- Reddy, B. J. and Sarma, K. B. N., Indian J. Pure Appl. Phys., 1982, 20, 74.
- 2. Faye, G. H., Can. Mineral., 1970, 10, 889.
- 3. Figgis, B. N., Introduction to Ligand Field Theory, Inter-science Publishers, New York, 1964, p. 1.
- 4. Blanchard, S. C. and Chasteen, N. D., J. Phys. Chem., 1976, 80, 1362.

ACKNOWLEDGEMENT. We thank the authorities of RSIC, Indian Institute of Technology, Bombay and Madras for providing optical and EPR spectral recordings of the sample.

7 September 1989; revised 10 November 1989

Record of Echinoid genus *Ditremaster* from Middle Eocene rocks of Kutch, India

D. K. Srivastava and S. Srivastava

Geological Survey of India, B-201, Rajendra Marg, Bapu Nagar, Jaipur 302 015, India

The echinoid genus *Ditremaster* is being recorded and described here for the first time from Middle Eocene rocks of Kutch and India. The genus is characterized by its subglobular test with faint frontal sinus and anteriorly excentric ethmolytic apical system with two genital pores.

Studies on Tertiary echinoids in Kutch have extended for nearly century and half to the present day by several workers¹⁻⁷. Among echinoids, Breynia, Eupatagus, Hemiaster, Meoma, Moira and Schizaster constitute the spatangoid group⁶, which occur commonly in the

Tertiary sediments of Kutch⁸. During field work in 1982, a well-preserved specimen of spatangoid echinoid was collected by one of us (S.S.) from the rock of Bermoti Series (Babia Stage) exposed at about 500 m north of Harudi (68° 41′ 15″: 23° 30′ 20″) village, district Kutch, Gujarat (Figure 1)⁹ and this specimen is described in this paper. Detailed morphological examination of the specimen has confirmed that the echinoid specimen belongs to the genus Ditremaster Munier-Chalmas, 1885 and is reported for the first time from Kutch and India. The microfauna, Nummulites perforatus, Truncorotaloides topilensis, T. rohri and Orbulinoides beakmanni present in association indicate a Lutetian age.

The specimen (Figure 2) is characterized by its medium-sized subglobular test having faint frontal sinus and anteriorly excentric ethmolytic apical system with two genital pores (diameter 0.68 mm). These pores are 1.68 mm apart. Ocular plates I and V are largest, pentagonal (maximum diameter 0.99 mm) and separated by 1.22 mm wide madreporite. Ocular plate III is smallest (maximum diameter 0.61 mm). Each ocular plate is perforated by a single, circular ocular pore (diameter 0.15 mm) lying close to the outer margin of the plate.

Ambulacral petals are five in number, depressed, petaloid and slightly flexuous excluding III which is straight and open; III is longest (14.53 mm) and narrowest (3.97 mm); I and V are shortest (8.69 mm) and II and IV are broadest (5.81 mm).

The pore pairs of poriferous zone in paired ambulacra are non-conjugate and consist of outer oval pores (maximum diameter 1.14 mm, minimum 0.38 mm) and inner elliptical pores (maximum and minimum diameters 0.84 mm and 0.26 mm respectively). A row of

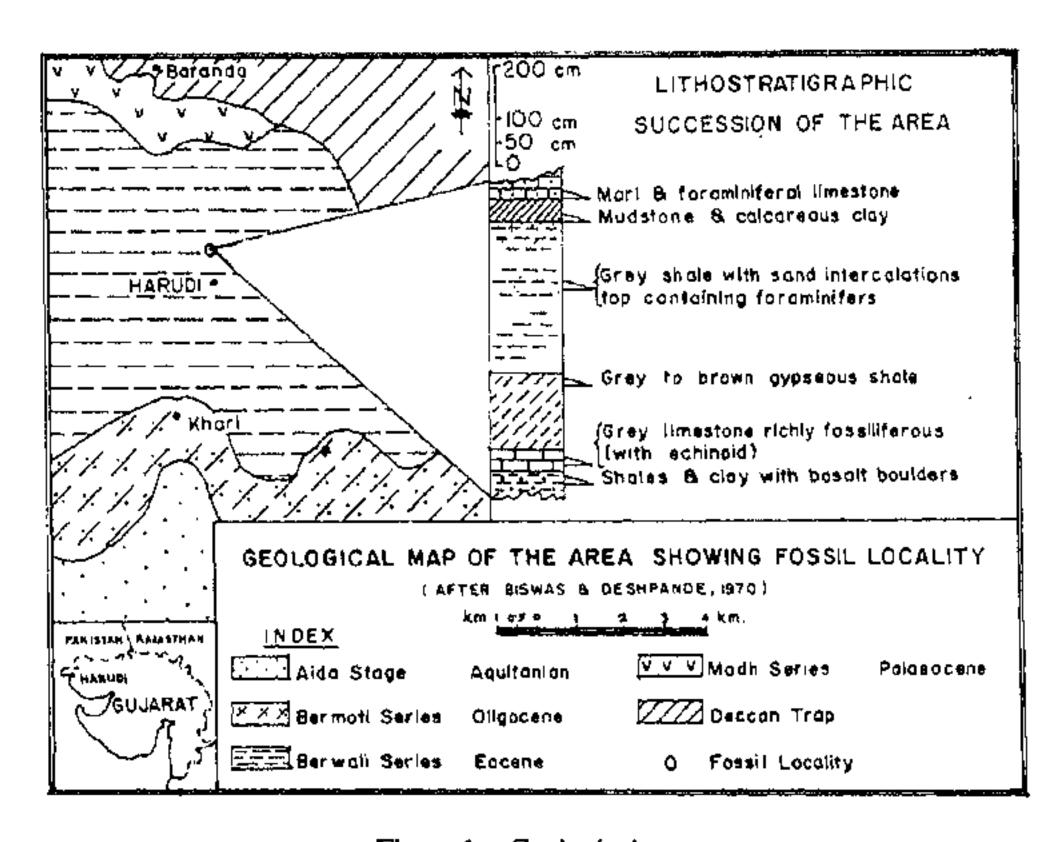


Figure 1. Geological map.

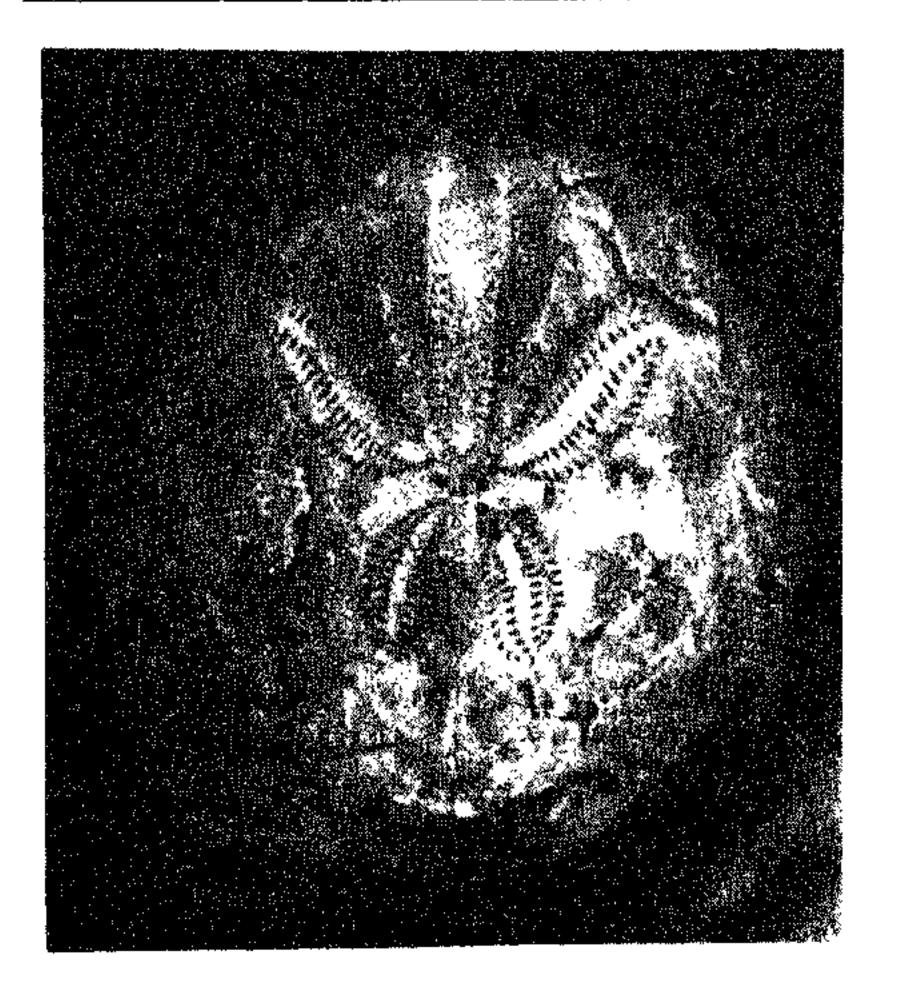


Figure 2. Ditremaster sp., aboral view ($\times 1.75$ approx.).

small tubercles is present on coastae between each pore pair. In ambulacrum III both the pores of pore pair are elliptical in shape (maximum and minimum diameters 0.45 mm and 0.15 mm respectively) and are separated by a single tubercle.

Ambulacral plates simple and in poriferous zone each plate is perforated by a pore pair. The length and width of the largest ambulacral plate are 2.28 mm and 0.45 mm respectively. The specimen has only a 1.14 mm wide peripetalous fasciole which passes all around the extremities of petals, curving sharply inwards just posterior of petals II and IV.

The test is ornamented with non-perforated and non-crenulated tubercles which are sunken in small circular scrobicules. Orally, these are denser than those on aboral side. However, peristome and periproct are not preserved in the specimen.

The presence of a peripetalous fasciole and ethmolytic apical system with two genital pores confirms it to be a hemiasterid. It has also been observed that at the generic level, the other morphological characters of the specimen share with two genera namely *Ditremaster* Munier-Chalmas, 1885 and *Opissaster* Pomel, 1883, but the former differs from the latter in not having an oval test, deep frontal sinus and a centrally situated apical system¹⁰.

The specimen no. I-133 has been deposited in the Regional Palaeontological Laboratory, Geological Survey of India, Jaipur.

- Srivastava, D. K., Proc. 7th Indian Colloq. Micropal. Strat., 1978, 421.
- 4. Srivastava, D. K., Rec. Geol. Surv. India, 1982, 112, 23.
- 5. Srivastava, D. K., Ph. D. thesis, Lucknow Univ., 1985, 255.
- 6. Srivastava, D. K., Geol. Surv., India Spl. Pub. no. 11, 1988, 147.
- 7. Tandon, K. K. and Srivastava, D. K., J. Pal. Soc. India, 1980, 23 and 24, 1.
- 8. Biswas, S. K. and Raju, D. S. N., Bull. ONGC, 1973, 10, 37,
- 9. Biswas, S. K. and Deshpande, S. V., Bull. ONGC, 1970, 7, 115.
- 10. Fischer, A. G., Treatise on Inv. Pal. (ed. Moore, R. C.), 1966, U3 (2), 563, 565.

ACKNOWLEDGEMENTS. We thank Dr U. B. Mathur for going through the manuscript critically and Dr K. J. McNamara, Department of Palaeontology, Western Australian Museum, for comments and suggestions.

February 1989; revised 25 September 1989

Marine Permian fossils from foothills of Bhutan Himalaya

Ashutosh Joshi

Geological Survey of India, Bhutan Unit, Samchi, Bhutan

The sequence of rocks with marine Permian fossils referred to as Seti Khola Formation in the present paper is well exposed in the Sankosh valley of Bhutan. The 1000-m-thick fossiliferous Formation is overlying Siwalik, with a northward dipping thrust (Main Boundary Thrust) separating the two. Fossils, represented by brachiopods, gastropods, bryozoans and crinoids, suggest late Lower Permian age. Sedimentological studies indicate a shallow-water mixed environment to lagoonal environment.

Well-preserved marine Permian fossils represented by brachiopods, gastropods, bryozoans and crinoids have been discovered from the Sankosh valley of Bhutan Lesser Himalaya (see Figure 1). The fossil locality is defined by coordinates 26° 44′ and 89° 48′; best outcrops are exposed along the Seti Khola. The Seti Khola Formation that lies north of Siwalik and south of Phuntsholing formation was considered part of the continental Gondwana sequence by majority of workers^{1,2} and Eocene by others³. Profuse biotic activity in the Formation warranted a closer examination and systematic search for the fossils.

Three mappable units separated from each other by a tectonic plane are demarcated (Figure 1). The Siwalik Group of rocks (thickness ~ 1700 m) are exposed in the south of the area and are thrust over by the rocks of the Seti Khola Formation. The northward dipping thrust designated as Main Boundary Thrust (MBT) separates the two units. In the north, Phuntsholing formation with quartzite and phyllite is thrust over the Seti Khola Formation. This Formation with over

^{1.} Duncan, P. M. and Sladen, W. P., Pal. India, 1883, 14, 104.

^{2.} Roy A. K. and Das Gupta, A., Q. J. Geol. Min. Met. Soc. India, 1970, 42, 149.