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ON THE OCCURRENCE OF FORAMINIFERA IN THE JURASSIC ROCKS OF JHURIO HILL, CENTRAL KUTCH

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ABSTRACT

The Jurassic rocks exposed at Jhurio hill, Central Kutch, have yielded fifty-three species of foraminifera. The microfauna is prolific and nodosariids dominate the assemblage. The foraminifera suggest a shallow marine environment of deposition and indicate a Callovian to Oxfordian age for the studied sequence. An endeavour has been made to demarcate the Callovian-Oxfordian boundary on foraminiferal evidence.

The thick pile of Jurassic strata exposed in Kutch is richly fossiliferous and is considered as a storehouse of excellently preserved fossils, including ammonites, all over the world. The magafossils contained in these sediments have been subjected to detailed studies in the past. However, the foraminifera of these deposits have not been extensively studied.

Tewari (1957), for the first time, reported five foraminiferal genera from the Patcham Series of Kutch. He was followed by Subbotina *et al.* (1960) who described thirty-four species of foraminifera from the Jurassic of Kutch and Rajasthan which included twelve new species; Bhalla and Abbas (1978) who made a comprehensive study of Jurassic foraminifera described and illustrated seventy-five species, including ten new, from the Habo hills, Central Kutch; and Bhalla and Talib (1980) who described and illustrated nineteen foraminiferal species from the Jurassic rocks near Badi, also in Central Kutch. Other studies which briefly deal with the Jurassic foraminifera from Kutch are by Agrawal and Singh (1961), Bhalla and Abbas (1975a, b, c; 1976a, b), Shringarpure and Desai (1975), Shringarpure *et al.* (1976), Singh (1977, 1979), and Bhalla and Talib (1978).

As a part of the research programme on Jurassic foraminifera from Kutch undertaken by the Department of Geology, Aligarh Muslim University, Aligarh, a study of the foraminiferal assemblage from the Jurassic rocks exposed in Sonwa *nala* cutting on the northern flank of the Jhurio hill, Kutch, (Table-1) was made and the present communication gives a preliminary account of the investigation.

The study yielded a fairly rich assemblage of foraminifera comprising the following fifty-three species. Those marked with asterisk are being recorded for the first time from the Indian region : **Reophax hounstoutensis* Lloyd, *R.* aff. **R. multilocularis* Haeusler *Psamminopelta bowsheri* Tappan, **Haplophragmoides latidorsatum* (Bornemann), **Ammobaculites cobbani* Loeblich and Tappan, **A. coprolithiformis* (Schwager), **A. fontinensis* (Terquem), **A.* cf. *A. reophaciformis* Cushman, **A. subcretaceous* Cushman and Alexander, **Ammomarginulina* cf. *A. cragini* Loeblich and Tappan, **Textularia 'jurassica* (Guembel), *Nodosaria* aff. *N. coulmnaris* Franke, *N. fontinensis* Terquem, *N. hortensis* Terquem, *N. lirulata* Loeblich and Tappan, **N. radiata* (Terquem), *N. simplex* (Terquem), *Nodosaria* sp. indet., *Astacolus anceps* (Terquem), *A. pauperatus* (Jones and Parker), *Citharina clathrata* (Terquem), *C. hetropleura* (Terquem), **Citharinella* aff. *C. compara* Loeblich and Tappan, **C. rhomboidea* Loeblich and Tappan, **Dentalina guembeli* Schwager, **D.* aff. *D. subguttifera* Bartenstein, *Frondicularia kutchensis* Bhalla and Abbas, **Lenticulina gaultina* (Berthelin), *L. quenstedti* (Guembel), *L. subalata* (Reuss), *L. tricarinella* (Reuss), *L. varians* (Bornemann), *Lenticulina* sp. indet., **Marginulina curvatura* Cushman, **M.* cf. *M. oolithica* (Terquem), **M. oxfordiana* Gordon, **M. sastryi* Bhalla and Talib, **M.* cf. *M. stratifera* Tappan, *M. woodi* Bhalla and Abbas, *Marginulina* sp. indet., **Saracenaria cornucopae* (Schwager), **Tribrachia inelegans* Loeblich and Tappan, *Vaginulina* aff. *V. barnardi* Gordon, **V. bhatiai* Bhalla and Talib, *Vaginulinopsis eritheles* Loeblich and Tappan, *Eoguttulina polygona* (Terquem), **Tristix oolithica* (Terquem), *Patellinella poddari* Subbotina and Srivastava, *Spirillina polygyrata* Guembal, **Patellina subcretacea* Cushman and Alexander, *Trocholina conosimilis* Subbotina and Srivastava, *Epistomina alveolata* Myatliuk, and *E. mosquensis* Uhlig.

The present foraminiferal assemblage is dominated by the family Nodosariidae constituting 64.15% of the total species. It is followed by families Lituolidae (13.20%); Spirillinidae, Hormosinidae and Cerato-

Table 1. Sequence of Jurassic rocks exposed in Sonwa nala-cutting, Jhurio hill, Central Kutch.

Series	Bed Nos.			LITHOLOGY	Thickness (in meters)
KATROL		Sandstone	:	reddish-brown, ferrugenous, hard, compact, medium to coarse-grained, with impersistant bands of whitish, yellowish, greenish, comparatively soft, friable, sandstone (devoid of Jurassic foraminifera).	
				—UNCONFORMITY—	
	C 23	Limestone	:	reddish-brown, oolitic, hard, compact, massive.	7.30
	C 22	Shale	:	blue, very soft, friable, thinly bedded, gypseous.	11.30
	C 21	Shale	:	blue, soft, with thin beds of sandy limestone.	7.70
	C 20	Limestone	:	yellow, aragillaceous, hard, compact, fine-grained, fossiliferous (brachiopods, lamellibranchs and cephalopods).	6.00
	C 19	Shale	:	yellow, soft, friable, thinly bedded.	21.00
C	C 18	Conglomerate	:	muddy, soft, friable, loose, pebbles well-rounded, poorly sorted, fossiliferous (brachiopods and gastropods).	5.33
	C 17	Limestone	:	pinkish-brown, sandy, hard, massive, medium-grained.	10.70
	C 16	Shale	:	yellowish-grey, soft, friable, thinly bedded.	23.30
H	C 15	Sandstone	:	pinkish-brown, hard compact, massive, carse-grained, with ferrugenous partings of reddish-brown colour.	66.00
	C 14	Conglomerate	:	similar to the conglomerates of bed no. C9 and C12.	9.32
	C 13	Sandstone	:	pinkish-brown, hard, compact, massive, coarse-grained, with shaly partings of yellow colour.	22.30
A	C 12	Conglomerate	:	similar to the conglomerate of bed no. C9.	3.65
	C 11	Shale	:	grey, soft, friable, thinly bedded.	64.00
	C 10	Sandstone	:	yellow, hard, compact, coarse-grained, thickly bedded, intercalated with yellow and blue shales.	39.31
R	C 9	Conglomerate	:	dirty white, dark brown on weathering, hard, compact, polymictic, pebbles sub-rounded, poorly sorted, with sandy matrix.	4.66
	C 8	Shale	:	yellowish-brown, soft, thinly bedded, with bands of blue shales.	7.40
	C 7	Limestone	:	dark grey, hard, compact, fine-grained, thinly bedded.	4.60
I	C 6	Shale	:	dirty white, hard, compact, thinly bedded, intercalated with limestones, showing mud-crack cast.	15.32
	C 5	Limestone	:	similar to the limestone of bed no. C2.	2.00
	C 4	Shale	:	dirty white, hard, compact, thinly bedded.	33.33
	C 3	Limestone	:	yellowish-brown, hard, compact, massive, fine-grained.	21.30
	C 2	Limestone	:	golden, oolitic, hard, compact, massive, coarse-grained.	4.70
	C 1	Limestone	:	yellowish-white, hard, compact, fine-grained, with shaley intercalations of dirty white colour.	5.40
				(Base not exposed)	

buliminidae (3.77% each) and Rzehakinidae, Textulariidae, Polymorphinidae, Glandulinidae, Discorbidae, and Involutinidae each representing 1.89% of the entire foraminiferal species.

In addition to the above, a few post-Jurassic foraminiferal species belonging to *Spiroloculina*, *Quinqueloculina*, *Triloculina*, *Uvigerina*, *Ammonia*, *Elphidium*, *Globigerina*, *Amphistegina* and *Cibicides* were also recorded. Their specimens show signs of windborne sediments and appear to have been brought in from the Tertiary sediments and Recent beach sands exposed at nearby western areas by strong westerly winds prevailing during summer months in the region and then getting entombed in the Jurassic sediments through percolating rain water during monsoon season (*vide etiam* Bhalla and Abbas, 1975c).

It has been endeavoured to date the present sedimentary sequence of Jurassic strata on the basis of the foraminiferal evidence. This could not be done precisely as most of the foraminiferal species are long-ranging and truly marker species are absent in the assemblage. However, on the basis of a fairly good number of species restricted to Callovian and Oxfordian, viz., *Citharinella* aff. *C. compara*, *Marginulina oxfordiana*, *Tribrachia inelegans*, *Ammobaculites cobbani*, *Citharinella heteropleura*, *Dentalina guembeli*, *Frondicularia kutchensis*, *Marginulina woodi*, *Vaginulinopsis eritheles*, *Patellinella poddari* and *Trocholina canosimilis*, a Callovian to Oxfordian age is being suggested for the present sequence.

An attempt has also been made to delineate the boundary between Callovian and Oxfordian part of the sequence in the present area. On the basis of a few diagnostic foraminiferal species, eg., *Epistomina mosquensis*, *Citharina hetropleura*, *Citharinella* aff. *C. compara*, *Tribrachia inelegans*, *Vaginulina eritheles*, *Astacolus anceps* and *Citharina clathrata*, the lower portion of the sequence (beds C_1 to C_6) (82.05 m from the base) is assigned a Callovian age, while the upper portion (beds C_7 to C_{23}) having *Marginulina oxfordiana* and *Epistomina alveolata*, is considered to be of Oxfordian age.

The Jurassic foraminifera are not very reliable for palaeoecologic interpretations of the enclosing sediments as they are nearly always dominated by nodosariids which have evidently changed their habitat since Cretaceous and none of the Mesozoic species has survived up to the Recent. Therefore, only a generalized picture of the depositional environment could be visualized on the basis of foraminiferal assemblage combined with some field observations. This indicates that the major part of the Jurassic sediments exposed at Jhurio hill, Kutch, was deposited in a near shore, shallow water, marine basin which was tectonically rather unstable.

The present Jurassic foraminiferal assemblage compares favourably with those from other Jurassic areas of India as well as other regions belonging to Tethayn Realm, viz., Afghanistan, Iran, Egypt, and Somalia. This supports the earlier view expressed by several authors that during the Middle and Upper Jurassic times, Kutch was covered by a gulf of Tethys which stretched from near Afghanistan to Madagascar covering parts of Iran and east coast of Africa.

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EURYDESMA FROM THE KULING FORMATION, SPITI VALLEY, H. P.

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1. 529 SECTOR 18B, CHANDIGARH-160018
2. 98-100 SECTOR 17C, CHANDIGARH-160017

ABSTRACT

Eurydesma hesdoensis Sahni and Dutt 1962 and *E. manendragarhensis* Sahni and Dutt 1962 are reported from the Calcareous Sandstone forming the lower part of the Kuling Formation exposed about 1.75km N. W. of Po village, Spiti valley.

It thrived in a shallow marine basin.

INTRODUCTION

One specimen each of *Eurydesma hesdoensis* Sahni and Dutt 1962 and *E. manendragarhensis* Sahni and Dutt 1962 were recovered from the basal part of the Calcareous Sandstone (Kuling Formation) exposed about 1.75 km N. W. of Po village in the Spiti Valley (Fig. 1). These fossils were found above the contact of the Ganmachidam (=Permian Conglomerate of Hayden, 1904) and Kuling Formations (Fig. 2). The ventral parts of both these specimens were partly damaged during extraction from the hard and compact sandstone. The specimens are in the form of casts and only a small part of the shell is preserved.

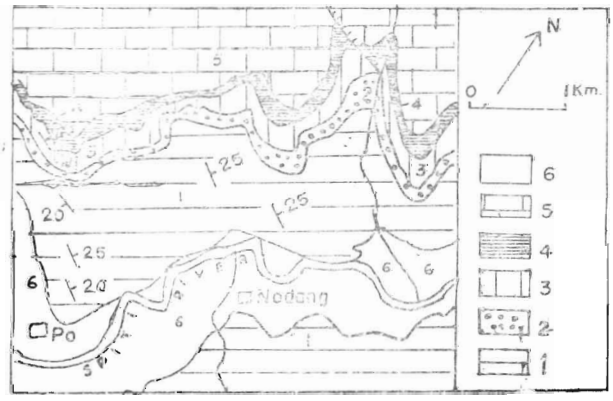

Fig. 1. Geological map of the Po area, Spiti valley. Expl. 1. PO Formation ; 2. Ganmachidam Formation; 3-4 Kuling Formation, 3. Calcareous Sandstone, 4. Shale; 5. Lilang Group; 6. Alluvium F. Fossil locality.

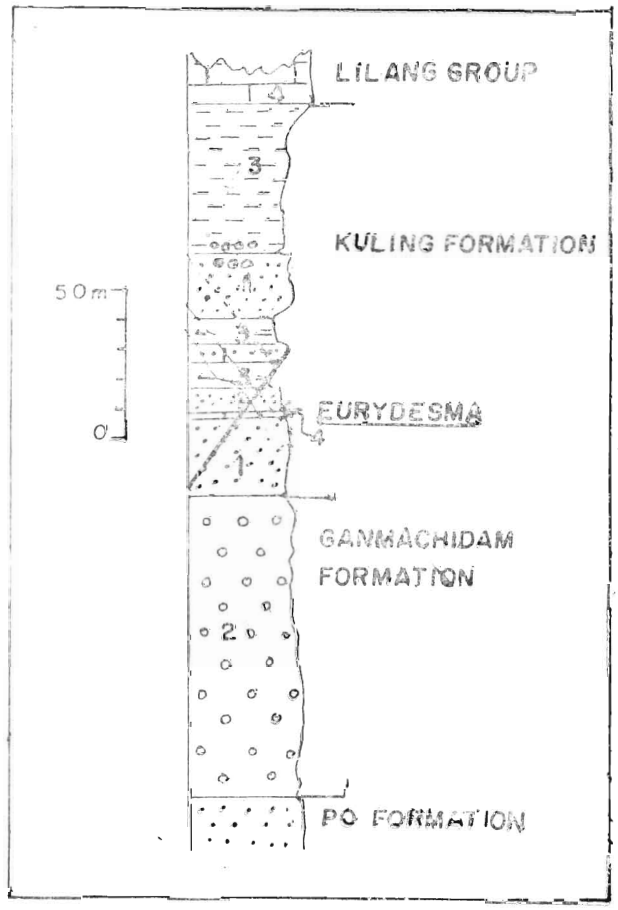

Fig. 2. Litholog showing the stratigraphic level of *Eurydesma* with respect to Ganmachidam Formation. Expl. 1. Sandstone; 2. Conglomerate; 3. Shale; 4. Limestone.

SYSTEMATIC DESCRIPTION

Family Eurydesmatidae
Genus *Eurydesma* Morris

Eurydesma hesdoensis Sahni and Dutt 1962

(Plate I—1)

Shell ovate in outline and prominently convex. Umbo subcentral beak-like pointed, slightly curved, prosogyrous extending 2 cm above the hinge.

Eurydesma manendragarhensis Sahni and Dutt 1962

(Plate I—2)

Shell vertically elongated, mildly convex, umbo central, slightly curved and 1.5 cm above the hinge.

Remarks : As both the specimens occur mainly as casts their identifications are based on general shape and size which are exactly identical to those of *Eurydesma hesdoenis* and *E. manendragarhensis* reported from Manendragarh area (Sahni and Dutt, 1962).

STRATIGRAPHIC AND PALAEOENVIRONMENTAL SIGNIFICANCE

Eurydesma is known to occur in the basal Permian (Asselian-Sakmarian) deposits of Gondwanaland (Waterhouse and Gupta, 1982). This fossil through out Gondwanaland is known from diamictite or a horizon just above it (Waterhouse and Gupta, 1982). In the Indian subcontinent, it is known from the Salt Range (Reed, 1936), Kashmir (Reed, 1932), Lahaul (Srikantia *et al.* 1978; Gupta and Waterhouse, 1978), Sikkim (Sahni and Srivastava, 1956), Arunachal Pradesh (Singh, 1978), Manendragarh (Sahni and Dutt, 1962), Daltonganj (Sastry and Shah, 1964) and Rajasthan (Ranga Rao *et al*, 1977). The present discovery of *Eurydesma* from Spiti leaves only Kumaon, Nepal and Bhutan areas of the Himalaya where this significant fossil is not known. The geological set-up of these areas is akin to that of the Spiti valley; it is, therefore, only a matter of time before this fossil is discovered in these areas as well.

In the Salt Range, Lahaul and the present area, *Eurydesma* occurs above the diamictites, elsewhere in the Indian subcontinent it is known from the diamictites. The occurrence of this index fossil within and above the diamictite even in the adjoining areas of Kashmir and Lahaul-Spiti respectively suggests that the upper lithologic limit of the diamictite is time transgressive. In other words the geological phenomena which caused the formation of the diamictite ceased to be effective during the basal Permian in Salt Range, Lahaul and Spiti, whereas it lingered into Sakmarian time in other.

Due to association of *Eurydesma* with the glacial beds in various parts of Gondwanaland, it has been regarded to represent a cold climate (Dickins, 1957). Clasts in the Ganmachidam diamictite in the Spiti area are water-worn and do not represent a glacial deposit. Thus it is difficult to confirm the existence of cold climate during Sakmarian time in these areas.

The Calcareous Sandstone from which *Eurydesma* has been extracted is coarse grained, ripple marked and cross-bedded in the basal part and in upper part encloses trace fossil *Zoophycos*—characterstic of slope and rise of shelf. The Calcareous Sandstone thus is interpreted to have been laid in intertidal to marginally subtidal environments in basal and upper parts respectively. The occurrence of *Eurydesma* in the basal intertidal part of the Calcareous Sandstone confirms its shallow marine habitat as suggested by Dickins (1957).

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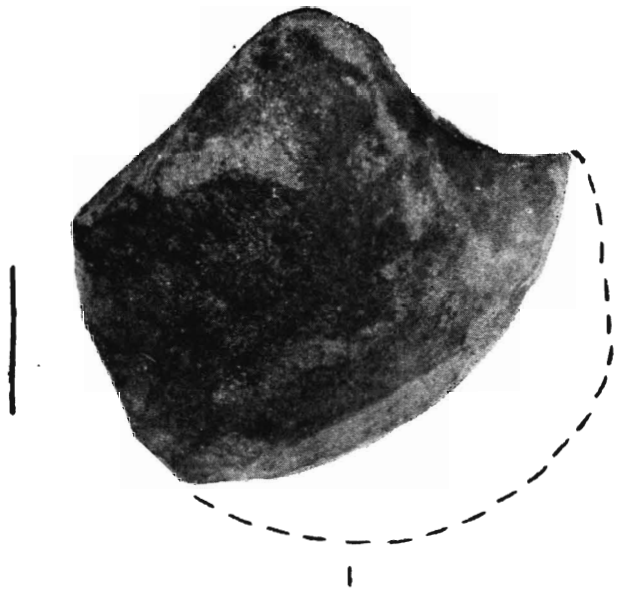
EXPLANATION OF PLATE

Plate I

1. *Eurydesma hesdoensis* Sahni and Dutt 1962
2. *Eurydesma manendragarhensis* Sahni and Dutt 1962

Dotted lines in the photographs show the original shape of of the fossils
Bar represents 2 cm.



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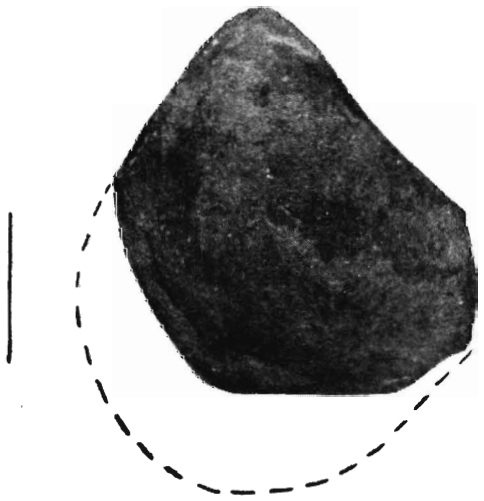

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