

DIVARISACCUS GEN. NOV., A NEW SACCATE POLLEN GENUS FROM THE PERMIAN SEDIMENTS OF INDIA

B. S. VENKATACHALA & R. K. KAR

Birbal Sahni Institute of Palaeobotany, Lucknow

ABSTRACT

A new saccate pollen genus *Divarisaccus* is described from the Barren Measures stage of the Lower Gondwana sediments of the Jharia coalfield, Bihar, India.

The pollen grains referred to this genus are characterized by proximally apparently subequatorial and distally bilateral saccus attachment.

The genus is compared with *Virkkipollenites* Lele, *Plicatipollenites* Lele, *Barakarites* Bharadwaj & Tiwari and *Crucisaccites* Lele & Maithy.

INTRODUCTION

SACCATE organizations hitherto unknown have recently been described by Lele (1964), Bharadwaj & Tiwari (1964) and Lele & Maithy (1964). Considerable interest has grown among Palynologists working in Gondwana continents to find out significant differences between palynological assemblages of the Gondwana Permian and the Permian of other countries. Valuable results have been obtained in recent years in this direction (HART, 1960; BHARADWAJ, 1966; LELE, 1966; KAR, 1966).

Gondwana monosaccate pollen previously referred to *Nuskoisporites* Potonié & Klaus, 1954, have been separated into two new genera *Plicatipollenites* and *Virkkipollenites* by Lele (1964). Bharadwaj & Tiwari (1964) have also instituted two new genera *Barakarites* and *Parasaccites* to accommodate monosaccate pollen from the Lower Gondwana rocks of Korba Coalfield, M.P., India. In a recent study *Crucisaccites* has been instituted by Lele & Maithy (1964). Besides these genera *Vestigisporites* originally described by Balme & Hennelly (1956) and subsequently emended by Hart (1960), is also common in the Lower Gondwana sediments studied by us. These genera fall into a group which has its own characteristic saccus attachment to the central body. The saccus is proximally equatorially attached and distally subequatorially attached in *Plicatipollenites*, *Virkkipollenites*

and *Barakarites* and proximally and distally subequatorially attached in *Parasaccites*, a condition referred to as "Paracondition" by Bharadwaj & Tiwari (1964). The saccus in *Vestigisporites* is proximally equatorially attached and distally attached along a broad zone in the middle of the central body, forming a broad circular, oval or rectangular bladder free area. The saccus forms a girdle along the equator. (Based on a study of co-type specimens of BALME & HENNELLY and type specimens of HART).

Crucisaccites Lele & Maithy is characterized by bilateral attachment of the saccus on both the sides of the central body. The present authors have recently described a new genus *Schizopollis* (VENKATACHALA & KAR, 1964), wherein the saccus is proximally equatorially attached; distally nearly subequatorially attached and sacci roots forming long tuberculoid processes irregularly anastomosing and bordering the sulcus. This genus shows a transition from monosaccate to polysaccate condition or *vice versa* and is characterized by subsaccate floating apparatus (air sacs).

The present paper deals with yet another type of saccate organization. The pollen described here are apparently monosaccate and are proximally equatorially-subequatorially attached and distally bilaterally attached, a type of organization which has not been recorded earlier. The pollen were recorded from thin bands of carbonaceous shales from the bore-core No. J. K. 5 supplied by the Geological Survey of India. The cores represent a good sequence of the Barren Measures (Ironstone Shale stage) sequence in the Jharia Coalfield, Bihar and is located at 23°44' N and 86°19' E. The shales were treated with commercial nitric acid for three days, followed by a quick wash with 5 per cent potassium hydroxide solution and subsequently treated with 40 per cent hydrofluoric acid. After repeated washing the macerate was mounted with glycerine jelly.

SYSTEMATIC PALYNOLOGY

Divarisaccus gen. nov.

Pl. 1, Figs. 1-4

Type Species — *Divarisaccus lelei* sp. nov.

Generic Diagnosis — Monosaccate, oval — elliptical, central body distinct or indistinct, intramicroreticulate. Proximal attachment of saccus to central body apparently subequatorial; distal attachment bilateral forming an ill to well-defined sulcus. Saccus intrareticulate.

Generic Description — Pollen grains 87-138 $\mu \times$ 128-197 μ ; mostly oval but may be elliptical. Central body oval-elliptical or subcircular, distinct to indistinct, size-range 78-96 $\mu \times$ 82-142 μ . Exine of central body up to 3 μ thick, mostly intramicroreticulate but in some cases may be imperfectly intramicroreticulate. Haplotypic mark not seen in the specimens studied. Proximal attachment of saccus to central body apparently subequatorial, attachment zone generally distinct; in some specimens semilunar folds are found in association with proximal attachment mostly on the lateral sides of the central body, perpendicular to longer axis (TEXT-FIGS. 2-4). In some cases, however, only one semilunar fold present or they may be found perpendicular to the shorter axis of the central body. Distal attachment of saccus to central body bilateral and throughout the entire length of central body; attachment zone mostly well defined but in some specimens it is obscured due to folding and tearing of the sulcus area. Distal attachment zone may or may not be associated with semilunar body infolds. Distal attachment more or less parallel to each other, juxtaposed, forming a narrow, rectangular sulcus, in some specimens saccus is folded along the distal attachment zone (TEXT-FIG. 5). Sulcus mostly well defined and uniformly broad. Saccus darker than central body, strongly built and coarsely intrareticulate, entire or minutely frilled on margin, in some specimens meshes apparently radially arranged; mesh size 1-3 μ , lumina shallow.

Organization — See Text-fig. 1.

Comparison — *Crucisaccites* Lele & Maithy (1964) shows some resemblance to this genus in possessing bilateral distal attachment of saccus to central body. *Divarisaccus* can, however, be easily differentiated in its apparently subequatorial proximal attach-

ment and bilateral distal attachment of the saccus to the central body, while *Crucisaccites* has bilateral saccus attachment on both the proximal as well as distal sides of the central body. *Plicatipollenites* Lele, *Virkipollenites* Lele and *Barakarites* Bhara-dwaj & Tiwari, share in common with *Divarisaccus* the equatorial proximal attachment of saccus to central body (*Divarisaccus* has subequatorial or nearly equatorial saccus attachment) but differs in the absence of bilateral distal attachment. *Parasaccites* Bhara-dwaj & Tiwari, is characterized by subequatorial saccus attachment on both sides of central body.

Divarisaccus lelei sp. nov.

Pl. 1, Figs. 1-4

Holotype — Pl. 1, Fig. 1; Size 170 \times 119 μ , central body 142 \times 96 μ . Slide No. 2212.

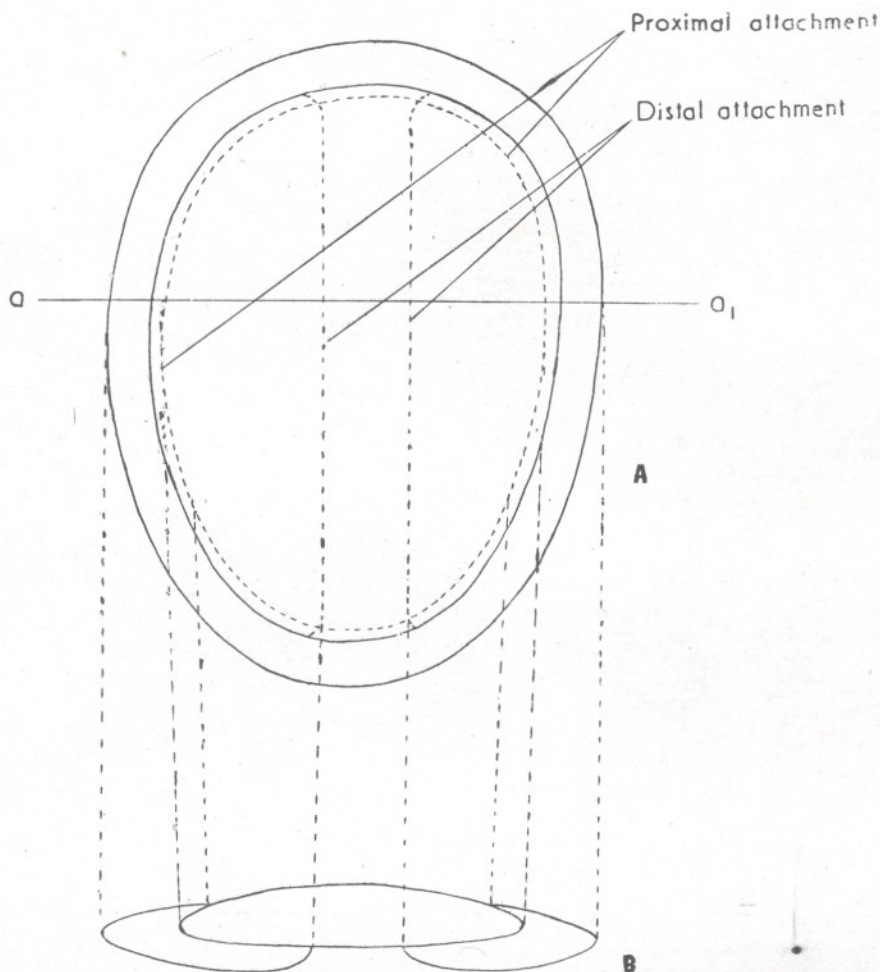
Type Locality — Jharia Coalfield, Bihar; core No. J. K. 5; Barren Measures Succession (Permian).

Specific Diagnosis — Monosaccate, oval-elliptical pollen, size range 87-128 $\mu \times$ 138-179 μ ; central body 78-96 $\mu \times$ 105-142 μ , intramicroreticulate. Proximal attachment apparently subequatorial, distal attachment bilateral, parallel to longer axis. Saccus narrowly encircling the central body, coarsely intrareticulate.

Description — Pollen mostly oval, sometimes elliptical. Central body oval-elliptical, mostly well discernible but may be ill-defined in some specimens; exine of central body up to 2 μ thick, lighter than saccus, mostly intramicroreticulate, in some specimens intramicroreticulate structure not very clear. Proximal attachment of saccus to central body apparently subequatorial, attachment zone generally associated with semilunar folds mostly found on the lateral margins of central body parallel to longer axis. Distal attachment bilateral, attachment region mostly distinct; closely placed, more or less parallel to each other extending along the longer axis of central body; sulcus well defined. Saccus narrowly encircling the central body, dense, strongly built and coarsely intrareticulate, mesh size 1-3 μ , lumina shallow.

DISCUSSION

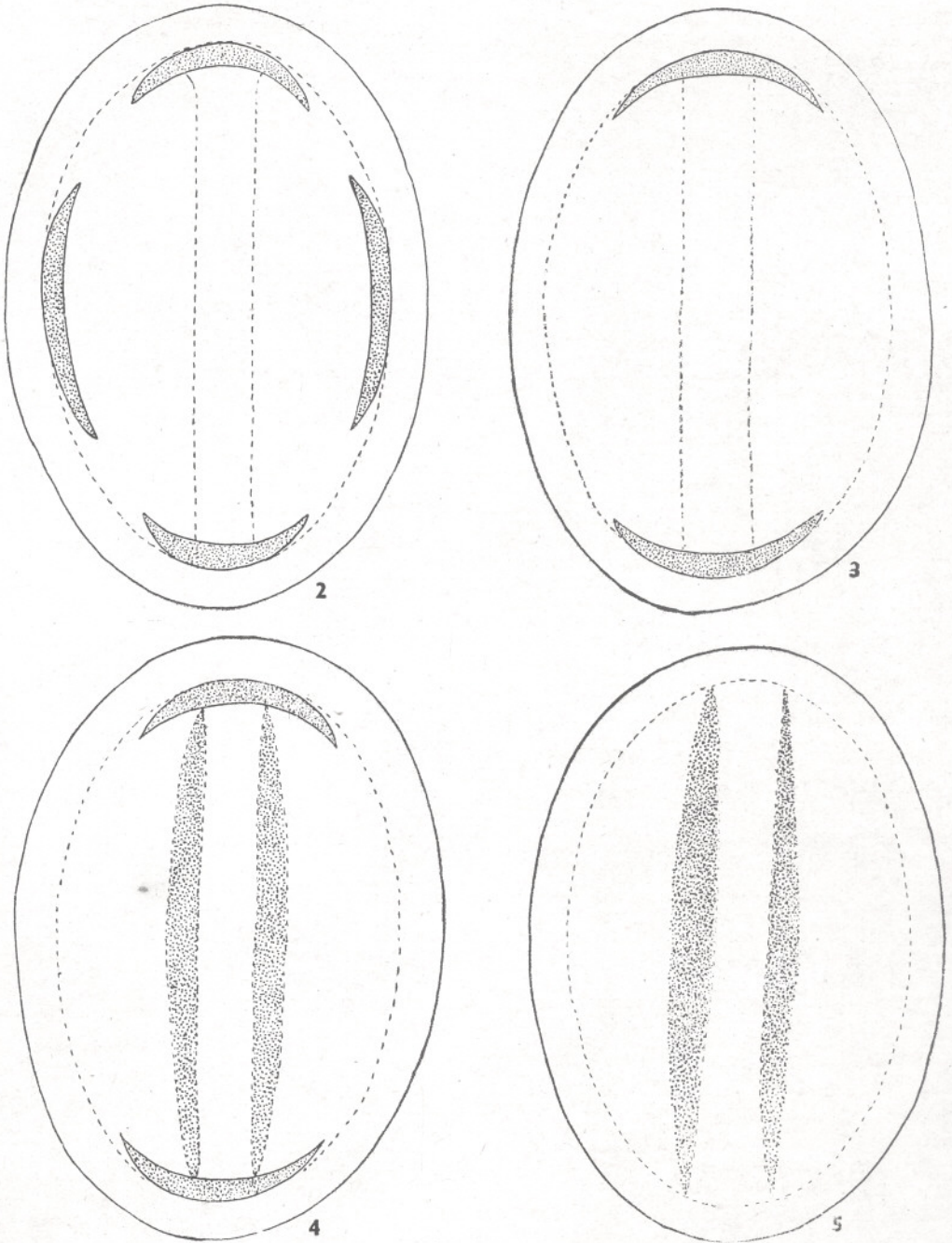
Divarisaccus seems to be singular in possessing bilateral distal attachment of



TEXT-FIG. 1 — Organization of *Divarisaccus* gen. nov., A, polar view, B, sectional view along a-a₁.

saccus to central body and apparently sub-equatorial proximal attachment. A variety of monosaccate genera are to be found in the Talchir, Karharbari and Barakar stages of the Indian Gondwana system. Some of them as far as the present knowledge goes are confined to particular stages while others show a considerable vertical distribution and present in all the stages of Lower Gondwana Succession in India. The monosaccate pollen are predominant in the Talchir, Karharbari and Lower Barakar stages while in the Upper Barakar, Barren Measures Succession (Ironstone Shale) and Raniganj stages the grooved bisaccate pollen dominate over the others.

The monosaccate pollen show different trends of specialization. In one group represented by *Plicatipollenites* Lele, *Virkkipollenites* Lele and *Barakarites* Bharadwaj & Tiwari, the proximal attachment is equatorial and the distal one is \pm subequatorial, encircling the central body to produce a typical monosaccate pollen. *Plicatipollenites* is conspicuous by the presence of body infold system in association with distal attachment while *Barakarites* is characterized by mud-crack like central body. This pseudo-reticuloid grooves are formed by fissures on the central body and apparently approximates the central body of the grooved bisaccate pollen. *Parasaccites*



TEXT-FIGS. 2-5—The fold pattern in *Divarisaccus* gen. nov.

Bharadwaj & Tiwari represents para condition of saccus attachment on both sides of central body and it is also typically monosaccate in construction. *Crucisaccites* Lele

& Maithy is, however, different from the construction of a typical monosaccate by the presence of bilateral attachment on both the sides of the central body. *Divarisaccus*,

proposed here, is also not a typical monosaccate pollen as it possesses bilateral distal attachment. Mention should be made here that the bilateral distal attachment of saccus to central body may be regarded as a step towards the evolution of bisaccate pollen. The predominance of the monosaccate pollen in the Talchir and in the Lower Permian and their subsequent dwindling down in the Upper Permian sediments of the Lower Gondwana Succession and the enormous raise in percentage of bisaccate pollen naturally lures one to believe that the bisaccate pollen might have developed from the monosaccate pollen. It may, however, be pointed out here that evolution of bisaccate

pollen perhaps did not follow the same line everywhere. However, from the present state of our knowledge, it is very difficult to find out all the transitory stages from monosaccate to bisaccate pollen.

ACKNOWLEDGEMENT

We take this opportunity to thank the Director-General of the Geological Survey of India for kindly allowing us to study the bore-core from which *Divarisaccus* has been recovered. We also thank Dr. B. E. Balme, University of Western Australia, for kindly supplying us the Australian material for study and Dr. R. Neves for permitting us to study the African material at Sheffield.

REFERENCES

- BALME, B. E. & HENNELLY, J. P. F. (1956). Tri-lete sporomorphs from Australian Permian sediments. *Aust. J. Bot.* **4**: 240-260.
- BHARADWAJ, D. C. (1966). Distribution of spores and pollen grains dispersed in the Gondwana formations of India. *Gondwana Symposium, Lucknow 1964*:
- BHARADWAJ, D. C. & TIWARI, R. S. (1964). On two monosaccate genera from Barakar stage of India. *Palaeobotanist.* **12**: 139-146, 1963.
- HART, G. F. (1960). Microfloral investigation of the Lower Coal Measures (K₂), Ketewaka — Mchuchuma Coalfield, Tanganyika. *Bull. geol. Surv. Tanganyika.* **30**: 1-18.
- KAR, R. K. (1966). Palynology of the Barren Measures sequence from the Jharia Coalfield, Bihar. *Gondwana Symposium, Lucknow 1964*:
- LELE, K. M. (1964). Studies in the Talchir flora of India: 2. Resolution of the spore genus *Nuskioisporites* Pot. & Kl. *Palaeobotanist.* **12**: 147-168, 1963.
- Idem (1966). Studies in the Talchir flora of India-4. Quest for the early traces and subsequent development of the *Glossopteris* flora in the Talchir Stage. *Gondwana Symposium, Lucknow 1964*:
- LELE, K. M. & MAITHY, P. K. (1964). An unusual monosaccate spore from the Karharbari stage, Giridih Coalfield, India. *Palaeobotanist.* **12**: 307-312, 1963.
- POTONIÉ, R. & KLAUS, W. (1954). Einige sporengattungen des Alpenen Salzgebirges. *Geol. Jb.* **68**: 517-544.
- VENKATACHALA, B. S. & KAR, R. K. (1964). *Schizopollis* Venkatachala & Kar, a new pollen genus from the Permian of North Karanpura Coalfield, Bihar, India. *Grana Palynologica.* **5**: 413-424.

EXPLANATION OF PLATE

(All photo-micrographs are enlarged 500 ×. The slides are preserved at the museum of the Birbal Sahni Institute of Palaeobotany, Lucknow, India).

PLATE 1

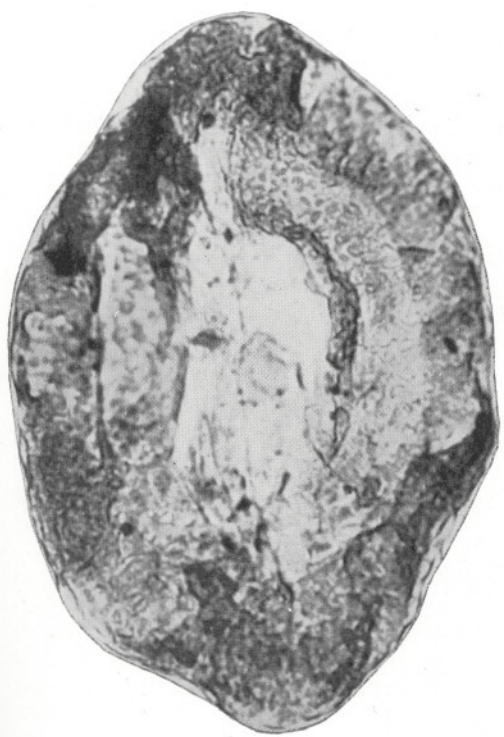
1-4. *Divarisaccus lelei* gen. et sp. nov. Slide Nos. 2194, 2212-2215.



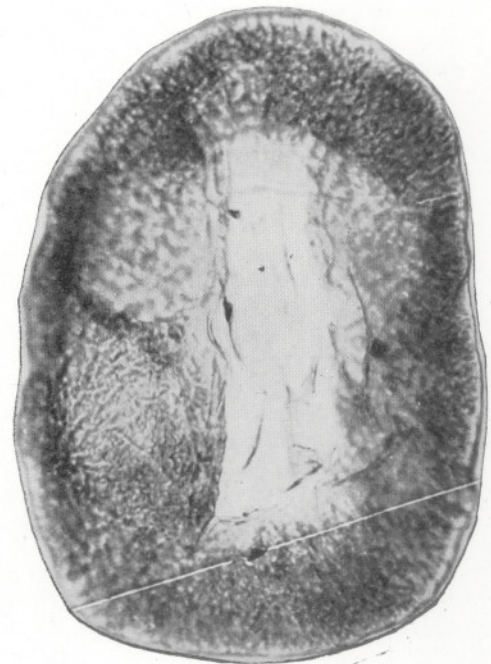
1



2



4



3