

STUDIES IN THE GLOSSOPTERIS FLORA OF INDIA —
39. *ALATOCARPUS* GEN. NOV. : A NEW PLATYSPERMIC SEED
FROM THE SINGRAULI COALFIELD

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ABSTRACT

A new genus, viz. *Alatocarpus* is instituted to contain certain large platyspermic seeds discovered in the Lower Gondwana beds of the Singrauli Coalfield, Uttar Pradesh. The species *Samaropsis johillensis* Saksena (1955) from the S. Rewa basin is transferred to *Alatocarpus*. The Singrauli material contains *Alatocarpus indicus* sp. nov. (the type species), some specimens comparable to *Alatocarpus* (*Samaropsis*) *johillensis* (Saksena) comb. nov., and *Alatocarpus* sp. It is suggested that *Samaropsis pincombei* Walkom (1928) may also belong to *Alatocarpus*. The bearing of the occurrence of the seeds and associated plants on the age of the beds is briefly discussed.

INTRODUCTION

A SMALL assemblage of Glossopteris flora collected from the Lower Gondwana beds of the Singrauli Coalfield, U.P., was described earlier in a short paper by Lele, Swarup and Singh (1968). These plants were mostly preserved in a bed of carbonaceous shale exposed in the Gaurbotha Nalla cutting, South of Bansi Village, Mirzapur District, U.P. The plants of the Bansi exposure included — (1) equisetalean and other stem impressions, (2) *Gangamopteris cyclopteroides*, (3) *G. cyclopteroides* var. *areolata*, (4) *G.* sp. cf. *G. angustifolia*, (5) *Gangamopteris* sp. A., (6) *Gangamopteris* sp., (7) *Glossopteris communis*, (8) *G. indica*, (9) *G.* sp. cf. *G. taeniopteroides*, (10) *Glossopteris* sp., (11) *Samaropsis* sp. A., (12) *Cordaicarpus* sp., (13) Coniferous shoot (? *Buriadia*) and (14) an indeterminate notched leaf.

A striking feature of this assemblage is the rather conspicuous presence of a number of large and small types of platyspermic winged or unwinged seeds, some of which are mere impressions, while a few others possess a carbonized crust. These seeds were provisionally described as *Samaropsis* or *Cordaicarpus* in the earlier publication (LELE, SWARUP & SINGH, 1968). A number of additional specimens were obtained by further splitting the rock. On

detailed re-examination it became evident that the large platyspermic seeds described earlier as *Samaropsis* sp. A. are closely similar in their general organization to *Samaropsis johillensis* Saksena (1955) known from the Ganjra Nalla beds (S. Rewa basin) of Karharbari age. The holotype of *S. johillensis*, preserved at the Birbal Sahni Institute's museum, was therefore, critically re-examined. As a result of this investigation, it seems now justifiable to segregate these large-winged platyspermic seeds having distinct morphological characters from the comprehensive genus *Samaropsis* which is more truly, a designation of convenience containing seeds of diverse morphographical characters (MAITHY, 1965). The generic name, *Alatocarpus* is, therefore, proposed to accommodate these seeds. *Samaropsis johillensis* Saksena (1955) is herewith transferred to *Alatocarpus*. The Singrauli material has revealed one or two specimens which can be compared with *Alatocarpus johillensis* (Saksena) while most of the remaining specimens belong to the type species, *A. indicus* sp. nov. of which the cuticular details are also known. Another solitary specimen, described as *Alatocarpus* sp. may perhaps represent a third species. A rich miospore flora has also been discovered in the fossiliferous shales which will be described in detail elsewhere.

DESCRIPTION

Genus — *Alatocarpus* gen. nov.

Type Species — *Alatocarpus indicus* sp. nov.

Diagnosis — Platyspermic seeds, transversely expanded in overall outline; sarcotesta well-spread, equally on either side of sclerotesta in transverse direction or inclined to it, a shallow to deep depression or sinus present in sarcotesta at two ends of seed, surface with fine striations; sclerotesta subcircular to pear-shaped, projected on

one end (distal) into two beak-like structures (micropyle) with a narrow cleft in between; beaks conical with sharp or blunt tips; beaks contained in distal sinus of sarcotesta, latter being connected to beaks laterally to various extent, several fine striations and a relatively stronger median longitudinal groove or ridge of variable length present on sclerotesta.

Description—A study of the present material as well as the species from South Rewa basin shows that the platyspermic seeds of *Alatocarpus* are fairly large in size and possess a well expanded sarcotesta. The sarcotesta may spread out along the transverse axis uniformly or may be distally inclined (as in *A. johillensis*). It has a shallow to deep sinus at the two ends of the sclerotesta. At one end, the sclerotesta is projected in the form of two beak-like structures with pointed or blunt tips. The beaks are more or less separated by a narrow cleft and may appear convergent or divergent. They lie in the sinus of the sarcotesta. The sarcotesta is connected to the beaks laterally and covers nearly half of the lateral extent of the beaks. However, in some cases the sarcotesta may be connected quite near the base of the beaks and the latter may then seem to be projecting out well. On the contrary the sarcotesta may sometimes nearly cover the entire lateral side of the beaks so that they appear almost immersed in the sinus of the sarcotesta and can not be easily discerned. The structural and organizational appearance of the beaks is strongly suggestive of a micropylar apparatus.

The sclerotesta is more or less obscure in outline. It appears somewhat subcircular or may tend to be pear-shaped. It shows a number of finer striations on its surface which may be more longitudinal in the median region and take a curvature corresponding to the body outline near the periphery of the sclerotesta. In the median longitudinal position there is a relatively stronger ridge or groove which starts from the base (proximal side) of the sclerotesta and may run for a part or whole of its length. The seed was probably attached on this side (opposite the beaks), although no definite stalk or any other sign of attachment is noticeable. In *A. johillensis*, however, there is an apparent mark at the proximal end which may suggest an attachment (SAKSENA, 1956).

1. *Alatocarpus indicus* sp. nov.

Pl. 1, Figs. 1-5, 12-15; Text-figs. 1, 2, 7-10

Diagnosis—Platyspermic seed, horizontally oval to subcircular in outline, measuring 2.5-2.3 cm. along transverse axis (width) and 1.3-2.3 cm. along vertical axis (length); sclerotesta obscure in outline, subcircular to broadly pear-shaped, approximately 1.1-1.8 cm. wide and 1-1.5 cm. long; beaks about 2-2.5 mm. long and \pm 1 mm. broad at base, conical with pointed or blunt tips; fine striations on sclerotesta \pm curved corresponding to body margin; a stronger median longitudinal ridge or groove runs from base upward across whole length of sclerotesta. Sarcotesta distinct, about 7 mm. to 10 mm, widest in middle on one side of seed. \pm hemispherical on either side and expanded uniformly along transverse axis without distal inclination, fine striations present, a depression or sinus present on sarcotesta at distal and proximal ends, sarcotesta covering beaks laterally \pm half way up from their base.

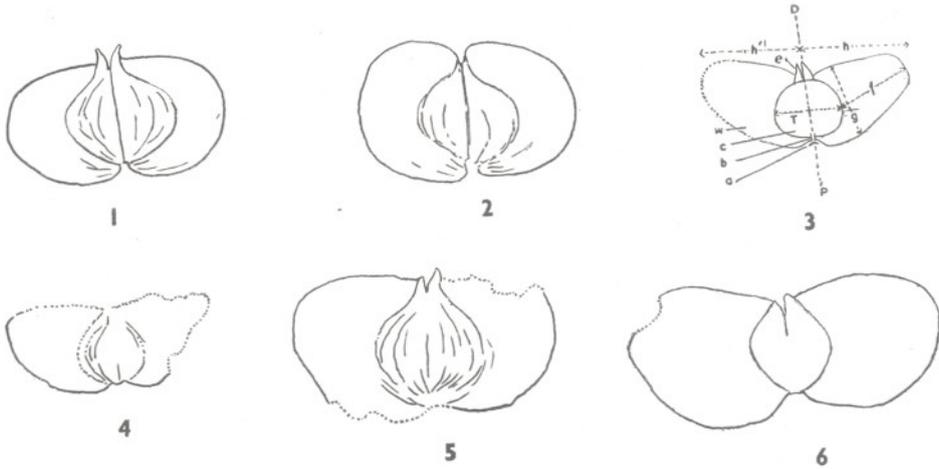
Cuticle on sarcotesta single layered, both surfaces possessing irregularly arranged, polygonal cells (4-8 sides) measuring 17-37 μ in length and 11-27 μ in width, cell wall about 3 μ thick. Cuticle on sclerotesta double layered; outer layers has (on either surface) polygonal cells (4-8 sided) showing a tendency to be arranged in longitudinal rows, cells usually longer than broad, 40-130 μ long and 25-72 μ wide, cell wall 2.5-3.5 μ thick, occasionally somewhat undulated, thickness irregular; inner layer somewhat pulpy in appearance, showing a fine reticulum, but no cells visible.

Syntypes—B.S.I.P. Collection No. 33782. Seed 2.9 cm.; sclerotesta \pm 1.5 cm., sarcotesta 7 mm. on one side (Pl. 1, FIGS. 1, 2, TEXT-FIG. 1). No. 33783, Seed 3.6 cm., sclerotesta \pm 1.6 cm. Sarcotesta 1 cm. on one side. (Pl. 1, FIGS. 3, 4, TEXT-FIGS. 2, 7-10).

Type Locality—Gaurbotha Nalla cutting, South of Bansi village, Singrauli coalfield, U.P.

Horizon—Lower Gondwana (Karharbari/Barakar).

Description—There are about a dozen examples of this species. The seeds are characterized by their large size and a transversely expanded sarcotesta which gives them an horizontally oval appearance.



TEXT-FIGS. 1-6. 1 — *Alatocarpus indicus* sp. nov. Drawing of the specimen in Pl. 1, Fig. 2. \times Nat. size. 2 — *Alatocarpus indicus* sp. nov. Drawing of the specimen in Pl. 1, Fig. 4. $\times \frac{3}{4}$. 3 — *Alatocarpus johillensis* (Saksena) n. comb. Reproduced from original drawing of Saksena, 1955. P, proximal end; D, distal end; PD, median vertical axis; a, mark of attachment; b, bridge; c, body; w, wing; e, beak; f, wing spread; g, wing breadth; hh', total wing span; T, transverse axis of body. \times Nat. size. 4 — *Alatocarpus* cf. *johillensis* (Saksena). Drawing of the specimen in Pl. 1, Fig. 9. $\times \frac{3}{4}$. 5 — *Alatocarpus* cf. *johillensis* (Saksena). Drawing of the specimen in Pl. 1, Fig. 10. \times Nat. size. 6 — *Alatocarpus* sp. Drawing of the specimen in Pl. 1, Fig. 11. \times Nat. size.

Some specimens approach a sub-circular shape.

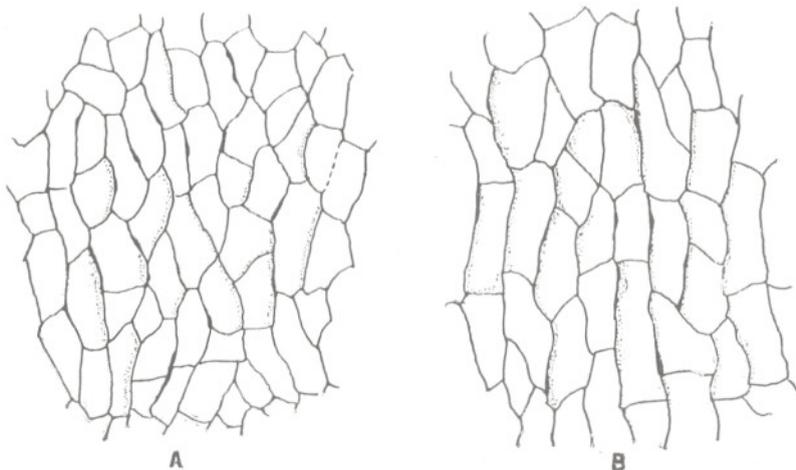
The sarcotesta is widest along the transverse axis and gently narrows towards the distal and proximal ends where it has a deep or shallow depression or sinus. The sarcotesta has fine striations, some of them being more apparent near the proximal end on either sides of the sinus.

The sclerotesta is indistinct, subcircular to broadly pear-shaped. It is projected out in the distal sinus of the sarcotesta in the form of two small, delicate, conical beak-like structures with pointed to blunt tips (PL. 1, FIG. 1). The sarcotesta laterally covers the beaks in various degrees. In some specimens the lateral contact of the sarcotesta is very near the base of the beaks which are thereby almost fully exposed, while more generally the sarcotesta covers nearly half of the lateral part of the beaks. In extreme cases the beaks appear to be almost immersed as they are nearly completely covered and cannot be easily made out in the distal sinus of the sarcotesta (PL. 1, FIG. 4). The beaks are separated by a narrow cleft running almost up to their base. The beaks may seem convergent or divergent in different states of preservation. The median ridge of the sclerotesta

runs right up to the distal end and appears to be in line with the cleft of the beaks (PL. 1, FIGS. 2, 4).

Epidermal structure—Some specimens with carbonized crust yielded a cuticle by cellulose pull method. Pulls were taken separately from the sclerotesta and sarcotesta regions. During maceration and alkali treatment, the cuticle on the sarcotesta was found to be made up of a single layer. Both surfaces of this layer are nearly identical, possessing polygonal cells arranged irregularly all over the surface (PL. 1, FIGS. 14, 15; TEXT-FIGS. 9, 10). The cells may be about 2-3 times longer than broad but often they may become almost isodiametric.

The cuticle over the sclerotesta region is found to be made of two layers. The outer layer shows, cells of more or less identical nature on both surfaces of the cuticle (PL. 1, FIGS. 12, 13; TEXT-FIGS. 7, 8). The cells are polygonal and may be 3 to 4 times longer than broad. They suggest here and there a rough orientation along their longer axes. Their walls are straight to somewhat undulated. The thickness is irregular. The inner layer appears as a brown film between the two flaps of the outer layer and can be easily separated by careful alkali treatment. Stronger alkali reaction tends to dissolve it.



TEXT-FIG. 7(A, B) — *Alatocarpus indicus* sp. nov. One surface of the cuticle of the outer layer of sclerotesta. $\times 250$.

The inner layer is somewhat pulpy and it was not possible to distinguish both surfaces of the cuticle of this layer. It does not show any cellular structure, but a fine reticulum is strongly developed on its surface (PL. 1, FIG. 5). This layer strongly recalls the megaspore membrane.

Comparison — The new species *A. indicus* shows the same kind of general organization as in the case of *A. johillensis* (described later). However, the chief differences between the two species lie in the fact that *A. indicus* does not possess a distally inclined sarcotesta whereas in *A. johillensis* the inclination is quite evident and may be very pronounced (about 60 degrees from the transverse axis as in the holotype). The overall shape of the two species is therefore very distinct from each other. Besides, the median longitudinal ridge in *A. indicus* is more obvious and runs throughout the entire length whereas it is short and rather inconspicuous in *A. johillensis*. The cuticular details of *A. indicus* sp. nov. are much better known than in the case of *A. johillensis*.

A platyspermic seed described as *Samaropsis pincombei* Walkom (1928) from the Upper Coal Measures of the New Castle District, Australia, also appears to suggest a plan of organization similar to *Alatocarpus*. Saksena (1955) has also pointed out strong resemblances between this species and *Samaropsis johillensis* which now belongs to *Alatocarpus*. *Samaropsis pincombei* has

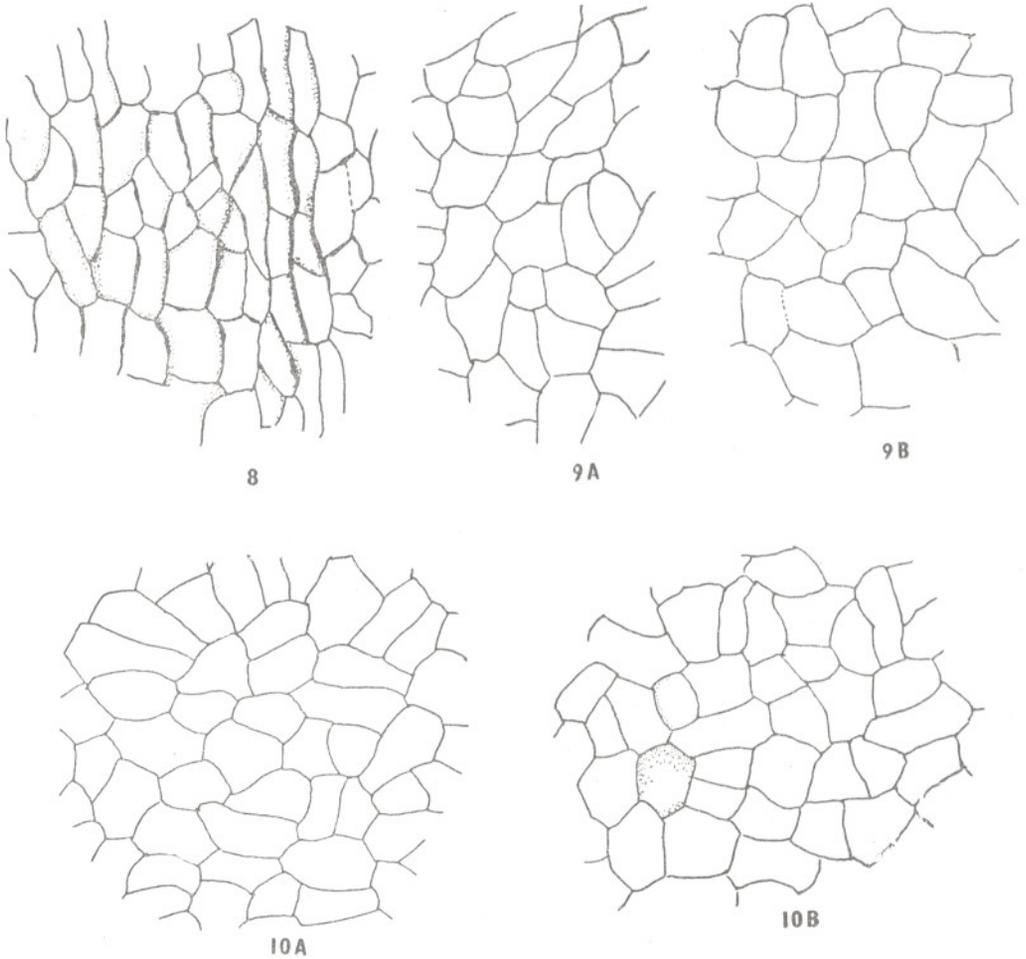
however, a very much transversely expanded sarcotesta which is characteristic. At any rate it is not unlikely that the Australian specimens may find a place under the present new genus.

2. *Alatocarpus* cf. *johillensis* (Saksena, 1955) comb. nov.

(Pl. 1, Figs. 8-10; Text-figs. 4, 5)

For Diagnosis and Description vide Saksena, 1955, p. 73, Text-figs. 1-4 (original figures reproduced here in PL. 1, FIGS. 6, 7; TEXT-FIG. 3). Examination of the holotype of this species (PL. 1, FIGS. 6, 7, TEXT-FIG. 3) reveals all the important characters given in the diagnosis of *Alatocarpus*. The two beaks are distinctly visible as projections of the sclerotesta. The sclerotesta is obscure and the median ridge is also rather short and indistinct. The species possesses a well expanded sarcotesta showing strong distal inclination of about 60° from the vertical axis. The variations in the angle of inclination are however unknown, and it is likely that some specimens, as those in the present collection, have less distally inclined sarcotesta. The angles of the sarcotesta on the distal side are flat, but some variation is probably admissible in this character as well.

In the present collection there are one or two specimens (PL. 1, FIGS. 8, 10, TEXT-FIGS. 4, 5) which are comparable to *Alatocarpus johillensis*. The specimen in Fig. 8



TEXT-FIG. 8-10. 8—*Alatocarpus indicus* sp. nov. Other surface of the cuticle of outer layer of sclerotesta. $\times 250$. 9(A, B)—*Alatocarpus indicus* sp. nov. One surface of the cuticle of sarcotesta. $\times 250$. 10(A, B)—*Alatocarpus indicus* sp. nov. Other surface of cuticle of sarcotesta. $\times 250$.

is probably more favourably comparable. In this the sclerotesta is subcircular tending to be somewhat broadly pear-shaped in outline. Precise measurement of the sclerotesta is difficult in view of its obscure margin. Approximately it is about 1.4 cm. long and about 1 cm. wide. A number of fine striations run over it; those towards the margin being correspondingly curved. A median ridge is faintly visible for a short distance from the base upwards. The beaks have apparently been not preserved or they might have been damaged during the process of clearing the rock matrix around the specimen. However, there is a suggestion of the beaks having been present. The

sarcotesta is incomplete, still its distally inclined character cannot be mistaken. The total wing span is about 3.4 cm. and the wing spread is about 1.5 cm. Evidently, the present example is somewhat larger than the holotype.

The Singrauli specimen seems to have undergone considerable oxidation during course of preservation as is evident from the rather brown colour of the sarcotesta. The other specimen (PL. 1, FIG. 10; TEXT-FIG. 5) shows the beaks faintly. The inclination of the wing is not, however, as prominent as in the holotype. It is likely that the present examples represent variations of the species *A. johillensis* which are

not unfortunately known in the original material of Saksena.

Epidermal Structure—The example in Pl. 1, Fig. 8 was tried for epidermal studies. The crust was easily removed from the sclerotesta by a cellulose acetate pull. On maceration, a brown cuticle was obtained showing a longitudinally arranged pattern of lines. Whether these represent badly preserved cells or not, cannot be confirmed at present.

3. *Alatocarpus* sp.

Pl. 1, Fig. 11; Text-fig. 6

A solitary specimen figured here is considered to be different from the other two species of *Alatocarpus* described in this paper. The specimen measures 4 cm. along the transverse axis and 1.8 cm. along the vertical axis of the wing. The sclerotesta is comparatively small in relation to the wing breadth. It measures about 1.2 cm. in length and about 1 cm. in breadth. It is rather obscure but a more or less pear-shape outline can be made out. The sarco-testa on each side of the seed is much greater than a hemisphere. The depression in the sarcotesta at the two ends of the seed is very clear, although there is no clear evidence of beak-like structures except for a slight indication on one side. No distinct median ridge is visible.

In view of no indication of distal inclination of the sarcotesta, the present specimen does not agree with *A. johillensis* (Saksena). Its reference to *A. indicus* is also difficult as the wing expansion on either side is considerably greater, the sclerotesta is comparatively smaller and the median ridge is not evident. The present specimen is likely to represent a distinct species but this needs to be established by more material.

AGE OF THE BEDS

The carbonaceous shales, containing the present plant fossil assemblage, have been generally considered to belong to the coal-bearing Barakar Stage of the Singrauli Coalfield. According to the available field

evidence (LELE, SWARUP & SINGH, 1968) the fossiliferous stratum lies fairly near the base of the coal-bearing sequence and is stratigraphically nearer to the top of the Talchir Stage of the Singrauli basin. A more or less similar situation obtains with regard to the Ganjra Nalla beds of the South Rewa basin which is adjacent to the Singrauli Coalfield. The fossiliferous shales in both the areas show a striking similarity in their lithic character and the mode of preservation of plant material. To add to this, the genus *Alatocarpus* is represented in both the localities by the common occurrence of *A. johillensis*. Platyspermic seeds of this peculiar kind are not present in the known floras of the Barakar or younger stages. These parallelisms are striking enough to raise the question whether the Singrauli shales could be considered as probable equivalents of the Ganjra Nalla Shales.

The Ganjra Nalla shales (referred to as Ganjra Nalla beds), were for a long time considered as Barakars. However, the fossil plant assemblage known from these strata has raised the possibility of their being Karharbari in age (SAKSENA, 1952). Recent microfloristic study of the Ganjra Nalla shales has further strengthened this view (LELE & MAITHY, in press).

If the Singrauli plant beds are equivalents of the Ganjra Nalla beds, their age would appear to be nearer to the Karharbaris than to the Barakars. The rather peculiar prevalence of platyspermic seeds—large and small—in the Singrauli plant bed is probably a point in favour of Karharbari aspects. It is further interesting to note that these seeds occur in association with fossil leaf material in which *Gangamopteris* is probably commoner than *Glossopteris* (LELE, SWARUP & SINGH, 1968). The flora is thus full of interesting possibilities but a greater amount of megafossil evidence is still needed for resolving the question of the age of the beds. It is satisfying to note in this connection that a rich microfossil assemblage has been recovered from the Singrauli plant-fossil bed, which is likely to shed light on this problem.

REFERENCES

- KRISHNAN, M. S. (1954). General report of the Geological Survey of India, 1951. *Rec. geol. Surv. India*. **85** (1): 158.
- LELE, K. M. & MAITHY, P. K. (1964). Studies in the Glossopteris flora of India-14. Revision of the epidermal structure of *Noeggerathiopsis* Feist. *Palaeobotanist*. **12** (1): 7-17.

- Idem (in press). Miospore assemblage from the Ganjra Nalla Beds, South Rewa Gondwana basin, with remarks on the age of the strata. *Ibid.* **17**(3).
- LELE, K. M., SWARUP, P. & SINGH, J. N. (1968). Occurrence of plant fossils in the Lower Gondwana Succession of Singrauli Coalfield, Uttar Pradesh. *J. palaeont. Soc. India.* **11**: 8-17.
- MAITHY, P. K. (1965). Studies in the Glossopteris flora of India-18. Gymnospermic seeds and seed-bearing organs from the Karharbari beds, Giridih coalfield, Bihar. *Palaeobotanist.* **13** (1): 45-56.
- SAKSENA, S. D. (1952). Correlation of the Gondwanas based on the evidence of plant fossils. *Agra Univ. J. Res.* **1** (Sci.): 1-13.
- Idem (1955). On two new species of *Samaropsis* (*S. johillensis* and *S. ganjrensii*) from the South Rewa Gondwana basin, Central India. *Palaeobotanist.* **4**: 73-76.
- WALKOM, A. B. (1928). Notes on some additions to the Glossopteris flora in New South Wales. *Proc. Linn. Soc. N.S.W.* **63** (5): 555-564.

EXPLANATION OF PLATES

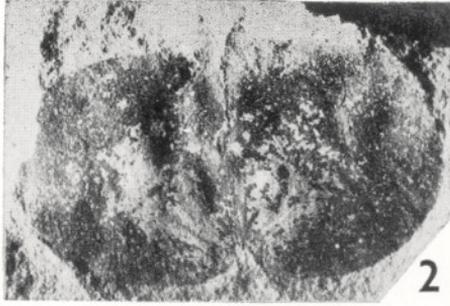
(Type-specimens, syntypes and figured specimens are preserved in the Museum of Birbal Sahni Institute of Palaeobotany)

PLATE 1

1. *Alatocarpus indicus* sp. nov. Nat. Size. Syntype No. 33782.
2. Same as above. $\times 2$, Negative touched near the distal side to bring out the beaks.
3. *Alatocarpus indicus* sp. nov. Nat. Size. Syntype No. 33783.
4. Same as above. $\times 1.5$.
5. *Alatocarpus indicus* sp. nov. Cuticle of the middle layer of sclerotesta showing fine reticulum. $\times 150$.
6. *Alatocarpus (Samaropsis) johillense* (Saksena) comb. nov. Nat. Size (reproduced from original photograph of Saksena, 1955). No. 7787.
7. Same as above. $\times 2$.
8. *Alatocarpus* cf. *johillensis* (Saksena). Nat. Size. No. 33790.
9. Same as above. $\times 1.5$.
10. *Alatocarpus* cf. *johillensis* (Saksena). Nat. Size. No. 33789.
11. *Alatocarpus* sp. Nat. Size.
12. *Alatocarpus indicus* sp. nov. One surface of cuticle of the outer layer of sclerotesta, showing somewhat longitudinally arranged cells. $\times 100$. From specimen No. 33783.
13. *Alatocarpus indicus* sp. nov. Other surface of cuticle of the outer layer of sclerotesta. $\times 100$. From specimen No. 33783.
14. *Alatocarpus indicus* sp. nov. One surface of cuticle of sarcotesta. $\times 100$. From specimen No. 33783.
15. *Alatocarpus indicus* sp. nov. Other surface of cuticle of sarcotesta. $\times 100$. From specimen No. 33783.



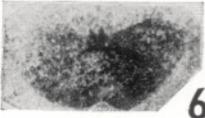
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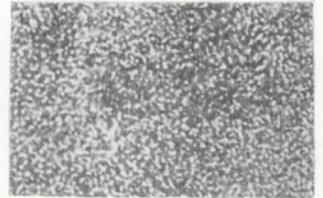
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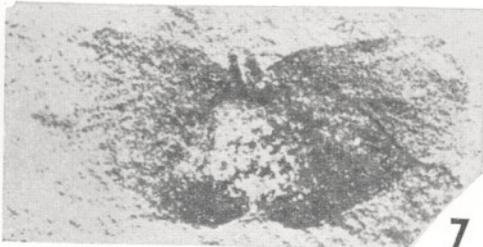
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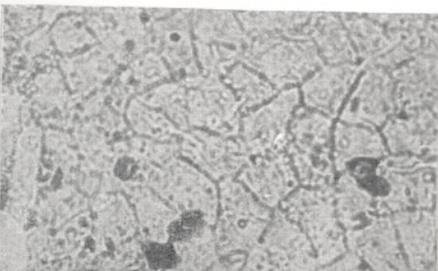
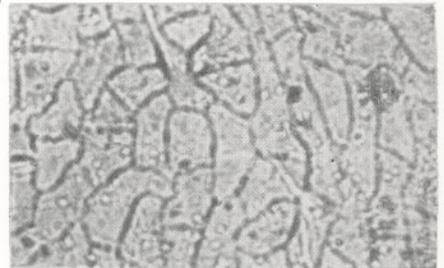
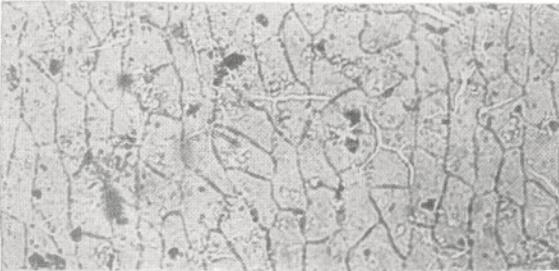
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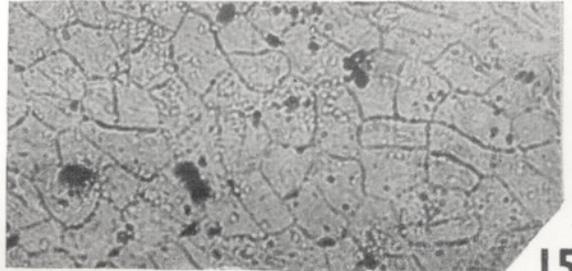
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