



FOSSIL *SCYTONEMA* (NOSTOCALES) FROM THE SUBATHU FORMATION OF TAL VALLEY, GARHWAL HIMALAYA, INDIA

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ABSTRACT

Fossilised filaments of the cyanobacterium *Scytonema* (Nostocales), viz., *Palaeoscytonema* Edhorn, 1973 were recovered from the early Ypresian sediments of the Subathu Formation of Tal Valley, Garhwal Himalaya, Uttaranchal. This is the first record of this cyanobacterium from the Indian Tertiary rocks. Two species, viz. *Palaeoscytonema talensi* n. sp. and *Palaeoscytonema eocaenicus* n. sp. are proposed as new. An attempt has also been made to throw light on the palaeoenvironmental significance of these taxa based on the distribution of modern *Scytonema*.

INTRODUCTION

Scytonema is a filamentous cyanobacterium of the order Nostocales and is capable of forming aegagrophilous balls in shallow-water environment. In spite of the fact that a large number of species of *Scytonema* are widely distributed in various types of environments, fossil records of this cyanobacterium from the Indian sedimentary rocks are scant (Goswami, 1955; Maithy and Shukla, 1977 and Mandal, Maithy, Barma and Verma, 1984). The present paper records *Scytonema* for the first time from the Indian Tertiary rocks. Fossil filaments of *Scytonema*, viz., *Palaeoscytonema* Edhorn, 1973 were recovered from the basal beds of the Subathu succession (early Ypresian), exposed near the village Bidasini in Tal Valley, Garhwal Himalaya, Uttaranchal (fig. 1). In this communication, two species of fossil *Scytonema* viz. *P. talensis* n. sp. and *P. eocaenicus* n. sp. are described and illustrated. Palaeoenvironmental significance of these taxa has also been pointed out.

GEOLOGICAL SETTING

The Subathu succession in this region rests unconformably over the Shell Limestone Formation (Nilkanth Formation). The general stratigraphy of the Bidasini area in Tal Valley is given in table 1.

The Subathu Formation in this area consists of silty shales, oyster-bearing limestones, green and purple splintery shales which were deposited during the transgressive phase of the Subathu epicontinental

Table 1: Stratigraphic set-up in Tal Valley, Garhwal Himalaya (modified after Mathur and Juyal, 2000).

Lithounits	Age	Lithological characters
Garhwal Group	Precambrian	Phyllite
----- Thrust Contact -----		
Subathu Formation	Ypresian	Calcareous shales, nummulitic limestone, grey-olive green siltstone, mudstone.
Kakara Formation	Late Thanetian	Carbonaceous shale, siltstone, limestone
----- Unconformity -----		
Shell limestone Formation (Nilkanth Formation)	Late Cretaceous	Oolitic, Shelly limestone

sea. Samples were collected from about 10 m thick silty shale horizon of a 30 m thick stratigraphic section of the Subathu Formation (late Thanetian-late Ypresian). The section is well exposed near the village Bidasini in Tal Valley, Garhwal Himalaya, Uttaranchal (fig. 2). The silty shale consists of centimeter scale alternation of dark grey and brown coloured horizons in which the dark grey horizon shows millimeter scale light and dark laminae. Fossil cyanobacteria were recovered from the dark laminae of the grey-coloured horizon. It consists of dense fibriller network of filaments of *Palaeoscytonema* and nodular colonies of *Gloeocapsomorpha prisca*. The light-coloured laminae are rich in silt-sized clastic substances.

Samples were processed using standard

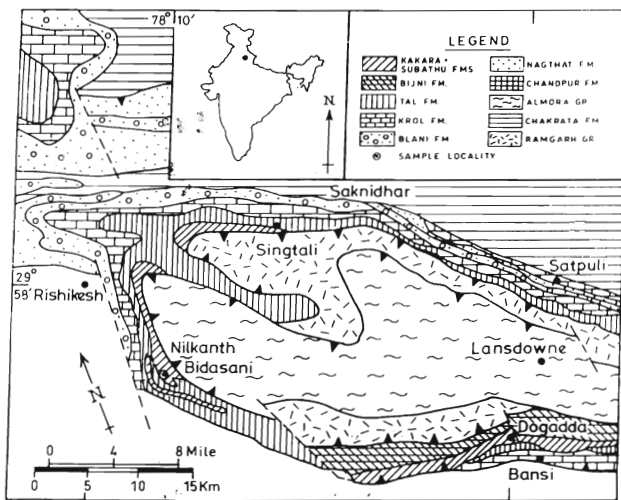


Fig. 1. Map showing the location of the area (after Valdiya,1980).

palynological procedures. The fossils were recovered from the dark brown laminae of laminated shales. Several thin sections were also studied for morphological interpretations. The sediments which yielded *Palaeoscytonema* are dated as the early Ypresian on the basis of foraminifera (Mathur, 1977). The slides are deposited in the repository of the Museum, Birbal Sahni Institute of Palaeobotany, Lucknow.

SYSTEMATIC DESCRIPTION

Kingdom **Prokaryotae**

Division **Gracilicutes**

Class **Oxyphotobacteria**

Order **Nostocales**

Family **Scytonemataceae**

Genus ***Palaeoscytonema*** Edhorn, 1973

(Type species: *P. moorhousei* Edhorn, 1973)

Palaeoscytonema talensis n. sp.

(Pl. I, figs. 3-4)

Holotype: Fig. 4, Size-200 μ m, Regd. Slide no. 12240, coordinates- 134.6x14.2.

Type locality: Bidasini River Section, Tal Valley, Uttaranchal, India.

Horizon and Age: Subathu Formation, early Ypresian.

Diagnosis: Filamentous, trichome straight, falsely branched, firm sheath, thick parallel laminations in sheath.

Description: Filamentous, individual filament up to 225 μ m long, 10-15 μ m broad, falsely branched, trichome sheathed, sheath 3-6 μ m thick, firm parallel laminations present, individual cells rectangular, trichome tubular, constricted at some places, septa distinct, thin, surface scabrate, heterocyst not clearly visible, hormogones present, round - quadrate.

Comparison: *P. talensis*, n. sp. is very distinct and differs from other known species of *Palaeoscytonema* by its very thick sheath which possesses firm parallel laminations.

Etymology: This species is named after Tal Valley, from where it has been recorded in this study.

Palaeoscytonema eocaenicus n. sp.

(Pl. I, figs. 5-6)

Holotype: Fig. 5, size 110 μ m Regd. Slide no. 12239, coordinates- 134.2x13.5.

Type locality: Bidasini River Section, Tal Valley, Uttaranchal, India.

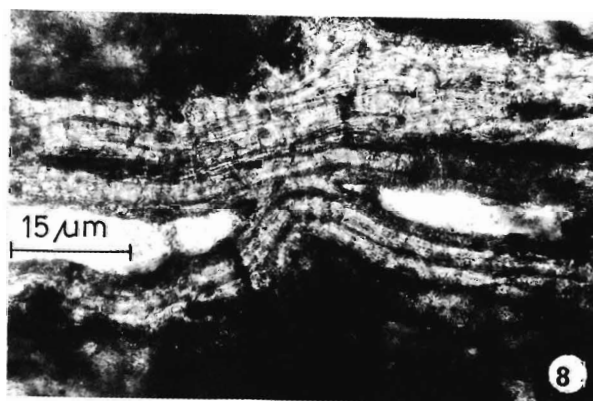
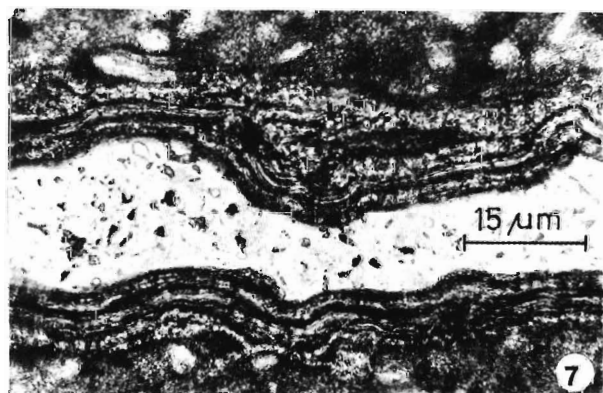
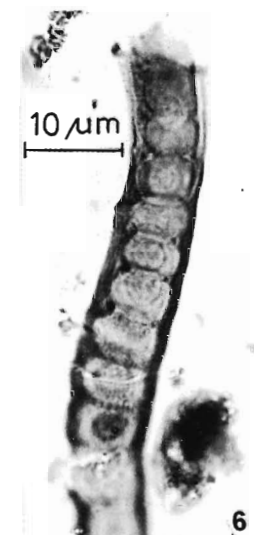
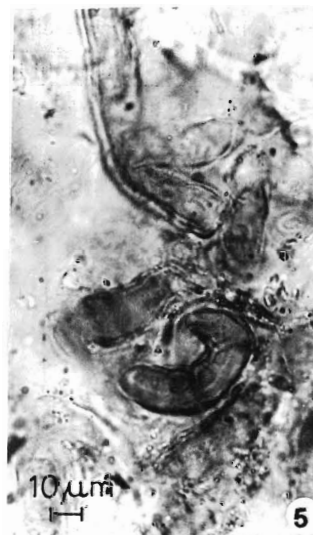
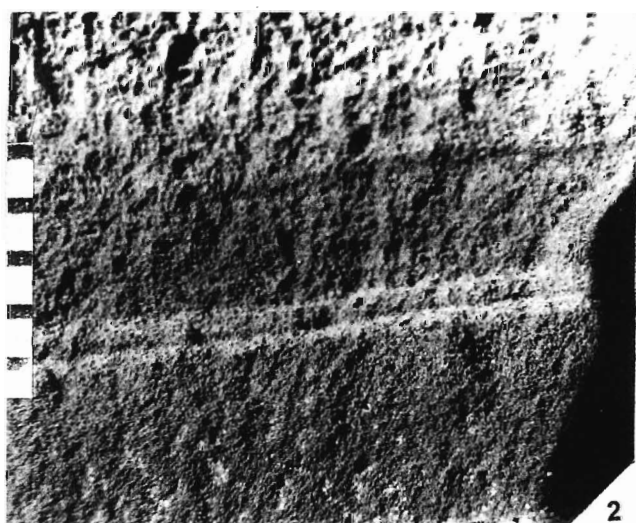
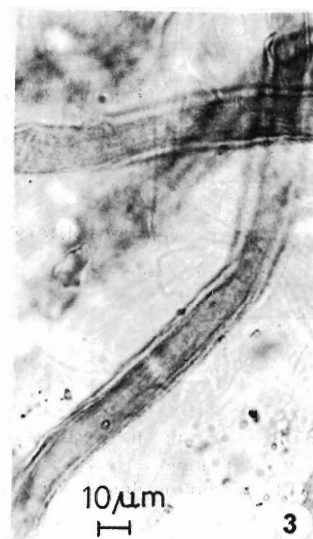
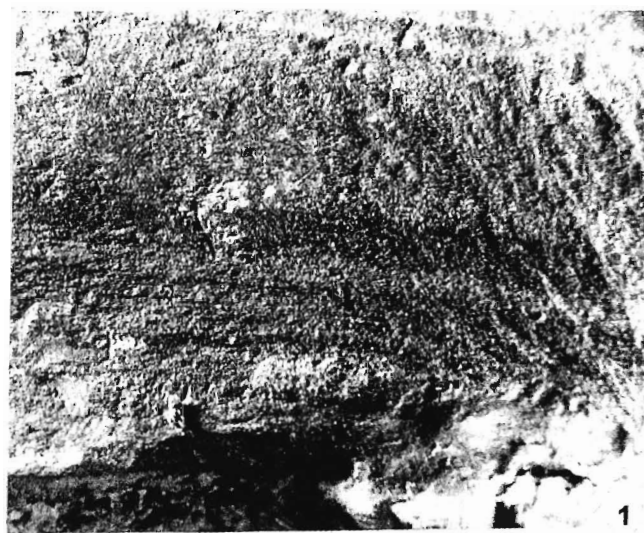
Horizon and Age: Subathu Formation, early Ypresian.

Diagnosis: Filamentous, trichome curved, undulated and long, falsely branched.

EXPLANATION OF PLATE I

- 1&2. Photomicrographs showing alternation of light and dark laminae of laminated shales.
3. *Palaeoscytonema talensis* n. sp., BSIP slide no 12240, co-ordinates -134.6x14.2.
4. *Palaeoscytonema talensis* n. sp., (Holotype) BSIP slide no 12240, co-ordinates -134.6x14.2.
5. *Palaeoscytonema eocaenicus* n. sp. (Holotype) BSIP slide no

- 12239, co-ordinates -134.2x13.5.
6. *Palaeoscytonema eocaenicus* n. sp. Showing serially arranged hormogones, BSIP slide no 12239, co-ordinates -134.2x13.5.
- 7-8. Thin sections of the laminated shale showing horizontally oriented filaments of *Palaeoscytonema* spp., BSIP slide no 12241, co-ordinates -143.2x16.8 & 141x23.5.



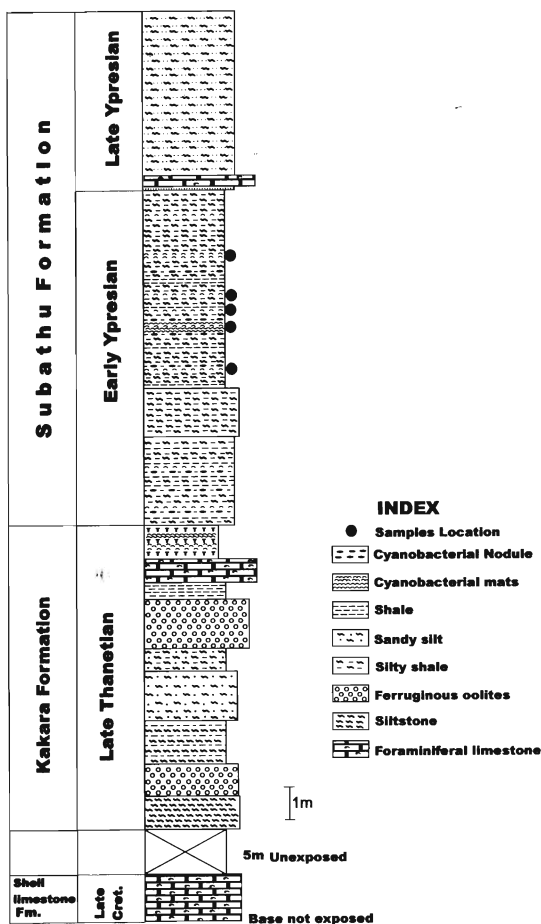


Fig.2. Litholog of the Tal valley succession showing location of the samples (modified after Mathur, 1977).

Description: Filamentous, individual filament up to 120 μ m in length, 8-10 μ m broad, falsely branched, false branches lateral, slightly narrow, 6-8 μ m broad, trichome long, tubular, sheath very thin, 1.5-2 μ m in thickness, individual cells subspherical, short, wall smooth, thin, 0.5-1 μ m thick, septa thin, branches swollen at the tip, hormogones present, 10-12 in numbers, serially arranged, heterocyst visible.

Comparison: *P. eoceanicus* differs from the other known species of *Palaeoscytonema* in possessing tubular trichomes with subspherical serially arranged hormogones.

Etymology: This species is named after the Eocene Epoch as it occurs in the horizon of Eocene

age in the study area.

Remarks: Trichomes of *Palaeoscytonema* described here closely resemble the description of several modern species of *Scytonema*, viz. *S. simplex*, *S. pseudoguyanense* Bharadwaja, *S. malaviyaensis* Bharadwaja, *S. chiasteem* Geitler, etc (Desikachary, 1959). Most of the species are very similar to each other in size range, trichome character, false branching and presence of lamellated sheath. It is very difficult to assign these fossil forms with certainty in any known modern species of *Scytonema*; therefore, we have accommodated these fossil forms in two new species, viz. *P. talensis* n. sp. & *P. eoceanicus* n. sp.

DISCUSSION

The family Scytonemataceae is an important family of Cyanobacteria and belongs to the order Nostocales. Based on the trichome, sheath and heterocysts, eight genera have been recognised in the family, viz., *Pseudoscytonema*, *Plectonema*, *Hydrocoryne*, *Scytonematopsis*, *Petalonema*, *Camptylonemopsis*, *Scytonema* and *Tolypothrix* (Deshikachary, 1959). Among these genera *Scytonema* and *Tolypothrix* are very closely related in having false branching pattern. However, both the genera can be separated on the basis of predominance of geminate or single branched trichome character. Bharadwaj (1933) suggested that the genus *Scytonema* should be restricted to the forms characterised by the presence of falsely-branched trichome, single or geminate. False branching, firm sheath and hormogones are some of the important characters which help in identifying this cyanobacterium in fossil forms. Very little is known about its fossil history from the Indian sedimentary rocks. Goswami (1955) for the first time reported two empty sheaths of geminate branches of fossil *Scytonema* from an undated lignite sample of the Karewa beds of Jammu and Kashmir. Later on, it has been reported from the Suket shales of Rampura (Late Precambrian), Madhya Pradesh (Maithy and Shukla, 1977) and Kushalgarh Formation (Precambrian) exposed near Delhi (Mandal *et al.*, 1984). Therefore, the present recovery of well preserved *Scytonema* fossil remains is very significant, as it will fill the gap in our

knowledge of its distribution in the geological successions. It also throws light on the environment of deposition in the area of investigation. *Scytonema* is represented in India by 40 extant species. It occurs in varied environmental conditions, such as in soils as calcium incrustation (Pia, 1934), in aegagrophilous balls of Cyanobacteria in the shallow-water environments (Nauman, 1925), in association with Lichens (Desikachary, 1959) and as building blocks of stromatolites (Flügel, 1982). It also shows a tendency to form laterally entangled accumulations at the margin of algal mats (Monty, 1965). Ecological preference of this cyanobacterium is shallow-water environments of restricted marine bays, lagoons and tidal flats close to freshwater interior (Wilson, 1975; Flügel, 1982).

The occurrence of *Palaeoscytonema* in association with colonies of *Gloeocapsomorpha prisca* (Zalesky, 1917) showing affinity to *Entophysalis* in the lower horizon of the Subathu succession clearly indicates that these sediments were probably laid down in a tropical, intertidal-supratidal zone during the initial phase of transgression of the Subathu epicontinental sea in this area. Well-preserved trichome, parallel laminations in the sheath as well as hormogones of *Palaeoscytonema* clearly indicate a favourable environment of fossilisation during the deposition of these rocks. We are of the opinion that warm and humid climate and reducing environment are the two major factors that provided ideal conditions for the growth and preservation of this cyanobacterium in the Subathu sediments.

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