1. Rao, A. R. and Malaviya, M., *Proc. natn. Inst. Sci., India*, 1963, **29 B**, 5.
2. — and —, *Proc. Indian Acad. Sci.*, 1964 *a*, **59**, 228.
3. — and —, *Proc. natn. Inst. Sci., India*, 1964 *b*, **30 B**, 1, 25.
4. — and —, *Ibid.*, 1965 *a*, **31 B** (3-4), 67.
5. — and —, *Ibid.*, 1965 *b*, **31 B**, 114.
6. — and —, *Phytomorphology*, 1967 *a*, **17**, 1.
7. — and —, *Ibid.*, 1967 *b*, **17**, 1.
8. — and —, *Proc. Indian Acad. Sci.*, 1967 *c*, **65 B** (3), 126.
9. Rao, A. R. and Malaviya, M., *Proc. natn. Inst. Sci., India*, 1967 *d*.
10. Foster, A. S., *J. Arnold, Arbor.*, 1946, **27**, 253.
11. —, *Practical Plant Anatomy*, D. Van Nostrand Company, Inc., Princeton, New York, 1949.
12. Kitamura, R., *Bot. Magazine (Tokyo)*, 1956, **69**, 519.
13. Rao, A. R. and Tewari, J. P., *Proc. natn. Inst. Sci., India*, 1961, **27 B**, 43.
14. Sahni B., *Philosophical Trans. Royal Soc., London*, 1920, **210 B**, 253.

*TIWARIASPORIS** GEN. NOV., A NEW SPORE GENUS FROM THE PERMIAN OF CONGO AND INDIA

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STRIATE spores and pollen-grains form a significant part in most of the Permian assemblages. In the simplest form the striations are straight, ± parallel to each other, extending from one end to the other, mostly on the proximal face of the central body. In the complicated forms the striations are interconnected by vertical partitions and in some extreme cases the latter may dominate over the former.

Striate monolete and trilete spores are very rarely met with in the Palæozoic sediments though in the Mesozoic pseudo-striate trilete spores are very frequently found. The present paper deals with *Tiwariasporis*, a new spore genus possessing pseudo-striations recovered from the Permian sediments of Congo and India.

SYSTEMATIC PALYNOLOGY

Anteturma	..	***Sporites*** **H. Pot. 1893**
Turma	..	***Monoletes*** **Ibrah. 1933**
Subturma	..	***Azonomonoletes*** **Luber 1935**
Infraturma	..	***Oranti*** **Pot. 1956**
Genus	..	***Tiwariasporis*** **gen. nov.**

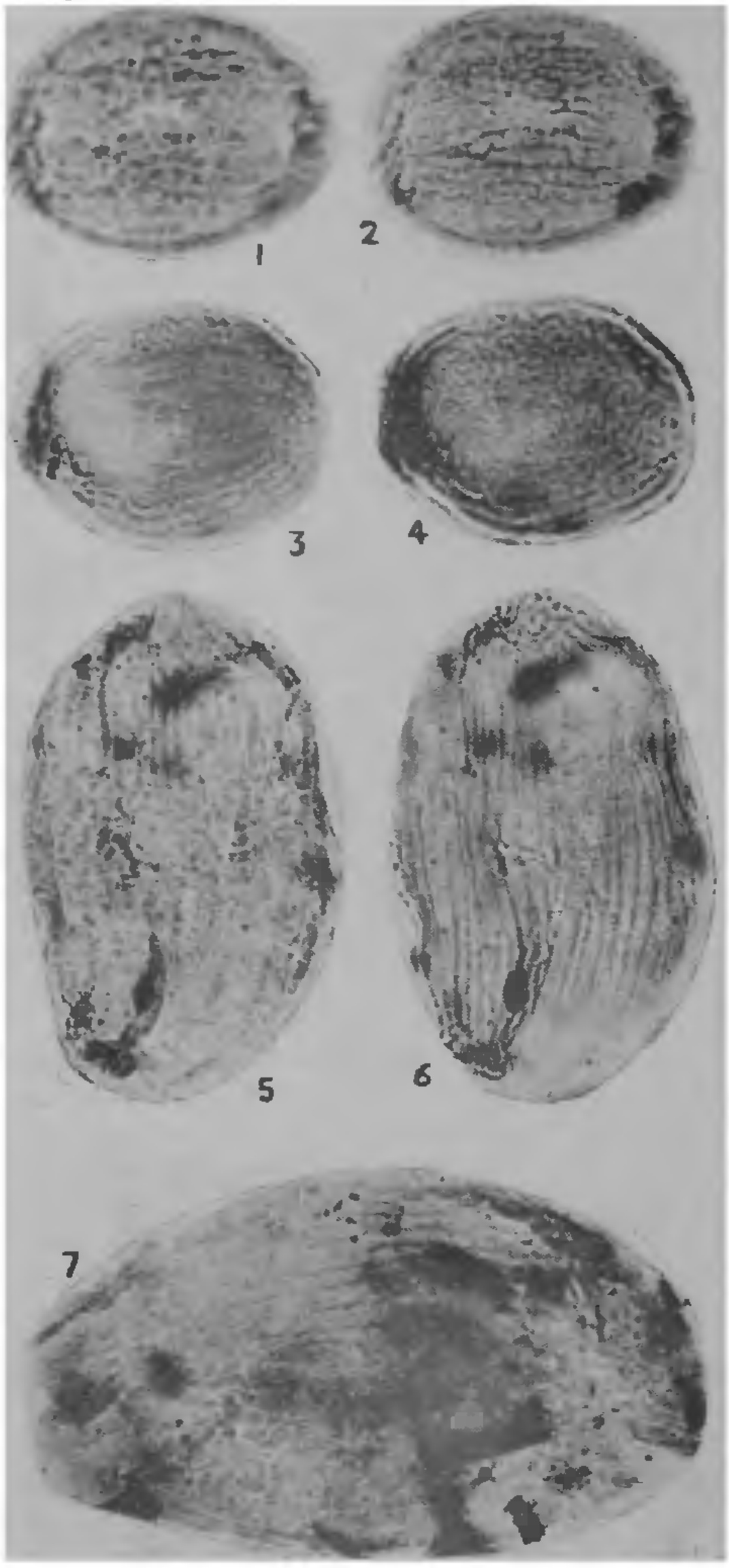
TYPE SPECIES—*Tiwariasporis flavatus* GEN. et SP. NOV.

Generic Diagnosis.—Spores mostly oval-elliptical, sometimes with an incipient monolete mark. Exine thick, sculptured with closely placed and ± evenly distributed verrucæ-bacula on both surfaces, aligned in linear rows forming pseudo-striations in surface view. Rudimentary saccoid nature may be observed in some cases.

Generic Description.—The spores are mostly oval in overall shape with equally broad and rounded ends. Sometimes, however, elliptical forms are also found with equal or unequal ends. Monolete when present is ill-defined and hardly traceable in most cases. In most specimens it is not seen at all. The exine is upto 8 μ thick, densely sculptured with verrucæ, sometimes interspersed with bacula and other elements. The sculptural elements are aligned in ± linear rows to form pseudo-striations in the inter-sculptural spaces. Both horizontal and vertical pseudo-striations are formed and in some specimens they may apparently look like a small, reticuloid grooves in the mud-crack-like pattern. Sometimes the sculptural elements along the outer margin may coalesce to form a small but uniform flange-like structure. Infrastructure of the exine may be present or absent; while present it seems to be infrapunctate in some, but in others it is not clearly discernible. In some specimens, incipient, saccoid lateral extensions of the exine are observed on both sides of the longer axis of the spore.

Comparison.—*Punctatasporites* Ibrahim (1933) is comparable to the present genus in its shape but is distinguished by its conid sculptural elements. *Thymospora* (Kosanke) Wilson and Venkatachala (1963) resembles the present genus in its sculptural elements; the former can, however, be readily differentiated by its strongly built verrucæ which are not very closely placed to align themselves to form pseudo-striations. *Lævigatosporites* Schopf, Wilson and Bentall (1944), *Latosporites* Potonié and Kremp (1954), and *Lucnites* Bose and Kar (1966) are all psilate or punctate, monolete spores. *Striasporites* Bhardwaj (1955) is a true striate monolete spore genus and thus can be easily be separated. *Vittatina* (Luber) Wilson (1962) has been regarded by most of the authors as bisaccate pollen-grain and can be distinguished from *Tiwariasporis* by its differential ornamentational pattern on the two surfaces and regular distal ribs perpendicular to the proximal ones. *Costapollenites* Tschudy and Kosanke (1966) apparently resembles *Tiwariasporis* in its oval-elliptical shape, striations and rudimentary sacci. The striations in the

former genus are, however, of true nature and the pollen-grains are devoid of any marked sculpture.



FIGS. 1–7. Figs. 1–2. *Tiwariasporis flavatus* gen. *et* sp. nov. (Holotype) proximal and distal views respectively. × 500. Figs. 3–4. *T. flavatus*, proximal and distal views of another speciman, × 500. Figs. 5–6. *T. simplex* (Tiwari) comb. nov, ×500. Fig. 7. *Tiwariasporis* sp. from Congo showing well developed sculptural elements and the pseudo-striations, × 500.

Remarks.—*Tiwariasporis* is singular among the monolete spores because its sculptural elements while compressed form pseudo-striations in surface view. In some cases, as has been observed, they seem to be true striations due to more or less complete coalescence of the adjacent sculptural elements.

Many hypotheses have been put forward to explain the origin of the striations on the spores and pollen-grains. According to one view striations developed from *Illinites—Jugasporites—Limitisporites* complex by gradual straightening of the haptotypic mark to form finally a slit. According to another view these developed from the sculptural elements while compressed and coalesced together to form striations in the inter-sculptural spaces. The present genus shows such character which in due course may form true striations by complete coherence of the sculptural elements.

Tiwariasporis proposed here is regarded by the present authors as spore not for the occasional presence of monolete mark but for the well pronounced sculptural elements which extend to some extent on the rudimentary sacci also.

Tiwariasporis flavatus SP. NOV.

FIGS. 1–4

Holotype.—Figures 1, 2.

Type locality.—North Karanpura coalfield, India.

Specific Diagnosis.—Spores oval-elliptical, size range 62–68 μ. Monolete sometimes seen. Exine thick, mostly verrucose, verrucæ closely placed, ± evenly distributed in linear rows forming pseudo-striations, along the inter-sculptural spaces. Exine mostly infra-structured, comprising fine and uniformly distributed puncta.

Tiwariasporis gondwanensis (TIWARI) COMB. NOV.

Synonym.—*Welwitschiapites gondwanensis* Tiwari.

Holotype.—Tiwari, 1965, pl. 8, fig. 195.

Tiwariasporis simplex (TIWARI) COMB. NOV.

FIGS. 5, 6.

Synonym.—*Welwitschiapites simplex* Tiwari.

Holotype.—Tiwari, 1965, pl. 9, fig. 200.

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* Named after Dr. R. S. Tiwari of the Sahni Institute, Lucknow, who first illustrated some specimens now referred to the new genus.

1. Bhardwarj, D. C., *Palæobotanist*, 1955, **4**, 119.
2. Bose, M. N. and Kar, R. K., *Annls. Mus. r. Afr. Centr. Sér. in 80*, 1966, **53**, 1.
3. Ibrahim, A. C., *Wurzburg*, 1933.
4. Potonié R. and Kremp, G., *Geol. Jb.*, 1954, **69**, 111.
5. Schopf, J. M., Wilson, L. R. and Bentall, R., *Rep. Illinois St geol. Surv.*, 1944, **91**, 1.
6. Tiwari, R. S., *Palæobotanist*, 1965, **13** (2), 168.
7. Tschudy, R. H. and Kosanke, R. M., *Ibid.*, 1966, **15** (1–5), 59.
8. Wilson, L. R., *Okla geol. Surv. Circ.*, 1962, **49**, 1.
9. — and Venkatachala, B. S., *Okla. Geol. Notes*, 1963, **23** (3), 75.