A NOTE ON THE NATURE OF STROMATOLITES OF KROL SEDIMENTS, NAINITAL, KUMAUN HIMALAYA, WITH SPECIAL REFERENCE TO *CONOPHYTON*

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ABSTRACT

Re-evaluation of the stromatolites from Krol sediments of Nainital area confirms the presence of Proterozoic form-genus, *Conophyton*. The branching columns, earlier described as *Baicalia* by SINGH AND RAI (1977), do show characteristics of Tungussida Supergroup, but are probably new form-genera. The nature of laminae of these columnar stromatolites and non-columnar algal structures suggests a latest Proterozoic age (late Vendian) to the Krol sediments.

INTRODUCTION

FUCHS AND SINHA (1974) recognized branching stromatolites from the Upper Krol sediments of Nainital area. Later, SINGH AND RAI (1977) discussed that the Upper Krol sediments of Nainital represent dominantly algal mat deposits with a few horizons showing columnar stromatolites of Riphean affinity, namely *Conophyton garganicus*, *Baicalia baicalica* and *Colonella* sp. The palaeo-environment of these algal mat successions is discussed by SINGH AND RAI (1980). This record of columnar stromatolites showing Riphean affinity (SINGH & RAI, 1977) led to the controversy of the age of Krol sediments which was pulled down from a traditionally presumed Mesozoic age to late Precambrian.

Lately, A. KUMAR (1980, 1981) recorded some stromatolitic structures and considered them to be typically of late Palaeozoic (Carboniferous-Permian) age. A. KUMAR (1981) questioned the identification of *Conophyton* of SINGH AND RAI (1977); VALDIYA (1980) also refuted stromatolite identification of SINGH AND RAI (1977), though they did not give any reasons in their publications as to why the identification of SINGH AND RAI (1977) are wrong.

During a visit by Madam M. E. RAABEN in April, 1982 to the Lucknow University, the present author had an opportunity to show and discuss with her the stromatolites from Krol sediments of Nainital area. She gave following comments on the stromatolites of Krol Formation :

"Evidence now available indicates that the possibility of a Precambrian (uppermost Precambrian ?) age for the Krol stromatolite-bearing beds cannot be excluded. Suggestive in this aspect is the presence of *Conophyton* Maslov in the beds (collection I. B. SINGH, Lucknow University). *Conophyton*, upto now, is known in Proterozoic only. The form-species in Krol is not *C. garganicus*. It seems to be a new one. A very low rate of thickening of the lamina in the axial zone as well as peculiarities in the texture of the lamina have to be noticed.

Columnar branching structures in Krol stromatolite-bearing beds do not belong to *Baicalia* or to any other Riphean form-genus and affinities to Phanerozoic (Cambrian and Ordovician mostly) stromatolites are seen in the shape and especially in the inner

structure of the columns and also in lamina texture. The outlook of some of this branching structures is slightly reminiscent of the Tungussida Supergroup (*sensu lato*), but the mode of branching has to be studied more in detail. As to the non-columnar stromatolites of Krol the morphology of the structures is not suggestive of any definite age, and the microstructures have not yet been studied.

The Krol assemblage as a whole cannot be compared to any other stromatolitic assemblage known in Lesser-Himalayas nor in the Vindhyan or the Riphean. It will be of interest to try a comparison with some assemblages of late Precambrian-Lowermost Cambrian age; the study of such assemblages now is on its starting point."

In the light of above comments, a latest Proterozoic (late Vendian) age for the Krol sediments seems to be reasonable.

A. KUMAR (1980) described a few stromatolitic structures from the Krol sediments of Nainital and gave new formal names (*Crossia, Krolia, Nainitalia,* and *Plumia*) without adequate description and comparison with the existing form genera (for detailed comments see SINGH, 1981). In another paper (A. KUMAR, 1981), the same forms are given informal names, viz. type A, B, C, and D. *Crossia* and *Nainitalia* (A. KUMAR, 1980), Type A stromatolite (A. KUMAR, 1981), branched stromatolites of FUCHS AND SINHA (1974), and *Baicalia baicalica* of SINGH AND RAI (1977) are the same, and are now tentatively put under supergroup Tungussida, and it is most probably a new form. The other forms described by A. KUMAR (1980), namely *Krolia, Plumia,* are most likely individual algal growth-forms related to the environmental conditions, as these forms occur only individually.

Plate 1 shows transverse and longitudinal sections of the *Conophyton*, branched columnar stromatolites, and linked columnar stromatolite. In the following account the *Conophyton* is redescribed.

DESCRIPTION

Supergroup—CONOPHYTONIDA

Group—**Conophyton** Maslov, 1937 emend. Komar, Raaben & Semikhatov, 1965.
Pl. 1 Figs. 1-4

The columns occur in a colony within a well-defined horizon where 8 individuals could be recognized. The columns are erect without any ramification, and closely spaced. Individual columns are conical to subcylindrical in shape, ranging in height from 10-25 cm, and vary in average diameter from 4-12 cm. The outer margin of the columns shows irregular, knobby appearance with minute bulges. The cross-sectional shape is circular to elliptical.

The laminae of the columns are mostly wavy to undulatory, wrinkled but continuous showing only slight thickening in the central part of the column. Nevertheless, the central axial zone showing thickening and contortion of laminae is well defined and rather broad (1-2 cm) in relation to the total width of the column. The axial zone shows a prominent tapering tendency upwards with displacement in the apical line. Mostly axial zone shows large vugs filled with sparry dolomite. The marginal laminae show a pronounced undulatory growth pattern, made up of alternating light and dark-coloured laminae. The dark-coloured laminae are sometimes streaky in nature and mostly less than 1 mm thick. The light-coloured laminae are mostly 1-2 mm thick, rather continuous, showing occasional subspherical thickening. Within the marginal laminae there are number of small fenestrae and vugs filled with sparry dolomite.

Remarks—The conical columnar stromatolites of Krol sediments show all the basic features of the group *Conophyton* Maslov, but does not compare well with any of the known forms of *Conophyton* (KOMAR, RAABEN & SEMIKHATOV, 1965). Earlier, SINGH AND RAI (1977) described this *Conophyton* as *Conophyton garganicus*. However, a restudy of this material suggests that it differs from *C. garganicus* in possessing a very low rate of thickening of laminae in axial zone.

Peculiarities of the form described above are : strongly wrinkled and undulatory character of laminae, presence of a broad axial zone, and a very low rate of thickening of laminae in the axial zone. It seems to be a new form of *Conophyton*, though at present no new name is being proposed.

The group *Conophyton* is restricted to only Precambrian and is not known from Phanerozoic rocks, although at present it is being formed under very specific conditions in Yellowstone National Park. WALTER *et al.* (1976) express the opinion that for the development of *Conophyton* quiet-water environments, largely free of grazing animals, are required; with the advent of grazing animals at the end of Precambrian, growth conditions for *Conophyton* became very unstable.

DISCUSSION

At this point, it is significant to mention that AZMI *et al.* (1981) recorded an assemblage of conodonts and suggested Cambro-Ordovician affinity for the Lower Tal phosphorite unit of Mussoorie, a lithounit immediately overlying the Upper Krol sediments containing late Vendian stromatolite assemblage in Nainital. Many of the so-called annelid-remains reported by SINGH AND SHUKLA (1981) from Tal phosphorite unit show strong resemblance with the conodonts recorded by AZMI *et al.* (1981), while others are some indeterminate forms. SINGH AND SHUKLA (1981) have not mentioned whether these fossils are made up of phosphate or chitin (worm remains are made up of chitin). As cited by AZMI *et al.* (1981) in the postcript, Prof. V. A. KRASHENINNIKOV, USSR also recovered conodonts from the same locality of Lower Tal phosphorite and suggested lower part of Lower Cambrian affinity; further Dr. MISSARZHEVSKIY AND DR. DOUBININA express the opinion that the conodonts of Lower Tal show deep inner cavities which is characteristic of ancient conodonts (so-called Protoconodonts).

In view of the above, it is suggested that Krol Formation represents deposits of latest Precambrian (Vendian), while Tal sediments probably extend into Cambrian. However, pending record of definite Cambrian faunal assemblage, the age of Tal Formation should be considered as latest Precambrian (Vendian).

It is proposed here that the Lesser Himalayan succession encompasses a rather complete record of late Proterozoic sediments; the Shali, Deoban belts representing the Lower and Middle Riphean deposits, while the Krol belt represents deposits of Upper Riphean-Vendian. The fossiliferous units of early Permian, late Cretaceous, and late Palaeocene-Eocene ages, interspersed within the Lesser Himalaya, represent deposits of three short-lived transgressions on the late Precambrian basement, as already discussed by SINGH (1976, 1979, 1981).

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EXPLANATION OF PLATE

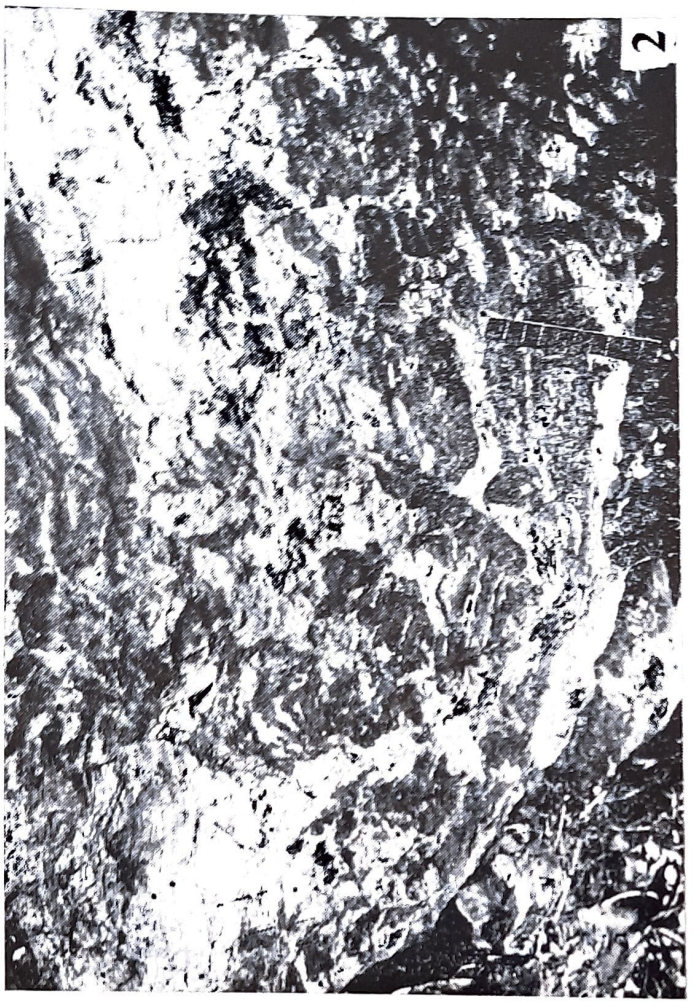
PLATE 1

1. Linked columnar stromatolite showing prominent V-shaped laminae in the trough, and rounded nature of laminae in the column. The lamination is rather continuous. Upper Krol sediments, Kaladungi road, Nainital. Length of scale=2 cm.

2. Branched, columnar stromatolites resembling the stromatolites of Tungussida Supergroup. Upper Krol sediments, Tallital-Tiffin top section, Nainital. 1 div. of the scale=1 cm.

3. Axial (longitudinal) section of *Conophyton* showing a prominent broad axial zone. The rate of thickening of laminae in the axial zone is very low. The marginal laminae show strong irregularities and undulations in the growth pattern. The light coloured laminae are thicker than the dark-coloured laminae, which may be streaky. The axis of axial zone shows displacements. Upper Krol sediments, Kaladungi road, Nainital. Magnification approx. ×1.

4. Transverse section of *Conophyton* showing about 2/3 part of the column. In the lower part axial zone is clearly visible. The laminations are elliptical and exhibit strongly undulatory and crenulated character. Some vugs and fenestrae filled by clear sparry dolomite are also present. Upper Krol sediments, Kaladungi road, Nainital. Magnification ×2.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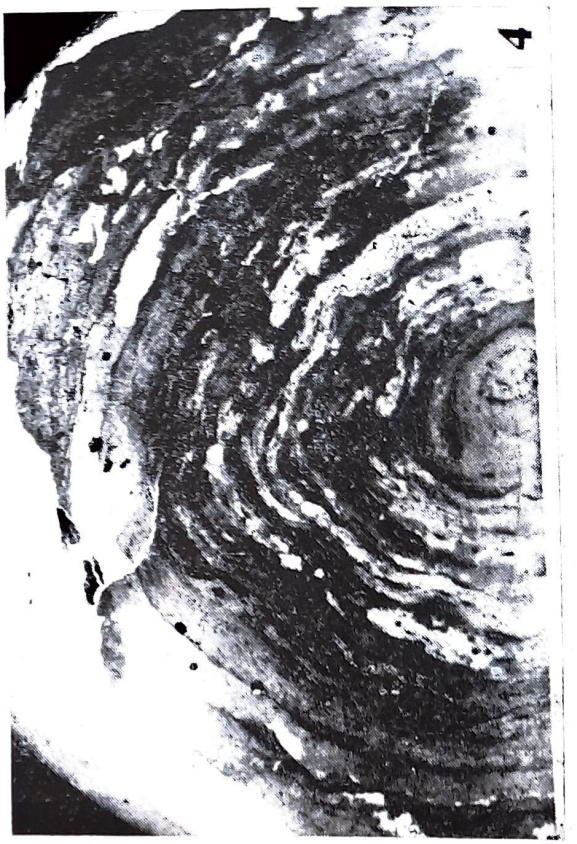
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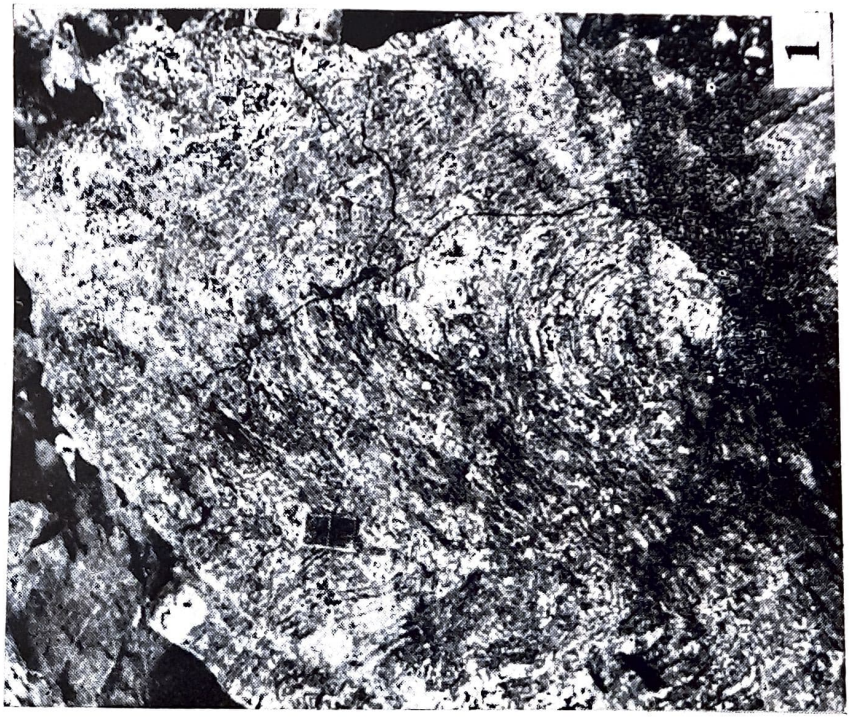
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