LOWER MESOZOIC MEGASPORES FROM THE VARIEGATED STAGE OF SALT RANGE (W. PAKISTAN)

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ABSTRACT

A megaspore assemblage, recovered from the Variegated Stage of Nammal Gorge, Salt Range (W. Pakistan), has been described. The assemblage is characterized by the presence of *Banksisporites sinuosus* Dettmann, *Nathorstisporites hopliticus* Jung, *N. reticulatus* Dettmann, *N. nammalensis* sp. nov., *Nathorstisporites peltasticus* Jung, *Minerisporites* sp. and *Hughesisporites novus* sp. nov. The Salt Range megaspore flora shows closest affinity with the Rhaetic-Liassic megaspores from South Australia and Tasmania.

The Jurassic profile in the Nammal Gorge Section of the Variegated Stage are considered by some geologists to range from Middle to Upper Jurassic while others think they may range from Lower to Middle Jurassic. However, the evidence of the megaspore assemblage described here tends to support a Lower Jurassic (Liassic) age for the two lowermost beds of the Variegated Stage of the Nammal Gorge Section.

INTRODUCTION

THE first description of plant microfossils from the Variegated Stage of Nammal Gorge, Salt Range (W. Pakistan) was made by Sah (1955) who figured a number of miospores, cuticular fragments and two 'megaspore-like bodies'.

The same material has now been reworked by us and on re-maceration has yielded a number of well preserved megaspores which have been described here.

The chief interest of the present megaspore assemblage lies in the fact that they show a close similarity in composition with the Rhaeto-Liassic megaspore assemblage of South Australia and Tasmania (DETTMANN, 1961). The megaspore assemblage comprises of seven species belonging to four genera, of which only two species are new while the rest have been placed under the previously described species.

The geological sequence in the Nammal Gorge (Bakh ravine) Section, from where the material comes, is given by Gee (1947; pp. 143-146).

The carbonaceous shale which has yielded the megaspores comes from bed b (Variegated, carbonaceous sandstones and shales) of the Variegated Stage (GEE, *l.c.*, p. 145). So it is clear that the megaspore assemblage comes from the lower zones of the Variegated Stage of the Nammal Gorge Jurassic succession.

SYSTEMATIC DESCRIPTION

Anteturma — *Sporites* H. Potonié, 1893
Turma — *Triletes* (Reinsch) Potonié & Kremp, 1954
Subturma — *Azonotriletes* (Luber) Dettmann, 1963
Infraturma — *Laevigati* (Bennie & Kidston) Potonié, 1956

Genus *Banksisporites* Dettmann, 1961

Banksisporites sinuosus Dettmann, 1961

Pl. 2, Fig. 16

Distribution — Tasmania-Cornwall Mine, Bore No. 1. Rhaetic-Liassic.

Turma — *Barbates* Mädler, 1954

Genus *Hughesisporites* Potonié, 1956

Hughesisporites novus sp. nov.

Pl. 2, Figs. 11-13

Holotype — Pl. 2, Fig. 13; Reg. No. 6403; Sl. No. 2778.

Locality — Variegated Stage, Nammal Gorge Section, Salt Range, W. Pakistan.

Horizon — Liassic.

Diagnosis — Megaspores trilete; amb spheroidal to sub-spheroidal, 275-380 μ in diameter. Laesura lipped, sinuous or straight, rays reaching upto the periphery or sometimes extending beyond amb, triradiate lamella very conspicuous, 40-45 μ broad. Exine two layered, cavate, 20-25 μ thick, porous, both ecto- and endo-exines granulose. Ecto-exine sculptured prominantly with raised elevations. Elevations verrucose, comparatively dense on the facets, distantly distributed near the periphery or the lower part of the spore. Verrucae 10-20 μ high and 10-15 μ broad at the base, top rounded; sometimes the bases of the verrucae fuse with the adjoining ones, forming an irregularly reticulate pattern. Ridge demarcating the lower part of the contact face sometimes seen.

Comparison — *Hughesisporites novus* sp. nov. compares well with *H. variabilis* Dettmann (*l.c.*, p. 76) in its shape, size and exine-ornamentation, but differs mainly in having longer laesura and in the distribution of verrucae on the ectoexine. *H. ionthus* (Harris) Potonié (1956) is comparable with *H. novus* but can be distinguished in having a smooth and unornamented exine in the lower part of the spore.

Genus *Nathorstisporites* Jung, 1958

Nathorstisporites hopliticus Jung

Pl. 1, Figs. 6-7; Pl. 2, Fig. 17

Distribution — *Nathorstisporites hopliticus* Jung has so far been recorded only from the Rhaetic-Liassic sediments of Australia (DETTMANN, *l.c.*) and Germany (JUNG, 1958, 1960). *Lycostrobus scottii* is regarded as a zone fossil for the Rhaetic — Liassic sediments (HARRIS, 1935, p. 154).

Nathorstisporites reticulatus Dettmann, 1961

Pl. 1, Figs. 8-9; Pl. 2, Fig. 10

Distribution — South Australia — Leigh Creek Coal Measures. Rhaetic-Liassic.

Nathorstisporites nammalensis sp. nov.

Pl. 1, Figs. 1-5

Holotype — Pl. 1, Fig. 1; Reg. No. 6403; Sl. No. 2780.

Locality — Variegated Stage, Nammal Gorge, Salt Range, W. Pakistan.

Horizon — Liassic.

Diagnosis — Megaspores trilete, spheroidal, to subspheroidal, 430-460 μ in diameter; Y-mark generally indistinct, lips elevated, 50-60 μ high, extending up to spore margin, ray ends incised, ornamentation and texture similar to exine. Exine homogeneous, 8-15 μ thick, granulose, texture porous, ornamentation mixed, reticulate-flagellate, lumen of reticulum penta or hexagonal, 4-10 μ in width; flagella (spin-like processes) 40-115 μ in length with rounded and unbranched apex, broader at the base, surface texture porous.

Comparison — *Nathorstisporites nammalensis* sp. nov. compares closely with *N. flagellulatus* Dettmann (*l.c.*) but differs mainly in possessing unbranched processes and a reticulate exine. In its general form and the flagellate character *N. nammalensis* also compares with *Triletes ales* Harris (1935) described from Rhaetic-Liassic of Greenland and *Minerisporites* (*Triletes*) *ales* Potonié (1956) described from the Rhaetic-Liassic of Germany by Jung (1958, 1960), but differs mainly in having a reticulate exine and in the absence of a zona.

Derivation of Name — The specific name is derived from the Nammal Gorge Section of the Salt Range, W. Pakistan.

Nathorstisporites peltasticus Jung

Pl. 2, Fig. 14

Distribution — Rhaetic-Liassic of Germany (JUNG, 1958).

Turma — *Zonales* (Bennie & Kidston) Potonié, 1956
Subturma — *Zonotriletes* Waltz, 1935
Infraturma — *Zonati* Potonié & Kremp, 1954

Genus *Minerisporites* Potonié, 1956

Minerisporites sp.

Pl. 2, Fig. 15

Description — The megaspore referred here are zonate (zona preserved only at places), spheroidal, measuring 440-460 μ in diameter; triradiate lamellae conspicuous, forming 70 μ high plates, length more than the spore body, surface granulose, with porous texture. Arcuate lamellae also present, about 70 μ high, sculpture similar to that of the tri-radiate lamellae. Exine surface distally ornamented with projections, 23 × 27 μ in size, bases fused, forming a negative reticulum, apex rounded or acute; both proximal and distal surfaces granulose, with a distinctly porous texture.

Remarks — All the megaspore specimens are not completely preserved. They show some resemblance with *Minerisporites* (*Triletes*) *ales* Potonié (1956) but differs mainly in having neither small holes on the lamellae surface nor bifurcated processes.

DISCUSSION

General considerations — The megaspore assemblage of the Variegated Stage of the Nammal Gorge Section comprises of the following seven recognizable species belonging to four genera:

Nathorstisporites hopliticus Jung
Nathorstisporites reticulatus Dettmann
Nathorstisporites peltasticus Jung
Nathorstisporites nammalensis sp. nov.
Bankisporites sinuosus Dettmann
Hughesisporites novus sp. nov.
Minerisporites sp.

An analysis of the assemblage count reveals that *Nathorstisporites hopliticus* and *N. reticulatus* constitute the dominant elements, forming nearly 50 per cent of the assemblage. The abundance of these forms indicates that the parent plant of these species might have occupied an important position in the plant community. *Hughesisporites novus* (20%) forms the next important constituent followed by *Nathorstisporites peltasticus* (8%) and *Minerisporites* sp. (5%). The remaining species are more or less equally represented.

Comparison — A comparison of the megaspore assemblage from the Variegated Stage of the Nammal Gorge with comparable contemporaneous megaspore assemblages indicates a general closeness with the Lower Jurassic assemblages of Australia, Tasmania, Germany and Greenland. This resemblance is particularly evidenced in the presence of *Nathorstisporites hopliticus* Jung. As has been mentioned earlier, this megaspore species shows close identity to the megaspores of the organ species *Lycostrobus scottii* Nathorst, which has been recorded and found to be restricted to the Rhaeto-Liassic sediments of Greenland (HARRIS, 1926, 1935, 1946), Europe (WICHER, 1951; REISSINGER, 1952; WILL, 1953; ZNOSKO, 1951; LUNDBLAD, 1956; MACINKICWIEZ, 1957 and JUNG, 1958, 1960) and Australia (DETTMANN, 1961). Harris (1935, p. 154) found *Lycostrobus scottii* to be a stratigraphically useful zone fossil of the *Thaumatopteris* zone (Upper Rhaetic – Basal Liassic). Lundblad (1956, p. 9) agreed that the megaspores of *L. scottii* could advantageously be used as indicator of Lias and also the transitional beds between Rhaetic-Liassic.

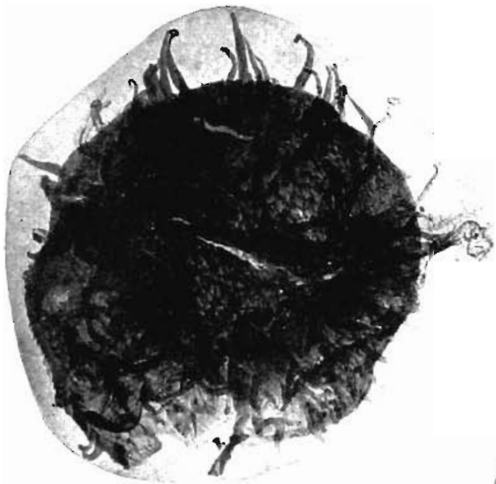
Furthermore, the presence of *Nathorstisporites reticulatus* Dettmann and *Banksisporites sinuosus* Dettmann brings the present Salt Range assemblage very close to the Rhaetic-Liassic deposits of Australia and Tasmania.

Comparing the present assemblage with the Middle Jurassic and Lower Cretaceous megaspores recorded from Europe (MURRAY, 1939; DIJKSTRA, 1951; HUGHES, 1955), India (SINGH *et al.*, 1964) and Australia (COOKSON & DETTMANN, 1958a-b), it becomes evident that the megaspore assemblage from the Variegated Stage is very distinct, there being no common elements. Sitholey (1943) described some megaspores from a sample collected near the top of the Triassic sequence about 10 feet below the massive, white Jurassic sandstones on the Gunjyal-Sakesar road, Salt Range. These megaspores are totally different and uncomparable to the megaspores described here.

Age of the Beds — From the published literature on the geology of the Salt Range, it seems that the question of the exact age of the Variegated Stage is a matter of controversy and still remains an open question. The earlier geologists, viz. Fleming (1852, 1853), Wynne (1878) and Gee (1947) have simply suggested a Jurassic age for the Variegated Stage. Later Wadia (1939, p. 174) suggested that there might have been a gap in the depositional history of the Salt Range sequence after Middle Triassic to early Jurassic due to the temporary withdrawal of the sea. As there had been no deposition after Middle Triassic to early Jurassic, it is naturally inferred that the deposition of the Variegated Stage took place sometimes during the Upper part of the Lower Jurassic. Krishnan (1960, p. 419) in Table 49 on "Jurassic Succession in Sheik Budin Hills" has assigned a Lower to Middle Jurassic age to the Variegated Series.

From the comparative analysis it is clear that the megaspore species in the Variegated Shale of the Salt Range are characteristic of the Rhaetic-Liassic assemblage. This assumption is based on our present knowledge regarding the vertical distribution of the species. The stratigraphical samples taken from the beds above the regional unconformity also demarcate the Jurassic succession from the underlying Kingriali Dolomites (Trias ?).

The palynological evidence indicates that the present assemblage is biostratigraphically equivalent to the Leigh-Creek beds of Australia (Rhaetic-Liassic) while their stratigraphical position in the Nammal Gorge succession is at the base of the Jurassic sequence (i.e. zones "a" and "b" GEE, 1947, p. 145). We are therefore inclined to favour a Lower Jurassic age for the zones "a" and "b" of the Variegated Stage.



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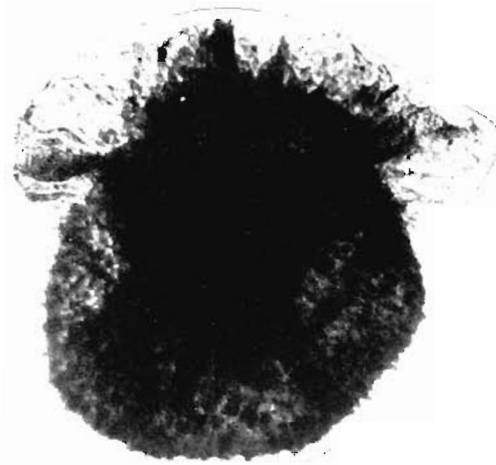

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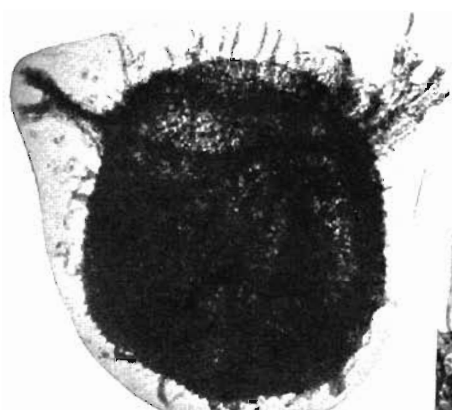

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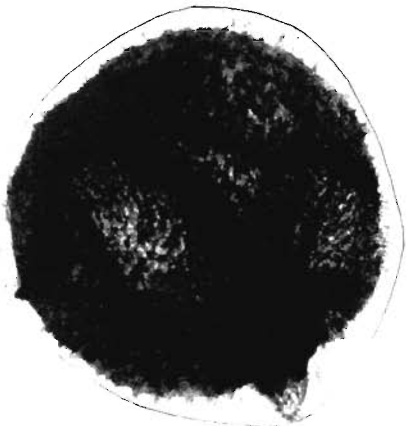

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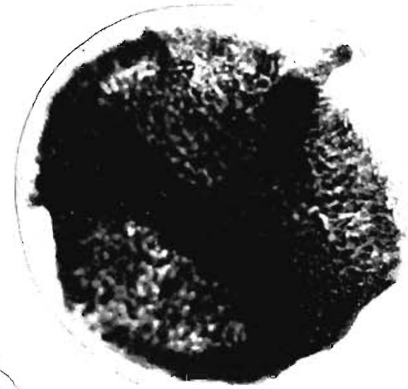

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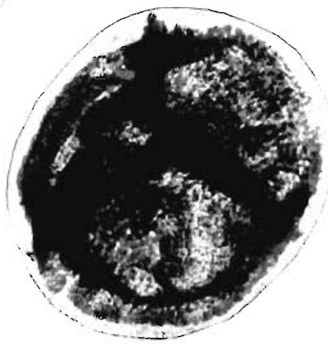

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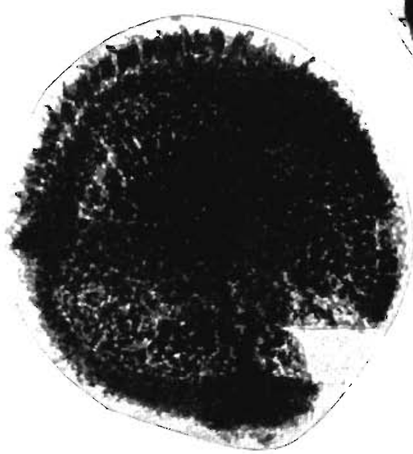

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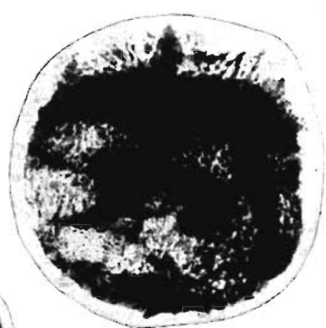

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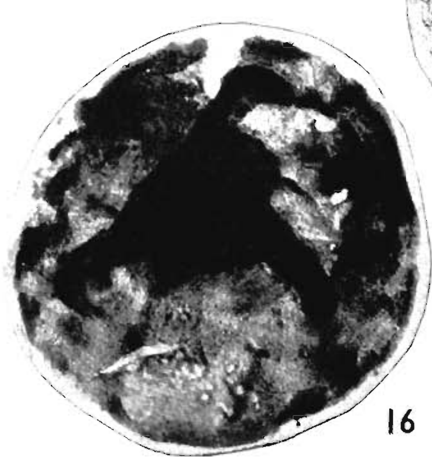

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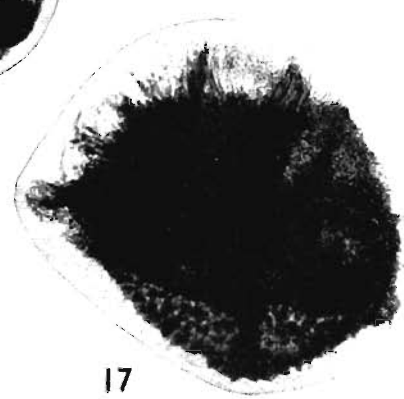

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REFERENCES

Cookson, I. C. & Dettmann, M. E. (1958a). Cretaceous 'Megaspores' and a closely associated microspores from the Australian region. *Micropaleontology*. **4**. 39-49.

Idem (1958b). Some trilete spores from Upper Mesozoic deposits in the eastern Australian region. *Proc. roy. Soc. Victoria*. **70** 95-128.

Dettmann, M. E. (1961). Lower Mesozoic megaspores from Tasmania and South Australia. *Micropaleontology*, **7**(1). 71-86.

Dijkstra, S. J. (1951). Wealden megaspores and their stratigraphical value. *Meded. geol. sticht.* **5**. 7-21.

Idem (1955). Some Brazilian megaspores, Lower Permian in age, and their comparison with Lower Gondwana spores from India. *Ibid.* **9**. 5-10.

Fleming, (1852). Report on the geological structure and mineral wealth of the Salt Range in the Punjab. *J. Asiatic Soc. Bengal*. **22**: 229-279.

Idem (1853). On the Salt Range of the Punjab. *Quart. J. geol. Soc.* **9**(1) 189-200.

Gee, E. R. (1947). Further note on the age of the Saline Series of the Punjab and of Kohat. *Proc. nat. Acad. Sci. India*. **16**(2-4): 95-154.

Harris, T. M. (1926). The Rhaetic flora of Scroesby sound, East Greenland. *Medd. Gronland*. **68**: 45-147.

Idem (1935). The fossil flora of scoresby sound, East Greenland, Part. 4. Ginkgoales, Coniferales Lycopodiales and Isolated fructifications. *Ibid.* **112**(1): 1-176.

Idem (1946). Liassic and Rhaetic plants collected in 1936-38 from East Greenland. *Ibid.* **114**(9): 1-38.

Hughes, N. F. (1955). Wealden plant fossils. *Geol. Mag.* **92**: 201-217.

Jung, W. (1958). Zur Biologie und Morphologie einiger disperser Megasporen, vergleichbar mit solchen von *Lycostrobus scotti*, aus dem Rhät-Lias Frankens. *Geol. Bl. No-Bayer*, **8**(3). 114-130.

Jung, W. (1960). Die dispersen Megasporen der frankischen Rhät-Lias-Grenzschichten. *Palaeontographica, B.* **107**(4-6): 127-170.

Krishnan, M. S. (1960). Geology of India and Burma. *Madras*.

Lundblad, B. (1956). On the stratigraphical value of the megaspores of *Lycostrobus scottii*. Preliminary report of some new finds and their interpretation. *Sverig. geol. Unders.* **50**(3): 1-11.

Marcinkiewicz, T. (1957). Liasowe megaspory z Praszki, Zawiercia i Gor Scwietokrzy skich. *Poland, Inst. geol. Kwart.* **1**(2): 299-302.

Murry, N. (1939). The microflora of the Upper and Lower Estuarine Series of the East Midlands. *Geol. Mag.* **76**: 478-489.

Potonié, R. (1956). Synopsis der Gattungen der Sporae dispersae. Teil. I. Sporites. *Beih. geol. J.* **23**: 1-103.

Reissinger, A. (1952). Uber den Ursprung der Angiosperms zayrenth. *Nat. Ges. Bayrenth*, **24.**

Sah, S. C. D. (1955). Plant microfossils from Jurassic shale of Salt-Range, West Punjab (Pakistan). *Palaeobotanist*. **4**: 60-71.

Singh, H. P., Srivastava, S. K. & Roy, S. K. (1964). Studies on the Upper Gondwana of Cutch-1. Mio- and Macrospores. *Ibid.* **12**(3): 282-306.

Sitholey, R. V. (1943). Plant remains from the Triassic of the Salt Range in the Punjab. *Proc. nat. Acad. Sci. India*. **13**(5) 300-327.

Wadia, D. N. (1939). Geology of India. *London*.

Wicher, C. A. (1951). Zur mikropalaontologischen Gliederung des nichtmarinen Rhat. *Hamburg. Erdol. Kohle.* **4**: 755-760.

Will, H. J. (1953). Palaontologische Untersuchungen zur stratigraphie des Ober Keupers in Nordwestdeutschland. *Tübingen Univ.* Dissertation.

Wynne, A. B. (1878). On the geology of the Salt Range in the Punjab. *Mem. geol. Surv. India*. **14**: 1-313.

Znosko, J. (1955). Rhaetic and lias between Cracow and Wielun. *Inst. geol. Prace*. **14**: 1-146.

EXPLANATION OF PLATES

Plate 1

1. *Nathorstisporites nammalensis* sp. nov. × 110. Sl. No. 2780.
2. Same, a portion magnified showing the flagella. × 260. Sl. No. 2780.
3. *Nathorstisporites nammatensis* sp. nov. × 110. Sl. No. 2779.
4. Same, a portion magnified showing the flagella. × 260. Sl. No. 2779.
5. A portion of similar spore magnified showing reticulate exine. × 170. Sl. No. 2788.

6-7. *Nathorstisporites hopliticus* Jung. × 150 and × 110 respectively. Sl. Nos. 2778 and 2784 respectively.

8-9. *Nathorstisporites reticulatus* Dettmann. × 150 and × 160 respectively. Sl. Nos. 2786 and 2782 respectively.

Plate 2

10. *Nathorstisporites reticulatus* Dettmann. × 130. Sl. No. 2778.

11-13. *Hughesisporites novus* sp. nov. × 150, × 130 and × 130 respectively. Sl. Nos. 2787, 2783 and 2778 respectively.

14. *Nathorstisporites peltasticus* Jung. × 120, Sl. No. 2779.
15. *Minerisporites* sp. × 120 Sl. No. 2778.
16. *Banksisporites sinuosus* Dettmann × 150. Sl. No. 2781.
17. *Nathorstisporites hopliticus* Jung. × 140. Sl. No. 2785.