes. J. Indian Bot. Soc. **91**: 160-182.
- Das, S.K. and S.P. Adhikary.** 2014. Freshwater algae of Eastern India. Astral International Pvt. Ltd., New Delhi. 453pp.
- Das, S.K., C. Radhakrishnan, J.P. Kociolek and B. Karthick.** 2018. Three new species of *Gomphonema* Ehrenberg (Bacillariophyta), from Eastern Himalayas, with a note on the unique girdle band structure. Nova Hedwigia **147**: 359-371.
- Das, S.K., S.P. Adhikary and L. Kovacik.** 2014. New distributional record of three coccal green algae (Chlorococcales, Chlorophyceae) from the alpine lakes of Eastern Himalayas, India. Nelumbo **56**: 286-290.
- Dhar, U.** 2002. Conservation implications of plant endemism in high-altitude Himalaya. Curr. Sci. **82**: 141-148.
- Entwistle, T.J. and R.A. Andersen.** 1990. A re-examination of *Tetrasporopsis* (Chrysophyceae) and the description of *Dermatochrysis* gen. nov. (Chrysophyceae): a monostromatic alga lacking cell walls. Phycologia **29(3)**: 263-274.
- Guiry, M.D.** in Guiry, M.D. and G.M. Guiry. 2019. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. <http://www.algaebase.org>; searched on 29<sup>th</sup> April 2019.
- Gupta, R.K., K.P. Singh and D.K. Singh.** 2002. Algae of the Mehao wildlife sanctuary, Arunachal Pradesh, India. Ann. For. **10**: 327-337.
- Lund, J.W.G.** 1960. Some new or rare Chrysophyceae from the English Lake District. Hydrobiologia **16(1)**: 97-108.
- Nicholls, K.H. and D.E. Wujek.** 2015. Chrysophyceae and Phaeothamniophyceae. In: Wehr, J.D., R.G. Sheath and J.P. Kociolek (eds.), Freshwater Algae of North America, Elsevier, USA. 1049pp.
- Pascher, A.** 1925. Die braune Algenreihe der Chrysophyceen. Arch. Protistenkunde **52**: 489-564.
- Ramanathan, K.R.** 1947. *Chrysodictyon indicum* gen. et sp. nov., a new member of the Chrysophyceae from South India. J. Indian Bot. Soc. **26**: 185-189.
- Reddy, P.M., D.D. Yumnam and T.Y. Imchen.** 1986. Investigations on the blue-green algae of North-east India: Distribution and habitat preferences. Phykos **25**: 148-158.
- Schmidle, W.** 1902. Notizen zu einigen Süßwasser-algen. Hedwigia **41**: 150-163.
- Singh, K.P. and R.K. Gupta.** 2000. A note on the algae from Apatani Valley, Arunachal Pradesh, India. Ann. For. **8**: 38-44.
- Singh, N.I., N.S. Singh, G.A. Devi and S.M. Singh.** 1997. Blue green algae from the rice growing areas of Arunachal Pradesh. Phykos **36**: 21-26.
- Takhtajan, A.L.** 1969. Flowering Plants: Origin and dispersal, Oliver & Boyd, Edinburgh. 310pp.
- Tschermak-Woess, E.** 1980. Zur Kenntnis von *Tetrasporopsis fuscescens*. Plant Syst. Evol. **133(3-4)**: 121-133.