Palynomorphs From Denwa Formation (Late Triassic), Satpura Basin, India

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Kumar P. 2000. Palynomorphs from Denwa Formation (Upper Triassic), Satpura Basin, India. *Geophytology* **29** (1&2) : 99-104.

Palynofossils are recorded from the Late Triassic beds of Denwa Formation exposed in subsurface artesian well-cutting near Anhoni Village, Chhindwara district, Madhya Pradesh. Palynoassemblage comprises : *Brachysaccus, Falcisporites, Krempipollenites, Satsangisaccites, Staurosaccites, Minutosaccus, Aratrisporites, Rimaesporites, Ashmoripollis, Samaropollenites, Denwasporites,* etc., alongwith some Jurassic elements present in low numbers, such as *Haradisporites scabratus, Dictyophyllidites, Callialasporites* cf. *dampieri, Podocarpidites* sp., *Vitreisporites* sp., etc.

This palynoassemblage suggests mixture of cool temperate upland and warm dry climate in low land areas with seasonal fluctuations. Presence of Dinocysts indicates the deposition of beds in lacustrine set up.

Key-words - Palynoassemblage, Palaeoenvionment, Denwa Formation, Late Triassic, Satpura Basin

INTRODUCTION

MEDLICOTT (1873) divided the Mahadeva Group into three units viz., Pachmarhi (lower), Denwa (middle) and Bagra (upper). The Denwa beds were characterised by red clays and subordinate yellow sandstones exposed in the Denwa river, north of the Pachmarhi plateau, Madhya Pradesh. Later, Crookshank (1936) studied the geology of the area in detail, and the Bagra Formation was suggested to be contemporaneous with the higher Denwa beds. Sastry *et al.* (1977) opined that due to facies variation all the three units grade into one another laterally. Raja Rao (1983) considered Bagras to overlie unconformably upon Denwa beds. Crookshank (1936) and Sastry *et al.* (1977) assigned Dewna beds as Late Triassic (Keuper), based on amphibian remains (Labyrinthodont) *Mastodonsaurus indicus* (Lydekker, 1885) and according to latter author it is Carnian to Early Norian in age. Chatterjee and Roy Choudhury (1974) dated it late Early Triassic to Middle Triassic, based on fossil *Paratosaurus*.

Due to paucity of plant fossils no age could be ascertained for these units. Recently, Nandi (1996) studied palynologically the carbonaceous sediments at the depth of 100 m and 200m in a bore-core ANH-1 drilled at Anhoni Village and dated them as Carnian to Norian age. Lately, Kumar (2000) studied palynologically the sediments exposed in an artesian well south of Anhoni Village. Three palynoassemblages were recognised on the basis of quantitative dominance of palynotaxa suggesting Norian-Rhaetian age.

The sample details and list of palynotaxa identified have been published in Kumar (2000). The present paper describes details of sporae dispersae and their palaeoenvironmental significance.

Haradisporites sinuosus Kumar, 1973

Pl.1, fig.1

Remarks - Haradisporites sinuosus Kumar (1973) was originally recorded from the Jabalpur Formation (Late Jurassic-Early Cretaceous) exposed at Harad river, near Hathnapur in Narsinghpur distict, M.P. A single specimen of this species and a few specimens of *Haradisporites scabratus* Kumar (1973) have been recovered from Denwa Formation. Its presence shows the earliest appearance during the Late Triassic time in Denwa sediments exposed in a well-cutting at Anhoni Village, Chhindwara district, Madhya Pradesh.

Verrucosisporites kazigaonensis Tripathi, Tiwari & Kumar 1990

Pl.1, fig.5

Two specimens of this species in broken form have been recorded from Denwa Formation of Satpura

basin. They resemble *V. kazigaonensis* Tripathi *et al.* (1990) described from Late Triassic Dubrajpur Formation of Rajmahal basin, Bihar in having robust verrucae and thickness of exine, fusion of verrucae to form a reticulate pattern. The nature of Y-mark could not be studied due to incompleteness of the specimens.

Cycadopites stonei Helby 1987

Pl.1, fig. 18

Remarks - Helby (1987) described *C. stonei* from Mungaroo Formation, Exmouth Plateau, Carnarvon Basin. He opined that it is confined to the Late Triassic (Carnian-? Norian) of northwestern Australia and prominently recorded in *Minutosaccus crenulatus* zone (Helby *et al.* 1987). Two specimens are recorded from Denwa Formation of Satpura Basin. These have mixed low relief sculptural elements as grana, verrucae and coni, sometime a fold is seen running parallel to the colpus margin.

Cycadopites sp.

Pl.1, fig. 23

Description - Laterally compressed pollen grain, monosulcate, elongated oval or weakly boat-shaped in equatorial view, size 82 µm long, 34 µm broad, ends are roundly pointed. Furrow extends one end to the other. Exine more or less 1.0 µm thick, smooth and folded.

Comparison - *Cycadopites* sp. A and B Kumaran and Maheshwari (1980) differs from this species in being larger size, broadly oval or spindle shape and colpus is narrower in the middle. *C. grandis* de Jersey & Hamilton in Kumaran and Maheshwari (1979, Pl.6, fig.8) is larger in size (130 x 50 µm) and colpus is dumb-bell shaped.

Callialasporites sp.

Only one specimen of *Callialasporites* sp. (Pl.1, fig.19) has been recovered from the Upper Triassic beds of Denwa Formation in Satpura basin. The appearance of *Callialasporites* in the Triassic sediments studied here may indicate its First Appearance Datum (FAD) since this genus fluorished well in the Jurassic Period. Dolby and Balme (1976, p.128; *in* Helby *et al.* 1987, p.11) suggested that "the Triassic passes into Lower Jurassic without evidence of pronounced unconformity".

Vitreisporites savitrii sp.nov.

Pl.1, figs. 9,10,17

Holotype - Pl.1, fig.9; Size 52 x 22 µm; Regd. Sl.No. 12256

Locus typicus - Anhoni Village, Chhindwara district, Madhya Pradesh, India.

Stratum typicum - Denwa Formation, Mahadeva Group, Satpura basin, M.P.

Diagnosis - Size 52.00-70.50 µm on horizontal axis and 22-52.00 µm on vertical axis. Central body broadly oval, indistinct outline. Exine thin, intramicroreticulate. Sacci hemispherical,

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PLATE-1 ⟶

All photomicrographs are x 500. The figured slides are deposited with the repository of the Birbal Sahni Institute of Palaeobotany, Lucknow. Co-ordinates of specimens in slides refer to the stage of Labor lux D no. 077055.

Fig.1 *Haradisporites sinuosus* BSIP Slide No. 12255; 24x101.5
Fig.2 *H. scabratus* BSIP Slide No. 12053; 25x95.
Fig.3 *Cyathidites* sp. BSIP Slide No. 12256; 39x98.5
Fig.4 *Osmundacidites senectus* BSIP Slide No. 12054; 32. 5x107.5
Fig.5 *Verrucosisporites kazigaonensis* BSIP Slide No. 12256; 12x102.5
Fig.6 *Podocarpidites* sp. BSIP Slide No. 12415; 26x104.5
Fig.7 *Samaropollenites speciosus* BSIP Slide No. 12255; 31x97.5
Fig.8 *Protohaploxypinus* sp. BSIP Slide No. 12414; 12x109.5
Fig.9 *Vitreisporites savitrii* sp. nov. holotype. BSIP Slide No.12256; 29x93.5
Fig.10 *V. savitrii* sp. nov. BSIP Slide No. 12054; 32x101.5
Fig.11 *Ashmoripollis reducta* BSI Slide No. 12053; 29x101.5
Fig.12 *Brachysaccus indicus* BSIP Slide No. 12255; 29x105.
Fig.13 *Arcuatipollenties ovatus* BSIP Slide No. 12255; 23.5x111.
Fig.14 *Chordasporites australiensis* BSIP Slide No. 12414; 35x100.
Fig.15 *Aratrisporites fischeri* BSIP Slide No. 12053; 45x105.
Fig.16 *Rimaesporites potoniaei* BSIP Slide No. 12256; 20x112.5
Fig.17 *Vitreisporites savitrii* sp. nov. BSIP Slide No.12413; 19x100.5
Fig.18 *Cycadopites stonei* BSIP Slide No. 12417; 40x98.5
Fig.19 *Callialasporites* sp. BSIP Slide No. 12416; 42x97.
Fig.20 *Minutosaccus maedlieri* BSIP Slide No. 12414; 24x95.5
Fig.21 *Corollina* cf. *simplex* BSIP Slide No. 12255; 45x96.5
Fig.22 *Denwasporites anhonie* BSIP Slide No. 12255; 42x95.5
Fig.23 *Cycodopites* sp. BSIP Slide No. 12054; 32x107.

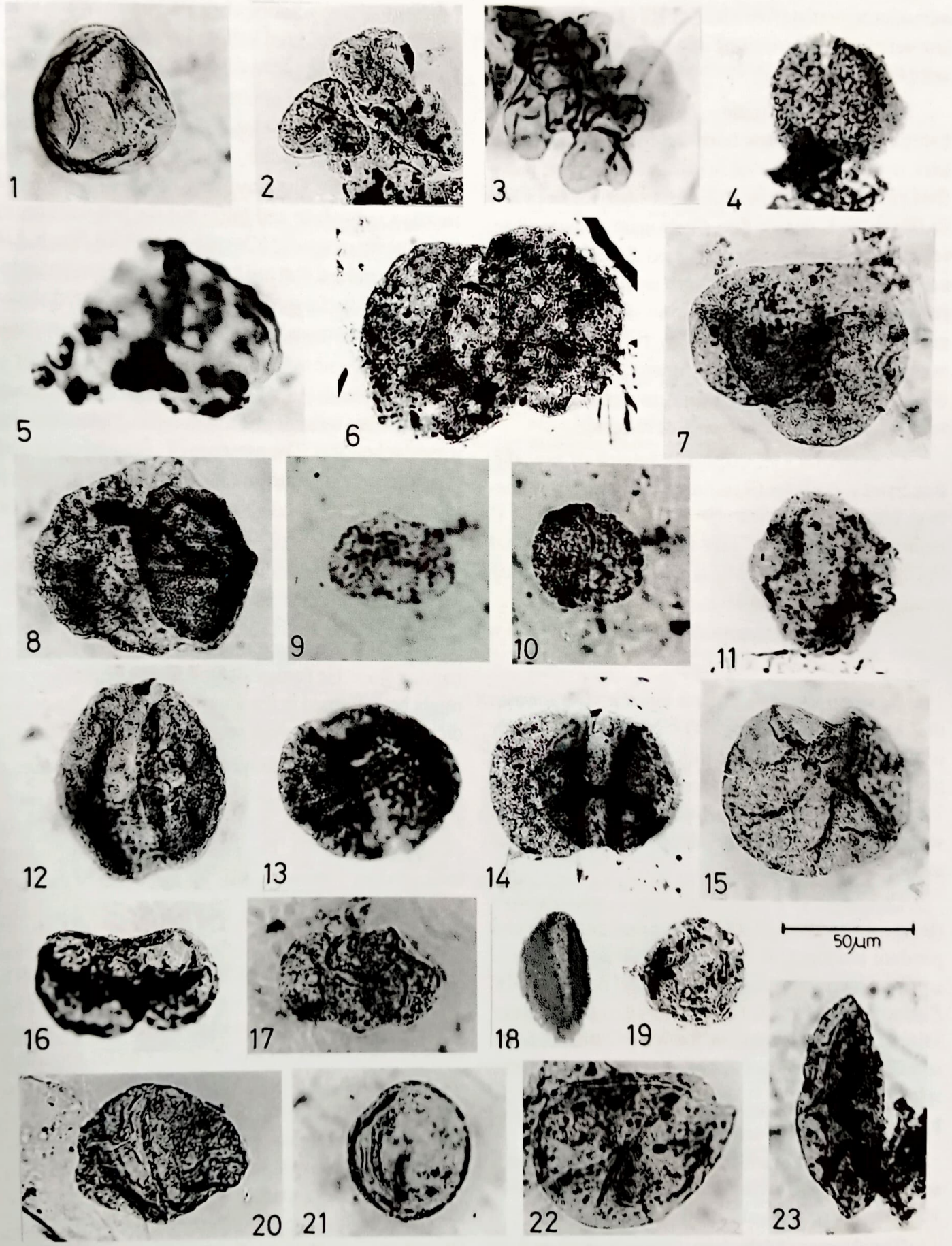

PLATE 1

intramicroreticulate, reticulum feebly developed. Sulcus not much wide, outline and its margin feebly developed.

Description - Pollen grains bisaccate, haploxylonoid, Central body 28-51.5 μm in vertical axis, oval to broadly oval in polar view, outline indistinct i.e., diffused. Exine thin, proximally more or less 01.00 μm thick, distally thin, finely intramicroreticulate, reticulum thin and feebly developed. Sacci hemispherical, normally equal to or slightly smaller vertically in respect to central body, measuring 18-33 μm in horizontal axis and 17-48.5 μm in vertical axis, intramicroreticulate, muri thin, lumina small puncta like but feeble. Sulcus 8-16 μm wide, marginal fold along sulcus margin absent or feebly developed.

Comparison - *Vitreisporites savitrii* sp. nov. differs from *V. pallidus* (Reissinger) Nilsson (1958) being smaller in size (9-13 x 11-16μm). *V. rajmahalensis* Sah & Jain (1965) from Rajmahal Formation, Rajmahal Hills is also different in having smaller size (32x 24μm).

***Podocarpidites* sp.**

Pl.1, fig.6

Description - Pollen grain bisaccate, diploxylonoid, measuring 100 x 74 μm. Central body is oval, 44 x 60 μm. Exine thin and granulose, grana fine, sacci unequal in shape and size 30.5-46.5x 68-74 μm, intrmicroreticulate. Sulcus more or less 8 μm wide and folds feebly developed along the sulcus margin.

Comparison-Podocarpidites multesimus (Bokhovitina) Pocock (1962) is smaller in size and pendant bladders. *P. ellipticus* Cookson (1947) is smaller in size and broadly elliptical central body. *Podcarpidites* sp. Kar (1970) recorded from Lower Triassic (Panchet Formation, Raniganj Coalfield) bears smaller central body (40x44 μm) and equal hemispherical sacci.

Palaeoenvironment

Satpura Gondwana basin originally comprised a series of lakes in a fluviatile complex which were never very deep (Crookshank, 1936).

The Triassic Mahadeva Group considered as Middle Gondwana comprises Pachmarhi sandstones, Denwa clays (middle) and Bagra conglomerates (upper) by Medlicott (1873). The Upper Triassic Denwa Formation consists of alternating beds of sandstone (with red jasper pebbles common) and variegated clays (always calcareous and often contain numerous calcite nodules). The clays vary in colour (green, red, mottled red, white and buff) but the red ones being the most characteristic (Crookshank, 1936). Singh, I.B. (1976) surmised that red beds and conglomerates indicated rapidly flowing rivers and red coloured shales suggested subtropical setting with pronounced seasonal droughts.

Crookshank (1936) opined that Mahadeva Group of sediments were deposited in typical lakes having irregular bottoms. The presence of coloured clays and conglomerates indicate denudation and deposition were most rapid and the regions were along coasts or around mountainous country subject to high rain fall, he denied the glaciation at this period because no ice scratched boulders were found. Though presence of erratic boulders in Denwa clays in some areas (along Sukha Nala) suggested that they were deposited by melting floes. He further suggested that occasional ice might have formed in the winter in any high region indicating arid climate with very little natural vegetation.

The animal fossil labyrinthodont *Mastodonsaurus indicus* (Lydekker, 1885), *Metaposaurus* and *Paratosaurus* were recorded from Denwa beds (Sastry *et al.*, 1977). The presence of labyrinthodont indicates that there was water for some part of the year (Shah 1976) and drying up of lakes (Singh, I.B., 1976).

The records of fragmentary plant fossils are very meagre, comprising some leaf impressions resembling *Phoenicopsis* and the trunks of a tree in the Denwa beds (Crookshank 1936). Kumar (2000) recorded palynofossils having poor trilete and monolete marked spores (pteridophytic/pteridospermic) and gymnospermic monocolpate *Cycadopites* (Cycadales/Bennettitales) and operculate nonsaccate pollen *Corollina* (Cheirolepidaceae), etc., indicative of low lying and the last one being the representative of shallow marine near shore areas (Ramanujam, 1993). The

conglomeratic nature of upper Denwa sediments further indicates a coast line or the propinquity of a mountainous area with a high rainfall (Crookshank, 1936).

The prominence of gymnospermic haploxylonoid disaccate pollen viz., *Brachysaccus, Falcisporites, Satsangisaccites* along with *Alisporites, Minutosaccus, Ashmoripollis*, etc., indicates a temperate flora which were dwellers of high mountain regions. Ueno (1958, 1979), Tiwari (1982), Tiwari and Tripathi (1987), Kumar (1996) suggested that haploxylonoid sacci bearing pollen are produced by the flora which thrived well in cool temperate and subpolar or subalpine zone, whereas taeniate pollen such as *Arcuatipollenites, Staurosaccites* and flange bearing spores, viz., *Aratrisporites, Callialasporites*, etc., are indicative of warmer dry conditions with seasonal fluctuations at low lying areas.

The presence of fungal and algal remains viz., spores, fruiting bodies (microthyriaceae) in the Denwa sediments indicate warm-temperate to tropical zones, especially where high humidity is present. the plants these fungi parasitize "inhabit either rain-forest areas or moist mountain gullies" (Cookson, 1947; *in* Elsik, 1978). Algal spores of Zygnemataceae family suggest a fresh water lake deposits for Denwa Formation.

The presence of dinocysts indicates lacustrine environment during the deposition of Denwa beds as similar dinocyst assemblage is known elsewhere (Jain *et al.* 1982; from ? Upper Jurassic Jabalpur Formation in Satpura basin, Madhya Pradesh). Whereas these being deposited near coastal areas is indicated by the presence of *Corollina* (=*Classopollis*) pollen and conglomeratic, calcitic (clacareous) nature of sediments indicating very near source. Nandi (1994) also reported the presence of dinoflagellate cysts in Denwa Formation, but suggested a marine environment during Late Triassic period.

ACKNOWLEDGEMENT

I am thankful to the Director, Birbal Sahni Institute of Palaeobotany, Lucknow, for kind permission to publish this work.

REFERENCES

Chatterjee S & Roy Choudhury T 1974. Triassic Gondwana vertebrates from India. *International Journal of Earth Sciences* **1** (1): 96-112.

Cookson IC 1947. Plant microfossils from the Lignites of Kerguelen Archipelago B.A.N.Z. *Antractic Research Expedition 1929-1931 Report A2*: 127-142.

Crookshank H 1936. Geology of the northern slopes of the Satpuras between the Morand and the Sher rivers. *Mem. geol. Surv. India* **66** (2): 242-272.

Dettmann ME 1963. Upper Mesozoic microfloras from south eastern Australia *Proc. Royal Society Victoria* **77** (1) : 1-148.

Elsik WC 1978. Classification and geological history of the microthyriaceous fungi. *Proceeding IV International Palynological Conference Lucknow* (1976-1977). **1**: 331-342.

Helby R 1987. Three Late Triassic palynomorphs from northwestern Australia. in: *Studies in Australian Mesozoic Palynology*. editor Jel, P.A., *Memoir Association of Australian Palaeontologists, Sydney* **4** : 95-100.

Helby R, Morgan R & Partridge Alan D 1987. A palynological zonation of the Australian. Mesozoic in: *Studies in Australian Mesozoic Palynology*. editor Jell. P.A. *Memoir Association of Australian Palaeontologists, Sydney* **4** : 1-94.

Jain KP, Kumar P & Maheshwari HK 1982. Dinoflagellate cycsts from 'Non-Marine sediments of Jabalpur Group at Morghat, Madhya Pradesh. *Palaeobotanist* **30** (1): 22-27.

Kar RK 1970. Palynological distinction between Upper Permian and Lower Triassic in Raniganj coalfield, Bengal, India. *Palaeobotanist* **18**(2): 118-126.

Kumar P 1973. The sporae dispersae of Jabalpur Stage, Upper Gondwana, India. *Palaeobotanist* **20** (1): 91-126.

Kumar P 1996. Permo-Triassic palynofossils and depositional environment in Satpura Basin, Madhya Pradesh. Geophytology **25** : 47-54.

Kumar P 2000. Palynodating of Denwa Formation, Satpura Basin, India. (editor) M Kedves. *Plant Cell Biology Development, Hungary* **11**: 9-18.

Kumaran KPN & Maheshwari HK 1980 Upper Triassic sporae dispersae from the Tiki Formation 2: Miospores from the Janar Nala Section, South Rewa Gondwana Basin, India. *Palaeontographica B* **173**: 26-84.

Maheshwari HK & Kumaran KPN 1979. Upper Triassic sporae dispersae from the Tiki Formation-1: Microspores from the Son River Section between Tharipathar and Ghiar, South Rewa Gondwana Basin. *Palaeontographica* **B171**:137-164.

Medlicott HB 1873. Notes on the Satpura Coal Basin. *Mem. geol. Surv. India* **10** : 159.

Nandi A 1994. Palynological, Palaeobotanical and Faunal studies of Upper (Mesozoic) Gondwana of Satpura Basin, M.P. *Rec. geol. Surv. India* **127** (6): 283-284.

Nandi A 1996. Palynodating of carbonaceous shales from Denwa Formation, Satpura Basin, M.P., India. *Ninth International Gondwana Symposium, Gondwana Nine* **1**: 79-87.

Nilsson T 1958. Über das Vorkommen eines mesozoischen

sapropelgesteins in Schönen. *Acta University Lundblad* **54** (10): 6-111.

Pocock SAJ 1962. Microfloral analysis and age determination of strata at the Jurassic-Cretaceous boundary in the Western Canada Plains. *Palaeontographica*. **B111**:1-95.

Ramanujam CGK 1993. Spore and pollen suits of some Upper Gondwana deposits of South India-critical appraisal. *Gondwana Geological Magazines 1993, Special Volume, Birbal Sahni Centenary National Symposium Gondwana India* : 462-478.

Raja Rao CS 1983. Coal resources of Madhya Pradesh, Jammu & Kashmir. *Bull. geol. Surv. India*, Series A, No. 45, *Coalfields of India* **III** 1-204.

Sah SCD & Jain KP 1965. Jurassic spores and pollen grains from the Rajmahal Hills, Bihar, India: With a discussion on the age of the Rajmahal Intertrappean Beds. *Palaeobotanist* **13** (3): 264-290.

Sastry MVA, Acharya SK, Shah SC, Satsangi PP, Ghosh, SC, Raha PK, Singh G & Ghosh RN 1977. Stratigraphic lexicon of Gondwana Formation of India. *Misc. Publ. geol. Surv. India* **36** : 1-170.

Shah SC 1976. Climate during Gondwana era is Peninsular India: Faunal evidences. *Geophytology* **6**(2) : 186-206.

Singh IB 1976. Minerological evidences for climatic vicissitudes in India during Gondwana times. *Geopytology* **6**(2): 174-185.

Tiwari RS 1982. Nature of striations and taeniae in Gondwana saccate pollen. *Geophytology* **12**: 125-127.

Tiwari RS & Tripathi A 1987. Palynolgical zones and their climatic inferences in the coal bearing Gondwana of Peninsular India. *Palaeobotanist* **36**:97-101.

Tripathi A, Tiwari RS & Kumar P 1990. Palynology of the subsurface Mesozoic sediments in Rajmahal Basin, Bihar. *Palaeobotanist* **37** (3): 367-388.

Ueno J 1958. Some palynological observations of Pinaceae. *Journal Institute of Polytech Osaka City University* **9**: 163:186.

Ueno J 1979. *Pinus* and Pollen analysis. *Palaeolimnology Lake Biwa & Japanese Pleistocene*. **7**: 125-127.

(Received 31.08.2000; Accepted 29.09.2000)