AN UNUSUAL MONOSACCATE SPORE FROM THE KARHARBARI STAGE, GIRIDIH COALFIELD, INDIA

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ABSTRACT

A monosaccate spore of unusual organization, occurring commonly in the Karharbari Stage (Lower Permian) of the Giridih Coalfield, is assigned to a new genus *Crucisaccites*.

INTRODUCTION

DISPERSED monosaccate spores and pollen occur in increasing abundance towards the lower part of the Lower Gondwana strata in India. In fact, they are the predominant constituents of the Talchir and the Karharbari spore floras and probably remain fairly well-represented in the succeeding Barakar Stage. Recent studies on the monosaccate grains from these horizons have already begun to reveal the diversities in the complex plan of their organization. A bulk of the Talchir monosaccate spores, hitherto referred to *Nuskoisporites* Pot. & Kl. have now been removed from that genus by Lele (1964), and segregated under the genera *Plicatipollenites* and *Virkkipollenites*. To these, Bharadwaj & Tiwari (1964) have added two more genera, viz. *Barakarites* and *Parasaccites* from the Barakar Stage which are also distinct from the northern *Nuskoisporites*.

The Karharbari Stage, which lies between the Talchirs and the Barakars, has not been systematically worked out in respect of its spore and pollen contents. Some carbonaceous shales collected by us from the Serampur colliery of the Giridih coalfield (Karharbari Stage) have revealed on maceration an overwhelming number of monosaccate spores and pollen, a majority of which should fall under *Plicatipollenites* and *Virkkipollenites*. In addition to these and perhaps next in abundance, is another monosaccate grain which is peculiarly distinct from other known monosaccate genera. It is proposed to describe this unusual spore under the name *Crucisaccites* gen. nov., pending a fuller account of the whole spore flora elsewhere by one of us (P.K.M.).

DESCRIPTION

Genus — CRUCISACCITES nov.

Genotype — *Crucisaccites latisulcatus* sp. nov.

Derivation — *Crucis* (L.) = Cross.

Locality & Horizon — Central pit, Serampur Colliery, Giridih Coalfield, India; Karharbari Stage (Lower Permian), Lower Gondwana, India.

Generic Diagnosis — Monosaccate grain, circular to oval in outline, body distinct to indistinct, circular to ellipsoid; saccus encloses most of the body but leaves free a bilateral zone on both sides of the body along which it is attached, saccus-free areas on the two sides of the body lie at right angles to each other; monolete mark present but inconsistently developed; body exine in the saccus-free areas apparently thinner, with a tendency to rupture; body infolds near saccus attachment may be strongly developed or absent; saccus structure intrareticulate.

Organization — The grains are usually oval but may also be nearly circular in polar view (PL. 1, FIGS. 3, 4). The body is distinct in the genotype but spores with indistinct bodies or other differences are present in the preparation and presumably belong to distinct species awaiting description elsewhere. The body exine, when ill-preserved, shows what appears like grana or microverrucae, but in better-preserved examples an intra-microreticulum is discernible.

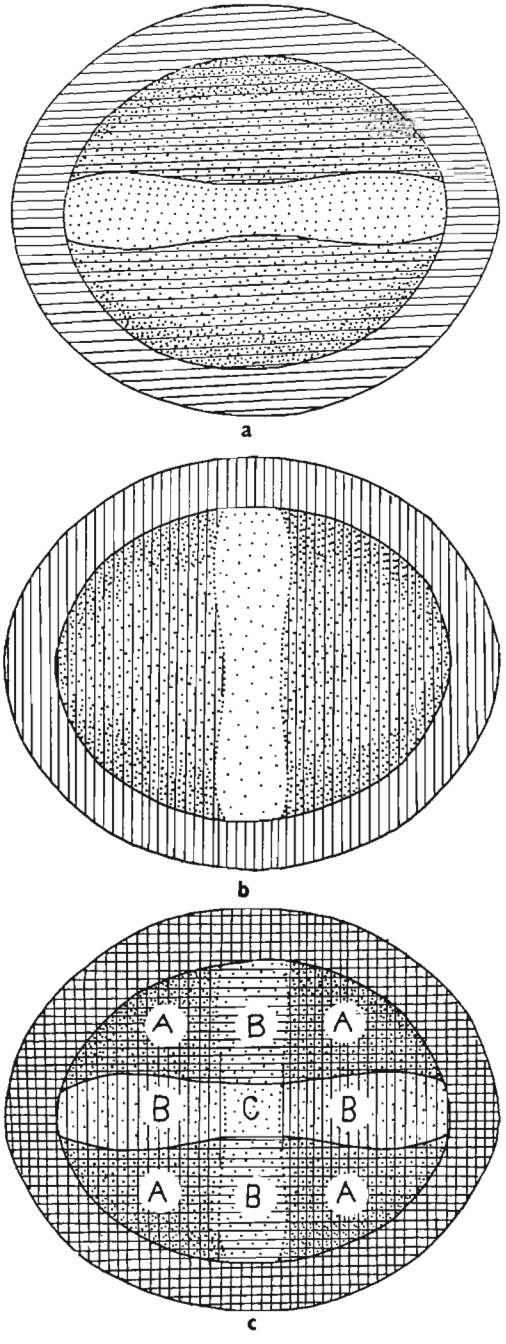
The saccus portion outside the body is narrow, its overlap on the body being comparatively much greater. The saccus width is more or less uniform outside the body but some variations occur owing to differences in the manner of flattening. The most remarkable feature of the saccus is the manner in which it encloses the body and is attached to it. The saccus encloses most of the body but leaves free on both sides a more or less wide bilateral zone along which

it is attached. The zones of attachment on the two sides of the body are disposed at right angles to each other with the result that the two saccus-free areas of the body are also cruciate. It can thus be imagined that the relatively large body of this spore was freely held between the opposite zones of saccus attachment. The organization of the spore is elucidated in Text-figs. 1 A-C.

The double-sided attachment of the monosaccus and the cruciate zones of its attachment on the two sides of the body could be made out in all well-preserved specimens. There are other strong indications which support the peculiar mode of saccus attachment. For instance, it is easy to detect in many grains the relatively sharp colour differences in specific regions of the spore. A polar view of a grain (TEXT-FIG. 1-C; also cf. PL. 1, FIG. 1) would often show that the extreme four corners of the body (marked A) are the darkest since the saccus is present in these areas on both sides of the body. The medium dark areas (marked B) are those where the saccus is present only on one side of the body. The central thinnest area (marked C) which includes the poles, is completely saccus-free and exposes the body alone.

There are a number of specimens where the body is partly or wholly lost, leaving the saccus alone. Such specimens (PL. 1, FIG. 7) are of additional significance, for they attest to the cruciate mode of saccus roots on the two sides.

The saccus is so constructed as to hardly leave any scope for lateral compression of the spore. On the contrary some grains tend to get obliquely or laterally folded more or less along one of the axes, especially along the longer one in oval grains. In this state of preservation (PL. 1, FIG. 6; TEXT-FIG. 2-f) it is possible to detect the saccus-free area of the body at least on one side. The other saccus-free side becomes obscure because of the superimposition of the folded part of the saccus and body.



TEXT-FIG. 1 — Interpretation of the organization of *Crucisaccites*. a, polar view showing the inward extent and attachment of the saccus (horizontal lines) on one side of the body (stippled). The saccus-free area of the body is horizontal and bilateral. b, polar view showing the extent and attachment of the saccus (vertical lines) on the other side of the body (stippled). The saccus-free area of the body is vertical and bilateral. c, combination of both polar views (a and b) showing the presence of saccus on both sides of the body in areas marked (A), on only one side of the body in areas marked (B) and the completely saccus-free body area marked (C).

A definite monolete mark is rarely noticeable (TEXT-FIG. 2-i). in the type-species, becauce the thin saccus-free areas often get ruptured. However, in another species referable to *Crucisaccites* (to be described elsewhere), a definite monolete is present along the longer diameter of the grain. It is apparent, therefore, that the monolete mark is not very consistently developed in this genus. The determination of the proximal or distal side of the grain is evidently not always easy although it may be imagined that the saccus-free area which runs at right angles to the longer axis of the grain, may be the distal sulcus. But in the case of more circular grains (cf. PL. 1, FIG. 4) even a speculation of this kind is difficult to make specially when the mark is not visible. It is also significant to observe that the spores have a peripherally single continuous saccus as in the monosaccates, but the zones of saccus attachment and the saccus-free areas of the body are bilateral which lend the grains an imperfectly disaccate appearance. May it not be that this spore is a member of a wider group of transitory character that was experimenting along perhaps several directions to attain a disaccate condition ?

Comparisons — Monosaccate or disaccate spores and pollen showing saccus attachment on both sides of the body are comparatively less known, but the fact that this kind of organization is well recognizable in a large number of spores, is becoming more and more clear due to recent critical studies.

From the Barakar Stage of India, the genus *Parasaccites* Bharadwaj & Tiwari is the only known monosaccate spore which shows what has been called a para-condition of saccus attachment. However, in *Parasaccites* the zones of saccus attachment and the resultant saccus-free areas on the two sides of the body are circular (i.e. radial in symmetry) as well as equal and superposed with respect to each other. These features, together with the presence of a week trilete mark, render *Parasaccites* sufficiently distinct from *Crucisaccites* gen. nov. In *Vesicaspora* (Schemel) Wilson & Venkatachala (1963), the symmetry of the attachment zones and their orientation with respect to each other are distinct both from *Parasaccites* and *Crucisaccites*. The grains of *Sahnisporites* Bhardwaj (1954) and *Potoniéisporites* Bharadwaj (1964) may at first sight recall those of *Crucisaccites* but both of them differ fundamentally from *Crucisaccites* in the plan of their saccus construction and attachment.

The genus *Crucisaccites* may in all probability include certain large specimens recorded by Virkki (1946, PLS. 5, 10, 11; FIGS. 49, 135-138) which have almost similar organization. Virkki's descriptions are not adequate in several essential details, but judged from the photographs, the saccus seems to be bilaterally attached on both sides of the body (VIRKKI, l.c. PL. 5, FIG. 49) so as to produce similar colour differences in specific areas as interpreted in the case of *Crucisaccites*. Virkki's specimens came from Kathwai (Salt Range) and the Pali Beds, the latter being regarded as Karharbari or Lower Barakar in age.

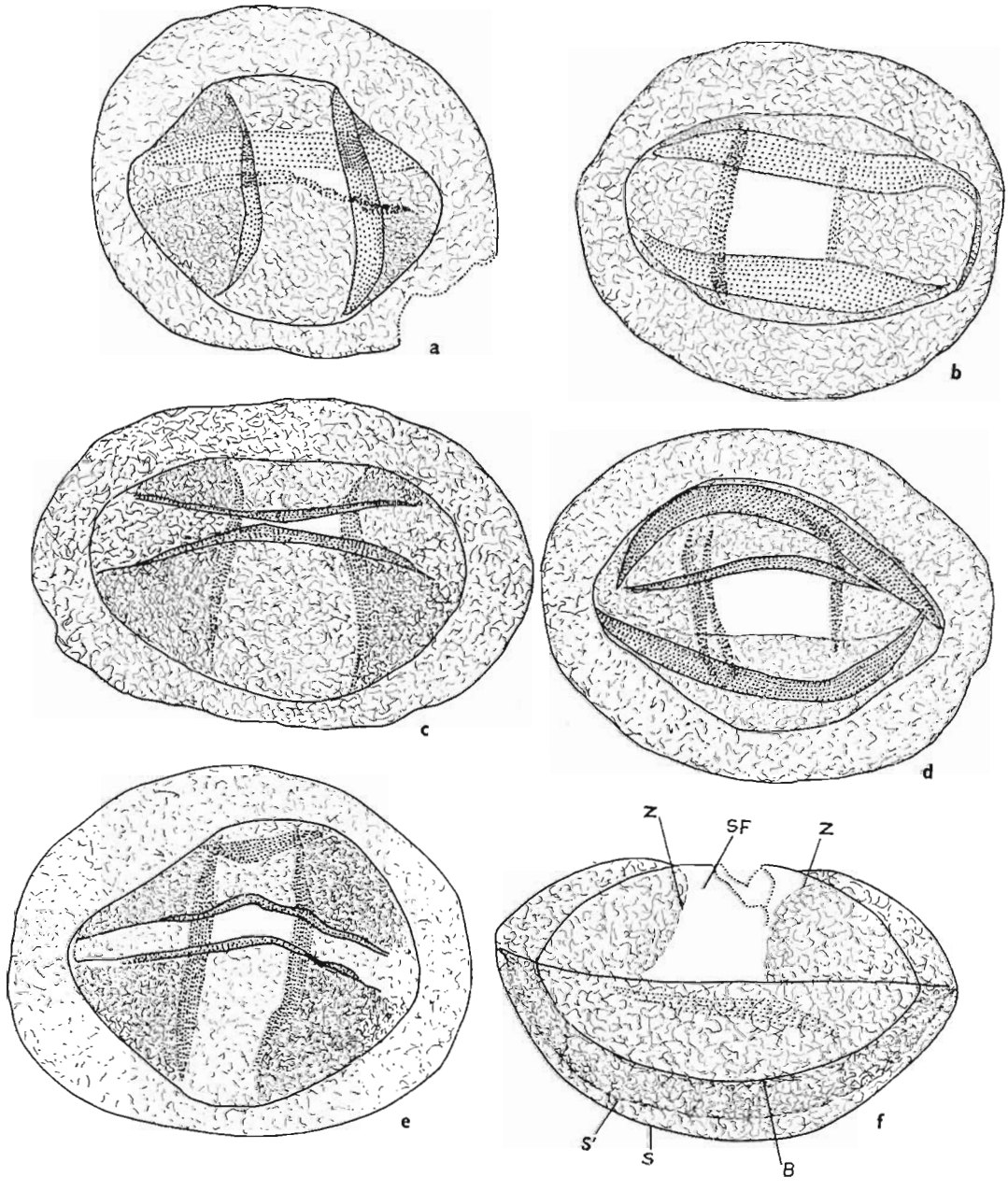
Crucisaccites latisulcatus sp. nov.

Pl. 1, Figs. 1-6; Text-figs. 1, 2

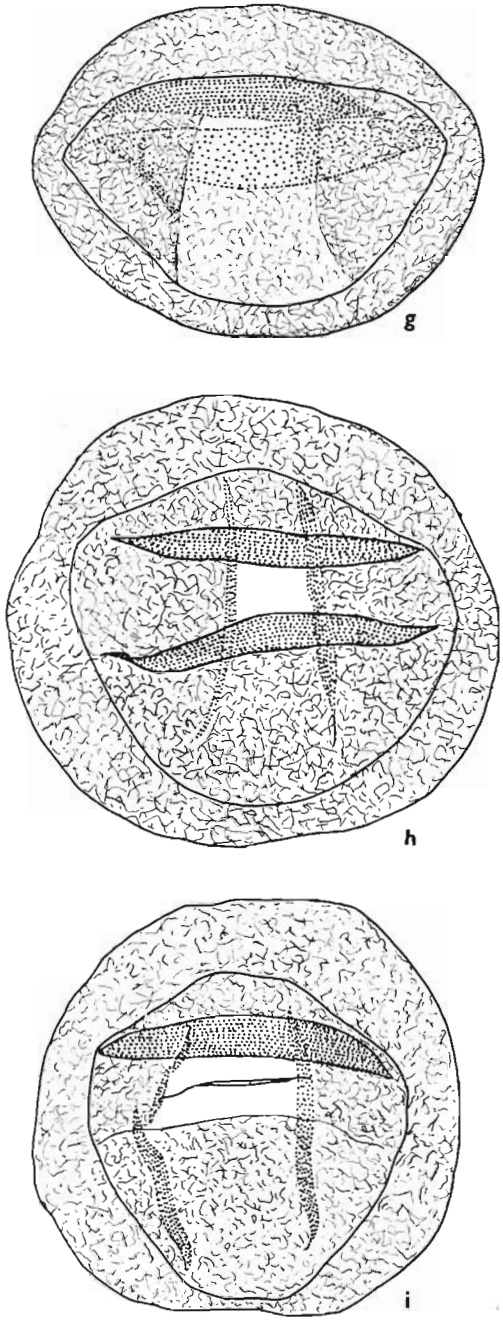
Specific Diagnosis — Size range about 200-260 microns (along the longer axis), outline ± circular to oval, body 160-190 microns (along the longer axis), mediumly thick, clear, subcircular to ellipsoid in shape, exine structure or sculpture obscure, saccus outside the body narrow, more or less uniformly wide; zones of attachment nearly reaching the body periphery, bilateral, cruciate with respect to each other on the two sides, saccus-free areas of body ± wide, thinner, sulcus-like; body-infolds near saccus roots strongly developed; monolete mark rarely visible, body exine in the saccus-free area may often rupture to simulate a monolete horizontal slit; saccus structure fine intrareticulate.

Holotype — Pl. 1, Fig. 1, Text-fig. 2-a; No. 1584/3. Birbal Sahni Institute of Palaeobotany, Lucknow.

Remarks — The species is characterized by spores of rather large size. A considerably large body having prominently convex faces is surrounded by a narrow peripheral saccus (30-40 microns wide). The saccus encroaches inwards for about 2/3 body radius. The polar view of the body appears ellipsoid at first sight but on closer examination its shape may be more likened with a rhombus having somewhat blunt angles (PL. 1, FIG. 2, TEXT-FIG. 2-e). Greater flattenning along the angles may further modify the shape of the body to an octogonal figure having four sides comparatively longer



TEXT-FIG. 2a-f — *Crucisaccites latisulcatus* gen. et sp. nov. Camera lucida sketches (magnification × 250) to show variations in the overall shape, body outline, body-infolds, saccus-free areas and flattening of the grain. Body-infolds are stippled; those with a continuous outline are in focus, those without any outline lie on the other side. Specimens 2-a to 2-i are numbered as 1584 3, 1586/3, 1583/3, 1584/1, 1585/1, 1586/2, 1584/2, 1587/2 and 1585/2 respectively. The body outline may appear to be oval (b, c) or ellipsoid (d), but it shows a marked tendency to become ± rhomboid (e) having blunt angles or even nearly octagonal (a, i). Body-infolds usually tend to develop near saccus attachment (a, b, c, e, h) but may also form away from saccus roots (d). The saccus-free areas may often show a slight widening at the two extremities (a, b, c). The grains in g and i suggest a comparatively oblique mode of flattenning of the body. The specimen in f is folded along the longer axis showing the lateral view of the body as well as exposing the zone of saccus attachment (Z) and the saccus-free area of the body on one side. The two margins of the folded saccus are seen at S and Ś. Compare Pl. 1, fig. 6.



TEXT-FIG. 2g-i — *Crucisaccites latisulcatus* gen. et sp. nov.

than the rest (PL. 1, FIG. 1; TEXT-FIG. 2-a, i) The structure of the body exine is not clear. Many ill-preserved specimens show what appear like grana or microverrucae. The presence of an intra-microreticulum can be only ascertained in better-preserved examples. The body-infolds near the saccus roots are often sharply developed as a result of flattenning of the strongly convex sides of the body. Differences in flattenning may cause wide displacements of the infolds and their contours (PL. 1, FIG. 3; TEXT-FIGS. 2-b, d). The zones of saccus attachment, as seen in the flattened specimens, are somewhat curved outward or inward so as to appear biconvex to nearly spindle-shaped (PL. 1, FIG. 5; TEXT-FIGS. 2-b, c). It may be that some of these shapes are secondarily derived to compensate the flattenning of originally parallel-sided zones which ran over the high convex surface of the body.

Synonymy — The following specimens probably belong to *C. latisulcatus:* Virkki, C. 1946-Pl. 5, Fig. 49; Pl. 10, Fig. 135, ?136; Pl. 11, Fig. 137.

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EXPLANATION OF PLATE 1

(*All photo-micrographs are enlarged* 250 *times. The slides are preserved at the museum of the Birbal Sahni Institute of Palaeobotany*)

Crucisaccites latisulcatus gen. et sp. nov.

1. Holotype. Note the rhomboidal body outline, the darkest four corners of the body, the mediumly dark areas inbetween and the completely saccus-free area, lightest in colour, in the centre. Compare Text-fig. 2-a. No. 1584/3.

2. A more oval specimen. The shape of the body tends to become somewhat rhomboid-ellipsoid. The horizontal body-infolds are biconvex. No. 1587/1.

3. A subcircular grain. The body is slightly obliquely flattened and one of the horizontal folds is displaced up to the periphery, the other horizontal fold has split into two. The body exine has ruptured in the centre so as to simulate a monolete slit. No. 1588/1.

4. Almost circular specimen with a radially symmetrical body outline. The saccus-free areas on the two sides appear almost equal. No. 1588/2.

5. Oval specimen. Horizontal saccus-free area is in focus showing the extent of the saccus and the somewhat spindle-shaped appearance of the zone of attachment. The saccus-free area and body-infolds of the other side are faitnly seen. Compare Text-fig. 2-c. No. 1585/3.

6. Specimen folded laterally along the longer axis. The two margins of the folded saccus are noticeable. The body shows strongly convex contours on both sides. The mode of saccus attachment on one side and the saccus-free area are clearly seen. The other saccus-free area is masked by the folded part of the grain. Compare Text-fig. 2-f. No. 1586/2.

7. *Crucisaccites* sp. A specimen devoid of the body. Such grains show with advantage the cruciate mode of saccus attachment on the two sides. The four darker areas at the corners and the mediumly dark areas in between are the result of the crossed, bilateral attachment. No. 1586/1.


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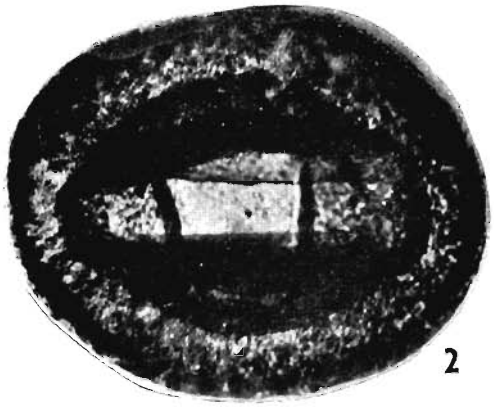
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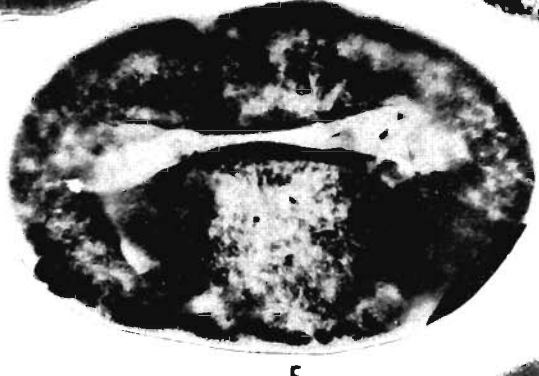
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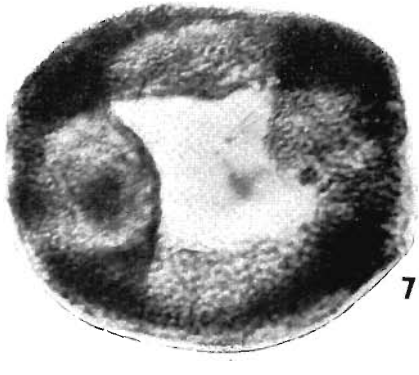
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