Journal of The Palaeontological Society of India
Vol. 41, 1996, pp 57-61

CORPUSCULES IN THE PERMIAN POLLEN FROM INDIA

VIJAYA and K.L. MEENA
BIRBAL SAHNI INSTITUTE OF PALAEOBOTANY, 53 UNIVERSITY ROAD, LUCKNOW-226 007, INDIA

ABSTRACT

In a Permian assemblage of dispersed spores and pollen, recovered from bore-hole RAD-7 from Raniganj Coalfield, a number of bisaccate pollen grains were found to contain dark circular bodies. Various characters of their morphology, number and arrangement have been recorded in different pollen taxa. In this paper, we suggest the identity of the microgametophyte-like bodies.

INTRODUCTION

While working on the palynostratigraphy of a Permian-Triassic succession in the bore-hole RAD-7, from Ondal Area (87°35'40" : 23°10'20") East Raniganj Coalfield, West Bengal (fig. 1), the presence of dark circular bodies in different patterns of arrangement was recorded in a large number of pollen. Such a condition prevails in striate as well as non-striate bisaccate pollen grains occurring in Late Permian assemblage at the depth level of 51.55m and 115.50m (fig. 2). The observations, based on different morphologies suggest that these structures represent components of the microgametophyte.

The classical works of Renault (1885); Oliver (1903, 1904) and Florin (1936, 1937), where peripheral jacket of sterile cells, or parenchymatous cells filling the spore cavity have been described, indicate the early interest of palaeobotanists in the study of fossil male gametophytes. Presence of prothalian cells in Cycadeoideae (Wieland, 1906) and the record of multicellular pollen grains in Cordaitales (Renault, 1881, 1896, 1902) have revealed that the male gametophyte in gymnosperms are multicellular. However, some of the structures were re-interpreted by Millay and Taylor (1970), and Taylor (1973). Our understanding in this aspect has also been enriched by the work of Millay and Eggert (1974).

As stated above, no *in situ* pollen with microgametophytes have been reported in the Glossopterid-flora. The present short account deals with the dispersed pollen having distinct dark ± circular bodies

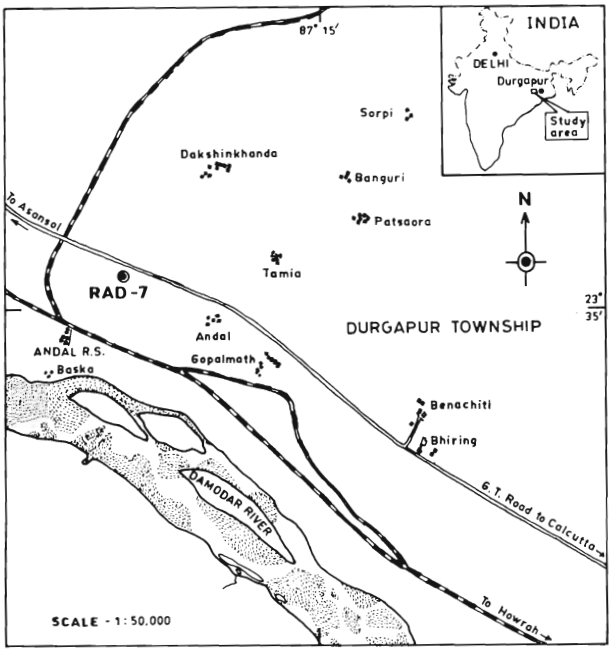

Fig. 1. Map to show the location of Bore-hole RAD-7, in East Raniganj Coalfield, W.B., India.

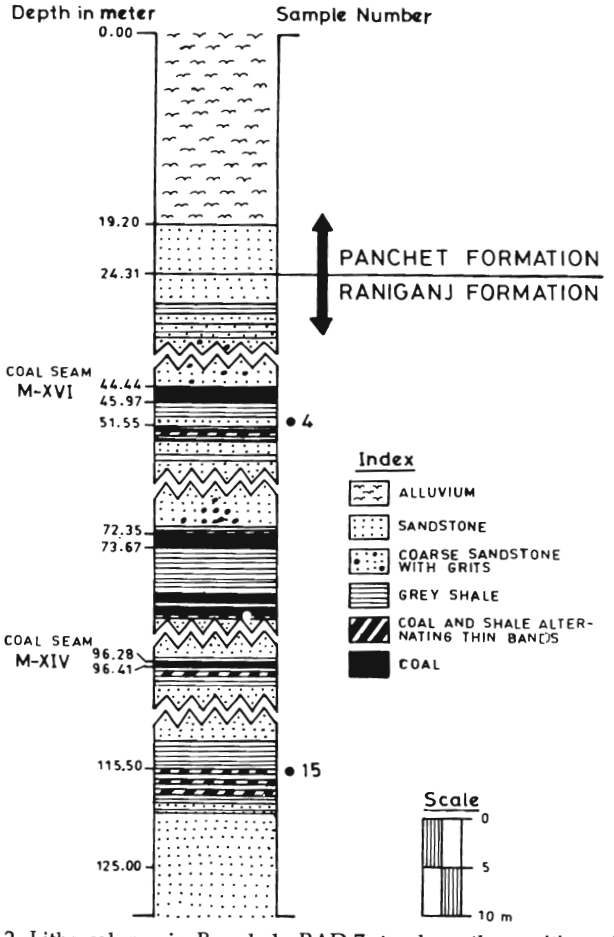

Fig. 2. Litho-column in Bore-hole RAD-7, to show the position of Samples (solid dot), in which the pollen grain with dark bodies have been studied.

within the central body, i.e., *nexine*, of the pollen grains. *Are these bodies the microgametophytes, or chytrids* (Taylor and Taylor, 1993).

OBSERVATIONS

Presently, in the population of bisaccate pollen, 55 specimens have been studied exclusively for their "unusual" bodies, which are found to be present within the corpus. It has been noted that the number of these opaque bodies varies from one to seven, or may be more, within a single corpus. Variations are observed in the overall size of each body, their peripheral thickenings, arrangement and other morphological characters.

Occurrence of a single, dark brown body is frequent. Range in size of these bodies is from 15 to 35 μm, ± circular to ovalish in outline. Marginal rupturing seems a regular feature, associated with irregular peripheral thickenings, which borders crevices. Only in few specimens, no such cracks occur along margin but thickening on the body equator is present. It is important to note that there is no cellular differentiation in these bodies, as has been recorded by Taylor and Taylor (1993, fig 3.39, p.90) in the case of chytrids. Depending on the over all size, each body occupies various space within the corpus as shown in (fig. 3A-C). These bodies occur in both the striate and non-striate bisaccate pollen (Pl. I, figs. 1-3,6).

The presence of more than one opaque structure in a single corpus is also observed. Pollen grains having more than one body are less frequently encountered than those with single body. The variations in the overall size and degree of darkening of colour are constant features as seen in these groups (figs. 4A, B, Pl. I, figs. 4-12). Bodies, 24-33 μm, oval to ± circular in shape and four in number are commonly found inside the space of a corpus. Each body is opaque, in contrast to lighter colour of the pollen, and exhibits irregular cracks at the margin. Peripheral thickening is also present, (fig. 4A, B), body surface is generally smooth, but at times, uneven reticulate pattern may be observed (Pl. I, fig. 9) with a horizontal slit-like thinning, which may split further, (fig. 4A; Pl. I, fig. 7). Such bodies occur in striate bisaccate pollen. Very rarely one of the bodies from the group ejects out of the nexine (Pl. I, fig. 8).

Rarely, a sequential arrangement of bodies with partial overlap of each other, is found. As shown in fig. 4c, the uneven peripheral thickening and rupturing at the margin suggests a globular nature of these bodies, (Pl. I, fig. 11).

From the detailed study, it has been observed that these bodies are generally darker than the pollen corpus and are present within the corpus part of the grain. They range in size from 15 to 40 μm in diameter. In some cases the uneven thickening can be noticed on the surface of the bodies, while others exhibit micro-cracks at their margin (Pl. I, figs. 1-12). The DIC Picture reveals their thick nature through the relief on the sexine of the pollen corpus. The general uniform size indicates that they are fully developed structures.

DISCUSSION

In the presently studied palynological assemblage, the dispersed striate, taeniate and non-striate bisaccate pollen contain distinct, spherical, dense structures which vary in size from 15 to 40 μm. These structures are circular, subcircular or rarely oval in outline (fig. 3 A-C; fig. 4 A-C). Repeated attempts to understand their fine structural details have failed, obviously owing to their dense nature.

With relation to the lumen of the pollen corpus, in which these bodies are located, they are generally excentric in position; they may touch the corpus outline from within in a compressed specimen, but only in very rare case they exit outside of the corpus limit. Numerous slides were observed in order to search laterally flattened specimens of the disaccate pollen containing these

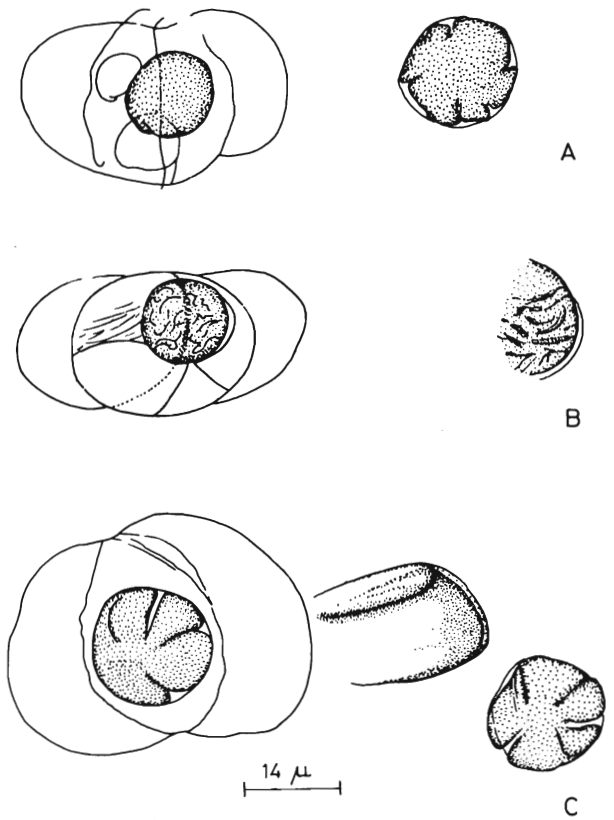

Fig. 3. Sketches based on observations of specimens under transmitted light microscopy and the photomicrographs. A-C. Details of exine characters in a single dark brown body with smooth (B), rupturing on margin (C), and uneven peripheral thickening.

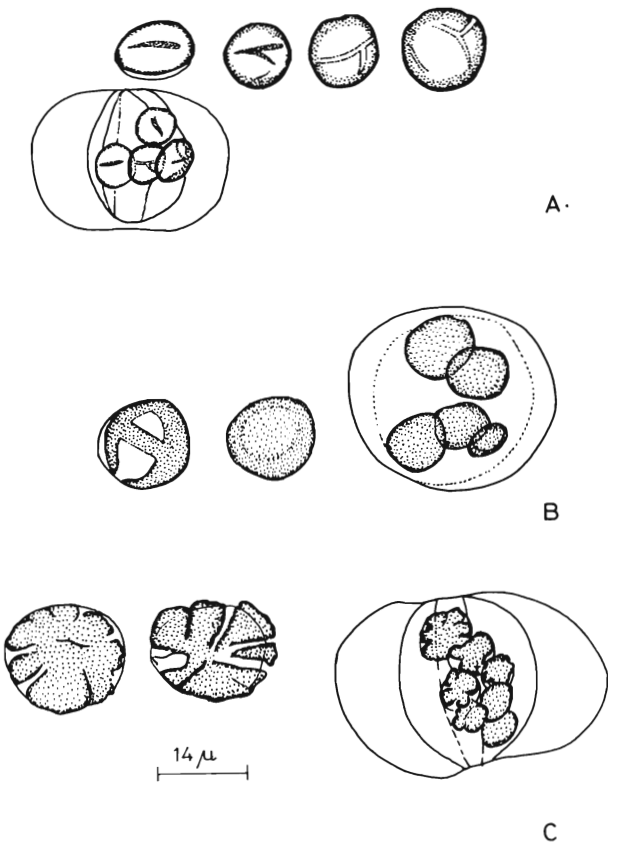

Fig. 4. Sketches based on the observations of specimens under transmitted light microscopy and the photomicrographs. A-C. Occurrence of the dark bodies, four to seven in number, with irregular cracks on the margin. Peripheral thickening is generally present.

dark masses so that their arrangement could be deciphered, but none could be located. In proximo-distally (or vise-versa) compressed specimens, the dense bodies are irregular in arrangement.

These dark bodies could be designated as microgametophytic stages of development. The fact that they do not occur outside of the pollen corpus, and their number varies from one to seven, rarely more. The L-0 analysis further confirms that these globular masses are within the nexinal layer and hence they form the part of the cell content. The possibility of their being detritus bodies is thus ruled out. The various stages of development of these dark bodies under study cannot be ascertained because of the unfavourable preservation.

Are they fungal bodies? with this question in mind, careful observations were made to search for septate or multicelled nature of the structures or association of hyphae with these organs. However, no such indications were located in the dispersed pollen containing these dark bodies. Moreover, the distortion of nexine by fungal activity through which the fungal hyphae could have entered into the corpus, also could not be found. In view of this, the fungal origin of these dark bodies within the corpus of pollen may not be ascertained.

Do they represent coagulated cytoplasm or general cell-contents? In all probability, they do not, because they are found as solitary or more than one - up to seven - in number. The cell-content cannot shape itself to form seven regular, shaped bodies! Moreover, they are very thick objects, much thicker than the exine itself, hence they cannot represent very thin cytoplasmic system.

Sterling (1963) has synthesised the evolution and development of the male gametophyte organization in primitive gymnosperms. The prothalial cell, generative cell and tube nucleus are the basic units of the cell in initial stage. Such distinctions are, however, not possible in the present material because of their irregular arrangement and non-orientation in an axial row fashion.

The pollen taxa of *sporae dispersae* containing these dark bodies are the product of Glossopterid flora (Pant, 1988). If these bodies are accepted to be of microgametophytic origin, it is naturally derived that these plants were not very primitive in the development of the microgrametophytic models, not much different from the extant gymnosperms.

ACKNOWLEDGEMENTS

The authors acknowledge, with gratitude, the help of Dr. R.S. Tiwari, Ex-Director, BSIP for his valuable suggestions in the preparation of this manuscript. The learned anonymous referees are gratefully acknowledged for reviewing the manuscript and offering useful suggestions.

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EXPLANATION OF PLATE

Plate I

All photomicrograhs are x 500, unless stated otherwise

1,2. Occurrence of a single dark brown circular body in the nexinal part of the corpus, showing uneven marginal rupturing and peripheral thickening; and on the body surface are seen uneven cracks. 1, non-striate bisaccate pollen (*Scheuringipollenites*); and 2, striate bisaccate pollen (*Striatopodocarpites*).

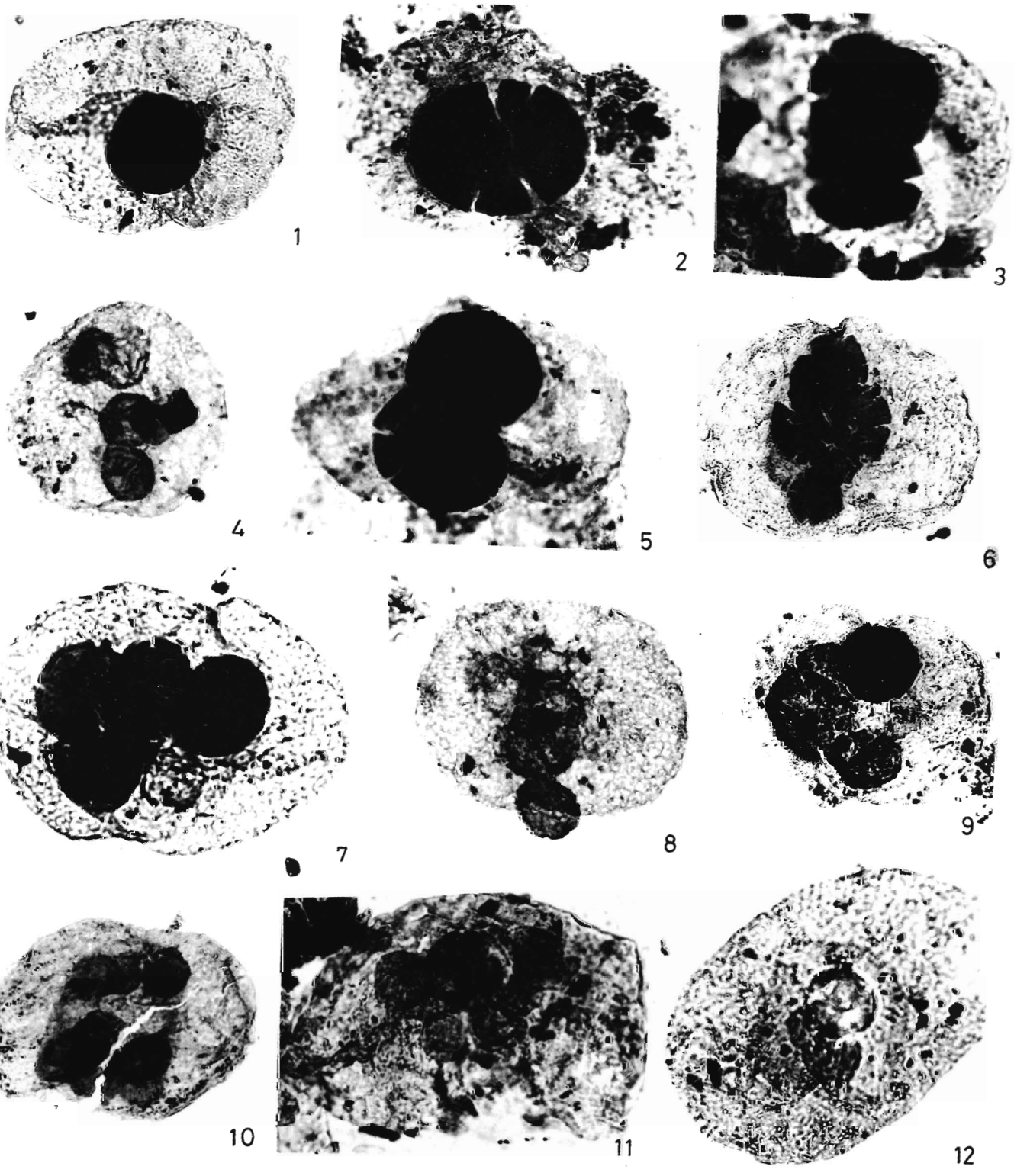
3. Single dark brown body with uneven horizontal tiering on margin, and unevenly thickened along the crevices, in a non-striate bisaccate pollen (*Ibisporites*).

6. In this specimen, the corpus content is dark brown and single, but it exhibits irregular division resulting into multi-tiering.

5,12. Striate bisaccate pollen (*Crescentipollenites, Striatopodocarpites*) having two dark ± circular bodies, occupying varied places within the corpus. They are closely attached with a third smaller body. The uneven peripheral thickening is present in all bodies with cracks on the margin.

4,8,9. The increased number of these dark bodies is shown in faintly striate bisaccate pollen (*Faunipollenites*). 4, the smaller one gets sandwitched in the cluster of four bodies. 8, one of the bodies is seen coming out of the corpus. 9, these bodies are relatively bigger with prominent peripheral thickening and cracks.

7,10,11. Faintly striate bisaccate pollen (*Crescentipollenites*) having four dark brown, and one thin circular body. 11, A non-striate bisaccate pollen (*Scheuringipollenites*) contains a cluster of seven or more brown bodies occupying maximum space within the corpus. Here cleavages on body surface are more prominent.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