induced secondary porosity in the dolomite which would act as effective conduits for groundwater movement. The dolomite deposits are therefore, promising aquifers for groundwater development in the area.

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A note on the occurrence of *Eurydesma* and *Deltopecten* assemblage from the Kuling Formation (Permian) Baralacha Ban Area, Lahaul Valley, Himachal Himalaya

S. V. SRIKANTIA, O. N. BHARGAVA, AND H. M. KAPOOR

Abstract

This note records the occurrence of *Eurydesma* and *Deltopecten* assemblage from the Kuling Formation (Permian) of Lahaul and discusses its significance.

Introduction

During a Himalayan geodynamics expedition to Lahaul and Rupshu, two of us (SVS and ONB) mapped the area between the Rohtang Pass in Lahaul and Upshi in Ladakh which also includes certain hitherto uncovered areas. In the course of mapping, besides several other Permian fossils, a shell of *Eurydesma cordatam* Morris and impressions of *Deltopecten cf. mitchelli* (Etheridge and Dun) were recovered (Srikantia, 1974) from the Kuling Formation (Permian) exposed near Baralacha Ban area about 7 km, southeast of Baralacha Pass, in the Lahaul Valley, Himachal Pradesh, (Fig. 1). The present note records the description and significance of these fossils.

Geological Set-up

In earlier maps published by the Geological Survey of India, the area is shown to contain only Precambrian Formations. However, the present survey has established the existence of a complete sequence ranging from Precambrian to Triassic.

The stratigraphic succession established in this area is presented in Table I. Nomenclature of various formations is after Srikantia (1974).

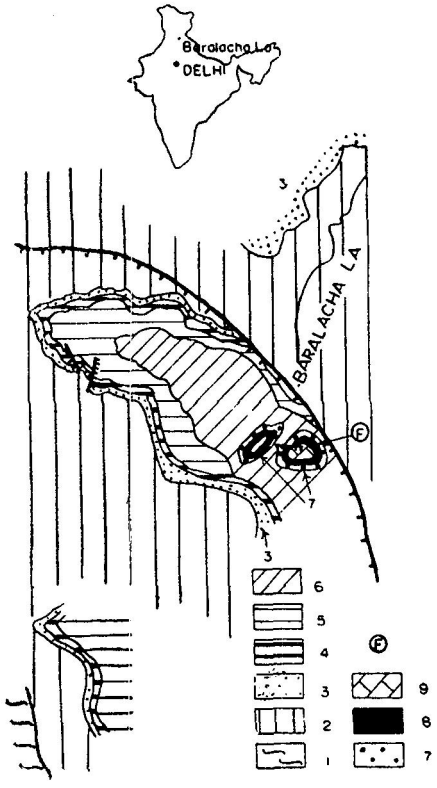

Figure 1. Geological sketch map of the Baralacha Ban area (after Srikantia and Bhargava 1976). Expl. 1–3. Haimanta Group, 1. Batal Fm., 2. Kunzam La Fm.; 3. Thango Fm.; 4. Muth Fm.; 5–7. Kanawar Group, 5. Lipak Fm.; 6. Po Fm.; 7. Ganmachidam Fm.; 8. Kuling Fm.; 9. Tamba Kurkur Fm. F. *Eurydesma* and *Deltopecten* locality.

The Palaeozoic-Mesozoic rocks of this area are folded in a NW-SE trending syncline (designated as the South Baralacha Syncline). A part of the northeastern limb of this syncline is cut off by the North Lahaul Fault (Srikantia and Bhargava, 1976). The counterpart of these Palaeozoic-Mesozoic rocks of the northern upthrow side of the North Lahaul Fault are the physical continuation of the rocks of the Spiti Valley.

Fossil assemblage

Eurydesma cordatum Morris
(Figs. 2a to c)

It has a large inflated shell with thickened umbones, obsolete notch and pointed inrolled beaks. The specimen conforms to the diagnostic characters of the species as defined by Runnegar (1968), and is fully comparable with the species described by Reed (1932) and Sahni and Srivastava (1956).

Measurement: Length 90 mm, width 60 mm, thickness 55 mm.

Registration No: G.S.I. type No. 19036.

Repository: Central Palaeontology Laboratory, Geological Survey of India, Calcutta.

Deltopecten cf. *mitchelli* (Etheridge and Dun) (Fig 3)

A faint but clear impression of right valve with prominent thick radiating ribs with a few ribs showing tendency of bifurcation is found in the shale.

TABLE I. Stratigraphic sequence of various Formations in the Baralacha Ban area, Lahaul Valley (after Srikantia, 1974)

Age	Group	Formation (approx. thickness)	Member	Lithology
Triassic	Lilang	Tamba Kurkur (450 m)		Greyish blue limestone with ferruginous chert in the basal part
Permian		Kuling	Gungri (100 m)	Carbonaceous shale and siltstone with phosphatic nodules
			Gechang (60 m)	Calcarenite to calcareous sandstone with shale partings
Carboniferous	Kanawar	Ganmachidam (150)		Diamictite, gritstone and sandstone
		Po (800 m)		Quartzite and carbonaceous shale
		Lipak (800)		Greyish blue, black and pink limestone with pockets of gypsum
Middle to Upper Devonian		Muth (150 m)		Compact to friable quartzite
Upper Silurian to Lower Devonian		Takche (30 m)		Calcilutite, brown dolomite and shale
Precambrian to Lower Silurian	Haimanta	Thango (400 m)		Purple quartzite, purple shale, sporadic diamictite
		Kunzam La (800 m)		Olive green shale, siltstone, dolomite interbedded in the upper part, quartzite olive green shale and graywacke in various alterations
		Batal		Quartzite and carbonaceous slate

Remarks: Reed (1932) described *Aviculopecten mitchelli* (Etheridge and Dun) from Brem spur of Kashmir. This specimen has been revised and included under the genus *Deltopecten* by Dickins (1957).

The impression from the Baralacha Ban area fully resembles *Aviculopecten mitchelli* (revised to *Deltopecten mitchelli*) described by Reed (1932) from Kashmir. However, because of the broken right side of the ear, we prefer to call the specimen as *Deltopecten* cf. *mitchelli.*

Registration No: PHP MU 501.

Repository: Himachal Pradesh Circle, Geological Survey of India, Chandigarh.

Discussion

Age: The *Eurydesma-Deltopecten* assemblage, as stated above, is found in the basal Gechang Member of the Kuling Formation. This is succeeded by the Gungri

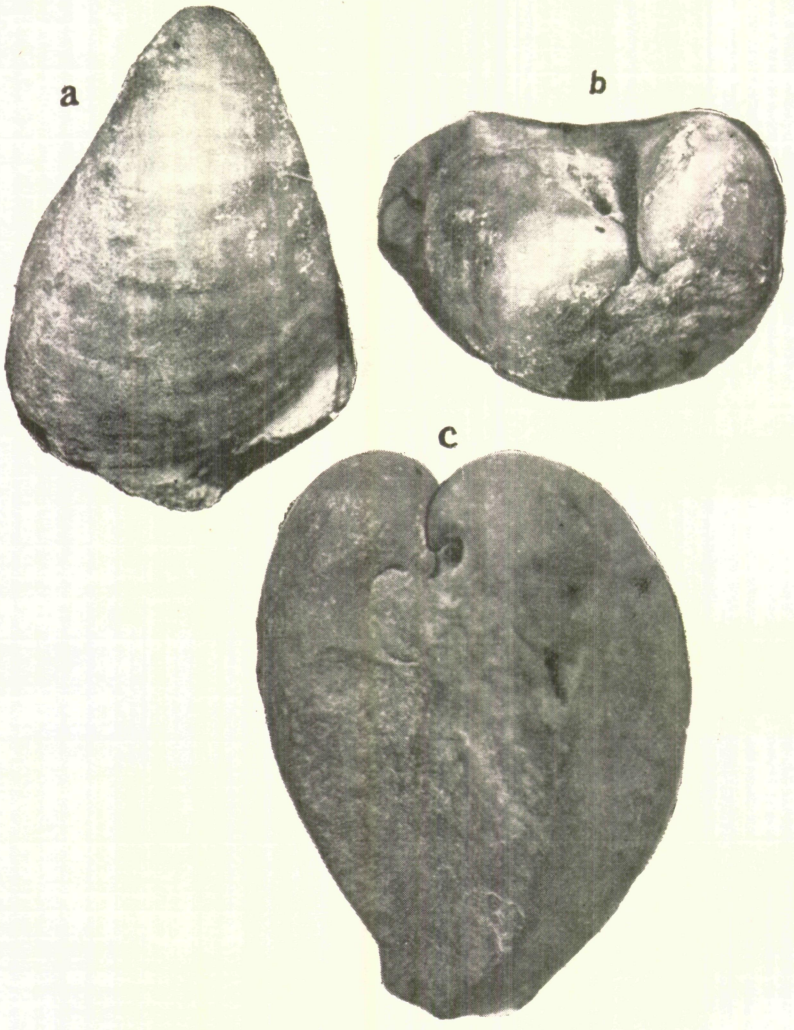

Figure 2a–c. *Eurydesma cordata* Morris, a. external view right valve (×0.8) b. dorsal view (×1), c. anterior view (×1).

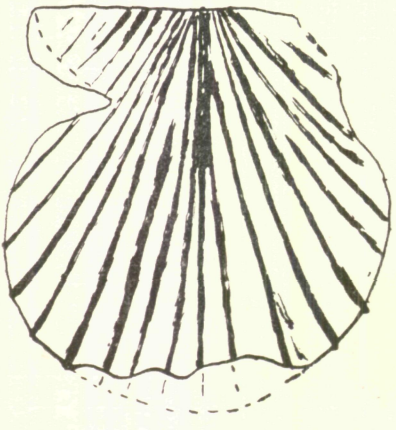

Figure 3. Camera lucida sketch of right valve impression of *Deltopecten* cf. *mitchelli* (Etheridge and Dan) ×0.8.

Member which contains abundance of productids. Thus, this zone corresponds to the *Eurydesma Deltopecten* zone of Bren spur of Kashmir which is assigned an Asselian age (Kapoor and Shah, 1976).

Palaeoclimate: The *Eurydesma – Deltopecten* bearing bed, since in several localities (e.g. Salt Range, Mahendragarh; Dickens, 1961), is underlain by tillite, this fossil assemblage is regarded as indicating cold climate. However, the Agglomeratic Slate of Kashmir, the lower Diamictite Division of which contains the *Eurydesma-Deltopecten* is not considered as glacial by Nakazawa *et al* (1975). Similarly in Spiti and also in the present area the Ganmachidam Formation of the Kanawar Group (Srikantia, 1974), which underlies the Kuling Formation, does not contain any character of glacial environment (Bhargava and Bhattacharyya, 1975) and is a molassic stage of the parageosynclinal cycle of the Kanawar (Srikantia, 1976). Therefore, it is difficult to comment upon the exact palaeoclimatological condition of that time until the identification of all other associated fossils collected from this section is completed.

Geographical distribution: In the Himalaya the *Eurydesma-Deltopecten* assemblage is known from the Agglomeratic Slate of Kashmir at Bren Spur (Reed, 1932) and Bhallesh (Kapoor, 1973). *Eurydesma* is reported from Sikkim (Sahni and Srivastava, 1956), Darjeeling foot-hills (Acharyya, 1972) and Siang district (Singh, 1975).

Gupta *et al* (1970a) reported *Eurydesma* from the 'Permian limestone' 'forming hill tops near Lach Lung La'. Since these authors have not given the horizon or sketch of their specimen no stratigraphic or palaeontologic comparison is possible with our form. Incidentally, the present survey (by SVS and ONB) has shown that the Lach Lung La is on Triassic-Jurassic sequence. Later, however, Gupta (1973) included *Eurydesma Cordatam* (an Early Permian fossil) in his Upper Permian 'Malung Shale' overlying the 'Sarchu Limestone' which has a *Fusulinid* zone (Lower Permian) at the base. Thus, there seems to be an incongruity in the stratigraphic exposition of the area by Gupta. Further, it may also be mentioned that the limestone beds exposed at Sarchu and the overlying black shale (? Malung Shale of Gupta, 1973) have yielded typical Upper Triassic fossils (Raina and Bhattacharyya, 1973). Therefore, the sequence built up by Gupta (1973) in the Sarchu area cannot be used for any stratigraphic work.

Conclusion

The discovery of the *Eurydesma* and *Deltopecten* in Lahaul part of the Spiti-Zanskar basin suggests that this association is not restricted to a corner of the Himalaya (i.e. Kashmir) as hitherto believed. There is a distinct liklihood of finding similar *Eurydesma* association with *Deltopecten* in the rest of the Himalaya where the geological set-up similar to that of Spiti-Zanskar basin is known to exist.

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