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ECHINOIDS FROM THE BHUBAN FORMATION (SURMA GROUP), MIZORAM

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ABSTRACT

The two echinoid genera namely, *Coelopleurus* (*Keraiophorus*) Michelin, 1862 (an arbacioid echinoid) and *Schizaster* L. Agassiz, 1836 (a spatangoid echinoid) are being recorded and described systematically, for the first time, from the rocks of the Upper Bhuban Unit, Bhuban Formation, Surma Group (lower to middle Miocene) exposed at South Hlimen Quarry, Aizawl, Mizoram.

Keywords: Arbacioid and spatangoid echinoids, Bhuban Formation (early middle Miocene), Mizoram, India

INTRODUCTION

The note systematically records, for the first time, the arbacioid and spatangoid echinoids (Echinodermata) from the rocks of the Upper Bhuban Unit of Bhuban Formation, Surma Group (lower to middle Miocene) exposed in and around Aizawl, Mizoram (Fig. 1). La Touche (1891) was the first to report a *Schizaster* sp. from the Surma rocks of Lunglei, Mizoram. Sinha *et al.* (1982), Das Gupta (1982) and Patil (1990), while reporting the occurrence of bivalves, gastropods, echinoids, crabs, shark teeth, foraminifers and ostracodes from the Surma rocks of Mizoram, made passing references about the echinoid fauna from these rocks. Detailed palaeontological investigations carried by subsequent workers in these rocks (Tiwari, 1992, 2001 & 2006; Tiwari and Bannikov, 2001; Tiwari and Kachhara, 2000 & 2003; Tiwari and Satsangi, 1988 and Tiwari *et al.*, 1997 & 1998) have also missed out detailed study of echinoid fauna. Recently, Jauhri *et al.* (2003) reported a hemiasterid echinoid from the rocks of Upper Bhuban unit of Bhuban Formation exposed in a section near Zemabawk, east of Aizawl, Mizoram. As such, a detailed documentation of the echinoid fauna from the Surma rocks of Mizoram is yet to come.

The echinoids described and illustrated here come from (a) 6.0m thick brown-coloured, fine grained poorly sorted silty-sandstone bed at South Hlimen Quarry (about 5.0 km South of Aizawl) (Fig. 2). These have also been recovered from (b) 3.0m thick sandstone bed at Bika Quarry (about 8.5 km N65^{0}W of Aizawl) and (c) 4.8m silty-sandstone bed near Luangmual Complex (about 7.8 km N50^{0}W of Aizawl). These echinoids are found in association with host of bivalves and a few gastropods, fish teeth, crabs and plates of barnacles.

GEOLOGICAL SETTING

Geologically, Mizoram is a part of the Tripura-Mizoram Accretionary belt of Cenozoic age (Evans, 1964). The state is occupied by the argillaceous and arenaceous rock sequences that occur in alternation. These rock successions are thrown into N-S trending and longitudinally plunging anticlines and synclines (Ganju, 1975; Ganguly, 1983). The general trend of the rock formations is N-S with dip varying from 20° to 50° either towards east or west (Karunakaran, 1974). Main rock types exposed in the area are sandstone, siltstone, shale, mudstone and their admixture in various proportions and a few pockets of shell limestone, calcareous sandstone and intra-formational conglomerate. Sequentially, these rock successions are organised into the Barail, the Surma and the Tipam groups in ascending order. The stratigraphic succession in the state (Karunakaran, 1974; Ganju, 1975) is given in Table 1.

SYSTEMATIC PALAEONTOLOGY

(Fell and Pawson, 1966; Smith, 2008)

Class **Echinoidea** Leske, 1778
Superorder **Echinacea** claus, 1876
Order **Arbacioida** Gregory, 1900
Family **Arbaciidae** Gray, 1855
Genus ***Coelopleurus*** L. Agassiz, 1840

Subgenus ***Keraiophorus*** Michelin, 1862

Coelopleurus (*Keraiophorus*) sp.
(Pl. I, figs. a-c)

Material: Eight specimens (Type Nos. MZ/E/1, 2, 3, 4, 5, 6, 7 and 8), few are broken and incomplete; preservation poor due to weathering and erosion.

Description: Test medium, ambitus rounded to subpentagonal and low hemispherical shape with almost flat oral surface. Apical system small and dicyclic. Ambulacra straight, expanding to ambitus; slightly inflated; pore-pairs small, uniserial, subconjugate, widely separated and obliquely placed. Interambulacra a little wider than ambulacra. Primary tubercles with imperforate mamelon and non crenulate. Peristome subcircular or subpentagonal, large.

Dimensions (in mm):

Specimen No.	Maximum diameter	Minimum diameter
MZ/E/1	31.12	27.43
MZ/E/2	29.91	22.42
MZ/E/3	29.22	?
MZ/E/7	30.52	24.21

Remarks: Depending on the preserved morphological characters, the studied specimens are placed, with much reservation, under the genus *Coelopleurus* L. Agassiz, 1840 and the specific identification of these specimens is not possible. However, in the Indian subcontinent, the genus is known from the Eocene sediments of Sind (d'Archiac and Haime, 1853), Kachchh (Wynne, 1872); Oligocene sediments

Table 1: Generalised stratigraphic succession in Mizoram (Karunakaran, 1974; Ganju, 1975).

AGE	GROUP	FORMATION	UNIT	GENERALIZED LITHOLOGY
Recent	Alluvium			Silt, clay and gravel
----------Unconformity----------				
Early Pliocene to Late Miocene	Tipam (+900m)			Sandstone with occasional clay bands
----------Conformable and transitional contact----------				
Miocene	S	Bokabil (+950m)		Shale, siltstone and sandstone
		----------Conformable and transitional contact----------		
	U	B	Upper Bhuban (+1100m)	Arenaceous predominating with sandstone, shale and siltstone
	R	H	------Conformable and transitional contact------	
to		U	Middle Bhuban (+3000m)	Argillaceous predominating with shale, siltstone-shale alternations and sandstone
	M	B		
		A		
	A (+5950m)	N	------Conformable and transitional contact------	
Late Oligocene			Lower Bhuban (+900m)	Arenaceous predominating with sandstone and silty-shale
----------Unconformity----------				
Oligocene	Barail (+3000m)			Shale, siltstone and sandstone.
---------- Lower contact not seen----------				

of Sind (Blanford, 1876, 1879; Duncan and Sladen, 1882–1886) and Miocene sediments of Sind (Duncan and Sladen, 1882–1886), Kachchh (Duncan and Sladen, 1883) and Kathiawar (Jain, 2002).

Locality: South Hlimen Quarry, 5 km South of Aizawl, Mizoram.

Horizon: Upper Bhuban Unit, Bhuban Formation (lower to middle Miocene).

Order **Spatangoida** Claus, 1876
Suborder **Hemiasterina** Fischer, 1966
Family **Schizasteridae** Lambert, 1905
Genus ***Schizaster*** L. Agassiz, 1836

Schizaster sp.
(Pl. I, figs. d-h)

Material: Six specimens (Type Nos. MZ/E/9, 11, 12, 13, 14 and 15), few are broken and incomplete; preservation poor due to weathering and erosion.

Description: Test medium, ovate to heart shaped with deep anterior sulcus; slightly pointed towards posterior side. Apical disc small, central and ethmolytic. Petal III deeply sunken; petals II & IV longer and more flexed than the petals I & V. Peristome kidney-shaped, excentric anteriorly.

Dimensions (in mm):

Sample No.	Length	Breadth	Height
MZ/E/9	15.02	10.42	06.61
MZ/E/11	36.63	21.72	?

Remarks: Depending on the preserved morphological characters, the studied specimens are placed, with much reservation, under the genus *Schizaster* L. Agassiz, 1836

EXPLANATION OF PLATE I

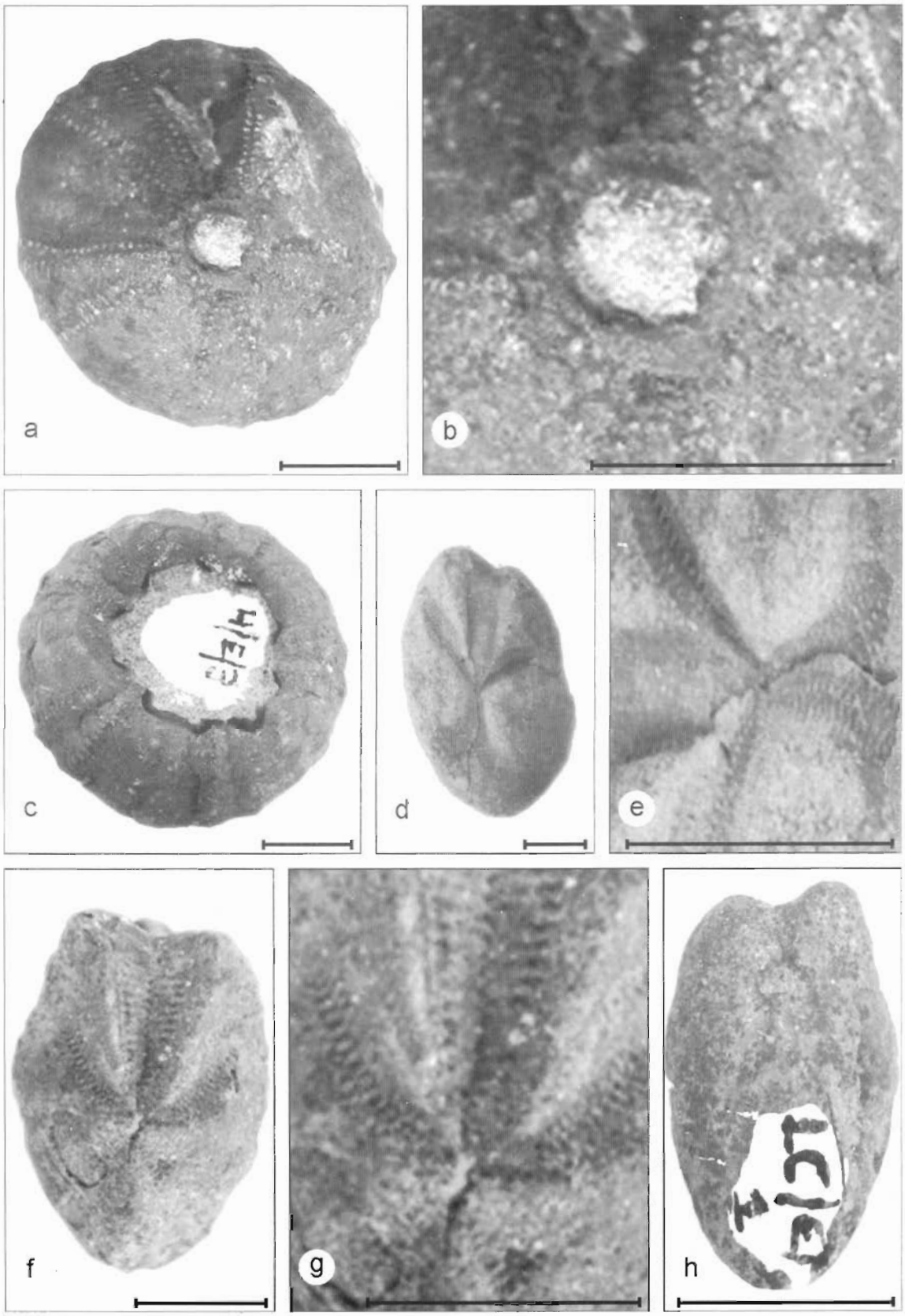
(Bar represents 10.00 mm)

a-c. ***Coelopleurus* (*Keraiophorus*)** sp. (Specimen No.MZ/E/1)
a. Aboral view.
b. Apical system.
c. Oral view.

d-e. ***Schizaster*** sp. (Specimen No.MZ/E/11)
d. Aboral view.
e. Apical disc (part).

f-h. ***Schizaster*** sp. (Specimen No.MZ/E/9)
f. Aboral view.
g. Apical disc.
h. Oral view.

Plate I



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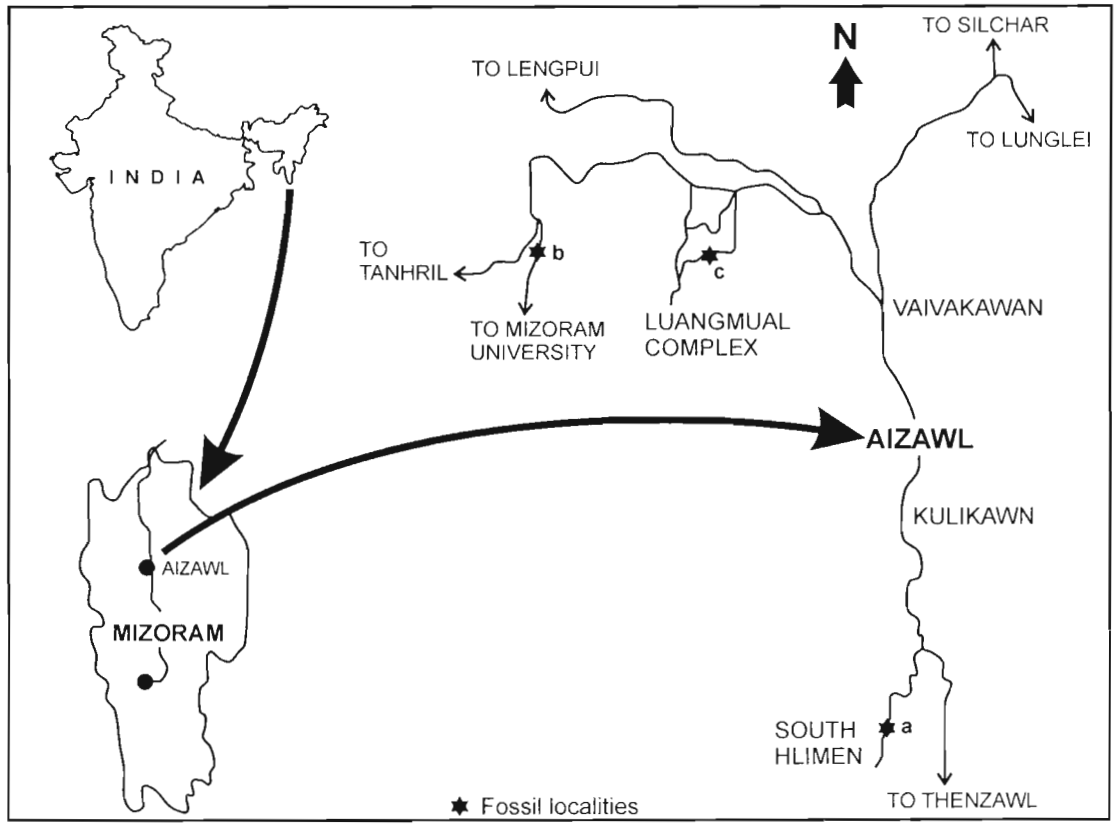

Fig. 1. Location map showing fossil localities around Aizawl, Mizoram, India (not to scale).

and the specific identification of these specimens is not possible. However, it has comparatively a wider geographical distribution in the Indian subcontinent than the genus *Coelopleurus* L. Agassiz, 1840 and it has been reported from the various sediments ranging in age from Eocene to Pliocene which are exposed at Assam, Kachchh, Kathiawar, Kohat, Makran and Sind (d'Archiac and Haime, 1853; Duncan and Sladen, 1882–1886; Duncan and Sladen, 1883; Pilgrim, 1908; Spengler, 1923; Davies, 1943; Jain, 2002 and Srivastava, 2004).

Locality: South Hlimen Quarry, 5 km South of Aizawl, Mizoram.

Horizon: Upper Bhuban Unit, Bhuban Formation (lower to middle Miocene).

DISCUSSION AND CONCLUSIONS

Echinoids are adapted to a wide range of environments on soft and hard sea bottom. They include epi- and endofaunal forms, using varied feeding mechanisms for different food resources. Echinoids are the common members of the benthic community colonising a wide range of habitats in shallow seas. Arbacioid echinoids represent a slightly deeper, moderate-energy environment with a highly structured habitat whereas the spatangoids exploit burrowing habitats (Kroh and Nebelsick, 2003).

Associated bivalve genera recovered from these beds include *Timoclea*, *Anadara*, *Diplodonta*, *Ostrea*, *Mactra*, *Pitar*, *Callista*, *Dosinia*, *Paphia*, *Nucula*, *Chlamys*, *Lucina*, *Cultellus*, *Clementia*, *Apolymetis*, *Astarte* and *Pinna*. *Lucina*, *Callista* and *Pitar* are stationary burrowers. *Cultellus* is an inter-tidal to euneritic bivalve. *Anadara* and *Apolymetis* are suborbicular forms. *Nucula* is a detritus feeder and *Chlamys* (an inter-tidal genus inhabiting gravel bearing rocky bottoms) is a byssate, free swimming form. *Ostrea* is a sub-tidal species cemented to rocky bottoms and common on beaches. *Clementia* and *Pecten* are warm water in nature. *Apolymetis* inhabits tropical embaymental (20m depth) environment and is a mangrove fauna. *Dosinia* inhabits muddy to sandy bottoms of lower to sub-tidal zones (Noda *et. al.*, 1994). All infaunal forms are compressed and indicate unconsolidated substrate. Thus, it can be inferred that an open shallow, warm sea with fluctuations from inner neritic to littoral water with depth certainly less than 30m existed during deposition of these sediments (Tiwari 2001, 2006).

REPOSITORY

All the specimens described in this article are housed in the Palaeontology Laboratory, Department of Geology, Mizoram University, Aizawl-796 009, Mizoram.

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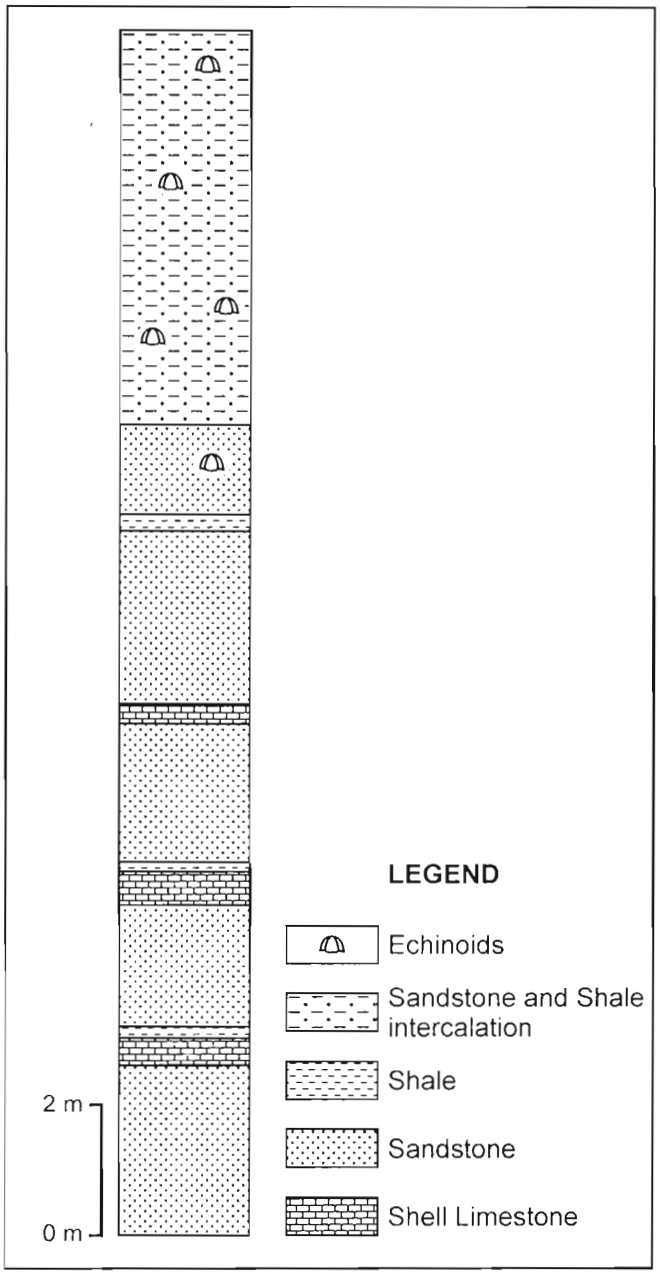

Fig. 2. Lithocolumn of the Bhuban Formation exposed at South Hlimen Quarry, Aizawl, Mizoram, India.

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