ON TWO MONOSACCATE GENERA FROM BARAKAR STAGE OF INDIA

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ABSTRACT

Barakarites gen. nov., and *Parasaccites* gen. nov. are described from Barakar Stage (Upper Permian) of Indian Lower Gondwanas. *Barakarites* has distally inclined, limbate (?) monosaccus, with a trilete central body having reticuloid striations on its exine. *Parasaccites* has proximo-distally, parasubequatorially attached, non-limbate monosaccus.

INTRODUCTION

THE present paper describes two monosaccate spore genera from Barakar Stage, which show such organizations and their associated structures as are not described so far. Barakar coals are quite rich in these forms quantitatively as well as qualitatively presenting an opportunity of their detailed study. Miospores referable to the two new genera described here have been described earlier by a number of other workers. Virkki (1946) has illustrated and described a large number of similar miospores grouping them on the basis of the presence or absence of a trilete mark. Ghosh and Sen (1948), and Sen (1953) have also described comparable monosaccate miospores from Raniganj and Karharbari coalfields. Datta (1957) has referred similar forms from Jhagrakhand area to *Densosporites* and *Florinites*. Balme and Hennelly (1956) have described similar monosaccate trilete miospores from Australian Permian sediments under *Nuskoisporites* and so also has been done by Potonié and Lele (1959) and Hart (1960). Leschik (1959) has referred spores referable to one of the genera described here, to *Accinctisporites*. Bharadwaj (1962) noted some differences in the few specimens found in the coals of Raniganj Stage as compared to *Nuskoisporites*, and referred them as cf. *Nuskoisporites*.

ACKNOWLEDGEMENTS

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MATERIAL

The material for the present study consisted of coal from West Bokaro Coalfield, Bihar, and Korba Coalfield, Madhya Pradesh.

Bokaro Coalfield belongs to Lower Gondwana system of India. It lies in the province of Bihar as a narrow strip, about 40 miles from east to west and less than 7 miles from north to south (Fox, 1934). Samples were collected from Datma and Pindra seams as well as from the neighbourhood of Topa and Mangardaha villages (for details *see* SURANGE, SRIVASTAVA & SINGH, 1953).

Korba Coalfield lies in the Hasdo Valley in Madhya Pradesh and named after Korba township (22° 21′: 82° 42′), which is situated about 24 miles from Champa railway station on the main line from Calcutta to Nagpur. A number of bore hole samples, from eastern and western sectors of this coalfield were available for study.

DESCRIPTION

Anteturma — *Pollenites* R. Pot. 1931
Turma — *Saccites* Erdtm. 1947
Subturma — *Monosaccites* (Chitaley) Pot. & Kr. 1954
Infraturma — *Triletesacciti* Lesch. 1955

Genus — *Barakarites* gen. nov.

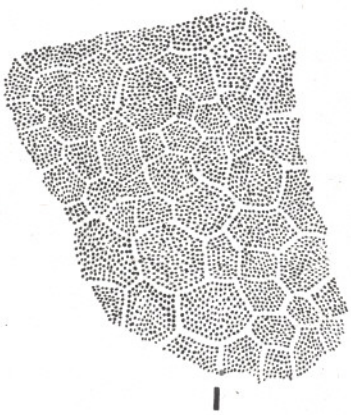
Pl. 1, Figs. 1-7

Genotype — *Barakarites indicus* sp. nov.

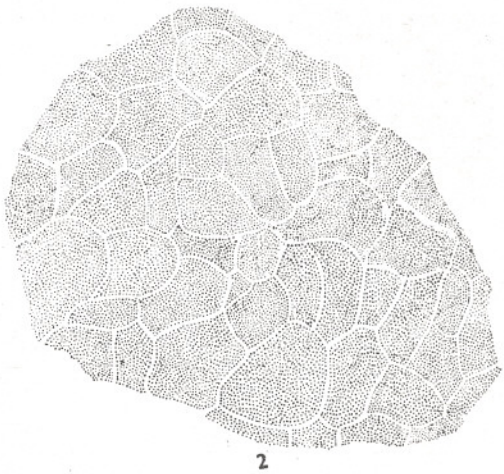
Generic Diagnosis — Circular, subcircular or subtriangular trilete bearing miospores with a saccus equatorially attached proxi-

mally but inclined distally to attach itself subequatorially with the central body. Proximal and distal bladder-free faces of the body exine intramicropunctate, divided into polygonal areas bound by narrow grooves; inner body generally present. Saccus finely intrareticulate, frequently two-zoned, the marginal, narrow zone usually denser.

Generic Description — Miospores mostly subcircular to broadly subtriangular with consistent proximo-distal plane of flattening along the equator of the central body. Body outline generally well marked, may be thick (Pl. 1, Figs. 1, 2, 4) or thin (Pl. 1, Fig. 6). Trilete mark distinct, trilete rays mostly not more than 2/3 of body radius long, labra thin, vertex low; may be open to form a triangular rent (Pl. 1, Fig. 3). Proximal and distal bladder-free faces of the body wall having polygonal areas of various shapes and sizes bound by narrow grooves, giving an appearance of a network of complete, reticuloid striations. In some specimens polygonal areas small, 2-5 μ in size (Text-fig. 1; Pl. 1, Fig. 4), while in others big, 5-10 μ in size (Text-fig. 2; Pl. 1, Figs. 1, 2, 6). Body exine fine (Pl. 1, Figs. 1, 2) to mediumly coarse (Pl. 1, Figs, 5-7) intramicropunctate; sculptureless. Saccus attached to the body equatorially on proximal face and subequatorially on distal face. Saccus width variable, being as narrow as 5 μ or broad up to 20 μ or more and either uniformly broad around the body equator (Pl. 1, Figs. 1, 2) or broader at the corners and narrower in the inter-radial regions (Pl. 1, Fig. 3). Saccus, in most of the cases, evenly flattened (Pl. 1, Figs. 1, 2, 6), but in others undulating or frilly in appearance (Pl. 1, Figs. 4, 5). Intrareticulation of saccus fine, usually with short, compact, narrow muri and small meshes, resulting in a finely punctate appearance of the saccus. In proximo-distally flattened specimens the margin of the saccus usually denser in a 3-5 μ wide marginal zone than the lighter zone of the saccus inwards (Pl. 1, Figs. 1, 2). In some cases the denser zone may be irregularly present or even indistinct as in the specimens with the " frilled " saccus (Pl. 1, Figs. 4, 5) or broader saccus. Central body generally containing an inner body, either with its wall thin yet forming a distinct outline (Pl. 1, Figs. 1, 2, 6), thick and dense with distinctly demarcated outline (Pl. 1, Fig. 5) or a diffused outline (Pl. 1, Fig. 4).



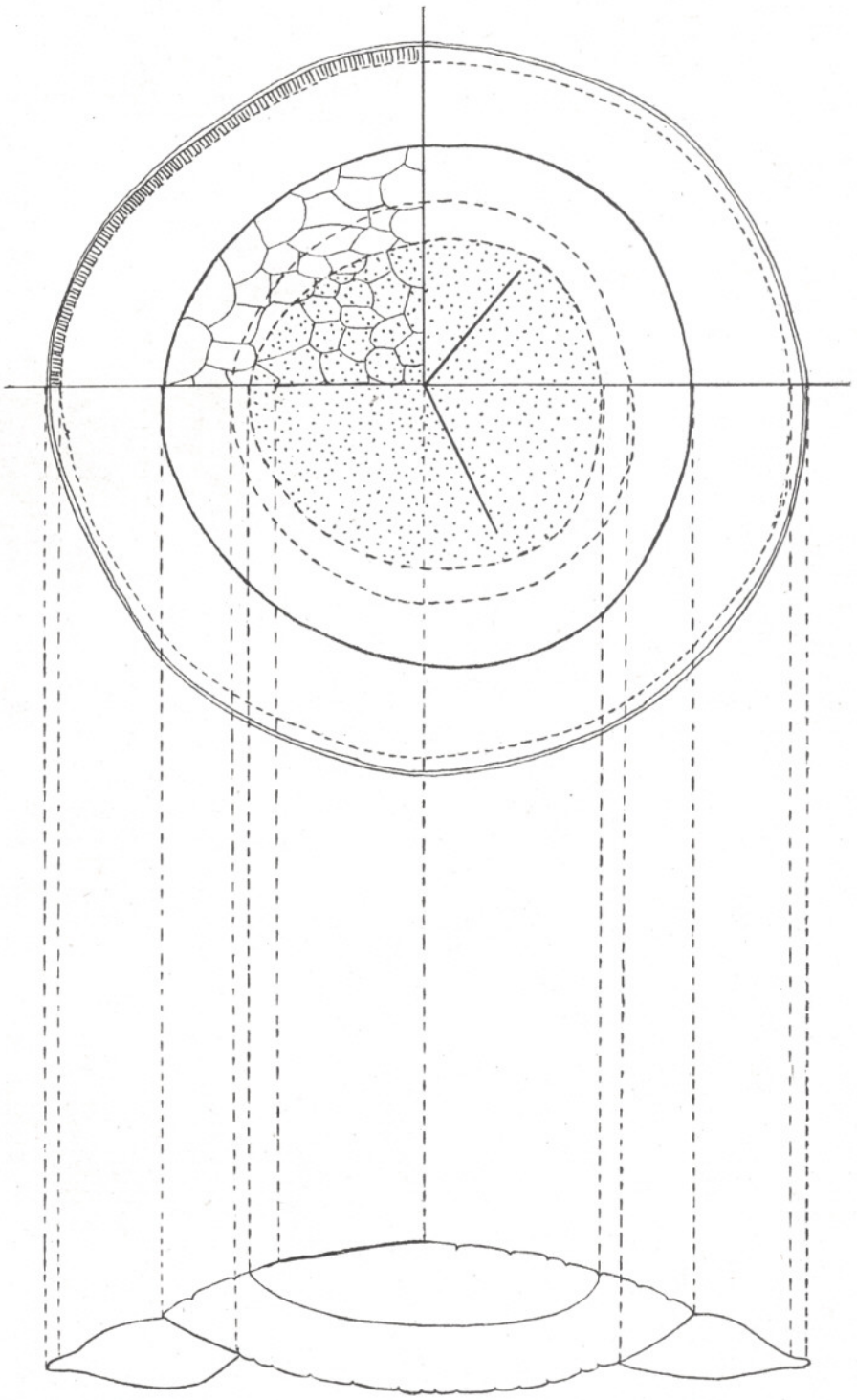
Text-fig. 1 — Size of smaller polygonal areas on the central body in *Barakarites* gen. nov. (1680 ×).



Text-fig. 2 — Size of bigger polygonal areas on the central body in *Barakarites* gen. nov. (1120 ×).

Organization — See Text-figure 3.

Comparison — Monosaccate genera with striations on the central body have been described by one of us (Bharadwaj, 1962) from the Raniganj Stage viz., *Striomonosaccites* bearing longitudinal, simple or branched striations on one of the two saccus-free faces of the body and *Distriomonosaccites* bearing longitudinal striations on both the faces. The present genus differs from these two striated monosaccate genera by having a trilete mark on the proximal face of the body and the reticuloid striations demarcating the polygonal areas on both the bladder-free faces of the body. No other miospore genus is reported so far to possess these characters.



TEXT-FIG. 3 — Schematic representation of the organization in *Barakarites* gen. nov., one quartet showing details.

Nuskoisporites Pot. & Kl. does not possess the reticuloid striations demarcating the polygonal areas on the central body as are found in *Barakarites*. An examination of some specimens of *Nuskoisporites klausii* Grebe, from the type material suggests that *Nuskoisporites* may, on a restudy, reveal significant organizational features not referred to in its present diagnosis, which may widen the differences between *Nuskoisporites* and *Barakarites* still further.

Among disaccate spore genera, *Fimbriaesporites* Lesch., resembles *Barakarites* in having roundish, squarish to polygonal areas demarcated by narrow striations (*See* BHARADWAJ, 1962, p. 90) but differs in all other respects e.g. absence of trilete mark, body exine structure and shape of distal sulcus besides other details.

Barakarites gen. nov. consists of monosaccate pollengrains referable to a number of distinct species, and so far as known, these are characteristic for a particular horizon of the Lower Gondwanas in India.

Barakarites indicus sp. nov.

Pl. 1, Figs. 1, 2

Holotype — Pl. 1, Fig. 1.

Locus Typicus — Topa village quarry, West Bokaro Coalfield, India.

Diagnosis — Circular to subtriangular; central body distinct; exine finely intramicropunctate; polygonal areas 5-10 μ broad, distinct; Y-mark weak, rays with thin labra and low vertex, reaching 2/3 of the body-radius. Saccus outline and width uniform all-round, finely intrareticulate with a distinct peripheral zone of thickened exine. Inner body thin, subtriangular.

Description — Miospores circular to broadly subtriangular, holotype 123 μ in size; body distinct, ±92 μ in holotype, exine along its equator 2-3 μ thick and dense as well as slightly wavy due to the flattening of the polygonal areas with their demarcating grooves giving a prominent outline to body in flattened condition, finely intramicropunctate, divided into polygonal areas 5-10 μ in size, delimited by linear grooves giving a complete reticuloid pattern to the exine (TEXT-FIG. 2). Saccus uniformly broad, 15 μ wide in holotype, marginally thickened zone uniformly 3 μ wide with its outer half structureless and inner half intrabaculate structured. Saccus exine finely intrareticulate with short muri and small meshes, thus appearing as intrapunctate; distal zone of saccus attachment subequatorial, saccus-free distal face circular. Inner body subtriangular, thin with faint outline.

Other Species — *Nuskoisporites rotatus* described by Balme and Hennelly (1956, p. 254; PL. 8, FIGS. 68-71) on the basis of its first two illustrations is referable to *Barakarites*. Although Balme and Hennelly (loc. cit.) do not mention about the presence of polygonal areas on the saccus-free body exine, these are quite distinctly apparent in the first and third specimens (B. & H., 1956, PL. 8, FIGS. 68, 70). In the second specimen illustrated by Balme and Hennelly, the presence of a subtriangular inner body is indicated. The last illustration of *N. rotatus* by Balme and Hennelly (1956, PL. 8, FIG. 71) is not of a well preserved specimen yet its similarity to the other specimens is unmistakable. In view of *N. rotatus* possessing all the diagnostic characters of *Barakarites* it is transferred to it as *Barakarites rotatus* (B. & H.) comb. nov., with the following emended diagnosis based upon the description of Balme and Hennelly (loc. cit. p. 254) and our observations — *Circular, subcircular or oval in polar view. Central body bearing a trilete mark, rays distinct, of variable length, sometimes extending to the periphery of the central body; exine of central body thin, intrapunctate and divided into nearly polygonal areas* 2-5 μ *wide, by narrow grooves. Saccus — uniformly broad, attachment equatorial proximally but subequatorial distally, saccus exine structured with extremely fine reticulum appearing punctate, outer zone about* 5 μ *wide along the margin.*

Barakarites rotatus differs from *B. indicus* in having smaller polygonal areas on the central body and wider marginal denser zone in the saccus exine. In addition to these considerations, *B. indicus* is distinctive on account of the thicker and denser equatorial margin of the central body in contrast to the thinner body margin of *B. rotatus*.

Some of the specimens (PL. 28, FIGS. 1, 2; PL. 30, FIGS. 2, 3) illustrated by Høeg and Bose (1960) are also comparable to *Barakarites*. In one of them (HØEG & BOSE, 1960, PL. 30, FIG. 2) the polygonal areas are distinctly visible. However, these are very much bigger than those observed in our specimens.

Genus — *Parasaccites* gen. nov.

Pl. 2, Figs. 7-13

Genotype — *Parasaccites korbaensis* sp. nov.

Generic Diagnosis — Circular to bilaterally oval miospores with a saccus, attached subequatorially both on proximal as well as on distal face of the spore-body, leaving almost circular, equal bladder-free areas on both faces i.e. para-condition of saccus attachment. Body distinct or diffused; exine intramicroreticulate. Proximally sometimes a weak trilete mark present. Saccus intrareticulate.

Generic Description — Miospores circular, subcircular or even bilaterally oval in overall shape. Body circular to subcircular with distinct or diffused outline; exine thin and wrinkled with many microfolds (Pl. 2, Figs. 9-13) or mediumly thick without wrinkles (Pl. 2, Figs. 7, 8), finely intramicroreticulate. Trilete mark weakly developed or ill-defined; rays 1/2-2/3 radius long, labra thin, vertex low. Saccus uniformly broad, usually 1/2-2/3 of the body radius wide in the ± circular forms (Pl. 2, Figs. 7-11) but in bilateral forms (Pl. 2, Figs. 12, 13) narrower along the lateral sides. Zones of saccus attachment regular to irregular, sometimes being difficult to make out. Para-condition of saccus attachment quite evident in L-O analysis. Even in the forms having diffused body outline (Pl. 2, Figs. 11-13) the extent of saccus invasion, both on proximal and distal sides, easily made out by differential focusing. Saccus finely intrareticulate, generally with radially arranged, elongated muri.

Organization — See Text-figure 4.

Comparison — No monosaccate genus with para-condition of saccus attachment has been described so far. *Vestigisporites* (B. & H.) Hart (1960) differs in view of its distally inclined attachment of the saccus and the presence of a monolete mark on the proximal face of the body besides other details.

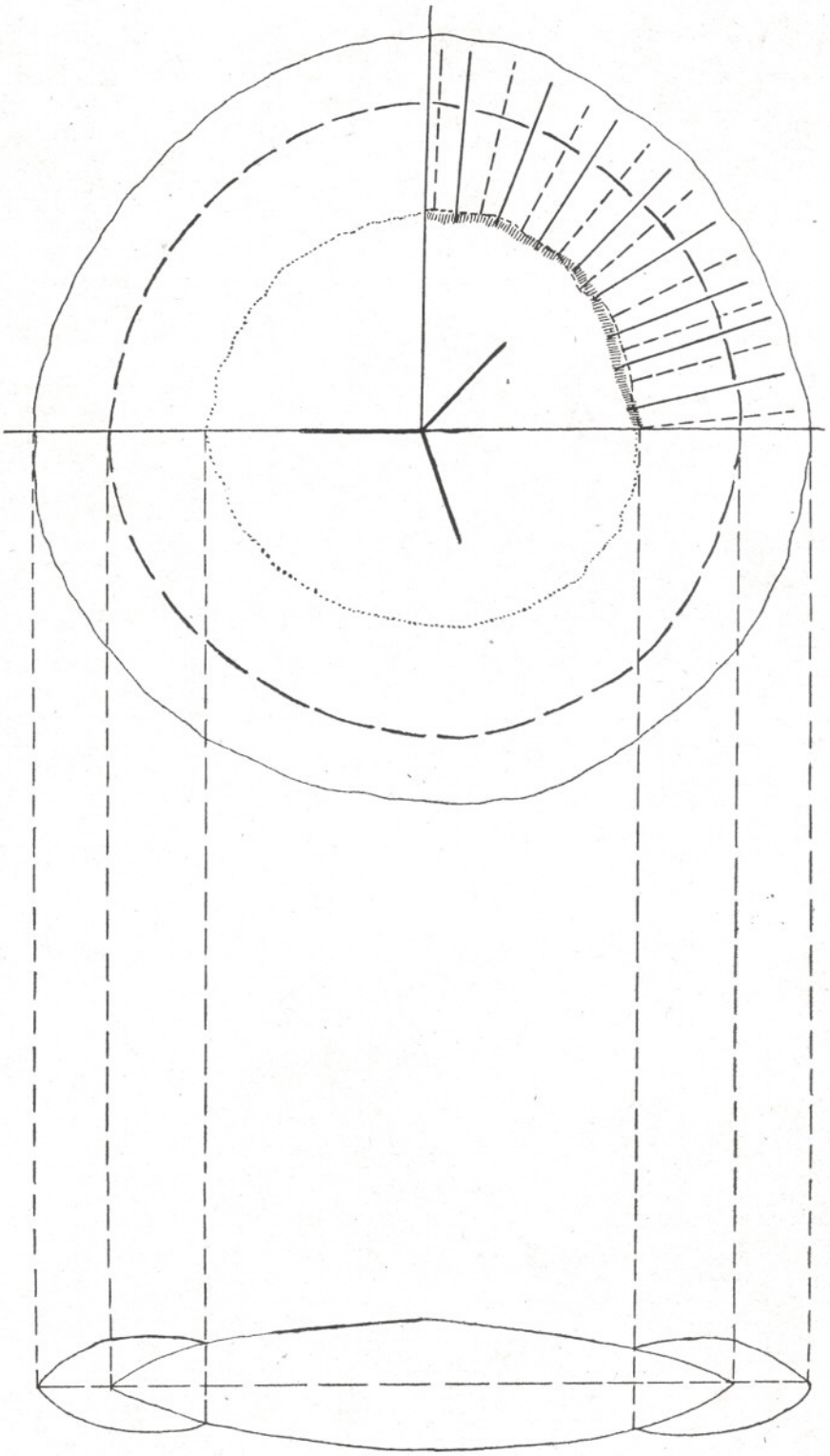
Sahnites Pant (1955) is supposed to have been a pollengrain with a laterally continuous and symmetrically attached (para-condition) monosaccus as explained in the hypothetical reconstruction given by its author. However, the photographs and camera lucida drawings of *Sahnites thomasii* (Pant 1955, Pl. XIX, Figs. 6, 7; 1, 2) indicate distally inclined sacci. Even in the diplotype illustration (Mehta, 1944, Pl. Fig. 2) distally inclined attachment is evidenced by the presence of two folds, presumably lying along the zones of saccus attachment, limiting the wide, distal sulcus. *Prima facie*, *S. gondwanensis* the genotype of *Sahnites*, closely resembles *V. rudis* B. & H., the genotype of *Vestigisporites* Balme & Hennelly (1955). In view of the fact that *Sahnites* and *Vestigisporites* both have distally inclined saccus and a monolete mark, it is very likely that both are the same.

Leschik (1959, Pl. 3, Figs. 21, 22) has referred some pollengrains to *Accinctisporites* which are similar to the forms included here (Pl. 2, Fig. 11) in *Parasaccites* after careful study.

As compared to *Nuskoisporites*, *Parasaccites* gen. nov. lacks the characteristic limbus and also shows tendencies towards having progressively thinner central body walls and reduced trilete mark in its members. *Nuskoisporites* is a genus of the European Upper Permian consisting of two species *N. dulhuntyi* and *N. klausi*. In both of these species ' limbus ' is a characteristic feature and the central body as well as the trilete mark is very prominent. Lately, in view of some Lower Gondwana forms closely approaching *Nuskoisporites*, Potonié and Lele (1959) have opined that the presence of a ' limbus ' is not absolutely necessary for *Nuskoisporites*. We differ from this point of view especially because in the European Upper Permian, from where *Nuskoisporites* has been initially described, ' limbus ' is a characteristic feature of the genus and must be maintained so.

General Remarks — It is interesting to note that there is a gradual transition from perfectly circular to bilateral forms in *Parasaccites*. In spite of this, no bilateral form has been found with more than hemispherical shape of saccus at the sides, or with notches on the lateral sides. The para-condition of the saccus attachment is an important character found uniformly in bilateral as well as circular forms. At times para-attachment may be deceptively apparent as distally inclined attachment if the grain is slightly obliquely compressed while flattening, so that the proximal and distal zones of bladder attachment fail to lie above each other as they ought to be in pollen grains with symmetrically arranged saccus. However, in such case a careful L-O analysis decides the true nature.

The genus, as constituted at present mainly on the character of the para-condition of saccus attachment, seems to include



TEXT-FIG. 4 — Schematic representation of the organization in *Parasaccites* gen. nov., with one quartet showing details.

two subgroups represented by forms having faint trilete mark but distinct body outline (PL. 2, FIGS. 7-10) as compared to forms without a trilete mark but having ill-defined body outline (PL. 2, FIGS. 11-13).

Specimens referable to *Parasaccites* have been illustrated by many workers in the past. Thus Virkki (1946; PL. 4, FIG. 47; PL. 8, FIGS. 113, 114), Balme & Hennelly (1956, PL. 6, FIGS. 62-65) and Potonié and Lele (1959; PL. 2, FIGS. 44, 51-55) have illustrated some probable members of *Parasaccites*. The simple nature of the body, somewhat diffused and irregular zone of saccus attachment and the nature of exine and the trilete mark, as far as made out from the above mentioned figures, suggest the nearness of these forms to the genus *Parasaccites*.

Parasaccites korbaensis sp. nov.

Pl. 2, Figs. 7, 8

Holotype — Pl. 2, Fig. 7.

Locus Typicus — Ghordewa Sector (Bore hole no. G-101), Korba Coalfield, India.

Diagnosis — ± circular miospores 128-147 μ in size; central body distinct, 105-119 μ in size, circular, with mediumly thick intramicroreticulate exine. Trilete mark distinct, rays small, up to 1/2 the body radius long; labra thin, vertex low. Saccus 24-38 μ, uniformly wide all-around the equator, zones of saccus attachment somewhat irregular, finely intrareticulate with apparently radially elongated muri.

Description — Holotype ±130 μ, circular; body circular with sharply defined outline, size of the central body 110 μ in holotype; body exine thin to mediumly thick without any folds or wrinkles, finely intramicroreticulate; Y-mark generally distinct, sometimes weakly developed, rays reaching not more than half the body-radius in length. Saccus ±uniformly broad, 30 μ wide in holotype, finely intrareticulate, muri radially arranged, 0·5-2 μ in size, meshes fine, elongated in radial direction; outline of the saccus generally wavy. Proximal as well as distal zones of saccus attachment subequatorial, irregular and diffused. Peripheral area of the body from 2/5 to 4/9 of its radius covered by the saccus proximally and distally.

Comparison — There is no other species described which can be referred to *Parasaccites*. However, the photographs given by Hart (1960; PL. 2, FIG. 31; PL. 3, FIG. 32) and Høeg & Bose (1960; PL. 33, FIGS. 1, 3) are very closely comparable to *Parasaccites korbaensis* in view of the obvious para-condition of the saccus attachment which has not been described by these authors, and some other details.

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EXPLANATION OF PLATES

(*All figures are* 500 ×)

PLATE 1

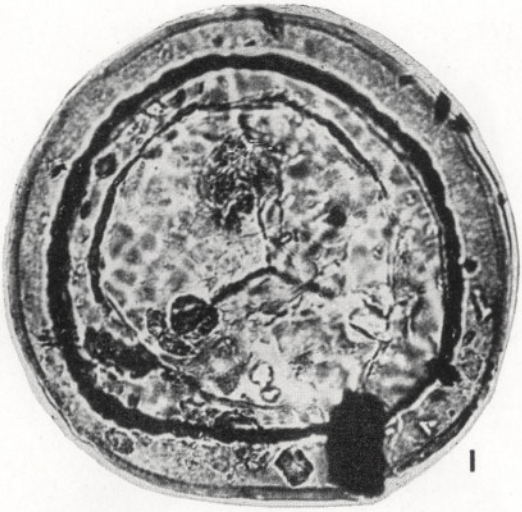
1-2. *Barakarites indicus* gen. et sp. nov., Ph. Nos. 364/5 (Holotype), 364/3.

3-6. *Barakarites*, Ph. Nos. 315/39, 277/25, 314/28, 316/21.

PLATE 2

7-8. *Parasaccites korbaensis* gen. et sp. nov., Ph. Nos. 313/37 (Holotype), 313/35.

9-13. *Parasaccites*, Ph. Nos. 376/32, 363/30, 286/7, 317/7, 317/9.



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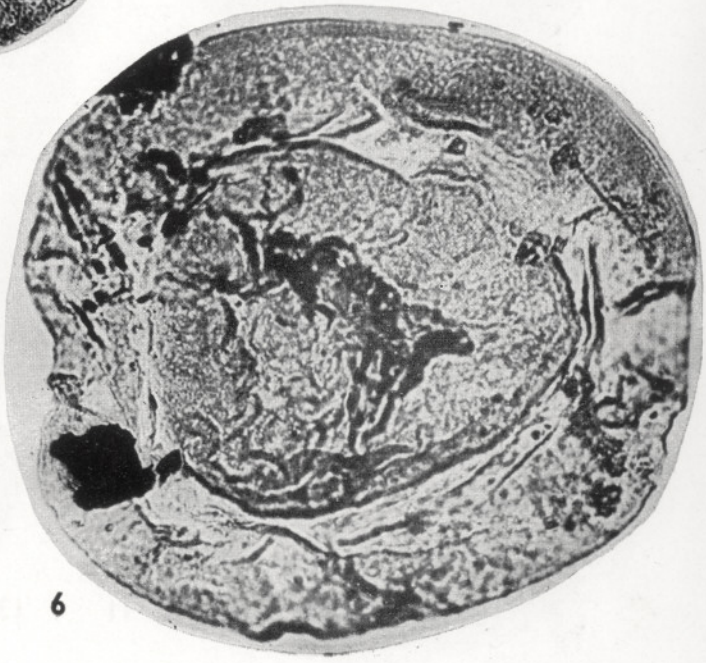

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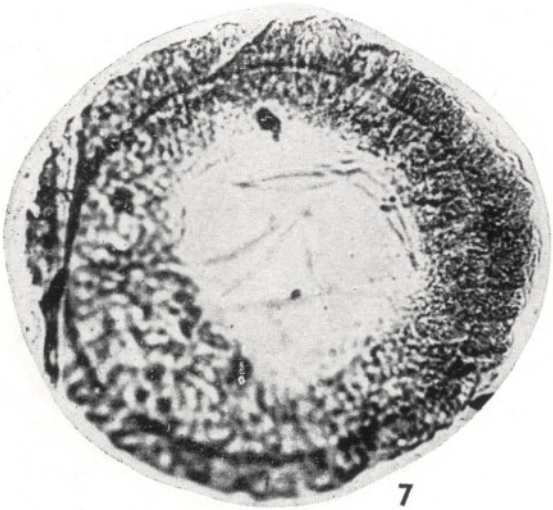

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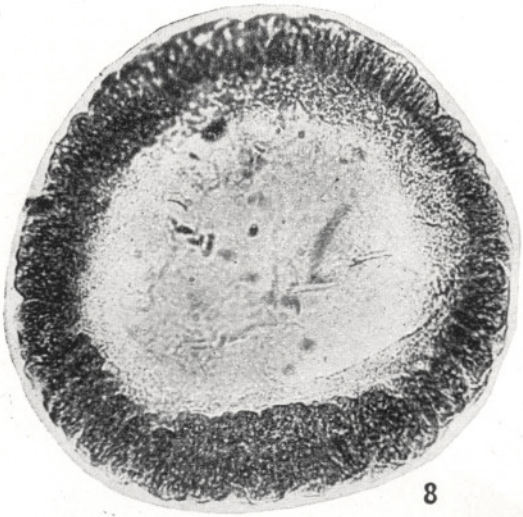

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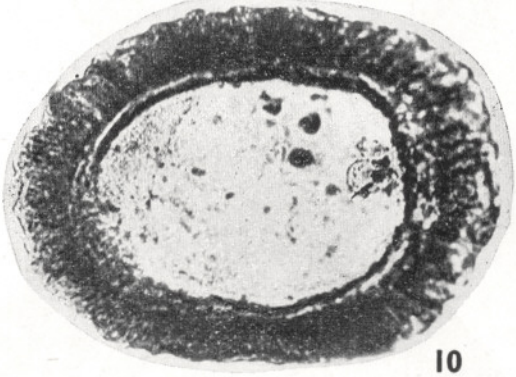

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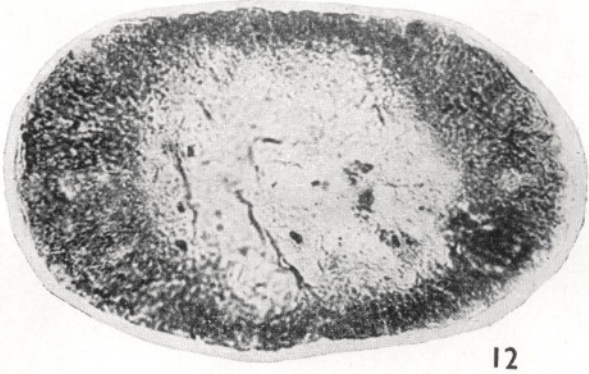

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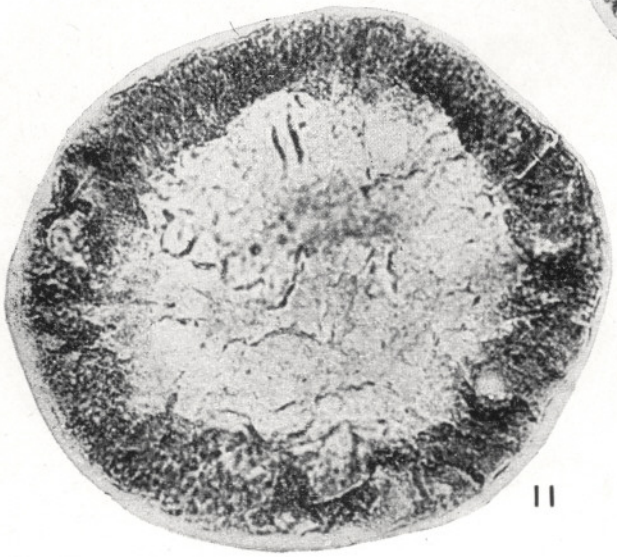

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