

PALEODICTYON AND CHONDRITES FROM TAKCHE FORMATION (ORDOVICIAN — ? LOWER DEVONIAN), SPITI VALLEY, HIMACHAL PRADESH, INDIA.

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ABSTRACT

Trace fossils *Paleodictyon* sp., *Chondrites* sp. cf. *C. type A* Pickerill, Fillion & Harland, and *Chondrites* sp. type *C* Osgood are recorded and described from the Takche Formation (Ordovician — ? Lower Devonian) exposed at Muth in the Pin river and Gechang in the Parahio river sections, Spiti, Himachal Pradesh, India.

Chondrites sp. cf. *C. type A* was considered to be a plant fossil possibly a psilophytean remain in the previous literature.

INTRODUCTION

During the course of studies in the Late Precambrian - Cambrian succession in the Spiti Valley, Himachal

Pradesh, India, in the summers of 1979, the opportunity was availed to examine the Ordovician - ? Devonian

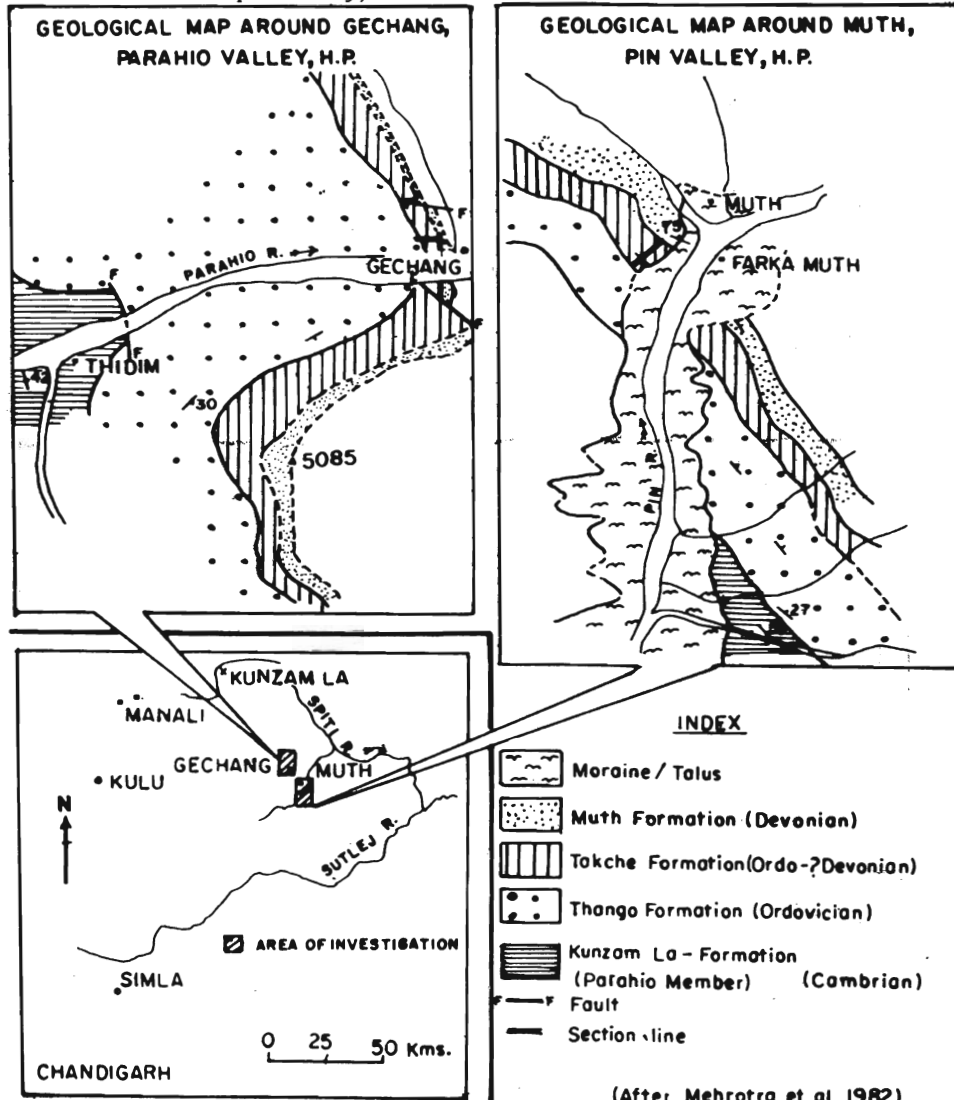


Fig. 1. Location and geological map of part of the Pin and Parahio valleys, spiti (after Mehrotra et al. 1982).

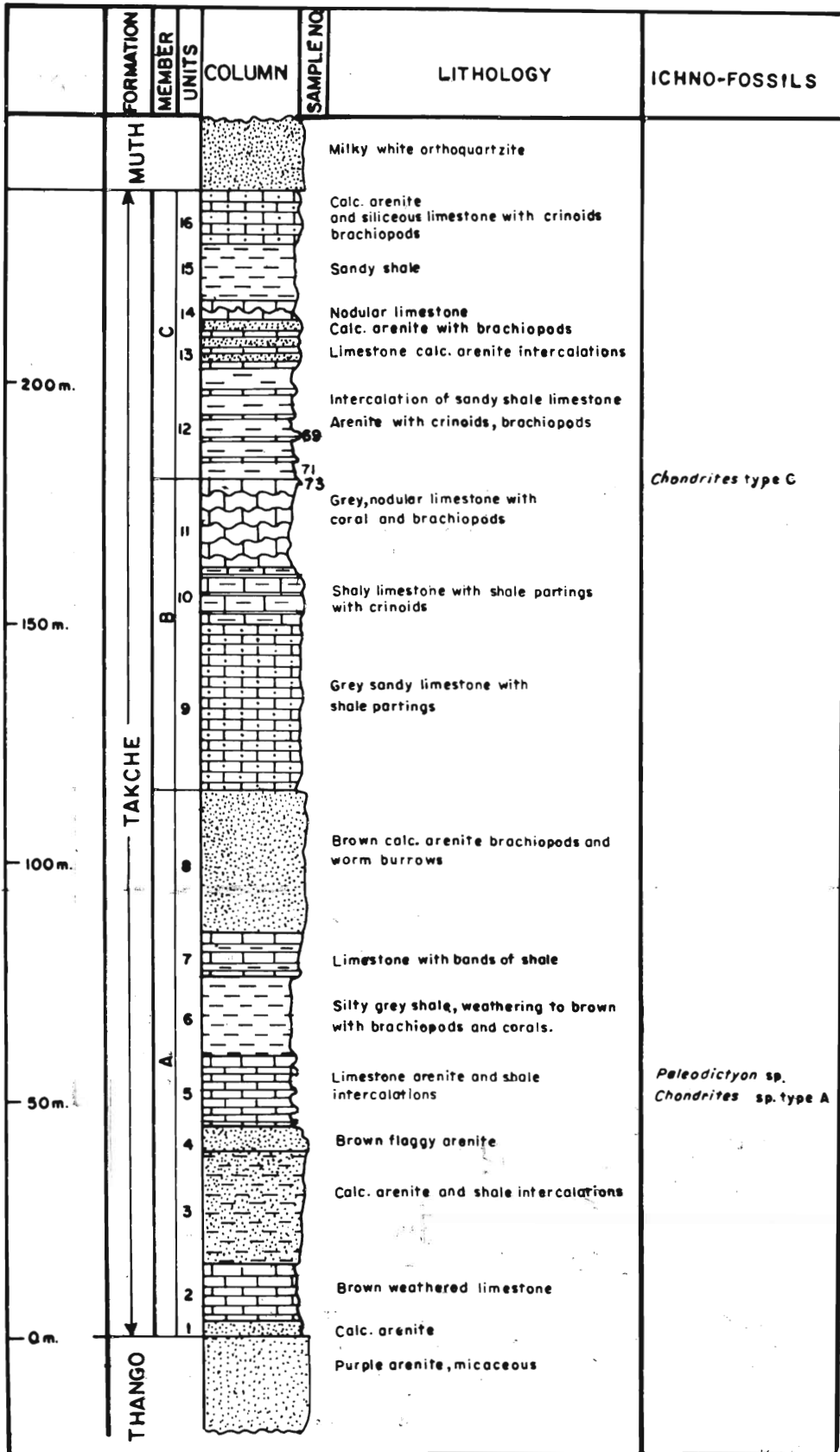


Fig. 2. Generalised lithocolumn of the Takche Formation, Pin and Parahio river sections showing trace fossil-bearing horizons.

succession constituting the Thango and Takche Formations (Srikantia, 1981) well exposed at Muth in the Pin river and at Gechang in the Parahio river sections (Fig. 1). In addition to collection of large number of mega-fossils, trace fossils were also collected from the Takche Formation which are described here.

GEOLOGICAL SETTING

In the Spiti Valley, Himachal Pradesh, India, two contrasting lithological successions occur between the underlying fossiliferous Cambrian Parahio Member of the Kunzam La Formation (Bhargava *et al.* 1982; Kumar *et al.* 1984; Parahio series, Hayden, 1904; Pascoe, 1959) and the overlying Muth Formation. Of these, the lower succession made up of red to purple coloured conglomerate and quartzite, unfossiliferous in nature, constitutes the Thango Formation (Srikantia, 1981; Shian quartzite, Goel & Nair, 1977). It rests over the Parahio Member with an angular unconformity and is conformably overlain by the upper sequence the Takche Formation (Srikantia, 1981; Pin limestone, Thanam limestone etc.; Goel & Nair, 1977), which is easily recognisable in field due to its rusty brown colouration on weathered surfaces. The Takche Formation is about 245 m thick. It has been classified by Kumar (in Mehrotra *et al.* 1982) into three members, viz. A, B. and C (table 1). Of these, members A and B were considered to be Ordovician in age whereas the Member C was assigned to Silurian on the basis of fauna (Hayden, 1904; Reed, 1912; Pascoe, 1959; Goel & Nair, 1977). Srikantia (1981), however, considered the entire succession of the Takche Formation to be Upper Silurian to Lower Devonian in age. The find of chitinozoa from members B and C (Mehrotra *et al.*, 1982) did not support this age assignment but favoured the Ordovician age for the members A and B as originally given by Hayden (1904) and Reed (1912), and suggested the Ordovician-Silurian boundary to lie within the basal part of Member C.

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Table 1. Lithostratigraphy of the Takche Formation after Kumar (in Mehrotra *et al.* 1982.)

Member	Lithology	Age
C	Intercalations of limestone, shale and arenite	Silurian to lower Devonian
B	Limestone with parting of shale	Ordovician
A	Alternations of limestone, calcareous arenite and shale	

The record of the trace fossils is from unit 5 of Member A and unit 12 of Member C of the Takche Formation (Fig. 2). The trace fossils identified are *Paleodictyon* sp., *Chondrites* sp. cf. C. type A Pickerill, Fillion & Harland from Member A, and *Chondrites* sp. type C Osgood from the Member C.

SYSTEMATIC DESCRIPTION

Ichnogenus: *Paleodictyon* MENEGHINI IN MUCHISON, 1850

Paleodictyon sp.

(Plate I—3 & 4)

Pasceolus mellifuus (Salter) and *P. shianensis* Reed, Reed, 1912, PL. XVI, Fig. 13-16.

Material: Several specimens along bedding planes in calcareous grey micaceous siltstone. (rusty brown on weathered surfaces). It occurs in association with *Chondrites* sp. of C. type A Pickerill, Fillion & Harland, brachiopods and crinoid stems in the Unit 5 of Member A.

Description: It is honeycomb-like geometrically regular fine net-work of ridges in hyporelief on convex surfaces having maximum diameter 2.5 cm. The diameter of the meshes varies from 0.5 mm to 1.5 mm but is constant within an individual net in most of the cases. Walls/ridges of the meshes are very fine.

Remarks: *Paleodictyon* is a long ranging form recorded from Cambrian to Tertiary. It has variously been interpreted as algae, sponges, corals, bryozoans, spawn of fishes or molluscs or even inorganic in nature. Recently, Kushlin (1982) has shown it to be of algal nature and has argued for its occurrence in shallow depths as against deep water flysch deposits.

Ichnogenus: *Chondrites* VON STERNBERG, 1833
Chondrites sp. cf. C. type A Pickerill. Fillion & Harland (Plate I—1)

'*Bythotrephis*' aff. *gracilis* Hall, Reed, 1912, Pl. XVII, Fig. 1; B. aff. *succulens* Hall, Reed, 1912, Pl. XVI, Figs. 21 & 22)

Material: Several specimens occurring as slender marking on bedding surfaces in association with *Paleodictyon* in Unit 5 of Member A.

Description: It occurs as short, 5mm wide and upto 1.5 cm long impressions of outer surfaces of tubes coated with brown oxide of iron. The fill material is of the same composition as the host rock and that is why on breaking only the outer brown coated part is more conspicuous and leaves behind impressions. These impressions either show some linear arrangement, i.e., long axes arranged parallel or haphazardly arranged. Some of the impressions are club-shaped with occasional long drawn base. Some are of varied size showing branching. Several specimens show unbranched longitudinal lines/rays, occasionally strong, on surface.

Remarks: The present specimens appear to 'Bythotrephis' aff. *succulens* Hall described by Reed (1912, Pl. 16, Figs. 21 & 22), though not so well preserved and do not show clear branching. The two specimens of *Bythotrephis* figured by Hall (1847), according to Fillion and Pickerill (1984), are morphologically separate, one is akin to their *Chondrites* sp. type A and the other falls within *Clematschina* as defined by Wilson (1948). The present specimens bear more resemblance with *Chondrites* sp. type A Pickerill, Fillion & Harland recorded from middle Ordovician Trenton Group, eastern Canada (Pickerill, Fillion & Harland, 1984; Fillion & Pickerill, 1984). It also resembles *Chondrites* sp. described by Hantzschel from the Upper Cretaceous (in Hantzschel, 1975; fig. 32, 1 e).

Chondrites sp. type C OSGOOD, 1970
(Plate I—3)

Material: Two specimens from calcareous arenite unit 12 of Member C (sample No. 71). It occurs in association with brachiopods.

Description: It consists of small cylindrical tubes branching in irregular pattern; the angle of branching varying from 25° to 45°. The individual tube/tunnels of different systems cross each other and vary in diameter upto 2 mm which remains constant within entire tunnel system.

Remarks: The present form of *Chondrites* resembles in all respects with the *Chondrites* sp. type C Osgood reported from the Upper Ordovician Whitewater beds, Cincinnati, U.S.A. (Osgood, 1970).

DISCUSSION

Hayden (1904) recorded some doubtful plant remains and fossils of 'doubtful biological position' from the horizon 'e' of Ordovician (Unit 5 of Member A, Takche Formation, Mehrotra *et al.* 1982) exposed near Shian and Muth in the Pin river section, Spiti, overlying the red conglomerate and quartzite (Thango Formation, Srikantia, 1981). These fossils were assigned respectively to genus 'Bythotrephis' Hall (*Bythotrephis* aff. *succulens* and *B.* aff. *gracilis*) and *Pasceolus* Billings (*Pasceolus melliformis* Salter) and *P. shianensis* Reed by Reed (1912). These 'plant remains' were later considered to be possible psilophyte remains by Sahni (1953) whereas Maithy (1974) opined them to be remains of lower group of plants. These fossils occur in association with marine fossils such as brachiopods (*Orthis*), *Rafinesquina cratera* (Salter), trilobites (*Lichas* sp.) and crinoid stems (Pascoe, 1959), and do not show such characters as xylem, epidermis with stomata etc. to put them in psilophytalean remains. These, on the other hand, compare very much with ichnofossils referable to *Chondrites* von Sternberg - the feeding burrows of worms found in varied environments and having a long

range from Cambrian to Tertiary.

In the present collection there are two species of *Chondrites*, one resembling *Chondrites* sp. type A Pickerill, Fillion and Harland (Pl. I, fig. 1), known from Middle Ordovician of Canada (Pickerill, Fillion and Harland, 1984), and the other occurring at a higher stratigraphic level (base of Unit 12 in Member C of Takche Formation) close to the Ordovician - Silurian boundary, is identical to *Chondrites* sp. type C Osgood described from the Upper Ordovician of U.S.A. (Osgood, 1970). Of these two species of *Chondrites*, the former (*C.* sp. type A) was considered previously to be the earliest known vascular plant fossil in India. In light of present work which shows its occurrence in association with marine fauna and assignment to ichnofossil, this concept of appearance of vascular plant in Ordovician from the Indian subcontinent is, therefore, not correct.

The other fossils of 'doubtful biological position' is the one described as *Pasceolus* Billings. This is now identified as an ichnofossil referable to *Paleodictyon* Meneghini which also ranges in age from Cambrian to Tertiary. The nature of this trace fossil has been variously interpreted but the recent work of Kushlin (1982) has clearly shown it to be of algal nature, and thus, he has argued for its occurrence in shallow depths as against the existing view of this association with deep water flysch sediments. The occurrence of *Paleodictyon* and *Chondrites* with other marine fossils in the present area further supports Kushlin's interpretations. The *Paleodictyon* in shallow marine sediments has also been recorded from Early Cambrian succession of southeastern Newfoundland, Canada (Crimes and Anderson, 1985).

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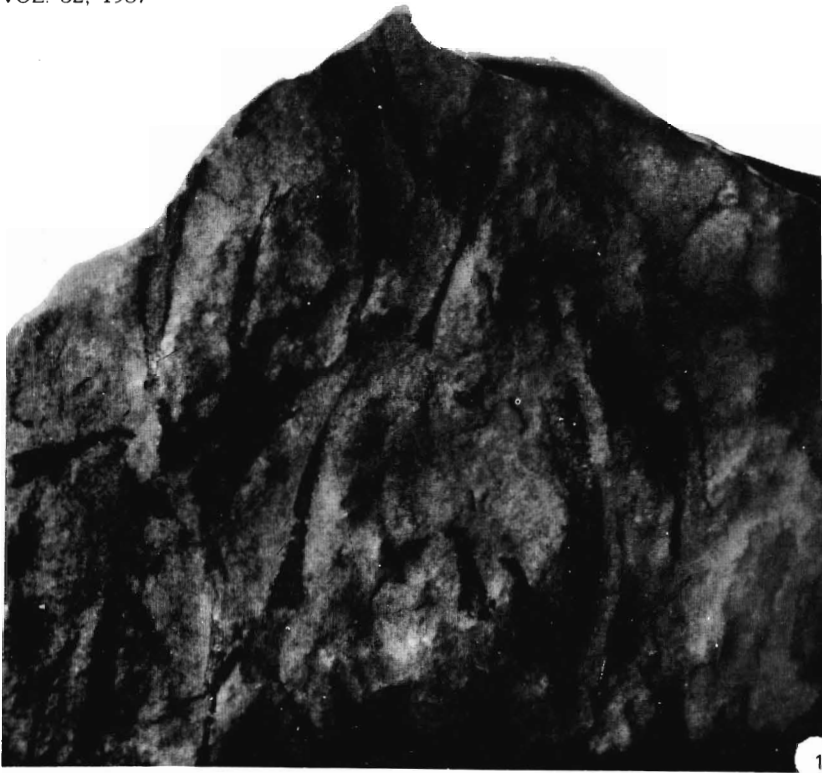
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EXPLANATION OF PLATE

PLATE I

1. *Chondrites* sp. cf C type A Pickerill, Fillion & Harland. X 2. G.S.I. Type No. 20258
- 2.a. *Chondrites* sp. cf. C. type A Pickerill, Fillion & Harland. Natural size
- b. *Chondrites* sp. cf. C. type A Pickerill, Fillion and Harland. Natural size
Both figures redrawn from Reed (1912), Pl. 16. figs. 21 & 22 and identifications revised.
3. *Chondrites* sp. type C Osgood. Muth section, pin river. GSI Type No. 20259
4. *Paleodictyon* sp. X 3. Gechang section, Parahio river. GST Type No. 20260.
5. *Paleodictyon* sp. X 4 (cast) Gechang section, Parahio river. GST Type No. 20261



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